Eighth Annual Student Research Poster Symposium

May 14, 2004
1-4 p. m.

Holt Hall

Department of Biological Sciences
California State University, Chico

Posters

Lower Division, Upper Division,
Undergraduate Independent Research
Holt 225

Graduate Classes, Thesis Research,
Environmental Sciences
Holt 227

Entomology Class Display

Holt 235

Ornithology Class Display

Holt 235

Department of Biological Sciences
California State University, Chico

Recipients of the
Tom Rodgers
Outstanding Researcher Award

1997 Ronald E. Loggins

1998 Maura Eagan

1999 Moaiad A. Kanaan

2000 Carina M. Jung

2001 Cary Coburn

2002 Glen Lubcke, Jack Campbell, Gary Lechner

2003 Julia Terry

Lower Division Class Projects

Effects of salt on tomato seed germination

Adam Haney

BIOL 006B – Sponsored by Dr. David Wood

The increased salinity (concentration of salt in soil) of agricultural land, due to human activities, agricultural practices and natural processes, is having a negative impact on soil fertility and crop productivity in many parts of the world. Recent reports published by the Food and Agriculture Organization (FAO) of the United Nations state that of the 260 million hectares of irrigated land world wide, 80 million are affected to some extent by salinisation. It has been estimated that salinisation is reducing the world's irrigated area for crop production by 1–2% every year. Corrections of the salinity problems are usually expensive and considered only a temporary solution. Tomato is one of the major horticultural cash crops in the world. Farmers, particularly in semi-arid parts of the world, are changing growing practices to cope with the economic effects of salinisation. To alleviate the deleterious effects of salinity some rehabilitations such as reclamation of salinised lands, improving of irrigation saline water and special cultural techniques are applied. Many scientists have, over the last few years, dedicated their time, talents and energy to develop a strategy that helps deal with the negative effects that salinity causes on cash crops. To show that salinity negatively effects seed germination in tomato plants the hypothesis that salt concentrations will negatively affect tomato seed germination was investigated. To show these negative effects twelve Petri dishes of five tomato seeds were combined with differing amounts of NaCl concentrations and two control groups. The results observed agree with the hypothesis.

Qualitative analysis of lichens as indicators on Big Chico Creek

Byron Mache

BIOL 009 – Sponsored by Dr. Ailsie McEnteggart

Lichens are well-known indicators of air pollution. In this study air quality of Chico, California was investigated qualitatively by observing lichen growth, density, and diversity at four points on Big Chico Creek. Each point moved east away from the first, which was located on the campus of CSU, Chico. The farther east the observation points were from campus the greater the growth, density, and diversity of lichens. This indicates that the air quality to the east of the town of Chico is better. Therefore the null-hypothesis that there was no difference in air quality at each point was not accepted.

Are some species of epiphytic lichen specific to different oak species?

Colleen Martin

BIOL 009 – Sponsored by Dr. Ailsie McEnteggart

I conducted a study focusing on the correlation between epiphytic lichen species and the species of the oak host in the foothills of Butte County, CA, northeast of Chico. With continuing development and loss of natural habitat, the abundance of oak trees in the foothills is decreasing. As oak numbers decline it is probable that the number of epiphytic lichens will also decline. If there are species of lichens that can only live on specific oak hosts, the loss of oak trees could be quite damaging to the survival of epiphytic lichen. Samples were taken from three different oak species, Blue Oak, Interior Live Oak, and Scrub Oak. Five samples were collected from five separate trees of each species. All identifiable species of lichen were numbered based on similarity of appearance. Color and texture were used to differentiate the different species. Each species of lichen was counted on every oak sample. From this study it can be concluded that certain species of oaks only act as hosts to specific species of epiphytic lichen. The results also suggest that certain species of epiphytic lichen are more dominant than others.

Effects of salicylic Acid and hydrogen peroxide defense mechanisms in tomato plants

Charles Moggia

BIOL 009 – Sponsored by Dr. Ailsie McEnteggart and Dr. Kristopher Blee

Hydrogen peroxide and salicylic acid are both molecules involved in plant defense. Most commonly, salicylic acid is incorporated with infections resulting from fungi and bacteria. The stimulation of salicylic acid is thought to aid in a signaling pathway that regulates defense genes in plants. Several tomato plants were sampled and proteins were extracted from their tissues. Treated plants were sprayed with Oxycom™ and compared to a set of control plants that were allowed to grow naturally. From the protein samples both cationic and anionic gel electrophoresis with .5M sodium chloride were run. A western blot was performed and probed for the presence of the protein PR1-alpha using monoclonal mouse antibodies. Both the cationic and anionic gels showed increasing peroxidase activity over the sampled time frame. Thus a treatment of salicylic acid and hydrogen peroxide does stimulate the defense mechanism within tomato plants. The antibody wash proved to be inconclusive and no conclusion could be drawn about PR1-alpha.

Upper Division Class Projects

Effect of fluorescent and incandescent light on chlorophyll development in bean plants

Shawn Fresz, Jessica Gaither, Ryan Mooney, and Jamie Raglin

BIOL 215 – Sponsored by Dr. James Pushnik

Leaves reflect and derive little energy from many of the yellow and green rays of the visible spectrum. The red and blue parts of the light spectrum are the most important energy sources for plants, and plants require more rays from the red range than from the blue. We examined the effects of incandescent (red) and fluorescent (blue) lighting on the development of the specific chlorophyll pigments *a* and *b* in bean plants. Chlorophyll *a* is essential for the oxygen-generating photosynthesis carried out by plants and chlorophyll *b* is an accessory pigment that is not directly involved in photosynthetic energy transduction but serves to broaden the range of light that can be used in photosynthesis. Groups of bean plants were grown under 100% incandescent, 100% fluorescent, and a 50/50% mixture of both incandescent and fluorescent lighting. After growth of approximately four weeks each of the three groups of plants was tested for different chlorophyll content (either *a* or *b*) using DMF to isolate the chlorophyll in media and testing the samples with a computer spectrophotometer. We observed high amounts of chlorophyll *a* in both isolated lighting chambers but a smaller ratio of chlorophyll *a* in the mixed lighting chambers. Chlorophyll *b* was found to develop more in the fluorescent growing chamber than in the incandescent.

Number of flowering buds compared with fruits from wild almond trees (*Prunus dulcis* var. *amara*) growing on opposite sites on the Rio Lindo Channel, Chico, California

Barbara Manning

BIOL 258 – Sponsored by Dr. Robert A. Schlising

Wild almond trees growing along opposite ridges of a 60 m² area on the Rio Lindo channel in Chico, California were studied for seven weeks to compare numbers of flowering buds produced by the trees with the numbers of almonds maturing. Two trees from the south-facing ridge and four trees from the north-facing ridge were chosen as study sites. From each tree, one south-facing branch, two meters high, was designated as a sample area. On April 3, 2004 all flowering buds from each sampling area were counted. After six weeks flowering buds which matured into almonds were counted and data of these counts were used to determine a flowering-bud-to-almond ratio for each tree, as well as a comparison of almonds produced by trees from opposite ridges of the channel. Average number of flowering buds growing on the north-facing ridge was 42.2 ±9.8 and those flowering buds from the south-facing ridge averaged 39.5 ±2.5. The average number of maturing almonds grown on the north-facing ridge was 20.2 ±2.9 and the average number of maturing almonds grown on the south-facing ridge was 14.5 ±2.5. Comparison of these data by t-test

showed 0.006 probability that there is significant difference between the numbers of maturing almonds from flowering buds. This suggests a difference in the environment of the two study sites. Temperature and intensity of wind flowing through the channel could possibly influence the south-facing trees in the maturation of flowering buds to almonds.

Does the presence of *Lupinus bicolor* affect soil temperature?

Niki Ott

BIOL 258 – Sponsored by Dr. Robert A. Schlising

Lupinus bicolor is a nitrogen fixing legume related to peas. This study tested the hypothesis that lupine would significantly influence soil temperatures. Data were collected in annual grasslands of Mediterranean California's Upper Bidwell Park north of Chico. The study was conducted over a seven week period. A nail was used to poke a hole 20 cm deep and a glass thermometer was immediately used for temperature measurement. Ten samples were taken weekly from soil under lupins and another ten samples were taken in bare soil. The first two weeks' samples were taken in the evening and the last five were taken between 1 and 3 PM. Quantitative data measured were soil temperatures from under lupines (n = 70) and bare soil temperatures (n = 70). A t-test indicated that there was a significant difference (t_{crit} = 1.977; t_{calc} = 3.29; p = .018) between mean soil temperatures under lupines (x = 32.9 ± 0.512 °C) and mean bare soil temperatures (x = 31.2 ± 0.531 °C). The cause of these results was uncertain. Most likely, lupines provide insulation to soil and heat was blanketed in. Heat produced from metabolism is not a recognized source of soil heat, although future studies might compare more plant species. Soil temperatures seemed to correlate with environmental temperatures more than plant presence even though this was not the parameter being tested. Regardless of the potential problem with samples taken at two different times of day the null hypothesis could be rejected with 98% certainty.

Height and seedpod production of *Lupinus bicolor* in relation to soil moisture

Kelly Schlauch

BIOL 258 – Sponsored by Dr. Robert A. Schlising

This study was done at Five-Mile Recreation Area of Bidwell Park, Chico, California. The area studied was in savanna vegetation. Soil samples were taken next to randomly selected Lupines, in which the height and seedpod production were recorded. Fifteen soil samples were taken 4 times, every other week in the spring of 2004. Soil moisture (in grams water/ 100 grams of fresh soil) varied from 9.90 during a rainy period to 1.73 during a dry period. The "R-squared value" was calculated to determine if there was a correlation between height and soil moisture. The R-squared data showed 0.0298 on March 23, 0.232 on April 4, 0.064 on April 20, and 0.008 on May 2. This indicated there is no correlation between the growth of *Lupinus bicolor* and soil moisture. In the first two sample dates few lupines produced seedpods (closed). The third sample date 10 out of 15 lupines had seedpods (nine were closed). The last and driest sample date all 15 lupines had opened seedpods, suggesting seedpods do open in relation to soil moisture.

A study of 3 microhabitats of fish larvae in Pine Creek: deep open water, shallow open water, and shallow aquatic vegetation

Josh Akin, Leslie Alber, Gary Cantwell, Margaret Etzler, Ben Ferraro, Mariah Garr, Alicia Seesholtz, Renny Spencer, Sean Ziniker

BIOL 261 – Sponsored by Dr. Michael Marchetti

Little research has been done on fish larval microhabitats in freshwater systems. One effective way of studying fish larvae in their environment is with the use of light traps. The purpose of our study was to examine three different microhabitats of fish larvae in the Pine Creek tributary of the Sacramento River in Chico, California. The three microhabitats of study were open deep water, open shallow water, and shallow aquatic vegetation. It involved the use of two different trap sizes in each habitat with a light source to attract the larval fish. Our results suggest that the shallow vegetation habitat does not support a high number of fish larvae. We also found that one fish species, Cottidae, preferred the open deep water habitat over the others. However, we did not find any habitat preference with the other fish larval species present in our area of study.

Larval fish abundance in permanent and temporary streams of Butte County, California

Ben Barker, Bob Haberman, Jeremy Johnson, Gabe Kopp, Ian Ledbetter, Ryan Mooney, Mary Olswang, Pete Piersons, and Greg True

BIOL 261 – Sponsored by Dr. Michael Marchetti

It has long been assumed that fish choose to spawn in permanent streams over seasonal streams, but some recent studies have found that intermittent streams are important spawning and nursery habitats. We examined the fish larvae in two local streams: Big Chico Creek (permanent) and Mud Creek (temporary) between February and April 2004. Drift nets were used to sample drifting fish larvae after sunset. A suite of atmospheric, aquatic, and terrestrial habitat parameters was measured on every sampling occasion. Fish larvae were preserved, identified and enumerated in the laboratory. The main goals of the study were: 1) to determine the quantities of larval fish relative to each creek, 2) to compare environmental habitat parameters between the creeks and 3) to identify correlations between environmental parameters and fish larval abundance. Our hypothesis is that there will be a difference in the numbers of fish larvae collected between the permanent and temporary creeks. Our results suggest that the temporary stream had an order of magnitude more larval fish than the permanent stream.

Habitat utilization and selection by birds of the Sacramento River riparian forest with notes on avian and plant diversity

Jeremy Johnson, Byron Mache, and Ryan Mooney
BIOL 265 – Sponsored by Mr. Raymond J. Bogiatto

We conducted a survey of the avian community within a riparian forest habitat on a restoration site adjacent to the Sacramento River, 8 mi west of Chico, Butte County, California. Birds were surveyed for 2h beginning at sunrise during the months of April and May 2004. Transects were designed and surveyed for both plants and birds within our 1 ha study area. Our goals were (1) to determine the species composition of both the avian and plant communities within are study area, (2) to calculate a foliage height profile of the vegetation present, (3) to calculate Shannon (H') diversity values for plant species, foliage heights, and bird species to be used in a comparison with values generated within other habitats, and (4) to determine whether birds use the various plant species and foliage heights randomly or selectively; our null hypotheses being that there are no difference in the utilization of these habitat components by each bird species relative to the availability of each habitat component.

Habitat utilization and selection by birds of the Big Chico Creek riparian forest with notes on avian and plant diversity

Will Kauffman and Valerie Henry
BIOL 265 – Sponsored by Mr. Raymond J. Bogiatto

We conducted a survey of the Big Chico Creek avian community within a riparian forest habitat in Bidwell Park, 1 mi east of the 5-mile Recreation Area, Chico, Butte County, California. Surveys were conducted during April and May 2004. 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 woodpeckers, cedar waxwings, California towhees and spotted towhees.

Habitat utilization and selection by birds within a chaparral community with notes on avian and plant diversity

Colleen Martin, Michelle Sopoliga, and Michelle Ocken
BIOL 265 – Sponsored by Mr. Raymond J. Bogiatto,

We conducted a study of habitat utilization by avian species within a local Butte County chaparral 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; the relationship between these diversity values will be addressed. Our 1 ha study site was located on the Big Chico Creek Ecological Reserve near Hwy. 32, east of Chico, Butte County, California. Our site was divided into 10 parallel transects, 10 m apart. Vegetation species and foliage heights were quantified at 100 vegetation measurement points (VMPs) regularly spaced along our transects. Common plant taxa within our study site include buck brush (*Ceanothus cuneatus),* mountain mahogany (*Cercocarpus betuloides),* scrub oak (*Quercus berberidifolia)* and others. The availability of the various plant species and foliage height intervals at our site will be compared with the utilization of these habitat parameters by each bird species in order to determine whether birds are selectively or randomly using these components of the environment.

Habitat utilization and selection by birds within a foothill woodland-riparian forest ecotone, with notes on avian and vegetation diversity

Carie Myers and Rebecca Haagens
BIOL 265 – Sponsored by Mr. Raymond J. Bogiatto

We conducted an investigation of habitat utilization by birds within a low elevation foothill woodland-riparian forest ecotone located in upper Bidwell Park, Chico, Butte County, California. Data were collected between April 3 and May 2, 2004, along 50 m transects within our 1 ha study site. The objectives of our study were (1) to determine avian and vegetation species composition within our study area, (2) to generate a foliage height profile for our site, (3) to calculate and then assess the relationship between Shannon diversity values (H') for avian species, foliage height, and plant species within our habitat type, and (4) to determine whether birds are randomly or selectively using those plant species and vegetation foliage height intervals present within our study area; our null hypotheses state that there are no differences in the proportion of plant species and foliage height intervals available within our study area and the utilization of these habitat components by birds.

Undergraduate Independent Research

An Investigation of decomposition rates as a measure of restoration success

Angela DeGraffenreid

BIOL 199 – Sponsored by Dr. James Pushnik and Ms. Brianna Borders

The restoration effort at the Sacramento River in Northern California is among the currently among the largest in the US. The study underway is investigating the leaf litter decomposition rates over a one year from restoration sites and old growth forest. Leaf litter bags were made up of 3 types of litter and were picked up over 5 collection periods. Leaf litter was cleaned and ground in order to perform digestions to collect information about carbon and nitrogen ratios. This study could be influential across the nation as decomposition rates may be an important way to measure restoration success, effecting efforts elsewhere.

Leaf senescence: why do leaves change color in the fall?

Arthur Laganowsky

BIOL 199 – Sponsored by Dr. John Nishio and Dr. James Pushnik

Research was conducted on the *Liquidambar* trees on the Chico State campus monitoring leaf senescence. Pigment analysis was used to monitor various pigments as the leaves would undergo senescence. The results clearly show that chlorophyll *a* degraded the fastest, followed by chlorophyll *b* and then carotenoids. As the leaves underwent visible senescence it was apparent that the pigment degradation occurred in the same fashion, but anthocyanin levels increased. The use of a thermal imager shows that leaf temperature is regulated, but as senescence came upon leaf temperature fluctuated, adversely showing stomatal control was unregulated. Thermal images also show leaf temperature gradients to be low temperature at base leaves and high temperature at tip leaves in the sun leaves respectively, but opposite temperature gradient in shade leaves. Gas exchange rates were taken to show that respiration levels increased through out the senescence period.

Effect of dietary glycemic index on postprandial glucose, insulin, triglyceride, and free fatty acid response in obese and normal weight premenopausal women

Troy Miles

BIOL 199 – Sponsored by Dr. Kathryn Silliman and Dr. John Mahoney

Abdominal obesity is highly associated with type 2 diabetes and dyslipidemia. The objective of this study was to determine if the type of carbohydrate [low versus high glycemic index (GI)] influences the postprandial glucose, insulin, free fatty acid (FFA) response in women with abdominal obesity. Subjects (27 - 9 years) were 15 normal weight (lean) and 26 abdominally obese healthy premenopausal women. Using a randomized cross-over design, subjects consumed two breakfast meals, high (66) and low (45) GI, after fasting for 12 hours on two occasions, separated by no more than 14 days. Blood samples were collected prior to each meal and then 1, 3, and 5 h after the meal and analyzed for glucose, insulin and FFA. Obese subjects had significantly ($p < 0.03$) higher 1 h blood glucose and FFA levels after consuming the high GI meal. The blood glucose response area under the curve (AUC) was also higher ($p = 0.06$) in obese subjects after the high GI meal. The insulin AUC after the high GI meal was significantly ($p < 0.04$) greater for both obese and lean subjects. There was no dietary effect in the AUC for chylomicron triglyceride levels nor were there ant differences at time points for either group. Low glycemic index meals containing whole grain breads and cereals, similar to the meal consumed in this study, may produce a more beneficial postprandial response, particularly in women with abdominal obesity.

Tracing stem cells: a demonstration of MRI use in medicine

Thien Ho, Daryl Despre, and Johnathan Sorger

BIOL 289 – NIH Internship – Sponsored by Dr. John Mahoney

Magnetic Resonance Imaging has set a foundation on helping to detect injuries or defects to body tissues in an invasive manner by putting the body in a magnetic field and targeting the point of interest. In this research, I worked with members of the National Institute of Heart, Lung, and Blood (NIHLB) using MRI technology to trace mesenchymal stem cells that were injected intravenously. Prior to this, the technique used was to inject stem cells directly and then image. However, we were also able to trace these stem cells when injected intravenously. When the heart is induced with a myocardial infarction (MI), the stem cells will circulate within the vascular system and over a period of time accumulate to the infracted site. The stem cells were labeled with a tracer that was able to be distinguished from other tissue. This is a great potential advancement for stem cell research.

Toxicity of mercury, copper, and PNP for *Arthrobacter aurescens*

Katsu Kichise, Tiffany Neal, and Natalia Guillen, Department of Biology

BIOL 298 – Sponsored by Dr. Larry Hanne and Dr. Larry Kirk

Arthrobacter aurescens strain TW17 is an obligate aerobic, gram-positive soil bacterium containing a 60kb plasmid that codes for p-nitrophenol (PNP) degradation. Bioinformatic analysis of cloned fragments from the 60kb plasmid revealed sequences homologous to a mercuric reductase gene and a copper-transport ATPase gene. We experimentally investigated the functions of these genes. We compared susceptibility to mercury and copper of strains with the gene (strains carrying the plasmid) and strains without the gene (strains cured of the plasmid). We also investigated the difference in susceptibility to PNP for the wild-type and the cured strains. There was no significant difference in the minimum inhibitory concentration (MIC) of each chemical between the wild-type and the cured strains. These data suggest that the 3 genes (mercury reductase, copper transport, and PNP degradation) play a role other than detoxification for the organism.

The effect of Chinook salmon carcass accumulation on biofilm compositions and concentrations at a spawning site on the Feather River

A.M. Ratcliff and A. Viramontes

BIOL 298 – Sponsored by Dr. Larry Hanne and Dr. Larry Kirk

Chinook salmon returning from the ocean to the Feather River to spawn have a widespread impact on other organisms in the spawning areas. Freshwater spawning provides an important food resource for wildlife, and after-spawning death introduces carbon, nitrogen, and phosphorus into the river system. Little is known of the impact that this increase in nutrients has on microbial biofilm accumulation on rocks in the Feather River. We used fluorescence *in situ* hybridization (FISH) to assess changes in concentration and composition of the biofilm communities during the salmon migration. Biofilm samples were collected monthly at Bedrock Park in Oroville, CA. We analyzed biofilm development on naïve (cleaned) rocks and changes in preexisting biofilm. Three probes with oligonucleotide sequences specific for archeal, eubacterial, and eukaryotic rRNA were used. New salmon carcasses reached their highest concentration on October 20, 2003. *Bacteria* concentrations in developing biofilm on naïve rocks at the Bedrock Park spawning site increased nearly 6-fold, *Archaea* concentrations decreased 2-fold, and *Eukarya* concentrations increased nearly 17-fold from September through December 2003. Comparisons of microorganism concentrations in existing biofilm at Bedrock Park versus a downstream control site suggest that the increase in *Bacteria* and *Eukarya* was due to salmon carcass accumulation.

A linear regression relating size and age of *Populus fremontii* along the Sacramento River

Matthew R. Brown

Undergraduate Research and Creativity Grant – Sponsored by Dr. David Wood

Accurate estimations of tree age based on size are useful for hydrologic, geomorphic, and ecological studies of riparian systems. The most accurate method for obtaining tree age is to core or obtain cross-sections of individual trees. However this process is time consuming, invasive, and labor intensive. Developing a linear regression model for stem diameter and age would be a more efficient way to estimate stand age because stem diameter is easily obtained. This study addressed the questions of whether the regression coefficient between stem diameter and age is greater then zero for *Populus fremontii* (Fremont cottonwood) and whether regression coefficients vary significantly among sampled sites. During the months of January and February 2004, diameter at breast height (DBH), and a small core of *P. fremontii* were randomly collected at four sites along the Sacramento River in Butte County ($n_{total} = 73$). Tree cores were used to estimate age by counting rings of latewood with the aide of a light table and a hand lens. All four regression coefficients for stem diameter and age were found to be significantly greater than zero ($p \leq 0.0001$) and were not significantly different among sampled sites. Therefore all samples were combined in a single regression model that explained 93% of the variance in the number of rings observed in *P. fremontii* sampled along the Sacramento River.

The insertion of a Fluorescing Arsenical Hairpin binding motif (FlAsH) into the VP2 region of the capsid gene of Adeno-Associated Virus Type 2 (AAV2)

Peter D. Cervenka, Giovanni DiPasquale, and Jay Chiorini.

NIH. Gene Therapy and Therapeutics Branch, National Institute of Dental and Craniofacial Research – Sponsored by Dr. Jeffrey Bell

A promising candidate as a vector for gene delivery is the Adeno-Associated Virus. To aid in the study of this vector the AAV Type 2 (AAV2) protein capsid was labeled with a six amino acid sequence that binds an arsenical reagent, causing it to fluoresce under UV light (FLAsH). The FLAsH sequence thus provides a way to visualize the virus life cycle. It was hypothesized that the insertion of the sequence and the subsequent labeling with the arsenical reagent would have no effect on the infectivity of AAV2. Restriction enzymes and gel electrophoresis were employed to test for presence of the insert, and transformation was performed on ultracompetent *E.coli* cells. Purified mutated plasmid DNA was transfected into the mammalian 293T cell line using adeno-helper and GFP. A crude viral lysate of AAV2 wild-type and the mutated virus was prepared by extracting virus from the 293T cells, followed by QPCR to test for DNAse resistant DNA. Cos cells were infected with dilutions of wild-type and mutant virus and treated with the arsenical reagent to determine whether the fluorescing reagent and/or the insertion sequence had any effect on infectivity of wild-type or mutated AAV2. Results from cell counts show wild-type AAV2 without the arsenical reagent (cell count and percent correlation to wild-type without reagent, 19 and 100%) to have no difference compared to wild-type with reagent (21.6 and 113%). The mutated AAV2 also showed no difference (without reagent, 19 and 90%; with reagent, 18.6 and 89%) and no difference compared to wild-type.

Graduate Class Projects

Working toward carbon neutrality on campus: a bottom-up approach to modelling carbon exchange in an elderberry (*Sambucus mexicana*)

Sarah Nash and Brianna Borders
BIOL 315 – Sponsored by Dr. James Pushnik

Increases in the concentration of atmospheric carbon dioxide are accelerating, and the threat of global warming is upon us. A reversal of this trend could be accomplished through a large-scale reduction in anthropogenic carbon dioxide emissions. However, the inability and resistance of many countries to work towards this goal reinforces the need for technology which can quantify both existing carbon sink capacity and improve or create carbon sinks. As a contribution to the goal of carbon neutrality on the Chico State campus, this project proposes a methodology for modeling the capacity of vegetation as a carbon sink. Physiological measurements such as leaf area index, incoming photosynthetically active radiation, and leaf-level photosynthetic rates were quantified for a blue elderberry (*Sambucus mexicana*) located on the Chico State campus. These measurements were incorporated into four models of increasing complexity, which predicted carbon sequestration. These models represent a bottom-up approach due to the estimation of whole plant photosynthetic capacity using leaf-level measurements. Models varied in the degree of structural and physiological heterogeneity considered. Model estimates of carbon sequestration ranged from 200-250 $C/m^2/s$. It would be useful to explore the sensitivity of these models through replicating existing measurements, including diurnal and seasonal variation, increasing sample size, and incorporating additional study species. These models could potentially be used to scale whole plant data into community predictions of carbon sink capacity. Scaling approaches will be valuable in working towards carbon neutrality on campus and characterizing the extent of global carbon sinks.

Comparison of growth and reproduction of *Triteleia laxa* within and between clumps of *Nassella pulchra* at the Vina Plains Preserve (spring 2004)

Matthew R. Brown and John W. Hunt
BIOL 352 – Sponsored by Dr. Robert A. Schlising

Triteliea laxa (Themidaceae) a native geophyte and *Nassella pulchra* (Poaceae) a native bunchgrass are co-occurring herbaceous perennials found growing in grassland communities at the Vina Plain Preserve (Butte County). This study addressed potential effects of *N. pulchra* on the growth and reproduction of *T. laxa* by measuring leaf and scape growth, number of flowers produced, fruit set, and seed production. Leaf and scape growth was measured from randomly selected individuals of *T. laxa* growing within and between ($n_{within} = 16$; $n_{between} = 18$) *N. pulchra* bunches. Growth of leaves and scapes was measured at approximately 2-week intervals between March 4 and April 8, 2004. Flower and fruit production was measured from randomly selected individuals of *T. laxa* growing within and between ($n_{within} = 48$; $n_{between} = 60$) *N. pulchra* bunches on April 22, 2004. Significance for all parameters was tested using a Student's t-test. Results indicate that there was no significant difference in overall leaf growth, fruit production, and seeds per fruit ($p > 0.05$) among *T. laxa* growing within and between clumps of *N. pulchra*. There was a significant difference in scape growth ($p < 0.02$) and number of flowers produced ($p < 0.03$).

Quantitative Traits of Triteleia laxa as Indicators of Reproductive Success Measured Over Three Years

James Lang and Kylene Klevinghaus
BIOL 352 – Sponsored by Dr. Robert Schlising

In an ongoing study of *Triteleia laxa* (Themidaceae) at the Vina Plains Preserve in northern Butte County, phenological data pertaining to plant characteristics including leaf length, scape height, number of flowers, and number of fruits have been continually collected for multiple years. Data from the 2002 ($n = 26$) and 2003 ($n = 20$) seasons were used comparatively with newly collected data from 2004 ($n = 23$) in order to discern and understand the relationship between *T. laxa.*'s reproductive success (fruit set) and mean leaf length and scape height. Using linear regression analysis it was found leaf length had little to do with *T. laxa.*'s reproductive success ($R^2 = .10$, .38, and .14) for years 2002, 2003, and 2004 respectively. The relationship between scape height and fruit set appeared to be more important producing R^2 values of 0.42 and 0.59 for the years 2003 and 2004; however, in 2002 scape height and fruit set showed no apparent relationship. There was a strong correlation between number of flowers and number of fruits set. The results of these analyses show that the quantitative traits of leaf length and scape height in *T. laxa* are not reliable indicators of the plant's reproductive success.

Reproductive success in *Triteleia laxa*

Colin Purdy and Halli Gaddis
BIOL 352 – Sponsored by Dr. Robert A. Schlising

The Vina Plains Preserve in the northern reaches of California's Sacramento Valley is home to numerous populations of *Triteleia laxa*. This species of Liliaceae native to Northern California is a perennial that requires a pollen vector in order to fruit. It flowers from spring to early summer. Over a three-year period, components of reproductive success were measured. The parameters measured included flower and fruit production, fruit-flower ratio and seed set per fruit as well as selfing capabilities that were measured by preventing pollination from occurring using a bagging method. Results showed a highly significant difference in the fruit-flower ratio as well as the seed set per fruit between the bagged and open pollinated flowers. These ratios demonstrate a relatively low level of self-compatibility with a greatly reduced number of fruits produced or seeds produced in those fruits in the flowers where all other means of pollination were prevented other than self pollination.

How climatic factors may affect the growth of *Triteleia laxa* (Themidaceae)

Sheila Whitmore and Briony Gniechwitz
BIOL. 352 – Sponsored by Dr. Robert A. Schlising

Triteleia laxa is a common native grassland geophyte growing on the Nature Conservancy's Vina Plains Preserve, Tehama County. A random sample of plants was studied in 2004 and compared to previous years' studies (n = 60 for each year) to determine differences in the mean leaf length and the mean scape length from year to year. In addition, we looked at variation in precipitation and temperatures between these same years. The leaf length (X ± S.E.) was significantly shorter in 2004 (17.49 cm ± 0.54) as compared to 2002 (25.92 cm ± 0.53) and 2003 (24.72 cm ± 0.54), p-value = 0.05. The temperature was significantly higher in 2004 as compared to 2002 and 2003, p-value = 0.05. The average scape length was shorter in 2002 (11.08 cm ± 0.88), as compared to 2003 (16.63 cm ± 0.93) and 2004 (17.89 cm ± 1.37), p-value = 0.05. There was no significant difference in precipitation between the years, p-value = 0.05. Further analysis may uncover correlations between climatic patterns and phenology of this common grassland plant, *Triteleia laxa*.

Thesis Research

Protist genetic diversity in the hydrothermal environments of Lassen National Volcanic Park, California

Patricia Bitterman Brown
Sponsored by Dr. Gordon Wolfe

Recent reports of novel microbial eukayote (protist) genes in extreme environments such as acidic mud pools or rivers suggest protists are more diverse that previously thought. We are examining protist molecular (18S rDNA) diversity in the hydrothermal systems of Lassen Volcanic National Park. Sites include acidic mud pots, streams and microbial mats in the areas of Sulfur Works, Bumpass Hell and Devil's Kitchen. The temperatures vary from 15 -85 C and pH 1.7-5.8. We comparred DNA extraction methods by DGGE and found similar results for all techniques. Most sites showed moderate diversity with 1-10 dominant rDNA bands. We also tested different PCR primers sets and found sets eukaryote 82/516 and 615/1200 yielded positive results from most samples. Preliminary sequences show eukayotic rDNA diversity is dominated by protists, including diverse alveolates and chlorophytes, as well as genes found in other acidic environments, such as the Rio Tinto, Spain. We are currently sequencing clone libraries. Future work will try to understand the role of protists in food webs along a gradient of temperature and pH.

Subcellular localization of polyunsaturated long chain neutral lipids in *Emiliania huxleyi* and *Isochrysis galbana*

Matthew Eitgroth
Sponsored by Dr. Gordon Wolfe

Emiliania huxleyi and some related prymensiophyte algae produce polyunsaturated long-chain (C31-39) alkenones, alkenoates, and alkenes (PULCA). Due to their temperature-dependent desaturation, these lipids, which are preserved in oceanic sediments, have been used by geochemists to estimate ancient sea surface temperatures. However, the physiology and ecology of these unique neutral lipids remain largely unknown, as does their biosynthesis and cellular location. Here, I show that *Emiliania huxley* and *Isochrysis galbana* possess neutral lipid containing vesicles, as measured by the fluorescent lipophilic dye Nile Red. The abundance of these vesicles correlates well with the amount of PULCA as measured by thin layer chromatography (TLC). In addition, lipid vesicles purified by sucrose density gradient centrifugation consist predominantly of neutral lipids. PULCA are also associated with other cell fractions, indicating a possible location in either membranes or chloroplasts, with which these vesicles are often associated. These results are consistent with recent work showing that PULCA appear to function as a form of energy storage, analogous to triacylglycerides of other algae.

Effectiveness of buffer strips in reducing dormant season diazinon loading to surface waters in Glenn County, Northern California

Kristine D. Gilbert

Sponsored by Dr. David L. Brown, Environmental Sciences

Over the past two years, a project was implemented to evaluate the effectiveness of certain Best Management Practices in reducing the transport of the organophosphate (OP) pesticide diazinon from almond orchards to local surface waters in Glenn County. Dormant season diazinon application in nut and stone fruit orchards coincides with the months of highest rainfall and surface runoff in California. Diazinon has been repeatedly detected in the Sacramento River and its tributaries at levels that are toxic to aquatic organisms. Three buffer strip treatments were established at the Lassen Lands almond orchard: one planted with native vegetation, one with weedy resident vegetation, and the third with a bare soil surface. As a demonstration and reconnaissance project, replication of the treatments in this study was lacking. Diazinon was applied in test orchard cells in January 2003. Surface runoff and groundwater were monitored for the transport of diazinon during the three subsequent storm events. Samples were analyzed using C-18 SPE and GC-MS. The largest diazinon mass reduction per unit area occurred in the native vegetation plot, followed by resident weedy and finally bare ground. This study indicates the benefits of buffer strips as a Best Management Practice for the reduction of dormant season pesticide loading to surface waters in Glenn County, California.

Utilization of a molecular DNA fingerprint method to examine the influence of plants on rhizosphere bacteria

John Hein

Sponsored by Dr. Gordon Wolfe

Much of what is known about plant defense against infectious diseases has focused on agricultural systems and applied biology. Molecular techniques in the last two decades have allowed scientists to take a more comprehensive look at both sides of plant-microbe interactions. I will examine the possible influence of the defense response in plants known as Systemic Acquired Resistance (SAR) on rhizosphere bacteria. In developing a method to examine this, my hypothesis is that terminal restriction fragment length polymorphisms (T-RFLP's) can differentiate between bacterial communities in different soils. To test this, I grew *Arabidopsis thaliana* Col-O plants in three soils and examined the bacterial community DNA in rhizosphere and non-rhizosphere samples. The results of my T-RFLP analysis indicate that each soil has a distinct community fingerprint. Although the community fingerprints between rhizosphere and non-rhizosphere soils are similar for each soil, the concentration of some individual species differed (based on T-RF peak amplitude). This change suggests that the plant root is exerting an effect on some microbial populations.

Perceived knowledge, attitudes, and practices of California RDs regarding dietary supplements

C.T. Hetherwick

M.S. Professional Paper – Sponsored by Dr. Michelle Neymann

In 1997, the ADA added dietary supplement education to the accreditation standards for dietetics programs. The purpose of this survey was to investigate whether California RDs are receiving training, investigate their perceived knowledge, attitudes and practices and determine if there was a difference in survey responses between RDs registered before or after 1997. 2020 surveys were administered via e-mail. 253 subjects responded. 83 % of respondents agreed that they are frequently asked questions related to dietary supplements. 98% of respondents agreed that RDs should feel comfortable discussing dietary supplement issues with the public while only 78% agreed that they feel comfortable doing so. Those RDs registered before 1997 ($n = 194$) are significantly ($p < 0.05$) more likely to agree that they are knowledgeable regarding dietary supplement uses, safety, interactions, and contraindications than those registered after 1997 ($n = 46$). 57 % of respondents had received formal training regarding dietary supplements. RDs who have received formal training regarding dietary supplements ($n = 145$) compared with those who have not ($n = 105$) are significantly ($p < 0.05$) more likely to agree that: they feel comfortable discussing dietary supplements with the public; they are knowledgeable regarding uses, safety, interactions, and contraindications and that they assess supplement use of their clients. Based on these findings, formal training is warranted.

Ultrastrictiral localization of calcineurin in rat hippocampus using microwave-assisted protocols

Julie R. Janes

Sponsored by Dr. Jonathan R. Day

Standard fixation times are often lengthy, taking at least two days. Time consuming protocols are also commonly used for immunolabeling, requiring upwards of 18 hours for antibody incubation times. Now it is possible to drastically reduce these times by using the MAX 3440 laboratory microwave oven (Ted Pella, Inc., Redding, CA). Microwave technology was first used in 1970 by Mayers. Since then many advances were made to stabilize the microwave processing environment. These developments include the Pelco® 3420 microwave load cooler, the Cold Spot® plate as well as the Pelco® 3430 microwave power controller (Ted Pella, Inc., Redding, CA). These advances allow shorter processing times and deliver quality results. This advanced microwave technology was employed for tissue fixation and immunolabeling processing to answer the question: where in a rat hippocampal synapse is calcineurin (an important protein phosphatase in cell signaling transduction pathways) localized? Currently, there is no literature localizing calcineurin at the ultrastructural level. Therefore, in this study we localize calcineurin immunoreactivity on the transmission electron microscope using microwave-assisted tissue processing and immunolabeling techniques. Immunolabeled tissue controls