



**Notes**

speciation or extinction over time. The Sutter Butte mountains of northern California represents unique possibilities for studying geographic isolation. The location of this mountain range is peculiar because it stands alone in the northern Sacramento River valley, surrounded by flatlands in all directions. These contrasting habitat types could deter or limit animal migrations to and from the Sutter Buttes, creating isolated populations. Instances of geographic isolation in this range have already been documented. Sage Brush lizards and San Joaquin Coachwhip snakes have populations in the Sutter Buttes well outside their expected range.

My research will utilize comparative proteomics to determine whether the northern Pacific Rattlesnakes (*Crotalus oreganus oreganus*) of Sutter Buttes are geographically isolated. 84 snakes from both the Buttes and the Sierras have been sampled for venom. Venom protein identifications are being made and will eventually be analyzed for meaningful correlations.

## Lower Division Class Projects

### LD-1

#### **Analysis of the Effect of Sunlight versus Shade on the New Growth of *Pseudotsuga menziesii* (Douglas Fir) in Butte County, Magalia, California (April 2013)**

Megan Anderson, Diane Eilerts, Aja Erskine, Dylan Heikens, and Shelby Rivers  
BIOL 152: Don Miller, [dgmiller@csuchico.edu](mailto:dgmiller@csuchico.edu)

Observations of perennial trees of the Northern California foothills showed that general growth (abundance of branches and overall fullness) appeared to be uneven. The uneven growth appeared to be related to the area(s) of the tree exposed to more sunlight. To determine whether there was a significant statistical difference between new growth (evident as softer, lighter green needles at the end of individual branches) on the sun-exposed area(s) of the tree versus the shaded area(s) of the tree, a sample group of ten Douglas Fir trees was analyzed for new growth using three randomized samples from each area of each tree. Although a relatively small sample size, a significant difference was determined using a T-test ( $t = 9.59$ ,  $df = 29$ ,  $P < 0.05$ ). Results suggest that the Douglas-Fir produces significantly longer pine needles in regions subjected to the sun regularly. This is perhaps due to increased surface area associated with photosynthetic benefits. Ideally, this experiment would be repeated to include all areas of new growth on a larger sample size of Douglas Fir trees.

### LD-2

#### **Mimicry of Peanuts with Squirrels**

Briana Azevedo, Kristina Barnsdale, Kyra Burke, Angeline Jacoby  
[bazevedo3@mail.csuchico.edu](mailto:bazevedo3@mail.csuchico.edu), [kbarnsdale@mail.csuchico.edu](mailto:kbarnsdale@mail.csuchico.edu),  
[kburke7@mail.csuchico.edu](mailto:kburke7@mail.csuchico.edu), [ajacoby1@mail.csuchico.edu](mailto:ajacoby1@mail.csuchico.edu)  
BIOL 152: Stephanie Foster, [sfoster8@csuchico.edu](mailto:sfoster8@csuchico.edu).

The significance of our paper was to test to see if squirrels on campus will understand the difference between the palatable peanuts and the mimics. Our scientific hypothesis was that the squirrels will recognize the mimics as unpalatable prey and not eat them as studied by Pilecki and O'Donald (1971). We set up three trays that had peanuts of all different colors with different numbers of palatable peanuts on them. Over the course of 5 days we set out the trays and checked to see the progress of them. One tray ended up being eaten while the other two were not. We believe that many reason could have accounted to the problem of the two trays that were not eaten. Overall we believe that from our data from the one tray the squirrels did pick up on the mimicry and adapted to the peanuts.

### LD-3

#### Soil analysis at Malakoff Diggins State Historic Park for future remediation

Morgan Blofsky and Michelle King

BIOL 152: Don Miller, [dgmiller@csuchico.edu](mailto:dgmiller@csuchico.edu)

Malakoff Diggins State Historic Park was the site of the largest hydraulic gold mining operations in California that took place between 1852 and 1884. The site was left in highly degraded conditions and never recovered its original forest structure. Research involving abandoned mine sites vary greatly depending on methods, material used and mineral extracted. In the case of Malakoff Diggins, 2,778 kilograms (~10.8 metric tons) of mercury were lost to the environment; constant erosion and sediment filling the mining pit and surrounding watershed makes Malakoff unique from other abandoned mine sites. The material in the pit, largely sediment from the eroding hillside and mine tailings, doesn't have the typical soil horizons found in undisturbed, healthy soils. We refer to this material as spoil and investigate its potential for improvement by amendments and revegetation (reforestation). A comparison was made of 10 samples from the mining spoil and 10 samples from the nearby Cohasset soil series; including, pH, electrical conductivity, percent carbon, and percent nitrogen. Statistical analysis suggested a significant difference between mine spoil and forest soil across all parameters tested excluding pH. Understanding the spoil composition in the pit is a crucial first step in developing optimal revegetation.

### LD-4

#### *Vinca major* and its Effect on the Diversity of Plant Species from Lower Bidwell, Chico

Nick Carter, Geneva Desin, Brianna Faulkner, Jessica Scott, Rachel Snyder

genevadesin@[yahoo.com](mailto:yahoo.com), rachelcsnyder@[hotmail.com](mailto:hotmail.com), bfaulkner3@[mail.csuchico.edu](mailto:mail.csuchico.edu), and jscott34@[mail.csuchico.edu](mailto:mail.csuchico.edu).

BIOL 152: Rick Wittsell [rwittsell@csuchico.edu](mailto:rwittsell@csuchico.edu)

This experiment was to look at the invasive species Bigleaf Periwinkle, *Vinca major*, and how it crowds out and affects the diversity of the surrounding native species in lower Bidwell Park in Chico, Butte County, California. *V. major* was found in a few spots along the west side of the creek running through Bidwell, and it was found everywhere along the east side of the creek. Once it is established in an area, Bigleaf Periwinkle will outcompete most other species present in the area and is very difficult to remove (California Invasive Plant Council). In the restoration sites, there was a much higher diversity of native species than any other area with *V. major*. Bigleaf Periwinkle covered more than 90 percent of the tested areas. After analyzing the comparison of the two means in-between the treatment areas ( $T = 75.58$ ,  $df = 79$ ,  $P < 0.01$ ), it was concluded that areas with *V. major* had

and timing of this phenomenon. For the fall and winter of 2010 and 2011, I radio-tracked captured migrant NSWO through BCCER to determine diet and roost characteristics. During the winter of 2012, I revisited previous NSWO roosts and took random vegetation measurements to determine if roosts were indicative of NSWO preference or habitat quality. The two seasons of radio-tracking sixteen NSWO to 109 roost sites has revealed overwintering owls roosting 81% of the time in canyon live oak (*Quercus chrysolepis*) and shrub toyon (*Heteromeles arbutifolia*), with roosts averaging 11.8 ( $\pm 9.57$ ) meters when in *Q. chrysolepis*, and 1.36 ( $\pm 0.64$ ) meters in *H. arbutifolia*. Preliminary diet analysis shows a majority of pellets containing remains from multiple individuals, including *Reithrodontomys megalottis*, *Microtus californicus*, and *Peromyscus* species. Random vegetation surveys showed that canyon live oak and toyon roosts were not the only two species present in abundance within NSWO territories.

### GR-11

#### Regulation of microRNA-375 by inducible cAMP early repressor in pancreatic beta cells.

Alexander Stanton [astanton2@mail.csuchico.edu](mailto:astanton2@mail.csuchico.edu), Melissa Martinez

[mhoff88@gmail.com](mailto:mhoff88@gmail.com),

David M. Keller [dmkeller@csuchico.edu](mailto:dmkeller@csuchico.edu)

MicroRNAs are important repressors of gene expression. They are involved in a variety of tissue-specific and developmental-stage expression including muscle differentiation, synapse function, and insulin secretion. MicroRNA-375 (miR-375) is expressed in pancreatic beta-cells and has been shown to repress insulin secretion<sup>1</sup>. By modifying miR-375 expression, it may be possible to control insulin secretion and be a potential therapeutic for diabetic patients. One potential factor controlling production of miR-375 is inducible cAMP early repressor (ICER). This protein is suspect because miR-375 has been shown to be downregulated as cAMP levels increase. We have found both ICER RNA and protein in INS-1 rat pancreatic insulinoma cells. Here, we show that ICER binds to the miR-375 promoter region. Current work is focused on testing whether ICER is necessary and sufficient for repressing miR-375. We are also investigating a potential primate-specific negative feedback loop between ICER and miR-375, as bioinformatic analysis of primate ICER 3'-untranslated region shows a possible miR-375 binding site.

### GR-12

#### Investigating Geographic Isolation in the Sutter Buttes using comparative northern Pacific Rattlesnake venom proteomics

Glenn Woodruff [Glennwoodruff@gmail.com](mailto:Glennwoodruff@gmail.com), Colleen Hatfield

[chatfield@csuchico.edu](mailto:chatfield@csuchico.edu), Daniel Edwards [dedwards@csuchico.edu](mailto:dedwards@csuchico.edu), Daniel Clark

[dclark@csuchico.edu](mailto:dclark@csuchico.edu) and Tag Engstrom [tengstrom@csuchico.edu](mailto:tengstrom@csuchico.edu)

Geographically isolated habitats are of special concern due to the potential for

United States to winter habitat in Mexico. They are cryptic and elusive cavity nesters and little is known about their migratory patterns. They have been named a Species of Concern by the U.S Fish and Wildlife Service because of potential habitat destruction. The goal of this research is to track the movements of these owls during their migratory season using light-level geolocators. The geocator records ambient light levels that correspond to sunrise and sunset times to determine specific bird locations. During 2012, 41 geolocators were attached to male and female owls at field sites in Washington, Utah and Colorado and 25 additional geolocators will be put out in California in 2013. Retrieval of geolocators will occur in 2013-14 and the data will be analyzed to determine owl migration patterns. This geocator study is the first step in assessing the current status of this species with the goal of a broader western US effort to follow in the future.

#### GR-9

##### **Utilizing a species distribution model to identify potential habitat for the yellow-billed cuckoo along the Sacramento River**

Matt Rogers [mrogers8@mail.csuchico.edu](mailto:mrogers8@mail.csuchico.edu) and Colleen Hatfield [chafield@csuchico.edu](mailto:chafield@csuchico.edu)

Though the yellow-billed cuckoo has a broad geographic distribution in the U.S. it has a limited distribution in the western U.S. and is an endangered species in California. With the potential federal listing of this species, it is important to understand the current range of this species within California and identify breeding sites, taking both vegetation characteristics and various environmental factors into consideration. Along the Sacramento River, surveys indicate site use appears to be dynamic, with a very small number of areas being used year to year. The Sacramento River population also appears to have declined precipitously in the last 5-10 years, which is troubling given the amount of available habitat and the efforts to restore riparian habitat specifically for cuckoos. Using a combination of survey detections for yellow-billed cuckoos within the last 5 years and Maxent, a habitat modeling program, potential species distribution maps were created for the Sacramento River which could provide insight into suitable yellow-billed cuckoo habitat distribution, as well as to refine survey efforts to concentrate on all suitable habitat within the region.

#### GR-10

##### **Winter Ecology of Northern Saw-Whet Owls (*Aegolius acadicus*) in the Sierra Nevada Foothills of California**

Julie Shaw [julieshaw12@gmail.com](mailto:julieshaw12@gmail.com) and Colleen Hatfield [chatfield@csuchico.edu](mailto:chatfield@csuchico.edu)

Northern Saw-Whet Owls (NSWO, *Aegolius acadicus*), one of the smallest raptor species in North America, migrate in large numbers every fall from Northern latitudes, including Big Chico Creek Ecological Reserve. An ongoing banding project has been capturing NSWO since 2005 in an attempt to determine the magnitude

significantly lower species diversity and a low number of evenness.

#### LD-5

##### **Samara Mass Affecting Dispersal in *Acer macrophyllum***

Jorge Cervantes ([jcervantes16@mail.csuchico.edu](mailto:jcervantes16@mail.csuchico.edu)), Lee Xiong ([lxiong23@mail.csuchico.edu](mailto:lxiong23@mail.csuchico.edu)), and Denny Yang ([dyang13@mail.csuchico.edu](mailto:dyang13@mail.csuchico.edu))  
BIOL 152: Stephanie Foster, [sfoster8@csuchico.edu](mailto:sfoster8@csuchico.edu).

Seed dispersal in plants is necessary for plants to reproduce. Ways to distribute their seeds come in various ways, but all occur to insure that there will be no competition between offspring and parent. In this experiment, samaras from an *Acer macrophyllum* (big leaf maple) were dropped, and their masses, descent times, and radial distances from original position, were recorded (N=50 from one tree) to determine the effect on dispersal of samaras that glide in the air. Mass was the main focus resulting in a negative relation with descent time but no significance to radial distance ( $R^2 = 0.002$ ,  $p = 0.76$ ). Assuming the samaras fell faster, there would be less time for them to travel farther. The data supported that mass did not have a strong effect on how far the samaras flew nor the descent time ( $R^2 = 0.16$ ,  $p = 0.0014$ ). This implies that there are other variables that contribute to a maple's evolutionary pattern of dispersal (i.e. samara shape, size).

#### LD-6

##### **Effect of distance from water source on stomata density in Buckthorn leaves**

Kathryn Daley [kate\\_daley15@yahoo.com](mailto:kate_daley15@yahoo.com), Courtney Champlin [courtney-champlin@ymail.com](mailto:courtney-champlin@ymail.com), Sarah Santich [ssantich@mail.csuchico.edu](mailto:ssantich@mail.csuchico.edu), Emily Welemin, Jacob Fleener [jfleener007@gmail.com](mailto:jfleener007@gmail.com)  
BIOL 152: Stephanie Foster, [sfoster8@csuchico.edu](mailto:sfoster8@csuchico.edu).

Plants are able to balance the exchange of carbon dioxide and water through stomatal density, which is the number of stomata in a defined area. Stomatal density is a phenotypic characteristic that can be influenced by the environment as the plant grows and develops. The objective of this study was to determine if proximity to a water source would have an effect on stomatal density in Buckthorn plants. Leaves were collected from Buckthorn plants that were at specified distances from water (5 feet, 25 feet, and 50 feet). Impressions of the underside of the leaves were made and used to count stomata density under a compound microscope. Using an ANOVA table, there were no significant differences in stomata density between the different sample groups ( $p$ -value = 0.40). According to the data collected in the study, stomata density in Buckthorn plants does not vary as distance from water source increases.

### LD-7

#### Effects of Scarification via Thermal Stress on Seed Germination in Snow Peas (*Pisum sativum*)

Melanie Erickson [merickson9@mail.csuchico.edu](mailto:merickson9@mail.csuchico.edu), Cassie Runyan [crunyan1@mail.cusechico.edu](mailto:crunyan1@mail.cusechico.edu), Emerald Sundai Iott [eiott@mail.csuchico.edu](mailto:eiott@mail.csuchico.edu), Francis Wright [franciswright3@yahoo.com](mailto:franciswright3@yahoo.com), Cindy Kue [ckue02@mail.csuchico.edu](mailto:ckue02@mail.csuchico.edu), and Raj Bola [Rbola@mail.csuchico.edu](mailto:Rbola@mail.csuchico.edu)  
BIOL 152: Rick Wittsell [rwittsell@csuchico.edu](mailto:rwittsell@csuchico.edu)

Scarification is a natural process which can overcome physical dormancy in a seed by breaching the protective seed coat via mechanical, microbial, or thermal means. This process is crucial for imbibition and the germination of seeds from a plethora of species including *Pisum sativum* (Pittenger, 2002). This experiment was conducted to further understand the effect of scarification via thermal stress on seed germination in *P. sativum* specimens. This was done by subjecting *P. sativum* seeds to a variety of thermal conditions prior to planting. We found that germination rates doubled in the seeds exposed to -20C conditions compared to the control ( $f=20.84$ ,  $d.f.=96$ ,  $P<1.76E-10$ ).

### LD-8

#### Variation in Rose Leaf Stomatal Density as Affected by Water Stress

Craig Erstad ([cerstad@gmail.com](mailto:cerstad@gmail.com))  
BIOL 152: Stephanie Foster, [sfoster8@csuchico.edu](mailto:sfoster8@csuchico.edu).

Through the identification and measurement of rose leaf stomatal density, we set out to determine the effect that water stress will exhibit, by selecting two plants—one that was watered daily, and the other that was dependent solely on the environment for watering. The results demonstrated that water-stressed rose leaves do indeed have a higher density of stomata per square millimeter than do non-water-stressed rose leaves ( $t\text{-stat}=1.75$ ,  $df=15$ ,  $p\text{-value}=0.001$ ). The results indicated, based on the stomata per square millimeter that stomatal density increases when rose leaves are given less water.

### LD-9

#### Floral Color and Insect Pollination Interactions at California State University Chico

Kelsey Escobar, Drew Howe, Margaret Jones, Kyle McDade  
([jones.mrgrt@gmail.com](mailto:jones.mrgrt@gmail.com))  
BIOL 152: Stephanie Foster, [sfoster8@csuchico.edu](mailto:sfoster8@csuchico.edu).

Pollination is a major source of interest and importance in ecology. Plants are not mobile organisms, and therefore must supply a reward to insects and other polli-

The mix of open fields and forested areas present in California's Central Valley presents challenges for medico-legal investigators. Human remains are often found in advanced stages of decomposition, so an important component of forensic investigations is estimating the post mortem interval (PMI) of the deceased. The goal of this preliminary study was to test the usability of the techniques used by Megyesi et al (2005) in which Total Body Score (TBS) and Accumulated Degree Days may be used retroactively to determine the PMI on a given set of remains in a Mediterranean climate where animal scavenging was not a variable.

### GR-7

#### Evaluating fluctuating asymmetry as a tool for conservation of the western pond turtle (*Emys marmorata*)

William McCall [wmccall001@gmail.com](mailto:wmccall001@gmail.com) and Don Miller [DMiller@csuchico.edu](mailto:DMiller@csuchico.edu)

Fluctuating asymmetry (FA) estimates can be as an indicator of developmental stability and few studies focus on the bilateral characteristics of reptiles. In this study turtle shell ventral morphological characters (plastron scutes) were measured to determine if FA differences were present. We compared turtles from populations with minor human modifications, Big Chico Creek Ecological Reserve (BCCER), Butte Creek Ecological Preserve (BCEP) to a site with major human modification Chico Wastewater Pollution Control Plant (CWPCP). Turtles with high FA were expected to be located in areas of high human modification (suspected high stress). In this northern California study of three isolated populations of western pond turtles, *Emys marmorata*, the above-expected hypothesis was not entirely supported. Over the course of three collection seasons (2010-2012) a total of 231 adult turtles were measured and photographed. With modern imaging software FA estimates were determined from scute pair differences (right-left). Principle component analysis (PCA) was used to generate a single body size measurement for each turtle. A MANCOVA was used to determine differences within and between sites regardless of body size. A significant difference in body size was found in individuals between sites and sexes. A significant difference in FA estimates of humeral scutes and directional estimates of humeral, pectoral and femoral scutes were found in individuals between sites. The results support previous studies that state FA increases with size and age. The difference in FA estimates of the humeral scute pair and the directional asymmetry estimates suggests behavioral related factors adding in asymmetrical development.

### GR-8

#### Migration Patterns of Flammulated Owls Using Light-Level Geolocators

Shannon Rich [srich2@mail.csuchico.edu](mailto:srich2@mail.csuchico.edu), David Johnson [djowl@aol.com](mailto:djowl@aol.com), Colleen Hatfield [chatfield@csuchico.edu](mailto:chatfield@csuchico.edu)

Flammulated owls (*Otus flammeolus*) are small nocturnal owls that are thought to migrate long distances every year from summer breeding grounds in the Western

lowest richness. While some measures of ecologic integrity suggest the restored meadow is becoming distinct from the disturbed meadows, the surprise is the less-disturbed meadows are less diverse and drier perhaps due to initially undetectable differences in hydrology. Further analysis will provide insights on how meadow plant communities correlate with hydrologic changes and meadow status. This will help inform current and future management decisions for restoration and conservation initiatives for this highly diverse habitat type.

#### GR-5

##### **Road to Recovery: Introduction of two rare vernal pool grasses, *Neostapfia colusana* (Colusa grass) and *Tuctoria greenei* (Greene's tuctoria)**

Erin Gottschalk Fisher, [egottschalkfisher@mail.csuchico.edu](mailto:egottschalkfisher@mail.csuchico.edu), J.G. Silveira<sup>1</sup>  
[joe\\_silveira@fws.gov](mailto:joe_silveira@fws.gov),

F.T. Griggs<sup>2</sup> [tgriggs@riverpartners.org](mailto:tgriggs@riverpartners.org), C.A. Hatfield [chatfield@csuchico.edu](mailto:chatfield@csuchico.edu)

<sup>1</sup> U.S. Fish and Wildlife Service, 752 County Road 99W, Willows, CA 95988

<sup>2</sup> River Partners, 580 Vallombrosa Avenue, Chico, CA 95926

Vernal pool habitats have been significantly reduced by conversion to incompatible agriculture and urbanization. As a result, a number of vernal pool dependent species have become rare, including *Neostapfia colusana* (Colusa grass) and *Tuctoria greenei* (Greene's tuctoria). The goal of my research was to examine the potential for introductions of the rare grasses into vernal pool habitats. To this end, we established four study sites, two sites for each species – one introduction site with restored or created vernal pools and one reference site with existing populations of the rare grass. In January 2011, we introduced Colusa grass and Greene's tuctoria into the restored/created pools and, for comparison, reintroduced the grasses into the reference pools. For Greene's tuctoria, the introduction pools had nearly 60% germination with over 67% of these surviving to produce an inflorescence. In contrast, at the reference pools germination was lower at less than 35% but a greater percentage (over 85%) survived to reproduce. For Colusa grass, germination was quite low at the introduction pools (13.0%) and only one Colusa grass plant survived to reproduce, compared to an average of 23% germination and almost 40% survivorship at the reference pools. In the second year, despite relatively low rainfall and only partial pool filling, we documented over 2,000 second generation Greene's tuctoria plants in the introduction pools. The results of this research are imperative in informing restoration and recovery efforts for Colusa grass and Greene's tuctoria populations as well as for other rare vernal pool plants.

#### GR-6

##### **Support for the Accumulated degree-day hypothesis for decomposition on exposed carrion in the California Central Valley using *Sus scrofa***

Jeff D. Mabry [jmabry@mail.csuchico.edu](mailto:jmabry@mail.csuchico.edu) and Don Miller [DMiller@csuchico.edu](mailto:DMiller@csuchico.edu)

nators to spread their genetic material to insure continued survival of their species. Using similar shaped fake flowers in four different colors, the group tested pollinator choice, by counting and timing each visit to the flowers in their array. Results showed that pollinator choice does lead to a difference in number of visit on different flower colors. This also helped support that plants with different colored flowers can survival with use of multiple different pollinators.

#### LD-10

##### **Role of Latex Production on Phenotypic Selection of *Euphorbia peplus***

Caitlin Greenwood [c\\_greenwood2@yahoo.com](mailto:c_greenwood2@yahoo.com), Nadine Morales [amora-ales20@mail.csuchico.edu](mailto:amora-ales20@mail.csuchico.edu)

BIOL 152: Stephanie Foster, [sfoster8@csuchico.edu](mailto:sfoster8@csuchico.edu).

Little is known about the actual function of latex in plants, but it has been hypothesized that plants produce latex for defensive purposes. In this study of thirty-one of *Euphorbia peplus* were collected and tested for latex production. All individual *E. peplus* that were collected for latex measurements were kept to count the number of leaves, flowers, and damaged leaves. Then the data was analyzed by regression to see if latex production is favored by natural selection. It was found that as latex Z-score increased as the relative fitness of the plants increased (P-value=5.01E-12). From the data collected it was also shown that as leaf damage increased latex production was also higher (P-value=.007). These results show that increased herbivore attack there is increased selection for latex production. Plants that produced the most latex were the most fit.

#### LD-11

##### ***Magnolia grandiflora* Stomatal Density in Sun vs. Shade**

Nick Grubiss ([gearsofnick@yahoo.com](mailto:gearsofnick@yahoo.com)), Brittany Tillotson, ([btillotson1@mail.csuchico.edu](mailto:btillotson1@mail.csuchico.edu)), Caitlin Francis ([cfrancis5@mail.csuchico.edu](mailto:cfrancis5@mail.csuchico.edu))

BIOL 152: Stephanie Foster, [sfoster8@csuchico.edu](mailto:sfoster8@csuchico.edu).

Phenotypic plasticity means an organism shows developmental change in phenotype caused by environmental cues. The experiment was of interest because very few studies have been done on the stomatal density specific to *Magnolia grandiflora*. This experiment shows that *Magnolia grandiflora*, exhibits phenotypic plasticity in stomatal density. This could benefit other studies because scientists will know that they can measure *Magnolia grandiflora's* water and carbon dioxide output into the atmosphere. The *Magnolia grandiflora* will show a higher stomatal density in leaves found in the sun opposed to leaves found in the shade. The study was conducted by collecting ten leaves from a sunny region and ten leaves found in a shady region from a *Magnolia grandiflora* tree, located near the Meriam library on the CSU, Chico campus. Stomatal density was measured by counting the number of stomata under a microscope set at 400X. The mean of the

leaves taken from sunny region was 20.1 (SD=2.9) and a mean of 13.8 (SD=1.9) for leaves found in a shady region (t-stat= 4.85, df= 9, p-val= .0005). Our results show that *Magnolia grandiflora* trees do exhibit phenotypic plasticity based on sunlight exposure.

### LD-12

#### Microclimate Effect on Stomatal Density

Morgan Hees, Dana Lund, Travis Richards, Nicholas Sajben, and Alyssa Torpey  
BIOL 152: Don Miller, [dgmiller@csuchico.edu](mailto:dgmiller@csuchico.edu)

The purpose of this research was to explore the phenotypic plasticity of stomatal density with regards to the plant Toyon (*Heteromeles arbutifolia*), and the difference in stomatal density of a riparian plant compared to that of a plant found in an exposed, upland area. The question explored was whether or not the climatal conditions of *H. arbutifolia* had a significant effect on the stomatal density of the leaves of the plant. The experiment was conducted by collecting multiple leaves from both a plant found near the water of the creek in Upper Bidwell Park, Chico, Butte County, California as well as leaves from a plant found in a dry, exposed upland area of Upper Bidwell. The stomatal density of each plant was measured, and a t-test was performed (P-value < 0.0051). The results of the t-test indicate that there is a significant difference between upland and riparian stomatal densities. Because of this, the data supports the idea that stomatal density is a phenotypically plastic trait.

### LD-13

#### Latex Production Difference in Shaded and Sunlit *Euphorbia peplus*

Faith Hostettler ([fhostettler@mail.csuchico.edu](mailto:fhostettler@mail.csuchico.edu)), Lucas Strand ([lstrand1@mail.csuchico.edu](mailto:lstrand1@mail.csuchico.edu)), and Andrew Ithurburn ([aithurburn1@mail.csuchico.edu](mailto:aithurburn1@mail.csuchico.edu))  
BIOL 152: Stephanie Foster, [sfoster8@csuchico.edu](mailto:sfoster8@csuchico.edu).

Plants prioritize plant defense before readily being able to receive nutrients. This theory motivated the investigation on latex production differences in *Euphorbia peplus* between the plants that were shaded and sunlit. The title of the experiment thus is "Latex Production Difference in Shaded and Sunlit *Euphorbia peplus*." The study was conducted by locating and collecting five of the aforementioned plants from both locations and collecting the latex of all ten plants. The results of the experiment was that the plants that were shaded produced up to a factor of two more than their counterparts in the sun did, (t=-2.5, df=4, p-value=0.03). That there was a difference between the mean amounts of latex produced in the two regions. The interesting notion from this experiment was that the *Euphorbia peplus* does prioritize defense over the product of photosynthesis.

analysis showed four of the seven had temperature tolerance for growth up to 45° C with one isolate up to 50°C; on or in various media.

### GR-3

#### Courtship of Northern pintail in relation to sex ratios, pairing chronology and hunting pressures

Stevie Foster [stevieroxelle@gmail.com](mailto:stevieroxelle@gmail.com) and Don Miller [dgmiller@csuchico.edu](mailto:dgmiller@csuchico.edu)

In studying animal populations of special interest to management, understanding the factors affecting mating and reproduction can be very important. Northern pintail (*Anas acuta*) is a North American duck with population levels that were below projected numbers until recently, and researching some of the mechanisms leading to pairing and mating can help managers regulate the population. In my study, I research a number of different variables and their potential effects on pairing behavior of Northern pintail. To understand trends in changing courtship flight size, I compare this variable to pairing status of females, sex ratios, and hunting pressures over time. My results show no significant trends between pairing status, sex ratios, and hunting pressures and the size of courtship flights. The distribution of courtship flight size appears to be random, suggesting that males randomly choose to join courtship flights, or that courtship flight size is affected by an environmental factor that I did not test.

### GR-4

#### Ecological trajectory of a restored Sierra Nevada montane meadow

Rachel Francis [rfrancis4@mail.csuchico.edu](mailto:rfrancis4@mail.csuchico.edu) and Colleen Hatfield [chatfield@csuchico.edu](mailto:chatfield@csuchico.edu)

Meadows in the Sierra Nevada are characterized as wet, heterogeneous habitats with diverse plant communities, often being biodiversity hot spots. These meadows not only provide resources for wildlife but also filter and store snowmelt, providing sustained water sources for both wildlife and Californians. Recognition of meadow significance combined with persistent human disturbance motivates restoration efforts to improve hydrologic connections and biotic health within these meadows. This research is evaluating the trajectory of a restored montane meadow in Big Trees State Park. Comparing soil moisture, plant community composition, species diversity, and invasive species extent of this restored meadow to disturbed and less disturbed meadows provided context for this assessment.

Preliminary results indicate soil moisture was highest in the restored meadow followed by the disturbed and then less-disturbed meadows, which were notably less moist. Similar numbers of patch types were found between the restored and disturbed meadows. The less-disturbed meadows in comparison had much fewer patch types. Species richness was intermediate for the restored meadow whereas disturbed meadows had the highest and the less-disturbed meadows had the

## Graduate Research

### GR-1

#### Picky protist feeding: the cellular basis for selective ingestion

Sean Cobb [scobb1@mail.csuchico.edu](mailto:scobb1@mail.csuchico.edu) and Gordon Wolfe [gwolfe2@csuchico.edu](mailto:gwolfe2@csuchico.edu)

Marine alveolate microzooplankton consume a large fraction of the world's primary production, making them fundamental participants in marine trophic webs; however, their complex feeding behaviors are poorly understood. The tintinnid ciliate, *Favella* sp., has previously been shown to interpret subtle chemical and mechanical cues to determine prey choice, and exhibits rhythmic membrane depolarizations that correlate with cytostomal feeding apparatus pulsations. As part of an ultimate goal to understand how *Favella* sp. integrate dissolved chemical cues and mechanical stimuli via signal transduction to regulate feeding, I examined how cytostomal contraction rates vary with feeding status, and related them to the functional response calculated from grazing rates relative to prey density. I observed that cytostomal contraction rates were highest in starved cells (70-120 min<sup>-1</sup>) and decreased rapidly over 20 minutes, following the addition and complementary rapid intake of the prey *Heterocapsa triquetra*. Contractions stabilized at 40-80 min<sup>-1</sup> as cells continued to feed until they became saturated with ~12 prey vacuoles at 120 min. These results, though preliminary, suggest that cytostomal contraction rates may help regulate feeding.

### GR-2

#### Hot springs fungi and lignocellulose degradation

Bryan Ervin [bervin@mail.csuchico.edu](mailto:bervin@mail.csuchico.edu) and Gordon Wolfe [gwolfe2@csuchico.edu](mailto:gwolfe2@csuchico.edu)

Conversion of plant fibers, or lignocellulose, into biofuels and other industrial products typically requires warm and acidic pre-treatment conditions not suitable to most commercial fungal enzymes. Here I characterized the ability of seven Ascomycota fungi associated with Boiling Springs Lake (BSL) in Lassen Volcanic National Park, a warm and acid environment, to utilize lignocellulose material. Due to these naturally occurring conditions of BSL, I hypothesized these fungal isolates produce thermal/acidic stable enzymes. To verify my hypothesis: the fungi were screen for growth on purified plant cell wall carbohydrates or natural fibers under warm and acid conditions; followed by the use of degenerate PCR to probe the genomic DNA for orthologous lignocellulose degradation genes. Growth assays at 40°C and pH 2.5, showed four of the seven fungi with increased hyphae growth on cellobiose, xylan, rice hulls, cedar needles, and or pine needles. Five of the fungi returned three degenerate PCR products that were identified by a BLAST search as orthologs to known fungal lignocellulose degradation enzymes Additionally

### LD-14

#### Flower color affect pollinators

Trevor Jensen, Sophia Weber, Eric Gonzalez Phia Yang

BIOL 152: Don Miller, [dgmiller@csuchico.edu](mailto:dgmiller@csuchico.edu)

As we already know, flowers are very attractive to the perceiving eye so why then do pollinators prefer color in choosing a flower? Flowers have many traits that become attractive to the visiting pollinators such as flower buds, scent, nectar guides and UV color in which lead the visitors into foraging and allow us to better understand why pollinators pollinate where they do. In this experiment, we used three approaches throughout the California State University, Chico campus of Butte County, California in order to distinguish which color was to a higher preference in the bee pollination and why. The first approach was locating two medium sized rhododendron plants of the same color in which we studied; four different colors so eight plants total. Second, the observation was done over a period of five days with a thirty minute time window as we counted and timed the bees as they landed on each plant by color. Lastly, we conducted an ANOVA test to gather further results in order to determine preference of visitors due to color. Species turnover was projected to be highest in the lighter colored flowers rather than the brighter more vibrant flowers, which we had predicted in the hypothesis.

### LD-15

#### The effect of time on populations engaged in Batesian mimicry

Derick Leiz, [dleiz@mail.csuchico.edu](mailto:dleiz@mail.csuchico.edu), Ashley Rodondi [ashleyrodondi@comcast.net](mailto:ashleyrodondi@comcast.net), Leo Savage-Low, [lsavagelow001@gmail.com](mailto:lsavagelow001@gmail.com)

BIOL 152: Stephanie Foster, [sfoster8@csuchico.edu](mailto:sfoster8@csuchico.edu)

Batesian mimicry describes the interaction whereby a nontoxic species will mimic a toxic "model" species for protection from predators. To further examine Batesian mimicry our team questioned whether or not a stronger predatory preference for the nontoxic, "poor mimic" would present itself if the experiment was conducted for a longer period of time. Random prey "seed" arrays were created consisting of both untreated and quinine treated dyed wheat. The wheat was glued to an array by droplets of lard. Arrays were set out every 24 hours and prey removal tabulated. The results were analyzed in Microsoft Excel and chi-square analysis conducted. We found there was no significant differences in treated and untreated wheat ( $\chi^2=1.063$ ,  $df=2$ ,  $p\text{-value}=0.50$ ).

### LD-16

#### Polymorphic Mimicry and Natural Selection

Tony Munoz, Megan Vanni, Ali Alzaki, Chiang Lor, Gahyun Lee

BIOL 152: Rick Wittsell [rwittsell@csuchico.edu](mailto:rwittsell@csuchico.edu)

Certain palatable species such as the scarlet king snake mimic more dangerous or unpalatable species. Works done by O' Donald and Pilecki (1970) confirmed that success of mimicry depends on how closely the mimic represents the original, and how frequent the mimic occurs. This is a peer review experiment to confirm the results of O' Donald and Pilecki (1970). Grubs made of lard and flour were made to mimic that of the prey for the native birds. The grubs were categorized into three separate classes and the unpalatable substance quinine was added to two of the classes in varying degrees. The experiment yielded a Chi-squared value of 43.47, significantly higher than the 5.9 required, to yield a  $P < 0.05$ , leading us to believe the findings of O' Donald and Pilecki (1970) were accurate.

### LD-17

#### **A Comparative Survey of Biodiversity both Downstream and Upstream of One Mile Recreational Swim Facility**

Zack Stoll ([zackstoll@gmail.com](mailto:zackstoll@gmail.com)), Patrick Townsend, Daniel Helfant, Jesse Nadeau  
BIOL 152: Stephanie Foster, [sfoster8@csuchico.edu](mailto:sfoster8@csuchico.edu).

As a group we are very interested in the the impact man has on the environment. Also, being in a class that focuses on ecology we believed that investigating this impact man intrusion on the environment would be a good direction to take our experiment. We believed that One Mile Recreational Swim Facility, being man made, had the potential to disrupt the environment around it. As a group we decided to explore this man made disruption by surveying the bio-diversity of Aquatic invertebrates on either side of One Mile. We conducted this study using nets to collect 30 invertebrates from each side and compared the diversity using the shannon diversity index. A survey of biodiversity of aquatic invertebrates done both upstream and downstream of one mile reveals that upstream has an evenness of 0.88069 and a shannon diversity index of 2.0278. Downstream we found had an evenness of 0.90254 and a shannon diversity index of 2.0781. Overall we found that with a T-Value of 0.36, the null variable, that there is no difference in bio-diversity in the two locations, cannot be rejected. There were however noticeable differences in water temperature and water flow that suggest that there were 2 unique and different environments present upstream and downstream of One Mile. This is evident in the observable patterns in the invertebrates collected.

### LD-18

#### **Microwave Water vs. Boiled Water Effects on Germination and Growth of Swiss Chard (*Beta Vulgaris*)**

Betsy Valdez [bvaldez2@mail.csuchico.edu](mailto:bvaldez2@mail.csuchico.edu), stephanie Godoy [sgodoy2@live.com](mailto:sgodoy2@live.com),  
jose cervantes [jcervantes10@mail.csuchico.edu](mailto:jcervantes10@mail.csuchico.edu), Mai ai chang  
[mchang7@mail.csuchico.edu](mailto:mchang7@mail.csuchico.edu), kota chihogi [kchihogi@mail.csuchico.edu](mailto:kchihogi@mail.csuchico.edu)  
BIOL 152: Don Miller, [dgmiller@csuchico.edu](mailto:dgmiller@csuchico.edu)

their distinctive geosmin scent and antibiotic producing properties. They are difficult to culture as they are slow growing and are not nutritionally unique. I originally enriched for *Actinomyces* by growing the sample on oatmeal agar. After realizing that *Actinomyces* and *Streptomyces* share many similarities, I used morphological observations and incubation temperature to confirm that our isolate was not *Actinobacteria*. From the result, the morphology of cells are gram positive filamentous bacteria with aerial mycelia and form endospores. We used PCR to sequence the 16srRNA of the unknown isolate. Once I got my 16srRNA sequence back I was able to use different technique from Bioinformatics to analysis my data. My project is focused on attempting to build a phylogeny and analysis how are they related to a specific species of *Streptomyces* and gram-negative bacteria. We assumed that the isolated organisms are to be *Streptomyces* from their morphology, but my analysis concluded that they are not related to *Streptomyces*.

### GC-5

#### **Potential Non-canonical cAMP Response Element Implicated in MicroRNA-375 Regulation**

Alexander R. Stanton ([astanton2@mail.csuchico.edu](mailto:astanton2@mail.csuchico.edu))  
BIOL 610: David Keller, [dmkeller@csuchico.edu](mailto:dmkeller@csuchico.edu)

MicroRNAs are short 21-25 bp segments of RNA which become targeting sequences for RNA-induced silencing complex (RISC) assemblies. These assemblies down-regulate specific genes, playing an important role controlling expression levels and can contribute to the development and progression of diseases. MicroRNA-375 (miR375) inhibits expression of myotrophin, a protein involved in the secretion of insulin. Additionally, previous research has observed its overexpression in pancreatic beta-cells of type II diabetic patients. Domains of the promoter and involved protein(s) governing miR375 repression have been narrowed down, but not defined. However, it has been shown that the cAMP pathway promotes its repression. My hypothesis is that the protein Induced cAMP Early Repressor (ICER) mediates miR375 repression through a cAMP response element (CRE). Understanding the repression of miR375 could potentially yield insight into creating new therapeutics for improving blood glucose levels. In this bioinformatic study, the implicated regions were analyzed by three transcription factor (TF) databases Patch, P-match, and AliBaba2. These data were compared, and analyzed. Two databases showed potential non-canonical CREB binding sites, one of which is positioned within a highly conserved region and shares 11/12 bp sequence similarity (91.7%) with the human promoter. Since CREB and ICER both bind to a CRE, the discovered sequence is highly conserved, and it matches with previous promoter characterization, this non-canonical site is likely the repressor-binding domain.

hundreds of probable targets for the transcripts. The existence of empirical data invited the question as to whether the prediction databases reliably anticipated the results. Ten different databases were queried for each of the three miRNA transcripts; their results were filtered by tissue type and compared to two datasets ('high confidence' and 'probable') obtained from Cambronne, et al. The databases varied wildly in their success rates, though none predicted more than 60% of the empirically determined targets. Additionally, the percentage of predictions validated by experiment ranged from 3% - 23%. No prediction database is judged to be clearly superior to the others.

### GC-3

#### Comparison of microbial species dwelling in different body sites using data from The Human Microbiome Project

Heather Quigley ([hquigley@mail.csuchico.edu](mailto:hquigley@mail.csuchico.edu))

BIOL 610: David Keller, [dmkeller@csuchico.edu](mailto:dmkeller@csuchico.edu)

The Human Microbiome Project is funded by the National Institute of Health and serves as a repository for all microbial genomes isolated from the human body. These data are of interest because the normal flora of the human microbiome is increasingly becoming recognized as an important component of human health. I would like to know if there is variety in the microbial populations found in the different body sites and I hypothesize that there is a difference in the major microbial groups present in different areas of the body. This dichotomy seems likely because there are unique chemical environments formed throughout the body which may be better suited to host one kind of bacteria over another. This study found that out of over a thousand microbes reportedly observed, there were a total of 130 microbes that were shared between at least two body sites. 98 of these were shared between two sites, 19 between three sites, seven between four sites, two each between five and six sites, and only one between seven sites. Some of the most conserved microbes were members of the *Streptococcus* genus, which accounted for six of the top twelve most shared bacteria. The three most shared microbes were the Gram positive bacteria *Bacillus cereus* and *Enterococcus faecalis*, and the Gram negative *Escherichia coli*. Based on the results of this study, it appears that most microbes present in the human body are specific to certain body sites, likely due to differing environments.

### GC-4

#### Using Bioinformatics to Analysis an Unknown Bacteria

Koy Saelee ([koysaelee1987@gmail.com](mailto:koysaelee1987@gmail.com))

BIOL 610: David Keller, [dmkeller@csuchico.edu](mailto:dmkeller@csuchico.edu)

In microbiology, I isolated an unknown bacteria that is obligate aerobe, and thus, not pathogenic, which was obtained from a soil sample provided by Dr. Wolfe on a hiking trip. *Streptomyces* are commonly found in most soils and are known for

According to McLynn, approximately twenty percent of all meals prepared in American homes between the years of 1990-2007 involved the use of a microwave (McLynn, 2009). Microwaves are a form of electromagnetic radiation (EM); waves of electrical and magnetic energy moving together through space. Microwaves are produced inside the oven by an electron tube called a magnetron. The microwaves are reflected off the metal inside of the oven and eventually absorbed by the food (FDA, 2013). Long term side effects have not been confirmed, despite many allegations. We investigated microwave side effects and whether they inhibit plant growth in *Beta vulgaris cicla*, more commonly known as rainbow swiss chard. We predicted that seeds sown and watered with microwave water would germinate slower than seeds that were watered with boiled water. We also believed seeds watered with microwave water would not grow as tall as plants that were watered with boiled water. Seeds were sown and observed for six weeks. During this time, we monitored their growth and recorded results. We did not alter the watering times, amounts of water, or the amount of sunlight each of the sixty plants received. Plants that were watered with microwave water had a significantly lower growth average (cm) than the group watered with boiled water with an average height difference of 1.07cm ( $t=2.977$ ,  $df=46$ ,  $P < 0.01$ ).

### LD-19

#### Effect of distance from a body of water on stomatal density in the California Pipevine (*Aristolochia californica*)

Jose Zelaya ([jzelaya3@mail.csuchico.edu](mailto:jzelaya3@mail.csuchico.edu)), Jorge Mendoza

([jmendoza33@mail.csuchico.edu](mailto:jmendoza33@mail.csuchico.edu)), Adrianna Matagulay

([amatagulay@mail.csuchico.edu](mailto:amatagulay@mail.csuchico.edu)), Sam Krasnobrod

([skrasnobrod@mail.csuchico.edu](mailto:skrasnobrod@mail.csuchico.edu)), and Dulce Padilla ([dulce.padilla93@gmail.com](mailto:dulce.padilla93@gmail.com))

BIOL 152: Rick Wittsell [rwittsell@csuchico.edu](mailto:rwittsell@csuchico.edu)

In an effort to determine how distance from a body of water affected stomatal density, a light microscope was used to count stomata on the leaves of plants from the species *Aristolochia californica*. Two leaf samples were taken from each of seven plants located far from a body of water (a distance of greater than 10 meters), and eight plants near a body of water (a distance closer than 10 meters). A t-test was performed to compare the stomatal density of the plants from those different distances. We failed to reject our null hypothesis due to a lack of a statistically significant difference between the means: ( $t=.5661$ ,  $df=28$ ,  $P > 0.57$ ). The null hypothesis stated that there was no difference in stomatal density between plants located near to, or far from, a body of water.

## Upper Division Class Projects

### UD-1

#### Elucidation of Phosphate Starvation Response Genes in *Pseudomonas stutzeri* and *Serratia marcescens* via Transposon Mutagenesis

Lindsey Arnaud [lmj083@gmail.com](mailto:lmj083@gmail.com), Alexander Austin, Donald Beck  
[dbeck8@mail.csuchico.edu](mailto:dbeck8@mail.csuchico.edu),

Danielle Boeking, Leslie Calzada [lcalzada@mail.csuchico.edu](mailto:lcalzada@mail.csuchico.edu), Jessica Garcia [jgar-cia124@mail.csuchico.edu](mailto:jgar-cia124@mail.csuchico.edu), Garrett Haffey, Tina Misuraca  
[cmisuraca@mail.csuchico.edu](mailto:cmisuraca@mail.csuchico.edu), Martha Montez [marthamntz21@gmail.com](mailto:marthamntz21@gmail.com), Amy Moran  
[glutenwise@yahoo.com](mailto:glutenwise@yahoo.com),

Adrian Torres, Mai Yang [Myang37@mail.csuchico.edu](mailto:Myang37@mail.csuchico.edu)  
BIOL 412: Andrea White [akwhite@csuchico.edu](mailto:akwhite@csuchico.edu)

While the phosphate response is well characterized in *E. coli*, a model bacterium, this response is not well understood in the common and environmentally important bacteria, *Pseudomonas stutzeri* and *Serratia marcescens*. To identify genes involved in the phosphate starvation response in both bacteria, and in phosphate-dependent prodigiosin pigment production in *S. marcescens*, we utilized transposon mutagenesis to disrupt genes in these organisms. We screened 12,500 mutants of *P. stutzeri* and 26,846 mutants of *S. marcescens*. The transposon insertion frequency for *P. stutzeri* and *S. marcescens* ranged from  $7.9 \times 10^{-2}$  and  $2.4 \times 10^{-5}$  to  $4.8 \times 10^{-4}$  respectively. Seven *P. stutzeri* mutants were identified, three of which were successfully cloned, while eighty seven *S. marcescens* mutants were identified, nine of which were successfully cloned. Uninducible, constitutively active, and hyperpigmented phenotypes were observed. Sequencing the transposon insertion site in each mutant revealed that the mutants had disruptions in genes *phoR* and *piT*, previously known for involvement in the response, and *tlyC*, *tatC*, *spoT*, *pacC*, *lysR*, *lrhA*, and *ent D*, not previously associated with this response. Phosphate starvation responses, shown by varying phenotypes during adequate and inadequate phosphate supply, were correlated with the protein functions normally expressed by the disrupted genes. Our effort resulted in the identification of new genes involved in the phosphate starvation response thus increasing our understanding of the signaling and phosphorus acquisition pathways in bacteria.

### UD-2

#### Investigating the Role of Class III Peroxidase Gene AT3G21770 using YFP Transfection of *Arabidopsis thaliana* via *Agrobacterium tumefaciens*

K. Babo, D. Beck, C. Camellari, M. Coetzer, M. Hartman, T. Sakulsinghduisit  
[karababo@sbcglobal.net](mailto:karababo@sbcglobal.net), [Mhartman4@mail.csuchico.edu](mailto:Mhartman4@mail.csuchico.edu), [Ma-reli.coetzer@yahoo.com](mailto:Ma-reli.coetzer@yahoo.com), [k-mita@hotmail.com](mailto:k-mita@hotmail.com), [islandgirl5480@yahoo.com](mailto:islandgirl5480@yahoo.com), [## Graduate Class Projects](mailto:atsa-</a></p></div><div data-bbox=)

### GC-1

#### Comparisons of microarray data indicates high fat diets cause alterations to the epigenetic code and lead to development of obesity

Kara Babo, [Karababo@sbcglobal.net](mailto:Karababo@sbcglobal.net)  
BIOL 610: David Keller, [dmkeller@csuchico.edu](mailto:dmkeller@csuchico.edu)

The occurrence of obesity in the population is increasing rapidly, and could be considered a global epidemic. The recent rise of this disease invokes questions about the underlying cause. Until recently, genetics were the chief culprit; now studies suggest epigenetic mechanisms play an essential role in the development of obesity and associated diseases. This study aims to determine if high fat diets affect the expression of genes, and if the altered epigenetic code persists into future generations. Microarray research done by Koza et al. and Sheau-Fang et al. was examined to determine if the epigenetic codes of various mice strains were altered following consumption of a high fat diet. Sheau-Fang et al. focused on how genes were expressed in offspring's of parents fed a fat diet and Koza et al. looked at changes in a single generation. Using bioinformatics tools the genes studied in the two experiments were evaluated and checked for similarities. Microsoft Access was employed to determine intersections in both data sets using ascension numbers for genes from University of California, Santa Cruz genome browser. In both studies it was determined tumor necrosis factor (tnf) experienced changes in expression. Altered gene expression prevailed after removal of high fat diets and proceeded to be expressed in future generations supporting my hypothesis an epigenetic mechanism for obesity.

### GC-2

#### Analysis of MicroRNA Target Database Predictions

Trevor Hunter [THunter@gmail.com](mailto:THunter@gmail.com)  
BIOL 610: David Keller, [dmkeller@csuchico.edu](mailto:dmkeller@csuchico.edu)

MicroRNAs (miRNAs) are short (~22 nucleotide) molecules capable of post-transcriptional regulation of hundreds of genes through association with the multi-protein RNA-induced silencing complex (RISC). Until recently, miRNA targets were only be validated one at a time, and full targetomes for individual miRNA transcripts were in turn piecemeal and woefully incomplete. As such, algorithms have been necessarily developed to predict the likely sites of RISC-based regulation in mRNA transcripts, and the databases hosting these predictions have been cited by hundreds of research publications in recent years. In November, a new method was proposed and tested by Cambronne, et al, for the isolation of actively down-regulated targets en masse, using miRNAs 124, 132, and 181. Their data showed

vated peroxidase activity that may provide a biochemical explanation for phenotypic differences between transgenic plants and non-transgenic controls.

#### UR-5

##### **Stop MiRNA 425, Save Diabetes Patients**

Liwenzhu Yao [yaoliwenzhu@hotmail.com](mailto:yaoliwenzhu@hotmail.com), David M. Keller [dmkeller@csuchico.edu](mailto:dmkeller@csuchico.edu)

Diabetes is a metabolic disease, which is one of the United States' worst epidemics. The high concentrations of glucose and free fatty acids (FFA) in the blood stream become a source of stress for cells, cause programmed cell death (apoptosis) and can lead to fatality for patients. A microRNA (miRNA) is a single-stranded non-coding RNA molecule which functions in post-transcription regulation of gene expression. MiRNAs play an important role in normal cell growth and physiology and also contributes to pathogenesis of many diseases such as cancer and diabetes. One study shows that miRNA-425 (miR-425) reduces cell proliferation in breast cancer. However, there is no data showing the relationship between miR-425 and pancreatic beta-cell growth or apoptosis. In this study, we wish to test this by studying the role of miR-425 and cell apoptosis caused by FFA. In our lab, we predicted that miR-425 contributes to pancreatic beta-cell death and a potential diabetes treatment may be developed by blocking miR-425. The FFA palmitate is transported across the cell membrane under physiological conditions. We show that palmitate was absorbed in the pancreatic beta-cell line, INS-1, via Nile Red staining. INS-1 cells exposed to 0.5mM palmitate and a MTS assay demonstrated lipotoxicity after 24 h exposure. Cell death dramatically decreased when miR-425 inhibitor was transfected into INS-1 cells treated with palmitate. The results suggest that palmitate caused stress and apoptosis in part by triggering the miR-425 pathway.

[kul@gmail.com](mailto:kul@gmail.com)

BIOL 409: Kristopher Blee [kblee@csuchico.edu](mailto:kblee@csuchico.edu)

The process of lignification in plants is not completely understood. It is thought that Class III peroxidases play an important role in lignification. To answer this question we looked for a gene in *Arabidopsis thaliana* that was targeted to the cell wall, localized in the root tip, and expressed early in development. We hypothesize that the AT3G21770 protein will be found in the cell wall because it lacks an n-terminal Kdel sequence. We utilized genevestigator to produce heatmaps of gene expression in plant tissue and time in development; the maps indicated AT3G21770 expression in root tips and early in development, indicating it was a suitable candidate. Tri-template PCR was used to tag the gene with YFP. An Agarose Gel Electrophoresis was ran and determined a DNA fragment that was 3200 basepairs in length. We concluded it was a successful TTPCR since the fragment was the correct length that we expected from the original primers and YFP. The YFP transfected gene was then amplified, first by incorporation into the pMN20GW *E.coli* plasmid, and eventually into *Agrobacterium tumefaciens*. The *Agrobacterium* was applied to *Arabidopsis* for transfection. The transgenic seeds were plated on appropriate media for growth. Using fluorescent microscopy we scanned the plates for expression of AT3G21770. We found luminescence localized in the xylem of the root and the cell walls of the root hairs. These findings support our hypothesis that the gene AT3G21770 is expressed in the cell wall and may be associated with the formation of lignin based on locality.

#### UD-3

##### **Comparative Allelopathy with Invasive and Endemic Plants of California**

Matthew Bancroft [mbancroft@mail.csuchico.edu](mailto:mbancroft@mail.csuchico.edu), Collin Crawford-Martin [collin-crawfordmartin@gmail.com](mailto:collin-crawfordmartin@gmail.com), Andrea Burgoyne [aburgoyne@mail.csuchico.edu](mailto:aburgoyne@mail.csuchico.edu), Crissanne Geiger [cgeiger3@mail.csuchico.edu](mailto:cgeiger3@mail.csuchico.edu)  
BIOL 409: Kristopher Blee [kblee@csuchico.edu](mailto:kblee@csuchico.edu)

Allelopathy describes the process in which the release of biochemicals from domesticated and weed species, called allelochemicals, cause harmful (sometimes beneficial) effects of one plant to another through mechanisms such as root exudation, vaporization, decomposition, and percolation. Invasive species such as Eucalyptus (*Eucalyptus cineria*) are more allelopathic than endemic species such as California White Sage (*Salvia apaina*) and Purple Sage (*Salvia leucophylla*). As a result, allelopathy may account for the success of invasive plant species relative to endemic ones. Each sample of the allelopathic species were crushed individually in a mortar and pestle and an equal volume of water added for each individual allelopathic plant species, allowed to soak for an equal amount of time, and then strained onto cut-up sections of paper towel. The paper towels were spread in each section of the planters, a layer of organic soil added on top, and the test seeds broccoli (*Brassica oleracea*) and lettuce (*Lactuca sativa*) planted with 2 cen-

timeters of organic topsoil. After two weeks, measurements were collected for the number of seed germinations and sprout length. After observing and letting our seeds germinate and grow we found that Eucalyptus inhibited plant germination of lettuce and broccoli at a higher rate than both White Sage and Purple Sage.

#### UD-4

##### **Foraging Ecology: Giving-up Densities in California Grey Squirrels**

Sean Bentinck, [sbsummitbikes@gmail.com](mailto:sbsummitbikes@gmail.com), Brittany Mundy, [bmundy1@csuchico.com](mailto:bmundy1@csuchico.com),

Travis Richards, [Travisrichards81@gmail.com](mailto:Travisrichards81@gmail.com)

BIOL 350: Glenn Woodruff [glenntwoodruff@gmail.com](mailto:glenntwoodruff@gmail.com)

Optimal foraging theory is a concept in ecology that states that organisms will forage for food in a manner that maximizes their total energy intake per unit time (Hancock 2006). In others words, organisms tend to consume food in a way that takes the least amount time and energy, while keeping their risk for predation as low as possible. In an experiment conducted around various locations of northern California, this theory was tested by observing the foraging patterns of California grey squirrels (*Sciurus griseus*). Multiple samples of sand/sunflower seeds inside of pie pans were placed in rural and urban locations for a period of 6 hours. The ratio of sand to sunflower seeds was 300 seeds per 1L of sand. The initial quantity and final quantity were recorded to determine the amount consumed. The results indicated a p-value greater than .05, meaning that there was no significant difference between foraging patterns of both the rural and urban areas. It should be noted that the method of sunflower seed collection differentiated between habitats, but this did not lead to a significant difference in the amount of seeds removed from the pie pans. This experiment did not show any conclusive evidence for differences between foraging patterns of California grey squirrels in rural and urban habitats.

#### UD-5

##### **Determining Expression of Peroxidase Gene AT1G05260 in *Arabidopsis thaliana***

Arturo Berran ([christobal92@gmail.com](mailto:christobal92@gmail.com)), Pablo Diaz ([pdiaz6@mail.csuchico.edu](mailto:pdiaz6@mail.csuchico.edu)),

Vang Xiong ([vxiong7@mail.csuchico.edu](mailto:vxiong7@mail.csuchico.edu)), Payton Laurie

([paytonlaurie@gmail.com](mailto:paytonlaurie@gmail.com)), Fuab Yang ([fyang8@mail.csuchico.edu](mailto:fyang8@mail.csuchico.edu))

BIOL 409: Mandeep Grewal [mgrewal@mail.csuchico.edu](mailto:mgrewal@mail.csuchico.edu)

Class III secretory peroxidases have multiple cellular functions in plants, including the potential in assisting with the production of lignin. This study follows the expression of peroxidase gene AT1G05260 in *A. thaliana*. Using data from temporal and spatial heat maps generated from Genevestigator, peroxidase gene AT1G05260 was determined to be highly expressed in the roots during development of cotyledons. After the gene was selected, four primers (P1-P4) were designed producing two fragments consisting of the P1/P2 primers at 3200bp in

significantly. Substituting a nitro R-group in place of hydrogen or t-butyl dramatically increased activity possibly due to affecting electron distribution. Growth kinetics in the presence of the thiosalens showed the compounds to be bactericidal against *Staphylococcus* and bacteriostatic against *E. coli*. Octanol coefficients were determined to measure water solubility, and therefore bioavailability. Studies to determine the mechanism of action of these salens are ongoing and include oxidative activity and the effects on membrane permeability.

#### UR-3

##### **Neuronal spine densities in the aging rat hippocampus: responses to lesion.**

Frans Honig [fhonig@mail.csuchico.edu](mailto:fhonig@mail.csuchico.edu) & Jonathan R. JDay@csuchico.edu

The brain undergoes a normal pattern of synaptic reorganization during development and learning. Synaptic connections in the brain are also affected by trauma and disease. Aging adversely affects this process of synaptic plasticity. Testosterone has been demonstrated to have a role in modulating brain plasticity. In this study, synaptic reorganization in aging hippocampus was induced by a deafferentation lesion similar to human neurodegeneration of the Alzheimer's type. The purpose of the experiment was to see if lesion-induced synaptic reorganization in the aging brain could be altered by gonadal steroid manipulation in male rats. The dendritic spine and varicosity densities were calculated in the distal dendrites of granule cells of the dentate gyrus in three age groups of rats (3 months; 12 months; 24 months). Within the age groups there were three different treatments: intact, castrated, and testosterone-implanted. Significant reductions in spine and varicosities densities were observed between the 3 month, 12 month, and 24 month old rats. Neither castration nor testosterone replacement affected the age-related decline in spine densities. These results suggest that popular notions of the beneficial effects of anabolic steroids on the brain may be limited.

#### UR-4

##### **Characterization of a Fluorescent Tagged Secretory Peroxidase Fusion Protein in Transgenic *Arabidopsis thaliana***

Seng Thao, [thaose@gmail.com](mailto:thaose@gmail.com), Kristopher Blee, [kblee@mail.csuchico.edu](mailto:kblee@mail.csuchico.edu)

The class III secretory peroxidase genes in *Arabidopsis thaliana* are involved in physiological processes such as lignin biosynthesis and stress response. These genes are expressed in the roots, stems and leaves, however their functions are not fully understood. Previous research in our lab using recombinant yellow fluorescent protein tagged peroxidase AT3g21770 indicated fluorescence in guard cells of stomates. To investigate the potential of the fluorescent fusion protein possessing peroxidase activity we used native protein gel electrophoresis on extracts from control and transgenic *A. thaliana* leaves. Native gels revealed a fluorescent band and active peroxidase isoform in transgenic plants that were not present in control extracts. These results indicate that transgenic plants have ele-

## Undergraduate Research

### UR-1

#### Frequencies of bird species on native and introduced tree species on the campus of University of Costa Rica, San Ramon

Morgan Blofsky [mblofsky@mail.csuchico.edu](mailto:mblofsky@mail.csuchico.edu), Cindy Rodríguez Arias, Bióloga UCR-SO [Cindyelena@gmail.com](mailto:Cindyelena@gmail.com) (University Studies Abroad Consortium)

The University of Costa Rica, San Ramon, provides an ideal environment to several bird species due to the abundance of tree species on the campus. It was hypothesized that more bird species would be attracted to the campus if non-native introduced trees were removed and more native trees were planted. The purpose of this study was to evaluate if birds showed a preference between native and introduced trees to determine if the removal of introduced tree species would be beneficial. In total, twenty-four trees of eight different species were observed to identify and count the birds that visited each tree. Through statistical analysis it was found that there was no significant difference of bird species diversity on introduced and native trees. From this research, it does not appear that an adjustment in tree species composition favoring more native trees would increase the amount of birds visiting the campus. Further research is needed to assess how this change in tree species may or may not impact bird species.

### UR-2

#### Investigation of the Biological Activity of Thio- and Oxo- Salens

Dylan A. Carroll [dcarroll4@mail.csuchico.edu](mailto:dcarroll4@mail.csuchico.edu), Devin S. McBain\*, Erik C. Wasinger\*, Larry F. Hanne [lhane@csuchico.edu](mailto:lhane@csuchico.edu)

\*Department of Chemistry and Biochemistry, California State University, Chico

Antibiotic-resistance among pathogenic bacteria is increasing at an alarming rate. This project has focused on synthesizing metal Schiff base complexes, salens, and determining their antimicrobial effects in the hopes of finding new potential antibiotics. Preliminary experiments with thio-salens and various metals showed that coordination with cobalt was essential for antimicrobial activity. Based on this result we developed a library of salen compounds with substitutions that alter the planarity, electron distribution within the phenolic moiety, hydrophilicity and the metal-complexing atoms. Initially we began with thiolated salens and later switched to oxygenated for ease of synthesis. These salens were created through the spontaneous condensation reaction of diamines with aldehydes. Antimicrobial activity of these compounds was screened against *Staphylococcus epidermitis*, *E. coli*, and *Candida albicans* using a Kirby Bauer disc diffusion assay. Some of the oxosalens were effective without being coordinated with cobalt. Making the oxosalens more planar, with a benzene backbone, increased antimicrobial activity

length and P3/P4 primers at 383bp in which a yellow fluorescent protein (YFP) gene was inserted in between. Tri-template PCR was used to assemble the fragments, which were successfully validated following electrophoresis. After synthesis of the P1/2::YFP::P3/4 hybrid gene, a cloning procedure ensued using a pDONRZeo plasmid. This plasmid was then used to transform *E. coli*, isolated from positive cultures, and sub-cloned into a pMN20 plant transformation vector. *A. tumefaciens*, a pathogenic plant bacterium, was transformed using the pMN20 vector and inoculated onto *A. thaliana* with intentions of producing transgenic plants. Presence of YFP in *A. tumefaciens* and *E. coli* from colony PCR ensured successful transformation. Visual inspection of roots during growth showed presence of the YFP hybrid gene in areas of vascular tissue.

### UD-6

#### Characterization of Bacteriophages Isolated from Sewage and Compost

Blake Brousseau, Nicole Fugate, Jeremy Hoptowit, Michelle Grek, Gem Larson, Coral Maier, Andrew Rich, Lindsey Richardson, Ashli Robertson, Alexander Stanton, Maria Vargas, Sonia Vasquez, Mackenzie Whipple  
BIOL 476: Larry Hanne [Lhane@csuchico.edu](mailto:Lhane@csuchico.edu)

Viruses are present everywhere and are able to infect all forms of life including plants, animals, protozoans, algae and bacteria. To better understand viruses it is critical to determine viral characteristics such as host range, temperature stability, envelope presence, burst size, infection kinetics, surface proteins, etc. Bacteriophage, viruses that infect bacteria, play a critical role in infectious disease and in ecology. Six different bacteriophages were isolated from compost and sewage that could infect 3 strains of *E. coli* (B, C91, MM294) and *Pseudomonas syringae*. Characterization of isolated bacteriophages showed: all were non-enveloped; some were specific for one strain of *E. coli*; all demonstrated single hit kinetics of infection; all could tolerate freezing and thawing; temperature stability ranged from 35 to 55 C; and, protein SDS-PAGE gels showed major capsid proteins. Additional studies determined whether the bacteriophage receptor was protein and optimal temperature for attachment.

### UD-7

#### Biodiversity of flora in relation to distance from decomposing trees

Jamie Bruce ([animalhouse143@msn.com](mailto:animalhouse143@msn.com)), Jennifer Oliver ([norcargirl4@yahoo.com](mailto:norcargirl4@yahoo.com)), Collin Pryor ([cpryor2@mail.csuchico.edu](mailto:cpryor2@mail.csuchico.edu)), and Kate Ronan ([katenanor@yahoo.com](mailto:katenanor@yahoo.com))  
BIOL 350: Shelly Kirn ([sakirn@csuchico.edu](mailto:sakirn@csuchico.edu))

The objective of this study was to determine the biodiversity of flora relative to its proximity to decomposing trees in Upper Bidwell Park, Chico CA. At six different decomposing trees, four plots were chosen in April, 2013. All plots were located halfway down the length of the tree, at 0m, 1.5m, 3m, and 4m from the tree. Data

were collected by counting the number of different types of forbes found in a 0.5 square meter quadrant. The data were analyzed using ANOVA and a p-value of 0.411 was obtained. Floral diversity was determined to not be significant at various distances from decomposing trees in a blue-oak woodland.

#### UD-8

##### **Insertion of Fluorescent Protein Sequence into Peroxidase Gene by Tri Template Assembly and Formation of Transgenic *Arabidopsis thaliana***

Leslie Calzada, Natalie Crippa, Martha Montez

[lcalzada@mail.csuchico.edu](mailto:lcalzada@mail.csuchico.edu), [ncrippa1@mail.csuchico.edu](mailto:ncrippa1@mail.csuchico.edu),  
[mmontez1@mail.csuchico.edu](mailto:mmontez1@mail.csuchico.edu)

BIOL 409: Kristopher Blee [kblee@csuchico.edu](mailto:kblee@csuchico.edu)

*Arabidopsis thaliana* contains a family of 73 peroxidase genes. We hypothesized that one of these genes, AT3G21770, travels through the secretory pathway to be expressed in the cell wall of the root maturation zone in the root tip and in young leaves. This was determined by use of the program Genevestigator, which uses DNA microarrays to assess where genes are expressed in plants, and PSORT data, which shows where genes are expressed in the cells. This hypothesis was tested by tagging the peroxidase gene with a yellow fluorescent protein (YFP) sequence. PCR was used to create gene fragments of AT3G21770, and then combined with the YFP for a second round of PCR to form a tri-template DNA construct 3,232 base pairs long. Gel electrophoresis showed that the reporter construct was assembled correctly. The tri-template was cloned into the bacterial plasmid pDONR221 and transformed into *E. coli*. Plasmid pD21770 was sub cloned into pMN20GW, a plant plasmid vector, and was inserted into *Agrobacterium tumefaciens*. *A. thaliana* flowers were inoculated with *A. tumefaciens* carrying pM21770::YFP and transgenic seeds germinated. These seeds were grown on selective media. We performed a Northern Blot to determine whether the AT3G21770 gene was expressed in the leaves, and while gel electrophoresis showed the presence of mRNA, the Northern Blot was inconclusive. Transgenic plants were viewed under ultraviolet light and it was determined that the tagged peroxidase gene was expressed in the primary roots' maturation zone, but results of gene expression intracellularly were inconclusive.

#### UD-9

##### **Evergreen Invasion: Analyzing the Competitive Advantages of Feral European Olive (*Olea europaea*) Colonization of Blue Oak (*Quercus douglasii*) Savanna in Upper Bidwell Park**

Tyron Chang, Ethan Snee, Abigail Whitaker, Bryce Zubiante

BIOL 484: Colleen Hatfield [chatfield@csuchico.edu](mailto:chatfield@csuchico.edu)

Blue oak is a native keystone species in savanna ecosystems of the arid Sacramento Valley foothills. Constrained by the limited rainfall and nutrient-depleted soils

cence was observed in the root tip and root vascular tissue at elongation zone under fluorescent microscopy in our transgenic *A. thaliana* plants.

#### UD-31

##### **Estimating Importance Value and Dispersion Patterns in Tree**

Nou Xue Yang, Matthew Lighthouse, Stefan Kirk, Phia Yang

BIOL 350: Glenn Woodruff [glenntwoodruff@gmail.com](mailto:glenntwoodruff@gmail.com)

The dispersion pattern in trees can tell us more about the local environment than just species diversity; it can also inform us about the local ecosystem as a whole. Our goal was to look at interspecific and intraspecific competition to see if an r-selected species, one with multiple offspring in a cohort and a short life span, will dominate in the riparian area of Lower Bidwell Park. We used the point quarter system to plot three different areas of uniform size of 60 feet long and 30 feet wide. We noticed that in areas of low disturbance the r-selected species were able to thrive in clumped dispersion patterns; whereas in areas of high disturbance, older growth k-selected species, one which lives long with few offspring, were able to dominate. Results of the experiment were supported by the intermediate disturbance hypothesis, which states that areas of high disturbance will have low species diversity; however areas with lighter more consistent disturbance will have higher species diversity.

#### UD-32

##### **Identifying Natural Barriers to Invasive Crayfish in Big Chico Creek**

Authors: Nick Delaney and Daniel Crawford

Affiliations:

BIOL484 Field Methods; Department of Biological Sciences, CSU Chico

Category: Class Project

Two stream sections of Big Chico Creek were surveyed during spring 2013 in the Big Chico Creek Ecological Reserve in Butte County, California. The distribution and composition of invasive crayfish (*Orconectes virilis*) were determined using traps and stream surveys. Crayfish were only found below a section of the creek known as the narrows. The composition of crayfish found below the narrows consisted of only *Orconectes virilis* (n=40). Not finding any crayfish above this section suggests that the narrows is a natural barrier that prevents further upstream colonization by crayfish. Further research is needed to determine the environmental conditions that apparently prevent movement of crayfish past this point.

(H<sub>2</sub>O<sub>2</sub>). Class III peroxidases are found in plants and have multiple tissue-specific functions including H<sub>2</sub>O<sub>2</sub> detoxification, auxin catabolism, and lignin biosynthesis. The *Arabidopsis thaliana* genome contains 73 genes coding for this class of peroxidases, but their exact role in plant cells is not fully understood. Determining the subcellular destination of an enzyme can give us insight to its possible function. For the purposes of our study, we selected the peroxidase gene AT3G21770 to determine the subcellular location of the translated protein in root cells. Protein sequence analysis suggests that our peroxidase travels through the secretory pathway of the rough endoplasmic reticulum, continues onto the golgi apparatus, and it is sequestered to the cell wall. To test our hypothesis, we amplified the AT3G21770 fragment and inserted a yellow fluorescent protein (YFP) tag through tri-template polymerase chain reaction (TT-PCR) techniques. Through several bacterial cloning and subcloning plasmid vectors, we transformed our modified gene construct into *Agrobacterium tumefaciens*. After inoculation of *A. thaliana* with the bacterium, potentially transgenic seeds were collected and grown on a selective agar media for plants containing our gene construct. Plants were analyzed for fluorescence using fluorescent microscopy. So far, no fluorescence has been found but we cannot come to a conclusion due to pending data collection.

#### UD-30

##### Exploring The Expression of Peroxidase Gene, AT1G05260, in *Arabidopsis thaliana*

Choua Thao [cthao27@mail.csuchico.edu](mailto:cthao27@mail.csuchico.edu), Christen Wyatt [cwtatt1@mail.csuchico.edu](mailto:cwtatt1@mail.csuchico.edu),

Choua Yang [cyang24@mail.csuchico.edu](mailto:cyang24@mail.csuchico.edu), Gina Sideli [gsideli@mail.csuchico.edu](mailto:gsideli@mail.csuchico.edu), Mackenzie Frost [mackfrost23@hotmail.com](mailto:mackfrost23@hotmail.com), Gladys Hernandez [ghernandez25@yahoo.com](mailto:ghernandez25@yahoo.com))

BIOL 409: Kristopher Blee [kblee@csuchico.edu](mailto:kblee@csuchico.edu)

The class III secretory peroxidase family is thought to be involved in the biosynthesis of lignin. There have been 73 peroxidase genes that have been identified within the *Arabidopsis thaliana* genome and specific function for each remains elusive. The purpose of this study is to attempt to figure out the location of expression and function of peroxidase gene AT1G05260. Peroxidase gene product expression in the cell wall of *A. thaliana* would implicate peroxidase involvement in this biosynthetic pathway. A yellow fluorescent protein (YFP) gene from a jellyfish was utilized to create a reporter construct for gene AT1G05260 through tri-template pcr. Using *Escherichia coli* as a plasmid clone and then subcloning into *Agrobacterium tumefaciens* many copies of gene were made in order to transform *A. thaliana*. Successful transformation resulted in fluorescence of *A. thaliana* root tip using fluorescent microscopy and analysis of RNA in young leaf tissue using a Northern Blot Analysis. This was confirmed through gel electrophoresis, successful colony growth on agarose plates and colony PCR, *A. bacterium* demonstrated to be transformed with reporter construct for gene AT1G05260. Furthermore, fluores-

characteristic of Mediterranean regions, *Q. douglasii* vies with understory species for scarce water and nutrient resources, creating an ecosystem characterized by a canopy of evenly spaced oaks with a grassland understory. European Olive is an introduced species to the oak woodlands of Upper Bidwell Park, and the exotic evergreen appears to have several physical performance advantages over *Q. douglasii*. In order to quantify the potential threat posed to blue oak dominance, water sequestration and suppression of understory species were compared between *Q. douglasii* and *O. europaea*. At each tree surveyed, soil moisture and density of understory grasses was sampled at three points, roughly equidistant to each other and one meter from the base of the trunk. Soil moisture was measured using a digital moisture sensor, and the grass stem density was counted within one square inch sample plots. All understory shrub and sapling individuals within a three meter radius of the sample tree's trunk were recorded by species. The density of understory grasses and the diversity of woody understory species varied significantly between olive and oak trees. Additionally, soil moisture levels were moderately negatively correlated with the number of woody understory individuals. Advancing our understanding of the impacts of *O. europaea* invasion on *Q. douglasii* can help to inform strategic management or intervention to minimize the impacts on wildlife and native biodiversity in the ecosystem.

#### UD-10

##### Habitat Utilization and Selection by Birds of the Big Chico Creek Riparian Forest with Notes on Avian and Plant Diversity

Christene Coffman, Ariana Gehrig, Margaret Jones, and Ellie Oliver  
BIOL 434: Jay Bogiatto [RBogiatto@csuchico.edu](mailto:RBogiatto@csuchico.edu)

We conducted a survey of the Big Chico Creek avian community within a riparian forest habitat in upper Bidwell Park, about 1 mi east of Horseshoe Lake, Chico, Butte County, California. Morning surveys were conducted during April and May 2013. Our 1 ha study area was divided into transects designed for surveying both the plant and bird communities. Our goals were (1) to determine the species composition of both the bird and plant communities within our study area, (2) to calculate foliage height and plant species profiles for our study area, (3) to generate Shannon diversity (*H'*) values for plant species, foliage heights, and bird species, and (4) to determine whether birds are using the various plant species and foliage heights randomly or selectively; our null hypotheses being that there are no differences in the availability of both plant species and foliage height intervals, and the utilization of these habitat components by birds. The most common avian species at our site include acorn woodpecker, European starling, lesser goldfinch and yellow-rumped warbler. Our results will be presented on our poster.

#### UD-11

##### **Allelopathy in Plants: Invasive VS. Endemic Species and Their Effects on Non-Allelopathic Endemic Species**

Rebecca Cole [rcole5@mail.csuchico.edu](mailto:rcole5@mail.csuchico.edu), Thomas Coots [tcoots@mail.csuchico.edu](mailto:tcoots@mail.csuchico.edu), Anoop Pandit, [apandit@mail.csuchico.edu](mailto:apandit@mail.csuchico.edu), Jonathan Schmidt [jschmidt29@mail.csuchico.edu](mailto:jschmidt29@mail.csuchico.edu)  
BIOL 350: Shelly Kirn ([sakirn@csuchico.edu](mailto:sakirn@csuchico.edu))

Several species of plants, in order to outcompete other species, release chemicals into the soil to prevent organism from growing around them while competing for the same nutrient; this is known as allelopathy. The purpose of this study is to better understand invasive allelopathic plants, compared to endemic allelopathic plants, in how they affect growth of endemic species. Using the California Poppy as an endemic test subject, seedlings were initially treated with water with crushed Eucalyptus leaves, the introduced species, and Black Walnut leaves, the endemic species, to compare the biomass to a control group after five weeks. Predicted results show a decreased average biomass between the seedlings treated compared to the control seedlings, treated initially with Chico's municipal water. Also, the seedlings treated with Eucalyptus water treatments show a decreased average biomass compared to the California-native Black Walnut water treated seedlings. Measured data, results, and conclusions forthcoming.

#### UD-12

##### **The effect of allelopathic chemicals from Black Walnut, Eucalyptus, and Sunflower on Tomato germination**

Jessica Dewey [jdewey2@mail.csuchico.edu](mailto:jdewey2@mail.csuchico.edu), Rosie Dean [rosie\\_d09@hotmail.com](mailto:rosie_d09@hotmail.com), Alexcia Everhart [aeverhart@mail.csuchico.edu](mailto:aeverhart@mail.csuchico.edu), Audrey Hollingsworth [audrey.hollingsworth@yahoo.com](mailto:audrey.hollingsworth@yahoo.com)  
BIOL 350: Glenn Woodruff [glennwoodruff@gmail.com](mailto:glennwoodruff@gmail.com)

Allelopathy is a type of interference competition demonstrated by plants in which a plant exudes toxic chemicals that are harmful to the growth of seeds of other plant species. This form of competition can allow the allelopathic plant species to eliminate competition by other plants for resources. This study tested the effect of allelopathic chemicals of three plants on the rate of tomato germination. It was hypothesized that if the extracts from black walnut, eucalyptus, and sunflower are applied to tomato seeds then the seedling germination would be inhibited. Leaves of each allelopathic species were crushed and mixed each separately with water in order to form extracts that we then applied to tomato seeds for a period of four days. The control consisted of a water treatment without any leaf extract. It was found that there was statistical significance between the germination rate of the control and of each of the allelopathic species based on our T-test p-values of  $3.73 \times 10^{-3}$  for eucalyptus,  $5.49 \times 10^{-5}$  for black walnut, and  $1.23 \times 10^{-3}$ . From these results the null hypothesis was rejected, therefore suggesting that tomato seed

more breeding bird species than any other habitat type in the state. With changes in land use these riparian woodlands disappeared at an alarming rate, and by the middle of the 20<sup>th</sup> century less than five percent of the historical riparian woodlands remained. With the loss of habitat came population declines and extirpation in a number of bird species, recent restoration efforts have tried to curb population declines and provide much needed habitat along the river corridor. Using area searches at six riparian plots (three remnant, 3 restored) we set out to examine differences in avian richness, evenness, abundance, density, and breeding activity between restored and remnant riparian forests. We expected to see higher values in each metric for remnant forest sites because of more developed vegetation structure. Species richness, diversity, and density were all significantly higher in remnant riparian forest plots, evenness was statistically similar between plot types, and 19 of the 21 breeding activity observations were made in remnant plots. One possible explanation is larger vegetation profile lends to more usable habitat in remnant areas when compared to restored areas.

#### UD-28

##### **Foraging Ecology in Squirrels: Differences in Urban and Rural Foraging**

Candice Sawyer [csawyer2@mail.csuchico.edu](mailto:csawyer2@mail.csuchico.edu), Brenda Avalos [bavalos@mail.csuchico.edu](mailto:bavalos@mail.csuchico.edu), Brianna Faulkner [bfaulkner3@mail.csuchico.edu](mailto:bfaulkner3@mail.csuchico.edu), Greg Bennett [gbennett@mail.csuchico.edu](mailto:gbennett@mail.csuchico.edu)  
BIOL 350: Shelly Kirn ([sakirn@csuchico.edu](mailto:sakirn@csuchico.edu))

Animals have to make decisions regarding the relative risk of predation and the potential gain from foraging. For this reason sometimes animals will leave an area even if there is still food in it. We hypothesized that squirrels living in urban areas would forage for longer periods of time in comparison to squirrels in rural areas. We attributed this difference to urban squirrels having relatively few predators in comparison to rural squirrels as well as having become desensitized to humans. To test this hypothesis, sunflower seeds were mixed with sand and placed in aluminum pie tins and then left in three separate locations in both rural and urban areas. We repeated this process using peanuts as well. After a 24 hour period the seeds were counted to determine the amount of foraging that occurred that day. To maximize accuracy this experiment was carried out over many days.

#### UD-29

##### **Gene Expression and Subcellular Location of Class III Peroxidase AT3G21770 in *A. thaliana* Root Tissues**

Nicholas Spadoni, [nspadoni@mail.csuchico.edu](mailto:nspadoni@mail.csuchico.edu), Christopher Paulo, [cpaulo1988@aol.com](mailto:cpaulo1988@aol.com), Kyle Hill, [khill18@mail.csuchico.edu](mailto:khill18@mail.csuchico.edu),  
BIOL 409: Mandeep Grewal [mgrewal@mail.csuchico.edu](mailto:mgrewal@mail.csuchico.edu)

Peroxidases are a general class of enzymes that promote the oxidation of numerous compounds using naturally occurring peroxides, such as hydrogen peroxide

gest a relationship between foliage species or height intervals and use by specific bird species. Results will be shown on our poster.

#### UD-26

##### **Habitat Utilization and Selection by Birds within an Old Growth Riparian Community with Notes on Avian and Plant Diversity**

Kayleen Rammell, Nicole Leeper, and Jeannie Trizzino

BIOL 434: Jay Bogiatto [RBogiatto@csuchico.edu](mailto:RBogiatto@csuchico.edu)

We conducted a habitat utilization study by avian species within a Glenn County old-growth riparian community. Our primary focus was on plant species, foliage heights, and the selective or random utilization of these habitat components by birds. We also generated Shannon (H') diversity values for plant species, foliage heights, and avian species within our study site by analyzing the data from one comprehensive vegetation survey and six bird surveys in the study area in April-May 2013. Our 1-hectare study site is located on the Packer Unit of the Sacramento National Wildlife Refuge south of the Hwy 45/Hwy 162 intersection in Glenn County, California, approximately 30 miles southwest of Chico, California. By dividing the 1-ha site into 10 parallel transects, 10 m apart, we generated 100 survey points and quantified vegetation species and foliage heights at each. Common upper-story plant taxa found within the study site include Fremont cottonwood (*Populus fremontii*), box elder (*Acer negundo*), and California black walnut (*Juglans californica*). The most common understory taxa included California wild grape (*Vitis californica*), blackberry (*Rubus* spp.), bedstraw (*Galium* spp.), and others. Our most common bird species were Bullock's Oriole (*Icterus bullockii*), Spotted Towhee (*Pipilo maculatus*), and California Towhee (*Melospiza crissalis*). Our goals were (1) to determine the plant and avian diversity within our study area, (2) to calculate a foliage height profile of all of the present vegetation, (3) to calculate Shannon Diversity Values (H') for the bird species, plant species and foliage height, and (4) to determine whether bird species are using the plants randomly or selectively within our study area; our null hypothesis states that there are no differences in both the proportion of plant species and foliage height intervals and the utilization of these components by birds in our habitat. Data collection and analysis are ongoing and results will be presented on our poster.

#### UD-27

##### **Area searches quantify avian richness, evenness, diversity, density, and breeding activity in restored and remnant riparian woodlands along the Sacramento River**

Matt Rogers ([mrogers8@mail.csuchico.edu](mailto:mrogers8@mail.csuchico.edu)), Benson Laurie

([btlaurie89@yahoo.com](mailto:btlaurie89@yahoo.com)), Wes Prochaska ([wprochaska@mail.csuchico.edu](mailto:wprochaska@mail.csuchico.edu))

BIOL 484: Colleen Hatfield [chatfield@csuchico.edu](mailto:chatfield@csuchico.edu)

Historically vast riparian woodlands surrounded the Sacramento River, supporting

germination was in fact inhibited by the chemicals from the black walnut, eucalyptus, and sunflower extracts.

#### UD-13

##### **Niche partitioning in the birds of northwestern Butte county**

Melanie Erickson [merickson9@mail.csuchico.edu](mailto:merickson9@mail.csuchico.edu), Jackson Price

[jprice13@mail.csuchico.edu](mailto:jprice13@mail.csuchico.edu), Christie Smith ([christierochelle@gmail.com](mailto:christierochelle@gmail.com))

BIOL 350: Glenn Woodruff [glenntwoodruff@gmail.com](mailto:glenntwoodruff@gmail.com)

Birds of Northwestern Butte County were observed in their natural habitat in the five-mile recreation area of Upper Bidwell Park in Chico, California. The question of whether or not these birds, of different sizes and species, occupied different sections of trees was examined. Our group hypothesized that these birds of different sizes would exhibit spatial preferences on trees through a process called niche differentiation. Niche differentiation describes how different species occupy different niches as a result of natural selection in order to decrease the consequences of competition. Several species of native birds were surveyed in this study and were categorized by relative size. Small species of birds, for example the Oak Titmouse, preferred the lower one third of trees and shrubs. Medium species of birds, such as the Acorn Woodpecker and the Western Scrubjays, statistically preferred areas in the middle one third of trees. Additionally, large species of birds, such as the Red-tailed Hawk, significantly preferred the upper one third of trees.

#### UD-14

##### **Estimating Importance Values and Dispersion Patterns of Trees in a Coniferous Forest**

Hugo Espinoza [hespinoza1@mail.csuchico.edu](mailto:hespinoza1@mail.csuchico.edu), Erik Martin [emartin13@mail.csuchico.edu](mailto:emartin13@mail.csuchico.edu),

Adriana Arroyo Gomora [agomoraarroyo@mail.csuchico.edu](mailto:agomoraarroyo@mail.csuchico.edu), Kaleb Fitzgerald [kfitzgerald2@mail.csuchico.edu](mailto:kfitzgerald2@mail.csuchico.edu), Desire'e Teran [dteran@mail.csuchico.edu](mailto:dteran@mail.csuchico.edu),

BIOL 350: Shelly Kirn ([sakirn@csuchico.edu](mailto:sakirn@csuchico.edu))

It is essential to determine importance values and dispersion patterns of species in order to project the fitness of future generations. This experiment involved six coniferous trees (*Calocedrus decurrens*, *Quercus virginiana*, *Quercus douglasii*, *Pinus lambertiana* Douglas, *Cornus florida*, and *Abies concolor*, ) found off of Highway 32 northeast of Forest Ranch in Butte County. The area selected to conduct the experiment was approximately 92 meters from the side of the road. Once a 30 meter transect line was established, points were picked at random in order to determine various quadrats. Each quadrat was comprised of four individual quadrants (A-D). A measurement was taken from the center of each quadrat to the closest tree in each quadrant. This process was repeated in 19 more quadrats, for a total of 20 replicates. We calculated an importance value by adding the relative

frequency, relative dominance and relative density. Our results indicate *Quercus virginiana* has the highest importance value (103.28) compared to *Pinus lambertiana Douglas* which had the lowest importance value (7.20). Finally, after applying the Holgate method the spatial distribution of the trees was determined to be aggregated.

#### UD-15

##### **Habitat Utilization and Selection by Birds of the Big Chico Creek Reserve Chaparral Ecotone with Notes on Avian and Plant Diversity**

Matthew Forster, Jackson Price, and Vanessa Applegate  
BIOL 434: Jay Bogiatto [RBogiatto@csuchico.edu](mailto:RBogiatto@csuchico.edu)

We conducted a survey of the Big Chico Creek Reserve avian community within a chaparral habitat along the Tuscan Loop portion of the BCCR. Surveys were conducted between April and May of 2013. Our 1 ha study area was divided into transects designed for surveying both the plant and bird communities. Our goals were (1) to determine the species composition of both the bird and plant communities within our study area, (2) to calculate foliage height and plant species profiles for our study area, (3) to generate Shannon diversity ( $H'$ ) values for plant species, foliage heights, and bird species, and (4) to determine whether birds are using the various plant species and foliage heights randomly or selectively; our null hypotheses being that there are no differences in the availability of both plant species and foliage height intervals, and the utilization of these habitat components by birds. The most common avian species at our site included wren-tit, spotted towhees, chipping sparrows, and golden-crowned sparrows. Our results will be presented on our poster.

#### UD-16

##### **Characterizing use of brush piles in woodland and meadow habitats**

Caitlin Graves [cgraves5@mail.csuchico.edu](mailto:cgraves5@mail.csuchico.edu) and Elizabeth Franceschini [efranceschini@mail.csuchico.edu](mailto:efranceschini@mail.csuchico.edu)  
BIOL 484: Colleen Hatfield [chatfield@csuchico.edu](mailto:chatfield@csuchico.edu)

Constructing artificial brush piles can be a great management technique to increase species diversity. These piles can attract many smaller mammals, ground-dwelling birds, songbirds and predators. The scope of our study was to assess the diversity of animals utilizing brush piles at the Big Chico Creek Ecological Reserve, in Butte County, CA. Brush pile usage in meadow and woodland habitats were compared. We hypothesized that there would be a significant difference between species composition and diversity between brush piles, with more avian species using brush piles in a meadow habitat and more small mammals utilizing brush piles in a woodland habitat. A series of small mammal trappings along with track plots and observations were used to record the scope of animal diversity. Overall, we had low trapping success, but fortunately recorded a few tracks and observa-

Squirrels will have a higher giving up density on Chico State campus due to human traffic perceived as risk of predation. The alternate hypothesis suggests that the squirrels giving up density will not be different between campus and Bidwell Park. The results revealed which area has a higher risk of perceived predation. Therefore, this experiment provided insight to how much longer the Western Gray Squirrel should stay in each site relative to each other according to GUD foraging model.

#### UD-24

##### **Habitat Utilization and Selection by Birds of a Restored Section of Sacramento River Riparian Forest with Notes on Avian and Plant Diversity**

Sara Luse, Johnny Ratcliff, and Catherine Yasuda  
BIOL 434: Jay Bogiatto [RBogiatto@csuchico.edu](mailto:RBogiatto@csuchico.edu)

Within the Pine Creek Unit of the Sacramento River National Wildlife Refuge a study site of one hectare was surveyed for avian and flora diversity. One hundred evenly spaced points were monitored weekly for bird diversity once a week for six weeks and surveyed once for floral diversity and variance in foliage height. This location is a recently restored riparian hardwood community dominated by cottonwood (*Populus spp.*) and willow (*Salix spp.*) with an understory composed primarily of non-native grasses. Our study investigated the variation within floral species diversity, foliage height diversity, and avifaunal diversity. Utilizing this data we explored the degree of selectivity demonstrated by the bird species present at our site in their utilization of the various plant species and foliage height available within the study area.

#### UD-25

##### **Habitat Utilization and Selection by Birds within the Big Chico Creek Riparian Forest with Notes on Avian and Plant Diversity**

Wes Prochaska, Megan Thomas and Bryce Zubiati  
BIOL 434: Jay Bogiatto [RBogiatto@csuchico.edu](mailto:RBogiatto@csuchico.edu)

We examined the avian community of the Big Chico Creek riparian zone of Upper Bidwell Park to determine whether or not a relationship exists between the bird species in the area and the diversity of the many plant species and their respective height profiles that make up these bird's habitat. A one-hectare study area was established between the Bidwell Municipal Golf Course and Upper Park Road, along which bird height and foliage use surveys were taken between April 14 and April 30, 2013. Our goals were to (1) determine the composition of the bird community and vegetation by species, (2) characterize the habitat by generating a foliage height profile for the area, (3) assess the Shannon diversity ( $H'$ ) of bird and plant species, as well as for foliage height intervals, and (4) determine whether or not bird species are utilizing the vegetation by species and/or height selectively or randomly. Our null hypothesis asserts that there isn't sufficient evidence to sug-

#### UD-22

##### **Ecological Facilitation of Poison Oak (*Toxicodendron diversilobum*) by Blue Oaks (*Quercus douglasii*)**

Sundeep Lally [slally@mail.csuchico.edu](mailto:slally@mail.csuchico.edu), Hayley Mirts [hmirts@mail.csuchico.edu](mailto:hmirts@mail.csuchico.edu), Liz Heller [eheller@mail.csuchico.edu](mailto:eheller@mail.csuchico.edu), Shayla Ramos [shayla21r@yahoo.com](mailto:shayla21r@yahoo.com)  
BIOL 350: Shelly Kirn ([sakirn@csuchico.edu](mailto:sakirn@csuchico.edu))

Ecological facilitation is the opposite of species inhibition, and acts to facilitate the establishment of other species through the actions of an observed species. Ecological facilitation is an understudied field of ecology that contributes to our understanding of species relationships and community organization. By studying ecological facilitation in ecosystems, we are better able to understand the biodiversity, structure and dynamic relationships between species. In our experiment, we observed the facilitation of Poison Oak (*Toxicodendron diversilobum*) by Blue Oak (*Quercus douglasii*) in Upper Bidwell Park. For our experiment we hypothesized that the facilitation of Poison Oak by Blue Oak would have an optimal growth distance. We were testing if there was a correlation between the size of the Blue Oaks and the relative growth and distance of the Poison Oak plants around them. To do this we measured the size of Blue Oak trees at breast height and the height, width and distance of the nearest poison oak plants within eight meters from each cardinal direction. We found a positive correlation between the diameter of the Blue Oak trees and the distance which Poison Oak grew from them. The larger and more established the Blue Oak tree, the closer Poison Oak was found to the tree, and the greater the height.

#### UD-23

##### **Effects of Squirrel Foraging Based on Location**

Kymerly Laubach [klaubach11@gmail.com](mailto:klaubach11@gmail.com), Jaclyn VanBuren [jvanburen1991@gmail.com](mailto:jvanburen1991@gmail.com)  
Jeremy Weller [weller92@gmail.com](mailto:weller92@gmail.com), Bettyjo Wright [bettyjo\\_wright@hotmail.com](mailto:bettyjo_wright@hotmail.com)  
BIOL 350: Shelly Kirn ([sakirn@csuchico.edu](mailto:sakirn@csuchico.edu))

A foraging model provides predictions about how long an animal should stay in an area before leaving. An animal will stay if the rate of food harvest (H) is greater than the food handling time (E), risk of predation (P), and the missed opportunity cost (M). The Giving Up Density (GUD) is defined as the density of resources in a patch below which foraging stops. To test this model, the GUD of the Western Gray Squirrel (*Sciurus griseus*) were evaluated. Five pans in numerous locations in Bidwell Park and five pans in numerous locations on campus were filled with two hundred sunflower seeds in one liter of sand. The pans were located a standard distance from the trees. The number of seeds in the pan after 24 hours represents local Squirrel's GUD. In the experiment H, E, and M are all assumed to be the same in both locations. The experiment hypothesis states that Western Gray

tions. Data is suggestive of increased bird use in meadow habitats, however, track plot data did not convey indicative results.

#### UD-17

##### **Disturbance Effects on the Foothill Yellow-legged Frog, *Rana boylei*: A Comparison of Horse and Three Forks Creeks, Big Chico Creek Ecological Reserve**

Packard Greer, Branden Hendrix, Taylor Kaizoji, and Courtney Silver  
BIOL 484: Colleen Hatfield [chatfield@csuchico.edu](mailto:chatfield@csuchico.edu)

The Foothill Yellow-legged Frog, *Rana boylei*, is a California Species of Special Concern. *R. boylei* populations are rapidly declining all over the Western United States. We focused our study on two specific populations in the Big Chico Creek Ecological Reserve in Butte County, CA. The population in Horse Creek was wiped out in January of 2013 due to a washout from a winter flood. Our second creek, Three Forks Creek, is comparable to Horse Creek in all ways except for the disturbance. Our objectives of this study were to see if the population in Horse Creek had rebounded and to see if there was any difference in activity and/or population dynamics between the two creeks that may be caused by the disturbance in January. This is based on the supposition that an area disturbed beyond a threshold value would have increased variability. We hypothesized that not only would we see a healthy population in the disturbed creek, Horse Creek, but it would in fact have an equal or higher population than that of Three Forks Creek. Data Collection included catching *R. boylei* along the same distance on both creeks and recording information on life stage, sex, habitat, activity and substrate the frog was located on. We recorded in Horse Creek an average of 34.6 frogs ( $\pm 0.71$ ) vs. an average of 30.8 ( $\pm 0.55$ ) frogs in Three Forks Creek, showing that their populations have no significant difference. ( $p=0.233$ ) We however did see a significant difference in population dynamics when comparing juvenile population across both creeks, with Horse Creek showing a mean of 27.4( $\pm 0.58$ ) and Three Forks showing a mean of 22.4 ( $\pm 0.59$ ) with a  $p=0.038$ .

#### UD-18

##### **Ecological Facilitation of *Toxicodendron diversilobum* Around the Bases of *Quercus douglasii* in Upper Bidwell Park**

Michael Greisen, Megan Jace, Kelsey Escobar, Andrew Gomez  
[mgreisen@mail.csuchico.edu](mailto:mgreisen@mail.csuchico.edu), [mjace1@mail.csuchico.edu](mailto:mjace1@mail.csuchico.edu),  
[kescobar1@mail.csuchico.edu](mailto:kescobar1@mail.csuchico.edu), [andrew.gomez177@gmail.com](mailto:andrew.gomez177@gmail.com)  
BIOL 350: Glenn Woodruff [glenntwoodruff@gmail.com](mailto:glenntwoodruff@gmail.com)

Facilitation describes a species interaction in which one species benefits, particularly in the growth and development stage, from the other species without any harm. Our study is to determine whether the presence of Poison Oak facilitated Blue Oak trees by measuring the density and size of the Poison Oak plants around the perimeter of the Blue Oak trees at five feet and fifteen feet increments. By

comparing the amount and the sizes of the Poison Oak at the two different distances, it gave us an idea as to whether the species use each other to grow or whether the species are competing with one another. We conducted our study in Upper Bidwell Park above Horseshoe Lake in Chico, California. Using a tape measure, we determined the two distances and measured the heights and density of the Poison Oaks around the Blue Oak trees. Given the two-tailed p-value of 0.265 from our t-test, we cannot make any definitive conclusions as to the presence of ecological facilitation with the Blue Oaks and the Poison Oaks. However, further experimentation could suggest a possible positive relationship between the two species given their close proximities to one another, which could be of valuable information for restoration ecologists wanting to restore an area with blue oak trees.

#### UD-19

##### **Making Transgenic Plants to Determine Peroxidase Gene ATG21770 function**

Frans Honig [fhonig@mail.csuchico.edu](mailto:fhonig@mail.csuchico.edu), Devyn Trenary [dtrenary92@gmail.com](mailto:dtrenary92@gmail.com), Sarah Eggert Sarah Eggert [segger-t1@mail.csuchico.edu](mailto:segger-t1@mail.csuchico.edu)

BIOL 409: Kristopher Blee [kblee@csuchico.edu](mailto:kblee@csuchico.edu)

Of the numerous mechanisms of cell function and development, one unanswered question is what leads to lignin formation. Lignin is a waterproofing compound that is an integral component of secondary cell walls in plant cells. One of the proposed mechanisms for lignin formation is monolignol radical formation by peroxidases which leads to free radical polymerization and formation of lignin. To test the role of peroxidases in lignification, a peroxidase gene was selected (ATG21770) and tagged with YFP; which was then transformed into a plasmid vector into *E. coli*, which was subcloned into *Agrobacterium tumefaciens*. *A. tumefaciens* was used to transform *Arabidopsis thaliana* via floral inoculation. Seeds from the inoculated flowers were then grown on selective media. To observe the location of the tagged peroxidase in the cell, transgenic plants were then looked at under a YFP illuminating microscope. In this experiment four transgenic plants were generated and expressing the YFP tagged peroxidase gene in developing root tips. In every plant the gene was expressed in the vascular tissue. The peroxidase gene is integrated at a random location in the genome by *A. tumefaciens*. The gene is being expressed in the same location and level in all plants which suggests it is free of epigenetic constraints.

#### UD-20

##### **Localization of Peroxidase Gene AT1G05260 to Vascular Root Tissue of Young *Arabidopsis thaliana***

Emerald Sundai Iott, Jessica Garcia, Melissa Martinez, Adriana Gomora Arroyo, Mai Yang

BIOL 409: Mandeep Grewal [mgrewal@mail.csuchico.edu](mailto:mgrewal@mail.csuchico.edu)

Class III secretory peroxidases belong to a large multigene family, and participate in a broad range of physiological processes, including catalyzing lignin formation, the primary structural component of plant cell walls. The early expression of peroxidase genes makes them an ideal candidate when designing a reporter construct which could determine where in the plant cell the functional protein is targeted to better understand the protein's function. Using heat map data from Genevestigator and analyzing the gene sequence, we predict that AT1G05260 will be found in the cell wall or membrane of the root tip during early development. Using genomic DNA isolated from *A. thaliana* leaf tissue, Tri-template PCR (TT-PCR) was used to construct a reporter gene containing yellow fluorescent protein (YFP) and the full length AT1G05260. The plasmid containing the reporter construct was first cloned, then subcloned into the plant transformation vector. The resulting binary vector was then transformed into *Agrobacterium tumefaciens* for use in creating the transgenic *A. thaliana*. The floral inoculation technique was used to transform the plants with the cloned plasmid. Antibiotic selection was used to ensure that only transgenic seeds germinated. The resulting seedlings were analyzed using a fluorescent microscope to test for the presence of a fused AT1G05260::YFP peroxidase protein. The peroxidase gene was localized to the vascular tissue found in developing roots. We were unable to identify the subcellular location of the peroxidase protein. The results supported our hypothesis that the peroxidase gene is located in the developing root tip.

#### UD-21

##### **Decomposition Rates of Leaves in a Stream**

Chris Kaiakapu ([ckaiakapu@mail.csuchico.edu](mailto:ckaiakapu@mail.csuchico.edu)), Jillian McCool ([jmccool@mail.csuchico.edu](mailto:jmccool@mail.csuchico.edu)), Paige Gutierrez ([pgutierrez4@mail.csuchico.edu](mailto:pgutierrez4@mail.csuchico.edu)), Ashley Gillespie ([agillespie2@mail.csuchico.edu](mailto:agillespie2@mail.csuchico.edu))  
BIOL 350: Shelly Kirn ([sakirn@csuchico.edu](mailto:sakirn@csuchico.edu))

Stream quality, species abundance and diversity, are highly dependent on decomposition within the stream. Organisms, particularly at the primary producer level, depend on the nutrients released through the breakdown of organic material such as leaves and branches. This experiment directly measures the rate at which leaves decompose within a stream. By utilizing the arboretum and creek on campus, we are able to investigate the difference in decomposition rates (by weight) between three common tree species: California Sycamore, Maidenhair, and Valley Oak. After collecting the remaining data we will be able to measure actual rates and infer how the leaves contribute differently to the stream community.