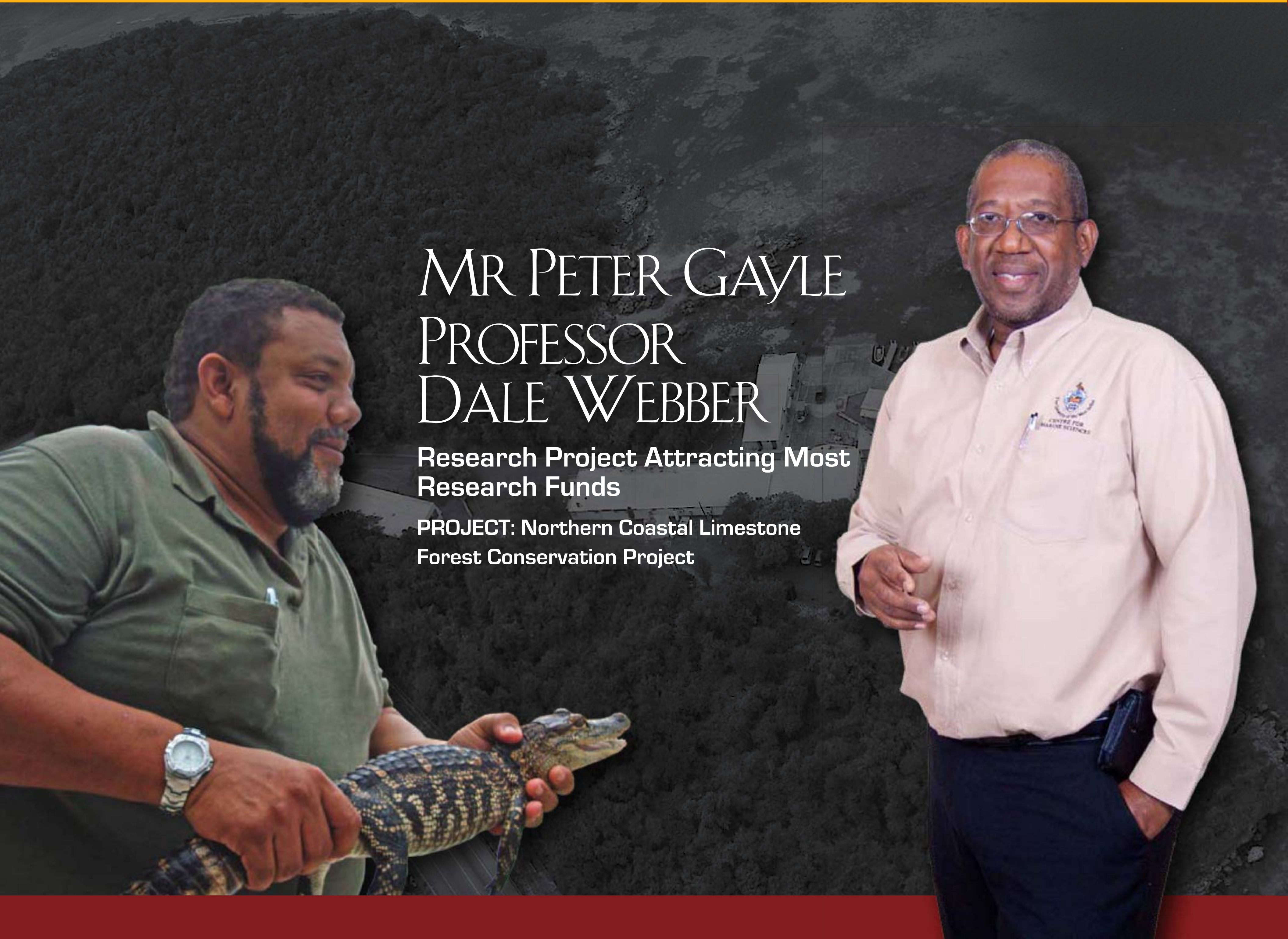
UWI MONA

Faculty of SCIENCE & TECHNOLOGY



Mr Peter Gayle
Professor Dale Webber

Research Project Attracting Most Research Funds

PROJECT: Northern Coastal Limestone Forest Conservation Project

Since the 1970s Jamaica has lost approximately 40 per cent of its coastal forests to developments for tourism and housing. The sensitive limestone forests dominating St. Ann's coastline are under increased scrutiny for development as more accessible, easily manipulated beach areas are taken. Land uses for waste management, uncontrolled settlement/squatting, deforestation (coal production, scaffolding and fish pot sticks) have increased significantly in the last 15 years. These pristine forests that are being destroyed are rich in plant/animal endemism and diversity; [including the Jamaican yellow boa, endemic frogs (Osteopylus & Eleutherodactylus spp.), 6 spp. of Anolis lizards, birds, bats and plants (Laphantes orchids)]. They also serve as sources of groundwater and are important buffer zones between strong ocean waves and the land.

The present situation calls for the conservation of threatened and increasingly fragmented primary limestone forest habitat combined with the rehabilitation of impacted coastal areas. These activities may be enhanced by the implementation of an environmental education programme that targets coastal ecosystems, their functions and exploitable resources so as to encourage alternative development and employment options that demonstrate sustainable uses of pristine or threatened coastal resources.

Discovery Bay Marine Laboratory (DBML) contains approximately seven acres of pristine coastal limestone forest on the western side of the facility and immediately adjacent the Queens Highway in St. Ann which forms part of the north coast tourism corridor. This forest contains many of the protected animals and endemic plant species noted above. DBML has received funding (J$21.3 M) from the Forest Conservation Foundation to develop and implement the Northern Coastal Limestone Conservation Project.

Specific activities within this project will deal with the construction of a Coastal Forest Interpretive/Visitor Facility that utilizes environmentally-friendly construction techniques, materials and alternative energy sources. Key terrestrial features of this Facility will include an 18m diameter wooden gazebo (as a display

and teaching area) outfitted with audio-visual presentation equipment and display terrariums and aquaria; a raised 2m wide, 300m long boardwalk/ trail through the forest. Plants associated with commercial, medicinal and folk uses are labelled using common and scientific names.

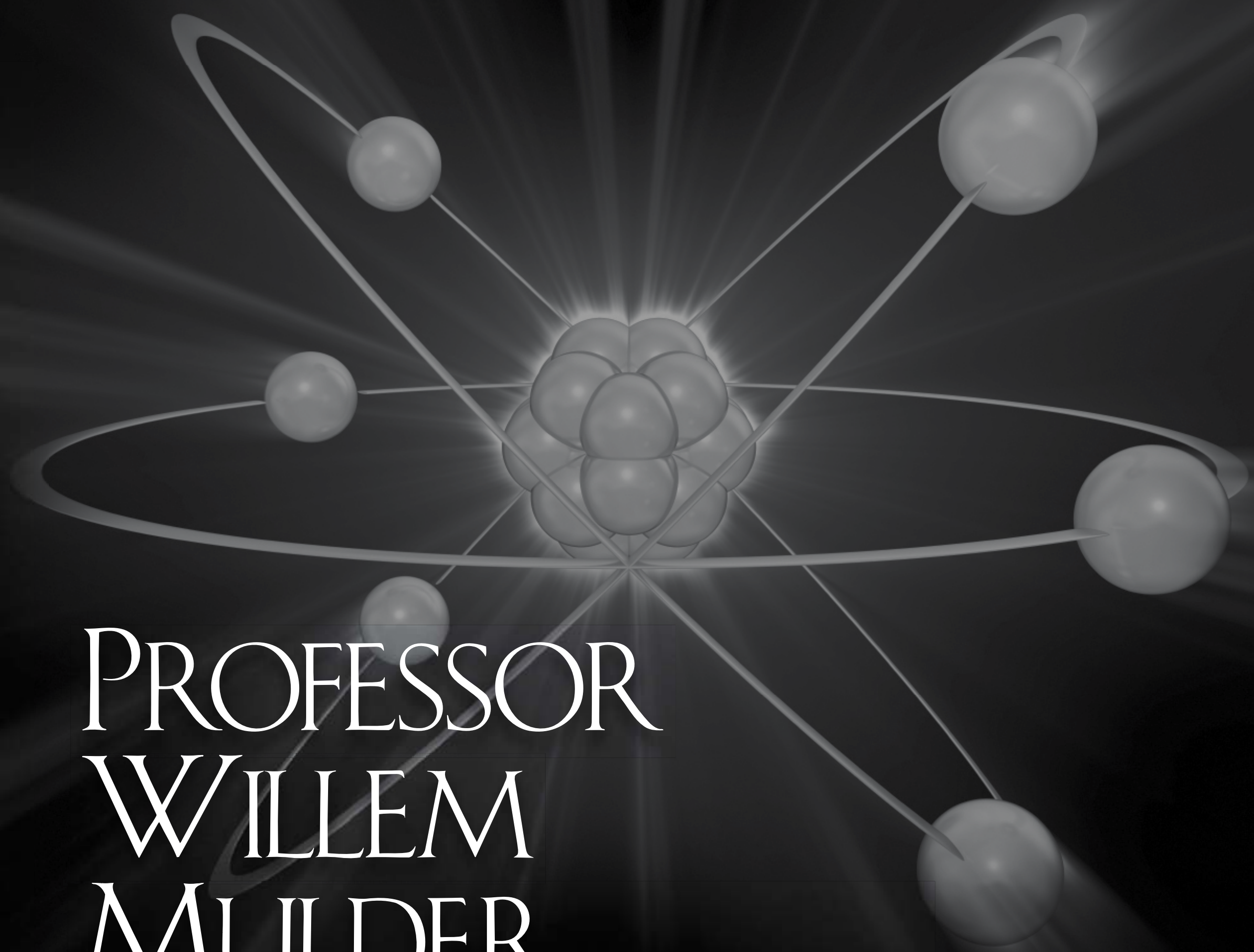
This unique project will fulfill five main objectives. First, it will assist the development of a comprehensive set of guidelines that will detail the best strategies for protecting and rehabilitating threatened coastal resources containing endemic and protected species (e.g. orchids, snakes – the Jamaican Boa, birds, frogs).

Second, this project will seek to conserve habitat biodiversity along Jamaica's north coast, and in particular, its remaining forested areas. The third objective recognizes the continued trend for increased coastal population densities and will therefore highlight options for sustainable use of coastal resources by preserving their basic structure and function. To achieve this calls for the provision of livelihoods linked to an "ecotourism based attraction" as a means of changing negative attitudes to the need for conservation. The fourth objective will see a concerted effort to create alternative and increased employment opportunities for residents from the surrounding community by focusing on those with skills and knowledge bases capable of highlighting coastal forest areas. Any successful ecosystem intervention also creates opportunities for scientific (research) and educational-based activities. This not only increases the stock of knowledge about local habitats but generates educational opportunities for impacting local and eventually international visitors.

Achieving this fourth objective opens the way for the realization of the fifth, namely showcasing ecosystem function. This conservation project will begin with terrestrial but extend to marine ecosystems and demonstrate the peculiar interdependence of coastal habitats and the dependence of the built environment on the natural. Best practices which encompass not only terrestrial activities but enlarge the concept to include coral reef preservation, restoration and fisheries management techniques can serve as a distinctive blueprint for the development of other types of eco-tourism destinations in Jamaica.

Mr Peter Gayle is a Co-Manager of and Principal Scientific Officer at the Discovery Bay Marine Laboratory. His current research interests relate to ecosystem rehabilitation, restoration and fisheries enhancement techniques.

Professor Dale Webber is Director of the Centre for Marine Sciences and the Discovery Bay Marine Laboratory. He holds the Grace Kennedy Foundation funded UWI Chair in Environmental Management named after James Moss-Solomon Snr.



Professor Willem Mulder and collaborators

The Best Research Publication

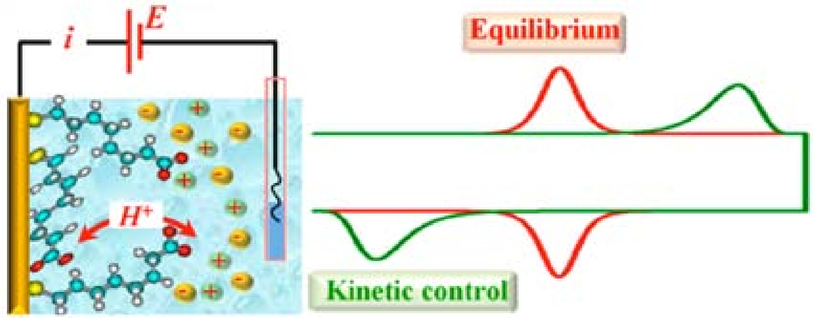
ARTICLE: Proton Transfer Voltammetry at Electrodes Modified with Acid Thiol Monolayers

Nanoscience is the study of objects with at least one dimension in the range from 1 to 100 nanometer (1 nm = 0.000000001 m). These objects exhibit interesting and unusual properties, in comparison with bulk materials, associated with the confinement to this scale, in particular quantum mechanical effects such as electron tunnelling through electrically insulating films. Peculiar phenomena such as these have found applications in diverse fields of technology, from computers (in the fabrication of giant magnetoresistance-based hard drives for reading and storage) to medicine, such as in drug delivery, cell repair and nanoelectronic biosensors.

Organic compounds with surfactant-like properties, typically hydrocarbon chains with a sulphur at one end, preferentially attach themselves to the surface of various types of metals, especially gold, through the formation of a strong chemical bond between the metal atoms and the sulphur (or "thiol") end group. Thus, layers of one molecule thickness are readily formed using techniques such as vapour deposition or electrolysis (via oxidation of sulphur). The resulting interfacial systems are commonly referred to as "self-assembled monolayers" or SAMs, for short. They are key elements in the manufacture and study of systems and devices in the field of nanotechnology.

The metallic nature of the substrate renders these systems suitable for use in analytical applications, in the form of electrodes. Since the properties of the bare metal surface are altered by the presence of the organic film, these electrodes are referred to as "modified electrodes".

The self-assembly of organic sulphur compounds offers a convenient route to impart functionalities to the metal surface, that will render it suitable for a wide range of applications such as bio-sensing and cell adhesion. This is achieved through the inclusion of chemical compounds at the other end of the hydrocarbon chains, such as oxidising or reducing ("redox") agents, which exchange electrons with the electrolyte solution present (in a galvanic cell), or protons, if the compound is an acid or base. (The proton, a building block of atomic nuclei, carries the smallest unit of positive charge, e, and is about 2,000



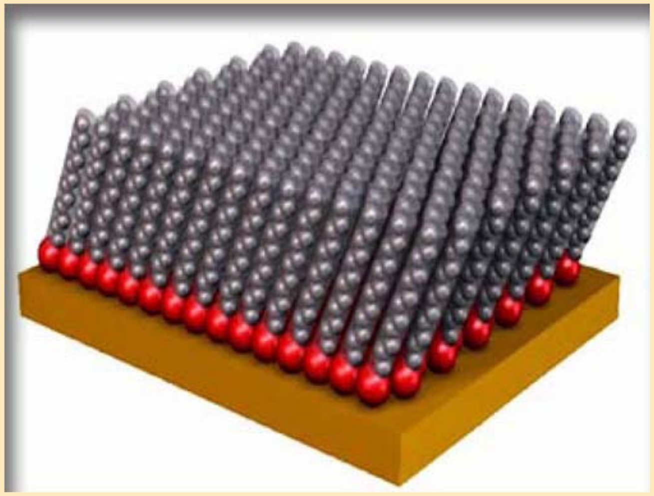
times heavier than an electron, the carrier of the elementary negative charge, –e). The nature of these terminal groups thus determines the (electrochemical) response of the electrode to various chemical and physical stimuli.

Despite the progress that has been made in the knowledge and application of these molecular assemblies, a fundamental understanding of their physical, chemical, and structural properties has remained elusive.

This paper describes a contribution towards the elucidation of some of these issues, summarising the recent outcomes of an ongoing collaboration between the UWI Chemistry Department and the Departamento de Química Física at the University of Sevilla (Spain), which focuses on the properties of modified electrodes. More specifically, the paper describes an experimental and theoretical study of the exchange of protons between a thin layer of chain-like organic molecules deposited onto metal electrodes and a, slightly alkaline, electrolyte solution.

The model system used in this study consisted of a single-crystal gold electrode coated with a compound known as "11-mercaptoundecanoic acid" which has a weakly acidic ("carboxylic") end group that has essentially the same structure as acetic acid (the main component of vinegar).

The electrode was used in an electrochemical cell configuration, connected to an auxiliary electrode via a device known as a potentiostat, which was used to control the voltage between the electrodes. Typically, the voltage is varied at a constant rate and the electric current that flows through the measuring circuit in response to this signal is measured simultaneously. The technique that was applied in this study is known as "cyclic voltammetry", where the voltage cycles back and forth at a constant rate between two extreme values.

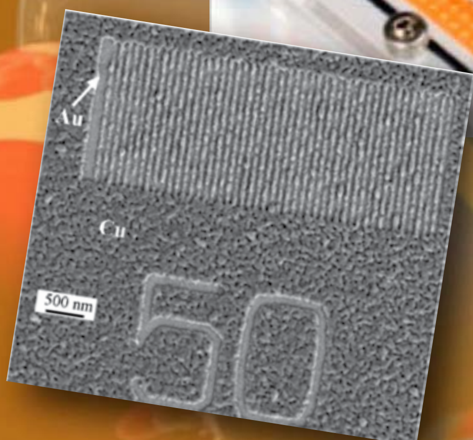


The experimental results have shown that only about 1% of the carboxylic groups are involved in the voltage-induced proton transfer between film and solution, that these groups are buried in the organic film, and that they lie close to the metal surface. The remaining groups are in direct contact with the alkaline medium, and permanently stripped of their protons (and hence electrochemically inactive).

A mathematical analysis of this system in light of a novel physicochemical model has led to the conclusion that a well-established conceptual framework, known as "Marcus Theory", which was developed in the 1950s and 60s for the description of electron transfer processes, is equally applicable to proton exchange since the agreement between theory and experiment was found to be excellent. This theory emphasises the role of the medium (electrolyte solution, film and metal in this case) in determining the feasibility of charge transfer, and quantitatively expresses this in terms of a so-called "reorganisation energy". This refers to the amount of energy required to produce a configuration of the molecules surrounding the proton donor and acceptor such that the proton can jump between them without a net loss or gain of energy, which is a prerequisite for the reaction to occur. The occurrence of a favourable configuration is a random event, governed by thermal fluctuations. Its probability, which is a direct measure of the rate at which protons are exchanged, has been calculated and found to agree remarkably well with the experimental results. In particular, a peculiar phenomenon known as the "inverted region effect" (where, upon increasing the "driving force" behind proton transfer between film and solution, the cell voltage in this case, the process actually slows down) is implicit in this theory, and has been observed in the experiments (albeit indirectly).

The insights gained from the model description in conjunction with the experimental findings can be expected to significantly aid in the rational design of modified electrode surfaces for use in a wide range of analytical applications.

Professor Willem Mulder is Senior Lecturer in the Department of Chemistry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Ms Safiyyah Dundee
Dr Donna Minott-Kates

The Best Research Publication

ARTICLE: Impact of Seed Size on Residual Hypoglycin Levels in Ackee

Historically there have been periodic outbreaks of a "mysterious illness", designated the Jamaican Vomiting Sickness, which would result in numerous deaths in rural Jamaica, typically among children and the elderly. Symptoms vary in severity and include vomiting, lowering of blood sugar levels and, in extreme cases, death. Almost one hundred years ago ackee was implicated as the cause of Jamaican Vomiting Sickness following a report many years earlier by the Island Chemist of extraction of a toxin from distilled ackee. In the 1950s this link was confirmed by researchers at the University of the West Indies who isolated and identified the toxin and determined that these outbreaks could be attributed to the consumption of unripe ackees.

Although the populace knows that ackee which is not fully ripened should be avoided there are still reported cases today of ackee poisoning, the latest occurring over the period December 2010 to February 2011, with several confirmed fatalities. Ackee consumption in Jamaica dates back centuries. Despite this, much remains unknown about the poison which it contains. While the identity of the toxin in ackee (hypoglycin) is known, the various factors which periodically contribute to elevation of the levels of this toxin are yet to be delineated.

Role of the ackee seed in hypoglycin conversion

Hypoglycin, the poison in ackee, occurs in two forms. Hypoglycin A is found in the edible part of the ackee (the aril) and in the seed, while its derivative, hypoglycin B, is found only in the seed which is typically not consumed. Minott's research group previously demonstrated that as the fruit matures and the ackee pod opens the level of hypoglycin A in the aril is exponentially reduced and drops to a concentration which is negligible or safe for consumption. Simultaneously, the amount of hypoglycin B in the seed increases. Evidently, hypoglycin A in the aril is being translocated to the seed and converted to hypoglycin B; the seed thus plays an important role in detoxification of the fruit as the poison moves into the seed where it is stored as hypoglycin B. Following on this finding, the characteristics of the ackee seed were investigated to determine the influence of the seed on the levels of hypoglycin A in the fruit.

Relationship of ackee seed size to hypoglycin content

Mature, open ackees collected from several trees were shown, not unusually, to have seeds of different sizes including very small seeds embedded in the aril. These immature or aborted seeds varied in frequency from 5 to 18% per tree of the ackee fruit population sampled. Ackee seeds, categorized according to size (large, regular, medium, very small), were analyzed using the technique high pressure liquid chromatography, wherein, an extract of the seed was separated into its components and the hypoglycin concentration measured. Levels of the stored toxin, hypoglycin B, in the very small or aborted seeds were less than half that found in the regular seeds and in some cases hypoglycin B was not detected. This indicated that fruits with aborted seeds had a lower capacity to assist in natural detoxification through the translocation route.

When the associated edible part of the fruits were similarly analyzed, the amount of the toxin hypoglycin A in arils from which aborted seeds had been removed were found to be significantly higher than in arils which had borne regular seeds. Fruits from one tree had much higher hypoglycin A concentration than other trees sampled, demonstrating the existence of natural low and high hypoglycin ackee varieties. Arising from this work, efforts should be directed towards identification of suitable low hypoglycin ackee varieties for propagation.

Implications

While it is known that only naturally opened mature ackees should be eaten, the findings adduced by Dundee and Minott suggest that ackee consumers could be well recommended to limit their consumption of arils from which embedded, very small or aborted seeds have been removed. It is advisable therefore, that food processors avoid including significant amounts of ackee aril from very small seeds in order to reduce the residual hypoglycin concentration in the product. Processed ackee is an important foreign exchange earner, ranked in the top five for the agricultural sector. Hypoglycin content in processed ackee is strictly regulated and measures that may be instituted to reduce the residual levels are actively being explored. It is recognised that several factors contribute to an increase in the levels of hypoglycin in ackee, seed size being only one. The possibility exists that these factors might vary at different times and seasons, according to environmental influences, and could act synergistically. This study by Dundee and Minott contributes to the limited information available on factors that are responsible for elevated levels of toxins in the ackee fruit.

Dr Donna Minott-Kates is a Lecturer in Food and Applied Chemistry and Coordinator of the Food Chemistry programme in the Department of Chemistry. Her current research interests include characterization of toxins and other components/ properties of Jamaican foods.

Ms Safiyyah Dundee (MPhil) is a graduate of the Department of Chemistry and is currently an entrepreneur pursuing research leading to potential commercial products of local origin.

Dr André Coy

The Best Research Publication

BOOK: Emulating Human Speech Recognition: A Scene Analysis Approach to Improving Robustness in Automatic Speech Recognition

Advances in Automatic Speech Recognition (ASR) have made it possible to dictate documents directly to a computer or smart-phone. One can, order pizza using an automated telephone-based response system and control various devices using speech. In general, speech recognition has the capacity to positively impact our lives by allowing natural interactions with computers in order to simplify complex tasks.

However, despite these great strides, users of the technology will attest to the fact that the performance of these systems is not quite what they expect. Modern ASR systems still do not perform as well as humans do when operating in noisy conditions, especially where there are multiple individuals speaking at the same time. Most conversations take place in a social context in busy locations. The normal environment in which we would use speech recognition systems is full of unwanted sounds and noises, as well as the buzz of other people's conversations and activity. Human listeners are exceptionally good at recognising and understanding what is said to them in these conditions, yet contemporary ASR is very fragile when placed in such circumstances and recognition accuracy deteriorates dramatically. This has significant implications for the ease of use of the technology as well as its acceptance as a tool for everyday use.

The research conducted in this project presents a systematic approach to the automatic recognition of speech signals from overlapping speakers using techniques inspired by what we know of human hearing. The outcome is a comprehensive insight into the mechanisms required if ASR is to approach human levels of performance. Experimental results prove that developing speech recognition systems that mimic human speech processing increases the robustness of these systems to noise, even when the noise is speech from others.

The potential benefits of this new approach are tremendous as it moves the technology a step closer to the goal of seamless, natural interaction between humans and machines. This enables us to use ASR to tackle real-world problems. Consider two potential applications for Jamaican society: literacy education and assistive technologies for the disabled. Speech recognition can be employed to assist in the drive to have 100% literacy in the future. By developing an automated literacy tutor that is augmented with speech recognition technology, it is possible to reach large numbers of struggling readers to provide the individualised assistance that is needed, but that cannot be delivered given the limited resources in our schools. The Ministry of Education has given permission to conduct a pilot project in 10 Corporate Area Primary Schools. The aim is to record the speech of 450 literate boys in grades 4-6. These recordings will be used to create models of Jamaican speech to be used in the literacy tutor, which needs models of correct pronunciation in order to recognise when errors are made by struggling readers. With additional funding the project will expand into rural schools.

The independence of members of our disabled community can be fostered with the use of speech recognition technology. Take for instance, the current practice of using a sighted individual to transcribe the utterances of a visually impaired student during an exam. The potential exists for the visually impaired to work independently using software developed to perform the transcription directly. If the software is developed using local expertise , the issue of recognising local accents, which commonly arises when using commercially available software, will be eliminated. This could pave the way for greater intake of disabled students and a reduction in the cost of scribes.

The outcomes of the research also have international relevance with the potential for the development of solutions that are applicable worldwide. The approach suggested in the book form the basis of a project currently being undertaken to develop intelligent hearing aids. Currently hearing aids blindly amplify or remove sounds in a certain frequency range, which can sometimes also remove important information. In collaboration with partners at the University of Sheffield, the project which began in September 2012 aims to use techniques based on human speech processing to distinguish between relevant and unwanted sounds in such a way that the hearing aid can remove those sounds that are not relevant to the user, allowing him/her to attend to the source of interest.

These applications are just a few of the many potential uses for the techniques developed in the work. The examples highlight the fact that speech recognition technology is not only useful for popular recreational applications, but it also offers the opportunity for the development of directly applicable solutions to some of the issues facing the most vulnerable in society. .

Dr André Coy is a Lecturer in the Department of Physics. His current work includes the development of automatic speech recognition systems for practical applications.

Professor Noureddine Benkeblia

Most Outstanding Researcher

Physiology, Biochemistry and Metabolomics of Fresh Crops

There are probably 1,000 to 2,000 crop species which contribute to man's diet. But little or next to nothing is known about many others because they are not extensively cultivated or known by local populations of small countries or regions. For example in Jamaica, fruits such as noni, ribena and 'stinking toe' are not well known. Because of the number and complexity of these crops, most aspects of biochemical and physiological changes as they relate to primary, and even secondary metabolism, in postharvest crops are at best incompletely understood, and even events of fairly general importance and which represent major change, such as starch-sugar transformations, are not fully understood at the biochemical level.

Postharvest technology should be given more emphasis, to prevent crop losses and promote the efficient use of agricultural products to meet demands for fresh crops. The development of postharvest technology is one of the contributing factors to securing a stable supply of food products in addition to increasing agricultural income and improvement of diet, especially in many developing countries. Postharvest losses are estimated at more than 45% in some developing countries while the acceptable level should not be more than 10-15%. Even though financial support for agriculture is increasing in a majority of countries, the investment in postharvest technology is still very low compared with other sectors, and this is contributing to negligible interest in this research work.

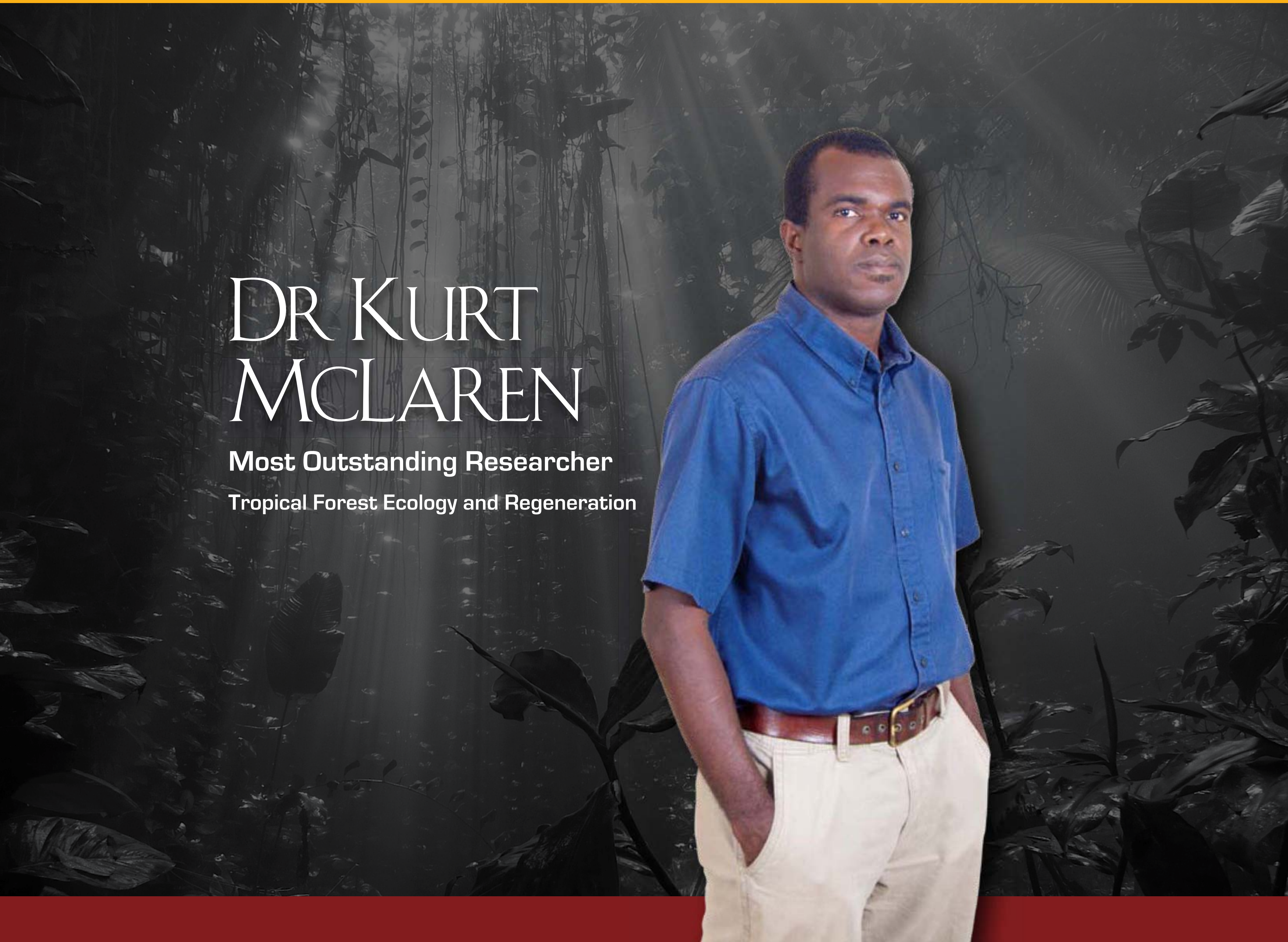
Postharvest physiology and biochemistry of fresh crops affect quality and storability of crops. This postharvest research aims to determine which factors are responsible for postharvest losses and how these factors link to a systems approach to deal adequately with the problem. The goal is not only to extend the storability of postharvest crops which varies considerably because of the specific physiology and biochemistry of each crop, but also to satisfy the consumers' demand for greater variety and better quality of fruits and vegetables.

So how can metabolomics be combined to conventional physiology and biochemistry of crops? From the last two decades, postharvest science has been using emerging technologies, such as genomics, and more recently transcriptomics and proteomics. Crops stresses resulting from natural processes, plant-microbe interactions, physiological disorders and biotic or biotic stresses or other inducing phenomena, trigger many biochemical reactions leading to the formation of hundreds of different molecules. Besides being specific to biochemical reaction, some of these molecules have a very short life and are indicators of specific reactions. Indeed, many molecules are well known to be elicited during specific stresses, and these components could be involved in accelerating undesirable processes, or to the contrary, trigger certain resistance of commodities to these undesirable processes. Metabolome profiling of the system biology constitutes a good survey of different molecules resulting from different reactions of different biochemical and enzymatic reactions. Profiling the molecules preceding, during and/or following the stresses or any other process, would indicate the behaviour of the produce not only at the whole level, but also at the cellular, even the compartmental (cell organelles) levels. This understanding would likely help to determine the appropriate conditions of storage, the physical treatments, such as modified atmosphere/controlled atmosphere, to divert the biochemical reactions towards the desired way, or at least slow down the production of the undesirable molecules by reducing the speed of the respective reactions. This will also help to make commodities acquire a self-defense biochemical system, extending the shelf-life of commodities with less stress and better quality attributes for preservation.

Fresh crops are very rich sources of bioactive compounds such as phenolics and organic acid. Biochemistry combined with metabolomics assay as a new dimension, are also focusing on the biochemical contents of tissues, and are gaining a rapidly increasing knowledge on the value of fresh crops value to human health. Thus, bioactive crops compounds, their characterization and utilization as functional foods, and assessment of their antimicrobial properties, are among the major targets of contemporary research that biochemistry and metabolomics of fresh crops aim to achieve.

The laboratory of Crop Science, in the Department of Life Sciences, UWI, Mona, is developing this research programme: "Physiology, Biochemistry and Metabolomics of Fresh Crops" which include three main topics: (i) The development of storage technologies by understanding physiological and biochemical behaviour of fresh crops during their postharvest life, (ii) the metabolome of postharvest life of fresh crops, and (iii) the profiling of the natural biological active compounds (NBAC) of Caribbean fresh crops and assessment of their biological activities for application as food preservatives and nutraceutical agents.

Professor Noureddine Benkeblia is a Professor of Crop Science in the Department of Life Sciences.



Dr Kurt McLaren

Most Outstanding Researcher

Tropical Forest Ecology and Regeneration

The continuous destruction and degradation of natural habitats and, as a cosequence, the increasing number of threatened species, is particularly severe in developing countries such as Jamaica. Furthermore, it now appears to be a certainty that existing impacts on natural ecosystems will be exacerbated by climate change. Jamaica, like many islands of the Caribbean is highly vulnerable to the impacts of climate change, and especially vulnerable to the effects of sea-level rise. Not surprisingly, the predicted impact of climate change on small island states in the Caribbean has been addressed.

However, many predictions of global climate change are made at the regional scale, and there is a lack of adequate observational data and models of sufficiently fine resolution to provide specific information for individual islands. These deficiencies need to be addressed, so that remaining uncertainties can be reduced or eliminated, and national and local-scale adaptation strategies for small islands can be more precisely defined.

Jamaica, like many other countries in the Caribbean, has been slow to assess the impacts of global climate change due to the same factors that have also inhibited assessment efforts in other countries within the region. These factors include insufficient funding, and most critically, basic data and the required technical expertise. In 2004, we (Prof Byron Wilson and I) embarked on research aimed at tracking biodiversity changes (specifically frogs and trees) in four important terrestrial ecosystems in Jamaica (a moist, wet and dry forest over limestone, and a herbaceous wetland) where we established and assessed a network of plots, and later expanded to include the landscape-level components.

Our current research agenda focuses on (1) generating comprehensive status assessments of biodiversity and habitats/ecosystems, (2) determining habitat specific deforestation rates and habitat fragmentation patterns from 1941 to present, and their effects on biodiversity, (3) assessing the impacts of socio-economic parameters and environmental policies on deforestation and habitat fragmentation, (4) assessing the impact of invasive flora and fauna on native species, (5) increasing local capacity to collect and analyze habitat and biodiversity information, and to use this information to inform conservation and management decisions, and (6) providing a framework for future long-term monitoring of species and habitats.

A more recent (funded) thrust seeks to build on previous initiatives. Specifically, we plan to (1) quantify and valuate the services provided by both ecosystems, using a combination of traditional and emerging technologies, (2) build local and regional capacities by providing training to individuals at the graduate and post-doctorate levels, including the development of a formal curriculum focused on the valuation of ecosystem services, (3) assess the impacts of sea level rise on the vegetation and local communities found within the herbaceous wetland, and (4) incorporate the resultant information into a web-based decision support system (DSS). This initiative has allowed us to invest in cutting edge, state-of-the-art equipment and expand a recently established 'Conservation GIS, Remote Sensing and Ecological Modelling' computer lab (which was established using funding granted by the MacArthur Foundation in 2007). This technology, together with emerging techniques, will be used to generate data and information essential for habitat and biodiversity status assessments, terrestrial and aquatic habitat monitoring, and ecosystem services quantification.

Our research to date has shown that local anthropogenic (human) effects have had significant impacts on these ecosystems. Deforestation in the Cockpit Country for the period 2001 to 2010 is at its highest level since 1941. The threats to the existence of the Black River Lower Morass (BRGM) remain unchecked, resulting in the continued loss or degradation of various habitat types. The Hellshire Hills is under constant assault, and we are yet to determine the impact of 40 years of unchecked cutting of trees for charcoal production at the level of the entire ecosystem. We have quantified some of the services provided by these ecosystems, and this research is ongoing. Also, we hope to determine the impacts of climate change on the provision of these services within the next year.

Dr Kurt McLaren obtained a Double Major (Zoology and Botany) from UWI in 1995, a PhD from Bangor University (UK) in 2001 in Tropical Forest Ecology, an MSc in GIS and Remote Sensing from University of Leeds in 2007. His areas of expertise are Tropical Forest Ecology, Landscape Ecology, Remote Sensing, GIS and Ecological Modelling.

DR MONA WEBBER | MRS SOPHIA DAVIS
MR CAMILIO TRENCH | MR HUGH SMALL
MS SHARDA SPENCE

Research Project with the Greatest Business/Economic/Development Impact

PROJECT: The UWI/EFJ Port Royal Marine Laboratory Biodiversity Centre Project

Coastal marine ecosystems are under threat worldwide with the negative effects from a range of activities destroying habitats, reducing biodiversity and removing ecosystem functions. Coastal and marine ecosystem research carried out by the University of the West Indies, (UWI) Department of Life Sciences at Mona, has documented the tremendous biodiversity associated with the Jamaican coastal area, the impact of pollution and human activities and ways to reduce and remove these threats.

The overall goal of the UWI, Environmental Foundation of Jamaica (EFJ), Port Royal Marine Laboratory (PRML) Biodiversity Centre project was to create a focal point to engage and educate Jamaicans about the habitats and biodiversity associated with mangroves, sea grasses and coral reefs and to show the importance and interrelatedness of these coastal systems.

To this end a grant of J$6,342,070 was obtained in 2009 from the EFJ to modify an un-used building at the PRML and carry out landscaping of the grounds to show natural coastal habitats. The Biodiversity Centre (BDC) was conceptualised as a visitor centre for environmental education and outreach using the research done at the UWI to educate and inform children and adults about these valuable coastal systems, and how their conservation and preservation can benefit us all.

The project had five specific objectives which are summarised into two main focus areas. The first was to design and present examples of mangroves and other coastal systems in indoor aquaria and through other visual and interactive displays. Another focus area was the creation of an outdoor display landscaped to show coastal forests (with emphasis on mangrove and sand dune environments). Scientific findings were converted into posters and visitor information guides which are displayed and used as part of the structured educational tour and visitor awareness activities. A typical visit to the facility may include a tour of the indoor and outdoor displays as well as a boat tour into the nearby Port Royal Mangroves or a snorkel over the reef and sea grass areas of Lime Cay.

The project objectives were fully achieved by January 26, 2010 when the UWI/EFJ/PRML Biodiversity Centre was officially opened to the public. The indoor displays included five main aquaria: mangrove tank, coral reef tank, fishes associated with coastal systems, a predator tank showing open water and benthic predators and a seahorse tank with seahorses grown at the facility. The aquaria are encircled by a touch-tank which houses harmless animals which can be handled by visitors, especially children. The display room has artwork that depicts the habitats and organisms associated with the live display. The indoor displays are constantly modified with addition of new coastal/marine organisms and habitats. A terrarium with baby crocodiles, an octopus tank and a cylindrical jellyfish tank are recent additions.

The outdoor facility displays the typical dry-limestone cactus and sand dune coastal habitats transitioning into a mangrove tree/forest habitat with flowing water connected by a boardwalk. The PRML mini-mangrove forest has all four species of mangroves found in Jamaica (Rhizophora mangle- red mangrove; Avicennia germinans (Black mangrove), Laguncularia racemosa (white mangrove) and Conocarpus erectus (Button mangrove). The cactus and sand-dune area has a range of beach-strand plants such as Beach Morning Glory (Ipomea pes-caprae), beach grass (Sporobolus virginicus) and a range of Cacti: Stenocactus cerus, Melocactus communis (Turk's cap); Opuntia jamacanensis (endemic). That area also includes an iguana hut with two sub-adult Jamaican iguanas.

The BDC can accommodate 150 children per day (three days per week being ideal). Thus the facility can host just over 17,000 visitors yearly. The ability to expose students and adults to Jamaica's marine plants and animals will go a far way in sensitising our population to the value of Jamaica's marine habitats and promote conservation and wise use of the resources.

The BDC has had visitors from all parishes and many schools throughout the year. The children's ages 4 to 18 years and the Prep/Primary schools prefer indoor/outdoor tours, while students from the high schools often combine the BDC tour with a mangrove tour (MGR). Some high schools students visit over a two-week period to cover aspects of the CSEC and CAPE syllabi and the tours and exposure assist with the School Based Assessments (SBA's). Visitors from Teachers' Colleges concentrate mainly on pollution, sustainable tourism and the use of equipment to collect environmental data.

Requests have increased for the demonstration of equipment and carrying out of basic water quality tests and so a "Pollution tour/Lab-at-sea" was developed to demonstrate the equipment and techniques used to sample water quality of the Kingston Harbour. With sufficient notice and dialogue, schools are able to have specific elements and activities incorporated into the "tours" so information/techniques with direct bearing on aspects of the CAPE or CSEC syllabus can be obtained.

Although the BDC project came into being through a grant to Dr Mona Webber, the work to establish and maintain the Centre has been done by past and present employees of the UWI Mona, Port Royal Marine Laboratory. These include Mrs Sophia Davis chief artist and display manager, Mr Hugh Small, Mr Camilo Trench and Ms Sharda Spence who conducted dives, set fish pots and liaised with fishermen to obtain appropriate specimens for the displays.

The Biodiversity Centre Project officially came to an end in November 2011 after the generation of the final project report and financial statements for submission to the EFJ. The UWI Mona Campus

2011 – 2012 financial statement of income therefore indicates funds generated solely from visitors to the facility showed a profit of J$2,224,662.55, however, the potential income from an estimated maximum 17,100 student visitors per year ($800 per student for the combined Biodiversity Centre and Mangrove tour) is J$13,680,000.

Dr Mona Webber is Head of Department of Life Sciences and Academic Coordinator of the Port Royal Marine Laboratory- PRML

Mrs Sophia Davis is Administrative Officer at the PRML and also a PhD student conducting research on the culture of the Jamaican seahorse found in mangrove areas.

Mr Camilio Trench is Senior Scientific Officer formerly at the PRML and now at the Discovery Bay Marine Lab. Camilio has an MSc in Marine and Terrestrial Ecosystems.

Mr Hugh Small is Chief Scientific Officer at The Port Royal Marine Laboratory. Mr Small has an MPhil in Marine Sciences.

Ms Sharda Spence was the first Outreach Officer employed to the newly launched Biodiversity Centre from August 1, 2010 – July 2011 helping to develop the tour packages and presentations. Ms Spence has a BSc degree in Marine Biology from Life Sciences.