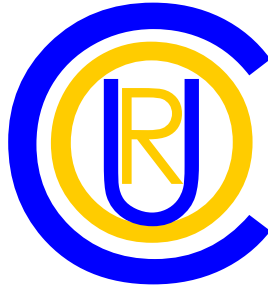


**WELCOME TO THE FOURTH ANNUAL
COUR SYMPOSIUM**

“We Center on Undergraduate Research”



**COLLEGE OFFICE OF UNDERGRADUATE
RESEARCH**

(COUR)

RESEARCH SYMPOSIUM

2009

ALLEN E. PAULSON

**COLLEGE OF SCIENCE &
TECHNOLOGY**



Message from the COUR Director Dr. David C. Rostal

Thank you for attending the 2009 College Office of Undergraduate Research (COUR) Research Symposium!

COUR is part of the Allen E. Paulson College of Science and Technology at Georgia Southern University. The mission of COUR is to support existing undergraduate research activities, to identify and foster new research opportunities for undergraduates, to showcase undergraduate research conducted within the college, and to enhance the quality of faculty-student collaboration. Through COUR, this successful collaboration is supported and developed further via competitive Allen E. Paulson Student Research Awards and an annual Research Symposium. COUR also sponsors Travel Awards each semester for COST majors who are presenting results of their research at a professional meeting or participating in a professional competition in their field of scholarly activity.

It has been my pleasure to take over the direction of COUR from Dr. Bruce Schulte. Dr. Schulte was the inaugural Director of COUR and was instrumental in bringing COUR to the high caliber it is today.

COUR continues to improve from the high level of support it receives from the Dean of COST, Dr. Bret Danilowicz, and Associate Deans, Dr. John Pascarella and Dr. Shahnava Navaee. Day to day running would not be possible without the assistance of Ms. Joanne Dannacher and Ms. Tina Brookins in the Dean's office. The COUR committee, past and present, has also contributed valuable time and energy. The COUR committee is represented by members from each of the seven departments in the college. It has been my pleasure to work with all these people during my first year as Director of COUR.

Our undergraduate researchers are one of the College's most valuable assets; they are some of the brightest and most motivated students we have and demonstrate our dedication to undergraduate research. To date, COUR has awarded over \$126,900.00 in research and travel awards to over 82 undergraduate students. In addition to our COUR Research Symposium, our students have presented their findings at professional meetings. Many of our students have received awards at these national meetings for their work. Many have also gone on to graduate programs and occupations related to their experience as undergraduate researchers.

Enjoy the symposium and keep up the great scholarship!



David C. Rostal, Ph.D.

Mission:

To further the Undergraduate Research Experience in Science & Technology at Georgia Southern University

Objectives:

- Support and enhance existing faculty-undergraduate research
- Facilitate the creation and support of new faculty-undergraduate research
 - Showcase faculty-undergraduate research

Bruce Schulte, Director, 2005-2008
David C. Rostal, Director, 2008-2011

COUR Committee Members	
Norman Schmidt	Chemistry
George Fu	CM&CE Technology
Jonathan Geisler	Geology and Geography
Lance McBrayer	Biology
Jiehua Zhu	Mathematical Sciences
Brian Vlcek	M&EE Technology
Sarah Higdon	Physics

The COUR committee is charged with furthering the mission of COUR. The COUR committee determines the recipients of the annual Paulson Scholarship Awards. The COUR committee gathers, organizes and disseminates information on undergraduate research experiences to the Georgia Southern community. Committee members serve as liaisons to their departments to further undergraduate research at Georgia Southern University

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2009 Paulson Student Research Award Symposium
April 8, 2009

Recipient	Project Title	Mentor
Wade Carruth	Relationship among egg size, pelvis size, and female size in the Gopher Tortoise, <i>Gopherus polyphemus</i>	David Rostal, Biology
Nicole Hutchinson	Population Genetics of the Threatened Gopher Tortoise in Southeast Georgia	Scott Harrison, Biology
Joseph Kelley	Effect of Fire on <i>Baptisia arachnifera</i> Germination Rates	Lissa Leege, Biology
Jeffery Lewis	Study the Effect of Number of Blades on the Aerodynamic Characteristics of <i>Savonius rotors</i>	Mosfequer Rahman, MEEET
Caitlin Madigan	Rational Design of Carbohydrate Replacements	Karen Welch, Chemistry
Jacob McBride	An Innovative Manufacturing Process and Mass Production	Aniruddha Mitra, MEEET
Ryan McDaniel	Implementation of Photoemission Measurement Capabilities to a High Vacuum Instrument	Gustavo Molina, MEEET
Nancy Montgomery	An Environmentally Friendly Oxidation of Cyclohexane to Adipic Acid	Shannon Davis, Chemistry
Ryan Mooney	Analysis of Beams Utilizing MATLAB and LabVIEW	Shahnam Navaee, MEEET
Kyle Morse	Improvement in Design, Performance and Fabrication of a Formula SAE Race Car	Mosfequer Rahman, MEEET
Samantha Peacock	SPME Analysis of Volatiles in a Bee Hive	Norman Schmidt, Chemistry
Mary Pittman	Bile Salt - Phospholipid Aggregation Studies Using a Headgroup Labeled Fluorophore	Laura Frost, Chemistry
Matt Smith	Determining the Influence of Testosterone Levels on the Foraging Behavior in a Non-territorial Lizard Species	Lance McBrayer, Biology
Kenneth Tabor	Defining Spiroplasma Evolutionary Relationships: rpoB Sequence Divergence	Laura Regassa, Biology
Christopher Thompson	Development Rates and Size Might Depend on Rearing Salinity and Nutritional State of Sea Urchin Larvae	Sophie George, Biology
Colin Westlake	Triaxial Test of Stabilized Savannah Soil using Crumb Rubber	Junan Shen, CMCEET

ABSTRACTS

Relationship among egg size, pelvis size, and female size in the Gopher Tortoise, *Gopherus polyphemus*

Wade Carruth, Jackie Entz, and David Rostal

Female size is directly related to reproductive output. A larger sized female has the ability to invest more energy into her offspring. Reproduction is viewed as a model; a female can either create fewer but larger offspring or more but smaller offspring. In many chelonian species egg size correlates with carapace length; however, in the gopher tortoise, *Gopherus polyphemus*, egg size does not strongly associate with carapace length. A higher correlation was found between egg size and pelvic size in *G. polyphemus*, but not enough to account for the variation seen in egg sizes. Similar to previous studies on various freshwater turtles, it is predicted that mass, clutch size and pelvic aperture will correlate with egg size.

Population and conservation genetics of two Georgia populations of the gopher tortoise (*Gopherus polyphemus*).

Nicole L. Hutchison, J. Scott Harrison, and David C. Rostal.

The gopher tortoise, *Gopherus polyphemus*, is a keystone species in sand hill, longleaf pine, and scrub ecosystems of the southeastern United States and is threatened throughout its range due to habitat loss and degradation. We studied two populations of *G. polyphemus* in close geographic proximity (112km) whose habitats differ as a result as a consequence of management practices. Fort Stewart Army Reservation (FSAR) is frequently burned where as George L. Smith State Park (GLS) is an infrequently burned habitat. Results of previous research have shown that female tortoises from FSAR are significantly larger and produced significantly larger eggs and hatchlings than female tortoises from GLS. In addition, surveys suggest that the FSAR site has a larger number of active burrows and a larger proportion of active to inactive burrows than the GLS site. The main objective of the study presented here is to characterize the genetic variation within and between the FSAR and GLS populations of *G. polyphemus*. Results show that the FSAR and GLS populations are genetically isolated. Estimates of genetic diversity (expected heterozygosity, gene diversity, etc.) were also generally higher within the FSAR population than the GLS population.

Effects of controlled burning on the population dynamics of the endangered legume, *Baptisia arachnifera*.

Joe Kelley and Lissa Leege

Hairy Rattleweed, *Baptisia arachnifera*, is a shrubby legume that is endemic to the southeastern coastal plain, an area that is historically prone to wildfires. The objectives of this study were to determine the effects of controlled burning on the germination rates, stage progression, and overall health of *Baptisia arachnifera* populations in timber-managed stands. Three 50x50m plots were selected on managed timber sites. Half of each of these plots was burned in late spring 2008 and the other half left as a control. Two censuses were conducted later in the summer to determine the effect of the burn of the *Baptisia arachnifera* species. There was no difference between burn and control sites in 1) the number of new individuals recruited, and 2) the proportion of individual plants that advanced to a larger stage, regressed to a smaller stage or stayed in the same life stage from pre-burn to the post-burn period in the control and burn sites. It was concluded that the burn did not have any immediate negative impact on *Baptisia arachnifera* populations.

Study the Effect of Number of Blades on the Aerodynamic Characteristics of Savonius Rotors

Jeffery Lewis and Mosfequr Rahman

Wind is the most popular among all other renewable energy sources because of its availability and pollution free characteristics. Wind is playing a leading role in the Green Energy revolution. The Savonius wind turbine is a vertical type wind turbine which has relatively low efficiency. However, this type of rotor is very popular due to its ease of construction, a good starting torque, and the ability to operate independent of wind direction at low wind speed. The purpose of this project was to setup a wind energy research facility at Georgia Southern University. The main goal of the proposed project was to experimentally investigate the effect of number of semi-cylindrical blades on the aerodynamic characteristics of Savonius wind turbine. The objectives of this project were: (i) design and physically develop Savonius rotor scale models with different numbers of blades, (ii) design and manufacture an inclined multi-manometer to measure pressures at different locations on the blades surface of rotor models, and (iii) testing the scale rotor models in the low speed wind tunnel set-up available at Georgia Tech, Savannah.

Because of the inconvenience to use the wind tunnel at Georgia Tech, Savannah a subsonic wind tunnel is designed and fabricated at Georgia Southern University under this project which is capable of generating wind speed up to 10 m/s. This wind tunnel will facilitate future wind research projects in Georgia Southern University. In order to get uniform wind flow two honey comb sections were placed in the wind tunnel, one before the internal test section and one after the fan in. Different types of Savonius rotors (i.e. two blade, three blade) and an inclined manometer were designed and fabricated. The rotor will be placed in front of the open circuit wind tunnel and pressure differences between the concave and the convex surface will be measured using the inclined manometer. Using the pressure differences the drag coefficient, torque coefficient, and power coefficient will be calculated. This will give a good insight into the aerodynamic characteristics of a Savonius rotor.

Rational Design and Study of Carbohydrate Mimetics

Caitlin Madigan and Karen Welch

Mammalian cell surfaces carry sugars of various types that enable cell-to-cell communication through their interaction or binding with a large and diverse group of proteins called lectins. Cell-surface carbohydrates have many far-reaching biological effects. Certain types of cancer, fetal development, and bacterial and viral infections all involve interaction between a lectin and a cell-surface carbohydrate molecule as part of the progression of biochemical events. Thus, the control of carbohydrate-mediated physiological processes is currently an active area of drug design.

Previous work in our laboratory on the design of carbohydrate-mimetic molecules has led us to consider polyphenolic compounds as replacements for carbohydrates. Currently, we have found several new molecules that inhibit the binding of the sugar mannose to concanavalin A. We have also synthesized a series of fluorescein-related dyes and evaluated their ability to prevent carbohydrate binding to concanavalin A. Our results support the promise of polyphenolic compounds as carbohydrate mimetics and give some insight on the structural features needed for binding to concanavalin A.

Fabrication of Polyurethane based Fabric Composite Shaft

Jacob A. McBride and Aniruddha Mitra

Poly urethane based composites are in use in various disciplines including thermal insulations, protective clothing, and medical and structural applications. It also has applications in race car industries. Due to its light weight and water resistant properties it has a potential to be used in water sports like water skiing. The most common form of fabrication of fabric composites of this nature is making sheets with a layer of fabric (pre-impregnated). In many cases equipment like autoclaves is necessary to manufacture these types of composites. Solid or hollow shafts made directly out of these composites are rare.

At Georgia Southern University, Poly urethane cored fabric coated composite shafts are being fabricated using a very low cost process. A high pressure injection molding process is used which utilizes high pressure air lines available in the laboratory. The entire process of creating composite shafts starting from the raw material is designed and optimized. This unique manufacturing technique creates the composite shafts with core matrix material completely wrapped around by the fiber cloths with very strong bonding. Three different types of fibers used for this purpose are: carbon fiber, Kevlar 49 and fiber glass. A manufacturing process is suggested and demonstrated where a mass production of this fabrication process can be accomplished with relatively low cost. In this entire fabrication process there is no direct use of electrical power and there is a very minimal loss of materials. As a follow up of this fabrication process, the shafts' mechanical properties are being tested.

Finally, a triple point bending test was carried out to test the mechanical properties of the shafts. In order to test the properties a triple point bending test apparatus was designed and fabricated in house. The apparatus was designed specifically to be used with these shafts. Once testing was carried out the results were analyzed and the mechanical properties could be observed.

Implementation of photoemission measurement capabilities to a high vacuum instrument

Ryan McDaniel and Gustavo Molina

The objectives of this research have been: (1) Complete set up and check the diagnostics of an ad-hoc high-vacuum instrument to measure triboemission, the electron and photon emission from sliding solid contacts. (i.e. check for vacuum leaks, lubricate vacuum pump bearings, etc.), (2) Design and put together a photon detector system to measure photon emission from sliding contacts for which electron emission has been previously detected (as alumina and silicon nitride when scratched by a diamond pin), (3) Install the photon detector system inside the chamber, and test it for different conditions that are known for emitting electrons, and (4) Acquire the data in a computer for materials' photon emission.

The following tasks have been completed or are being developed:

- Implemented vacuum pump systems, including a high vacuum turbo-pump and the design of an air cooling system for it.
- Installed and debugged a high-vacuum gauge to the system
- Fully tested the system for high vacuum, developed a protocol for its use, and optimized the sequence for high-vacuum build-up: the large-chamber system can reach a level of vacuum of 10^{-7} Torr, a research quality vacuum, in just two hours.
- Specified and purchased a state-of-the-art solid-state photon-counter, and installed and debugged data acquisition software.
- Designed experiment setup for calibrating photon detector outside of the vacuum chamber.
- Specified and purchased fiber optics and feedthroughs to pick up signal from vacuum chamber
- Designed setup to implement fiber optics inside vacuum chamber to detect photons from emitting surfaces.
- Designing experiment sequence to test differences of photon emission between conditions of vacuum vs. those of atmospheres (including dry nitrogen atmosphere)

Many unique studies can be carried out by adding the photon counting capabilities to the existing instrument. Simultaneous detection and characterization of photons and electrons can lead to understanding of surface modification by mechanical deformation and wear. This research and its results will help the understanding of surface processes that are connected to lubrication, dry sliding contact, wear, and catalysis.

Copper/Iron Encapsulated Zeolite Catalysts for Cyclohexane Oxidation

Nancy Montgomery and Shannon Davis

The focus of this project is to determine the efficacy of a series of copper/iron encapsulated zeolite catalysts with hydrogen peroxide for the single step production of adipic acid from cyclohexane. The production of adipic acid, an intermediate chemical used in the manufacturing of various goods such as nylon-6,6, food additives, plastics, and glass protection agents, involves the oxidation of cyclohexane in a two-step process which produces a large amount of intractable waste, toxic greenhouse gases, and few marketable byproducts. One way to reduce waste and obtain higher yields would be to produce adipic acid in a one-step oxidation of the commodity chemical cyclohexane. A new, extremely cost efficient method for producing hydrogen peroxide has recently been announced, making an improved study of peroxide-based oxidation chemistry worthwhile.

An Alternate Approach for Analysis of Beams

Ryan Mooney and Shahnam Navaee

In this research, Virtual Instruments (VIs) are developed for studying the behavior of beams subjected to various beam and loading conditions using classical approaches in Mechanics of Materials. Segments of the VIs developed for this project employ MATLAB to produce the numerical results. In several earlier publications of my mentor in the proceedings of the ASEE's conferences, various computing and programming tools and features of LabVIEW were discussed.

The LabVIEW programs developed in this project will specifically determine the distribution of shear force, bending moment, slope, and deflection along the length of the beam for several loading conditions. Using these distributions, maximum stresses and deflection of beams are also determined. An added component of the developed VIs additionally computes the "principal" normal and shearing stresses using the stress transformation equations to ensure that these stresses do not exceed the allowable stresses. In case of failure, a visual indicator placed on the front-panel of the created VIs will alert the designer.

One of the more important advantages of LabVIEW over other available software tools is its convenient and easy-to-use interface. Through utilizing this interface, the problem input can easily be modified to calculate and display the results in any desired form. The final developed VI for this project allows the user to select and add any combination of loads to compute the results for the specified problem. This program can be utilized as an educational tool to better understand the behavior of beams and aid the user in his or her design. Sample VIs developed for the poster presentation clearly illustrate how the tools and techniques developed for this project can be employed to determine the solution for more complicated problems. The proposed project can also be extended to analyze and test the beams experimentally in the laboratory. The available tools in LabVIEW are ideally suited to perform this experimental analysis.

Improvement In Design, Performance, And Fabrication Of A Formula Sae Racecar

Kyle Morse and Mosfequer Rahman

Formula SAE is a collegiate engineering competition where students design, fabricate, and race a scaled down open wheel formula-style race car. The goal of Eagle Motorsports for the 2009 FSAE competition is to significantly improve our car in the area of suspension and frame design. Using advanced software solutions, the development of the frame and suspension was done faster and more in depth than what was possible before. Aside from improved design technique, the challenge of having to reuse components from the previous car (EMS07) and use them more optimally tested the reverse engineering skills of the designers. The team will travel to Michigan International Speedway to compete alongside 119 other teams from around the world. The competition will be the ultimate evaluation of the EMS08R.

Fundamental Studies Collecting Volatiles in a Honey Bee Hive Using Solid Phase Microextraction with Analysis by Gas Chromatography Mass Spectrometry

Samantha N. Peacock, Koomi A. Orr and Norman E. Schmidt

The volatile chemicals in a honey bee hive were determined using solid phase microextraction (SPME) and gas chromatography-mass spectrometry (GCMS). Three kinds of SPME fibers were used in this study: carboxen/polydimethylsiloxane, polydimethylsiloxane and polydivinylbenzene. The SPME fibers were placed inside a copper wire cage to protect the fibers from damage in the bee hive for periods of time ranging from five minutes to 72 hours. Chemicals from the bees, from the plastic foundation, from the wax and from the surrounding forest environment were detected in the bee hive. Some of the bee chemicals identified include nonadecane, heneicosane, tricosane, tricosene, pentacosane and pentacosene. Chemicals from the plastic foundation include diethylphthalate, styrene, benzoic acid and dichlorobenzene. Chemicals from the wax include decanal, nonanal, octanal, and nonanoic acid. Chemicals found from the surrounding forest include pinene, sabinene, myrcene and eudesmol. Peak areas of chemicals were generally linear over the range of 24-72 hours. However, using shorter exposure times peaks were generally smaller and difficult to identify. Carboxen/polydimethylsiloxane was found superior to polydimethylsiloxane in collecting chemicals. Both of these fibers were superior to polydivinylbenzene for collecting bee hive volatiles. It is believed that the copper wire cage slows down the transport of chemicals from the bees to the SPME fiber.

Comparison of fluorescence signal during bile salt aggregation to a head group labeled vs. tail labeled phosphatidylethanolamine.

Mary Pittman and Laura Frost

Aggregation of the bile salt sodium cholate (NaC) was investigated using environment sensitive fluorescent phospholipids as a seed for aggregation. One of these was a head-group labeled phospholipid, 1,2-dipalmitoyl-*sn*-glycero-3-phosphoethanolamine-N-(7-nitro-2-1,3-benzoxadiazol-4-yl) (16:0 NBD-PE), the other a tail labeled phospholipid, 1-palmitoyl-2-[6-[(7-nitro-2-1,3-benzoxadiazol-4-yl)amino]hexanoyl-*sn*-glycero-3-PE (NBD-C6-HPE). The resulting difference in the fluorescence trace for bile salt aggregation using the two phospholipids (NBD-PE vs. NBD-C6-HPE) is likely due to the position of the fluorophore (head vs. tail) not different aggregation behavior of the bile salt. Experiments for each phospholipid were performed below the critical micelle concentration of the phospholipid to ensure monomeric seeding. Variations in the results are discussed.

Foraging rates in a non-territorial lizard species (*Aspidoscelis sexlineata*): determining the effectiveness of mesocosms for experimental research

Matthew E. Smith and Lance D. McBrayer

The behavior of animals is a constantly changing field, and with these changes comes new innovations in data sampling and quantification. One such innovation is using a mesocosm for studying smaller animals, such as lizards, in a controlled, semi-wild environment. A mesocosm is simply a rectangular barrier that prevents the animal from escaping, while allowing the researcher to control and manipulate key ecological parameters (e.g. vegetation density). Mesocosms are an excellent tool for studying behavioral patterns in species that occupy varying habitats or ecological conditions in nature. Due to their small size and low energetic requirements, lizards have frequently been used in studies involving mesocosms. The objective of my research was to determine if foraging rates and patterns (tongue-flicking, percent time moving, etc.) differed between lizards living in mesocosms and lizards living in the wild. Also, I investigated foraging patterns of a lizard species that occupies a variety of habitat types. The six-lined racerunner, *Aspidoscelis sexlineatus*, lives in long-leaf pine (LLP) and scrub ecosystems, and can easily be maintained in mesocosms. I hypothesized that there is no difference in foraging patterns between LLP and scrub habitats and no difference in behavior between these natural habitats and foraging patterns of lizards in large mesocosms. If these hypotheses are supported, then these results would verify that mesocosms were efficient for behavioral studies of on movement and foraging in this species.

Movement and foraging data were collected in the Ocala National Forest during the summer of 2008. Digital video recorders were used to film the movements of male *A. sexlineatus* while foraging in LLP, scrub, and mesocosms. Filming of movement patterns allows for careful quantification of movement rates, distances, and foraging behaviors, and allows the researcher to repeatedly view events that might be missed by sight alone. The vegetation within the rectangular mesocosms was manipulated to mimic typical scrub and LLP habitats (~ 30% cover).

If there is no difference detected between the mesocosms and the natural habitat, it could prove to be of significant importance for future research on lizard behavior, particularly with respect to foraging and mating systems. Mesocosms would greatly enhance data collection and replication if the organisms could be maintained in such a relatively stable and controlled setting. With mesocosms, the behavioral possibilities, such as studying foraging decisions and locomotion, are expansive and have many future applications for scientific value and understanding of lizard systems.

Biochemical and Phylogenetic Evaluation of Novel Spiroplasma Species.

Kenneth Tabor, Abram Townsend, Haritha Jandhyam and Laura B. Regassa

Spiroplasmas are helical, motile bacteria found in association with plants, insects and crustaceans. In most cases, the host/microbe interaction is not harmful but there are several cases of documented disease resulting from infection (e.g. corn stunt, citrus stubborn). The abundance of *Spiroplasma* and their agricultural impact make the biodiversity and biogeography of this species important. In this study, biochemical and evolutionary relationships were examined for 34 representative isolates collected from tabanid flies in the United States, Ecuador, Costa Rica, and Australia. Specifically, a urease test was conducted and the suitability of the *ftsY* gene for evolutionary inferences was investigated. Spiroplasmas are not known to degrade urea, but this is an important biochemical test to differentiate spiroplasma from ureaplasma; and a requirement for new species designations. The spiroplasma strains tested were negative for urease activity. Evolutionary studies of the novel isolates based on 16S rDNA sequence alone did not provide robust tree resolution, so the *ftsY* protein-encoding gene was investigated as a tool for phylogenetic analyses. Genomic DNA was isolated from representative strains for *ftsY* gene amplification and several oligonucleotide primer pairs were designed. In all trials, amplification was unsuccessful. Future work will focus on optimizing amplification conditions for the *ftsY* gene and/or investigating other possible DNA sequences for phylogenetic analyses. The results from this study will be combined with a larger, on-going effort to characterize geographically diverse, novel *Spiroplasma* species.

Combined Effects of Diet and Salinity on Growth and Survival of *Lytechinus variegatus* larvae.

Christopher M. Thompson and Sophie B George

The present study investigated the effect of three mixed algal diets (*Isochrysis galbana* and *Dunaliella tertiolecta*, *Rhodomonas* sp. and *D. tertiolecta*, *D. tertiolecta* and *Chaetoceros gracilis*) and two salinities (32‰, 22‰) on growth and development of sea urchin larvae. Adult sea urchins that had been maintained in the laboratory for over a year were spawned, and embryos distributed into 12 jars. Six jars were filled with 2000ml fresh filtered sea water (FSW) at 32‰ and the remaining 6 were filled with 2000ml FSW at 22‰. For each salinity, larvae in 3 jars were fed *I. galbana* and *D. tertiolecta*, and larvae in the other 3 were fed *Rhodomonas* and *D. tertiolecta*. When *Rhodomonas* was in low supply *Chaetoceros gracilis* was used. Every 2-3 days, larval length and rudiment size, when present, was measured and every 5-6 days, larval survival was determined. A separate experiment was carried out to monitor algal survival at 22 and 32‰. Sea urchin larvae at 32‰ grew to significantly bigger sizes than those at 22‰ regardless of diet. Larvae fed *D. tertiolecta* and *I. galbana* and *D. tertiolecta* and *Rhodomonas* did not differ significantly in size 9 and 27 days after fertilization. When the diet was switched from *D. tertiolecta* and *Rhodomonas* to *D. tertiolecta* and *C. gracilis*, larvae fed the latter diet were significantly bigger than those fed *D. tertiolecta* and *I. galbana*. The highest survival was observed for larvae at 32‰ fed *D. tertiolecta* and *Rhodomonas* (100%), and the lowest for larvae at 32‰ fed *D. tertiolecta* and *I. galbana* (45%). Algal cell mortality was lower for the intermediate and large algae regardless of salinity and should be considered when deciding on single or mixed algal diets. In conclusion, salinity had a greater effect on larval growth and survival but less of an effect on the various algae used.

Properties of Soil Stabilized With Crumb Rubber.

Colin Westlake and Juana Shen

The research was conducted to determine the changes of crumb rubber-stabilized soft soils in engineering and physical properties, primarily the compressive strength. The project was also intended to determine the feasibility of using crumb rubber as an alternative soil stabilizer for substandard soils in coastal areas. The soil used for sampling was extracted from the field and compared to samples that had been treated with the crumb rubber, and samples treated with the widely used stabilization material lime. Compared to the untreated soil, properties of the lime added soil resulted in increased strength, resulting in lower CBR and higher unconfined strength. Lime added soil also resulted in increased liquid limit with more optimal moisture content and decreased permeability. The addition of crumb rubber resulted in a decrease of unconfined strength, greater CBR, rise in the plastic limit of the soil, and an increase in permeability.