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2006 - The Eleventh Annual Symposium of Student Scholars

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The Eleventh Annual
Symposium of
Student Scholars

Recognizing Excellence
in
Student Scholarship

April 7, 2006
Eleventh Annual Symposium of Student Scholars

April 7, 2006

Program

9:00 a.m. Welcome
Dr. Lendley Black
Vice President for Academic Affairs

9:00 a.m. – 12:00 p.m. Posters
Presenters available to discuss their works

Organizing Committee
Dr. Bill Ensign, Committee co-chair, Associate Professor of Biology
Ms. Carol Pope, Committee co-chair, Assistant Director for disabled Student Support Services, Advisor for Phi Kappa Phi
Dr. Mark Patterson, Associate Professor of Geography

Special thanks to Phi Kappa Phi for support of the reception and printing of the abstract booklet.
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College of Health and Human Services

Tsunami Relief and Photography Projects Through the Eyes of Children

Emily Walters and Dr. Anne Hicks-Coolick

Department of Human Services

On December 26, 2004, a deadly Tsunami struck many countries in Southeast Asia, instantly killing over 200,000 people and making millions homeless. It was an event that captured attention worldwide as millions mourned the loss of life, homes and livelihood. On June 17, 2005, I arrived in Banda Aceh Indonesia. From June until December of last year I volunteered with a Christian aid organization in Banda Aceh. My job was to coordinate relief teams that came to help in our organization. I was able to meet many people, especially in the community of Kampung Mulia, a fishing village on the outskirts of the city. It was in this village that an idea began to form in my mind. I taught a few of the young girls at Kampung Mulia how to use my digital camera. I soon noticed that the photos they were taking were amazing, coming from a unique perspective and capturing a unique world. I decided to research the benefits of photography as an art form for children who had experienced trauma. I then developed a proposal and sent it to my support team in the United States for funding. I got an immediate response and was able to raise five hundred dollars and eighty disposable cameras were donated. I passed the cameras out to children in different parts of the city. We gave them a list of questions and had them answer them with a picture. The questions were designed to cause them to reflect on their experiences and how the tsunami had affected them. We took the cameras, developed the pictures and then returned them to the children with a discussion and reflection time. It was an incredible experience and I was able to see how this project helped our overall organization’s relationships with children and their families as we met many new people. At the symposium I will display a posterboard that offers keypoints on the reason for my trip, the children’s trauma, and photography as an intervention. The board will display many of the photos taken by the children and how these photographs reflect the tragedy of the tsunami and the resilience of children as they come through this trauma. This work is interesting to all, but it is especially important to those who work with trauma victims and children.
Anwar Sadat at the Egypt-Israeli peace treaty signing: A case study for Bitzer’s model of rhetorical situations.

Chad Burwick, Alan Crocker and Dr. Elizabeth Giddens

Department of English

This project explores the historical situation surrounding the signing of the Egypt-Israeli peace treaty and analyzes the speech given by Anwar Sadat at the 1979 signing using the framework provided by Lloyd F. Bitzer in his 1980 revision of his model for rhetorical situations. It will also explore the approach of Smith and Lybarger toward rhetorical situations and attempt to explain why Sadat’s speech, seemingly straightforward and innocuous, contains so much depth and complexity.
Central Europe in Transition

Irina Kroeger and Dr. Mark Patterson

Department of Sociology, Geography, Anthropology and Criminal Justice

This project is designed as an informational poster depicting the transformation of Central European countries from the controlled economic system under communism to a Western-style market economy. In late 1989, the countries of Central Europe broke from the Soviet Union and began to construct democratic institutions and market-oriented economies. The people of the region want to return to Europe. What complicates the process of economic transformation is the burden posed by the inheritance of the communist economic system. The laws, institutions and ownership structure under communism are very different from what is needed for a modern, capitalists economy, so nearly all must be changed. After forty years of the communist economic system failed to sustain itself, leaving industrial collapse, financial distress and very low living standards. The move from a controlled economic system under communism to a Western-style market economy, required measures that initially triggered increased levels of unemployment and inflation. Having started with different levels of economic development and following varying timetables in implementing reforms, the countries of Central Europe now face different economic situations. The layout includes a map of the focus countries and charts highlighting the economic changes occurring over a ten year period. The text examines the historical perspective of the transition, the desire of Central European governments to integrate into the European Union and the future prospects of success. Assorted graphics depict historic landmarks and modern industry found throughout the region.
Ten Years of Sprawl and Urban Growth in Cobb County, Georgia

Shane Peden, Melissa Pfiel and Dr. Harry Trendell

Department of Sociology, Geography, Anthropology and Criminal Justice

Sprawl and suburbanization have become a hot button issue around Metro Atlanta over the past few decades. Urban sprawl (the unplanned development of open land) and suburbanization emanating from its base in urban Atlanta have significantly impacted the surrounding counties and communities. Cobb County, Georgia is no exception. While traveling southbound on Interstate 75 through Cobb County it has become difficult to tell where Marietta, its county seat, ends and Atlanta begins. Tall, glass office buildings dot the landscape of South Cobb and new subdivisions now replace what used to be forests, farmland and open spaces in throughout Cobb County. According to the US Census data, in 2000 Cobb County reached a population of 607,751 while in 1990 it was 447,745, which amounts to more than a 25 percent increase in population within a 10 year period. It is hypothesized that this population impact has significantly changed the landscape of Cobb County because of the housing and employment needs of this expanding population.
Zaxby's is a rapidly growing restaurant chain that began in the college town of Statesboro, Georgia. The restaurant chain has expanded throughout the Southeast, with exceptional growth in the late 1990's and into the 2000's. Within Georgia, Zaxby's has recently made significant moves into the Metro Atlanta region. While Zaxby's currently has several locations in Gwinnett, it may be favorable for the company to expand its share of the restaurant scene in this important regional county. In order to expand, Zaxby's has become interested in using GIS technology to plot and plan new and existing locations for restaurants within Gwinnett County. In order to determine feasible sites for new Zaxby's the locations of all current Zaxby's were to be mapped. The locations of current Zaxby's were studied in order to detect any trends in their locations. Once plotted, the locations of Chick-fil-A competitors were mapped to determine any competition trends that existed. The locations of the Chick-fil-A restaurants would aid in determining the new sites for future Zaxby's in Gwinnett. Continuing, the addresses of all current Zaxby's and competing Chick-fil-A's within Gwinnett County were collected and organized. A shapefile for the county was acquired, followed by a TIGER map for the roads in the county in order to map the locations of restaurants and future sites. A map of the census tracts for Gwinnett was also obtained from the Census; the population density and the median income for the census tracts were too obtained from the Census. A Geodatabase was developed to organize the information in ArcMap. The shapefiles for the county and the census tracts were imported, as well as the tables for the Zaxby's and competitor restaurant locations. The table(s) with the population density and the median income were imported; followed by the table that correlated with the TIGER map. Using ArcMap, a spatial representation of the information could be developed to be used in the determination of new restaurant sites. The use of the GIS software allowed three new sites to be selected for future Zaxby's locations. Each of these locations is near an intersection of high activity, such as shopping or residences. Each is within suitable distance from a Chick-fil-A in order to compete for business. With the use of GIS software, the possible locations for Zaxby's to effectively expand were determined through spatial methodology.
An Analysis of Liquor Store Locations Relative to Average Income Level Areas in Cobb County, Georgia

Benjamin Roberts and Dr. Mark Patterson

Department of Sociology, Geography, Anthropology and Criminal Justice

Alcohol consumption and abuse are often associated with poverty and crime. Research dealing with alcohol and the problems related to alcohol, the link between alcohol availability, and using Geographic Information Systems (GIS) to track these topics is examined in this research. Alcohol consumption has been found to be directly related to alcohol availability. Geographic Information Systems can be used to examine the spatial relationships between alcohol outlet distributions and alcohol-related problems of particular geographic areas. The purpose of this research, differing from the reviewed studies previously conducted, is to illustrate the relationship between alcohol outlet density and poverty. The question being, is there a relationship between the location of liquor stores and poverty? The occurrence of more liquor stores in lower income areas will indicate that more liquor stores are found near poverty-stricken areas than in areas with higher per capita income. By using GIS, the exact spatial relationship between liquor stores and their frequency in particular income districts is made readily visible. With GIS analysis, this research expected to find that the lower income areas would contain more liquor stores than the higher income areas in Cobb County, GA. The final results were similar to the expected results, in that more liquor stores were found in the lower income areas.
The People of Iraq

Jeffrey Shea and Dr. Mark Patterson

Department of Sociology, Geography, Anthropology and Criminal Justice

This display illustrates the complex task that coalition peace keeping forces face while supporting the newly installed Iraqi Government. Historically the region that is Iraq has been long divided for various reasons long before its existence. These divisions today are primarily along ethnoreligious lines. This presentation displays the civil complexity of Iraq by using colored shading areas with legend to represent the majority ethnoreligious groups in Iraq, a background text narrative, bar graph, and pictures. The thematic map was created using Micromedia Freehand 10 with a Lambert Conformal Conic Projection, SP 29 30N/36 40N derived from various internet sources (see map credits). The methods used outline the five major concentrations of ethnoreligious groups of people in Iraq today. They are the Shia Arab/Sunni Arab, Sunni Arab, Sunni Arab/Sunni Kurd and Sunni Kurd. This shows the mixing of these different, and often, confrontational people. Each has their own reason for not trusting the other. With this presentation one is able to visualize the coalition of different ethnoreligious groups in Iraq. A problem that predates United States lead coalition involvement, Sadam Hussan, the British and any previous governing entity.
Bioactive Peptides with Enhanced Antimicrobial Activity: the Testing of D2A21

John Avery and Dr. Jesse Jaynes

Department of Biological and Physical Sciences

The objective of this study was to test the bactericidal efficacy of the novel synthetic lytic peptide D2A21 against seven common human pathogens. The rate of acquired resistance developed by pathogenic bacteria has increased to such an extent that in 2004 in the United States alone, 2 million people acquired nosocomial infections. As a result of these infections 90,000 patients died. More than 70% of the bacteria that cause these infections are resistant to at least one of the antibiotics used to treat them. Past and current strategies to combat resistance have not been effective. The current repertoire of antibiotic therapeutics disrupts singular targets by interrupting cell wall synthesis, protein synthesis, or nucleic acid synthesis. Pathogenic bacteria maintain several mechanisms to abrogate these interferences, including but not limited to active efflux of the antibiotic, reduced intake, overproduction of antibiotic target, and metabolic bypass of inhibited reactions. Antimicrobial peptides, like D2A21, selectively and fatally disrupt the lipid bilayer of the outer membrane of prokaryotic organisms as a consequence of electrostatic interactions between the cationic peptides and anionic membranes. Effective resistance must be accomplished by changing the phospholipid constituents of the prokaryotic membrane. Changing the phospholipid architecture of the membrane is an intricate and complicated process which may lead to a further reduction in bacterial fitness. We expected D2A21 to inhibit bacterial survival to an extent greater than that of a battery of ten commonly prescribed antibiotics. In order to determine a benchmark, we performed antibiotic susceptibility tests for each of the seven microorganisms. Of the 70 tests performed, 26 demonstrated either resistance or intermediate resistance. Growth curves for each of the organisms were established spectrophotometrically to determine log phase growth. Kill assays were performed by adding 500nM-50μM concentrations of D2A21 during mid log phase of each respective bacterial species. Comparison inoculum plates were created to determine most probable number counts of the assayed specie concentrations. D2A21 was found to inhibit growth at concentrations as low as 500nM and at specimen concentrations of up to 298 x 10^6 CFU/ml. In contrast to the antibiotics, every organism tested was susceptible to D2A21, thus meeting our expectations based on peptide/membrane interactions. In light of the results of this research, further exploration into the practical use of D2A21 as an antimicrobial therapeutic agent is warranted.
Detection of Sigma Factor Changes in Bacteria

Lyric Curtis, Dr. Karen Duda-Rippe and Dr. Jerald Hendrix

Department of Biological and Physical Sciences, Department of Chemistry and Biochemistry

Sigma factors are a part of the core enzyme bacterial RNA polymerase. The sigma factor helps the core enzyme recognize the gene initiation sites. There are several different types of sigma factors in Escherichia coli that are expressed under varying conditions of growth. These varying conditions of growth such as nutrient limitation and starvation prompt the bacteria to change their genetic patterns to allow them to adapt to environmental stress. The various sigma factors compete to bind with the core domain of bacterial RNA polymerase, which is responsible for the catalysis of RNA synthesis. In a batch culture, the transition between exponential to stationary growths of E. coli prompts a significant shift in the expression of different sigma factors. During the exponential stage, σ70, is the major sigma factor expressed in E. coli. However, the closer E. coli gets to stationary phase, the more σs is expressed along with σ70. σs regulates the transcription of genes that are responding to the environmental stresses. To detect these changes a modified western blot procedure was performed by the Jishage method. As is shown in the experiments performed, the original procedure was altered so that it was optimal for the information we wished to detect. It was determined that nitrocellulose membranes were not sensitive enough to detect an adequate amount of protein to allow for quantification. Additionally, it did not offer reproducible results. Polyvinylidene difluoride membrane is shown to be more sensitive and provided better reproducibility. Other experimental variables, such as the stringency of the wash steps were also adjusted to maximize the productivity of the assay.
DNA Sequence Library of the trnL Intron of Several Tree Species from the Yucatan Peninsula, Mexico

Savoun Long, Dr. Thomas McElroy and Dr. Paula Jackson

Department of Biological and Physical Sciences

The result of rapid urbanization in Mexico poses a potential threat to the tropical deciduous forest of the Yucatan Peninsula by rendering ecological changes; therefore, it is essential to protect the availability of fresh water in that area. However, there is a lack of knowledge on how these dry tropical trees obtain their water sources due to the lack of research in the Yucatan Peninsula; hence, it is important to investigate the patterns of water acquisition in these area, which will enhance further understanding on how to conserve these areas. The goal of this study is to create a DNA sequence library for tropical deciduous tree species from the Yucatan Peninsula of Mexico, which will help delineate differences in source water use among local tree species. The DNA from the plant leaf tissue was extracted with CTAB buffer, and followed the Qiagen Plant DNA Extraction Kit protocol. Agarose gel electrophoresis was used to detect if the DNA extraction was successful. Polymerase chain reaction (PCR) was used to amplify chloroplast trnL (UAA) intron for sequencing. Following PCR amplification, the PCR product was sequenced on an ABI 310 Genetic Analyzer. The DNA sequences from the plant tissue samples were submitted to GenBank and recorded in the local sequence database.
Interspecific Associations and Physical Factors Influencing a Growing Population of *Cypripedium acaule*

Jillian Mason and Dr. Heather Sutton

*Department of Biological and Physical Sciences*

*Cypripedium acaule*, which is commonly known as the pink lady’s slipper, is an orchid that grows in pine forests in northern Georgia, which represents the southern limit of its range. Kennesaw State University is fortunate to have a growing population of these plants in a remnant patch of forest. In 2004, a long-term study was initiated to track population dynamics of this orchid. Data is being collected yearly on the emergence of leaves and blooming dates, as well as the location of each plant. Students contributing to this ongoing research also complete an individual short-term project each year. In 2004, physical factors such as soil temperature, leaf litter depth, light intensity, and soil compaction were measured in areas both with and without pink lady’s slippers. Only litter depth was correlated with the presence of pink lady’s slippers. This year’s project investigated the associations pink lady’s slippers have with other plants, including loblolly pine (*Pinus taeda*), poison ivy (*Toxicodendron radicans*), Japanese honeysuckle (*Lonicera japonica*), Virginia creeper (*Parthenocissus quinquefolia*), white oak (*Quercus alba*), grapevine (*Vitus sp.*) and greenbriar (*Smilax sp.*). Greenbriar and poison ivy were found to have negative associations with pink lady’s slippers, while loblolly pine was found to have a positive association with the pink lady’s slippers.
Genetic Characterization of the Stone Roller (*Campostoma oligolepis*) in the Euharlee Creek system

Chelsea Mays, Dr. Thomas McElroy and Dr. William Ensign

*Department of Biological and Physical Sciences*

The analysis of genetic variation within and among populations is important because it allows us to understand the factors driving evolutionary change. Patterns of genetic variation among populations can be used to investigate connectivity among sites. We studied several populations of *Campostoma oligolepis*, a species of fish in the minnow family. We determined if they exhibit significant population genetic structure among creek sites. Samples of *C. oligolepis* were collected from three different tributaries branching off the Euharlee Creek system in northern Georgia, USA. A 25 milligram portion of muscle tissue was then removed from each sample and the DNA was extracted. The Polymerase Chain Reaction was then run on the samples in order to amplify several microsatellite loci located within the nuclear genome. The microsatellite fragments were analyzed on an ABI 310 Genetic Analyzer. These data allowed us to genetically characterize populations within and among collection sites. Gene flow among the sampled sites was estimated in order to determine if barriers to gene flow may exist.
Soil Fungal Diversity Among *Cypripedium acaule* Communities

Amy Mundell, Dr. Thomas McElroy and Dr. Heather Sutton

*Department of Biological and Physical Sciences*

The pink lady slipper orchid, *Cypripedium acaule*, is a large, showy wildflower that is a native terrestrial orchid listed as unusual, endangered or exploitably vulnerable and endangered throughout the northeastern and southeastern United States. The pink lady slipper is listed in Appendix II of CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna) and is also protected through various individual states and federal programs. The orchids' habitat is very selective and little is known about the microbial community or soil requirements for growth and maintenance of the orchid. Soil samples were collected from a large community of pink lady slipper orchids after emergence from their dormant period. Understanding soil community structure will play an important role in preservation and/or relocation of pink lady slipper orchids that are in danger of certain demise. Terminal restriction fragment length polymorphism (TRFLP) is a culture independent method used to analyze the microbial communities. Whole genomic DNA was extracted from the soil samples. The ITS region of the fungal genome was subjected to PCR amplification with fluorescently labeled primers. The amplicons were cut with *Taq1* endonuclease restriction enzyme and the fragments were analyzed with an ABI 310 Genetic Analyzer. Differences in microbial communities within and among *C. acaule* populations are being analyzed and will be discussed.
Analysis of Phytochelatin Accumulation in the Sensitive Wild Type Strain of *Ceratopteris richardii* Exposed to Cadmium Stress

Saman Nematbakhsh and Dr. Dale Vogelien

*Department of Biological and Physical Sciences*

T Phytochelatins (PCs) are a class of small thiol-rich peptides that accumulate in plant tissues upon exposure to heavy metal stress. Because they bind to metal ions they have been recognized as a possible mechanism for heavy metal detoxification in plants. The purpose of this study was two-fold: 1) to substantiate the efficacy of a new, faster, relatively inexpensive electrophoretic approach to detect and quantify PCs (Fan et al., Phytochem. Anal. 15, 175-183, 2004) and 2) to document the accumulation of these peptides by the sensitive wild type strain of *Ceratopteris richardii* (C-Fern), a model plant used in the study of metal toxicity and homeostasis. To confirm the effectiveness of this new approach, standards of glutathione (GSH), PC$_3$, PC$_4$ and PC$_5$ were derivatised/labeled with monobromobimane (mBrB), a thiol-selective fluorescent tag, and subjected to Tris-Tricine SDS-PAGE (12.5% T) for peptide analysis. All standards were successfully detected and distinguished from one another using this method, and a linear relationship between fluorescence image density and amount of a given standard was observed. These results suggest that this approach would be acceptable for detecting and quantifying PCs in plant tissue. Consequently, wild type C-Fern gametophytes (19 days old) were exposed to 0, 12.5 and 100 µM CdCl$_2$ for 120 hours, and the thiol-rich peptides extracted from the dried harvested tissue. SH-rich peptides in extracts were labeled with mBrB and examined by gel electrophoresis following the same procedure used previously to examine standards. A single fluorescent band was detected in all tissue samples, even that of unexposed tissue, however none of the bands co-migrated with any of the standards. These results suggest that the labeled material observed in gametophyte samples is not one of the standards used (either GSH or PC$_{3-5}$). Because this band migrated faster than any of the standards, this material could be a larger PC (e.g. PC$_{6-11}$) or, more likely, a by-product(s) of the labeling reaction that forms due to polymerization of molecules prior to mBrB labeling. It is unlikely that the material in the 0 µM treated tissue sample represents a larger PC, for PCs have not been detected in plants in the absence of Cd (or other) metal stress. We suggest that aspects of the tissue harvesting and derivatisation steps be further examined.
Ecoregion Effects on Stream Fish Condition Factors across Trophic Levels

Steven Ranney, Dr. William Ensign and Dr. Joseph Dirnberger

Department of Biological and Physical Sciences

In this study, we investigated the hypothesis that fish condition (quantified using Fulton condition factors \([K]\)) is correlated with water conductivity. Since increased conductivity may be related to increased primary productivity, we expected to see \(K\) higher in streams that had higher conductivities. Our hypothesis was based on the ecoregion concept that suggests that areas of land with similar geologic and agricultural characteristics will have similar flora and fauna. We sampled five streams of varying conductivities (from 32 \(\mu\)S – 183 \(\mu\)S) in the geologically diverse Euharlee Creek watershed which flows across two ecoregions (Piedmont and Ridge and Valley) in west central Georgia. Our three target species (Campostoma oligolepis, Notropis chrosomus, and Lepomis machrochirus) represent three trophic levels, herbivore, insectivore and piscivore/insectivore, respectively. Therefore we would expect the effect of increased primary productivity to be most noticeable in \(C.\) oligolepis and least noticeable in \(L.\) machrochirus. Samples were obtained from June through early September. Fish were collected with a backpack electroshocker, identified to species and measured for length and weight. Contrary to our expectations, \(K\) declined as conductivity increased for all three species. This unexpected trend was attributed to a new year class of fish recruited to our samples later in the sampling season. Since condition typically increases with increasing fish size, this effectively lowered the condition factor for both \(C.\) oligolepis and \(N.\) chrosomus averaged across all age classes.
Genetic Structure and Parentage Analysis of the Marble Salamander (*Ambystoma opacum*) in Marshall Forest, Rome, Georgia

Robin Renteria and Dr. Thomas McElroy

*Department of Biological and Physical Sciences*

There are many factors leading to the unprecedented worldwide decline in the amphibian populations; the most obvious factors being habitat destruction and alterations such as clear cutting and draining of wetlands. Other factors include disease, global environmental change, as well as other contaminants. Due to amphibians having permeable skin and a biphasic life-cycle they are more sensitive to environmental disturbance which makes amphibians a good indicator species for assessing environmental quality. One good method for determining the overall diversity and population health in amphibians is to monitor their breeding sites. Since December of 2003 Dr. Tom McElroy and Dr. Ricky Fiorillo have monitored a vernal pond in Marshall Forest which serves as a breeding site for many amphibians, including the Marble salamander (*Ambystoma opacum*). Adult male and female salamanders will be captured as they enter and leave the pond, along with the juveniles as they leave in late spring. The parental analysis and genetic structuring is expected to indicate a general skew in reproduction of these amphibians. A survey of 3 polymorphic microsatellite loci for *A. opacum* was performed. The microsatellite were amplified using PCR. The amplified products were electrophoresed on an ABI 310 automated DNA sequencer. Analysis of allele frequencies will determine feasibility and power of parentage analysis with the microsatellite loci that are surveyed. Critical values will be calculated in order to determine confidence levels in parentage.
Ecoregion Effects on Physical Habitat and Fish Community Structure

Joshua Smith, Dr. William Ensign and Dr. Joseph Dirnberger

Department of Biological and Physical Sciences

The objective of this study was to quantify differences in stream physical habitat and fish communities across an ecoregion boundary in the Euharlee Creek watershed in west central Georgia. We sampled five streams with varying degrees of influence from Piedmont and Ridge and Valley ecoregions. Physical parameters measured at each site include water conductivity, depth, velocity, substrate, discharge, local stream slope and reach slope. We sampled fish with a backpack electroshocker and all fish collected were identified, measured, weighed and released. Although water conductivity was strongly correlated with the proportion of watershed area contained in the Ridge and Valley ecoregion, there were no significant trends in the physical parameters of the sites as a function of water conductivity. There were also no significant trends in fish community structure associated with changes in conductivity. Inferences related to fish community structure are tentative due to seasonal differences in collection times among sites. Qualitative observations of differences in land use and quantitative assessment of the percentage of fine particles in the stream channel suggest that human disturbance may be a more important factor influencing both physical characteristics and fish community structure than ecoregion.
Ecoregion Effects on Stream Aquatic Invertebrate Scraper Communities

Erin Squires, Dr. Joseph Dirnberger and Dr. William Ensign

Department of Biological and Physical Sciences

Regional ecosystem patterns have been delineated into ecoregions based largely on terrestrial characteristics including geology. It is unclear as to the effects of these characteristics on aquatic systems from one ecoregion to the next. The influence of ecoregion delineation on invertebrate assemblages was examined. Conductivity was used as a measure of the influence of underlying geology on each stream because hardness of rock between these two ecoregions differs substantially. Because conductivity has been shown to influence primary productivity of periphyton it was predicted that the functional group of scrapers will increase in streams with higher conductivity due to more readily available food sources. However no correlation was indicated between scrapers and periphyton. While there was no evidence of bottom up control on the scraper assemblage, there was evidence of top-down effects on periphyton. A positive correlation between periphyton growth and insectivorous fish could be the result of decreased grazing due to predation. The data does not indicate that ecoregion delineation and conductivity affect the assemblages of the stream ecosystems; this could be due to the close proximity of the stream sample sites.
Ecoregion Effects on Stream Periphyton Communities

Ryan Stoner, Dr. Joseph Dirnberger and Dr. William Ensign

Department of Biological and Physical Sciences

This study examined whether differences in underlying geology between two different ecoregions (Piedmont and Ridge and Valley) affect periphyton standing crop in five streams straddling the ecoregion boundary to various degrees. Conductivity was used as a measure of underlying geology on each stream because the hardness of the rock among these two ecoregions differs substantially (conductivity varied from 32 µs to 184 µs over the five streams studied). Standing crop (biomass) of periphyton was estimated by determining the amount of chlorophyll in periphyton growing on glass slides incubated in streams for 5-15 days. Two separate studies were performed. In the first study, periphyton standing crop was not correlated with conductivity, but rather more closely with overstory density. In the second study, sites were chosen with similar overstory densities. Chlorophyll concentrations increased with conductivity over four sites. The fifth site had high chlorophyll relative to conductivity, possibly due to anthropogenic nutrient input as suggested by the presence of large filamentous algae on slides at the site. The ratio of chlorophyll c to chlorophyll a showed a strong positive correlation with conductivity over the five sites indicating a shift in the proportion of diatoms within these communities. The results suggest that geology can influence periphyton standing crop and community makeup over relatively short distances.
Selection and Preliminary Ion Analysis of *Ceratopteris richardii* Mutants Tolerant to Toxic Levels of Cadmium

Deserah Strand, David Clements, Dr. Dale Vogelien and Dr. Marina Koether

*Department of Biological and Physical Sciences, Department of Chemistry and Biochemistry*

Heavy metal toxicity and homeostasis are complex processes in plants, each associated with a wide variety of biochemical and physiological processes. This study used the model plant *Ceratopteris richardii* to select for mutants tolerant to toxic levels of cadmium (Cd) and initiate comparative studies with the wild type (W.T.) strain in order to examine how contributing mechanisms interact to produce an effective strategy for metal tolerance. Using an established haploid selection system, two putative mutants were obtained, Cdt1 and Cdt2. Spores collected from completely homozygous Cdt1 M1 sporophytes showed significantly higher germination rates than sensitive W.T. spores, however mutant and W.T. gametophytes were equally sensitive to increasing levels of Cd. These results indicate that Cdt1 mutation confers tolerance to Cd only during spore germination. The levels of seven essential minerals and Cd were determined using atomic absorption spectroscopy for Cdt1 and W.T. spores and gametophytes exposed to no, sublethal and lethal levels of Cd stress. Levels of essential minerals were similar in Cdt1 and W.T. spores prior to germination and in gametophyte tissue in the absence and presence of Cd stress. Tissue levels of Cd and Fe increased similarly in gametophyte tissue of both strains as external concentrations of Cd increased. These results suggest Cd toxicity in W.T. gametophytes is associated with increased Cd and/or Fe accumulation and not alterations in accumulation of other essential cations; the basis for the low level of tolerance observed in Cdt1 spores during germination is not associated with a difference in spore mineral content.
Physiological Differences Among Three Tree Species of a Dry Deciduous Tropical Forest

Ellen Eubanks1, Jose Carlos Cervera2, Dr. Jose Luis Andrade2 and Dr. Paula Jackson1

1Department of Biological and Physical Sciences, 2CICY (Mexico)

Seasonally dry tropical forests are one of the most globally threatened ecosystems, but have been studied less in comparison to tropical rainforests. The Yucatan Peninsula contains one of the greatest expanses of dry tropical forests in Mexico. In these ecosystems water is likely to be the major limiting resource for both the native vegetation and the encroaching human population. Few studies have investigated the physiology of the tree species of the area; however gaining insight into the physiological mechanisms of the trees’ survival is an essential component in predicting the impact of disturbances on the forests and to indicate how to better manage and protect them. This research is part of an ongoing more extensive study of the woody vegetation of the Yucatan, specifically the area of Dzibilchaltún, and has as an objective the study of the physiology of trees that differ in their leaf flushing patterns. In this research two briefly deciduous species: Gymnopodium floribundum Rolfe (Polygonaceae) and Piscidia piscipula (L.) Sarg.(Leguminosae); and an evergreen species, Diospyros cuneata Standl.(Ebenaceae) were considered. The study took place at the end of the dry season (May, 2005) and during the estación de Nortes (December, 2005). Daily courses of gas exchange (LiCor 6400 photosynthesis system) as well as water potentials (using a Scholander-type pressure chamber) were determined. Preliminary data indicate potential differences in the average photosynthetic rates of Diospyros cuneata (evergreen) and Piscidia piscipula (brevi-deciduous) (4.5 µmol m-2s-1 vs.3.8 µmol m-2s-1) however under field conditions light availability was also higher for Diospyros. Diospyros also exhibited a lower conductance and greater water use efficiency than Piscidia. Minimum water potentials for both Gymnopodium and Diospyros were beyond the scale of the pressure chamber (less than -4 MPa). However, the most negative reading for Piscidia was recorded at -1.8 MPa. Further research is needed to elucidate the causes for the differences observed in this preliminary study.
Tree Species Patterns of Distribution and Diversity with Distance to a Water Source in a Tropical Dry Forest

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The Yucatan Peninsula of Mexico contains some of the most threatened ecosystems of the world: tropical dry deciduous forests, yet little information exists regarding these ecosystems. This project examines the patterns of distribution and diversity of tree species with distance from an underground water source or cenote in Dzibilchaltún (89° 49'W and 21° 9'N), an archeological park in Yucatan. Two 100 m base line transects were set at 50 m and 800 m from the cenote. Within each transect, eight 10 m x 10 m quadrats were established, and all trees were identified. For ten tree species patterns of distribution as well as relative density and relative frequency were calculated. The distribution of tree species (even, random, or clumped) was analyzed using the coefficient of dispersion (variance/mean). Differences in overall species diversity (Shannon Index) and similarity (Sorensen’s Index) among sites (far or near from the cenote) were also determined. Results indicated that species area curves did not level off even after sampling 800 m². Data indicate no significant difference in diversity among sites far or near from the cenote (t-test p >0.05). Sorensen’s Index indicated a ~ 62% similarity among sites. Tree species’ patterns of distribution appeared to be independent of leaf flushing pattern (evergreen or deciduous) and site (near and far from the cenote. Two species were found only at the far site, and two only at the near site, and this was also independent of leaf flushing pattern. Future studies will address other factors such as source water use, which may play a role in the patterns of distribution and abundance of species.
Phytotoxicity Of Monomeric And Polymeric Aluminum To Native Wetland Plant Species

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The most commonly used coagulant for the treatment of drinking water is aluminum sulfate (alum). The aluminum (Al) species in alum is the monomeric species $\text{Al}^{3+}$ ($\text{Al(H}_2\text{O)}_6^{3+}$). However, polymeric Al coagulants such as polyaluminum chloride used to treat drinking water may contain up to 10% of the Al as the polymeric species, $\text{Al}_{13}^{7+}$ ($[\text{AlO}_4\text{Al}_{12}(\text{OH})_{24}(\text{H}_2\text{O})_{12}]^{7+}$). These Al species can enter the environment through the land farming of the aluminum hydroxide sludge produced during the sedimentation process in the treatment of drinking water. Aluminum in this sludge can then enter waterways and wetlands through leaching or runoff. The toxicity of $\text{Al}_{13}^{7+}$ in the environment relative to $\text{Al}^{3+}$ is in question. The goal of this study was to investigate the relative toxicity to wetland plants of $\text{Al}_{13}^{7+}$ as compared to $\text{Al}^{3+}$. Native wetland plant species tested were swamp milkweed (Asclepias incarnata) and saw-tooth sunflower (Helianthus grosseserratus). Additionally, radish (Raphanus sativus) was tested, as it is an agricultural species commonly used as a surrogate in place of native plants. Concentrations ranging from 0 to 500mg/L were evaluated. Endpoints measured were shoot and root length and mass, as well as internal plant concentrations of aluminum and various nutrients. Despite high variability in the data, a number of patterns emerged. Radish showed more differences in response between the two aluminum species than the native plant species did. With some of the internal plant aluminum or nutrient concentrations, the two aluminum species caused a different pattern of response.
Understanding Proton Mobility in Water Ions

Craig Clark and Dr. Martina Kaledin

Department of Chemistry and Biochemistry

Water is known to play a role in the translocation process by forming a hydrogen-bonded chain, to serve as a pathway for the proton. The hydrated hydroxide ion, \( \text{H}_3\text{O}^2^- \) is one of two fundamental structures (i.e. \( \text{H}_3\text{O}^2^- \) and \( \text{H}_5\text{O}^{2+} \)) involved in the proton transfer. The structure and dynamics of \( \text{H}_3\text{O}^2^- \) have been the subject of several theoretical and experimental studies. Recently, the spectra of many water molecular ions have been reported for excitation energies below 2000 cm\(^{-1}\) using free electron lasers. This region is especially important for strongly bound systems such as \( \text{H}_3\text{O}^2^- \) and \( \text{H}_5\text{O}^{2+} \), where the shared-proton vibrations were predicted to occur. For larger molecular systems, for example \( \text{H}_7\text{O}^{3+} \) and \( \text{H}_9\text{O}^{4+} \) clusters the fitting of potential energy surface and dipole surfaces are not feasible due to high dimensionality. The DMD method combined with electronic structure theories (DFT, MP2, etc.) can provide a full dimensional treatment of the problem. We will present also preliminary results for the \( \text{H}_7\text{O}^{3+} \) and \( \text{H}_9\text{O}^{4+} \) clusters using electronic structure theory.
Effect of Angiotensin II and ACTH on Expression of P-glycoprotein in a Human and Mouse Adrenocortical Cell

Monir Clark, Jennifer Yam and Dr. Jennifer L. Powers

Department of Chemistry and Biochemistry

P-glycoprotein (Pgp) is a 170 kDa membrane-bound protein that is found in a variety of cell types, but shows higher levels of expression in cells of the liver, kidney, biliary tract, adrenal cortex, and blood-brain barrier. One isoform of Pgp is known to become overexpressed when cells are exposed to various chemotherapeutic agents. Under these conditions Pgp functions as an ATPase that transports these agents out of the cell, leading to the phenomenon of multi-drug resistance. Our goal is to further understand the biological role of Pgp in the adrenal cortex and the physiological conditions that could lead to an up-regulation of Pgp. Toward this goal, human and mouse adrenocortical cells, H295R and Y1, respectively, have been cultured and treated with and without hormones known to increase production of steroid biosynthesis enzymes and efflux of steroids in these cell lines. Our hypothesis is that these hormones also increase expression of Pgp, since Pgp is thought to be involved in efflux of certain steroids. Early experiments focused on troubleshooting the procedures for cell solubilization and protein concentration determination. Some of these results will be presented. Once these procedures were established, cells were treated in the presence and absence of 50 nM angiotensin II (All) or 0.20 mg/mL adrenocorticotropic hormone (ACTH) for 24 or 48 hours. Media was removed and cells solubilized for determination of protein. This was followed by Western blotting using a C219 antibody and Opti-4CN detection kit. Western blotting results show evidence of Pgp in both cell lines, but suggest higher expression of Pgp in the murine cell line (Y1). Treatment with All or ACTH for 24 or 48 hours has failed to consistently show an increase in total protein compared to control. However, in one trial, when approximately the same amount of total protein was examined by Western blotting, the H295R cells did show an increased amount of Pgp compared to control. Other studies have shown both a high molecular weight band (~170 kDa) and a band of less than 100 kDa for both cell types, suggesting possible protease digestion or loss of carbohydrate groups on the Pgp in our cell fragments. Future studies will focus on concentration and time-dependence of Pgp expression in the presence of All in the H295R cell line.
Thioflavin T and Polyglutamines: Solvent effects

Dayne Fraser, Lissette Davila and Dr. Deborah Sauder

Department of Chemistry and Biochemistry

Thioflavin T (ThT) fluorescence is used to verify the presence of amyloid plaques in brain tissue samples to confirm a diagnosis of Alzheimer’s disease post-mortem. Abnormally long polyglutamine repeats form similar plaques in Huntingtin’s and related neurodegenerative diseases. The exact nature of the binding between ThT and amyloid plaques is unknown. Here we report results of preliminary studies to evaluate the effect of solvent variation, including pH and buffer constituents, on the kinetics and thermodynamics of binding between ThT and polyglutamine fragments as they undergo controlled aggregation.
Study of Enzymatic Activity in Pool Products

Michelle Garner, Kevin Hosterman, Shae Harris, Erica Williams and Dr. Karen Duda-Rippe

Department of Chemistry and Biochemistry

Many pool products are currently being produced that contain enzymes. These pool products are sold by various companies for the purpose of breaking down fatty acids and oils and thus eliminating haze and water-line rings from swimming pools. Most of the fatty acid and oil build-up in swimming pools comes from natural oils from the skin and hair of swimmers, suntan oils, and lotions. Each of the products analyzed in the study contain one or more enzymes that catalyze the decomposition of the fatty acids and oils present in the pool water. The concern is that the activity of the enzymes is often not measured or documented, therefore this study quantifies and compares activity levels of several products. The research was conducted using pool water from a local pool and a commercially available pool kit was used to assure the pool water always met proper regulations regarding free chlorine concentration. The substrate used in the assay was the lipid, pNP-butyrate, which consists of a 4-carbon fatty acid tail and an aromatic nitrophenyl ring. When the pNP-butyrate is added to the pool water containing the pool products, the enzymes in those products cleave the bond between the carboxyl carbon and the oxygen attached to the ring, freeing the aromatic ring and allowing it to absorb UV light at a different wavelength than the intact molecule. This absorption can be read at a wavelength of 405nm using a microplate reader. The more of the pNP-butyrate the enzyme(s) cleave, the higher the absorbance value. These absorbance values were read at various time intervals up to 150 minutes. In this way, the activity of the enzyme(s) in each pool product can be studied.
Optimal Method for Gravimetric Determination of Nickel in Nickel Ore

Katherine Gilbert and Dr. Marina Koether

Department of Chemistry and Biochemistry

In finding the amount of nickel in raw nickel ore, the theory of gravimetric analysis is applied by using Dimethylglyoxime (DMG) as a complexing reagent. This multi-step process can be utilized in an educational setting to aid in the understanding of this theory, but must also be simple and straightforward. Consequently, students should be able to perform the procedure with accuracy and precision. Three methods were tested for the determination of nickel in nickel ore and it was determined that the Thorn Smith Chemists' method produced the most accurate and precise results.
Coagulating Ability of Various Aluminum Solutions Using a Coagulant Charge Analyzer

Amanda Hess, Richard Murphy, Michelle Garner and Dr. Marina Koether

Department of Chemistry and Biochemistry

A coagulant charge analyzer measures the colloidal charge of a solution. By adding a coagulant with a positive charge, such as aluminum, the negative charge of the colloid is neutralized. The amount added is a function of the amount of colloid present, temperature of the water and nature of the aluminum solution added. Aluminum chloride, commercial aluminum sulfate, a synthesized polymeric aluminum solution made from aluminum chloride, and a partially neutralized aluminum solution made from the commercial aluminum sulfate have been investigated on a number of colloidal suspensions. Results indicate that as the turbidity increases the amount required of monomeric aluminum species also increases. However, as turbidity increases the amount required of the polymeric aluminum species decreases. The partially neutralized aluminum solution was ineffective. In comparing the monomeric solutions, aluminum chloride performed worse than aluminum sulfate. A mixture of the polymeric species and monomeric aluminum indicate that at a 50/50 ratio optimum performance is achieved. Requiring more polymeric aluminum is not necessary. Polymeric aluminum works better than monomeric aluminum both at warm and cold temperatures. Experimental design, a description of the coagulant charge analyzer used in this study and characterization of the solutions will be provided.
Characterization of Over-The-Counter Food Supplements by GC/MS

Amelia Robinson and Dr. Huggins Z. Msimanga

Department of Chemistry and Biochemistry

Most herbal food supplements, although their chemistry is not well-known, are widely used to treat diverse illnesses. For example Salvia officinalis, commonly called sage, is used to stimulate digestion and in the treatment of other intestinal ailments. Using GC/MS, we have analyzed sage in order to understand its chemical composition. From the two brands studied (Nature’s Sunshine Products and Kroger brands), camphor, nerolidol, limonene, and some fatty acids (essential oils) were found. Individual fatty acids were further identified by a derivatization technique using N,O-bis(trimethylsilyl)trifluoroacetamide (BSTFA) before injection.
PGC1 Expression and Purification

Ana West and Dr. Karen Duda-Rippe

Department of Chemistry and Biochemistry

PGC-1 (PPAR gamma coactivator-1), a transcriptional coactivator, plays an important role in glucose metabolism as it stimulates the expression of phosphoenol pyruvate carboxykinase (PEPCK) and glucose-6-phosphatase, key enzymes of the gluconeogenic pathway. The activity of PGC-1 is often researched by monitoring its effects on the glucose output by the hepatic cells as well as on the intake of glucose by skeletal muscle cells. In order for this coactivator to do some of its function it needs to bind to the transcription factor HNF4-α. This transcription factor is part of the nuclear receptor superfamily and it affects the expression of various genes involved in cell proliferation and differentiation as well as in energy production (metabolism). During the interaction of HNF4-α and PGC-1 the amino terminal of PGC-1, specifically the LXXLL motif, attaches itself to the AF-2 domain of the HNF4-α at the carboxy-terminus. The specific research described here, includes the expression and purification of the PGC-1 coactivator protein. PGC-1 was cloned into the pGEX 5X3 plasmid that incorporates a GST tag that allows for the affinity purification of PGC-1. The concentration and purity of the isolated protein was analyzed using acrylamide gel electrophoresis and Bradford Assays. Purified protein was then used in a pulldown experiment to investigate the nature of its interaction with HNF4.
P-glycoprotein: Overexpression and Role in Steroid Transport

Ibuhije Akinjobi, Dr. Jennifer Powers and Dr. Xueya Hauge

Department of Chemistry and Biochemistry, Department of Biological and Physical Sciences

P-glycoprotein, also known as phosphoglycoprotein or Pgp, is a 170kDa transmembrane protein glycoprotein when glycosylated and 140kDa when unglycosylated. Pgp is normally expressed at high levels in the adrenal cortex, colon, liver, blood-brain barrier, and kidney tissues. Pgp is also an ATP-dependent efflux pump that serves as a transporter of a variety of dissimilar compounds including steroid hormones, cholesterol, lipids, peptides, and antineoplastic agents or cancer drugs. Multidrug resistance (MDR) is a phenomenon that occurs when cells develop a natural resistance to cytotoxic compounds and are also resistance to structurally unrelated chemotherapy agents. Pgp is the only known human transmembrane glycoprotein that confers to MDR by acting as a drug efflux pump that actively transports xenobiotics out of the cells thus causing these cells to be MDR. The overall goal of this project was to determine what steroids Pgp transports and to examine the correlation between Pgp expression and steroid transport. For this research project H295R cells, a human adrenocortical cell line, were cultured. According to work published by others, these cells secrete aldosterone, cortisol, 11-beta-hydroxyandrostenedione and cortisone when stimulated with angiotensin II. In order to detect and quantify these compounds, standard solutions of these were made and extracted using Sep-pak cartridges, then identified and quantified using HPLC. Western blotting was also performed in order to verify the presence of Pgp in the H295R cells. To examine changes in expression of Pgp, RNA studies were also performed. Total RNA was isolated from H295R cells, and reverse transcription PCR (RT-PCR) was performed using the total RNA isolated and two sets of primers derived from MDR1 and human ß–actin gene sequences. The MDR1 mRNA transcript for Pgp, which is about 530 base pairs, was isolated from the H295R cells. The expressions of both genes were detected successfully in H295R cells. Optimization of all these preliminary experiments was important for future studies of the regulation and expression of the MDR1 gene that encodes for Pgp.
Pricing American Put Options Using the Binomial Model

Josh Brackett, Trina Hirsch, Thomas Hippchen and Dr. Anda Gadidov

Department of Mathematics

A put option gives the holder the right to sell stock at a later date for a specified price. An American put option allows the option to be exercised at any time up to the expiration date. The question that arises is how much should such an option cost? In this project we have written a program to compute the fair price for these options using the binomial method.
A Study of the Type I and Type II Error Rates of Tests for Species Diversity Based on Shannon's Index of Diversity

Kristina Corts and Dr. Lewis VanBrackle

Department of Mathematics

Ecologists routinely test equality of species diversity in two communities using a test statistic with an approximate t distribution based on Shannon's diversity index. However, the type I and type II error rates of this test are not well known. I performed simulation studies of this test under several population models (broken-stick, geometric and extreme) to examine its achieved alpha levels and power. I found the test to be very conservative for populations with one dominant species and to have rather poor power for detecting levels of differences in species diversity that are often of interest to ecologists.
A Knights Tour for all Rectangular Boards with Minimum Square Removal

Thomas Hippchen and Dr. Joe DeMaio

Department of Mathematics

A closed knight’s tour is a tour that, using legal moves of a knight, visits every square on the chess board exactly once and returns to its starting position. In 1991, Schwenk classified all rectangular chess boards that admit a knights tour. For a rectangular chessboard that does not contain a closed knight’s tour, this research determines the minimum number of squares that must be removed in order to admit a closed knight’s tour. Also, constructions that generate a closed tour once appropriate squares are removed are presented.
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