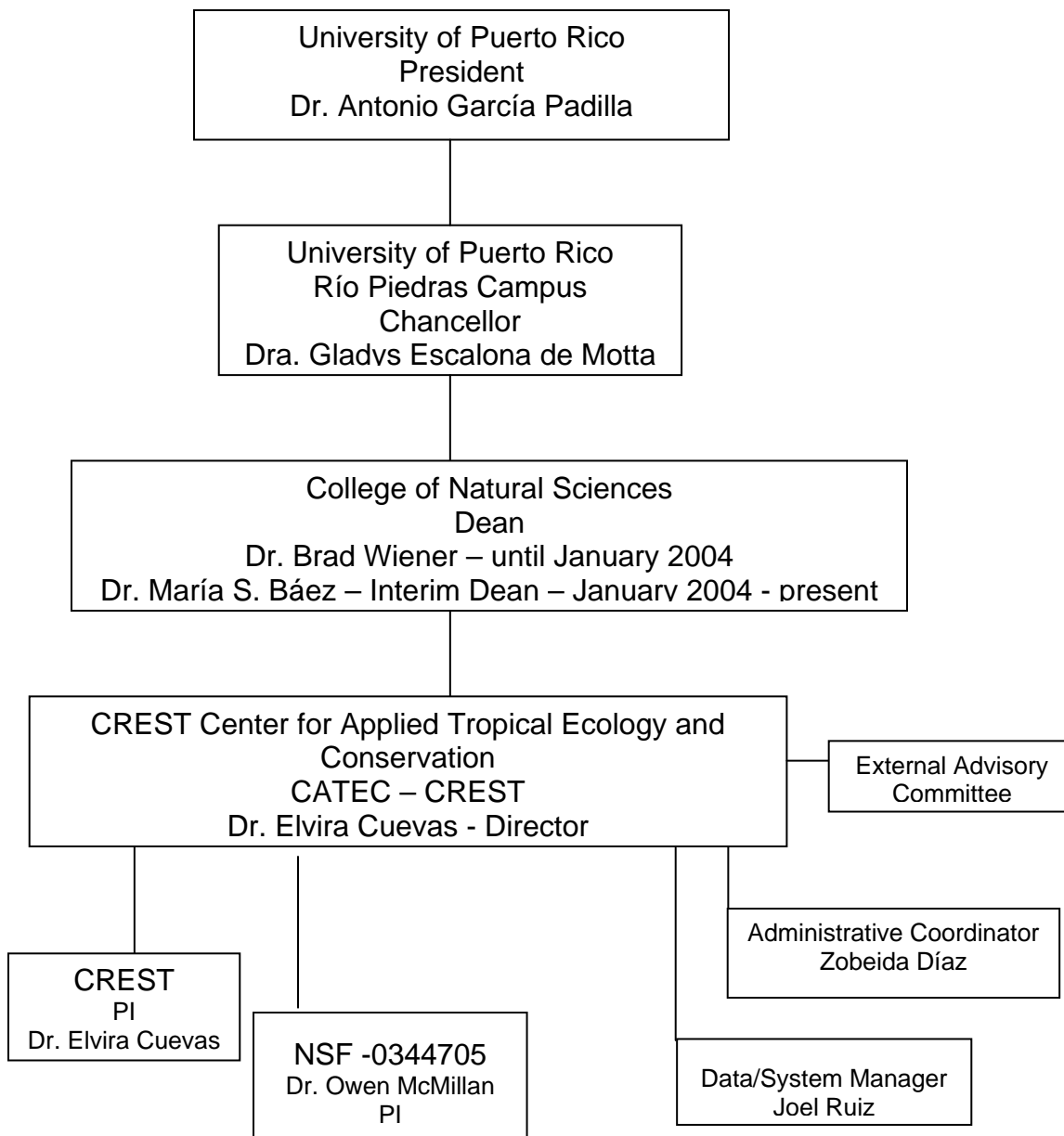


ANNUAL REPORT OF CREST-CATEC: SEPTEMBER 1ST, 2003 – AUGUST 31ST, 2004.

I.PROJECT PARTICIPANTS:

I.1. PARTICIPANTS BY THRUST AREA: ALREADY IN PARTICIPANTS VIA FASTLANE

1.2. ORGANIZATIONAL CHART OF THE CENTER





May 13, 2003

Dr. Victor Santiago
 CREST Program Director
 Division of Human resource Development
 National Science Foundation
 4201 Wilson Boulevard, Room 815
 Arlington, Virginia 22230

Dear Dr. Santiago:

I am pleased to write this letter of support for the CREST Center for Tropical Applied Ecology and Conservation (CATEC-CREST), under the direction of Dr. Elvira Cuevas. As Chancellor of the Río Piedras Campus of the University of Puerto Rico, I express my full support to the Center, which I believe has already shown excellent progress in its establishment and development.

I fully endorse the continuation of the CREST grant and will continue to allocate the established 25% of the matching funds required by NSF during the rest of the four-year duration of the grant. The Central Administration of the UPR System will contribute the other 75% of the matching funds as established in the letter of November 14, 2001.

Sincerely,


 Gladys Escalona de Motta, PhD
 Chancellor

UNIVERSIDAD DE PUERTO RICO
 Recinto de Río Piedras
 Oficina de la Rectora

PO Box 23300
 San Juan, PR 00931-3300
 Tels. 787-763-3877
 787-764-0000, Exts. 2424, 3240
 Fax 787-764-8799

Patrón con Igualdad de Oportunidades en el Empleo M/M/V/I

I.3 DIRECTOR'S NARRATIVE OF THE CENTER'S MAJOR ISSUES:

CREST-CATEC has successfully continued its operations. The monies from NSF for the second year and the matching funds from the UPR Central Administration and Río Piedras campus became available in October, 2003. We have continued to expand the number of research fellows and students involved in the various research programs of CREST-CATEC. We have also improved the

administrative help and facilities, established the web page for the Center, and promoted, supported or co-sponsored activities such as seminars, symposia and workshops. We have provided student support for participation in national and international congresses, attendance in international courses, and the fostering of graduate student research by establishing research grants.

The Center has also established close collaborations with other UPR programs such as PR-EPSCoR, of which one national and one international activity have resulted.

Issues at hand:

Administrative aspects:

1- Hiring of personnel - Ms. Reyes, former Administrative Officer, left us in June 2003 to work in the private sector. The position had to be re-evaluated as a result of the increased complexity of the projects and activities, increased number of participants, and the multiple and very diverse tasks that it entailed. The new position was classified as Center Coordinator. Ms. Zobeida Díaz was hired as the Center Administrative Coordinator in October 1st 2003. At the same time Mr. Joel Ruiz was hired as the Computing/Data system manager for the Center. I will hire a secretary/assistant for the Program Administrative Coordinator in order to maintain the administrative efficiency of the Center due to the expansion of CREST activities and management of other grants.

2 - Headquarters – For the last year and a half we were operating from a small office. Since early May we have our headquarters in operation (one office, one small conference room) already set up with wireless connection for LAN and INTERNET for the administrative personnel and 30 more computers at any one time. Additional space is required to incorporate an office for the Center Director and working area for additional personnel and part time students.

3 – Grant management - The administrative part of CREST-CATEC has intensively worked on the following tasks:

- Contracts and student stipends for the Center participants
- purchasing of equipment, materials and supplies

- administrative work for Drs. Raymond Tremblay and Dennis Fernández, University of Puerto Rico, Humacao campus, and Dr. Jorge Ortiz, Institute of Topical Ecosystem Studies, UPR Rio Piedras, new recruit and research fellow of CREST-CATEC.
- administrative work for field work in Mona Island
- administrative work related to travel for researchers, students and visitors.
- arranging and supervising the logistics of the activities sponsored by the Center
- hiring and training of computer data manager/system specialist
- advising and being an active part in the recruitment of a Biology professor and researcher for which CREST- CATEC will provide the startup funds this coming August from its matching funds.
- following-up and finally succeeding in establishing a memorandum of understanding between UPR – Rio Piedras and PR – Department of Environment and Natural Resources of the Government of Puerto Rico.
- general administrative work related to the activities of the thrust areas.

4. Other grants management - This summer we will begin managing two more grants, apart from the CREST already at work. Dr. Owen McMillan (PI of Thrust area 1 – MEEG) was awarded an NSF competitive grant of \$750,000 for three years (NSF –0344705). Dr. Alberto Sabat, CREST-CATEC research fellow in collaboration with Dr. Paul Bayman, Department of Biology were awarded a NOAA grant of \$53,000 for three years. I expect at least two more grants to be added to the Center during the next year.

Identification of problems related to efficiency of grant and Center management.

We have continued to be very successful in the short time the Center has been active, however there are pertinent issues that need to be addressed. We continue to have the full support of the Chancellor, Dean of Natural Sciences, and the heads of the Department of Biology and ITES, however the administrative part of the University is a constant source of problems and delays.

Ms. Diaz the Center Coordinator, and myself has to spend a considerable amount of time just dealing with petty problems related to hiring of students, payment of fees, payment of compensations, and transfers of monies from one account to another. The system is very conservative and outdated, so it takes between 3-4 months, sometimes more, for the Finance Office to clear whatever orders or requests are done. That includes equipment purchase, payment of students, personnel contracts and compensations, etc.

The hiring of Ms. Diaz has significantly improved the situation, but at the expense of nearly 40% of her time in following up and personally pushing the paperwork to be done on time. This is the first big grant (five million dollars in five years) that the Rio Piedras administration has had to deal with. It has been with considerable effort that we are continuing but successfully retraining bureaucrats to understand how and why research administration has to be efficient and fast. However, the Center is expanding and more research grants are being added, so if the slow and excessively bureaucratic functioning of the personnel and finance and accounting offices continue as of now, it will have a deleterious effect on the medium term outcomes of the grants. The Chancellor is cognizant of the situation and has promised a short-term solution to it. Dr. Ana Guadalupe, Dean of Graduate Studies, has promised that the administrative aspects of handling research grants will be solved this year. An example of the ongoing situation was that it took me nearly a year and a half, working along and with full cooperation from the Office of the Graduate Studies, to have the Dean of Administration rule that student fees can be paid from grant monies, a standard procedure at other universities in the States.

Proposed solution: to establish an accounting and finance office at the University exclusively in charge of processing external funding finances, and to evaluate and establish a more stream-lined and time and cost effective way of doing the administrative procedures.

Technical and Information Support:

1- Web page: Mr. Joel Ruiz, the new computing/systems manager, in coordination with the High Performance Computing Facility (HPCF) of the Resource Center for Science and Engineering is developing the Web site of CREST-CATEC. The web site, <http://CREST-CATEC.upr.edu>, is already functional, but some parts are still under construction. It provides information about the Center, ongoing research projects and activities, announces the different activities of the research groups, other research centers, and people related to CREST-CATEC. In addition each member of the program can have his/her own web page into the CREST-CATEC Web Site. We expect to have the web page completed by early January of 2005

2 – Development of web collaboration:

This system is a web based application so that the professors, investigators, students and collaborators can save, share, and publish all the information related to their investigations. The system is divided by each sub-project with the capacity to be able to work altogether. Input and management of the meta data will follow after the system is in place. We expect to have it completed also by January 2005.

3 – Computational support for other laboratories:

- a) Sequencing and Genotyping Facility and the Bioinformatics Satellite Lab. CREST-CATEC provides critical computational support for integrating and managing hardware and software components of both facilities. Mr. Ruiz and Mr. Humberto Ortiz, from HPCF, are coordinating the network development and the programming of the system that will be implanted.
- b) Coordination and technical support for the research fellows in the Center.

4 – Research references and information resources

The previous year problems in maintaining an up-to-date access of information of reference sources have considerably improved. The resource Center for Science and Engineering of the University of Puerto Rico, Central Administration, provided the funds to establish ISIS Web of Science at the Library of Natural Sciences. This has considerably expanded the reference

search and will have direct benefits to the Center. The Natural Science library is well equipped and is improving the electronic access to references for students and academics. The library continues to be short of funds to purchase books and hard copies of journals. **Proposed solution:** get supplemental funding to cover the costs of paper and electronic subscription to the journals.

Other issues:

I still consider that the Center will benefit with the hiring of an officer in charge of identifying new sources of funding, helping in grant writing and working along with the Director and research fellows. The matching funds do not provide for this person so I am to identifying sources of funding for the hiring of personnel.

Laboratory infrastructure

The fourth thrust area of CREST, Ecosystems Ecology Group, is being developed research wise (see collaborations, activities and findings), however infrastructure for this area is still waiting. Construction and remodeling of the laboratory for the CREST-CATEC director and PI (Elvira Cuevas) is waiting for the construction permit and bids. The facility will be equipped with analytical instrumentation to study carbon and nutrient dynamics in soils and plants, as well as eco-physiological parameters of plant dynamics. It will also provide office space for six graduate students and postdoctoral researchers. This laboratory will be the first one of its kind in the University, and will allow students and researchers from CREST-CATEC and other groups in the University to carry out research that will complement the present and future ecological studies that lack the analytical understanding of the problem.

Dr. Jorge Ortiz, hydrologist and new recruitment at the Institute of Tropical Ecosystem Studies and research fellow of CREST-CATEC, leads the hydrology component of the Ecosystems Ecology area. CREST-CATEC provided the set up funds to renovate his laboratory facility currently used as storage. At the request of the Dean of Natural Sciences, the UPR President recently granted additional funds to complement CREST-CATEC funds to renovate this laboratory. It is

expected that remodeling can start during the next school year and the facility be ready by the Spring 2005. The facility will be equipped with analytical instrumentation to study water chemistry (nutrients, major ions, and carbon), bioassay work with macro invertebrates, and will provide adequate space for graduate students. This laboratory will be the first facility dedicated to limnology research in Puerto Rico and will be available to interested students to develop research projects in the field including projects on the effect of land use on the ecology of urban streams, a research aspect of important social implications given the many impacted rivers in urban areas.

Both laboratories are to be located in the same wing in the Facundo Bueso building in order to develop synergic interactions among researchers and students.

I.4. CURRENT CENTER ADVISORS:

External Advisory Committee members CATEC-CREST:

Robin Chazdon, PhD: University of Connecticut – tropical plant ecology – chazdon@uconnvm.uconn.edu

Deborah Clark, PhD: University of Missouri – St Louis – tropical forest conservation and management – daclark@sloth.ots.ac.cr

Larry Gilbert, PhD: University of Texas, Austin – Evolutionary biology and economical entomology – LGilbert@mail.utexas.edu

Ariel A. Lugo, PhD: USDA Forest Service International Institute of Tropical Forestry – ecosystem ecology and forest restoration dynamics – alugo@fs.fed.us

Javier Francisco Ortega, PhD: Florida International University – molecular genetics and island biogeography – ortgaj@fiu.edu

Daniel Simberloff, PhD: The University of Tennessee - dsimberloff@utk.edu – Conservation biology and island biogeography

Peter Vitousek, PhD: Stanford University - ecosystem processes and island ecosystems- vitousek@leland.stanford.edu

I.5. BIOGRAPHICAL INFORMATION OF NEW INVESTIGATORS:

Jorge Ortiz

I.6. ACCOMPLISHMENTS

Current collaborations and interactions:

The establishment of UPR-CREST - CATEC documented the important synergy between UPR researchers and local and federal agencies and laboratories. It has also documented the important synergy that can be developed among campuses within the UPR University system. The grant facilitated the development of a cooperative agreement between UPR-Río Piedras and the Department of Natural Resources and Environment of the Government of Puerto Rico, an important milestone in the recognition of synergic collaborative work.

Joint research activities and interactions:

- Effect of invasive species on the soil nutrient dynamics of wetlands in Puerto Rico. UPR-Río Piedras and USDA Forest Service International Institute of Tropical Forestry and Puerto Rico Conservation Foundation. We are determining how an invasive tree species, *Melaleuca quinquenervia*, is affecting the soil nutrient availability in eutrophicated wetland areas in the San Juan Bay area in Puerto Rico in order to establish management strategies for the control and use of this rapidly growing invasive tree.
- Downstream effects of plant species plasticity at the ecosystem level in a seasonally dry forest in Guánica, Puerto Rico. UPR-Río Piedras, USDA Forest Service International Institute of Tropical Forestry and Puerto Rico Conservation Foundation. Will provide a better understanding of how species diversity affect ecosystem functioning, and to develop better management strategies for selection of tree species for rehabilitation of degraded areas. Both CREST-CATEC and USDAFS-IITF are providing funds to a PhD student.
- Morphological and physiological plasticity of tropical trees modulated by physicochemical stressors: nutrients, salinity and wind. UPR-Río Piedras, USDA Forest Service International Institute of Tropical Forestry and Puerto Rico

Conservation Foundation. Will provide a better understanding of how species diversity affect ecosystem functioning, and to develop better management strategies for selection of tree species for rehabilitation areas under different environmental stressors.

- Climate change and sea level rise as measured by ^{13}C and ^{15}N natural abundance in a dwarf mangrove peat substrate in northeastern Puerto Rico. UPR-Río Piedras and USDA Forest Service International Institute of Tropical Forestry. The research is allowing understanding how sea level rise and paleoclimatic changes in the last 4500 years have occurred in the Caribbean region.

- Hydrologic evaluation of the habitat of the endangered crested toad (*Peltophryne lemur*) in Guánica, Puerto Rico. UPR-Río Piedras and Department of Natural and Environmental Resources of the Government of Puerto Rico (DNRE), US Fish and Wildlife Service, and Toronto Zoo, development of a project proposal to gather preliminary data.

- Puerto Rico Water Plan. Department of Natural Resources and Environment of the Government of Puerto Rico. Jorge Ortiz, from UPR-Río Piedras participated as a water resources consultant to the Government of Puerto Rico in the development of a comprehensive evaluation of water reservoirs in Puerto Rico. This project was also sponsored by the Chancellor's Office of the University of Puerto Rico, Río Piedras campus.

- Population biology of hawksbill turtles, an endangered species. UPR-Río Piedras and Department of Natural Resources and Environment of the Government of Puerto Rico. Ongoing collaboration involving molecular/field projects.

- Reproductive biology of the Mona Rock Iguana. UPR-Río Piedras and Department of Natural and - Environmental Resources of the Government of Puerto Rico. Ongoing collaboration involving molecular/field projects.

- Status surveys of marine turtles aggregations inhabiting coastal waters of Puerto Rico. Department of Natural Resources and Environment of the

Government of Puerto Rico, NOAA. Provided foundation for continued research on marine turtles.

- Population biology of black mangroves in Puerto Rico, University of Puerto Rico-Humacao, Provided forum for inter campus collaboration.
- The developmental architecture of wing pattern variation in *Heliconius erato*. NSF, Duke University. Provided attached undergraduate and graduate studentship. Also, CREST-CATEC will be responsible of administering the grant.
- Metapopulation dynamics of an endangered riparian orchid. UPR-Río Piedras and UPR-Humacao, Provides funding for molecular/field project on endangered riparian orchids. Many Puerto Rican undergraduate students from Humacao are actively involved in this project.
- Effects of Introduced Feral Ungulates on the native vegetation of Mona Island Reserve. UPR-Río Piedras Department of Natural Resources and Environment, USDA Forest Service International Institute of Tropical Forestry, UPR-Humacao, UPR-Bayamón, University of Minnesota. CREST-CATEC is providing most of the funds for materials, student and faculty salaries, equipment and travel. By providing student funding, CREST-CATEC allows this project to expand its scope to ecosystem parameter. Matching funds in UPR-Humacao have been approved to Dr. Denny Fernandez and Dr. Raymond Tremblay (also a CREST-CATEC researcher) to complement research activities related to the CREST project. The funds include materials, equipment, stipends and travel funds, used mainly to facilitate local undergraduate student participation. The project is generating data on the relationship between plant and insect diversity at the site. The following investigators will contribute with insect identification: Mr. Miguel Garcia (Department of Natural Resources and the Environment), Dr. Michael Ivy (University of Minnesota), Dr. Alonzo Ramirez (ITES-UPR), DR. Ariel Diaz (UPR-Humacao, and Dr. Juan Torres (UPR-Bayamon). The information generated will allow us to address questions related to the indirect effects of introduced herbivores on trophic structure.
- Development of Conservation Center for Neotropical Zingiberales. Zingiberales Society of Puerto Rico, Puerto Rico Chapter of Heliconia Society International,

Crest funds for PI summer salary are facilitating the development of a Strategic Plan for the Conservation Center.

Dr. Elvira Cuevas- Board of Directors AAAS, Caribbean Division (2003 - present). Co-leader Thrust Area: Environment and Ecology, PR-EPSCoR – University of Puerto Rico (2003 – present).

CREST-CATEC has been very active in promoting and sponsoring seminars, workshops and short courses.

- We provided the financial support for Dr. David Siegler from the University of Illinois at Urbana-Champaign, to offer a field course in plant ecology to the graduate students in the CREST-CATEC program. The course took place in April-May of this year.

- We also provided financial support to the department of Biology to bring Dr. Ananías Escalante, Investigator at the Instituto Venezolano de Investigaciones Científicas, Research Fellow of CDC and Adjunct Professor of Emory University, to give a seminar in the department of Biology and be interviewed as a candidate for the position of Geneticist in the Department of Biology.

- November 17-19, 2003. Presentation by Dr. Robert Buschbacher, and meeting with potential applicants for the University of Florida's Working Forests in the Tropics program. This inter-disciplinary program focuses on tradeoffs among economic uses, ecological conservation and regional development in the tropical forests of Latin America. They offer an innovative "PhD-plus" curriculum where students take their PhD in a wide variety of participating programs, to which we add coursework and practical experiences to provide interdisciplinary theoretical tools and cross-cultural skills. See www.tropicalforests.ufl.edu/wft. The program works to attract minority applicants.

Results of this activity: The Puerto Rican student Ivellise Ruiz, was accepted as a PHD student at the University of Florida, Gainesville and into the Working Forests in the Tropics program and starts in September, 2004.

- December 11-14, 2003. Stormwater Management Workshop and Charette.

Invited speaker: Dr. Robert Neville. This activity was held in conjunction with the faculty of architecture of the University of Puerto Rico, Rio Piedras campus.

Results of the activity: Brought together faculty and students from various disciplines, and persons from government agencies and non-governmental organizations, to attend seminars and discuss the issues of water management in Puerto Rico, especially in urban areas.

- April 21, 2004. invited speaker: Dr. Terry Hazen, Director of the Microbial Ecology and Environmental Engineering laboratory, Lawrence Berkeley National Laboratory, University of California. Seminar co sponsored by CREST-CATEC and the UPR Resource Center for Science and Engineering and the Department of Biology. Presentation: "Metabolomics, Bioinformatics, and Ecology: A New Paradigm for Environmental Biology"

Results of the activity: Brought together faculty and students from interested disciplines to be informed about the possible research collaborations that can be developed in these areas.

I.7. International activities:

Dr. Elvira Cuevas - Adjunct faculty at the Department of Management and Conservation of Natural Tropical Resources, Faculty of Veterinary and Zootechnology, Universidad Autonoma de Yucatán, Mérida, México. May 2004.

Dr. Elvira Cuevas, Visiting scientist (equivalent to adjunct scientist) in the Plant eco-physiology laboratory, Centro de Ecología, Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela. Three graduate students from the Department of Biology, UPR-Rio Piedras are doing the chemical analyses of the samples from their thesis research at IVIC. One graduate student will receive training in phenolic derived compounds' determinations in plant and soils at the IVIC lab. There is ongoing collaboration with Drs. Francisco Herrera and Ernesto Medina, Centro de Ecología, Venezuelan Institute for Scientific Research (IVIC) in Caracas, Venezuela. This collaboration encompasses research activities in

Venezuela as well as development of new research in the Karst region of Puerto Rico. In this last effort the USDA Forest Service International Institute of Tropical Forestry will also be involved. There were four presentations in the Vth Venezuelan Congress of Ecology, Margarita Island, Venezuela on 3-7 November, 2003 and one oral presentation in the Society for ecological Restoration in Austin, Texas. December 2003:

- Herrera, F.F. & Cuevas, E. 2003. Soil fauna as bioindicators of recovery in disturbed systems. Vth Venezuelan Congress of Ecology, Margarita Island, Venezuela on 3-7 November, 2003
- Armenise A., Herrera F., Flores S., Alceste C. y Cuevas E. 2003. Fire effects on the soil enzymatic activity of early successional plant communities. Vth Venezuelan Congress of Ecology, Margarita Island, Venezuela on 3-7 November, 2003
- Alceste, C., Herrera, F., Flores, S., Armenise, A. y Cuevas, E. 2003. Soil biological activity and enzymatic activity relationships in fire-affected ecosystems. Vth Venezuelan Congress of Ecology, Margarita Island, Venezuela on 3-7 November, 2003
- Herrera, F., Alceste, C., Flores, S. Armenise, A & Cuevas, E. 2003. Soil enzymatic activity dynamics in a successional mosaic during the rainy season. Vth Venezuelan Congress of Ecology, Margarita Island, Venezuela on 3-7 November, 2003
- Herrera. F. & Cuevas, E. 2003. Linking aboveground and belowground dynamics in a successional mosaic of vegetation in Venezuela. Society for Ecological Restoration's 2003 Conference: Assembling the pieces: restoration, design and landscape ecology. Austin, Texas.

There are also three publications from this collaboration:

- Herrera, F.F. & Cuevas, E. Vegetation shifts affect the composition and dynamic of soil communities in disturbed tropical ecosystems. **Biotropica in revision.**
- Herrera, F.F. & Cuevas, E. Soil arthropods as bioindicators of recovery in disturbed systems. **Venesuelos in press.**

- Tremont, O. & Cuevas, E. Organic carbon, nutrients and seasonal changes in microbial biomass in soils from the dominant tree species two types of tropical forests. **Venesuelos in press.**
- Dr. Eugenio Santiago is collaborating with the National Botanical Garden of the Dominican Republic. *Goetzea* is also found in Hispaniola, where it is very rare. Colleagues of this institution are collaborating with Dr. E. Santiago in a project to determine the taxonomic boundaries of the species in this genus.
- January 2004. Dr. Elvira Cuevas was the speaker along with Dr. Ernesto Medina, IVIC, Venezuela on the three day workshop: Eco-physiology of trees from seasonally dry areas: nutritional and eco-physiological aspects from tree to the ecosystem. Graduate course given at the Department of Management and Conservation of Natural Tropical Resources, Faculty of Veterinary and Zootechnology, Universidad Autonoma de Yucatán, Mérida, México. Fifteen mexican students participated in course.
- 2003 – Two day Workshop. Population dynamics applied to Conservation of Orchids. Orchid Forum II, Royal Botanical Gardens, Melbourne, Australia. Dr. Raymond Tremblay and Fiona Coates from the Conservation and Sustainability Department, Victoria, Australia were the workshop speakers. Twenty six participants from Victoria and South Australia attended this workshop.
- 2003- Two-day Workshop. “Insitu Conservation of Orchids” prior to the 1st International Conference on Neotropical Orchidology. 20-25 of May, 2003, Ciudad de la Investigación Universidad de Costa Rica, San José. Dr. Raymond Tremblay and Dr. Pavel Kindlmann, University of South Bohemia, Czech Republic were the workshop speakers. Ten participants from USA attended this workshop.
- April 17-18 2004: International meeting on "Evolution and Development in the Lepidoptera". UPR - Central Administration Building, UPR Botanical Gardens, San Juan Puerto Rico. Coordinated by Owen McMillan, UPR-Rio Piedras and Antonia Monteiro, SUNY- Buffalo. The meeting was attended by over 30 students and researchers from around the world and provided an excellent venue for dialogue and collaborative exchange.

- Dr. Owen McMillan is a participant in the recently funded Research Coordination Network grant to establish protocols to monitor, document, and study invasive species.

Dr. Raymond Tremblay - Chair of the International Committee for In Situ Conservation of the Orchid Specialist Group, Species Survival Commission, IUCN – The World Conservation Union.

- May 16-21, 2004. International Workshop “ Population dynamics applied to Conservation of Orchids”. Dr. Raymond Tremblay, UPR-Humacao, along with Pavel Kindlmann from the University of South Bohemia, Czech Republic were the workshop speakers. International Orchid Conservation Congress II. The Conservation Balance. Marie Selby Botanical Gardens, Sarasota Florida,. Twenty one persons from Latin America and the USA participated in this workshop.

- May 23-27 2004. Inter-american Nitrogen Network Workshop. Cosponsored and organized by CREST-CATEC, Interamerican Institute for Global Climate Change (IAI), Cornell University and PR- EPSCoR. Embassy Suites Hotel, Isla Verde, Puerto Rico. The objective of this workshop is to build a network of scientists from across the Americas devoted to study human alteration of the nitrogen cycle and to develop plans for a larger Science Program called the Inter-American Nitrogen Network to tackle problems related to nitrogen pollution in this region of the globe. Drs. Elvira Cuevas was the workshop organizer and also participant. Dr. Jorge Ortiz from UPR-Río Piedras and Dr. Eduardo Schröder, from UPR-Mayagüez participated in the workshop. Three graduate students from UPR-Río Piedras also participated in the workshop.

- Dr. Melendez-Ackerman submitted a proposal to the "Visiting Scholar Program" of the University of Puerto Rico, Río Piedras to bring Dr. Jon Paul Rodríguez-Fernández, from the Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela to give a workshop on GIS applications in Conservation that will be open to faculty and students of the University of Puerto Rico. He is currently the director of the International Center for Tropical Ecology of UNESCO in Venezuela and is coordinator of the Applied Program for Wildlife

Studies supported by the “Wildlife Trust”. Dr. Rodríguez-Fernández also presides the Neotropical and Austral section and is member of the Directive Board of the Society for Conservation Biology. This status of this proposal is still pending.

Dr. Elvira Cuevas submitted a proposal to the "Visiting Scholar Program" of the University of Puerto Rico, Río Piedras to bring Dr. Ernesto Medina, from the Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela to teach a graduate course in Plant-ecophysiology in the Department of Biology. Dr. Medina, an internationally renowned scientist in the field of plant ecology and eco-physiology, is a foreign member of the US National Academy of Sciences and the American Academy of Sciences. The status of this proposal is still pending.

All the international activities reflect the very strong presence and relevance of the research fellows in CREST-CATEC in the international scientific field.

I.8 . Objectives of the shared experimental facilities.

The Sequencing and Genotyping Facility is a core research facility designed to allow students and researchers access to state-of-the-art sequencing and genotyping equipment. In addition, the facility is charged with creating essential infrastructure for archiving, manipulating and analyzing large molecular data sets. One of the most important contributions to research infrastructure was continued growth and development of core genomic facilities at the University of Puerto Rico, Rio Piedras. Specifically, we were able to use this project as leverage to secure additional funds for growing and integrating the UPR-RP’s Genotyping and Sequencing Facility. In addition to allowing CREST researchers to collect high-resolution molecular data, the expanded Sequencing and Genotyping Facility has been critical for attracting new researchers and new research funding.

The Bioinformatics Satellite Lab is in the very beginning stages of establishment and will act as a core data processing and storage center for all molecular based research activities associated with CREST projects. In addition,

the lab will provide critical space for professional workshops and computational support for graduate classes in genetic data manipulation and analysis.

The Plant Ecology and Conservation laboratory of Dr. Raymond Tremblay in UPR-Humacao was established in part with the funds from CREST-CATEC.

I.9. Special equipment/facilities and examples of use by CREST personnel and others and impact on the scientific community.

The facilities described below all have the following two objectives:

1 - to make available state-of-the-art- equipment and facilities needed by faculty and students to achieve their goals.

2 - to make it available to the broader scientific community at large.

The Sequencing and Genotyping Facility was recently upgraded with the arrival of a new capillary-based automated DNA sequencer (MegaBACE™ 1000) and Li-Cor NEN Global DNA Analyzer System and Odyssey Infrared Imaging System. The MegaBACE is a high throughput sequencer and genotyper and will be instrumental in the characterization and development of the microsatellite loci that are cornerstone of the core MEEG projects. The Li-Cor DNA Analyzer and Imaging systems was purchased specifically for our genotyping needs. The Li-Cor software and LIMs support for analysis of microsatellite or Amplified Fragment Length Polymorphisms (AFLP) data is excellent and will allow researchers to easily manage the large molecular datasets generated over the course of this proposal.

The Bioinformatics Satellite Lab will house computers (and associated software), servers, and miscellaneous small molecular equipment for molecular data storage, generation, processing, and analysis. In addition, the lab will be outfitted with fast connections to UPR's Bioinformatics Resource Center (BiRC) and will work closely with researchers and staff at the BiRC and CREST-CATEC to design and implement specific software and hardware solutions associated with CREST projects. Approximately 600 ft² of space has been allocated by the Biology Department. This space (JGD 207A) is centrally located and adjacent to the Sequencing and Genotyping Facility. Much of the equipment has been

ordered and we expect that the facility will be functioning by August 2004. Funds to establish the Cluster were recently awarded through the NIH-S.C.O.R.E program and CREST-CATEC will provide computational and networking support.

Both the Sequencing and Genotyping Facility and the Bioinformatics Satellite Lab are essential for the success of the CREST-CATEC's Molecular Ecology, Genetics, and Evolution Program. Although NIH provide the primary funding, CREST-CATEC will provide critical computational support for integrating and managing hardware and software components of both facilities. In addition to allowing CREST researchers to collect and manage large molecular data sets, the expanded facilities are important assets for attracting new researchers and new research funding into the CREST program. For example, the Biology Department has recently hired two new faculty, both of whom will likely join CATEC's Molecular Ecology, Genetics, and Evolution Program. However, neither research would have accepted the position without unimpeded access to a functioning sequencing and genotyping facility. Furthermore, we were able to secure recent NSF funding largely because we could document our ability to produce and manage a large sequencing and databasing project.

The Plant Ecology and Conservation laboratory of Dr. Raymond Tremblay in UPR-Humacao: Equipment includes, PCR, Centrifuge, Gel ridges, refrigerator, freezer (-20C°), pipette man and power pack were acquired and used for research and involve undergraduate students in research activities. The fledging molecular facilities provide an important resource for students and researchers at UPR-Humacao. The facility serves two functions: first, it will allow students to conduct most of the molecular techniques needed in the genetic components of our core project at UPR-Humacao. This greatly facilitates training and technology transfer and increases the number of students served by the MEEG group. Second, the establishment of this facility is essential for attracting external research funds to this UPR campus.

The Bee Population Genetics and Physiology research laboratory of Dr. Tugrul Giray in UPR-Rio Piedras provides a state-of-the-art population genetics and physiology laboratory in close proximity to the Sequencing and

Genotyping Facility and the Bioinformatics Satellite Lab. The 1000 sq ft laboratory is fitted with all necessary equipment for endocrine physiology, and protein biochemistry of honey bees. This lab receives funding from NSF CREST-CATEC, SCORE-NIH, and PR-EPSCOR-NSF. This lab currently houses the Co-PI, 5 graduate students (2 minority), 2 technicians (1 minority), one postdoctoral researcher (minority), 4 undergraduate researchers (all minority), and 2 undergraduate student hourly workers (minority).

Bee Research Facility makes available a state-of-the-art bee behavior and field research laboratory. The 1500 sq. ft. laboratory is located in an isolated building at 20min distance to the campus lab, with rooms for artificial insemination facility, observation colonies, incubators, woodshop, wet lab, and research atrium. This lab receives funding from the Dean of Natural Sciences at UPR, NSF.CREST-CATEC, SCORE-NIH, and PR-EPsCOR-NSF. This lab is the location for bee colonies and field research. This lab is currently being used by Giray's lab personnel. In addition, Carla Restrepo, PI in the landscape component, has ongoing research at the same site and will utilize the facilities.

Molecular Laboratory JGD 207-8 - The objective of this facility is to support research by one of the PI's in the CREST-CATEC, Dr. Owen MacMillan. The laboratory is additionally used for molecular marker studies of *Goetzea* and *Apis mellifera*. The 1000 sq ft laboratory area is fitted with all necessary equipment for molecular genetics work. This lab receives funding from NSF-CREST-CATEC, SCORE-NIH, and PR-EPsCOR-NSF. McMillan, Giray, and Santiago lab personnel involved in molecular genetics research are currently using the lab.

Herbarium (Botanical Garden, UPR) - The objective of this facility is to support studies on plant biodiversity and distribution of Puerto Rico and the Caribbean. CREST-CATEC personnel uses the facility for processing voucher specimens and taxonomic identifications. The herbarium contains approximately 35000 specimens of plants representing flora of Puerto Rico and the Caribbean. The University of Puerto Rico mainly funds the facility. The herbarium is accessible to CREST-CATEC personnel through Co-PI Eugenio Santiago.

Experimental Plots (Botanical Garden, UPR) - The Botanical Garden of Puerto Rico has about 250 acres of land open to public and researchers. Garden grounds also provide for study sites for other plant species, such as the invasive legumes. Specific plots in the garden grounds have been prepared for study of pollination in cultivated plants of *Goetzea elegans*. The Botanical Garden grounds are accessible to CREST-CATEC personnel through Co-PI Eugenio Santiago.

Herbarium Collections, located in the Biology Museum of UPR-Rio Piedras will contain reference species of all plants in the island. Collections contain a dry specimen of a plant species and information on the date of collection, locality, phenology, collector as well as some complementary materials (i.e. pictures). These collections ensure the correctness of plant identifications in the study plants. Researchers can use the collection initially to validate species identification in the field. These collections can also be used as reference for identifying organisms in taxonomic, systematic and ecological studies and obtaining species or individual specific information. For example, a researcher may want to plant a census on a plant population during the flowering period. Voucher information can be accessed to estimate the best time to plan for that. The collections will improve the current biological collections and inventories of plants at two herbaria (UPRRP, DNRE). Information will be data based at the New York Botanical garden Virtual Herbarium. This collection will provide better access to information on Mona species to researchers and students not only in Puerto Rico but also in the Mainland since specimens can be loaned among certified herbaria.

Virtual Herbarium - Will consist of a digitized collection of all voucher specimens. Data will be stored and managed by the New York Botanical Garden but entered from computers at UPR-Rio Piedras. It will allow for the benefits of the actual collection from any computer with Internet connection. . Information on Mona Island plant species will also be available for the scientific community around the world given the expected internet access to these collections.

The Institute of Tropical ecosystem Studies Computer server is used to maintain the Tropical Plant Ecology and Evolution Laboratory page and an introductory Page to The Mona Project Web Page. On the first page potential students and researchers will be able to get information on the PI (E. Melendez-Ackerman), her laboratory activities, funding opportunities and other relevant information. The second web page provides general information on one of the CREST funded project and its main collaborators. We are currently developing links for students, opportunities for involvement, and relevant links such as publicly available data on the project, collaborating agencies, contact information etc. Expected databases to be placed in this server will include (but will not be limited to) a digital photo collection of Mona Island Plants, climate data and, annual censuses of permanent plots. The web pages will provide increased visibility for CREST-CATEC as well as collaborating departments, programs, institutions and agencies (i.e Institute for Tropical Ecosystem Studies, The Biology Graduate Program at UPR, DNRE) will facilitate the goals of the program including, faculty development, student training, dissemination of information to the public.

The UPR- Humacao computer server will house daily micro-climatic data as well as the web page of Dr. Dennis Fernandez. This data is site dependent can be linked to organismal data collected at permanent points. This data can be used to look at correlations of spatio-temporal changes between climate and organismal/ecosystem responses. Remote access to these types of data will provide scientific information that may be useful to individual researcher not necessarily related to the project as well as facilitate cross-site collaborations among research groups through data exchanges.

The Morphology lab at UPR-Rio Piedras is currently used for the identification of plant species based on microscopic plant tissue, seeds and fruits from stomach and feces samples of exotic ungulates and insect species collected from Malaise and Pitfall trap samples. Digital seed, fruit and insect collections are being developed. This information may also be valuable to other researchers working on plant and insect identification on dry tropical forests in

the Caribbean Region. This information will eventually be made available to the scientific community.

The Microbial Observatory laboratory is part of a NSF project awarded to Dr. Lilliam Casillas of UPR-Humacao. The facilities are designed mainly to process microbiological materials from salt marshes, sediments and water. The CREST-CATEC personnel will use the light microscopy equipment, with an state-of-the-art digital photography system, to obtain photomicrograph of plant epidermis replicas. These photomicrographs will serve as a reference graphic tool to identify the plants in the stomach and feces. The photomicrograph will be available through the web to the scientific community. This material will serve for research (identification of plant species) and educational (botany and plant anatomy) purposes. Forensic investigations may benefit from these photomicrographs.

The Electromicroscopy laboratory located at UPR-Humacao and directed by Dr. Carmen Hernández, is available for research activities of the local faculty. CREST-CATEC personnel will use the scanning electron microscope (SEM) to obtain surface microphotographs of those plant species with rough and hairy epidermis, when the replica procedure is not effective. The photomicrograph will be available through the web to the scientific community. This material will serve for research (identification of plant species) and educational (botany and plant anatomy) purposes. Forensic investigations may benefit from these photomicrographs.

High Performance Computer Facility of the University of Puerto Rico (HPCf) is located at UPR-Central Administration Facilities in the UPR Botanical Gardens. The High Performance Computing facility of the University of Puerto Rico has a technology and service infrastructure for the research and education community of the University including: Advanced Research Network, Core High Performance Computational Resources, Services in Support of Users of Computational Resources, Standards and Architecture, and Evaluation of Emerging Technologies, Various projects are concurrently administered by the High Performance Computing facility:

- Center for Numerical Supercomputing
- Bioinformatics Resource Center
- Visualization Laboratory
- Internet2 in Puerto Rico
- Teaching Laboratories and Access Nodes
- Services to the UPR Community

The Bioinformatics Resource Center (BiRC) - contains high-end hardware, software and services essential to all researchers and educators in biomedical sciences at Puerto Rican institutions. The areas considered as essential to be developed and supported at the Bioinformatics Resource Center are:

1. genomic and proteomic databases
2. sequence analysis software
3. phylogeny software
4. protein structure prediction and visualization
5. bioinformatics programming
6. microarray data visualization and analysis
7. biostatistics
8. research support services and training

In order to alleviate the accessibility problems of CPU cycles for the bioinformatics community, there is a second supercomputing server totally dedicated to the bioinformatics community. HPCf is being used as the main platform for CREST-CATEC web page, web collaboration (MEEG) and data depository.

El Verde Field Station - The Institute for Tropical Ecosystem Studies of the University of Puerto Rico administers El Verde Field Station. El Verde Field Station, located within the Caribbean National Forest in Puerto Rico, is a main center in tropical research. A wide variety of ecological research is conducted at El Verde, including research on forest dynamics, stream ecology and hydrology, and ecosystem processes. Most research is conducted by the Luquillo Long-Term Ecological Research (LTER) program and by scientists from the University of Puerto Rico. The station's laboratory have eleven offices, most of them

occupied by long-term researchers. Laboratory equipment includes compound and dissecting microscopes, fiber optics illuminators, balances, pH meter, a LI-COR 3050A leaf area meter, drying ovens, stirrer/hot plates and a chemical hood. A computer and conferences room provides visitors with access to five PC computers and one Macintosh. All computers have internet access. The field station is a historic research landmark in Puerto Rico and in the tropics given that it started operations in 1930. Currently it hosts many Puerto Rican and international students that visit the station to conduct ecological research. It is therefore, an important training center for young scientists and faculty. The personnel of the orchid metapopulation study actively utilizes these facilities, as well as the newly incorporated hydrology group.

I.10 Future collaborations with other CREST Centers.

CREST-CATEC and CREST-RESSACA (Texas A&M) will jointly participate in a GIS course for Hispanic students and researchers that will be taught in February 2005 in Puerto Rico. This activity will provide an excellent venue to establish collaborations and exchange between the two universities. There are also plans to prepare a Symposium for 2005 where CREST-CATEC, CEA-CREST (California State University) and CREST-RESSACA will jointly participate. The Directors of the three Centers are planning a partnership based on their common interests, e.g. the effect of climate change on ecosystem dynamics. The GIS course and the joint symposium will further the interaction and integration of the three Centers. These are the first steps towards the development of a research alliance where mutual benefits will be enhanced.

II. ACTIVITIES AND FINDINGS

II.1. ACTIVITIES:

Thrust area 1 – MEEG

The Mona Island Hawksbill project: We accomplished all of our major goals 2003-2004. In summary, the team led by Carlos E. Diez, Robert P. Van Dam (in water work and ecology), Ximena Velez (nesting and molecular analysis), and CREST-CATEC investigators Durrell D. Kapan and W. Owen McMillan accomplished the following:

- 1) Collected and achieved 2178 tissue (blood and skin) samples from hawksbill nestlings representing 70 different focal nests.
- 2) Continued extensive in-water surveys of adults and juvenile turtles around Mona.
- 3) Conducted beach surveys of nesting activity from August- January 2003.
- 4) Tagged and retrieved DNA samples from 38 male Hawksbill and 54 female hawksbill turtles during the 2003 breeding and nesting season.
- 5) Deployed satellite transmitters and tracked four focal hawksbill turtles.
- 6) Began molecular characterization (both mtDNA and microsatellites) of adult hawksbill and hatchling turtles.
- 7) Secured additional funding (\$100,000) from the National Fish and Wildlife Foundation (NFWF) to augment field and molecular studies on hawksbill turtles on Mona.

Specific details concerning the field and in-water components of this research are presented in the attached report.

For the upcoming year we will:

- 1) Continue in-water surveys to assess the remigration or persistence frequency of adult male hawksbill turtles at Mona. This work will also allow us to gather addition DNA samples from previously unmarked male turtles and to estimate the size of the male breeding aggregation.
- 2) Deploy satellite transmitters on additional males (and females) to verify the shorter non-breeding dispersal distances apparent from our preliminary data.
- 3) Continue nesting survey and monitor hatchling success on focal beaches on Mona.
- 4) Finish molecular analysis of male and female hawksbill turtles for stock assessment.

5) Finish molecular analysis of multiple paternity in hawksbill turtles.

The data generated over past year will result in at least three publications in the coming year. Two of these publications will focus on molecular aspects of this study, including evidence for multiple paternity in hawksbill nests and mixed-stock analysis of adult male hawksbills captured on Mona. In addition, we expect to publish several papers that detail the results of our in-water, telemetry, and nesting studies. With the continued success of this project, we will submit additional grants to extend our research efforts.

Metapopulation Biology of Riparian Orchids:

The Orchid Metapopulation project accomplished all of its major goals for the field and lab season of 2003-early 2004. In summary, the team led by Raymond Tremblay, Elvia Melendez-Ackerman and Denny Fernandez (from Thrust area 2), Durrell D. Kapan and W. Owen McMillan accomplished the following

- 1) Created a three-dimensional map of the Quebrada Sonodora *Lepanthes rupestris* patch complex for subsequent analysis of the spatial autocorrelation of population size, extinction and colonization. Over 1000 rock and tree patches were located and mapped by a team of three undergraduate students (Maria Agosto, Jenny Maldonado and Noel Rivera Gómez) led by CREST-CATEC Research Associate Durrell D. Kapan.
- 2) All data were processed and analyzed by the undergraduate team leader Noel Rivera who is continuing the study under Dr. Tremblay and Dr. Kapan.
- 3) In addition to orchid mapping several ecological attributes of each orchid patch, whether occupied or unoccupied was assessed by this team.
- 4) Bi-annual censuses of the 1000+ patch network were completed in June 2003 and January 2004. Teams of over twenty trained undergraduate and graduate volunteers from University of Puerto Rico Humacao and University of Puerto Rico Rio Piedras collected all the data.
- 5) DNA samples from *L. rupestris* orchids were extracted and employed on a microsatellite enrichment library. Library development continues in collaboration with Jesus Mavarez and Genetic Information Services.

6) Initial analysis of the *L. rupestris* metapopulation colonization and extinction probabilities was performed and several posters, talks and workshops were presented by investigators Tremblay, Kapan and students from UPR Humacao. Laboratory work over this period was focused on the development of an enriched microsatellite library. Genomic Identification Services has recently completed the library and we proceed with the development of highly polymorphic markers. These markers will be key for estimating gene flow among focal populations. We have continued to collect data in the field on the dynamics of the metapopulation, including extinction and recolonization and population dynamics and recolonization. We have now completed five years of field research. Drs. Kapan, Tremblay and Melendez-Ackerman have presented a poster and talks on colonization and extinction rates at local and international conferences. With five years of data on metapopulation dynamics we are starting to get stabilization and consistency in the parameters and patterns appear to be consistent consequently we can feel confident that we have true metapopulation.

In the coming year, we will

- 1) Develop a database of plant tissue
- 2) Perfect genomic DNA extraction techniques
- 3) Test and optimize available microsatellite resources for the orchid
- 4) Continue data collecting of population dynamics in the field
- 5) Collect data on the spatial distribution of the metapopulation structure
- 6) Collect data on light environment of the individual populations.

For the upcoming year we will:

- 1) Continue biennial census to assess patch persistence in turnover in *L. rupestris*.
- 2) Begin to gather DNA samples from a greater number of individuals on focal patches
- 3) Optimize microsatellite library and marker characterization.
- 4) Begin microsatellite molecular characterization of dispersal in *L. rupestris* metapopulations.

5) Begin to apply for additional funding to aid field and molecular studies on *L. rupestris* orchids.

The data generated over the 2003 and 2004 field seasons will result in several publications in the coming year. The first paper currently being drafted estimates the population turnover of the metapopulation using the entire 10 census (5 year data set). Subsequent publications will focus on molecular estimates of dispersal to determine whether isolation by distance or lottery colonization important in this metapopulation.

In addition other activities of Dr. Tremblay's group that benefited and benefit the CREST-CATEC MEEG group include:

- Dr. Tremblay has extensively involved many US Minority students in research, research presentation and publication (6 students involved in peer-reviewed publication) total of 16 minority students mentored.
- Dr. Tremblay with international collaborator Pavel Kindlmann, University of South Bohemia, Czech Republic has conducted three international workshops on orchid conservation (Costa Rica, Australia and currently in Florida, USA) with over 57 participants.
- The plant ecology and conservation laboratory of Dr. Raymond Tremblay in Humacao was established in part with the funds from CREST-CATEC. Equipment including, PCR, Centrifuge, Gel ridges, refrigerator, freezer (-20C°), pipette man and power pack were acquired and used for research and involve undergraduate students in research activities.
- Dr. Tremblay has submitted one proposal for the production and growth of seeds the orchid *Lepanthes caritensis* to the Arizona Orchid Society.

Reproductive Biology of the Mona Rock Iguana:

We have accomplished most of our project goals established for 2003-2004. In summary, the research team led by Nestor Pérez, Alberto Sabat, Owen McMillan, and Durrell Kapan, with logistic and field assistance from Alberto Alvarez, Carlos Diez and Miguel García (Department of Natural resources and

Environment, DNRE) and a large number of UPR student volunteers accomplished the following:

- 1) Captured 71 iguanas of all size classes from our three targeted study areas. All animals were sexed, measured [snout-vent-length (SVL), length tail and body mass] and multi-tagged (i.e. internal pit-tags, external mark using color beads, and removing dorsal spines in specific combinations). In addition, we have recorded information on basic health status (blood smears and fecal samples of internal parasites and external survey of ectoparasites), phenotypic traits (tail breaks, missing toes and missing spines) and have collected hard tissue (spines) and blood of all individuals for genetic analysis.
- 2) Outfitted a total of 30 animals with external or internal radio-transmitters.
- 3) Tracked 16 individuals across three time periods in 2003-2004 (March, June-July and October-November). We now have extensive information (more than 20 GPS localities for each animal/period) on home range and social interactions across one reproductive season.
- 4) Collected tissue and blood samples from the offspring of 9 radio-collared females. All hatchlings were measured, sexed, and marked with pit-tags. In addition, blood and tissue sample were archived for planned paternity analysis. Half of these hatchlings are kept in captivity as part of the DNRE's "Headstart" Program and the other half were released.
- 5) Developed two (one di- and one tetra-) genomic libraries for the Mona rock iguana. Both libraries are highly enriched and over 80% of the recombinant plasmids possess a microsatellite repeat. Most of the repeats are large and uninterrupted. We have now designed primers for 15 of these repeats.
- 6) Established collaborative links with veterinarians at the Toledo Zoo.

In the coming, year we will:

- 1) Continue capturing, marking, and recording basic biology information on adult and juvenile iguanas in our focal study areas. We hope to have captured most of the animals within these areas by January 2005.
- 2) Outfit another 30 iguanas with radio-transmitters.

3) Extend radio-telemetry studies of focal animals to determine home range and social interactions across the year with special emphasis on the breeding and nesting season.

4) Start the construction detailed habitat maps of the territories of all focal animals.

5) Develop a suit of microsatellite markers from our enriched library and use them to test for multi-paternity in iguana clutches and for genetic differentiation among different nesting areas.

The data generated over past year and a half will result in at least two publications in the coming year. One of these publications will focus on molecular aspects of this study, including evidence for multiple paternity in iguana nests and an initial description of the genetic structure of the Mona population. In addition, we expect at least one paper on iguana territoriality and social behavior. Furthermore, we will use the research foundation established of the last 1 1/2 years to write a full grant proposal to continue research on the reproduction and behavior of the Mona rock iguana

Thrust area 2 – Populations

Effects of exotic ungulates on the native vegetation of Mona Island Reserve, Puerto Rico.

Some aspects of this project were on track to achieve second year goals but not others.

1. Biological reference collections of Mona Island vegetation for Plant Ecology studies. These collections include:

a) A voucher collection of dry specimens of all Mona Island species to be deposited at the University of Puerto Rico, Rio Piedras Herbarium (UPRRP). To date 233 have been collected and processed;

b) A digital replica of the voucher collection to be worked through the digitalization project of the UPRRP-Herbarium which is part of "The Virtual Herbarium Project" of the New York Botanical Garden and is funded by the Mellon Foundation. To date 350 labels have been processed for 233 species out

of 400 that are expected. Processed data has been delivered to NYBG information system staff for publication at their web site.

c) A digital collection of epidermal tissue of all species in Mona Island. This collection will be helpful at identifying microscopic samples of plant tissue in ongoing studies of ungulate diets. To date, the collection has 1093 micrographs for 134 species (an additional 60 species will be done by this summer).

d) A collection of digital photos of seeds/fruits of all plant species of Mona. The need of this collection was not determined a priori but rather preliminary results from one of the studies pointed out to the need of such collection.

e) Proposal to the Biotic Surveys and Inventories Program - In spite of monthly sampling for over a year, completion of reference collections is slow and is taking a considerable amount of human resources from the rest of the project activities. Yet, such collections are needed for the proposed ecological studies and more than ever it is important to have a complete survey to understand the current status of Mona Island's flora as Management Plans for the Island are currently being developed. The PI (E. Melendez) will seek NSF funds (Biotic Surveys and Inventories Program- Jul, 2004) to finish the collections in collaboration with Dr. James D. Ackerman.

2. Permanent transects for biodiversity studies at Depression Forest sites in Mona Island. Three 250 m transects were established between November 2002 and Jul 2003 and baseline data has been collected for a number of parameters including

- 1) tree species at fixed points (GIS marked) along the transect,
- 2) plant species composition and herbivory detection at the understory,
- 3) reproductive and herbivory, phenology at the canopy level around these points,
- 4) canopy light environment by analysis hemispherical digital photos of canopy cover,
- 5) continuous measurements of temperature and relative humidity, and
- 6) presence and absence of feces of the three large herbivore species (goats, pigs, endemic iguana).

Four studies are currently have been developed around these transects. The first one directed by Dr. Denny Fernandez looks at the extent of spatial heterogeneity and patterns of plant diversity and canopy structure (analyzed with hemispherical photos) of depression forest communities. Data management and image processing has been completed. Data analyses are underway and manuscript preparation and submission should be completed by the end of the summer of 2004.

The second project is co-directed by D. Fernandez and E. Melendez-Ackerman in collaboration with G. Gonzalez-IITF. This project will look for patterns of association between vegetation biodiversity, plant community structure and microenvironment within the context of depression and platform forest types in Mona Island. For the vegetation analyses two additional transects were set up in platform forest sites in October 2003. A total of six transects (three in depression forests and three in platform forests) are now established. Data has been quality checked and transformed to PCORD format and analyses are underway. Environmental data will include several parameters: air temperature, relative humidity, soil ph, soil % water content, soil depth, C and organic matter content, macronutrients). Soil samples were collected in October of 2003. Processing and analyses of soil samples is in progress under the direction of G. Gonzalez - IITF. Forest structure data includes analyses of hemispherical photographs taken at along the transects (102 photos). A student will be hired during the summer to perform the required image transformations (in Adobe Photoshop) prior to analyses.

The third project directed by Dr. Elvia Melendez-Ackerman looks at the relationship between indicators of herbivory (vertebrates and insects) activity with spatial and temporal vegetation traits at the understory and canopy levels. Monthly data collection in permanent transects (4) will be extended to July 2004 to be able to include a full year of monthly censuses for these sites. Data Management for this censuses is in progress and includes quality checks and transformation of monthly census data for canopy and understory censuses into PCORD format (finished up to January 2004 census), collection for monthly

censuses will be extended begin management through monthly censuses that are expected to take place for at least a year and a lower frequency census scheme on the second year depending on the data results. Data collected includes plant diversity and density at the understory level at permanent points, vertebrate activity through presence and absence of fecal samples at these points, plant phenology, herbivory (vertebrates and insects), recruitment, leafing, fruiting and flowering.

All three studies will provide a general characterization of the forest habitat of depression forest sites, information on the potential interplay between microclimate parameters and herbivore activity on plant density, composition as well as information on which plant species (native and otherwise) may be more susceptible to the action of herbivores at this site. See abstracts below for preliminary results.

The fourth study, on the relationship between herbivore diversity and plant composition started in Jan 2004. This study is co-directed by E. Melendez-Ackerman and Miguel García (DNRE) and will include various collaborators (see collaborative projects). This project was originally expected to start in July 2003 but a variety of problems related to travel to the site and weather logistics delayed the starting date six months. Malaise and pitfall traps have been set up at 3 of the four permanent transects (9 points - for a total of 9 malaise traps and 36 pitfall traps) and insects are collected monthly from each collection site. Insect collection will run for a full year. A graduate student and two undergraduates are working in sample processing.

3. Stomach samples of feral ungulates for diet studies.

We have finished the processing and analyses of stomach samples of goats and pigs for studies of the plant diets of these animals. The work was done in coordination with the DNRE and taking advantage of their hunting season that lasted from January to March of 2003. Final sample size was more than adequate for goats ($n = 85$) but not for pigs ($n = 3$). We were unable to obtain pig stomachs during the 2004 hunting season. These animals are not the preferred hunting item of hunters and they seem to be more active at night. Data analysis

is almost completed. It reveals marked temporal changes in the diet composition by goats and that these changes may be dictated by plant preferences as well as changes in plant community composition. Forbs, grasses and plant taxa where harsh secondary compounds are frequent seem to be less common in the goat diets. Carla Cortés, an undergraduate student, was in charge of most of the plant identification and presented the results in the 2004 Annual AIBS Meetings. She received the Minority Scholar Award for her poster presentation. This has truly been a team effort and most participants of the projects are co-authors in all this as well as the previously described projects.

4. Study on differential nutritive values of plant species.

The results from the previous study allowed us to identify a list of potential candidate plant species to further investigate if and why some species that may be most and least susceptible to consumption by goats. One way to accomplish that is by performing bromatological studies of different focal plant species to determine potential differences in nutritive values among them. This study was expected to begin in August of 2003 but final processing of stomachs was only completed by December of 2003 and most analyses were not completed until recently (March 2004). We have selected 30 species of plants for bromatological analysis. The selection was based on different degrees of preferences and avoidance from the goats, according to previously described studies and our goat diet study. Samples will be collected and prepared during the summer to be sent for analysis to the selected laboratory. Results will be analyzed by October 2004. Dr. Denny Fernandez from UPR-Humacao is leading this project.

5. Purchasing and Set up of Meteorological Station.

Purchasing of Meteorological Station for Mona Island was completed recently (Feb 2004) and not as expected previously (July 2003). Calibration, set up and programming is underway. Transportation of equipment to Mona Island has been scheduled for May 27, 2004. Set up and programming of equipment is underway. Station installation should be completed by July 2004. Permits for satellite transmission of data are being requested. The station should provide continuous data on temperature, precipitation, relative humidity, solar

radiation, and wind speed and direction as experienced in the center of the Island. These data will be invaluable for determining the extent by which variability in climate is related to our focal biological responses. CREST researchers as well as the scientific community in general will be able to access these data through our web pages.

Spread of Africanized bees in Puerto Rico and extent of africanization.

We have tested additional Africanized colonies using a stringent assay for defensiveness where bees from colonies were induced to sting a leather patch (8cmx7cm) for one-minute duration. The mean time to first sting is 60 seconds and mean number of stings in a minute from 20K to 40K sized colonies is 100. These results are comparable to European bee colony results reported in the literature. In addition we tested presence of *Varroa*, a parasite of the honeybee, in the feral honeybee colonies. The parasite was present but did not cause colony deterioration over one year of observation period in the absence of miticide application. This contrasts with European bee colonies that needed regular intervention over the year. In conclusion, Africanized bees in Puerto Rico appear to have escaped the most important natural enemy, *Varroa*. These generalized pollinators should be considered a permanent aspect to *Goetzea* conservation effort. The reduced defensiveness in Africanized bees also present a new research direction which lead to preparation of a USDA genomics project on defensiveness.

Additional research indicate *Goetzea* fruit set by the exotic honeybee, *Apis mellifera* is comparable to the fruit set obtained by the bird *Coereba flaveola*. Morphometric and geographic data was initiated for the largest wild population of the *Goetzea* in Northwestern Puerto Rico. Additional field search in the area resulted in the discovery of approximately 40 new individuals. Approximately ten of these have reached the reproductive stage. We have sampled 76 individuals in 2 populations, and tested genetic divergence and heterozygosity within and between populations using AFLP markers. There is considerable genetic

variation within each population. This result is encouraging for conservation efforts.

Summarizing outstanding research accomplishments:

- Small *Goetzea* populations have considerable genetic variation, encouraging for conservation efforts.
- We have demonstrated Africanized honeybees in Puerto Rico to co-exist with *Varroa*, the most important natural enemy of honeybees elsewhere.
- We also demonstrated that Africanized colonies in Puerto Rico are more similar to European bees in their defensiveness.
- We have demonstrated that honeybees are the most efficient pollinators of *Goetzea*.
- In frequency of visits, honeybees are not different than bird pollinators, such as the bananaquit.

Thrust area 3: Landscapes Ecology Group

This project had three components: 1) development of tools to detect multimodal distributions and evaluate landscape complexity, 2) collect body size and fluctuating asymmetry data for frogs and birds in fragmented habitats, 3) collect body size data for large-scale assemblages of birds and frogs.

1) Development of tools to detect multimodal distributions in ecological data and evaluate landscape complexity

The UNM team completed a comparison of the small and large sample behavior of three tests for multimodality: Silverman's (1981) original test, Hall and York's (2001) correction to Silverman's test, and the excess mass test (Cheng and Hall, 1998). The results indicate, for example, that the kernel-based tests are more sensitive to modes corresponding to small clusters of observations in the tails of a distribution. In addition, Bayesian approaches to assessing modality including posterior analysis of Gaussian mixtures arising from finite mixtures (Roeder and Wasserman, 1997; Richardson and Green, 1997) and Dirichlet process mixtures (Escobar and West, 1995; Ishwaran and James, 2002) were implemented. The Bayesian approaches allow not only the consideration of

whether multimodality is present, but if so, quantify how many modes a distribution has.

The UNM team begun examining the problem of testing whether modal, or cluster locations are equal across populations in an effort to determine how various aspects of habitat (fragmentation) and phenotype (e.g. asymmetry) affect body mass distributions (#). They have implemented reversible jump MCMC algorithms to test simple hypotheses (Green, 1995) of this type within the Bayesian framework in FORTRAN, Matlab, and Mathematica. Initially, our models test for equality of cluster locations in two component mixture models across two populations.

During the summer of 2004 we will extend our models to multiple (more than two) random cluster locations and multiple populations. If time permits, we will research the inclusion of covariates in the model.

A first algorithm to evaluate landscape complexity at multiple scales was developed. During the summer of 2004 it will be tested on a large data set of elevation points coming from DEM's.

It was realized that the detection of multimodal distributions has greater implications beyond the analysis of body size data. In the context of fluctuating asymmetry it seems to be a prevalent problem with a profound meaning. In a paper that will be submitted this summer (2004) we will refer to these additional applications of multimodality to ecological data.

2) Data on body size and fluctuating asymmetry has been collected 100% for frogs and 50% for birds (one additional field season). The latter data has been extensively analyzed whereas the former is currently under analysis. The data shows that asymmetry tends to increase in highly fragmented habitats both in frogs and birds. In addition to the analysis of FA, we have examined how morphological variables of birds vary in fragmented habitats. Specifically, we have looked at the joint probability distribution of several body size with tarsus, wing, and tail length. This analysis revealed interesting connections between multimodality and complex allometric relationships that parallel observations made at the level of several animal populations.

The data on FA and body size will be ready soon to test the general idea of the proposal that FA may represent a mechanism that explains the occurrence of body size modes in fragmented habitats (see #3).

3) The compilation of body size data for Colombian/Caribbean birds and frogs is underway. That on Colombian birds has been 90% completed. We will take advantage of the visit of Dr. Fernando Castro to the RANA meeting here in UPR-Rio Pideñas to establish some sort of collaboration to accomplish this task. The data on Caribbean frogs was partially analyzed to present it at the symposium.

For next year we propose to develop the following activities:

1) Statistical tools

a) The collaboration with UNM was proposed for two years; we are requesting a non-cost extension of the subaward to wrap up our work.

During the symposium on multimodality we identified two key issues that need to be addressed: extension of the models to multiple (more than two) random cluster locations and multiple populations and the inclusion of covariates in the model.

b) A first algorithm to evaluate landscape complexity at multiple scales was developed. During this coming year we will test the algorithm on a large data set of elevation points (DEM's), make proper adjustments, and then applied it to each of the Caribbean islands and Colombia. Towards this end I am planning to incorporate into the group undergraduate students from the recently created Computer Science Department-UPR-RP.

2) Investigation of biological mechanisms

a) We need to collect bird data on fluctuating asymmetry and body size in fragmented habitats of Colombia along an altitudinal gradient. Now that the statistical tools are relatively well developed we are in a position to test the main premise of the proposal, that multimodality in body size may arise by the differential vulnerability of species to habitat fragmentation, where vulnerability can be expressed in terms of varying levels of fluctuating asymmetry.

b) We will complete data collection of body size data for Colombia frogs

and toads. Towards this end I will establish a collaboration with a former professor of mine at the Universidad del Valle, Colombia.

3) Manuscript preparation

My goal is to write and submit three papers in year 3. Other 3 will follow once the grant is over.

II.3. TRAINING AND DEVELOPMENT

II.3. EDUCATIONAL & HUMAN RESOURCE RELATED ACCOMPLISHMENTS, CURRENT AND PLANNED ACTIVITIES

- Sofía Olivero has been accepted to participate in a Ethnobotany course in Costa Rica (OTS).
 - Pablo Hernández has been accepted to participate in the REU summer program of the Rocky Mountain Biological Laboratory in Colorado.
 - Chamarry Fuentes is applying to the program "Increasing diversity at the annual Botanical Society of America meeting," for travel funds. This program is supported by the National Science Foundation (Undergraduate Mentoring in Environmental Biology (UMEB)).
 - Susan Aragón is currently enrolled in the Ph.D. program in Environmental Sciences at Clark University, Mass.
 - Mariely Morales received her Masters degree in 2003. She also worked on the thrust area 2 projects as a Taxonomist Specialist and field technician and now holds a job as Biodiversity Specialist with an environmental firm.
- José Fumero gave an oral presentation of the project titled 'attended the 2003 BSA (Botanical Society of America) meetings in Mobile Alabama.
- Esther Toledo earned her Bachelors degree in Science Education. She plans to enroll in a Science Education Masters Program. She has kept ties with the project volunteering for field work.
 - Jesús Vázquez earned his BSC degree in Biology in May 2004.
 - Ernesto Beltrán earned his BSC in Environmental Science in May 2004.
 - Jesús Vázquez made the list for the "2004 Who's Who Among Students in American Universities and Colleges" and has been accepted to medical school.

- Ernesto Beltrán has been accepted to Law School and plans to specialize in Environmental Law.
- Web Page Construction. Mariely Morales (Project Tech) and co-PI Elvia Melendez-Ackerman implemented two Web Pages for dissemination of project information. One page focuses on the research and activities of the Laboratory of Tropical Ecology and Evolution (directed by Melendez-Ackerman) and the other focuses on the research nature of the project and in the immediate future will include activities, educational opportunities and data from this sub-project. The web pages were first published in August of 2003 (<http://www.ites.upr.edu/~elvia>). They will soon undergo reconstruction with the help of Mr. Joel Ruiz, the Compting/System Specialist hired by Crest in August of 2003. The project has also a webpage in UPR-Humacao (www.uprh.edu/~crest). This e page is administered by Dr. D. Fernandez and will be linked to the main website of the project. The main purpose of this web page is to disseminate information about the specific participation of faculty and students from UPR-Humacao on the CREST project, and to publish meteorological data from the station located in Mona Island.
- Dr. Owen McMillan's laboratory launched its Web Site (<http://zephyr.hpcf.upr.edu/~mcmi-lab/>) (Summer 2003)- The website is an important resource for advertising our research program and for attracting students to Puerto Rico. The site details current research projects, members of the research groups, and provide links to our databases.
- Workshop on microsattelite enrichment techniques (Summer 2003)- Workshop to teach graduate students how to create and screen genomic libraries enriched in microsattelite repeats. The workshop resulted in the production of 10 enriched libraries on organims ranging from wetland trees to Mona rock iguanas.
- Symposium on "Multimodality in Ecological Data: A Theoretical Puzzle and a Statistical Challenge" that was held at UPR-RP in March and organized by Dr. Carla Restrepo. In total 9 people from 3 universities gave interesting talks. The symposium was opened to the public and around ~12-15 people besides the speakers attended this event. People from the Mathematics department of the

College of Natural Sciences, UPRRP and the Institute of Tropical Ecosystem Studies (ITES) were among them. Dr. Carla Restrepo prepared “pre-symposium” event for the UPR-RP Biology students where the UNM statisticians gave two talks. In total around 12 students attended the talks.

OUTREACH ACTIVITIES

Dr. Elvira Cuevas -

Judge at the XXXI Scientific Research Congress sponsored by Puerto Rico Science Teachers Association and other associations. The Congress was held at UPR from 26-27 February 2004.

Dr. Jorge Ortiz -

- Judge at the XXXI Scientific Research Congress sponsored by Puerto Rico Science Teachers Association and other associations. The Congress was held at UPR from 26-27 February 2004.

- Judge at the XXIII State Science Fair of the San Juan Archdioceses held on Guaynabo on 9 March 2004.

Judge at the 2004 Science Fair of the Colegio Santa María de Camino in Trujillo Alto, Puerto Rico on 18 March 2004.

- Dr. Elvia Melendez-Ackerman gave a presentation in the University of Puerto Fair at Plaza Las Américas Mall in San Juan PR, on April 2, 2004; an outreach activity organized by the University of Puerto Rico. The title of the talk was "Introduced exotic species in Mona Island".

- Dr. Elvira Cuevas gave a presentation in the University of Puerto Fair at Plaza Las Américas Mall in San Juan PR, on April 2, 2004, an outreach activity organized by the University of Puerto Rico. The title of the talk was "Ecology and Conservation in Puerto Rico".

- Dr. Elvira Cuevas participated in talks about scientific research given to the Science Clubs at the Central High School in San Juan, PR and the Intermediate school in Toa Alta, PR. November 24-25, 2003

II.4 CONTRIBUTIONS TO THE DEVELOPMENT OF HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY

- Two technicians has been integrated to the molecular population genetics and honey bee behavior components of our project. Sylvia Planas and Manuel Mercado have been trained in molecular research and honey bee research respectively.
- A new minority graduate student, Bert Rivera Marchand has been recruited to study the spread of Africanized bees in Puerto Rico.
- Field technician Manuel Mercado is going to a training on artificial insemination of honey bees that will facilitate research on Africanized bee genetics. Technician J. Manuel Mercado, a member of a minority group, is now equipped better for future employment or education in ecology and conservation.
- The Goetzea project is providing professional development for Mr. Marcos Caraballo. Part of this project will be Mr. Caraballo's Masters thesis project. The project also provided research experience to two undergraduate students of the Biology Department. These students also earned credits for their research activities. One of the students was enrolled in the LS-PR-AMP program, which provides incentives for research experience to underrepresented groups.
- MEEG group members sponsored 17 undergraduate students (all Hispanic). Students conducted both field and laboratory research on a variety of MEEG-associated projects. Several of our students have been accepted into graduate programs in Biology.
- Sponsored REU students (Summer 2003): MEEG group hosted two undergraduate research students. Students participated in CREST-CATEC related research activities. One, David Cheek presented his results at the Annual Biomedical Research Conference for Minority Students (ABRCMS) in San Diego, California.
- As a member of ITES REU Program, Dr. Jorge Ortiz will mentor a student during summer 2004 on a research project to study freshwater shrimp populations with an automated drifting larvae water sampling technique.
- The teaching of water-related courses by Dr. Jorge Ortiz exposed students to limnological concepts and research possibilities. The new course in Limnology

was developed to improve undergraduate and graduate student experiences in aquatic research and to spark their interests in limnology.

- Dr. Jorge Ortiz also offers career advice to students based on previous experiences in the private sector.
- Dr. Jorge Ortiz represented the Institute for Tropical Ecosystem Studies (ITES) at the Welcoming Meeting for New Students at the Faculty of Natural Sciences, UPR-Rio Piedras May 2004. At this meeting, a general description of ITES faculty and their current research programs was presented.

II.5. ACTIVITIES DESIGNED TO INTEGRATE RESEARCH AND EDUCATION

- A stream ecology workshop for high school science teachers organized by Dr. Jorge Ortiz will take place in June 2004 sponsored by the AlaCiMa Program of UPR.
- Dr. Jorge Ortiz developed a course on Limnology with both theoretical and laboratory components as part of the Department of Biology course curriculum. The course was co-developed along with Professor Alonso Ramírez.
- Dr. David Seigler from the University of Illinois at Urbana-Champaign, offered a field course in ecology of invasive plant species to the graduate students in the CREST-CATEC program. The course included both theoretical and practical components, student research projects on invasive legumes has been completed. Dr. Seigler also presented a seminar on chemical ecology of plants. The Co-PI Dr. Giray organized and hosted the activity. This course exposed more of the qualified minority graduate students in the program to the CATEC-CREST research and equipped them with the necessary conceptual and practical background to tackle research on the invasive species.
- Dr. Denny Fernández is part of the Wildlife Management program in UPR-Humacao and teaches regularly General Ecology, Community Ecology and Plant Systematics for undergraduates. Dr. Elvia Melendez-Ackerman teaches regularly General Ecology at UPR-Rio Piedras. Both have been incorporating in his courses information on the background, design and results of this project. They have also used their courses as platforms for student outreach. Both will

continue developing course-context activities about the main theme of this project: the effect of exotic species in native biota.

- Dr. Owen McMillan developed and taught new graduate course in Geographical Genetics in Fall of 2003. The course, which included a two week workshop on microsatellites, taught students essential concepts in population and conservation genetics and, in particular, how to analyze multilocus genotypic data. Of the 10 students that participated in the course, 7 were already directly supported by CREST and the remaining 3 were participants but not currently supported.

- Dr. Tremblay has extensively involved many US Minority students in research, research presentation and publication (6 students involved in peer-reviewed publication) total of 16 minority students mentored.

II. 6. Awards and Honors

Research Fellows:

Dr. Owen McMillan (PI) & Fred Nijhout (Co-PI) - Developmental Architecture of wing patterns in *Heliconius erato* - NSF-0344705, \$540,000/3 years.

Carlos Diez (PI) and Robert Van Dam (Co-PI)- Status surveys of marine turtles aggregations inhabiting coastal waters of Puerto Rico - NOAA, administered by National Fish and Wildlife Foundation (NFWF), \$122,771.

Dr. Tugrul Giray (PI) - Integrated analysis of muscle and behavioral development in a model organism - NIH-NIGMS (SCORE Program Grant), \$395 000.00

Dr. Tugrul Giray - Startup grant - Effect of molecular changes in flight muscle on bee behavior - NSF-PR-EPSCOR, \$136 311.00.

Dr. Jorge Ortiz - Obtained UNESCO recognition for existing and planned efforts to promote integrated water resources management in the Luquillo Mountains region of Puerto Rico.

Students:

Carla Cortés: received the Minority Scholar Award for her poster presentation "Characterization of the plant diet of introduced pigs and goats in Mona Island Reserve, Puerto Rico" at the 2004 AIBS (American Institute of Biological

Sciences) in Washington, DC. She is graduating this year and will explore graduate studies opportunities.

Jesús Vázquez made the list for the "2004 Who's Who Among Students in American Universities and Colleges .

II.7. Summary of minutes of external advisory group meetings:

There have been no meetings yet. The first meeting will be held in Fall 2004.

III. Publication and Products

To be submitted via CREST-WEB

IV. 1-3. Development of human resources; submitted directly to CREST

IV.4.

NSF support by thrust area and other activities

Thrust area	Current year	9/1/04 – 8/31/05
1 -MMEG	320,638.00	359,224.00
2 -PEG	303,239.00	298,804.00
3 - LEG	327,062.00	154,806.00
4 - ECG	-	-

IV.5 Level of complementary support for this year from collaborating institutions: estimated dollar equivalent

DNRE - government of PR	USDAFS IITF - Federal	Chelonia - International	IVIC - Venezuela International
\$15,000	\$25,000	10,000	\$6,000

V. Cost-share certification and statement of funds to remain un-obligated at the end of the current CREST project year.



FACULTAD DE CIENCIAS NATURALES
UNIVERSIDAD DE PUERTO RICO
Recinto de Río Piedras

Oficina del Decano

May 28, 2004

Dr. Victor Santiago
CREST Program Officer
Human Resources División
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Dear Dr. Santiago:

I hereby certify that the University of Puerto Rico shared an amount of \$337,316 of cost sharing funds to cover the CREST Cooperative Agreement No. HRD-0206200 for the period September 1, 2003 – August 31, 2004. We also agree to share in the costs of the next three years for \$922,827 as specified in the Chancellor's letter of May 13, 2003 and the president's letter of November 14, 2001.

If you have any questions, please do not hesitate to contact us.

Cordially,

Dr. María S. Baez
Acting Dean
Faculty of Natural Sciences

The budget for the coming year stays the same as specified in the proposal. Supplemental funding will be discussed with Dr. Santiago, NSF CREST Program Director.