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- To provide a scientific resource center capable of coordinating international collaborative research of the highest caliber in the areas of medical and veterinary public health, anthropology, ecology, marine and terrestrial biology and ethics.

- To provide a first rate academic opportunity to scientists from the Caribbean and around the world offering unique research opportunities to enhance the knowledge and welfare of local and international communities.

- To conduct applied scientific research for the benefit of community and health development at the local, national and international levels.

- To share relevant scientific information with local and international communities.
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7.2.  Grants

We would like to thank all of the donors who have made WINDREF’s work possible in 2004. These include:

- The Bartholomew J. Lawson Foundation for Children for the rebuilding of secondary schools in Grenada.
- Mary Glenn and the Humbolt State University Grenada Disaster Relief Fund for Grenadians.
- Fogarty International provided support for four veterinary students and two medical students from SGU who spent ten weeks during the summer of 2004 studying wildlife and the population living in and around Queen Elizabeth National Park in Western Uganda, as well as for a student who conducted research in the Dominican Republic.
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- The Iams Company for donations of pet food and products.
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- SGU Docs for Grenada who donated time, resources, and medical and other services to the General Hospital and clinics.
- UNICEF for the support of the Return to Happiness Program.
- A very special thanks to all who provided support, time, and energy to the WINDREF / SGU Hurricane Relief Project.

8.0.  Past, present and future research projects (present research projects bolded)

8.1 Non-communicable diseases

- Angiotensin converting enzyme and angiotensinogen gene polymorphisms in the Grenadian population: relation to hypertension
• Development of a decision rule for screening Obstructive Sleep Apnea and its epidemiologic relevance to the people of Grenada
• Prevalence and associated risk factors of hypertension in a sample population of native Caribbean’s in Grenada, West Indies
• Assessing the prevalence of diabetic complications by examining type I and type II adult diabetics for signs of retinopathy, neuropathy, nephropathy and dermatological changes associated with poor glucose control within the native Caribbean population of Grenada
• Hypertension management and control in two Caribbean countries
• Assessment of the effectiveness of broad-spectrum treatment to children with protozoan and nemathelminthic parasitic infections on diarrhea and school attendance
• The effects of iron-deficiency anemia on cognition and behavior in infants
• Diurnal variation of urinary endothelin-I and blood pressure: related hypertension
• Alcohol consumption in Grenada
• The incidence and mortality of cancer in Grenada over the ten year period: 1990-1999
• The prevalence of abnormal haemoglobin traits in Grenadian secondary school adolescents
• Knowledge, attitudes, beliefs and practices of Sickle Cell Anemia in Grenadian Primary and Secondary school children
• Decompression sickness among the indigenous fishing population in

Grenada: Assessing the burden of disease

• WINDREF / SGU Hurricane Relief
• Spice Research Program
• Sulfate-Reducing Bacteria in Oxidized Freshwater of Tropical Mangroves
• Novel Antibiotics from Tropical Marine Environments: Drug Development in Grenada
• Study of the Mutacin C-7A
• Gram-negative bacteria isolated from aquatic environments of Grenada (61.4°W, 12.0°N), West Indies
• Identification of bacteria producing antibiotics isolated from deep marine biofilms of Grenada
• SGU Environmental Testing Unit (ETU)
• Post-hurricane water surveillance in problematic areas of Grenada
• Evaluation of the relocation potential for villagers residing in Queen Elizabeth National Park, Uganda
• Study of the Calls of the Spotted Hyena at Feeding
• Survey on the attitude of villagers in Queen Elizabeth National Park, Uganda towards the threat of lions, leopards and hyenas
• Epidemiology of Human Injuries Resulting From Wildlife in Ten Villages within Queen Elizabeth National Park, Uganda
• Rural Ugandan Village Perspective on Lion, Leopard and Hyena Conservation
• Epidemiology of Human Injuries by Wildlife in Six Villages within Queen Elizabeth National Park, Uganda
• Prevalence of *Campylobacter fetus* subspecies *venerealis* and other Microorganisms in the Reproductive Tracts of Cattle from the Southern Region of Santo Domingo, Dominican Republic

8.2 Infectious diseases

• Investigation of the prevalence of SIV in the mona monkey (*Cercopithecus mona*) in Grenada
• Seroprevalence of HIV-I and HIV-II in pregnant women in Grenada, W.I. Their knowledge of AIDS and their exposure hazards to the virus
• A cross sectional study of the current status of *Schistosoma mansoni* in St. Lucia by field surveys and supplementary data collection
• Identification and characterization of hantaviruses among the mammal population of Grenada
• HIV/AIDS health education and evaluation program in Grenada
• The seroprevalence of *Toxoplasma gondii* in a population of pregnant women and cats in Grenada, West Indies
• The efficiency of diagnosing women of *Toxoplasma gondii* using PCR techniques in comparison with ELISA
• Dengue virus in Grenada: seroprevalence and associated risk factors
• A current appraisal of dengue virus in Grenada - serotype analysis and vector assessment
• A site receptivity study determining the threat of reintroduction of malaria into Grenada through the study of Anopheline spp. mosquito vectors
• Chlamydial infection among STD clinic attenders in Grenada
• Fever in Grenada
• Mosquitoes and Tourism in Grenada
• Effectiveness of a formula feeding/weaning intervention program in preventing transmission of HTLV-1 from seropositive mothers to newborns in Grenada
• A multi-center longitudinal research study of the behavioral significance of the prevalence of HIV-1 infection in pregnant women and their babies on the islands of Grenada and St. Vincent
• A multi-center longitudinal research study of the ethical analysis of informed consent of the prevalence of HIV-1 infection in pregnant women and their babies on the islands of Grenada and St. Vincent
• Determining the role of IL-15 in mediating function of viral-specific CD8+ T cells in the myelopathogenesis of HTLV-1: Symptomatic versus asymptomatic patients
• Intestinal protozoan infections in 6-12 year old children in Grenada
• Intestinal helminth infections in 6-12 year old children in Grenada
• The prevalence of intestinal parasites in school children in rural Guyana
• The prevalence of filariasis and its effects on children aged 8-14 in the central corentyne region of rural Guyana
• The prevalence of streptococcal infection in school children aged 5 – 15 years in Grenada, Carriacou and Petit Martinique
• Studies examining the elimination of lymphatic filariasis as a public health problem in Guyana
• Seroprevalence of heartworm infection in dogs in Grenada.
• Dengue in Grenada
• Assessing the potential risk factors of dengue and dengue hemorrhagic fever in the tri-island state of Grenada, Carriacou and Petit Martinique
• A comparative study to find out if there is an association between sexual practices and knowledge in adult populations of Botswana and Grenada with the prevalence of HIV/AIDS
• HIV/AIDS in rural Botswana differentiating between informing and educating
• Rheumatic Fever in Grenada
• Isolating T cells from Rheumatic Fever positive blood: Immunofluorescent assay of T lymphocytes via fluorescently labeled monoclonal antibodies
• Possible genetic predisposition to Rheumatic Fever: Demonstrating the inheritance fashion of non-HLA B lymphocyte alloantigen D8/17, a marker for Rheumatic Fever
• ELISA antibody titres against group A streptococcal M protein moiety and cell wall N-Acetyl-D-Glucosamine in Grenadian Rheumatic Fever patients
• Evaluating the effectiveness of educational methods in the prevention of Rheumatic Fever and Knowledge, Awareness and Practices
• Prevalence of intestinal helminth infections in rural Grenadian school children
• Cystic echinococcosis in Morocco and Uganda
• Elimination of Lymphatic Filariasis in Guyana Program

8.3 Unique projects

• Characterization of five amphibians inhabiting Grenada and subsequent isolation and antimicrobial assay of potential antibiotics derived from their skin
• Mona Monkey studies in West Africa
• Investigation of medicinal plants in Grenada
• Use of medicinal plants in Grenada
• Medicinal drugs from the sea. What do Grenada’s waters have to offer?
• Beekeeping in Grenada: Effects of the mite Varroa jacobsoni and its control
• Effects of Grenadian Medicinal Plants on Endemic Microbial causes of Diarrhoeal Diseases
• The neurobiological basis of hypoglycemia-associated autonomic failure
• Stimulation of angiotensin 4 in cardiac fibroblasts activates matrix metalloproteinases through MAP kinases pathways: A model for astrocytes
• REM sleep and memory
• End of life care in Grenada
• Novel antibiotics from tropical marine environments

• Genetic Correlates of the Addictive Diseases: Cocaine, Alcohol, and Marijuana Addiction—Grenada

• An Investigation of Pediatric Botanical Medicine for Acute Respiratory Infections

9.0. Conferences, meetings, workshops sponsored in 2004

Annual Regional Chief Medical Officers Meeting, at St. George’s University, co-sponsored by SGU, WINDREF, and the Ministry of Health. 19-20 April 2004.

CHRC 49th Annual Council and Scientific Meetings, co-sponsored by SGU, WINDREF, and the Ministry of Health. 21-24 April 2004. Held for the first time in Grenada, approximately 250 participants. SGU hosted the Opening Ceremony and Reception.


10.0. Abstracts, Presentations at International Conferences, Invited Plenary / Workshop / Roundtable / Professional Meetings, CME International Seminar Presentations in 2004


- **Macpherson, C.N.L.** (2004). Invited speaker at a course on Ultrasound in Tropical Medicine from 16-24 February 2004 at the University of Pavia in Italy. Presentation was entitled: The role of ultrasound in community based parasite screening programs.


- **Townsend, M.E., Forde, M.S., Persaud, S., and Macpherson,**


11.0. Publications


12.0. Seminars


Ethics of organ donation and transplantation. Robert M. Veatch, PhD, Professor of Medical Ethics, Kennedy Institute of Ethics, Georgetown University, Washington DC. 25 February 2004.

Lymphatic Filariasis in Guyana - the education of health workers. Dr. Shanti Singh, MBBS, MPH candidate. 3 March 2004.


History of Medicine. Dr. David Lennon PhD, Chairman of Microbiology. 24 March 2004.


Immunologic studies on lymphatic Filariasis. Yolanda Ng. 7 April 2004.
CHRC Presentations. Scott Forman, Anthony Junck and Yolanda Ng. 21 April 2004

Cystic Echinococcosis in Morocco. Ella Cameron, MPH, MD/MSc candidate. 28 April 2004

Asphyxia. Dr. Fred Jordan MD, Chief Medical Examiner, State of Oklahoma., and Clinical Professor of Pathology at Oklahoma University Health Sciences Centre. 5 May 2004

Pediatric botanical medicine for treatment of acute respiratory infections. Daniel Firer, MD/MSc Candidate. 12 May 2004

Probiotic microorganisms from coral reef fish mucous. Cynthia Bruno MSc/Ph.D Student. 25 August 2004.

Studies on the people and wildlife in and around Queen Elizabeth National Park, Uganda. MHIRT students. 1 September 2004.
University of the West Indies, European and American universities, research centres, industrial laboratories and innovative small enterprises (SMEs) with local Grenadian SMEs, government and community, in the field of research and industrial innovations protecting the environment and public health.

One of the aims of CERI is to bring all benefits from rationally used resources and targeting priorities which have emerged from a broad-based consultation of the competent political authorities, the scientific world, the business sector, and user representatives.

To contact CERI or to join with the CERI team and contribute with your time, competence or funds, please contact WINDREF/CERI, St. George’s University, Grenada, West Indies. Tel: (473) 444-4357 extension 2465, Fax: (473) 439-1845, E-mail: skotelnikova@sgu.edu.

By Dr. Svetlana Kotelnikova
Associate Professor of Microbiology

6.1.8. Post-hurricane water surveillance in problematic areas of Grenada

The post-hurricane water surveillance project was initiated in October of 2004 at the Caribbean Environmental Research Initiative (CERI). The research focused on the consequences of category 5 Hurricane Ivan, specifically the problems faced in drinking and recreational water quality on Grenada. Figure 1 shows the location of the project’s sampling sites. The project provided educational opportunities for graduate students in the Masters of Public Health program and simultaneously contributed to Grenadian community services provided by CERI, WINDREF, and SGU. The purpose of the project was to assess damages from the hurricane in reference to:

- The quality of the drinking water in a small community of the island
- The management of the water supplies
- The quality of recreational water and tourism management.

Figure 1. Planned sampling sites.

Environmental Testing Unit members Godrick Cornwall (left) and Annette Gerlach (right) working in WINDREF’s lab.

The project is relevant for the White Water to Blue Water Initiative and the climate and global change. The United Nations Educational, Scientific and Cultural Organization (UNESCO) describes the importance of this topic...
explaining that, “[s]ustainable development and poverty reduction cannot be achieved without healthy environment, most important including drinking water.” Today, around 70% of Grenada’s population has access to freshwater through their taps. The remainder of the population obtains their water from rivers, water catchments, and lakes. The natural cleaning capacity that is based on soil and ground surrounding the water effects the quality of the water distributed by tap and in bodies of water. Hurricane Ivan destroyed more than 90% of roofs and 20% of buildings, reduced the number of nutmeg trees by 80%, and demolished the infrastructure of the island. The hurricane’s wind and tornados caused defoliation of bushes and trees, breakage of tree trunks and destruction of the ecosystems in the rain forest. This may lead to deforestation with a number of serious consequences such as landslides, reduction of rainfall, and most important, the reduction of water cleaning capacity based on the rhizosphere microflora.

Jennifer Hooten and Rashneesh Chelapilla collecting samples from a river in November 2004.

The tropical soil contains a thin organic matter-rich layer. This causes the growth of flora to occur in stages with different species in each stage. The period of time for the succession is not known and is very difficult to predict based on available studies of post-hurricane recoveries. Even if the rain forest areas surrounding the important water catchments areas are protected as governmental reserves, a number of animals live there and use the water as drinking source (manaku monkeys, sheep, iguanas, lizards, and so on). Our earlier studies showed that water of Grand Etang Lake even before the hurricane contained gram-negative microflora that was opportunistically pathogenic and probably originated from the animals’ intestines and plant surfaces (Davids and Kotelnikova, 2004). Quality of water in subsurface aquifers depends heavily on capacity of rhizosphere and subsurface biofilm-associated microflora to remove nutrients from the water trickling through the ground and compete with opportunistic bacteria, protozoa and viruses that pollute the water. Many Grenadians live in coastal areas and depends heavily not only on access to pure drinking water but also on oceans and coastal resources for survival. Our previous data showed that a significant proportion of marine pollution comes from land run-off.

Natural disasters (hurricanes) and increased pollution may lead to degradation of marine habitats like corral reefs, areas where fish reproduce and young fish mature. This in turn may lead to decrease of fishing stocks and challenge the ability of coastal populations to meet basic health, economic and social needs. The result is a deficit of food, risk of health impacts, and missed opportunities for sustainable economic development. The program is designed to engage government and business partners in the major growth sectors, such as water treatment and distribution, agriculture and tourism to
promote best business and environment practices, and to support regional activities in watershed and marine coastal management. Part of the activity will be to promote cross-sector management of watersheds and marine ecosystems. The other part will provide community outreach education and training of competent personnel.

The current situation should be studied, documented and used to:
1. manage water quality;
2. estimate alleviation and efficiency of ecosystem to recovery after the hurricane;
3. study effect of deforestation on water quality; and
4. model response of different tropical ecosystems cleaning capacity to hurricane damage and other predictions.

Grenada is a small and isolated island that may be successfully used as a study model system. There are seven different climatic zones going through different monsoons rainy periods. There are three major ecosystems situated in four different climatic zones that are responsible for clean drinking water supply and clean sea water that have been studied pre-hurricane as well as post-hurricane: mountain rain forest lake, mangroves, river, and sea water.

We selected several sampling sites on the island after consultation with the chief environmental officer of Grenada, Mr. Andre Worme. Recreational water was collected and tested from a range of habitats including: recreational beach areas, an estuary edging with fringing reef, river banks, and a volcanic lake at an elevation of 1,800 feet. Sites include Grand Etang Lake, Annandale River, village Apres Tout, Radix, Munich near St. Andrew. Water was also collected from Mangrove Rivers in Woburn. Mangroves can clean sewage from populated areas in rivers running through them. Water was also collected from Grand Anse Beach, Prickley Bay, True Blue, and Black Sand Beach. Samples were collected and analyzed for numbers of CFU of coliforms, MPN of coliforms, dissolved oxygen, salinity, temperature, and pH. Pure cultures of coliforms were isolated from the tested waters and identified. There was no significant increase in pollution in marine samples after the hurricane.

St. George’s General Hospital rear kitchen water drain (above) and the Melville Street standpipe in St. George’s (below) were tested during the project.

The drinking water sites used in the study are listed in Table 1. The most problematic area identified was in Apres Tout village. The water quality was reported and recommendations have been issued to the health officials. Data
indicates that 35 person–weeks are lost per month to diarrhea on average. This is based on information obtained from

Grenada’s Ministry of Health for the five last months of 2004 in St. Andrew’s Parish for children below 5 years old and adults and teens above 5 years old. Drinking water was shown to be the cause of the observed diarrhea. The number of reported cases of diarrhea for small children correlated with number of faecal coliforms in the drinking water studied under the same period (r=0.97) while for the adults the correlation was r=0.70. These facts allowed us to conclude that at least 97% of cases would be alleviated if management of the water source was improved.

Recommendations for drinking water at the Après Tout dam are as follows. The tank in Après Tout Village is at health risk. The water was contaminated with faecal coliforms before and after the hurricane. The main goal of water treatment is the removal and inactivation, as well as prevention of pathogenic organisms. For rural communities with limited access to funds and technical resources, slow rate sand filtration could be the best method to purify the water. The bed will quickly form biofilm-predating protozoa, which will help to purify the water from both pathogenic bacteria and viruses. Additionally, the entire dam should be fenced to protect the water source from animals and allowing only authorized personnel to approach it. Finally, a pipeline should be connected to the tank to prevent water contamination from people’s hands. The drinking water source may be easily protected with these restrictions and policies in place.

The number of hospital reported cases of diarrhea for children below 5 years old (Figure 2) and those over 5 years (Figure 3) increased after the hurricane. Our data showed that bacterial pollution of drinking water observed

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### Table 1. Drinking Water Quality in Problematic Areas of Grenada After Hurricane Ivan

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>Total Coliforms cells per 100 ml</th>
<th>Faecal Coliforms cells per 100 ml</th>
<th>Faecal Enterococcus cells per 100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Après Tout, St. Andrew</td>
<td>23.11.04</td>
<td>TNC</td>
<td>TNC</td>
<td>TNC</td>
</tr>
<tr>
<td>Standpipe, Melville St.</td>
<td>23.11.04</td>
<td>34</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>General Hospital</td>
<td>23.22.04</td>
<td>18</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Standpipe, Radix, St. George</td>
<td>30.11.04</td>
<td>25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Standpipe, Happy Hill Secondary School</td>
<td>23.11.04</td>
<td>TNC</td>
<td>TNC</td>
<td>0</td>
</tr>
<tr>
<td>Holy Cross Secondary School, Munich, St. Andrew</td>
<td>31.11.03</td>
<td>TNC</td>
<td>TNC</td>
<td>0</td>
</tr>
<tr>
<td>Point Salines Airport</td>
<td>7.12.04</td>
<td>19</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>

TNC – Too Numerous to Count

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Apres Tout Water Quality Team:
Lt to rt (back row): Roy Campbell, Cal Macpherson, Lester Arnold, Charles Daniel, Svetlana Kotelnikova, Trevor Noel, Shakera James.
Lt to rt (front row): Christopher Husbands, Andre Worme, Annette Gerlach, Thirath Chau, Rhonda George, Min. Ann David-Antoine, Boscoe George, Lauriston Hosten.
after the hurricane was greater than before the disaster.

The initial program seeks to observe the quality of drinking water, understand patterns of water variability on seasonal time scales, and assess chemical and biological variability based on data from SGU and NAWASA. Part of the program involves analyzing water

Figure 2. Cases of Gastro-Intestinal Disease \(<5\) 2 months before and after Hurricane Ivan in St. Andrew’s, St. George’s and St. John’s parishes

for levels of pollution and understanding factors contributing to pollution and ultimately health risks. The ultimate goal of the project is to develop skilful predictions of water quality variability and changes that result from a natural disaster.

Submitted by Svetlana Kotelnikova, Jennifer Hooten, Annette Gerlach, and Cynthia Bruno

6.1.9. An Overview of Fogarty International-Sponsored Students’ Studies in Uganda

Thanks to a grant from Fogarty International, four veterinary students and two medical students from SGU spent ten weeks during the summer of 2004 studying wildlife and the population living in and around Queen Elizabeth National Park in Western Uganda. The veterinary students studied various aspects and behaviors of the large carnivores in the area, particularly lions, leopards, and hyenas, while the medical students examined the occurrence of injuries inflicted by wildlife on humans who live in villages near the park.

Dr. Raymond Sis, Dean of the School of Veterinary Medicine, was the principal investigator of the Fogarty grant, which enabled the six students, Dana D’Ostroph, Vicki Harris, Chanda Moyers, Aidin Sabet, Emily Talkington, and Asiya Tschannel, to conduct their research in Uganda. Dr. Richard Kabususu, Veterinary Teaching Associate, Clinical Veterinary Pathology at SGU, and Dr. Calum Macpherson supervised the students in the field.

Each of the four veterinary students, under the supervision of Dr. Ludwig Sieffert, a wildlife veterinarian at Makerere University, had their own assignment. One student worked on analyzing and digitizing hyena calls, while another was charged with attaching collars to lions to track their movements and behaviors. “The work on these large predators, which are a threatened population, greatly helped the Uganda Wildlife Authority to better understand the biology of this dwindling population in Western Uganda,” said Dr. Macpherson.
Map of all National Parks in Uganda. Queen Elizabeth National Park is in Southwest Corner

Queen Elizabeth National Park, which is more than 750 square miles, borders on the Democratic Republic of the Congo. “The carnivores often migrate across the international borders, so it’s important to track them,” Dr. Macpherson said. “Studying the movements of the large predators gives a greater understanding of the biology of the animals and helps identify potentially problematic ones and their frequent encroachment on human inhabitants.” WINDREF donated US$1,000 for lion collars and transmitters to Makerere University’s Wildlife Department.

The two medical students studied, under the direction of Dr. Richard Sauer, a surgeon who has worked on injuries caused by wildlife over the last five years, the extent of human injury caused by wildlife in the villages around the park. By interviewing surviving victims and family members of those who did not survive, they learned, among other things, that injuries caused by hippopotamuses and buffaloes were most common and that most of the victims were surprised by the attacking animal.

Fogarty International also granted funds for Jennifer Moran-Morales, a DVM/MPH student, to travel to the Dominican Republic to carry out studies on Bovine Tuberculosis.

Fogarty International, a major research program within the US National Institutes of Health, has sponsored students at SGU through WINDREF for the past three years and is set to continue through 2005.

Dr. Macpherson signed on behalf of St. George’s University a Memorandum of Agreement between the University and Makerere University in recognition of the need for collaboration in areas of mutual interest. The two Universities will work together in facilitating exchanges amongst students and faculty in areas of study and research, especially for those wanting to study wildlife medicine. The agreement facilitates SGU graduate students in programs such as MSc, MPH, and DVM to work in Uganda and take advantage of studying and doing research in the world-renowned national parks. In turn, students from Uganda will have the opportunity to study in the Caribbean. The agreement also facilitates the exchange of faculty; faculty from Makerere will come to SGU as visiting professors and SGU faculty will go to Uganda and work as external examiners.

6.1.10.1. Evaluation of the relocation potential for villagers residing in Queen Elizabeth National Park, Uganda

An increase in population sizes of villages located within Queen
Elizabeth National Park is interfering with the conservation of the park’s large predators. The large predators considered in this evaluation are lions, leopards, and hyenas.

Expanding populations have contributed to increased contact between humans and large predators as well as contact between large predators and domestic livestock. The need for additional grazing land within the park boundaries has become problematic for park officials and for livestock owners. Park officials lack the resources for continuous patrolling of the park area, and livestock owners do not have enough land outside the park boundaries to sustain their growing livestock populations. There is also competition for these grazing areas with wildlife.

Continuous growth of these villages and loss of grazing lands for wildlife have brought the lions, leopards, and hyenas into the villages in search of food. This influx of large predators into the villages has disturbed the residents immensely as their livestock have become the next available prey for these large carnivores. Unfortunately this movement of the large predators into the villages has lead to their death through poisoning and trapping.

Relocation of villagers out of the park area has been considered but is not desired option for village residents. Many generations of the same family have existed in these areas long before Queen Elizabeth National Park was established in the 1950’s. Most of the villages located within the park are fishing villages and depend on the lakes to sustain them. The continued expansion of the population living within the boundaries of the park will continue to challenge the viability of the park in the years to come. Novel solutions to this growing problem will have to be developed if the park is to retain its status as a National Park. Providing education for the local population to see the value of the park may be the only solution.

Submitted by Dana D’Ostroph
MIRT Scholarship Recipient

6.1.10.2. Study of the Calls of the Spotted Hyena at Feeding

The spotted hyena (Crocuta crocuta) is known to have at least twelve different calls that are each used for various social interactions. These hyenas live in large clans and will quickly defend their territory against other rival clans. Spotted hyenas are carnivorous and usually hunt solo or scavenge the prey of other animals. While present at a kill site, spotted hyenas will make many different vocalizations with each call having a specific sound and intention. Listed below are some of their calls and their meanings:

- The “whoop” is the most often sounded at a kill and usually is made in order to bring other clan members to the food source; a characteristic o-o-o-oop!
- The “laugh” of the spotted hyena indicates great excitement; a high giggle sound.
- The “growl” is a warning call, and is a typical deep rumbling sound.

Spotted hyenas are found in many different countries in Africa. Queen Elizabeth National Park in Uganda is home to several spotted hyenas, which are relatively easy to study. It is somewhat rare to actually see the hyena as it makes its gathering call rather than just hear the “whoop” from
Attempts were made for three weeks to get adequate eyewitness recordings of some hyena calls, but only one evening was successful. There was only success once because the times previous to this the bait used was small pieces of fish that was tossed to the ground after the hyenas had arrived. It was finally decided that placing much larger bait on the ground and then calling the hyenas in would provide much more stimulation and thus more vocal activity. On June 24, 2004 at approximately 10:00 pm, a clan of hyenas known to reside in Queen Elizabeth Park was tracked and called in via previously recorded vocalizations of hyenas at a kill site; also the lowing sounds of the wildebeest was used. A kob carcass was placed on the ground as bait and spotlights were used to aid in identification of the animals that arrived. As the hyenas approached and fed their calls were recorded to later be transferred to compact disc so the sounds could be used for further research into the spotted hyenas feeding behavior.

Five hyenas (1 juvenile and 4 adults) immediately responded to the recorded calls and began feeding at once on the bait. Two of the adults began to make growling sounds at the approach of a leopard, thus keeping the animal at bay. Once the leopard was in check, an adult hyena began a long series of whoops that eventually lead to the arrival of six more clan members. Much whooping and laughing proceeded and the feast continued. Another leopard approached, but was also soon sent to the sidelines by the growls of an adult hyena. This hyena was then delegated the task of sitting nearest the leopards to ensure they maintained their distance. A total of approximately 19 hyenas came to feed on the carcass. About half were juveniles. The feeding continued for about 2 hours until almost every remnant of bait was eaten. Throughout the feeding, intermittent whoops, laughs, and growls were emitted.

Submitted by Vicki Harris
SGU School of Veterinary Medicine
MIRT Scholarship Recipient

6.1.10.3. Survey on the attitude of villagers in Queen Elizabeth National Park, Uganda towards the threat of lions, leopards and hyenas

Introduction

Queen Elizabeth National Park (QENP) is one of 10 national parks in Uganda and lies in the southwestern region of the country. QENP's boundaries contain many villages in which the people must try to live harmoniously with the wildlife surrounding them. Of the wildlife species, lions, leopards and hyenas (LLH) are particularly problematic when it comes to domestic livestock deaths. This human-large predator conflict has lead to several deaths of all three carnivore species, causing a decline in their numbers, predominantly lions and leopards. Villagers have tried to find ways to live in peace with the large predators by taking several preventative measures, such as building enclosures for the livestock to stay in at night, putting the livestock up earlier in the evening before the predators have started hunting, and asking the park rangers for assistance before an altercation occurs between either predator and livestock or predator and human.

Conservation of large predators is paramount to QENP for several
reasons. First, the large predators are a key factor in maintaining the balance of nature throughout the park by keeping the prey animals’ population/health in check. Second, the economic survival of QENP is based largely on the revenue brought in by tourism. This revenue in turn is distributed to the villages on a percentage basis by the Uganda Wildlife Authority (UWA). Without this revenue the villages are unable to build proper roads, build schools and provide community benefits that are necessary for a village to thrive. When detrimental interactions between the villagers and the wildlife occur, the people will often kill the large predators to protect their village and livestock. This jeopardizes the population of these animals and in turn jeopardizes the tourism industry: no lions, leopards or hyenas to look at, no money brought in from tourists.

**Objectives**

The objectives of this study were to gather information on the perspectives of some of the people within the villages of QENP on how they felt regarding the large predators coming into their villages and killing their livestock as well as understanding the general attitude of the villages living with the large predators, and to assess the attitude of the villagers regarding the interaction between the lions, leopards and hyenas and the communities and the problems that arise out of this interaction. This information would be given to UWA so that they can take action on recommendations given so that both the wildlife and human communities can live in harmony.

**Methods**

1) Surveys were taken at 3 villages within QENP; Katwe, Kasenyi and Hamukungu, using an interpreter. As the surveys were quite lengthy, in some instances the surveys were modified to try to ask the most pertinent questions to the study. This would be done when an individual agreed to participate in the study, but not for a great length of time.

2) Pictures were taken of the corrals, enclosures or accommodations used to put the animals in for protection against the large predators at night. These will be used to recommend changes to the enclosures if needed.

**Results**

A total of 30 interviews were conducted and 95.2% of the respondents kept livestock. Goats constituted the largest proportion (76.2%) of livestock kept, followed by cattle (61.9%) and poultry (52.4%).

As a whole, the general attitude of the three villages surveyed felt threatened by the large predators,
however, two of the three villages still felt that their community benefited from the presence of these predators, regardless of the negative interactions that take place between the two. All of the people surveyed used methods such as shouting and throwing stones to deter the large predators from proceeding into their village. A large majority of the people felt they wanted to learn more about the LLH so that they could better protect themselves by learning the behavior of these animals. All three villages practice putting their animals in enclosures at night for protection from the predators. However, these enclosures are not constructed adequately to keep out the LLH; therefore all of those surveyed said that they would appreciate free advice on how to construct a proper enclosure for plenty of protection.

**Recommendations**

1) Educate the villagers on how to prevent negative interactions between humans and LLH by holding seminars or workshops planned through the local council. Additionally, the education should be on the behavior of the animals.
2) Provide consultation by UWA to the villagers on how to construct proper enclosures using local materials such as mud and acacia tree branches that will protect the livestock from the large predators at night.
3) Provide the villagers education on the importance of large predators to both the ecosystem and the tourism industry, and the revenue that is brought by tourism goes toward the village income from UWA.
4) As the attitudes of the villagers can tend to be hostile toward the predators, it is very likely that education and law enforcement may not prove to be effective in preventing the animals from being killed by the villagers. Therefore, one drastic, but very feasible recommendation would be to withhold a portion of the revenue distributed by UWA to the villages and put it in a saving account to accrue so that in the future there are funds to totally relocate the villages. The relocation would be on land purchased outside the park with buffer zones so that the villages and wildlife can live harmoniously in their respective lands.

It is significant for the park authorities to study the attitudes of the people living in the park so that measures can be designed to reduce, eliminate or even prevent problems that arise between the humans and the animals.

Submitted by Chanda Miles, Bsc  
(DVM candidate)  
MIRT Scholarship Recipient

6.1.10.4. Epidemiology of Human Injuries Resulting From Wildlife in Ten Villages within Queen Elizabeth National Park, Uganda

**Introduction:**

Human injuries resulting from wildlife are common in fishing villages within Queen Elizabeth National Park in western Uganda. This trend is repeated in parks across East Africa where people live in close proximity to concentrations of protected wildlife and, as a result, represents a significant public health concern. Many of the affected villages subsist in extreme poverty and thus lack adequate access to health care. Record-keeping of the attacks and injuries are often non-existent beyond the word of mouth. The purpose of this study was to
attempt a systematic documentation of as many incidents as possible in the fishing villages surrounding the park.

**Materials & Methods:**
A series of on-site semi-structured interviews were conducted with the people attacked, in the case of injuries, and with the family and friends of the people attacked in the case of fatalities. Over the span of several weeks, 105 interviews were performed in the villages of Katunguru, Kazinga, Kasenyi, Hilltop, Kaganda, Rwenjubu, Kyakitale, Kyaruha, Hamakungu, and Mweya. When appropriate, digital photographs were taken for future analysis.

**Results:**
Of the reports collected, 82.4% were male and 55.4% were fishermen at the time of attack. Whereas cases of hippopotamus and buffalo attacks and fatalities predominated (58.1% and 25.7% respectively), other animals included snakes (4.1%), lions (2.7%), leopards (2.7%), monkeys (2.7%), elephants (1.4%), and warthogs (1.4%). Approximately 59.5% of the victims were taken to a hospital, while 33.9% visited a local clinic and 6.8% settled for local herbal and massage therapy. The average duration of stay under care was 2.3 months and the average time until resuming normal life was 13.9 months. It should be noted that many could not return to their previous lifestyle and often experienced pain long after the attack. Interestingly, few attacks were noted between the months of October and January. The Uganda Wildlife Authority (UWA) was informed roughly 2/3 of the time, although this was difficult to ascertain due to the seeming lack of a formal notification system.

**Discussion:**
The fear of repercussions for illegal fishing and gathering activities mostly likely influenced the validity of some of our data, particularly with respect to the location of the attack and the notification of UWA. Nevertheless, about half of the victims reported being attacked either in the village or on the river landing site. These locations are thus logical points of focus for future intervention and preventative measures. The ultimate goal of the research was to paint an accurate picture of the problem and, if possible, identify risk factors for such violent encounters.

Aidin Sabet  
MIRT Scholarship Recipient

**6.1.10.5. Rural Ugandan Village Perspective on Lion, Leopard and Hyena Conservation**

There is a land-usage conflict between 11 villages within and near Queen Elizabeth National Park (QENP), Western Uganda, and the wildlife that exists there. Once abundant populations of lions, leopards and hyenas are declining rapidly due to encroachment and poaching done by people. The massive increase in human population is destroying Uganda’s most important money-maker and natural resource—theyir animals. This study was done to determine village perspective, ideas and possible solutions on how people and wildlife, more specifically lions, leopards and hyena (LLH), can live safely and in harmony with each other.

Using translators and a 22 question survey, over 25 villagers were randomly interviewed in three different communities located within and nearby
QENP in late June of 2004. The results showed that education regarding the behavior of wildlife and how to properly protect livestock and villagers from wildlife is absolutely needed. 100% of those surveyed believe that LLH should be conserved, yet they all feel threatened by wildlife. Only 40% believe they benefit from wildlife financially, although each community receives 25% of the park’s revenue annually for communal projects like schools and clinics. Digging trenches, planting spear grass and putting up tree-trunk fences were a few ideas they came up with to further prevent attacks or crop pillaging. The solutions given for land-use conflict included: giving more parkland to villagers, giving them permission to kill animals coming into their village OR offering them seminars and workshops building proper livestock enclosures and about their eating and hunting behavior. The latter solution seems optimal.

Recommendations to the Uganda Wildlife Authority include: integrating wildlife education/conservation classes into schools starting at the elementary level, training those caught for poaching to become conservation education leaders in their community, offering workshops on how to build safe cattle, goat and poultry enclosures, and offering wildlife conservation and behavior classes to rangers as part of their training. A human family planning project should also be installed. With more education and improved management, there is a better chance of future prosperity for both humans and animals. However, this will only come about if humans start taking care of their land and animals now.

Emily Talkington
MIRT Scholarship Recipient

6.1.10.6. Epidemiology of Human Injuries by Wildlife in Six Villages within Queen Elizabeth National Park,

The extent of human injuries caused by wildlife in the eleven villages within Queen Elizabeth National Park, Uganda, is largely unknown. A retrospective study of victims of wildlife attacks was thereby conducted in six villages: Hamakungu, Kasenyi, Katunguru, Katwe, Kazinga, and Mweya. Data was collected by photographs and standardized structured interviews with as many victims as possible. Translators in the form of hired staff and local chairmen were used to facilitate the interviews.

In total, 74 surviving victims and 31 contacts of dead or surviving victims were interviewed, with the majority of data originating from the villages of Katunguru and Kazinga. Of the victims interviewed 82.4% were male and 55.4% were fishermen, with an average of 3.6 children. Injuries caused by hippopotamuses and buffaloes were most common, amounting to 58.1% and 25.7%, respectively. Less common were attacks by snakes (4.1%), leopards (2.7%), lions (2.7%), monkeys (2.7%), warthogs (1.4%), and elephants (1.4%). All but one victim were surprised by the attacking animal, and the injuries were found to consist of either deep cutting, penetration, or crushing. Interestingly, few attacks on humans occurred between the months of October till January.

Data gathered from surviving victims showed that 59.5% went to the a hospital for care, with most attending Kagando hospital, located some 40 to 60km away from the villages studied. Alternatively, 33.9% went to local clinics in their village or nearby, and
6.8% used local herbal and massage therapies. The average stay for victims who went to hospitals and clinics was 2.3 months. Considerable morbidity was found to result from wildlife injuries; victims on average took 13.9 months before resuming their normal lifestyle and many still felt pain. During those inactive months, many victims had to request help from family members to take care of their children.

Population growth in these villages has forced many people to fish, graze livestock, and collect firewood in protected areas where wild animals reside, creating a public health hazard. It was difficult to discover the extent of attacks occurring during these illegal activities, however, with close to half of the injuries sustained either in the village or at the landing dock, other risk factors are indicated. Most victims injured, 67.6%, notified the Uganda Wildlife Authority, but only 8.2% received any form of compensation. Families of victims who died fared better, with 15% of the families interviewed receiving compensation.

It is hoped that this research will create a better understanding of why these injuries occur, and lead to the identification of the risk factors for wildlife attacks. It is clear that more research is needed and that the communities affected need to be involved in the formation of and education about appropriate preventative measures.

Asiya S. Tschannerl
MIRT Scholarship Recipient

6.1.10.7. Prevalence of Campylobacter fetus subspecies venerealis and other Microorganisms in the Reproductive Tracts of Cattle from the Southern Region of Santo Domingo, DR

From May 31 to August 6, 2004, I worked at Laboratorio Veterinario Central (LAVECEN) in Santo Domingo, Dominican Republic. Under the supervision of the bacteriology and mycology staff at the lab, I investigated the prevalence of Campylobacter fetus and other pathologic microorganisms in the reproductive tracts of cattle from various farms of the country.

All of the media needed for the research is prepared in the media preparation department of the laboratory. These included Selective Enriched Transport Media, also known as “Cooked Meat”, saline tubes, blood agar Petri plates, Eosin Methylene Blue (EMB) Petri plates, Vibrio agar plates and Cary Blair agar transport tubes. I was responsible for ordering the appropriate media in a timely manner. I also helped prepare the media when I had extra time. In addition to media preparation, other materials had to be prepared. To obtain the best sample, we needed sterile swabs that were long enough to reach the outer wall of the cervix of the cows. The swabs that were available for purchase were extremely expensive so we had to improvise with shish-ka-bob sticks and cotton. After the
swabs were made by hand, they were packaged and sterilized in an autoclave.

Dairy farms visited across the country to collect samples ranged from very clean and well managed to filthy and poorly managed. Samples were collected by first washing the vulva of the cow with fresh water. The vaginal lips were then held open to further prevent fecal contamination on the sterile swab as it was inserted up to the outer cervical wall. The swab was then stored in a tube of saline or Cary Blair transport agar. After several hours, about 2ml of inoculated saline was then further inoculated into Selective Enriched Transport Media (cooked meat media). Over the weekend, the saline and Cary Blair was kept in a refrigerator and the cooked meat was incubated at 37°C.

Vials of cooked meat, tubes of saline, Cary Blair media, filters and swabs.

The cooked meat solution was streaked onto Vibrio agar plates and incubated at 42°C in a 10% CO₂ enriched environment for at least 3 days. The Vibrio plates were used to specifically culture Campylobacter bacteria. The Cary Blair swabs were streaked on both Blood agar and Eosin Methylene Blue agar and incubated at 37°C for 24 hours. These were used to culture other pathologic bacteria besides Campylobacter. The saline swab was inoculated onto tubes of Sabouraud agar to select for pathogenic fungi. These tubes were left at room temperature for at least 5 days.

After allowing the blood agar and EMB plates to grow for 24 hours, I inspected the plates for colony growth. Each unique, abundantly growing colony was recorded descriptively and gram stained. Bacteria that could not be identified by these techniques, was then inoculated into distinguishing media such as Triple Sugar agar, Urease agar or SIM agar. We then tested the bacteria for antibiotic resistance.

192 vaginal swabs and 7 preputial flushes were taken to isolate Campylobacter fetus subsp. venerealis, and other infectious agents within a two month period. No Campylobacter fetus subsp. venerealis were isolated. The following table lists the pathogens that were found and their prevalence in frequency and percentage out of total amount of samples.

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli</td>
<td>116</td>
<td>58.3</td>
</tr>
<tr>
<td>Proteus spp</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Staphylococcus spp</td>
<td>17</td>
<td>8.5</td>
</tr>
<tr>
<td>Streptococcus spp</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Shigella spp</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Escherichia freundii</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Alcaligenes faecalis</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Klebsiella spp</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Levaduras</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Candida spp</td>
<td>49</td>
<td>24.6</td>
</tr>
<tr>
<td>Aspergillus niger</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>No bacterial proliferation</td>
<td>61</td>
<td>30.5</td>
</tr>
<tr>
<td>No mycotic proliferation</td>
<td>139</td>
<td>70</td>
</tr>
</tbody>
</table>

The microorganisms with the highest prevalence were Escherichia coli.
and Candida spp. Further tests were conducted to verify if the Candida species that we isolated was Candida albicans, a known pathologic species. None of the Candida isolates were. The rest of the Candida species are considered normal flora in the vagina of cattle. Escherichia coli is found in the normal intestinal flora and consequently fecal flora of cattle. Therefore we questioned whether Candida spp and E. coli are truly a reproductive problems or if we got cross-contamination.

Several other factors cast doubt on the pathogenicity of these microbes. To start with, the samples taken were vaginal and not uterine. To get a proper causative diagnosis of reproductive problems, the sample should be taken from the uterus or the affected foetus. It should also be taken as soon after the reproductive incident as possible. Many of the cattle that we sampled had histories of reproductive problems but the times of occurrence were not indicated. After a length of time passes, secondary infections may occur with opportunistic bacteria or the infection may be naturally flushed out of the animal’s system. You must also take into consideration that once abortions or stillbirths occur the cattle are given antibiotics to clear the infection. This tampers with the accuracy of diagnosis and the flora of the reproductive tract. Considerations must also be made for pathology not categorized as bacterial or mycotic. Bovine reproductive problems may be caused by parasites, viruses, toxins and physiologic problems such as stress and trauma.

I conclude that E. coli and Candida spp are not significant reproductive pathogens in cattle. The pathogens on the list that I felt more worthy of investigation are Pseudomonas aeruginosa, Proteus spp and Aspergillus niger. These microbes have been previously documented to cause reproductive diseases in cattle and other animals. They were also previously reported in the journals at LAVECEN. They are also known to be zoonotic.

There were several problems encountered during my investigation. The Dominican Republic is under electrical crisis and so the entire laboratory is run on a generator. The generator is run only during working hours and so at 2pm or usually even earlier, the generator is shut off. This limits the amount of work accomplished in a day and effects the temperatures of the refrigerators and incubators when the laboratory is closed. There was even an incident where the generator broke down and the laboratory was, for the most part, non-functional. A few departments improvised in order to get their work done without electricity or water. These conditions make it very difficult to grow bacteria that are as finicky as Campylobacter.

I also ran into problems with the people picked to do the investigation with me. Two other students, undergraduates were also chosen for the internship. However, they had no practical laboratory experience, they did not speak Spanish and their school
training had nothing to do with public health or veterinary medicine. It was pretty obvious that they also were indifferent about the investigation and how the results would turn out. Therefore, a lot of mistakes such as contamination and forgetting to report significant information occurred. At one point the head veterinarian in charge of the investigation wanted me to do the work entirely myself. This put additional stress and responsibilities on me and negatively affected the investigation. Overall, the knowledge I gained from this experience was very beneficial and enjoyable. I had the opportunity to experience what it would be like to work in an actual public health setting. I got a taste of how a clinical laboratory is run and the politics that go along with it. I was also able to help cattle farmers understand how to prevent future infections in their cows and consequently transmission to themselves and consumers of their products.

Submitted by Jennifer Moran-Morales, MIRT Scholarship Recipient

6.2. Communicable Diseases

6.2.1. Genetic Correlates of the Addictive Diseases: Cocaine, Alcohol, and Marijuana Addiction – Grenada

Following our final meeting in August, the Genetic Correlates of Addictive Diseases study was approved to begin on the 20th September. On September 7th Grenada was hit severely by Hurricane Ivan.

The proposed source of our samples was supposed to be residents of Carlton House, St. Paul’s. The drug rehabilitation building was destroyed and closed. As a result, the blood samples and the administering of family origin and KMSK scale questionnaires was prevented.

Carlton House, St. Paul’s, before and after Hurricane Ivan.

Through further meetings with the Ministry of Health, another site, Rathdune Clinic, was selected for the sample draws. This site was considered in the initial proposal to be a secondary site. From an ethical perspective the change of site was approved by the SGU IRB and the Ministry of Health Research Oversight Committee. The change of venue requires that all informed consents will be administered to patients who are at minimum four days drug free and who have no active psychoses. This diagnosis will be made by the physicians at the Mt. Gay hospital.
Trevor Noel, Mary Jeanne Kreek and Esperance Schaeffer with members of Mt. Gay hospital staff at the Rathdune clinic.

The study is now scheduled to start on the 11th April 2005.

Submitted by
Trevor P. Noel
Assistant Director, WINDREF

6.2.2. Elimination of Lymphatic Filariasis in Guyana Program

A reliable supply of DEC fortified salt has been ensured. Community-wide promotion of the use of the DEC salt has been established through focus groups in several areas of Guyana. Sentinel site studies are planned to take place in August/September 2005. Morbidity studies have continued throughout the review period in eight sites. Two new nurses have been added to the morbidity team. The core task force group has been meeting through early January 2005, and four subgroups meet more regularly: these included the morbidity and DEC salt production and supply subgroups. Research activities are ongoing in the areas of morbidity assessment and salt standardization. Currently, the coastal areas of Guyana are experiencing extensive flooding, and an intensive DEC salt promotion distribution is planned.

Shamdeo Persaud, MD, MPH
WINDREF Research Fellow

6.2.3. An Investigation of Pediatric Botanical Medicine for Acute Respiratory Infections

The prevalence of acute respiratory infections in Grenada and worldwide is at an alarming rate. Resistance to the common pharmaceutical drugs applicable for respiratory infections is becoming quite evident. Ethnobotanical research in tropical areas as well as globally has bestowed the field of medicine with an astounding number of valuable drugs (Filipendula ulmaria; aspirin, Papaver somniferum, morphine, Digitalis purpurea, cardiac glycosides). This particular study investigates the medicinal plants recommended by experienced traditional healers for children with acute respiratory infections. Eighteen traditional healers from the island of Grenada, West Indies, and several from the neighboring islands of Carriacou and Petit Martinique, will help target the plants applicable for this study. The semi-structured interviews will be conducted with approximately three traditional healers per each of the six parishes. The focus is primarily the symptoms accompanied by Streptococcus pneumonia and Streptococcus pyogenes. The medicinal plants discovered to have antimicrobial properties will be utilized against the specific bacterial strains for any biological activity.
Based on previous research in Grenada, botanical medicine is still practiced by the traditional healers and the general population. The question arises whether these botanical remedies have specific biological activity to combat the acute respiratory infections targeted in this study.

Traditional healers, otherwise known as shamans or yachaks in other cultures, have been the leading source of knowledge and education for ethnobotanists in addition to being the primary source of healing when conventional medicine is not available (Plotkin, 1993).

When identifying the common pediatric diseases of Grenada, information was gathered from the World Health Organization (WHO) and the Ministry of Health (MOH) in Grenada. Table 1 illustrates the disease prevalence in Grenada for the various age groups bracketing children. The bacterial strains most common among acute respiratory infections were identified by Dr. Nelson (personal communication) as *Streptococcus pneumonia*, *Streptococcus pyogenes*, and general influenza.

As illustrated from the table, the prevalence of disease for ARI and ARS are substantially higher in comparison to other diseases in Grenada targeting children. Acute respiratory infections are also a global concern in developing countries based on health standards and hygienic practices (Nascimento-Carvalho, 2001).

The proper investigation for this type of research requires a dichotomous approach encompassing ethnobotanical investigation and *in vitro* antimicrobial experimentation of the plant extracts against bacterial strains *S. pneumonia* and *S. pyogenes*. Before traditional healers were contacted, the researcher identified the focus of research based on prevalence of disease. Additionally, familiarization of flora and vernacular associated with culture and botanical medicine within the region provided ease when study is underway. Semi-structured interviews and a free-listing method will comprise a study population of eighteen traditional healers from Grenada. Once botanical remedies have been documented, the plants extracts will be tested against the *S. pneumonia* and *S. pyogenes* bacterial strains to determine any inhibition and bactericidal effects. Plants will be air-dried and extracts held in 95% ethanol. Once experimentation begins, the solvents are evaporated and plant extracts are ready for the antimicrobial assays. The antimicrobial activities of the plants applicable to ARI’s will be evaluated by means of the minimum inhibitory concentration (MIC) and the minimum bactericidal concentration (MCB). The test tube indicating no visible growth of antimicrobial activity during the MIC test will be applied to the MCB assay.

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### Table 1: Prevalence of Disease in Grenada (MOH, CAREC Program 2004)

<table>
<thead>
<tr>
<th>Disease**</th>
<th>Age 0-1</th>
<th>Age 1-4*</th>
<th>Age 5-14*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHC</td>
<td>6</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>ARI</td>
<td>0</td>
<td>4</td>
<td>413</td>
</tr>
<tr>
<td>ARS</td>
<td>331</td>
<td>628</td>
<td>0</td>
</tr>
<tr>
<td>DIA</td>
<td>12</td>
<td>15</td>
<td>23</td>
</tr>
<tr>
<td>GEI</td>
<td>19</td>
<td>53</td>
<td>0</td>
</tr>
<tr>
<td>GES</td>
<td>1</td>
<td>3</td>
<td>63</td>
</tr>
<tr>
<td>SCA</td>
<td>8</td>
<td>18</td>
<td>16</td>
</tr>
</tbody>
</table>

* The age groups targeted for this project are 1-4 and 5-14 years of age.

** Explanation of coding: AHC is acute hemorrhagic conjunctivitis, ARI and ARS are acute respiratory infection and syndrome, DIA is diarrhea, GEI and GES are Gastro-enteritis diseases, SCA is scabies.
Subsequent concentrations will be increased and applied to the MCB assay.

The information gathered from the traditional healers and the antimicrobial assays will be utilized for prospective studies in addition to potential for drug development. Plant monographs will properly illustrate the visual images, the characteristics describing its biological activity, and any descriptions of environment and morphology relating specific to species. The antimicrobial assays will conclude the potency of plant compound by set amount of mass of plant and part (i.e. 0.2g/mol, root).

Daniel Firer in the field posing questions to a knowledgeable botanist.

As the number of cases of infectious disease victims rise, there is a necessity for more advanced antimicrobial agents to combat this health concern. Ethnobotanical investigation not only searches for the miraculous drugs available in tropical settings, but also is concerned with the practical use and cultural context associated with botanical medicine. Especially in Grenada, the prevalence of use has been diminishing since the advent of pharmaceutical intervention; however, there still exists a reasonable amount of Grenadians entirely reliant upon botanicals for health remedies.

Submitted by Daniel Firer, WINDREF Research Scientist

7.0. Acknowledgements

WINDREF works in close collaboration with a number of local and internationally based institutions and individuals. In Grenada, we would like to thank the Ministry of Health, Ministry of Education, Ministry of Agriculture and the National Parks and Protected Areas Department, Ministry of Tourism and the Forestry Department for their help and cooperation with the research projects. We would also like to thank Senator Ann David-Antoine, the Minister of Health, and Dr. Satnarine Maharaj and Dr. Bert Brathwaite, Chief Medical Officers, for their considerable input during 2004.

7.1 Associated faculty, staff and collaborators

Collaborator  Project(s)
Mr. David Alexander ... Substance Abuse
Min. Ann David-Antoine......All projects
Dr. Bert Brathwaite............All projects
Mr. Roy Campbell .......... Water Quality
Min. Clarice Charles.........All projects
Ms. Anna Chobor...............Relief
Dr. C. Cox-Macpherson.......All projects
Mr. Charles Daniel......... Water Quality
Ms. B. Douglas ....... Gram Negative Bacteria
Dr. Paul Garner.................. Relief
Mr. Boscoe George .......... Water Quality
Mrs. Rhonda George......... Water Quality
Mr. P. Giesler....... Gram Negative Bacteria
Ms. Jean Gough ...... Return to Happiness
Mr. Lauriston Hosten....... Water Quality
Mr. Christopher Husbands .... Water Quality
Dr. David Lennon ............ Water Quality
Dr. C.N.L. Macpherson....... All projects
Dr. Satnarine Maharaj......... All projects
Dr. Dr. Tess McPherson............ LF
Mrs. R.J.M. Mendez ............ Nutmeg
Microbiology Division.. Water Monitoring
Dr. Fran McGill ................. Relief
6.1.6. Identification of bacteria producing antibiotics isolated from deep marine biofilms of Grenada

Search of new antimicrobials is important, because multi-drug resistant pathogenic bacteria are continuously being selected due to wide usage of antibiotics in clinics and as food additives in meat-producing agriculture. Antibiotics are progressively being rendered as “outdated,” and new substances or methods are being sought by the medical community for defense against nosocomial infections. The discovery of “natural antibiotics” has, and will continue to play a crucial role in developing an antibiotic regimen to which bacteria are not yet resistant to. This project was undertaken to characterize eight new marine isolates that shown antagonistic activity against gram positive pathogens Staphylococcus aureus (TB4-32, DB6-33), Enterococcus faecalis (TB5-22), and gram-negative pathogens Klebsiella pneumonia (TB5-22), Enterobacteria faecalis (TB5-22), Escherichia coli (DB9-33). The antibiotic-producing microorganisms have been selected from 450 isolates originating from various marine bays around the island of Grenada (Picture 1) by Mr. N. Caputo (SGU). These organisms have been kept in SGU culture collection under specific designations. The culture collection served as source of microorganisms for the current project, however two out of eight isolated needed to be purified. Streak plate technique and bead-associated biofilm serial dilutions were used to obtain pure cultures (Picture 2).

All these bacteria formed similar regular, colorless, mucus, round, smooth, convex colonies ranging between 2 and 8 mm in diameter on reduced artificial sea water agar (RASWA). All isolates were aerobic and halotolerant oligotrophs and grew at salinity of 38 g/l. Morphologically cells of most of the isolates were small (2 micrometers in diameter) non-motile cocci and diplococci of regular shape, however DB-6 had gram-negative while TB 4-32, TB 5-22, DB 9-33, PB 4-31, PB 5-21, and PB 7-11 had gram-positive cell walls. DB-2 was gram-negative curved rod. The gram-positive isolates were oxidase and catalase positive, and could reduce nitrate. API Staph tests (BioMereux, France) were used for their characterization and identification. Gram negative rod was tested using API 20 NE system. Both systems included 31 biochemical tests/reactions.

Figure 1. A view of True Blue Bay from WINDREF at SGU.

The gram-positive coccoid strains could oxidase D-glucose, D-fructose, D-trehalose, D-mannose, D-melibiose and N-acetyl-glucosamine, they all were urease and arginine dihydrolase negative. Gram-positive cocci differed from each other and organisms listed in Bergey’s Manual of Determinative Bacteriology, 9th edition in their citrate utilization, H2S production, deaminisation of tryptophane, indol production from tryptophan,
fermentation/oxidation of sugars (D-sucrose, D-ramnose, D-arabinose, D-lactose, D-maltose, D-xylose, D-raffinose, sucrose), alcohols (inositol, sorbitol, D-mannitol, xylitol), amygdalin, oxidation of pyruvate (Vogel-Proskauer), Methyl-alpha-D-glucopyranoside, 2-nitrophenyl-alpha-D-galactopyranoside, L-lysine, and gelatin. Usage of physiological and biochemical testing showed they belonged to the genus *Marinococcus* in accordance with Bergey’s Manual (2003). However, none of earlier identified halophilic, aerobic, heterotrophic coccus-like species (*M. albus, M. halophilus, M. hispanicus*) matched 100% with our isolates. Therefore, our isolates were classified as possibly new, previously unknown species. Sequencing of 16S rRNA gene is required to establish new taxa.

Gram negative isolates had active lysine and ornithine decarboxylases, could oxidase glucose, mannose and sucrose. They were oxidase, catalase, urease and alpha-galactosidase negative, did not produce hydrogen sulfide, did not use alcohols (inositol, sorbitol, D-mannitol), such sugars as melibiose and arabinose. DB2 differed from DB6 morphologically and with its capacity to oxidase pyruvate, citrate, amygdalin and had active arginine dihydrolase. Isolate DB 6 had a numerical profile (41_6120), which was close to that of *Vibrio alginolyticus* (4146124, 4146125, 4146126, 4156124); however it was a coccus which implies that a new unknown species was found. DB 2 had a numerical profile as follows: 63_5121. This numerical profile did not even remotely match any of those found in the Analytical Profile Index. It indicated that a new bacterial species has been discovered. Our project confirmed that Grenada and other Caribbean Islands in the West Indies are very suitable research environments for the search of new forms of life and organisms producing unique antagonistic biological compounds. Aquatic marine biofilms is specifically appropriate for this goal because they represent a highly competitive environment selecting genetically different organisms.

Submitted by Sidhard Mehta, Sidhant Mehta, Sukrant Mehta and Svetlana Kotelnikova

### 6.1.7. SGU Environmental Testing Unit (ETU)

The creation and activity of the SGU ETU is a collaborative effort of the Caribbean Environmental Research Initiative (CERI), WINDREF, the Pathology/Microbiology Department of SGUSOM, the SGU Safety Department, the Business Department, and academic SGU administration. The Unit was established to ensure the safety of the learning environment for SGU students, in particular the safety of drinking and recreational water, food and terrestrial plains including both campuses, and the University Club. The ETU was officially established in January of 2004 and includes a team of people working in
different departments under the academic supervision of Dr. Kotelnikova, PhD in Microbiology. The team includes C. Bruno, MSc in Microbiology, Environmental officers, B. Paterson, G. Cornwall, G. Lambert, R. Chellapilla, Rodney Bartholomew, Eric Boatswain, and Grace Dolphin.

An already established activity of ETU in 2004 was weekly monitoring of chemical and bacteriological qualities of drinking water at all distribution sites of True Blue Campus, Grand Anse Campus, the water transporting truck, and the University Club Hotel and Restaurant. Beaches and pool water are also subjected to regular monitoring. Water sampling and testing methodology was adapted responding to major requirements of WHO and EPA. The development of broad range confirmation tests for faecal coliforms and Enterococcus minimised the probability of false-positive results. Cultivation methods used at ETU are as sensitive as PCR reaction. Protocols for sampling, sample transportation, storage and cataloguing of established information, and ensuring high quality and reproducibility were developed and currently in use at ETU.

Quality of water is one of the most important public health issues considering that SGU community is third in population size in Grenada after the capital, St. George’s, and Grenville. Water means safe consumption of liquid, food, hygiene and household water for SGU students and staff. Regular reports are generated and distributed to all responsible members of SGU administration and sanitary committee. They comprise information on the quality of water production, storage, distribution and transport.

SGU ETU is an excellent example of collaborative effort, inter-departmental interaction and independent judgment. ETU utilises many hidden internal resources, including transportation, maintenance personnel for sampling, and competence from academics at the University. This joint effort proved to be very productive in assuring a safe environment for all SGU students, faculty and staff.

The issue of safe drinking water was especially important during the post-hurricane period. Notably, the first post-hurricane report was issued by ETU by 16 September 2004, warning the SGU community about bacteriological contaminations and therefore preventing a major outbreak of GI disorders after the hurricane. The ETU’s activity helped to improve safety during orientation in January 2004 by transferring the orientation site from the sport field to the True Blue upper campus, and therefore eliminating risks of bacterial aerozolation from sewage polluted grass. Today, ET is continuing to serve the health environment of SGU and Grenada.

Established in February 2003, CERI coordinates efforts of SGU faculty and runs environmental related research with educational purpose, with the Grenadian and international community. The vision of Caribbean Environmental Research Initiative is the creation of modern science by a network of competent faculty of St. George’s University, the
severe blow to the nutmeg industry, Grenada’s most important agricultural product. Monthly production of nutmegs prior to Ivan was 12 million pounds annually. About half of Grenada’s cultivable land was under nutmeg propagation, or about 13,000 or 26,000 acres. An estimated 90% of the nutmeg trees, or 50,000 trees, were lost to Ivan.

As well as being a spice, nutmegs have medicinal properties, and contain myristicin, which is highly desirable by the pharmaceutical industry, as well as cancer-causing safrol. Dr. Lorenz first came to Grenada from Germany well before Ivan with the aim of encouraging the development of high-yielding nutmeg trees with high oil content, low safrol content, and high myristicin content. His analysis showed that 110 trees of some 400-500 trees had suitably low levels of safrol; these were selected for continued propagation. Nearly 30 were left standing after the hurricane, which completely uprooted most trees. In October, Dr. Lorenz provided the GCNA 2,000 seedlings from these trees for replanting.

Dr. Lorenz has been meeting with members of the GCNA, the Ministry of Agriculture, WINDREF/CERI, and stakeholders, culminating in a Seminar on the Development of the Nutmeg Industry: A New Perspective, on 8 December 2004, hosted by WINDREF, in order to help revitalise the industry and find a new direction. The aftermath of Ivan is a very critical time for the future of Grenada and its agriculture, and represents an opportunity to plant the right genetic material of nutmeg, interspersed with other crops as ginger, cinnamon, cloves, pepper, and tumeric.

Cinnamon contains compounds responsible for the treatment of diabetes; a lab can screen and identify those that contain these so they can be multiplied. Security of production should be developed, as, other than the GCNA for nutmeg, there is currently no partner to contact in Grenada to supply tons of other spices such as cinnamon; only small packets are available. Other products such as essential oils and oleoresins, alcoholic extracts that combine perfumed and flavouring compounds of the original spice, can be developed for all spices.

Dr. Lorenz is continuing to research fungus in Grenadian nutmegs. Farmers, who number about 30,000 mostly small farmers in the nutmeg industry, must know how to protect and treat for fungal infection. Also, as nutmeg trees were producing fruit only on their periphery and not so much on vertical branches, farmers need to be encouraged to prune their trees annually, which would also make them easier to harvest and perhaps less susceptible to hurricane winds.

Rosa S. Rolle, PhD, Agricultural Industries Officer of the Food and Agriculture Organization of the United Nations, addressed the seminar,
reinforcing the need for market research to develop sustainable and appropriate processing technologies, and determine market needs in terms of product and quality. The FAO is working on technical post-harvest activities and new strategies. Laboratories are required and receiving stations need be redesigned to be brought in line with international standards as soon as possible, so that quality checks can be done throughout the post-harvest process.

Quality assurances and new product development research, conducted in close collaboration between Munich University, PhytoConsult, GCNA, and WINDREF/CERI, will enhance SGU graduate programs, provide new research opportunities for SGU students, and support local agriculture stakeholders.

6.1.2. Sulfate-Reducing Bacteria in Oxidized Freshwater of Tropical Mangroves

Organic pollution and eutrophication are great threats to life in the coastal marine environment. Therefore, any advancement made in studies on improvement of health of the environment is of critical importance. Since sulfate-reducing bacteria (SRB) are a specialized group of anaerobic bacteria that are responsible for terminal step of organic degradation and respiration of sulfate to sulfide in tropical mangroves, they are considered to be good indicator organisms for pollution. Specifically, in this project, a method was developed for most probable numbering of SRB based on sulfide levels using Hungate technique. This technique was, then, applied for marine and freshwater. The first site, Clark’s Court Bay (Figure 1), was a marine water source, supposedly polluted by illegal dumping and with byproducts from a nearby alcohol-producing factory. Water had temperature of 28°C, pH of 7.7, and salinity of 35‰. The second site, Woburn Mangrove Swamp (Figure 2), was fresh-water swamp. This latter site was chosen due to presence of a strong H₂S odor generated within the water. Water had a temperature of 32°C, pH of 7.3, and salinity of 0‰.

![Figure 1. Clark’s Court Bay, located at 12°00, 848’ North and 61°44, 344’ West at an elevation of 160ft.](image1)

![Figure 2. Woburn Mangrove Swamp, located at 12°01, 016’ North and 61°44, 372’ West; elevation of 22ft.](image2)

As part of the project, a calibration curve and a corresponding regression were generated for
approximation of sulfide concentrations (Figure 3). Statistical approach was taken to demonstrate that there is a significant difference in spectrophotometric readings (and, hence, sulfide concentration) between test tubes with positive growth versus those without growth.

These new tools were then tested by using them in detection of sulfide production and, hence, identification of positive growth of SRB. The results are presented in Figure 4 for the two tested sites. Corresponding sulfide concentration values were calculated using a regression from Figure 3.

Organisms cultured from samples obtained at the two sites were sulfate-reducing bacteria. Application of the MPN technique for enumeration of SRB yielded alarming results for the sample obtained at Clark’s Court Bay. There were roughly $1.122 \times 10^6$ SRB in 1.0 ml of the sea water, and that is only the SRB alone, without considering any other aerobic and anaerobic bacteria and other microorganisms. Since SRB are organic carbon degraders our results indicate a serious pollution problem.

Figure 4. Using Thomas equation, MPN for Clark’s Court Bay sample is $1.122 \times 10^6$ organisms/ml and Mangrove swamp pool sample yields an MPN of $5.691 \times 10^2$ SRB/ml. Two-sample t-test is used with positive and negative test tubes serving as the two samples. Difference was statistically significant (p<0.05).

Although the numbers for Mangrove Swamp sample were quite small, $5.691 \times 10^2$ SRB per ml, a strong sulfide odor present at the site indicated on-going activity of SRBs. The most likely cause for the low numbers is the fact that the sample was obtained from oxygen exposed environment. Indeed, it has been earlier reported that two distinct communities (fresh-water and salt-water) of SRB exist and have been discovered. Previous results of BOD₅ measurements in the seawater of Clarks Court Bay did not show values statistically different from other locations in Grenada (Kotelnikova and Davis, current report). Our results are interesting because SRB are strict anaerobic bacteria, however we found them in the oxidized water that makes them for good indicator organisms. SRB may show pollution long time after the release of the source contaminant. This explains the observed discrepancy between BOD values and numbers of SRBs. Another reasonable explanation for the presence of SRB in the studied
environments is following. Sulfate is used by heterotrophic bacterial communities as electron sink rather than oxygen in the periodically polluted environments situated close to the sea. Their activity is crucial for the degradation of organic pollutants. In our case it was waste discharged from Clark Court Rum distillery. Similar discharge is typical for the rest of Caribbean islands, Venezuela and Guyana. Activity of sulfate reduction may be now estimated using the method developed during our project. The SRB activity is expected to correlate with the overall rate of organic degradation. The found high numbers of viable SRBs indicate high rate of degradation of the organic pollution in the studied environments. The observed low BOD values are result of the intensive degradation process. High temperature, the absence of seasonal temperature and oxygen variations and abundance of electron acceptor other than oxygen contribute to the high rate of the degradation. In conclusion, the developed method may be used in any laboratory to measure not only MPN but also activity of sulfate reduction. Finally, identification of the cultured bacterial species using in-situ fluorescence hybridization with species specific 16S rRNA or sulfate-reductase gene probes would have also been worthwhile.

Submitted by Vladimir Zheltkov and Svetlana Kotelnikova

6.1.3. Novel Antibiotics from Tropical Marine Environments: Drug Development in Grenada

Recent studies conducted by the Centers for Disease Control (CDC) have reported an alarming rise in the rates of bacterial resistance to contemporary antibiotics (Figure 1).

![Figure 1: Chart showing the increase of antibiotic resistance rates in nosocomial infections.](chart)

Other studies conducted by the World Health Organization (WHO) confirm these results, as well as stating that on average a person who enters a hospital and acquires a nosocomial infection will have his/her stay lengthened by double. This costs hundreds of millions of dollars a year. In order to stop the current trend and possibly even reverse it, the WHO has formulated an action plan healthcare providers are suggested to follow. The plan calls for containment of resistance to hospitals, further education of healthcare providers in the use of medicines, reduction of the use of antimicrobials in animals, and increased research for the development of new drugs and vaccines.

This study is interested in seeking new avenues for the development of antimicrobial substances. Previous studies performed by Matsunaga et al., 2000, derived a novel acetylenic acid from the sponge
Oceanapia sp. which exhibited inhibition to Gram - E. coli and Pseudomnas aeruginosa and Gram + Bacillus subtilis and Staphylococcus aureus. Ford and Capon, 2000 derived Discorhabdin R (a pyrroloiminoquinone) from the sponge Negombata sp. which inhibits Gram - Serratia marcescens and E. coli and Gram + Staphylococcus aureus and Micrococcus luteus. Bruno, 2003, extracted antibacterial compounds from the microorganisms living on the skin of fish. Cephalosporins were extracted from sea sponges by Brutso. The study sought to apply the methods and findings of these marine studies, which focus on the development of antimicrobial substances from marine organisms, to the development of such substances from microbes which inhabit inanimate marine surfaces such as rocks.

We hypothesize that due to differing evolutionary pressures and available niches, microorganisms of varying genetic make up will inhabit rocks of the sea floor in biofilms. These microbes will produce different secondary metabolites to help combat the stress of competition; these metabolites can be isolated and possibly used as antibiotics to combat current healthcare problems.

To test this hypothesis, the waters around the island of Grenada were sampled at five distinct locations chosen based on accessibility, safety, etc. The sites are True Blue Bay, Dragon Bay, Prickly Bay, Grand Anse Bay, and off the leeward side of Glover’s Island. Ten rock and water samples were taken from on or around reefs at each site via scuba diving or snorkeling. These samples were then brought back to the labs in the Science Building at St. George’s University for further testing. Water was tested for pH, salinity, and temperature to design an appropriate medium. The biofilms on the rocks were swabbed with a saline soaked sterile cotton swab which was used to inoculate plates of Reduced Salinity Artificial Sea Water Agar (RSASWA). Three plates were inoculated per rock. These were then incubated at 29°C for 48 hours. From these plates, individual and differing species of microbes were streak plated on RSASWA and again incubated at 29°C for 48 hours. From these streak plates Gram staining and microscopy observations were performed as well as a creation of culture collection in which all isolates were stored at -80°C in 5% glycerol. To test the marine isolates for antimicrobial properties, a modified Kirby Bauer Assay was developed. Six pathogens were chosen from a list generated by the CDC as those microbes with the fastest rising rates of resistance in nosocomial infections. These pathogens include Staphylococcus aureus, Enterococcus faecalis, Enterobacter cloacae, Klebsiella pneumoniae, Escherichia coli, and Streptococcus pneumoniae. Working under a hood, Kirby Bauer plates were
inoculated with a pathogen and plugs of RSASWA were cut from the streak plates inoculated with a marine isolate and placed on the pathogen-inoculated Kirby-Bauer plates; the theory being that any marine isolate that produces a secondary metabolite will diffuse into the Kirby Bauer agar and if the substance is effective, than a zone of inhibition will appear around the plug. Penicillin was used as a positive control and RSASWA was used as a negative control. These plates were then incubated, inverted, at 37°C and checked at 24 hours then again at 48 hours (Figure 3).

Totally 141 marine isolates were tested for antimicrobial activity, gram-stained and saved in culture collection.

Two tailed T test showed that 10.6% of these isolates produced secondary metabolites as compared to a negative control (Figure 4). To test true effectiveness of the metabolites, the size of the zone of inhibition was compared to that of penicillin at each plate. One-tailed T test demonstrated that 5.6% of the isolates showed inhibiting activity against one or many aforementioned pathogens. The secondary metabolites should be extracted at low pH and further tested against multi-resistant strains of the pathogens, against pathogens growing in biofilms and, in future, clinically.

Figure 4: Chart showing the percent of marine isolates that were found to be active, those that weren’t and those that were active but not as great as penicillin.

Submitted by Nicholas Caputo
Research Scientist, WINDREF

6.1.4. Study of the Mutacin C-7A

Mutacins are bacteriocins produced by Streptococcus mutans. The mutacins are classified into 24 groups labeled from A to X based on their activity spectrum. Within those 24 groups, the mutacins A, B, C, D, I, K and L have the greatest antimicrobial activity (Morency et al., 2001), thus they hold a very high interest for future pharmaceutical use in human antimicrobial therapy. In the present research the main objectives are to efficiently produce the Mutacin C-7A, to purify it and ultimately to determine its amino acids sequence, and perhaps its secondary structure.

Project Objectives:
Elaboration of an appropriate extraction method

The extraction method will be elaborate based on the previous studies of the Mutacines and the previous work done on the Mutacin C-7A at Laval University. The hydrophobicity of the peptide, as well as its size, will have to be taken in consideration. The detection method that will be performed is a modified adaptation of the differed antagonist method described in Parrot et al. (1990).

Purification and sequencing of the extracted peptide

The purification of the Mutacin C-7A will be performed according to the methods previously elaborate for the purification of other Mutacins (i.e. the Mutacin B-Ny266, Mota-Miera et al. (2001)). The sequencing of the peptide will be performed by Edman degradation.

Project Methodology:

Bacterial strains

The bacterial strain used for mutacin production will be: *Streptococcus mutans* C-7A, producing mutacins C-7A (Parrot et al, 1989, Morency et al 1995). *Micrococcus luteus* ATCC 272 (ATCC, Rockville, MD) will be used as the indicator strain for the mutacin detection.

Inoculum preparation

A single colony of the mutacin-producing *S. mutans* strain is inoculated in a Trypticase Soy Broth enriched with 0.3% Yeast Extract (TSBYE) and incubated overnight at 37°C. A 1% inoculum of this overnight culture will be added to 1 litter of fresh medium used for the mutacin C-7A production.

Culture media

The basal medium use will be trypticase soy broth (TSB) (Becton, Dickinson et Co., Sparks) to which 2% (w/v) Yeast Extract (Becton, Dickinson et Co., Sparks), 2% lactose and 1% (w/v) CaCO₃ will be added. The medium will be prepared by dissolving the powdered TSB in bi-deionised water and the solution will then be autoclave at 121°C for 15 min.

Growth condition

Cultures of *S. mutans* C-7A in TSB-YE will be incubated for 36 h at 37°C, and at the end of the incubation period, aliquots will be withdrawn and tested for its mutacin activity.

Extraction of the mutacin C-7A

Aliquots from *S. mutans* C-7A cultures will be adjusted to pH 2 with 4N HCl to permit the desorption of the mutacin from the cell surface (Yang et al., 1992). Subsequently, they will be heated for 10 min at 70°C to kill the S. mutans cells and inhibit the proteases through a thermal denaturation process. The supernatants containing the antibacterial peptide will be obtained by centrifugation at 10,000 X g for 5 min to allow cellular debris and residual CaCO₃ to precipitate and used for mutacin C-7A extraction and purification.

Mutacin activity detection test

A volume of 5 µl of the medium to be tested for activity will be deposited on top of the indicator plates which are then incubated for 48 hours and the activity is gauged by the appearance of an inhibition zone. The indicator plate are made as such: Trypticase Soy Agar (Difco Laboratories, Detroit, MI) plates enriched with 0.3% yeast extract (TSAYE) are overlaid with 5 mL of melted TSA-YE soft agar (0.75% agar)
containing a standardized suspension (0.2 ml of an exponentially growing culture at an optical density of 0.1 at 600 nm) of Micrococcus luteus ATCC 272.

Future Health Impact

The past years have been marked by the emergence of antibiotic resisting strains of bacteria – even time to time multi-resistant strains – and it have obligated the microbiologist, pharmacist and other professionals of the entire scientific community to seek for new antimicrobial agents and alternatives to allow a better microbial control. As a consequence, recently, there has been a growing interest for antimicrobial peptides like the mutacins. Unfortunately, it has been virtually impossible to synthesize efficiently active peptides in vitro but due to their great curing potential on gram positive infection, the research of natural producer of these peptides is very important and promising.

Although the look for new antibiotics may not be a priority for the West Indies, the eventual discovery of a new patented antibiotic might be beneficial by selling the eventual patent to pharmaceutical majors or conduct to an eventual local production thus enhancing the commercial diversity of the West Indies.

Submitted by François Hallé

6.1.5. Gram-negative bacteria isolated from aquatic environments of Grenada (61.4°W, 12.0°N), West Indies

Extensive agricultural and tourist exploitation of the Windward Islands and growing human population may lead to irreversible damage caused by pollution and eutrophication. Recent fish kills and coral reef bleaching are indications of on-going environmental disturbance in the region. Long-term monitoring is crucial for understanding anthropogenic and climatic trends and their potential impact on aquatic environments. We studied the occurrence and persistence of enteric and aquatic pathogens in various types of tropical water and characterized factors that contribute to waterborne pollutions and transmission.

Physical parameters (pH, temperature, dissolved oxygen, BOD$_5$, and salinity) have been monitored in coastal and inland waters and CFU, MPN of thermotolerant faecal coliforms (FC) and Enterococcus (FE) were evaluated as indicators of faecal pollutions. We isolated and identified gram-negative bacteria, to learn if the presence of FC will correspond with presence of gastro-intestinal pathogens in the water.

Two sites in True Blue Bay, two in Black Sand Bay, three in Prickly Bay, and one site each in Grand Anse Bay, La Sagesse Bay, Carenage Bay, La Sagesse River, St. John’s River and Grand Etang Lake are shown as stars at Figure 1.

![Sampling sites in Grenada](image)

Figure 1. Sampling sites in Grenada. Bacterial pollution of coastal seawaters was studied around the southern part of the island at two weeks intervals between June 2003 and July 2004.
The results were compared to the phenotypical database. Sixty three strains of gram-negative bacteria were isolated from marine and fresh water and saved as culture collection. 43 strains have been identified including 3% of non-pathogenic and 97% of opportunistic pathogenic organisms. All of the samples with high FC and FE contained bacteria that have been identified as opportunistic GI pathogens. Unidentified organisms (20 isolates) did not match with any known in the API database and may represent new species.

**Physical parameters of the seawaters**

Grenada is a tropical island of volcanic origin which was formed due to continental subduction. There are only two seasons: dry and rainy. The continental slope reaches the depth of below 560 m at 5-7 km both east and west of the island.

Temperature in the studied waters varied between 27 and 33°C, pH between 7.0 and 8.2; salinity between 32 and 38 ppt. Most of the surface marine and freshwater environments showed similar concentrations of dissolved oxygen that ranged between 3 and 8 mg per litre. Example of dynamics of the physical parameters in GA is presented in Figure 2. The physical parameters likely characterize subsurface events taking place in the bay due to marine currents, upwellings and deep water exchange. Tidal currents in the coastal region of Grenada were not studied. The variation patterns observed for the water temperature were rather linked to months than to days or weeks. PH cycles had minima in October and June, while the cycle of dissolved oxygen was linked to salinity and temperature cycles that had critical points in October, February and June (Figure 2). Cold saline O$_2$–poor water with pH of 7.7 periodically replaced the usual water. Patterns of dissolved oxygen concentrations in other tested sites were reproducible and had three distinctive picks: Late October-early December, late January-early March and June. The periodic change of water chemistry indicates to seawater circulations that may flush eventual pollutions off the coast. The water exchange patterns were not linked to the rainfall. We did not observe any water variation patterns that would affect statistically the bacteriological situation in the tested aquifers.

**Biological oxygen demand**

Marine water around coral reefs is an ecological niche for the development of fish, invertebrates and lobsters, a significant food resource for Grenada. Surveillance of sewage impact on the marine and coral reef environment is important. Pelagic and reef fish occupy the top of the food chain. Sudden change of the environment around coral reefs is a serious detestation for stability of the ecosystem, in particular for coral reef fish populations. The inability to assess the health of exploited fish, lambi and shrimp hinders export to the European
Community and other countries. Systematic pollution of coastal waters with excessive organic matter or inorganic nutrients may lead to overgrowth of microscopic and plant life.

Biological oxygen demand (BOD) characterizes biologically degradable organic matter in water. We observed that BOD ranged from 0.96 to 6.9 mg/l. BOD5 values did not exceed 6.9 mg/l at any of the tested sites that indicates that both marine and fresh waters were oligotrophic and not eutrophicated in result run-off from the volcanic soils or agricultural activities.

Variations of BOD5 may reflect deep currents, since no correlation with rainfall was observed. The sites listed in Figure 1 were sampled in June, October and November of 2003, and January of 2004. BOD positively correlated with pH of marine water (r²=0.89), CFUs (0.76) and FC (0.67). Dissolved oxygen negatively correlated with BOD values (0.7). Depth, temperature, or salinity of the water did not affect BOD.

**Gram-negative bacteria in coastal seawater**

The project dealt with isolation and identification of microorganisms that thrived in the sampled waters and were selected on Lauryl Tryptose broth, Brilliant Green Bile Agar, Levine Eosin methylene Blue Agar, Mc Conkey agar and Nutrient agar.

The goal of the identification was to determine whether the organisms were pathogenic and what kind of pathogenic microorganisms may thrive in the aquatic environments of the tropical island.

Gram-negative bacteria isolated from marine water were less diverse than bacteria isolated from freshwater environments. Three different strains of *E.coli* PB(b), PB3-11 and SI-11 were isolated from Prickly Bay. Isolate *E.coli* GA3-10 originated from water of Grand Anse Beach. Carenage Bay resulted in four isolates of *E.coli: CB-1, CB-2, CB-3, CB-4, Enterobacter cloacae CI-6, Acinetobacter, SI-7 and E. vulnaris, SB-6. Clark’s Court Bay: *Enterobacter cloacae, SI-5.*

Genus *Enterobacter* are known to be widely distributed in nature, occurring in fresh water, soil, sewage, plants and animal/human feces. The species isolated in our study are considered to be opportunistic pathogens causing burn, wounds, and urinary tract infections, and occasionally, septicemia and meningitis.

La Sagesse Bay contained *Enterobacter cloacae, S-3, E.coli, S-1 and S-4, and True Blue Bay E.coli S-8, SI-9, and SI-10. E. coli* represents fraction of resident microflora of the intestines in humans and warm blooded animals. This organism is not necessarily pathogenic. Some strains of *E.coli* may cause enteric disease or urinary tract infections due to production of enterotoxins or other virulence factors in different immune-compromised groups.

**Gram-negative bacteria in freshwater**

The estuary of La Sagesse River showed presence of *E.coli, F-4 and Cedeca sp., F-3; and Cedeca lopagei, F-2. St. John’s River showed presence of Serratia plymuthica, SI-4, Pseudomonas sepatica, SI-1; *Enterobacter agglomerance, SI-3; and Enterobacter cloacae, SI-2. Twenty five gram-negative pure cultures were isolated from volcanic Grand Etang Lake (Figure 3) including Proteus sp., GE-8; Citrobacter freundi, GE-12; Pantoea spp., GE-14, GE-24; *Pseudomonas aeruginosa, GE-15 and Shigella spp.,*
GE-10; *Escherichia coli*, GE-17, 18, 19, 20; F-1; *Ochrobactrum anthropi*, GE-22; *Chryseobacteria* sp.GE-25 and *Pasteurella haemolytica*, GE-26. Tested fresh water (June, 2003 – July 2004) contained variety of typical water associated heterotrophic bacteria that are related to *Serratia marcescens*, *Pseudomonas sepatica* and *Acinetobacter* sp. Coliforms found in the freshwater were identified as *Shigella flexnery*, *Cedeca* sp., *Proteus* spp., *Pantoea* sp., *Klebsiella ozonae*, *Pantea agglomerans*, *Enterobacter cloacae*, *Enterobacter amiguensis* and different strains of *Escherichia coli*.

Faecal coliforms and enterococci are consistent indicators of pollutions in the studied tropical waters

Poorly treated or untreated sewage discharged into coastal environments can affect public health by contact with viral and microbial pathogens via recreational activities or consuming fish and shellfish contaminated with viruses and heavy metals. Number of FC and FE were used in our study as indicators of faecal pollution. Fecal coliforms have been questioned as good indicators in subtropical regions because they might reproduce in the freshwater. One of the tasks of our study, therefore, was the evaluation of FC and FE as indicators of the quality of earlier non-studied tropical environments: volcanic lake, rivers and estuary seawater. We looked at correlation of high numbers of FC and FE with appearance of gram-negative pathogens, BOD₅, oxygen concentrations, pH, rainfall and number of diarrhoeal cases and gastro-enteritis (GI). FC exceeded health risk levels in 37% of tests between June and December of 2003 (rainy period) and just in 31% of tests between February and March (dry period). The overall frequencies of pollution of the coastal marine environments with FC or FE, therefore, were not affected by rainfall. Distribution of pollutions with FC and FE over different sites are shown in Figure 5. E.coli and fecal enterococci survive for a short time in illuminated seawater. There are three facts that indicate that faecal coliforms and enterococci are indeed consistent indicators of faecal pollutions in the studied tropical waters. First, they have not been found in all tested samples, second, the presence of FC and FE was not linked to the water chemistry or rainfall, third, gram-negative opportunistic bacteria have been identified in the samples containing high numbers of FC and FE.

Outbreaks of diarrhea in Grenada could not be linked to the contamination of recreational waters

Some locations showed FC or FE in 80% of samples (Figure 4). However, we did not observe a positive correlation of the FC in the bathing water of the
major beach used by people of St. George’s and numbers of diarrhoeal diseases and GI disorders.

**Figure 4.** Percent of samples polluted with thermotolerant faecal coliforms (EC at 44°C) and enterococci (KF medium at 44°C) in coastal marine water around Grenada between June, 2003 and July, 2004. Designations: BSB: Black Sand Bay, GA: Grand Anse, TBB-1 and TBB-2: sites in True Blue Bay, PB-1: Calabash Beach, PB-2: Boatyard, and PB-3: University Beach in Prickly Bay.

The percent of samples tested over the year containing FE more than risk level (35 cells/100 ml) varied between 5 and 84%. We observed a weak correlation between FE in Grand Anse Bay and numbers of diarrhoeal and GI cases in St. George’s (r²=0.5). This pattern might be affected by rainfall caused run-off because rainfall affected diarrhoeas (r²=0.6). It is evident that Grand Anse is subjected to rainfall sewage run-off since we observed strong correlation of FC with rainfall (r²=0.96). Similar process might take place in river freshwater that is being used for domestic purposes. Enteric viruses and protozoa may be associated with waters showing high numbers of FE.

**Sources of bacterial pollution**

Faecal coliforms were found at numbers exceeding health risk levels in 23-80% of tests between June of 2003 and July of 2004. The studied areas are situated around evenly populated areas of the island. Thus, if the rainfall caused run-off would be the only source of the pollution, we might have observed all of the studied coastal seawater equally affected by the rainfall. There was no correlation between FE and rainfall in any of the tested waters. FC pollutions correlated with rainfall in least polluted sites TBB-1 (r²=0.8), GA (r²=0.96), and BSB (r²=0.55), while we did not observe significant correlations for Prickly Bay sites. These facts indicate that major source of pollution in GA and BSB (r²=0.6) was runoff from the grounds while PB had source of pollution independent of the run-off. In addition, FC/FE ratio was above four, indicating the human source in 27% of samples in PB-1 and 100% in PB-2. Thus, the most likely source of pollution might be sewage discharge from the septic systems of hotels, houses or recreational boats parked in the bay. The bay was used by boatyard for 40-65 boats a day year round. In addition, t-test showed that percent of FC polluted samples was higher in seawater collected from three sites of PB (Figure 5, p<0.001) then in the rest of the studied marine environments which also indicates to a source of pollution additional to the rain run-off. Frequency of pollution in PB did not decrease during the dry season indicating the domestic sewage discharge, and recreational yachts discharge being possible sources of water pollution.

*Submitted by Susanne Davis and Svetlana Kotelnikova*
The Fund distributed more than twenty thousand pounds of pet food, donated by the Purina Pet Institute, in every parish of mainland Grenada. This generous donation from Purina was made following a suggestion from an associate of the agreement between SGU and the Fund to pay the shipping cost.

The NAVI store (turning Ivan around) was created to distribute donated clothing.

The NAVI store (turning Ivan around) was created to distribute donated clothes to persons who had lost their clothing following the storm. Grenadians are proud people, so the concept of distributing in a boutique fashion was more favourably accepted by the Grenadian community.

Hurricane Ivan over Grenada, 7 September 2004.

6.1.1. Spice Research Program Established

Dr. Matthias Lorenz, the newly appointed Director of the Spice Research Program

Dr. Matthias Lorenz was appointed Director of the Spice Research Program and WINDREF Research Fellow by Dr. Macpherson on 9 December 2004. In this capacity, Dr. Lorenz, who is also Executive Manager of International Projects for PhytoConsult, based in Munich, Germany, will broaden the scope of research WINDREF is engaged in and liaise with the Grenada Co-operative Nutmeg Association (GCNA), the University of the West Indies (UWI), the Caribbean Agriculture Research and Development Institute (CARDI), Grenadian spice stakeholders and other relevant people and organizations, to coordinate the development of Grenada’s spice and nutmeg industry, which was devastated by Hurricane Ivan.

The hurricane, which struck Grenada on 7 September 2004, was a
5.0 Human Subjects Institutional Review Board (SGU IRB)

Members of the IRB include Dr. Cheryl Cox Macpherson, Chair, Dr. Theresa McCann, Vice Chair, Ms. Ann-Marie George, Secretary, Dr. Loren Nelson, Past Chair, and Sir Paul Scoon, GCMG, GCVO, OBE., and several members of the Grenadian community. Ms. Meg Conlon serves as Administrator.

The following proposals were reviewed and approved during 2004:


- **An Investigation as to the Use of Botanical Medicine for Three Common Diseases in Grenada** – Daniel Firer, MD/MSc Student, WINDREF Research Scientist.

- **Comparative Food Safety and Handling Knowledge of Students in the UK, US and Canada** – Zara Ross, PhD, Associate Professor of Microbiology, SGU.

- **Food Safety and Handling Knowledge of Adults in Grenada** – Zara Ross, PhD, Associate Professor of Microbiology, SGU.

- **Attitudes Toward Live Animal Use in Veterinary Education** – Diana Stone, Visiting Professor, Paraclinical Studies, SGU SVM.

- **Pilot Project to Increase Rates of Optimal Control of Type 2 Diabetes and Essential Hypertension in Primary Care Settings in St. Vincent and the Grenadines** – Dr. Rosemarie Ramsingh, Community Medicine Physician, Canada.

6.0 Current Projects

The projects currently being undertaken at WINDREF are briefly reviewed below.

6.1 WINDREF / SGU Hurricane Relief

Hurricane Ivan hit Grenada on the 7th September 2004. Wreaking havoc on both residential and commercial buildings, an estimated 90% of the island’s buildings were damaged or
destroyed. Even places of worship, regardless of religion, were left in ruin.

Typically in Grenada, places of worship are used as shelters, however due to the state of the churches following the passage of Hurricane Ivan, alternative housing had to be sought by persons whose houses had been destroyed. The strongest hurricane to ever hit Grenada, Hurricane Ivan left a death toll of 39 directly related deaths.

Grenada was defoliated by the hurricane. Note the circular pattern of downed trees.
Residential and commercial damage.

The residences of the Prime Minister and the Governor General were left in ruins. The hurricane force winds combined with the effects of several tornadoes leveled most buildings in their path.

At the request of the Minister of Health and hospital officials, the WINDREF SGU Relief Committee undertook the task of repairing the Grenada General Hospital Laboratory. Hurricane Ivan had left the hospital with no laboratory diagnostic capabilities.

WINDREF facilitated the SGU Docs for Grenada program. This program was crucial in that it allowed St. George’s University alumni to come to Grenada and act in a supportive role to the doctors on the island.

Governor General’s residence.

Grenada General Hospital Laboratory before repair.

Grenada General Hospital Laboratory during repair.

left to right: Trevor Noel, Assistant Director WINDREF, Senator Ann David–Antoine, Minister of Health, and Fran McGill, President of SGU Alumni, following the organizational meeting for SGU DOCS for Grenada program.
WINDREF was involved in the distribution of medical supplies from the Toronto Emergency Medical Services (TEMS) to the Ministry of Health. Members of the TEMS voluntarily came and gave assistance in the rural areas and at the Home for the Aged.

WINDREF facilitated a food distribution program with food and water products provided by the people of Toronto through Spice Isle Relief members, Alexandra Otway-Noel and Ian Winsborrow.
The WINDREF / SGU Relief Committee assisted with the purchase of building materials for 230 Grenadians who had either lost their entire house or sustained damages. The WINDREF / SGU Relief Committee partnered with the Agency for Rural Transformation (ART) to assist the community of La Poterie, St. David. A portion of the 5,127 pounds of canned food and clothing that was shipped to Grenada by the WINDREF/SGU Relief Fund was donated to ART for the families of La Poterie. The fund also donated a portion of the shipment to the St. Vincent de Paul Society which serves the Grand Anse and Mont Toute areas.

Dr. John McKibben, Director of the Veterinary Teaching Hospital, distributing pet food donated by Purina Pet Institute.
Internationally, studies were conducted on cystic hydatid disease (Uganda and Romania) and lymphatic filariasis (Guyana).

A team of seven DVM, MD, MPH and a potential PhD student worked on CHD and related research on wildlife in the Queen Elizabeth National Park in western Uganda and one conducted research amongst the nomadic pastoral peoples of northern Kenya. The studies in Uganda were sponsored by a grant from Fogarty International through their MIRT initiative, a grant administered by Dr. Ray Sis through Texas A & M University.

1.2. The Post-Ivan Year

Soon after September 7\textsuperscript{th} the WINDREF-SGU Relief for Grenada Fund was established and donations started to pour in from SGU alumni, faculty, students, foundations, individuals outside of SGU, and pharmaceutical and pet food companies. The response was generous and desperately needed. The relief fund brought in building materials, food and clothing, which was distributed to many in need throughout the country. Following discussions with the Minister of Health, Senator Ann David-Antoine, the hospital laboratory was renovated and donations of medical supplies provided. SGU Docs for Grenada saw 13 alumni provide their expertise at their own expense for the Ministry. Discussions with the Permanent Secretary in the Ministry of Education, Mr. Michael Pierre, facilitated a generous donation to rebuild schools from the Bartholomew J. Lawson Foundation for Children. Dr. Zuri Amuleru-Marshall and her team received a large grant from UNICEF to facilitate a \textit{Return to Happiness} program, a psycho-affective recovery program for children who have experienced the trauma of natural disasters or armed conflict. The program employs the strategies of play therapy and creative arts to encourage children to express their concerns, fears, anxieties, and other emotions related to their experiences during and following a disaster. Adolescent volunteers work with children ages 6-12 in small groups, using program materials such as puppets, cloth dolls, wooden toys, arts and crafts, and storytelling. In addition to the \textit{Return to Happiness} program, Zuri’s team is involved in the UNICEF-supported Grenada Wellness Program coordinated by the Ministry of Social Development.

Towards the end of 2004, WINDREF hosted two workshops with the Grenada Cooperative Nutmeg Association to see how best to help the spice producers upon whom 60\% of Grenada’s population made a living. Dr. Matthias Lorenz was appointed as a Research Fellow to facilitate a research program on spices over the coming years. Dr. Lorenz has worked with members of the GCNA over the last few years and will contribute much to the re-
growth of the future nutmeg trees in the country and other spice crops.

Dr. Dennis Paul, Dr. Mirta Roses, PAHO Director, and Dr. Macpherson discuss the PAHO project.

The three new WINDREF research fellows appointed during the year will greatly add to the breadth of research activities on coral reefs and the marine environment (Dr. Clare Morrall), the spice project (Dr. Matthias Lorenz) and the return to wellness program (Dr. Zuri Amuleru-Marshall).

1.3. Funding

The Liverpool Support Center continued to support the lymphatic filariasis project. Trevor Noel was supported by grants from Rockefeller University through Dr. Kreek. UNICEF generously supported the Return to Wellness program, the Bartholomew J. Lawson Foundation for Children funded the rebuilding of schools project, Mary Glenn at Humbolt State University raised funds for local Grenadians, and a number of pet food companies, especially Hills, Purina and Iams, gave generously. Hundreds of other donations were received, particularly for the WINDREF\SGU Relief for Grenada fund and I would like to thank everyone for their contributions to our activities. Thanks also to our collaborators for their valuable input.
2.1 WINDREF Research Institute Board of Directors

- Dr Keith B. Taylor, (President)
- Dr Calum N.L. Macpherson (Vice President)
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- Sir Frederick Ballantyne, MD
- John R. David, MD
- John J. Ferguson, MBChB, FRCGP
- Edmond Fischer, DSc
- C. James Hospedales, MB, BS, MSc
- Sir Malcolm MacNaughton, MD, LLD, FRCPG, FRAC
- Calum Macpherson, PhD, DIC
- Thomas W. Meade, CBE, DM, FRCP, FRS
- Graham Serjeant, MD, FRCP, CMG
- Malcolm Ferguson-Smith, MBChB, FRCP, FRCPath
- Sir Kenneth Stuart, MD, DSc (Hon)
- M.S. Swaminathan, DSc
- Keith Taylor, DM, FRCP
- John B. Żabriskie, MD

2.4 WINDREF Research Institute Research Fellows

The following investigators have been appointed to the Windward Islands Research Institute as research fellows and are currently conducting collaborative research projects.

2.4.1 Senior Research Fellows

- Paul J Fields, PhD, Brigham Young University
- Michael Fisher, PhD, Merck Research Laboratories
- Paul Garner, PhD, Liverpool School of Tropical Medicine
- Mary Glenn, PhD, Humboldt State University
- Duane Gubler, ScD, CDC Fort Collins
- Ruth Milner, MSc, Vancouver Hospital
- Stephen Morse, PhD, Columbia University
- Leslie Ramsammy, PhD, Minister of Health, Guyana
- Stanley Weiss, MD, University of Medicine and Dentistry, New Jersey

2.4.2 Research Fellows

- Zuri Amuleru-Marshall, PhD
- Glennis Andall, PhD
- Charles Avgeris, MSc
- Orazio Giliberti, MD
- Svetlana Kotelnikova, PhD
- Matthias Lorenz, PhD
- Theresa McCann, MPH, PhD
- Barrymore McBarnette, MD
- Craig McCarty, PhD
- Clare Morrall, PhD
- Shamdeo Persaud, MD, MPH
- Shanti Singh, MD
- Richard Kabuusu, DVM, MPH

2.5 WINDREF Research Institute-Research Scientists

Research Scientists appointed to the Research Institute include: John Adamski, Sadiq Al-Tamini, Sumita Asthana, Yitzhack Asulin, Bishara

2.6 WINDREF Research Institute Administration

Mr. Trevor Noel continues as Assistant Director in 2004, Mrs. Isha English as Administrative Assistant, and Ms. Meg Conlon as Executive Secretary.

3.0 WINDREF (USA)

WINDREF (USA) was established to facilitate coordination of the USA activities and to administer charitable donations from the United States to the WINDREF Research Institute. As a non-profit organization, its goal is to enhance the development of WINDREF’s research and educational programs. The offices are located on Long Island in New York to provide administrative and logistical support for the WINDREF Research Institute. Ms Melissa Conway replaced Ms. Donna Damm as program coordinator in the New York Office.

4.0 WINDREF (UK)

WINDREF (UK) was set-up in Winchester, England in 1999 to promote collaboration between WINDREF scientists and academic centers of research in the United Kingdom. It is hoped that by reaching out to a larger scientific community, WINDREF will broaden its research opportunities by forming collaborations with scientists from the European community.

4.1 WINDREF (UK) Board of Trustees

A Board of Trustees was appointed in 1999 to oversee the activities of WINDREF (UK). Our distinguished Board of Trustees members were selected for their scholarly academic accomplishments and international acclaim. Members include:

- Lord Soulsby of Swaffham Prior, MA, PhD, DSc, DVM, FRCVS (Chairman)
- Sir Kenneth Calman, KCB, FRCSE
- Richard Summerfield, MB, BChir, MA, FRCA
- Sir Kenneth Stuart, MD, DSc
- Keith B. Taylor, DM, FRCP
- Calum Macpherson, PhD, DIC (Ex Officio)

4.2 WINDREF (UK) Administration

Ms. Sue Huntington continues as Executive Secretary. Ms. Huntington provides the administrative support and expertise that is central to WINDREF’s (UK) fundraising, administrative and collaborative activities.
1.0 WINDREF ACTIVITIES: HIGHLIGHTS FROM 2004

This was a year with two distinct halves: the first half was a very busy continuation of the established goals of the research institute, and the second was dominated by the necessary change in activities following the devastating impact of the most powerful hurricane to hit Grenada in recorded history.

1.1. The Pre-Ivan Year

The 5th WINDREF Lecture was presented by Lord Soulsby of Swaffham Prior and entitled “Zoonoses old and new – the price of freedom is eternal vigilance”.

Scientific meetings were attended in Italy, Egypt, Puerto Rico, USA and Kenya, and the 49th annual Caribbean Health Research Council meeting was held for the first time in Grenada. Seven papers were presented by WINDREF scientists at the latter meeting and one of the research scientists, Scott Forman, received an award for the best student public health paper to be presented at the conference.

All of the main research activities continued during the first half of the year. In Grenada, these included studies on dengue, intestinal helminthes, medicinal plants, genetic correlation of addictive diseases with specific reference to cocaine, alcohol and marijuana (conducted in collaboration with Dr. Kreek, Rockefeller University; Dave Alexander, Drug Avoidance Officer, Ministry of Education; and Thorne Roberts, Director, Carlton House, Ministry of Health), nutmeg and water quality testing.

(Top) The MIRT research group on the Equator close to the Queen Elizabeth National Park in western Uganda. Dr Ludwig Sieffert, the deputy director of the Department of wildlife at Makerere University, oversees the Uganda collaboration. (Below) Elephants frequently visited our camp site.
The Caribbean Health Research Council (CHRC) Scientific Meeting was held in Grenada for the first time in its 49 year history on April 21-24, 2004. The Conference was co-sponsored by Grenada’s Ministry of Health and SGU/ WINDREF. Dr. Calum Macpherson and Grenada’s Chief Medical Officer, Dr. Satnarine Maharaj, co-chaired the organizing committee. The Grenada Medical Association lent its support during the preparatory stage and throughout the meetings.

The Conference brought together more than 200 leading scientists, physicians, medical researchers, and policy makers from PAHO, CARICOM, MRC, UWI, UG, CAREC and other research institutes throughout the region. Members of the Council include the Chief Medical Officers of 17 Caribbean countries, and representatives of CARICOM, The Medical Research Council (UK) and others.

More than 140 oral papers, which were well received, were presented. Dr. Macpherson gave an invited plenary paper, and four conference papers were presented orally by WINDREF Research Scientists Scott Forman, Anthony Junck, Yolanda Ng, and Sebastian Kreitschiltz, all of whom are MD/MSc students. Trevor Noel, WINDREF’s Assistant Director, presented a poster.

Scott Forman (left) was awarded the Caribbean Public Health Association (Trinidad and Tobago chapter) prize for the best public health paper presented by a student. The title of his winning paper is “Decompression illness among the fishermen divers of Grenada.” Fisherman tank diver with speared fish, Calliste, St. George’s, Grenada (right).

Organisation of the CHRC Scientific Meeting was a collaborative effort by the Ministry of Health, the Grenada Medical Association, SGU and WINDREF (left).
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