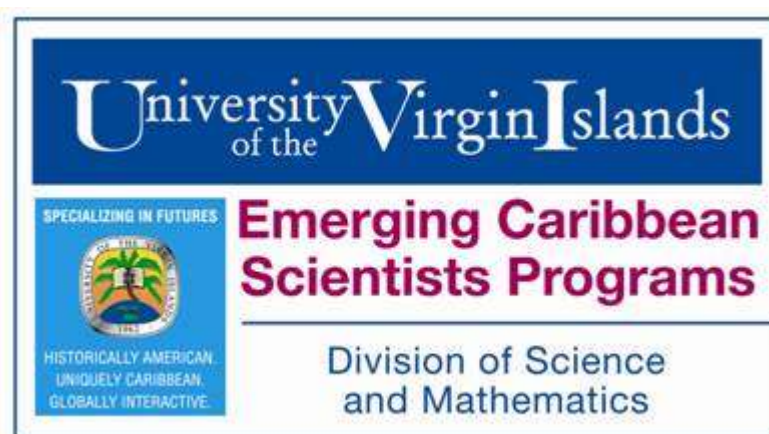


University of the Virgin Islands

9th UVI Undergraduate  
Research Symposium



***Abstracts booklet***  
September 23, 2007

# 9<sup>th</sup> UVI Undergraduate Research Symposium

St. Thomas, U.S.V.I.

Sept. 23, 2007

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## **A Sequence Mining Approach for Predicting Normal and Abnormal Environmental Induced Coral Reefs Health and Stress**

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This preliminary work explores the usage of sequence mining techniques to derive normal or abnormal environmental conditions prior, during and after coral reef bleaching. Sequences of events are derived to identify frequent and infrequent environmental patterns. These patterns are then used to determine which environmental conditions are more likely to induce coral bleaching, or be most favourable to coral reef recovery. After presenting the sequence mining algorithm, examples of event sequences are analyzed. The viability of this approach is finally discussed on NOAA CREWS data sets.

This work is partially funded by VI-EPSCoR National Science Foundation award #0346483 and the NSF CSEM program. Any opinions, findings, conclusions, or recommendations expressed in the material are those of the author and do not necessarily reflect the views of the National Science Foundation.

## Use of Thermal Imaging to Predict Parturition in Hair Sheep

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St. Croix, VI

Digital infrared thermal imaging (DITI) is a modern technique which is used to measure infrared radiation as an indicator of the temperature of an object (animate or inanimate). Images are displayed in color with a scale related to temperature.

This project was conducted to determine if thermal imaging could be used to detect temperature changes of the vulva of pregnant ewes around the time of parturition.

Twenty-eight St. Croix White hair sheep ewes were used. Thermal images were taken of the vulva and udder every other day beginning 7 days prior to expected lambing (day 0) and continued though 5 days post lambing using a FLIR ThermaCAM EX320 digital infrared camera. The rectal temperature was measured at the time of imaging using a digital veterinary thermometer. Expected lambing date was based on mating dates obtained during the previous breeding season. Images were taken with the camera at a distance of approximately 30-40 cm. The images were then transferred to a computer and analyzed using the ThermaCAM Resercaher Pro 2.7 software. Minimum (MIN), average (MEAN) and maximum (MAX) temperatures were obtained for each image. Data were analyzed using GLM procedures of SAS using the days' pre and post partum as independent variables for udder, vulva and rectal temperature.

Results showed that digital thermal imaging can be used to measure temperature changes in the vulva and udder of sheep. From the values obtained the minimum temperature changed more than average or maximum temperature. The rectal temperature of the ewes showed no significant change around the time of lambing. Monitoring temperature changes (vulva, udder, rectal) may not be a good indicator for predicting parturition

Funded by USDA-CSREES grant 2006-38416-17727



## **Preliminary Study of the Effects of Duckweed on Tilapia Growth and Accumulation of Dissolved Inorganic Nutrients in a Closed Recirculating System**

**Kavita Balkaran**, R. Charlie Shultz, James Rakocy and Jason Danaher  
University of the Virgin Islands, U.S.V.I

Aquaponics is the culture of fish and hydroponic vegetables in a closed recirculating system. Nutrients in the aquaculture effluent are used for plant growth. This technology could be applied in developing countries. However, commercial fish feed is very expensive, and an alternative source of feed is needed. Duckweed (*Lemna* sp.), could be used as an inexpensive natural feed substitute.

A study was conducted at the University of the Virgin Island Agricultural Experimental Station to raise Nile tilapia (*Oreochromis niloticus*) on a diet of duckweed. The hypotheses for this research were that tilapia will increase in weight when fed duckweed, and nutrients in the culture water will increase over time. A positive result would prove that a duckweed diet can be used for the hydroponic production of vegetables and other plants.

A small recirculating system was established. It consisted of a 1-m<sup>3</sup> fish rearing tank, a 0.2-m<sup>3</sup> solids filter, and a 0.2-m<sup>3</sup> biofilter. The rearing tank and biofilter were aerated using air stones. A small submersible water pump continually circulated water from the rearing tank through the solids filter and biofilter and then back to the rearing tank. The rearing tank was stocked with 100 male tilapia fingerlings (90 g average weight) and cultured for 28 days.

The fish were fed duckweed *ad libitum* three times daily at 9:00 a.m., 12:30 p.m., and 4:30 p.m. The duckweed was freshly collected and weighed. The pH was measured daily and maintained at 7.0-7.5 by adding sodium bicarbonate. Other water quality parameters of importance were measured.

Water quality remained optimum with dissolved oxygen, total ammonia-nitrogen and nitrite-nitrogen averaging 7.17, 0.53, and 0.00 mg/liter respectively.

Results showed that duckweed did not provide the minimal requirements for sustained tilapia growths: average fish weight decreased from 90 to 83.6 g. The first hypothesis was unsupported. However, duckweed did provide a source of dissolved inorganic nutrients for hydroponic plant production. Electrical Conductivity (EC), nitrate levels and phosphate levels increased: 0.05 to 0.68  $\mu$ S/cm, 0.00 to 52.3 mg/L and 0.33 to 19.41 mg/L, respectively. The second hypothesis was supported.

The high moisture content of the duckweed (95%) could have caused poor fish growth. Although duckweed contains high protein levels, the fish were not able to obtain sufficient amounts of dry matter. For future experiments the duckweed will be partially dried to 50% moisture content before it is fed to the tilapia. Also in future research the aquaculture effluent will be used to determine its effectiveness for growing vegetables hydroponically.

**Funding by NIH MBRS-RISE Grant # GM061325**

## When does the Sigma Function Preserve Addition

Everard Bellot and Douglas Iannucci  
University of the Virgin Islands.

Sigma is an arithmetic function whose domain and range is the set of natural numbers  $N$ , and is represented by the Greek letter  $\sigma$ . Let  $m$  and  $n$  be natural numbers; then  $\sigma(m)$  and  $\sigma(n)$  denote the sum of the positive divisors of the natural numbers  $m$  and  $n$  respectively. It is known that  $\sigma(mn) = \sigma(m)\sigma(n)$  as long as  $m$  and  $n$  are relatively prime, i.e. they have no common divisor besides one. In this study we endeavor to find properties which  $m$  and  $n$  must have for which  $\sigma(m + n) = \sigma(m) + \sigma(n)$ . We decided to look at  $m$  and  $n$  each as a multiple of two numbers, where one of the numbers is prime and the pair is relatively prime. We let  $m = ap$ ,  $n = bq$  and  $m + n = cr$ . Because we know sigma is multiplicative, we are able to take the product of the sigmas to obtain the sigma of the product (i.e. for example  $\sigma(m) = \sigma(a)\sigma(p)$ ). After manipulating the two equations  $ap + bq = cr$  and the equation obtained from taking the sigma of the numbers, various assumptions are made. From the assumptions, we found that it is demanded that  $\sigma(a)/a < \sigma(b)/b$ . After making these assumptions, we arrived at two relatively complex congruencies. We are yet to solve the properties that  $m$  and  $n$  must have for which  $\sigma(m + n) = \sigma(m) + \sigma(n)$ , however we have made several assumptions that have made our search for these properties much easier.

## Identifying Relationships between Scleractinian Coral Families Using the Nuclear 18S ribosomal RNA gene

C. Boateng, J. Stake, and S. Romano

Division of Science and Mathematics, University of the Virgin Islands, #2 John Brewers Bay, St. Thomas, V.I. 00802

Coral reefs are underwater gardens found in clear, warm tropical seas. Coral polyps are small animals that are responsible for a coral reef's calcium carbonate framework. Coral reefs are very important because they provide shelter and food to many marine organisms and protect our shorelines from erosion. Coral reefs are also important to the economy in the U.S. Virgin Islands because their beautiful appearance attracts many tourists to the islands. The health of coral reefs is drastically declining because of coral diseases, coral bleaching and human activity. A third of the world's coral reefs have already disappeared and many more remain threatened. For coral conservation we need to be able to distinguish between scleractinian coral families. Results from molecular and morphological data support different hypotheses about the relationships within the Scleractinia. Molecular phylogenetic analyses divide the order into two large subgroups. In contrast, morphological analyses divide the scleractinian corals into seven suborders. However, molecular analyses are unable to resolve the relationships within each of these subgroups. Our analysis will use the nuclear 18S gene which is the small subunit of ribosomal RNA (rRNA). Partial sequences from the 18S gene have been used in previous studies. We hypothesize that phylogenetic analysis of complete nuclear 18S rRNA gene sequences will be able to determine relationships within the two subgroups of scleractinian coral families. To date, we have obtained sequences from eight species of scleractinian corals representing six of 24 scleractinian families: *Porites porites*, *Montastrea annularis*, *Stephanocoenia* sp., *Favia fragum*, *Madracis mirabilis*, *Agaricia agaricites*, *Siderastrea* s.p and *Meandrina meandrites*. Whole genomic DNA was extracted using a CTAB protocol and the 18S gene region was amplified by the polymerase chain reaction (PCR) using previously published primers. Genomic DNA and PCR products were visualized by gel electrophoresis, and DNA sequencing was performed using an automatic sequencer. The complete 18S gene consists of an approximately 1600 bp region. A blast search demonstrated that 18S partial sequences match those in GenBank from other scleractinians. Initial analyses of partial 18S sequences support the hypothesis that the order is divided into two large subgroups, but do not differentiate relationships within the subgroups. Further analyses based on complete 18S sequences from at least 25 taxa species representing currently recognized scleractinian coral families will be used to determine relationships within the two subgroups of scleractinian coral families.

This work is supported by NIH MBRS- RISE grant # GM061325 and NSF EPSCoR grant 0346483 to UVI as well as NSF grant EF-0531735 to SLR.

## **Reproducible Colloidal Gold Systems**

Jeremiah Browne<sup>1</sup>, Paul Carpinone<sup>2</sup> and Kevin Powers<sup>2</sup>

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<sup>2</sup> Particle Engineering Center, University of Florida

The goal of my colloidal gold research was to study how various parameters affected the reproducibility of the colloid. I was then to determine an effective system for the large scale production of the gold colloids, with an aim of 40nanometers in diameter for all of the gold. Generally, production of a colloid is achieved by mixing a metal salt with a reducing agent to produce a metallic particle. There are several reducing agents available, but we narrowed them down to two for our tests. To make the colloidal gold a container (such as a beaker or a flask) containing a weak gold solution was first placed to boil while stirring. After this sodium citrate was added to the solution (various volumes were attempted until the amount that produced the most favorable results was found, generally a molar ratio of 1.25:1). We were able to continuously reproduce our goal by adjusting the speed and timing of the stirring of the solution.

## **Particle-Process Analytical Technology (P-PAT)**

**Javan Cooper<sup>1</sup>**, Li Jie<sup>2</sup>, Kevin Powers<sup>2</sup> and Gary Scheiffele<sup>2</sup>

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The goals of this study are to identify and evaluate on-line analytical tools, develop process control strategies based on the feedback gathered and identify gaps in existing quality assurance techniques. The FDA is mainly concerned about the development of particle characterization methods for in-process materials. Our approach for this project will be to develop a synthesis loop, which will gather feedback data that will be used to develop new process control strategies. The proposed outcomes of this study are increased production efficiency and improved product quality.

The Stober Synthesis method produces the particles that will be studied in this project. In this synthesis method, ethanol, deionized water and ammonia hydroxide (catalyst) reacts to form a basic cosolvent system. Once formed, tetraethoxy silane (TEOS) is added to the solution. TEOS hydrolyzes and supersaturates the solution with silicic acid, which nucleates and grows into spherical, relatively monodisperse silica particles. In an effort to semi-automate the production of these particles inside the synthesis loop, the pump rate of an air-driven pump was tested. Unfortunately, the tests proved that the pump rate was very unstable. As a result, the implementation of a more reliable pump is being considered for this project.

**This research project is being funded by the Particle Engineering Research Center (PERC) and its industry partners.**

## **Pak 1 expression in Cardiomyocytes**

**Tryphena Cuffy**<sup>1</sup>, Dr. Rui-Ping Xiao<sup>2</sup>, MD PhD, Dr. Nicole Glaser<sup>2</sup> PhD

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Pak1, the best characterized member of the p21-activated kinase (Pak) family, is an important downstream effector of the small GTPases, cdc42 and Rac1. Pak1 plays a crucial role in various vital cellular activities, including cell motility, cell survival and proliferation. However, it remains elusive as to Pak1's activation under certain pathological and physiological conditions and the role it plays in cardiac cell survival. Here we demonstrate that Pak 1 is activated under classic physiological beta-adrenergic stimulation and that active Pak 1 protects cardiomyocytes against cell death. This is supported by the evidence that beta-adrenergic stimulation by isoproterenol (ISO) leads to a significant increase in Pak 1 phosphorylation (active form) in a time- and dose-dependent manner. We also observed that an enhanced Pak 1 mutant, protects cardiomyocytes against death-inducing-stimuli mediated death by over 40 percent. Additionally, in myocardium infarction (MI) induced cell death; Pak 1 activity was induced after 4 hrs of MI treatment when compared to sham groups. We also did genotyping of four separate conditional and inducible Pak 1 overexpressing transgenic mice models were done in order to better define Pak 1's role in cardiac remodeling. Altogether, these results provide compelling evidence for the importance of Pak 1 activation in the heart and our understanding of the benefits of Pak 1 as a possible therapeutic agent in cardiomyocyte death.

This research is supported by MARC 2 T34 GM008422 and NIH

## **Experimental tree seed germination for *Guazuma ulmifolia***

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*Guazuma Ulmifolia* is both native and widely distributed in the western tropical world. On St. Croix, the population is restricted to only a few locations and seedlings are not observed to occur. We collected guazuma seeds from multiple trees on St. Croix in order to test various pre-germination methods on the seeds. We also developed a baseline data on the fruit and seed weight and time for germination. Preliminary results showed rates for all four treatments were below published averages; Water soak (0.667%) Control (1.33%) Gibberellic acid (5.33%) and Water boil (0.00%). The fruit are known to be palatable to livestock and wildlife, suggesting that consumption may provide a potential benefit to germination. We tested a scarification method by feeding the fruit to sheep in enclosed pens for four days. We collected the sheep feces daily and planted it germination trays. Time to germination decreased to 12.5 days for this treatment, but the germination rate remained low. We conclude there may be viability problems with seeds produced on St. Croix. Future research on *G. ulmifolia* should include germination experiments in multiple years and seed dissection to identify whether embryos are present.

## **A New Bifunctional Dendrimer**

Geoffrey Bosire Jr., Nikita Thompson and Ferlicia Fergusson

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What if it was possible for human beings to breathe like the many fishes that surround us? To many this may seem impossible, but to others this is a reality. Today, there is a machine that is capable of extracting the O<sub>2</sub> molecules from sea water. However, this process is limiting by the slowest of two processes: redox and O<sub>2</sub> binding. In order to extract O<sub>2</sub> at a sufficient rate, a transporter was designed to be able to reversibly bind to molecular O<sub>2</sub> and have redox properties. The two functional centers used to build this transporter were ferrocene carboxylic acid (redox agent) and protoporphyrin IX (O<sub>2</sub> binding agent) added onto a 32 – NH<sub>2</sub> dendrimer framework. Coupling of these centers to make the amide linkages was aided with TBTU. The formation of the new bond was observed using infrared spectroscopy, focusing on the 1700 cm<sup>-1</sup> region. By adding these compounds to the dendrimer, we were successful to make a potential transporter for the O<sub>2</sub> extraction from sea water.



## **Effects of muscarinic agonists on central control of rhythmic bursting of a small, peripheral motor circuit in the spiny lobster, *Panulirus argus***

Maisha Frederick and Richard Hall, University of the Virgin Islands, St. Thomas, VI 00802.

The pyloric central pattern generator (CPG) is a small motor circuit in the stomatogastric nervous system (STNS) of lobsters. The pyloric CPG produces rhythmic bursts of action potentials that control the activity of muscles involved in food sorting in the foregut. Extracellular recordings of the pyloric CPG allow easy identification of five motor neuron types: two pyloric dilators (PD), one ventricular dilator (VD), a lateral pyloric (LP), an infracardiac (IC), and eight pyloric constrictors (PY). While pyloric bursting stimulates muscle activity, all chemical synapses between pyloric neurons are inhibitory. Consequently phasing of bursting activity is maintained in large measure by graded synaptic transmission and electric synapses, neither of which can be recorded extracellularly. We hypothesize that as cycle frequencies increase, phasing of cell bursting should advance so as to insure coordinated motor activity within shorter burst intervals. To test this hypothesis we superfused central neurons known to stimulate pyloric frequency with a cholinergic mimetic, oxotremorine and measured phasing of two pyloric cells, the LP and VD which have reciprocal, inhibitory synapses.

Phasing was reported as averaged fractions of a normalized cycle, thus LP tends to begin bursting half way through a typical cycle and has a mean phase of 0.5 while late bursting VD has a mean phase of about 0.85. All phasing is reported as mean  $\pm$  1 standard deviation for between 60 and 400 cycles. Superfusion with  $10^{-2}$ M oxotremorine typically increased cycle frequencies by 50% from approximately 1 to 1.5 Hz. Under these conditions, VD phase advanced by only 9.8% (from  $0.895 \pm 0.042$  at 1 Hz to  $0.807 \pm 0.031$  at 1.5 Hz,  $P < 0.001$ .) In contrast, LP phasing retreated from  $0.427 \pm 0.035$  Hz to  $0.489 \pm 0.048$  Hz. Thus LP moved back in the pyloric cycle by -14.3%,  $P < 0.001$ . When the pyloric cycle was allowed to slow from 1.4 to 1.3 Hz, phasing of VD remained unchanged ( $0.837 \pm 0.035$  versus  $0.831 \pm 0.084$ ,  $P = 0.218$ , n.s.) but LP phase advanced by 3% (from  $0.509 \pm 0.008$  to  $0.493 \pm 0.042$ ,  $P < 0.001$ .) Thus, phase advance by VD is associated with increasing cycle frequency while phase advance by LP is associated with slowing of the pyloric frequency. Therefore we must revise our hypothesis to account for relative changes in pyloric phasing.

## **The Effect of Monetary Rewards and Punishments on Stimulus-Response Learning**

Afiya Fredericks<sup>1</sup> and Karin Cox<sup>2</sup>

<sup>1</sup>University of the Virgin Islands

<sup>2</sup>University of Pittsburgh

The caudate nucleus is located within the basal ganglia in the brain. We know the caudate (whose activity appears to be modulated by both valence and magnitude of monetary outcomes) is involved in learning stimulus-response relationships. This project stemmed from questions concerning monetary rewards and punishments and their effect on learning. Ultimately, we wanted to see if different kinds of monetary outcomes influenced how well people learned. The stimulus-response program was created where subjects had to learn which response was correct based on the stimuli that were presented. This program was comprised of round 1, round 2 and round 3 sequences which were repeated three times for each of the three sets. Each set presented 24 different stimuli (flags) to the subject. Round 1 was where the subject received feedback. This feedback included whether or not the response was correct or incorrect and simultaneously, small or large monetary rewards and punishments. Both Rounds 2 and 3 were different from Round 1 in that no feedback was solicited. Learning was measured based on the findings that report both the valence and magnitude effects of subject's performance on round 2, in terms of the kind of outcome they received on round 1. We found that reward feedback was associated with better learning and that lower-valued rewards and punishments were also linked to an increase in learning.

## **Crustacean Symbionts of *Bartholomea annulata* Display Varying Levels of Host Loyalty**

Sara Gennusa  
University of the Virgin Islands, St. Thomas, U.S.V.I

The Corkscrew Anemone (*B. annulata*) is commonly found in shallow tropical waters throughout the Caribbean, and often hosts a number of symbiotic crustaceans who benefit from their association. Because two of these associates are known cleaners (*Periclimenes pedersoni* and *Periclimenes yucatanicus*), these anemones may be important to the larger ecosystem as a whole, and understanding the relationships between associate and host may assist in conservation efforts for the future. This study sought to determine how loyal four crustacean species were to individual host anemones. These four associates (*Stenorhynchus seticornis*, *Alpheus* sp., *P. pedersoni*, and *P. yucatanicus*) are commonly encountered and easily identified in the field. Previous research as well as field and lab studies were used to gather information from these associates, and results indicate that *Alpheus* sp. and *P. yucatanicus* exhibited the highest levels of loyalty in the lab, while both *Periclimenes* sp. and *Alpheus* sp. were also loyal in the field. *S. seticornis* appears to be more opportunistic than the other species and exhibited no loyalty either in the lab or in the field. Future research will include long-term frequent monitoring of tagged field anemones, as well as better controlled lab experiments with more replication. Studies accounting for competition, predation, and cleaning behavior/ client availability can also be conducted to paint a more accurate picture of the dynamics of the associate relationship.

## **Conservation of Genetic Variation in *Zanthoxylum Thomasianum***

Sayvi George, Duvane Hodge and Alice Stanford, mentor

University of the Virgin Islands  
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One of our local flora, *Zanthoxylum thomasianum*, has become endangered due to deforestation and habitat destruction for the building of roads and other properties. In order to properly design a conservation project for this species, we will be continuing research started by Charnise Goodings and Prof. Stanford by studying a conjugate species, *Zanthoxylum monophyllumi* for comparative purposes. Leaf samples of this plant were collected from St. Thomas and St. John and subjected to various techniques in order to develop population genetics information on the species. DNA was extracted using CTAB procedures, then quantified and amplified through a series of different experiments. Of the numerous extractions that we performed, few produced pure DNA. There was no significant difference in the primers that were used but all primers appeared to work better at higher temperatures. For future studies a different extraction procedure may need to be used or different procedures for cleaning the samples should be considered. We may also need to use different annealing temperatures and primers, taking into consideration that different primers work better with different temperatures.

## **<sup>57</sup>Fe Exchange in Hemoglobins Starting with <sup>57</sup>Fe<sub>2</sub>O<sub>3</sub> by Heme Exchange**

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Hemoglobin is a compound made of iron and protein. When oxygen enters the blood stream the oxygen attaches to the iron ion of hemoglobin and it is then transported to the tissue. With hemoglobin S, when the oxygen is released the red blood cells then become distorted into a “sickle”, a crescent shape. This then makes it difficult for the red blood cell to pass through the blood stream. Nitric oxide (NO) plays a role in treating vascular ailments and resembles O<sub>2</sub> in structure. Is it possible for the Fe in the hemoglobin to pick up the NO molecule like it picks up the O<sub>2</sub>? **Mossbauer spectroscopy can observe an interaction between NO and the Fe ion in hemoglobin via, but the iron must be enriched in <sup>57</sup>Fe.** Iron oxide was dissolved in 6 M HCL and then reduced from Fe (III) to Fe (II) with several reducing agents. Protoporphyrin IX was added to the Fe (II) solution, producing a heme. UV-Visible spectrometry was used to analyze the absorbance data for these solutions, at different wavelengths. Commercial hemoglobin was purified using a tris buffer with a pH of 8.0 and exclusion chromatography. Hemoglobin was unfolded and its heme removed using dialysis and high concentrations of urea. Again spectrometer was used to find out if heme was released into urea solution from the hemoglobin. The newly synthesized heme was then inserted into the hemoglobin and the protein refolded by lowering the urea concentration.

## Separation of Lanthanide Ions with Kläui Ligands

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Separation and pre-concentration of the desired analyte is often a critical step in many radioanalytical methods. Current procedures for separating and concentrating analytes for detection are complex, and can be both expensive and time consuming. Therefore, the purpose of this research is to develop an alternative method of separating lanthanide ions through the use of an extraction chromatography resin containing a Kläui ligand salt. This research is a continuation of a concerted effort to develop new methods of detecting small concentrations of radionuclides and lanthanides using Kläui ligands. The Kläui ligands,  $C_5Me_5Co(OP(OR)_2)_3^-$  (R=Me, Et, n-Pr) ( $L_{OR}^-$ ), have unique affinity for lanthanide and actinide ions in the presence of competing metal ions. The use of 1 wt%  $NaL_{OR}$  (R=Et or n-Pr) adsorbed onto resin support has been shown to extract lanthanide ions from aqueous nitric acid solutions of different concentrations. In order to further evaluate the utility of these materials in radiochemical separation, the selectivity of the resins for the different lanthanide ions was examined by measuring the distribution coefficients ( $K_d$ ) for a series of lanthanides over a range of solution conditions. Based on prior research with actinide ions, it was hypothesized that the lanthanide ions would bond strongly with the Kläui ligands. The success of this research is important, because it will assist in expanding and improving current automated radiochemical methods, which will decrease the cost of developing and implementing radiochemical methods. To date,  $K_d$  values have been determined for  $Eu^{+3}$ ,  $Nd^{+3}$  and  $Pr^{+3}$  under varying nitric acid ( $HNO_3$ ) concentration, using a resin consisting of 1.0 wt%  $NaL_{OPr}$  on Amberlite XAD-7HP. The dependence of the  $K_d$  values for  $Eu^{+3}$  has also been examined as a function of the ligand-to-europium ratio and the nitrate concentration. Decreasing  $K_d$  values were obtained upon increasing the nitric acid concentration, indicating protonation of the ligand, which competes with binding of the lanthanide ions. As expected, increasing the Kläui ligand-to-europium ratio results in increasing  $K_d$ , but no conclusions could be made from these data regarding stoichiometry of the complex formed on the resin. No dependence of the  $K_d$  on the nitrate concentration was observed, supporting the notion that the  $HNO_3$  dependence is dominated by the presence of the acidic hydronium ion (as opposed to the nitrate ion). Future work will involve the determination of the  $K_d$  values for the remainder of the lanthanide series to further assess the potential of the Kläui ligand for intra-group lanthanide separations.

## **Changes in Mound Size of the Lugworm *Arenicola cristata* Over Time in the United States Virgin Islands**

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The lugworm, *Arenicola cristata*, builds dense assemblages of sandy mounds covering thousands of square meters in Brewer's Bay, St. Thomas, United States Virgin Islands. These mounds have the potential to bury other organisms, particularly sessile, benthic invertebrates such as sea anemones, corals and sponges. This study investigated the dynamics of mound building by lugworms near an area that is part of a long term study of the sea anemone, *Bartholomea annulata* (corkscrew anemone). We believe that lugworm mounds are responsible for the disappearance of some sea anemones. A field study was conducted on SCUBA in approximately 6 m of water. We performed six 20 m x 4 m transects around the reef to count the number of lugworm mounds in relation to distance from the reef. We also constructed three quadrats off the reef, each 16m<sup>2</sup>, and measured the area and volume of each mound within the quadrats every 2-3 days. From the 6 transects, we determined the density of lugworm mounds to be about 0.5/m<sup>2</sup>. From the 3 quadrats, we found that very few mounds less than 100cm<sup>3</sup> persisted for 2-3 days. Mounds 200-1000cm<sup>3</sup> grew 50-200cm<sup>3</sup> per day. Mounds over 1000cm<sup>3</sup> grew 200-400cm<sup>3</sup> per day. Maximum size seems to be 4000-7000cm<sup>3</sup>. We believe that there is a connection between the growth of these mounds and the health of coral reefs. Corkscrew anemones, which serve as cleaning stations for fish and home to various symbiotic shrimp, may be buried by the mounds. These data will be useful in parameterizing a model of mound growth and persistence, as well as the potential impact on the sessile benthic community.

## **The Caribbean Coral Reef Keystone Species *Diadema antillarum* (long-spined black urchin) have a preference to *Acanthophora spicifera* over other algal species**

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During the early 1980's, an unknown pathogen swept through the Caribbean and Florida waters killing over 95% of the long spined sea urchin, *D. antillarum*. Reefs underwent a phase shift from coral dominance to algal dominance. Though the *D. antillarum* has shown signs of recovery, does this mean that our reefs will return to being coral dominated if the *D. antillarum* population returns to pre-die off numbers? That is the question this research will attempt to answer. Knowing the feeding preference of urchins can help us to determine if indeed urchins are the keystone species for reefs to return to coral dominance.

Experiments were conducted at University of the Virgin Islands from May-July 2007. Urchins were collected and placed in 14 separate buckets in seawater tables. Urchins were starved for 48 hr. Two species of algae were collected, weighed, and fed to the urchins after the starvation period. Urchins were given 14 hr to graze on algae, afterwards the algae were weighed to determine the percent eaten. The urchins were then placed back into their natural habitat and new urchins were collected for future trials. In total four different algae used were: the red algae, *Acanthophora spicifera*, the brown alga, *Dictyota menstrualis*, and the green algae, *Caulerpa sertularioides*, and *Halimeda opuntia*. Urchins preferred *A. spicifera* over other algal species.

In the future more algal species should be tested to see which algal species urchins ultimately prefer. These results may explain the dominance of *Dictyota*, *Caulerpa*, and *Halimeda* on the reefs in St. Thomas.

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## **Location Proteomics**

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The primary goal of location Proteomics is to automate protein classification through the development of numerical features that can help to identify and differentiate between protein images. The images used are fluorescence microscope images of protein location patterns within cultured cells. These images were obtained from the Murphy Lab at Carnegie Mellon University. It is believed that the proteins can be classified by their shape signatures and that proteins in the same class would have similar shape signatures. This work involves developing new sets of geometric features that can find dissimilarities between 2-d and 3-d images by creating shape signatures for each protein image. These signatures are derived from shape distributions and probability distributions derived from samples of geometric measures between random points on the images. After these distributions are obtained we employ different norms to quantify the dissimilarities. Before the images are analyzed they are converted to binary images and preprocessed to remove excess background noise and to define clear boundaries. After preprocessing, a shape distribution is found by the calculating the Euclidean distances between random points in the image and constructing a normalized histogram. The shape distributions of different images are compared using the L-2 norm. Our study focuses on comparing our algorithm's performance using different geometric measures and norms.

## **Influence of Sucrose Concentration on In Vitro Growth and In Situ Acclimatization**

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Cassava (*Manihot esculenta*) is a tropical crop grown for its starch storing tuberous roots. Cassava is a major source of food in Africa and South America, as well as being tolerant to poor soils and drought. New highly productive cassava varieties are being developed and tissue culture has been a tool to micropropagate and distribute them. However, cassava suffers from high mortality during acclimatization from in vitro. The purpose of the research was to compare the growth and development of cassava plants grown in vitro on Murashige and Skoog medium containing 2% and 8% sucrose. The high sucrose concentration reduced plant height and rate of growth in vitro. Because cassava roots are sensitive to wounding and can deteriorate rapidly, in vitro grown plants were directly rooted ex vitro in potting soil or in sterile vermiculite. A high survival rate was obtained from both rooting in vermiculite and direct rooting. The high sucrose allows for starch to accumulate in the stems assisting the plants to quickly develop roots and continue growth during acclimatization. This protocol has potential to assist in assuring greater survival of micropropagated cassava.

## **A Comparative study of species diversity in Caribbean dry forests: A baseline study for the British Virgin Islands**

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Caribbean dry forests have been on a steady decline in the British Virgin Islands due to development and other anthropogenic impacts such as grazing by feral animals. Quadrants 200 m<sup>2</sup> were established in three Caribbean dry forests within the national parks system on Tortola and Beef Island, British Virgin Islands in order to compare species richness and abundance and to identify environmental variables. Sage Mountain National Park is the oldest National Park currently managed by the B.V.I. National Parks Trust and was previously cultivated for sugar cane during the Plantation Era in the B.V.I. It was then reforested before acquisition by the Trust. Shark Bay National Park was privately owned land that was donated to be managed as a National Park by the Trust. Mount Alma is a proposed National Park to protect the *Malpighia woodburyana* and was used as a comparison forest outside the national park system of the B.V.I. Spatial patterns of trees  $\geq 10$ cm diameter at breast height (d.b.h.), were studied in three Caribbean dry forests by mapping the trees within each quadrant during July 2007. A total of 405 trees were encountered from 15 different plant families. Trees were identified to species and family as required. Tree species diversity was greater than 1.5 in all dry forests studied. Differences in canopy and tree density were noted at the three study sites. At Sage Mountain, 221 trees were observed from nine different families with a Shannon index (H') value of 2.37. At Mount Alma there were 47 trees from eight families and an H' value of 1.89. A total of 137 trees from nine families were identified at Shark Bay with an H' value of 1.87. *Nyctaginaceae* was the dominant family at Shark Bay, but no one species was dominant at all sites. The combination of high species diversity and clumped appearance of trees, suggests that environmental variables other than rainfall are important in determining species diversity. Although the rainfall data available showed significant differences at the study sites, rainfall was not considered a significant factor in species diversity in this study. These results call for further research in Caribbean dry forests to analyze other environmental factors such as climate and soil type, which may be affecting species diversity.

This research was conducted on Tortola and Beef Island, British Virgin Islands as part of the Biodiversity conservation programme made possible by the British Virgin Islands National Parks Trust.

## ***Studies on determining the crystal structure of Phenylalanine Hydroxylase***

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Our research centers on trying to understand the structure of the enzyme Phenylalanine Hydroxylase (PAH). PAH is the enzyme responsible for catalyzing the essential amino acid phenylalanine to convert to tyrosine, another amino acid. PAH uses the cofactor tetrahydrobiopterin and molecular oxygen to catalyze this reaction. Malfunctions of the enzyme leads to a condition known as Phenylketonouria (PKU), a genetic disorder which symptoms include extraneous amounts of phenylalanine within the blood stream and mental retardation. Currently, truncated PAH crystal structures are available. However, structures of wild-type PAH have yet to be determined. These structures would strengthen our knowledge in regards to where a mutation could occur on the enzyme and provide insight into the chemical basis of PKU. Additionally, the crystallization of PKU mutants could be used in comparisons to the crystal structures of the truncated enzyme to further understand the dynamics of the enzyme. Wild-type, truncated and PKU-inducing mutant forms of the PAH that we wish to study have been expressed in E. Coli cells, purified by ammonium sulfate precipitation and ionic exchange chromatography techniques. The purified enzyme was then tested for purity using SDS-Gel electrophoresis analysis prior to crystallization.

## **Will Comprehensive Molecular Data Accurately Identify Relationships Among Scleractinian Coral Families?**

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Coral reefs are intricate ecosystems that serve as habitats for a diverse array of organisms. In addition to this role, they provide economic benefits, construction materials, pharmaceutical compounds for medicine, beaches and islands, protection from the sea, and regulation of carbon dioxide levels. To small island nations such as the Virgin Islands, coral reef preservation is vital. Before we can accomplish this task, we must understand and know what they are. Scleractinian corals, or “hard” corals, are the foundation of coral reefs. Previous taxonomic classifications of scleractinians based on their morphological traits divide the order into seven distinct suborders. Morphological characters, due to their high variability, make species classification a difficult task, obscuring the determination of relationships among the families. Phylogenetic analyses based on molecular data do not support this hypothesis based on morphological data. Molecular analyses divide the order into only two distinctive groups. However, the relations within these two large groups are still very unclear. We hypothesize that using more taxa and complete gene regions will accurately establish higher level relationships within the two large groups of scleractinian corals supported by all molecular analyses. We are examining sequences from the complete nuclear 28S ribosomal RNA gene region, which is approximately 2,400 base pairs long. Thus far, we have collected eight species of scleractinian corals (representing 5 families) from St. Thomas, USVI. They include *Siderastrea sp.*, *Meandrina meandrites*, *Porites porites*, *Montastrea annularis*, *Stephanocoenia sp.*, *Favia fragum*, *Madracis mirabilis*, and *Agaricia argaricia*. We extracted the coral DNA using a CTAB protocol, and our gene regions were amplified by the polymerase chain reaction (PCR) using previously published 28S primers. Gel electrophoresis provided visual evidence of our extracted genomic DNA and PCR products. DNA sequences of PCR products were determined by automatic sequencing. A BLAST search of our DNA aligned our sequences to other scleractinian 28S sequences in GenBank. These sequences represent 5 scleractinian families, but include only 200 -700 bp of the entire 28S gene region. Due to the limited length of sequences obtained thus far, a thorough analysis of our data is not yet possible. Our results will be used to construct a phylogenetic tree of scleractinian coral genera to establish robust hypotheses for relationships among families.

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## **Device for Automated Encapsulation of Stem Cells for Therapeutic Applications**

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Stem cells hold enormous potential for therapies of diseased or injured tissues and organs. However, precise control over stem cell fate is necessary to ensure success of treatments. Microcapsules based on cell-instructive polymeric materials are well suited to afford control over stem cell fate in vitro (e.g. reliable stem cell expansion for autologous treatments) as well as in vivo (e.g. advanced delivery vehicle with tunable degradation properties for programmed release and activation of implanted stem cells). This study hypothesized that it would be possible to design a device capable of automatically producing large numbers of cell-containing polymeric capsules, with tight control over of capsule properties such as diameter, number of encapsulated cells, capsule wall thickness, as well as wall porosity for controlled ingress and egress of nutrients, signaling molecules, and waste. A coaxial airflow device was manufactured from polycarbonate. By creating an air sheath coaxial with a 16-gauge blunt-ended needle, a 0.75 wt% aqueous solution of sodium alginate was dispensed as micro-sized droplets traveling with sufficient velocity to penetrate the surface of an aqueous calcium chloride crosslinking solution. Calcium diffusion into the alginate droplet led to almost instantaneously crosslinking of alginate molecules and gelling of dispensed alginate droplets. However, initial observations revealed that the produced microspheres were spherical in shape but polydisperse, ranging in diameter from 500  $\mu\text{m}$  to less than 100  $\mu\text{m}$ . With modifications to airflow speed and device design, the capsule generator could be modified to create a narrower, controlled range of sphere sizes. The general functionality of the capsule generator has been proven. Future work must focus on encapsulation of stem cells (e.g. adult human neural stem cells) and design of cell-instructive microenvironments inside the capsule for example for maintenance of stemness and rapid proliferation. Towards creating such a microenvironment, polymeric backbone molecules that offer cell adhesion peptide sequences will be embedded as well as various growth factors and nutrients. The design parameter space will be explored to optimize efficiency of microcapsule-based culture.

## **The Effect of Compost, Sheep Manure, and Aquaculture Effluent on the Production of Cucumbers (*Cucumis sativus*) in the Tropics**

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To improve farming in the tropics, research was conducted on a small scale integrated model farm at the University of the Virgin Islands Agricultural Experiment Station. The farm produced vegetables intensively on a continuous basis using agricultural byproducts to maintain soil fertility. An experiment was conducted to evaluate the effect of sheep manure, compost and aquaculture effluent on the production of cucumbers. There were three treatments (sheep manure, compost, aquaculture effluent) and a control, which were all replicated five times. The hypotheses were that each treatment would produce higher yields than the unfertilized control and that one treatment would be significantly higher than the others.

Cucumber seedlings were planted in 27.9 m<sup>2</sup> plots. There were three rows of plants per plot spaced 30.8 cm apart and irrigated by three drip irrigation lines. The cucumbers were planted 30.8 cm apart within rows. Sheep manure was collected from the floor of earthen sheep pens. Compost was produced from a mixture of spoiled fruits and vegetables, plant residue and fish carcasses. A sludge holding pond for tilapia tank production systems provided the aquaculture effluent. The agricultural byproducts were applied once before planting and incorporated into the soil. The application rates were for 3.6 kg/m<sup>2</sup> for sheep manure and compost. Aquaculture effluent was applied at a rate of 40.7 liters/m<sup>2</sup> (1.6 kg /m<sup>2</sup> on a dry weight basis). It was not feasible to apply more aquaculture effluent because the soil became saturated, and any additional effluent would run off. The cucumbers were planted on the July 12, 2007 and were harvested weekly for three weeks (August 8, August 15 and August 22). Only cucumbers of a marketable size (>10 cm) were harvested.

Total harvest weight averaged 1.07 kg/m<sup>2</sup> for compost, 0.88 kg/m<sup>2</sup> for sheep manure, 0.72 kg/m<sup>2</sup> for aquaculture effluent and 0.29 kg/m<sup>2</sup> for the control. The data was analyzed by an ANOVA test and a pair-wise ANOVA test. The results showed that only compost produced significantly higher ( $p < 0.05$ ) cucumber production than the control. There were no significant differences between treatments. Therefore, only one hypothesis was proven to be correct. The use of compost will be recommended to farmers to improve cucumber production in the tropics.

## **Constraining Ocean Acidification in the Greater Caribbean**

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Ocean acidification is an increasing problem facing marine ecosystems, largely attributed to rising atmospheric CO<sub>2</sub> over the last century. With effects that range from coral degradation to the breakdown of marine ecosystems -due to changes of the oceanic chemistry of the region- ocean acidification has become a prime focus of subtropical regions, namely the Greater Caribbean Region (also known as the GCR; 17° to 26° N to 63° to 83° W.) Due to such recent attention, the National Oceanic and Atmospheric Association (NOAA) has made several studies (via the Atlantic Oceanographic and Metrological Laboratories *Explorer of the Seas* cruise line) to observe and assess such fluctuations in oceanic chemistry. The analytical procedures used to assess those observations have become the focus of this project. In attempt to derive an effective basis of climatic information for the GCR, this experiment focused on analyzing and improving techniques of data analysis overall yielding important information such as: salinity data collected from the AOML cruise line and data predicted from past climatology reports were 95% synonymous; and the major lack of alkalinity data pertaining to the GCR. These results will be used by NOAA to improve current models of ocean acidification in the GCR. Overall, the effort proved successful in displaying not only the immediacy of ocean acidification but also the several steps currently being used to analyze and properly assess it.



## **Decision Tree Models for Solving Classification Problems**

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This preliminary research studies classical data mining problems such as classification using decision trees. One of the most representative algorithms used to build these trees is the Quinlan ID3. Step by step execution of this algorithm are showed using examples. ID3 has some limitations. It can not handle numeric attributes or missing data. C4.5 is an extension of ID3 algorithm and solve these limitations. These two algorithms are compared in terms of classification rates using several data sets such as the IRIS database (classification of flowers). Results in terms of classification accuracy are presented.

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## **Effects of Muscarinic Agonists on Central Control of a Peripheral Neural Circuit**

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The stomatogastric nervous system (STNS) controls all motor activity of the lobster foregut and is comprised of four ganglia. The paired commissural ganglia (COG) are located within connectives of the central nervous system and send axonal projections to two peripheral ganglia: the esophageal ganglion (EOG) and through a single nerve to the most distal stomatogastric ganglion (STG). The pyloric central pattern generator (CPG) in the STG produces rhythmic bursts of action potentials even in isolated STNS preparations. Central nervous system input is necessary for the pyloric CPG and cutting all connections from the COG or EOG to the STG stopped bursting activity. While two neurons in the COG are known to influence the pyloric rhythm, the pharmacology of these influences is not clear. Lobsters, like most animals, employ relatively few types of neural transmitters in motor circuits. We hypothesized that control of higher motor centers will involve neurotransmitters also used in peripheral centers: acetylcholine is an important inhibitory neurotransmitter in the pyloric CPG and acts through muscarinic type receptors. To test this hypothesis we superfused both COGs with a cholinergic mimetic, oxotremorine, for one minute followed by repeated washes with lobster saline. We observed a dose dependent increase in the bursting frequency of the pyloric CPG. Superfusion with  $10^{-4}$  M oxotremorine had a significant effect that caused an increase in burst frequency by 23% (from  $0.10 \pm 0.02$  Hz to  $1.35 \pm 0.09$  Hz,  $P < 0.01$ ) for up to an hour. Treatment with  $10^{-2}$  M oxotremorine also increased burst frequency by 50% (from  $0.99 \pm 0.03$  Hz to  $1.52 \pm 0.15$  Hz,  $P < 0.01$ ) for at least 5 minutes. Thus, at least one neurotransmitter common to the STG also influences activity of higher centers known to control the pyloric CPG.

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## **Fine Tuning the Multi-Layer Perceptron and the J48 Algorithms to Predict Coral Reef Health**

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Data mining algorithms are studied to predict coral reef health based on environmental stressors such as water salinity, sea temperature, light intensity etc. One important aspect of data mining algorithms is to fine tune the learning parameters that will permit to increase prediction accuracy rates. This research focuses on learning parameters of two predictive algorithm families: artificial neural networks and decision trees. In specific, we will be comparing the Multi-layer Perceptron and the J48 algorithms to determine which combination of learning parameters in each case gives the highest percentage of correctly classified instances and therefore allow us to infer the best predictions. Experiments use NOAA CREWS 2005 data sets. This research is currently in progress.

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## Insertional Mutagenesis of T-cells by Human T-cell Leukemia Virus Type 1

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Retroviruses integrate into cellular genomes and can activate oncogenes or inactivate tumor suppressor genes. This research is focused on the effects of HTLV-1 integration on T-cells. HTLV-1 is a complex retrovirus that induces Adult T-cell Leukemia/Lymphoma (ATLL) after a long latency and in only 5% of carriers. The latency of over 30 years and low incidence implies that multiple oncogenic “hits” accumulate before leukemia/lymphoma develops. To evaluate the role of insertion sites in HTLV-1 induced transformation an *in vitro* assay was applied to transform T-cells by an irradiated HTLV-1 viral producing cell line. Splinkerette-PCR was used to clone and map insertion sites from infected T-cells. An insertion site of HTLV-1 was identified upstream of the *GLI2* gene in the HUT102 (HTLV-1 secreting) cell line. This insertion was activated resulting in overexpression of *GLI2* mRNA and protein. *GLI2* has been shown to bind to the HTLV-1 Long Terminal Repeat in complex with the viral transactivator and oncoprotein Tax. The effect of *GLI2* expression on HTLV-1 was investigated by measuring the effect of varying *GLI2* concentration on Tax expression. Results show that retroviral insertional mutagenesis may be an important mechanism in HTLV-1 induced cancer.

## **MACROALGAL SUBSTRATE AFFECTS MOVEMENT OF THE LONG SPINED SEA URCHIN *DIADEMA ANTILLARUM***

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Ever since the mass die-off of the echinoid herbivore *Diadema antillarum* in the 1980s, coral reefs in the Caribbean have undergone a major phase shift from coral to algal dominance. In laboratory feeding trials, urchin grazing rates depended largely on the species of macroalgae. To determine if field movement patterns were affected by algal species, urchins were collected and numerically tagged in Brewer's Bay, St. Thomas, US Virgin Islands. The urchins were separated into either a control or experimental groups. The control group was placed on a rocky substrate at a depth of 1-2m with little/no algae present while the experimental group was placed on high densities of the brown alga *Dictyota spp.*, the green alga *Caulerpa sertularioides*, or the green alga *Halimeda opuntia*. The movement of the urchins was monitored every 2-3 hr during darkness for 8-10 hours and the distance traveled was recorded. All three treatment groups were significantly different from one another in terms of distance moved; with the least movement on *C. sertularioides* (1.1-1.7 m per night) and the most movement on *Dictyota spp* (3.3-4.1 m per night). Urchins placed on bare substrates moved between 3.1-3.7 m per night on average. The results suggest that urchin grazing patterns are dramatically affected by the type of macroalgae. Urchins are believed to be the key to a return of high coral dominance; however, if urchins do not return in high enough densities then perhaps the lack of competition will allow urchins to be more particular in their diet, and thus not remove species of algae most fiercely competing with corals. Urchins traveled greater distances when placed on *Dictyota spp.* or *Halimeda opuntia*, perhaps because they are not as palatable as other algae. Determining grazing patterns of *Diadema* based on the presence of specific species of macroalgae may allow for a better assessment for the ability and likelihood of coral reefs to regain dominance in the Caribbean.

## **Study of Relationships between Coral Reef Stress and Environmental Factors**

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The purpose of this research is to detect relationships or associations between environmental variables and coral stress due to environmental changes prior to coral bleaching. Association Rules are the most popular representation for patterns in data mining. In this research, the Apriori association rules algorithm uncovers hidden patterns among the NOAA station datasets. These patterns are described in the form of rules. The relevance of each rule is analyzed and the rules with the greatest confidence describe the strongest patterns in the datasets. Examples of some results are that the coral is less likely to stress if the interval of light intensity is not less than zero, but not greater than 5.353. Other results also showed that there was a pattern between the wind gust and coral stress. These rules generated by the Apriori algorithm indicate that there are other patterns to be discovered that will indicate when a coral is most or less likely to stress. Therefore, the goal of this research is to find the strongest patterns in the dataset.

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## **Solving the unmixing problem**

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Currently, there is a need for automated systems for recognition of subcellular location patterns in images of cultured cells. Location patterns provide information about a specific protein's structure and function. In this investigation, we attempt to analyze images of cells that contain fundamental and mixture pattern. Our purpose is to determine the distribution of fundamental types in a mixture pattern. This process is called unmixing. Additionally, we want to estimate the concentration of the fluorescent dyes in a mixture pattern. A linear regression approach was used to estimate the concentrations and a multinomial approach was used to estimate the distribution. We found that the average fluorescence strategy worked well for estimating concentration. Also, we were able to achieve cell grouping without segmentation to calculate certain features. For future work, we recommend to use other features relative to dye concentration and to investigate more image processing techniques for preprocessing, like multi-level thresholding.

## **Antimicrotubule Metabolites from *Ircinia strobilina* and other Virgin Islands Sponges**

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Cancer is one of the most researched diseases of the 21<sup>st</sup> century. Despite this fact it remains one of the leading causes of death in the world. The race for a cure has led to the isolation of anticancer components from a wide variety of organisms, especially marine sponges, which are a rich source of biologically active metabolites. Recent examples include the microtubule stabilizing agent discodermolide isolated from the Caribbean sponge *Discodermia dissoluta*. Antimicrotubule metabolites have been successful in treating various cancers, of this group taxol the most potent. Herein we describe the fractionation and biological evaluation of the ethyl acetate extract of *Ircinia strobilina* resulting in several potential anticancer leads. The sephadex fractionation of this Virgin Islands' sponge yielded six semi-pure fractions, four of these fractions displayed microtubule depolymerization activity in vitro at concentrations of 10 µg/mL and 25 µg/mL. Furthermore, several other crude fractions from *Mycale laxissima*, *Agelas conifera* and *Agelas wiedenmyeri* also displayed microtubule depolymerization activity at these concentrations. The microtubule assays were conducted in A-10 rat aortic smooth muscle cells. The cells were exposed to the extracts for eighteen (18 hrs) hours then stained and visualized microscopically. Samples are currently being assayed for general cytotoxicity against a panel of human and murine cancer cell lines. The cell proliferation and microtubule inhibitory activity, in addition to the chromatographic separation and elucidation of compounds from *Ircinia strobilina* will be discussed.

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## **Clustering approaches with the K-means algorithm**

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Clustering approaches are used when data sets needs to be divided in groups having similarities. This work looks at the K-means algorithm which partition data into disjoint clusters. The principle of this algorithm is to specify the number of desired clusters  $K$ .  $K$  data are selected at random as centroids or cluster centers. Data points are then assigned to their closest centroid according to a distance function such as the Euclidean distance. The centroid of all the data in each cluster is recomputed. The new centroid is becoming the center for their respective cluster until the cluster values of each cluster have stabilized (no more changes). This algorithm is discussed and experimented on the IRIS datasets. Limitations are also described.

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## Cytotoxic metabolites from *Pseudoceratina Crassa*

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In 2004, it was estimated that over 1.3 million Americans were diagnosed with various forms of cancer and of this number; in excess of 560,000 have died from the disease. Natural products, natural product derived drugs or natural products inspired drugs account for the vast majority of chemotherapeutic agent currently in clinical use. In recent years marine sponges have been established as a sustained source of biologically active and biosynthetically diverse natural products. Sponges of the order Verongida are known to produce interesting and biologically active bromotyrosine derivatives. Recent examples include psammaplins isolated from *Verongida*, which exhibit potent HDAC (Histone Deacetylase) and DNMT (DNA Methyltransferase) activity. As a result, several synthetic psammaplin-inspired compounds are currently in phase I clinical trials against hematologic malignancies. As a part of our on-going search for novel anticancer drugs from Virgin Island sponges, extracts of *Pseudoceratina crassa* are currently under investigation for antimicrotubule activity. The hexane and the ethyl acetate extracts displayed classic microtubule inhibitory activity at 25 µg/mL and 10 µg/ml. The bioactivity observed at the crude extract level is not surprising as *Pseudoceratina* is a prolific producer of the extremely cytotoxic psammaplins. The microtubule assays were conducted in A-10 rat arotic smooth muscle cells. The cells were exposed to the extracts for eighteen (18 hrs) hours then stained and visualized microscopically. Chromatography of the extracts of *P. crassa* has yielded two pure fractions. Samples are currently being assayed for general cytotoxicity against a panel of human and murine cancer cell lines. The cell proliferation and microtubule inhibitory activity will be discussed. The identity of the elucidated metabolites will be determined based on 1D and 2D NMR data.

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## **Do the Remote Pacific Islands Deserve International Protection?**

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Coral reefs are one the world's most biologically diverse ecosystems. They support hundreds of species of fish by providing, food, shelter, and juvenile nursing habitats. Many efforts have been made to preserve these reef ecosystems by establishing marine protected areas. The range of the types of protection a particular marine protected area provides varies. Some MPA's are no take zones or closed seasonally. Others, like National Wildlife Refuges have very open usage. National Wildlife Refuges can allow fishing and hunting under their national mandate. Six National Wildlife Refuges consisting of three low reef islets (Baker, Howland and Jarvis) and three atolls (Kingman, Palmyra and Rose) are being proposed to be further protected by being considered Ramsar Wetlands of International Importance. Ramsar is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Are these remote Pacific Islands internationally significant? The reef habitats found here are unique because they support the few "perfect" food chains. This perfect food chain is one where there are several top predators, a trophic level that is highly depleted in other systems because of overfishing. The reefs at these locations also provide larvae for other reefs that have human populations like the main island of Hawaii.

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