University of the Virgin Islands

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Student Research Projects
Abstracts

CONTENTS

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Lehmer Numbers (Abstract)

A Lehmer number is a natural number with a quotient K. It follows two basic properties: The first property states that the natural number n is equal to $a_1 a_2 a_3 ... a_m$, where n is a lehmer number and the a's are the factors of n. Property two states that the number $n - 1$ is equal to the product of K times each of the factors minus 1. To find lehmer numbers, we used five methods which are trial and error, random selection, fermat numbers and quadratic equations, however, we found the most efficient method to be a computer program, which was designed by our mentor. Our goal was to find all lehmer numbers with six factors and by using the computer program there were 23 lehmer numbers.

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

Sara Gennusa, mentored by Stephen Ratchford

   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.

Identifying Relationships Among Scleractinian Corals

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Scleractinian corals, also referred to as hard corals, are the frameworks of our coral reefs. They provide a diverse habitat for many organisms. Previous methods of classification using morphological characters to construct phylogenies have shown high variability. Species of corals are very difficult to differentiate using morphological traits. Phylogenetic analysis of corals has produced varying results between morphological and molecular data. A suite of molecular markers will be used to evaluate relationships among scleractinian coral families. Our results will be used alone and in combination with data from other Cnidarian taxa to construct a phylogenetic tree. We collected eight species of scleractinian corals from Brewer's Bay, St. Thomas, USVI. Coral DNA was extracted using a CTAB extraction protocol and our gene regions were amplified by the polymerase chain reaction (PCR). Gel electrophoresis provided visual evidence of our extracted genomic DNA and PCR products. PCR primer pairs for mitochondrial (18S) and nuclear (28S) DNA are being used to amplify specific gene regions from each coral. Our data will be used to construct phylogenetic trees and to identify relationships among scleractinian corals.

^{57}Fe Exchange in Hemoglobins Starting with ^{57}Fe$_2$O$_3$ by Heme Exchange

Charnise A. Goodings   Faizah Syed-Ali

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_2 in structure. Is it possible for the Fe in the hemoglobin to pick up the NO molecule like it picks up the O_2? **Mossbauer spectroscopy can observe an interaction between NO and the Fe ion in hemoglobin via, but the iron must be enriched in ^{57}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.

Decision tree models for solving classification problems: and introduction to data mining

Dana McDougal

Mentor: Marc Boumedine

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. This algorithm is explained using simple 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).

A data mining clustering approach with the K-means algorithm

Andrew C. Warbington

Mentor: Marc Boumedine

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

Changes in mound size of lugworms, *Arenicola cristata*

Jacinthia Greaux, mentored by Stephen Ratchford

Lugworms (*Arenicola cristata*) build large and sometimes dense assemblages of sandy mounds covering thousands of square meters in Brewers Bay. These mounds have the potential to impact other organisms, particularly sessile, benthic invertebrates such as anemones, coral ad sponges. I investigated the dynamics of mound building by lugworms near an area that is part of a long term study of anemones. From five 20x4 m transects, I determined the density of lugworm mounds to be about $0.5/m^2$. I also laid three $16m^2$ quadrats and measured the area and volume of each mound in each quadrat every 2-3 days for one week. I noted that very few mounds less than $100cm^3$ persisted for 2-3 days. Mounds $200-1000cm^3$ grew $50-200cm^3$ per day. Mounds over $1000cm^3$ grew $200-400cm^3$ per day. Maximum size seems to be $4000-7000cm^3$. These data will be useful in parameterizing a model of mound growth, persistence, and potential impact on the sessile benthic community.

BIOACTIVE METABOLITES FROM CARIBBEAN SPONGES

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The fractionation of the ethyl acetate extract of *Pseudocerateina crassa and Ircinia stroblina* has resulted in several potential anticancer leads. The sephadex fractionation of extracts of these two VI sponges yielded thirteen semi-pure fractions, six 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, Agelas wiedenmyeri* also displayed microtubule depolymerization activity at these concentrations. Herein we discuss the collection, extraction, preliminary chromatographic separation and biological evaluation of several above mentioned VI sponge species.

Conservation of *Zanthoxylum thomasianum*

by Sayvi George & Duvane Hodge
Mentor: Alice Stanford

Abstract

A species of our local flora, *Zanthoxylum thomasianum,* has become endangered due to deforestation and habitat destruction for the building of roads and other properties. Population genetic data have already been collected for *Z. thomasianum*. In order to properly design a conservation project for this species, we will be studying a congeneric species, *Zanthoxylum monophyllum,* 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 a hot CTAB procedure, then quantified and amplified through a series of different procedures. Of the numerous extractions that we performed, few produced pure DNA. There were no observable differences among 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, and 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.

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

Kavita Balkaran* and R. Charlie Shultz

As an alternative source of feed, duckweed (*Lemna* sp.) may result in a more sustainable and economically viable substitute for commercial diets. The two purposes of this study were to determine if tilapia fed only duckweed would gain weight and determine the accumulation of inorganic nutrients for hydroponic plant production. One-hundred sex-reversed male tilapia (*Oreochromis niloticus*) (90.0 g) were stocked into a 1-m^3 closed recirculation system and grown for 28-days. Fish were fed duckweed daily, *in situ*, based on *ad libitum* response. Over the course of the study water quality parameters remained optimum. Duckweed alone does not provide minimal requirements for sustained tilapia growth; however, it may provide a source of dissolved nutrients important in hydroponic plant production. Future experiments should look at duckweed as a partial replacement of commercial fish diets.

Diadema antillarum have a preference to *A. spicifera* over other algal species.

Fitzherbert Harry and Teresa Turner

Abstract: 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.

Experiments were conducted in the Marine lab at U.V.I from May-July 2007. Urchins were collected and placed in 14 separate buckets in seawater tables. Urchins were then starved for 48 hours. Two types of alga was collected, weighed, and fed to the urchins after the starvation period. Urchins were given 14 hours to graze on algae, afterwards the algae were weighed to find out the percent eaten of each. The urchins were then placed back into their natural habitat and new urchins were collected for future trials. In total four different algae was used: *Acanthophora spicifera*, *Dictyota menstrualis*, *Caulerpa sertularioides*, and *Halimeda opuntia*.

Results show that urchins had a preference to *A. spicifera* over other algal species used. In the future more algal species should be used and more tests should be done to see which algal species urchins ultimately prefer. Knowing this information can help us to know if indeed urchins are the keystone species for reefs to return to coral dominance.