

Tenth Annual

# Summer Research Symposium



**July 27, 2012**  
**St. Thomas Campus**  
**College of Science & Mathematics**  
**University of the Virgin Islands**

# Participants

Mathematics Behind the Science	Summer Sophomore Research Institute	Summer Undergraduate Research Experience
Cyril Benjamin, II Keturah Bethel Kemisha Browne Elijah Brumant Lensey Casimir Shakim Cooper Arlette De Haza Terrance Gordon Sheresia Gumbs Isaiah Horsford Peter John-Baptiste Meyoko McQuilkin Vivani Pickering Ariane Ramsundar Kwame Simmons Kai Vincent Richardson- Lemuel Zamore	Murchtricia Charles Tasha Corneille Chantel Ible Suresh Sookraj Samuel Williams	NicholasCromwell Jr SandraDaniel Lauritz A. David, JR Anthonios Doliotis Shamelle Farrington Anthonio Forbes Heather Gaston Abrar Husein Clyde Joseph Thalia Lake Jemanuel Viera Nicole Etienne Lynisha Farrell Shelsa Marcel

# Organizers

Provost Camille McKayle, Dr. Marc Boumedine, Dr. Robert Stolz, Dr. Linda Wymer,  
 Ms. Alexia Mintos, Mr. Andre Douglas and Ms. Amanda Wright

Emerging Caribbean Scientists Programs  
 College of Science and Mathematics  
 University of the Virgin Islands  
 2 John Brewer's Bay  
 St. Thomas, VI 00802  
 Phone: 340-693-1230  
 Fax: 340-693-1245  
 Website: <http://ecs.uvi.edu>

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## **Utilizing Eye-tracking to Determine Students' Comprehension of Chemistry While they Read**

**Murchtricia Charles**

Dr. Justin M. Shorb (Mentor)  
University of the Virgin Islands

Over the years, eye-tracking has proven to be an essential resource for Human-Computer Interaction Researchers around the globe. Eye-tracking is a technique where a subject's eye movement can be measured in order to locate of his or her point of interest at any given time. Additionally, it allows researchers to observe the sequence in which the subject is looking from one location to another. This in return can permit observers to determine whether or not the movement of one's eye can be used to indirectly study the cognitive responsiveness of a student. The basis of this study is to utilize eye-tracking to determine whether Chemistry students have the ability to make conceptual connections between different representations of the same Chemistry information. Making use of microscopic, macroscopic and symbolic representations, we would be able to observe the variations in attention which the student gave representations to determine their understanding of the relationship between them. There are a few ways to view the data of an eye-tracking experiment, however; we will be focusing on the saccade/ fixation mapping and heat mapping. After the experimental procedure and once the raw data was formatted, we then transformed that data using rotation matrices with Microsoft Excel and it was then imported to OGAMA (Open Gaze and Mouse Analyzer). With this software, we were able to view the both above mentioned mappings using the different module available in the OGAMA software. Initial results will be discussed regarding the analysis procedure and quality of the data.

This research was funded by NSF HBCU-UP (Grant Number HRD – 0506096)

# Analysis of twenty species of the USVI fishery for overfishing

Tasha Corneille

Angela Dikou, PhD (Mentor)

Currently 44, 16, and 6 % of fish stocks are fully to heavily exploited, overexploited and depleted, respectively, worldwide. Overfishing is the depletion of fish from the population to such an extent that it can't be replenished naturally. Overfishing may occur as recruitment or/and growth overfishing. Recruitment overfishing is the removal of the fish from the population before it matures whereas growth overfishing is the depletion of larger size fish from the population such that fewer larger fish are represented in the catch. Fisheries management addresses overfishing for the sustainability of biological productivity through conservation of marine ecosystems.

To determine whether or not overfishing is occurring at the USVI, data for 20 out of approximately 70 species of a port biosampling database [1980-2009] was analyzed and values of critical fish lengths ( $L_{mat}$ : length at maturity;  $L_{\infty}$ =infinite length) were obtained from FishBase. Specifically, trends in average fish size in the catch; differences in average fish size among gear types; and contrasts of critical fish size values of the catch with those reported at Fishbase for relevant populations were evaluated. Significant trends in average fish size were revealed through regression analysis; significant differences in average fish size among gear types were revealed through one-way Analysis Of Variance; contrasts between fish size critical values were evaluated graphically. During the thirty year period, mean fish size decreased for two species (mutton snapper,  $R^2_{adj.}=0.48$ ,  $p=0.0004$ ,  $Y=15529.84-7.57*X$ ; Spanish hogfish,  $R^2_{adj.}=0.99$ ,  $p=0.0331$ ,  $Y=7948.8-3.82*X$ ); increased for three species (longspine squirrelfish,  $R^2_{adj.}=0.23$ ,  $P=0.0023$ ,  $Y=-1103+0.65$ , spotted trunkfish,  $R^2_{adj.}=0.37$ ,  $P=0.0065$ ,  $Y=-3141.3+1.67*X$  and white grunt,  $R^2_{adj.}=0.48$ ,  $P=0.0281$ ,  $Y=-3128.16+1.72*X$ ); and remained unaltered for the rest of the fifteen species. However, contrast of critical values of  $L_{mat}$  and  $L_{\infty}$  from FishBase indicated that Spanish hogfish and spotted trunkfish may be subject to recruitment overfishing regardless of the negative and positive trends, respectively. Differences in mean fish size among different gear types were species-specific. In particular, there was significantly lower mean fish size for 6 out of 17 species caught with fish traps compared to the other fishing gear types. Mismatches between the direction of trends in mean size of fish in the catch and contrasts of critical length values of fish with minimum, maximum and average values of fish length in the catch, indicate probable creeping overfishing.

Examination of the whole suite of species in the future may assist in highlighting the magnitude of creeping overfishing in USVI fisheries and prompt appropriate adjustment of regulatory tools, such as protected areas, gear restrictions, and species-specific restrictions, by the Department of Planning and Natural Resources, if necessary.

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This research was funded by NSF HBCU-UP (Grant Number HRD – 0506096)

## **Investigation in the Use of Optical Spectroscopy to Determine Metal-Ligand Binding Constants**

**Nicholas Cromwell, Jr. and Suresh Sookraj**

Stanley Latesky (Mentor)

Department of Chemical and Physical Sciences

University of the Virgin Islands

2 John Brewers Bay Road

St. Thomas, VI 00802

Metal ligand binding constants ( $K_f$ ) values are important for a number of reasons in relation to biochemical and chemical processes. In biochemistry, they are important in the understanding of the mechanism of binding metal ions to proteins and enzymes. For example, such complexes aid in the transport of essential metal ions across cellular membranes and the removal of metal ions from the body. In nuclear chemistry, these studies are important to the understanding of the separation of radionuclides during the manufacturing and waste processing of nuclear materials. In the past, the customary approach used in determining binding constants consisted of titration and gravimetric methods. This study, using iron, chromium, and copper (metals found in high concentrations in the preparation of radionuclides), sought to determine the validity of using infrared and ultraviolet-visible spectrophotometry to determine binding constants for a variety of metal-ligand complexes. First, we had to learn how to use two analytical instruments- the Varian Fourier-Transform Infrared Spectrometer (FTIR) and the Varian Ultraviolet-Visible Spectrometer (UV-Vis). We then constructed a library of FTIR spectra of common chemicals using three different sampling techniques- Attenuated Total Reflectance (ATR) of solids, liquid sampling, and ATR sampling of liquid mixtures. We at first tried using FTIR spectrometry to determine the binding constants but found that the ATR cell did not have enough energy throughputs to allow such determinations. Subsequently, we used UV-Vis spectrometry to obtain our spectral data and we then used commercially available HYPSPPEC software that allowed us to perform spectral subtraction followed by spectral analysis to determine the binding constants. We used two different ligands, ethylenediaminetetraacetic acid (EDTA) and ethyleneglycol-tetraacetic (EGTA) acid, both known to form 1:1 ML complexes, in order to test the efficacy of the spectral determination of the M-L binding constants. Our studies showed that our constants agreed well with literature constants.

This research was funded by NSF HBCU-UP (Grant Number HRD – 0506096)

# **OSSEC INTRUSION DETECTION SYSTEM'S ABILITY TO DETECT DENIAL-OF-SERVICE ATTACK ON THE LINUX OPERATING SYSTEM**

**Sandra Daniel**

Dr. Marc Boumedine (Mentor)

University of the Virgin Islands

Due to the growing number of cyber-attacks, Intrusion Detection System (IDS) are becoming a vital part of any enterprises conducting business over the Internet. IDS monitor suspicious activities on a network and alert the system or network administrator of any abnormal activities. This idea of cyber-security emerged from a paper that introduced the notion of intrusion detection written by James Anderson, in 1980. A common attack is the Denial of Service attack where computing or memory resources are stressed to serve legitimate traffic request. This study focuses of Host-based Intrusion Detection System, a software running on individual host machines that analyzes activities and maintains system file or integrity with a specific purpose of detecting DoS attacks. The main thrust of this research is the design and configuration of an IDS such as the open source Office of State Security and Emergency Coordination (OSSEC). OSSEC performs log analysis, integrity checking, rootkit detection, time-based alerting and active response. Rules are defined in order to detect HIDS attacks such as DoS attacks, based on the analysis of the webserver (Apache) log files. To accomplish such a task, XML and regular expressions languages are used to identify patterns and respond by actions such as alerting the system administrator or stopping the attacks by killing processes. The next step is to test the IDS effectiveness by generating DoS attacks with the TevDos tool. This tool is used to simulate DoS attacks by sending multiple requests to the webserver (Apache). The effectiveness of the IDS is discussed in terms of detection rate and false positive rate.

This research is funded by Emerging Caribbean Science (ECS) Program, the National Science Foundation (NSF) HBCU-UP program (Grant Number HRD – 0506096) and the University of the Virgin Islands.

## Developing an Automatic Scheduling Program

**Lauritz David and Samuel Williams**

Dr. Marc Boumedine (Mentor)

University of the Virgin Islands

Many institutions, businesses, and organizations require scheduling to keep it on track with daily, weekly, monthly, and even yearly tasks. Scheduling is the action of sorting, organizing, and structuring required demands into available resources. In some cases there are constraints on the demands, which can only work for particular resources. There are two types of constraints, soft constraints and hard constraints. Hard constraints must be met for the demand to be scheduled, but the soft constraints are requests that are satisfied for convenience. For example a college schedule would have hard constraints such as the amount of seats in the class, but soft constraints such as the time the class was held. To implement this program, research was done on which algorithm (, which is a step by step procedure for calculations,) to use to get the best results in a reasonable amount of time. The *Tabu Search* algorithm was chosen because it was simple; it would check possible solutions and choose the one that satisfies all hard constraints and the most soft constraints producing a satisfying schedule. First a priority queue program organizes the demands from most constraints to least. Next, a blank schedule is created for the beginning of a binary tree. As the tree branches out it the first row of branches adds one resource to a blank schedule, and creates leaves for each instance where the demand can fit in the schedule .This 'leaf' is called a node. Before the tree continues branching a cost function is added to determine which node satisfies most of the soft constraints without violating any hard constraints. The tree continues branching and adding demands into available resources and follows the branch with the best cost until there are no more demands to be placed creating a complete schedule. Learning that the University of the Virgin Islands also made its schedules by hand sparked an interest in seeing if it was possible to write a scheduling program and apply it to the UVI classes. Not only would the program be to schedule UVI classes but it will also find the best solution, satisfying as many constraints as possible.

This research was funded by NSF HBCU-UP (Grant Number HRD – 0506096)

## **Comparative Study to Determine the Water Quality Parameters of Bioluminescent Mangrove Lagoon and Salt River Bay, St. Croix, USVI**

**Anthonios Doliotis**, Lynisha Farrell, Anthonio Forbes & Shelsa Marcel  
Dr. Bernard Castillo II and Kynoch Reale-Munroe (Mentors)  
University of the Virgin Islands

Located on St. Croix, US Virgin Islands, Salt River Bay National Historical Park and Ecological Preserve contains both historic ruins and a diverse ecosystem. Salt River Bay is known for its mangrove forests and coral reefs. Bioluminescent dinoflagellates can be found throughout the entire bay. The dinoflagellates responsible for bioluminescence are small unicellular protists. Bioluminescence results from the conversion of chemical energy to light energy. Bioluminescence appears to be most concentrated in Mangrove Lagoon. The main objective of this study was to determine and compare water quality parameters of Mangrove Lagoon and Salt River Bay. Water quality parameters, namely dissolved oxygen, salinity, temperature, pH, and turbidity were collected using a YSI data logger within the bioluminescent Mangrove Lagoon and Salt River Bay. Salinity and temperature are the two water quality parameters that this research project focused on and the results acquired were compared to known bioluminescent bays in literature. Results showed that the average salinity in Salt River Bay was 36.47 ppt and 37.98 ppt in Mangrove Lagoon, while the average temperature was 29.86°C in Salt River Bay and 30.30°C in Mangrove Lagoon.

This research was funded by UVI CS-Summer Undergraduate Research Experience Program, and NSF HBCUUP Grant Award No. HRD – 0506096.

## **Data Mining: Exploring the association between semantic categories and attributes in Large Databases.**

**Nichole Etienne**

Dr. Kostas Alexandridis (Mentor).

College of Mathematics and Science, University of the Virgin Islands

Data mining is an interdisciplinary field which refers to the process of extracting and analyzing the content and value of information from existing datasets and databases. From the existing information, associations are made through text mining (extracting or categorizing information within semantic categories) and identifying statistically important connections between attributes, among attribute states, and across states and attributes in the database. This results in the discovery of patterns of interconnectivity within and across data variables and their states. This research looks at (a) the emergence of significant patterns and associations among demographic, attitudinal and belief information in survey datasets collected across a range of participants of ecotourism activities (Kobrinski, 2012), and (b) how classified semantic categories extracted from open-ended text responses are linked across and within associative attributional databases. In addition, the research study examines the performance of a range of different data mining models and algorithms, to extract and explore patterns of associations. Such algorithms range from simple models (linear regression, cluster, and multi-dimensional factor analysis models) to complex tree algorithms (classification and regression trees, CHAID, Interactive Trees, Random Forest Trees), to probabilistic algorithms (such as Artificial Neural Network and Naïve Bayes Classifiers). The importance of this research includes: benchmarking (i.e., finding the average model performance) in the development of a modeling platform for more advanced scientific inferences; facilitating the emergence and discovery of complex patterns of associations within existing data structures, and linking parametric (i.e., normally distributed) with non-parametric inference using machine learning and data mining tasks. Such analysis can aid the discovery and mining of complex patterns of relationships especially in large and seemingly unrelated relational database structures.

This research was funded by NSF HBCU-UP (Grant Number HRD – 0506096) and the MBRS-RISE Grant Award No. GM061325.

## **Preliminary Studies on Water Quality Parameters in Bioluminescent Mangrove Lagoon, St. Croix, USVI**

**Lynisha Farrell**, Anthonios Doliotis, Shelsa Marcel and Anthonio Forbes  
Dr. Bernard Castillo II and Kynoch Reale-Munroe (Mentors)  
University of the Virgin Islands

Mangrove Lagoon is closely situated to the east side of Salt River Bay, south of Hemer's Peninsula, St. Croix, US Virgin Islands. This bay was part of a hotel/marina project produced by dredging an existing salt pond, which connected a previously enclosed pond to Salt River Bay in the 1960's. Currently, the bay has an oval shape, a depth of 4 meters, 250 meters in length, and 130 meters in width. Mangrove Lagoon is known for its bioluminescence. Bioluminescence results from the conversion of chemical energy to light energy. Small unicellular protists called dinoflagellates are responsible for the bioluminescence; however, the specific species has yet to be determined in Mangrove Lagoon. Each dinoflagellate emits greenish-blue light when it feels pressure against its cell wall, resulting in bioluminescence. The main objective of this study was to determine the water quality parameters of Mangrove Lagoon and compare two water parameters, salinity and temperature with known bioluminescent bays in existing literature. Water quality parameters were collected using a YSI data logger, which was deployed in the middle of Mangrove Lagoon. The YSI data logger collected water quality data every thirty minutes for 45 days within the lagoon. Our results showed that salinity is between 36.04-38.48 ppt and the temperature ranges from 29.07-32.01°C.

This research was funded by NIH MBRS-RISE Grant Award No. GM061325 and supported by NSF HBCU-UP (Grant Number HRD 0506096)

## **Substrate type affects fragment survival of *Montastraea annularis* and *Porites porites***

**Heather Gaston**

Dr. Stephen Ratchford (Mentor)

University of the Virgin Islands

In the last decade, coral disease has greatly increased and is not fully understood. One method of reproduction for corals is fragmentation. When fragmentation happens, the fragment may land on different types of substrate. The objective of this experiment is to find out if a fragment residing in the sand rather than on a hard substrate is more susceptible to disease. *Montastraea annularis* and *Porites porites* were the two species of corals we chose to do this study on. Both of these species are very common in the USVI and easily accessible. *Montastraea spp.* are some of the most abundant and largest framework corals in the Caribbean; however, in recent years, their populations have been declining due to disease. *Porites* species are more prone to disease than many other coral species. Fragments of these 2 species were gathered from a relatively healthy reef on the west end of Brewer's Bay. Fragments were then placed on either a tile or in the sand and monitored over a period of 3 weeks for any signs of disease and increases in dead tissue. 44 fragments were placed in the field and 10 were placed in an outdoor, seawater-fed barrel. Percent cover of live tissue and dead tissue were measured using ImageJ software; increases in dead tissue were then calculated each week. While preliminary results showed increased mortality in coral fragments lying in the sand, there were very few signs of disease observed in any fragments, whether lying on sand or tile. This study could provide useful information for coral reef restoration efforts, especially following major storms or intense fragmentation due to careless anthropogenic behaviors. Longer term studies will need to be done in order to determine if there is higher susceptibility to disease when coral fragments are in the sand.

This research was funded by NSF HBCU-UP (Grant Number HRD – 0506096)

## **Molecular Diagnostics can Detect and Identify Prokaryotic and Eukaryotic Pathogens in Terrestrial and Marine Organisms**

**Abrar Husein**

Jennilee Beth Robinson, PhD (Mentor)

Molecular diagnostics, PCR and DNA analyses, can differentiate between prokaryotic or eukaryotic pathogens' unique DNA sequences. The proteobacterial order, Rickettsiales contains numerous pathogens including medically important Rickettsia and Ehrlichia spp. transmitted by ticks. Babesia, blood-borne eukaryotic, protozoan parasites, are also transmitted by ticks. Rhipicephalus sanguineus, the brown dog tick, is ubiquitous and distributed worldwide. R. sanguineus transmits numerous pathogens, including disease-causing Rickettsia, Ehrlichia and Babesia to humans and animals.

DNA sequence analysis reveals whether Rickettsia spp. infect V.I. brown dog ticks R. sanguineus was recently implicated in transmission of fatal Rocky Mountain spotted fever (Rickettsia) infections to humans. Previously, a Rickettsia-specific PCR assay amplified DNA fragments of various sizes from total genomic DNA extracted from R. sanguineus of V.I. canines. When visualized by gel electrophoresis, amplified DNA matches the expected length, 381 bp, of the Rickettsia gltA gene region targeted by this assay. To test my hypothesis that R. sanguineus in the V.I. are infected with Rickettsia, I gel-purified the PCR amplified ~381 bp DNA fragments. The purified DNA was submitted for direct DNA sequencing and cloned on a plasmid in Escherichia coli for future analyses. Sequence results obtained from either gel-purified or cloned DNA will reveal if the amplified ~381 bp DNA is from Rickettsia or from non-specific PCR-amplification.

PCR-RFLP quickly detects and differentiates between species that cause canine babesiosis

Species of Babesia are known to cause diseases in select hosts including dogs, cattle and humans. B. canis and B. gibsoni are the cause of severe disease and fatality in V.I. canines. Infections require different, high-risk treatments. Unfortunately, rapid diagnostics required to determine appropriate treatment are not available here. Therefore, I developed an assay that will rapidly detect and differentiate between agents of canine babesiosis. The assay (RFLP) uses restriction endonucleases to cut PCR-amplified DNA into different length fragments based on nucleotide sequence differences. Conserved PCR primers were selected to amplify 18S rDNA from all canine Babesia pathogens. Selected enzymes will generate unique fragment lengths for each pathogen, allowing species differentiation. An attempt was made to include a related hematozoan parasite of fish, Haemogregarina.

This research was funded by NSF HBCU-UP (Grant Number HRD – 0506096)

## **Exploring Participants' Attitudes Towards Environmental Conservation**

**Chantel Ible**

Dr. Kostas Alexandridis, PhD (Mentor)  
Summer Sophomore Research Institute (SSRI)  
University of the Virgin Islands

The marine ecosystem is crucial to the U.S. Virgin Islands, as it provides habitat to a vast array of marine life, including corals, mangroves, and a variety of different fish. Degradation of our coastal marine ecosystem results in the loss of key marine species with serious impacts to ecosystem health, biodiversity, and aesthetic environmental values of our islands. In effect, our islands may suffer economically, because these factors contribute to our vibrant tourism industry. Moreover, local fishers will no longer have a good source of livelihood for them and their families. Therefore, it is important that Virgin Islanders understand what can be done to support our collective conservation efforts of our marine and natural environment. It is especially important that the younger generations become more aware and involved with this issue, as they will be the ones most likely to be affected in the future. Our research study focuses on exploring the attitudes, beliefs and behaviors of young Virgin Islanders (high school students) towards marine and environmental conservation. These participants took part in Coral Reef Discovery Week 2012 (CRDW12), an informative week-long summer program that teaches them about marine science and conservation. During this time, the participants were exposed to presentations about corals, fish, and different threats to marine life. They also participated in interactive activities that allowed them to experience and learn about marine life. During such interactive activities, the researchers observed their individual behaviors and peer group behavioral patterns to examine how they were learning (i.e., individually, as groups and collectively). In addition to behavioral observations, the researchers studied the attitudes and beliefs of the participants by analyzing their responses from a pre- and post- attitudinal/belief survey instrument that the students completed before and after CRDW12 respectively. The surveys were comprised of questions about basic demographics, their attitudes towards corals, attitudes towards environmental conservation, and nature in general, and about their exposure levels to similar activities. The pre- and post-surveys allowed us to track any changes in attitudes of the students, after having participated in CRDW12. The data analysis revealed important trends that (a) indicated shifts in post-attitudinal scales; (b) quantified the effects of experiential learning in both their cognitive and social perceptions and interactions, and; (c) provided an insight on how attitudes, beliefs and behaviors affect and are being affected by experiential learning both at the individual (cognitive/dispositional), and at the collective (social/group/peer) levels of interactions.

This research was funded by NSF HBCU-UP (Grant Number HRD – 0506096)

## Development of Water Quality Labs for General Chemistry at UVI

**Clyde Joseph** and Micadel Hazell

Dr. Justin M. Shorb (mentor)

University of the Virgin Islands

There are different styles of chemistry laboratories: some have been proven to be more effective at helping students to master the material. The four types of labs, as defined by Domin<sup>1</sup>, are expository, inquiry, discovery and problem-based. Up until this past year at UVI, all of the laboratories were expository or discovery styles. These use given procedures which students follow like a cookbook recipe. The inquiry and problem-based styles of lab make use of student generated procedures. Research has shown that having students generate their own procedures improves the ability for students to think creatively and retain information longer. In this work, a set of water quality tests were used as a foundation to design new laboratory exercises for general chemistry. The choice to incorporate water quality testing was decided based on the ubiquitous appeal water quality measurements have within our island territory. Laboratory exercises and their pedagogical design are discussed for measuring pH, turbidity, and salinity/Total Dissolved Solids.

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1. Domin, D. S. A Content Analysis of General Chemistry Laboratory Manuals for Evidence of Higher-Order Cognitive Tasks. *J. Chem. Educ.* **76**, 109 (1999).

This research was funded by NSF HBCU-UP (Grant Number HRD – 0506096)

## **Developing a PCR protocol for the Greater Bulldog Bat (*Noctilio leporinus*) in the Northern US Virgin Islands**

**Thalia C Lake and Shanelle Farrington**

Alice Stanford, PhD (Mentor)  
Summer Undergraduate Research Institute (SURE)  
University of the Virgin Islands

Bats are diverse and can be found almost everywhere except in polar regions. *Noctilio leporinus* belongs to the class Mammalia and is found in the order Chiroptera. *Noctilio leporinus* are one of the largest species of bats found in the Virgin Islands. It is known that these bats are becoming endangered due natural and anthropogenic causes. This results in decreased biodiversity within the bat population(s) of the Virgin Islands. The study will allow us to apply genetic techniques to the conservation of biodiversity. This information would be used in conservation planning which would help to maintain the natural balance of the ecosystem by identifying means of protecting our species and their habitats. Our ultimate goal is to assess the degree of relatedness between populations of *N. leporinus* to further analyze ways in which this species could be conserved. However, since this is a fairly new project, the objective this summer is to develop a Polymerase Chain Reaction (PCR) protocol for *N. leporinus*. Tissue was excised from the bat's wing and was used for the extraction of nuclear DNA (deoxyribonucleic acid). We developed a PCR protocol to help amplify the copies of the DNA fragments. We tested different annealing temperatures to determine the best PCR protocol. We then visualized the results using gel electrophoresis. Conclusively, each primer has one particular temperature at which it works best. The protocol that we developed was successful using the primers at annealing temperatures between 55 degrees Celsius and 59 degrees Celsius.

This research was funded by Vento Foundation and the National Science Foundation's (HBCU-UP program)-grant # HRD-0506096.

**Damsel fish territorial behaviors on the spread of disease in coral reefs  
Threats to Our Reefs: Lionfish Invasion in St. Croix, USVI and GIS Mapping of  
Distribution**

**Shelsa S. Marcel**

Dr. Bernard Castillo II and Prof. Kynoch Reale-Munroe (Mentors)  
University of the Virgin Islands

The incursion of the invasive species of lionfish, *Pterois volitans*, in the Western Atlantic and Caribbean has been an issue of great scientific concern since their first detection in the Atlantic in 1992. November 28<sup>th</sup>, 2008 marked the first confirmed sighting of lionfish in the waters around our United States Virgin Islands territory, specifically St. Croix. Only four years later, St. Croix waters are being ravaged by proliferating populations of these indigenously Indo-Pacific lionfish. *Pterois volitans*' presence in the ecological system of our waters could have detrimental effects on native populations of fish, the local fishing industry, and the ecology of our coral habitats. In reaction to this invasion, there have been early dive attempts at search and recovery efforts of lionfish around the island of St. Croix, USVI. Our study aimed to create a GIS map of the spatial distribution and abundance of lionfish using the data from these dives, in response to the threat of the lionfish. The island was divided into six sectors, each sector serving as a dive spot for the collection of data on lionfish GPS location and abundance. GIS, Geographic Information System, was then used as a tool to plot the data onto a satellite map of the territory. The resulting map is a powerful tool useful for identifying spatial distribution and determining regions of abundance of lionfish around St. Croix, enabling analysis and solution development concerning this current threat to our reef.

This research was funded by NIH MBRS-RISE Grant Award No. GM061325, supported through UVI-ECS (Emerging Caribbean Scientists) program.

## **Social Factors Associated With How College Students Select A Major**

**Darrell Mercer**

Dr. Kostas Alexandridis (Mentor)  
University of the Virgin Islands

Selecting a major is one of the most important decisions a college student has to make during their undergraduate career. Some people are committed to a decision regarding their major right from the beginning of their college careers, while others may be indecisive and try a couple of different majors before they settle into one they prefer. The research examines self-motivation and the role of the family as decisive forces in the involvement of choosing a major. From the Fall 2011 semester – Spring 2012 semester, 37 group peer student interviews with a total of 135 participants were completed and transcribed. The average length of the peer student groups were 1.5-2hrs. The interviews were then entered into the NVivo qualitative analysis software and coded into nodes and further more into themes, using a Grounded Theory qualitative social science methodological analysis. The purpose of this study was to understand the reasoning for why and how students chose their college majors. The analysis of the cognitive and social factors influencing the choice of major in college careers, can better aid students who enter into college undecided with respect to their major area of study. Our analysis also can aid college students, who are unhappy with their current major, clarify their reasoning, attitudes and expectations in selecting an appropriate college major for them.

This research was funded by NSF HBCU-UP (Grant Number HRD – 0506096) and the MBRS-RISE Grant Award No. GM061325.

## **Machine Learning to Classify E. coli Promoters into Functional Categories Using Single Nucleotide Positions as Features**

**Jemanuel H. Viera**

Stuart Ketcham PhD (Mentor)

Summer Undergraduate Research Experience

University of the Virgin Islands

DNA is comprised of many segments called genes. Information is encoded in a sequence of nucleotides on these genes. Usually each gene has the information or instructions to make a protein. Usually, each protein performs one biological function. The promoter is the region of DNA that facilitates the transcription of a particular gene. Transcription is the use of information from a gene by an RNA polymerase enzyme to produce an RNA. With E. coli as well as other bacteria, the protein that recognizes the promoter region is called sigma ( $\sigma$ ). And since depending on the environment, there can be different types of  $\sigma$  active which will recognize different promoters, the  $\sigma$ 's have a major part in regulating the gene expression for these bacteria. The test-tube experiments that biologists use to identify the different types of promoters can be time consuming. So Machine Learning can provide a fast and inexpensive way of identifying candidates of different types of promoters. The purpose of my research is to try and find ways to improve the machine learning process, so that the learning algorithms can more accurately classify the promoters into their different classes. Last summer, Camacho, Dore and Ketcham used tetranucleotide frequencies in promoter regions as features to classify promoters into sigma 70 vs sigma 54 categories and obtained a maximum % of promoters correctly classified of 82-84%. We compared classifications using the following set of features: the single nucleotides at each position in 80-nucleotide -long DNA segments including known promoters. We used the programming language Java to develop a script to create the different permutations of possible nucleotide combinations for the larger nucleotides and to organize and create ARFF files for the data mining platform WEKA. Within WEKA we will use the J48 tree and Naïve-Bayes algorithms to classify promoters into the two sigma classes we are using,  $\sigma$ 70 vs  $\sigma$ 54. We will compare the percentage of promoters correctly classified using this approach vs the approach using tetra nucleotide frequency features used last summer by Camacho, Dore and Ketcham.

This research was supported by NSF HBCU-UP grant number HRD – 0506096. The promoters used in this research were retrieved from the RegulonDB Database (<http://regulondb.ccg.unam.mx/>).

## **Threats to our Reefs: Establishing Baseline Data for Total Maximum Daily Loads (TMDLs) Development**

**Antonio Forbes** and Shelsa Marcel

Dr. Bernard Castillo II and Professor Kynoch Reale-Munroe (Mentors)

University of the Virgin Islands

Terrestrial sedimentation is a large contributor to increased turbidity in relatively large bodies of water. Turbid waters have been known to negatively impact coral reefs by smothering the coral's exoskeleton and decreasing the availability of the sunlight used for photosynthesis by the coral reef's symbiotic partner; the zooxanthellae. In October of 2010, the United States' Environmental Protection Agency (EPA) published a list of impaired waters in the U.S. Virgin Islands, which indicated that the most common causes of pollution were sedimentation. As a result, Total Maximum Daily Loads (TMDLs) for turbidity from terrestrial sediment delivery has been targeted for development. Boiler Bay, located at the east end of St. Croix, USVI is the site of this study. Boiler Bay was selected as an ideal site to develop what baseline water quality parameters might be since it is undeveloped and free of direct sources of discharge, such as effluent or industrial. At the study site, we have deployed a YSI 6920 model sonde, approximately seventy feet away from its shoreline. The sonde collected water quality data, such as, temperature, dissolved oxygen, salinity, and turbidity data at an interval of five minutes over an eight-week period. Data collected from the sonde has shown that under ambient conditions, Boiler Bay meets the standards for optimal Nephelometric Turbidity Units (NTU) of no greater than 3 NTU. By using Boiler Bay as a standard of good quality water for other bodies of water around St. Croix, USVI, we can create a Total Maximum Daily Load (TMDL), in an attempt to safeguard our reefs.

This research was funded by NIH MBRS RISE Grant Award Number No. GM061325, as well as the United States Geological Survey-Water Resource Research Institute project number 2012VI220B.

# Tenth Annual Summer Research Symposium

July 27, 2012  
St. Thomas, U.S. Virgin Islands

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- Summer Undergraduate Research Experience (SURE) - SURE fellows work closely with faculty on challenging scientific programs.

The University of the Virgin Islands' Emerging Caribbean Scientists Programs are sponsored by local and national grants from National Institute of Health, National Science Foundation, J. Raymond Jones Foundation, Google, and other donors.



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