Annual Report of CREST-CATEC
September 1\textsuperscript{st}, 2005 – August 31\textsuperscript{st}, 2006
Dr. Elvira Cuevas
Director
NSF HRD-0206200
I. Project Participants:

I.1. Participants by thrust area:

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1.2. Organizational Chart of the Center
May 8, 2006

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 Applied Tropical Ecology and Conservation (CREST-CATEC) under the direction of Dr. Elvira Cuevas. As Chancellor of the Rio Piedras Campus of the University of Puerto Rico, I express my full support to the center, which has continued to show excellent progress in its development.

I fully endorse the continuation of the CREST grant and will allocate $24,766 of the total amount of $249,766 of the fifth year of the cooperative agreement No. HRD-0206200. The Central Administration of the UPR System will contribute the other $225,000 of the matching funds as established in the letter of November 14, 2001.

Sincerely,

[Signature]

Dr. Gladys Escalona de Mota
Chancellor

jml
CREST-CATEC continues to be very successful in the following areas:

a) Improvement of administrative helps and research facilities, both at UPR-Rio Piedras and Humacao,
b) Update of web page for the Center,
c) Promotion, support or sponsoring of activities such as seminars, symposia and workshops, and
d) Support for researchers' and students' travel for training, courses, or presentations in congresses and symposia.

e) Thesis support for students working in the area of applied ecology and conservation other than those directly supported in the CREST grant.

CREST-CATEC has continued to closely collaborate with other UPR Centers and programs such as the Resource for Science and Engineering and PR- EPSCoR of UPR Central Administration and DEGI (Deanship of Graduate Studies and Research) of UPR-Rio Piedras. We have also established close collaborations with universities and institutions such as Duke University, North Carolina State University, Fairchild Botanical Garden and the CRC-Smithsonian Institution among others. We continue to build on the collaborative ties with the Department of Natural resources and Environment of the Government of Puerto Rico and the USDA Forest Service International Institute of Tropical Forestry. Our research fellows have also been successful in obtaining other grants, and increased our number of publications. We have also added other research fellows to the Center in the area of evolutionary genetics, plant genomics and microbial ecology.

This year CREST-CATEC sponsored visiting scientist Dr. Stephan Funk, wildlife conservation geneticist from Durrell Wildlife Conservation Trust (DWCT) in Jersey, England. CREST-CATEC and DWCT established collaboration in order to facilitate research in applied tropical ecology and conservation biology within the Caribbean, Central and South America. The collaboration is managed and maintained by Dr Stephan M Funk, Conservation Geneticists at DWCT. Dr Funk
conducted research at CREST-CATEC for one year (starting May 2005), jointly funded by CREST-CATEC and DWCT. Alongside research projects specific to both organizations, the collaborative approach includes joint research in behavioral ecology and conservation genetics of several iguana populations across the Caribbean. Benefits for UPR included lectures and seminars in conservation biology and conservation genetics, supervision of UPR students associated with ongoing CREST-CATEC conservation genetics projects and several projects that are in the early stages of development, and further development and optimization of UPR molecular facilities. Benefits for DWCT include the use UPR state-of-the-art molecular laboratory. Both organizations hold unique positions within the Caribbean and Central and South America, with CREST-CATEC being particular strong in academic research and DWCT being particularly strong in applied conservation biology. The set of field sites is complementarily. The mutual collaboration will further both organizations' goals to become key centers for research and conservation, respectively, in tropical ecology and conservation biology in the Caribbean region. CREST-CATEC has benefited so strongly with having Dr. Funk in Puerto Rico that the collaboration has been extended for one more year.

CREST-CATEC had its first symposium where researchers and students presented their work. We brought the External Scientific Advisory Committee (ESAC) at the same time, allowing the ESAC to interact with the whole CREST-CATEC community, both in their labs and in the Symposium. The activity was a great success and will be repeated every year. In fact, the ESAC members were so impressed with the work being carried out in Mona Island (see enclosed ESAC review) that they requested a field trip to the island for next year.

CREST-CATEC has also been working very closely with one our natural partners, the Department of Natural Resources and Environment (DNRE). The results of the research being carried out in Mona island are very important in the management of the natural resources of this island reserve. We have had two meetings with heads of areas within the agency directly related to management
of conservation, and a meeting with the Hon. Javier Vélez Arocho, Secretary of the Department, The purpose of the meetings were to present the how DNRE has benefited with the research, training of DNRE personnel and infrastructure development in Mona island that CREST-CATEC has done during the last four years. DNRE recognizes how important this collaboration has been and we are working now to establish a cooperative agreement that will encompass the whole of Puerto Rico and the next 6 years of research, as we are already working toward the next five years of CREST-CATEC.

Our graduate students (almost all US Hispanics) benefited this year from training in laboratories at other universities, such as Duke University and North Carolina State University, the Smithsonian Tropical Institute in Panamá, Organization of Tropical States (OTS) courses and training, and courses in genomic techniques at the University of Florida at Gainesville, among other institutions. Many have presented their work at local, national and international meetings in Vienna, Greece, Brazil and the Dominican Republic.

We also graduated our first CREST-CATEC sponsored Hispanic PhD student, Bert Rivera-Marchand. He received in December 2005 the Robert Laurus Award in the First Congress of the American Association for the Advancement of Science Caribbean Division, for the best student scientific presentation. Dr. Rivera-Marchand is being hired in a tenure-track position as Assistant Professor at the Interamerican University, Bayamón campus in Puerto Rico.

We continue to "educate" the administrative part of UPR-Rio Piedras on the management of large grants. As there is no post award management office, Rio Piedras manages the grants just as they manage the every day expenditures related to teaching.
Issues at hand:

Administrative aspects:

1- Hiring of personnel - The amount of administrative personnel has been kept at a minimum: one Administrative Coordinator and One Informatics Coordinator. However, the Center administrative responsibilities have considerably expanded in the last year as a result of the expansion of CREST activities, increased amount of students and research fellows and management of other grants. In order to maintain administrative efficiency a secretary/assistant for the Administrative Coordinator and the center’s Director was hired in November.

2 - Headquarters – Our headquarters in the Facundo Bueso building Rooms 301A-C are fully operational. We have two offices and one small conference room already set up via wireless connection for LAN and INTERNET for the administrative personnel and 30 more computers at one time. In the conference room we also have video conferencing facilities that became operational last July. The conference room and video conferencing facility is in constant use for presentations, graduate committee meetings, research and laboratory meetings and even a job interview. This last one was a success and Dr. Juan Felipe Blanco, who received his PhD in Biology last year, is now a professor at the Institute of Biology, University of Antioquia in Colombia. This is an example of the added value of ancillary infrastructure development that feeds back into improvement of research and communication.

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

a - Contracts and student stipends for the Center participants
b - Purchasing of equipment, materials and supplies
c – Administrative work for Drs. Raymond Tremblay and Dennis Fernández, University of Puerto Rico, Humacao campus, Dr. Jorge Ortiz, Institute of Topical Ecosystem Studies, UPR Rio Piedras, and Drs. Jason Rauscher, Tomas Hrbek, Loretta Roberson (hispanic) new recruit and research fellow of CREST-CATEC.
d - Administrative work for three additional proposals: NSF –0344705 (PI - Dr. Owen McMillan), NSF (James Ackerman) and NOAA Sea Grant (Bayman and Sabat) and US Fish and Wildlife Service (Santiago).
e - Administrative work for field work in Mona Island
f - Administrative work related to travel for researchers, students and visitors.
g - Arranging and supervising the logistics of the activities sponsored by the Center
h - Training of computer data assistant
i - Following up on the financial logistics for the memorandum of understanding between UPR – Rio Piedras and PR – Department of Environment and Natural Resources (DNRE) of the Government of Puerto Rico.
j - General administrative work related to the activities of the thrust areas.
k - Organization and logistics of the Scientific Advisory Committee visit and meeting on March 31-April 1, 2006, and the First CREST-CATEC Symposium held in April 1, 2006

4. Other grants management - Since July 2004 we are managing three 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, research fellow in collaboration with Dr. Paul Bayman, Department of Biology were awarded a NOAA grant of $53,000 for three years. Another grant was added on February 2005: DBI-0447067 for the amount of $391,486 (PI - Dr. James Ackerman). Dr. Eugenio Santiago was awarded a $22,290 from US Fish and Wildlife Service.

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

We continue to have the full support of the Chancellor, Dean of Natural Sciences, Dean of Graduate Studies and Research, and the heads of the Department of Biology and ITES, however the administrative component of the University continues to be a constant source of problems and delays. The system
bureaucracy is overwhelming and almost intractable. Ms. Diaz the Center Coordinator, and myself still spend an inordinate 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 continues to take 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 Dean of Administration is taking a series of steps to improve the situation, such as changing to Oracle the extremely outdated and almost dinosaurian financial program. The new system will become functional by August. Also the Financial and Human Resources offices have improved in their turnover rate of response. We hope that this will be the first step towards a more streamlined, time and cost effective way of doing the administrative procedures. The situation has improved but there is still a considerable amount of time invested in just making the bureaucratic machine to work.

**Proposed solution:** Establishment of a post award office at the University exclusively in charge of processing external funding finances. We suggest that NSF recommends UPR Rio Piedras the implementation of such office.

**Remodeling of laboratory facilities:**

The highly bureaucratic structure of the UPR system makes construction and remodeling a very long and tedious situation. The centralization of all permanent remodeling or construction at the central Administration of the UPR system compounds the problems, therefore severely affecting the remodeling of laboratory facilities for new faculty recruitment and myself. The university system does not recognize as a priority the remodeling of laboratories, so it can take up to five years for the remodeling to happen.
The fourth thrust area of CREST, ecosystems ecology, continues to be developed research wise (see activities and findings). The Biology Department provided an interim use of a laboratory that became functional in February, however infrastructure for this area is still waiting. The bid results for construction and remodeling of my laboratory (Elvira Cuevas) are to be announced in the next three weeks, so construction should start within the next two months. The President of the university, Dr. Antonio García Padilla, promised to personally follow-up on this situation, therefore we expect a speedier resolution to the problem.

With CREST-CATEC financial support Dr. Jorge Ortiz, leader of the hydrology component of the Ecosystems Ecology area, has been able to make important advances in his research program, this despite the lack of a research laboratory facility where he can conduct basic research and attract new students. In September 2005, a 350 square foot temporary laboratory was made available for his use and Dr. Alonso Ramirez, another research fellow. They started to equip the laboratory with instrumentation to conduct water chemistry determinations and macro invertebrate taxonomy. A new lab for the Tropical Limnology research group is now designed and funds are been allocated to start construction. However, this is a very slow process and there is concern that despite the available temporary laboratory their research productivity can be compromised in the future. The present space is too small to accommodate the activities of two professors; therefore Dr. Cuevas decided to share her interim laboratory with them in order to setup chemical equipment that will be shared.

Dr. Elvia Meléndez-Ackerman, thrust area leader of the Population and Ecology and Management Group, has shared for the last three years a small laboratory in the basement of the Facundo Bueso building. The Dean of Natural Sciences is very much aware of the unsatisfactory space situation and has promised to provide a bigger and independent laboratory space to Dr. Meléndez within the next twelve months.
Technical and Information Support:

1- Web page: Mr. Joel Ruiz, the data/systems-informatics manager, in coordination with the High Performance Computing Facility (HPCF) of the Resource Center for Science and Engineering has continued to develop the Web site of CREST-CATEC. The web site, http://crest-catec.upr.edu, is already functional, with some parts under construction. It provides information about the Center, ongoing research projects and activities such as workshops, symposia, meetings, etc, 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 expected to have the web page completed by early January of 2005, however as the center has continued to expand it is a work in progress. This is an example of the highly successful collaboration established between the Resource center for Science and Engineering and CREST-CATEC.

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. An undergraduate student is assisting Mr. Ruiz.

This year Mr. Ruiz continued to train CREST-CATEC participants in content management system. He has given two additional trainings to other departments in the Rio Piedras campus. Mr. Ruiz is also assists the Dean's Office in other activities. This is another example of CREST-CATEC involvement and collaboration with other areas of the university.
3 – Computational support for other laboratories:

a) Sequencing and Genotyping Facility and the Bioinformatics Satellite Lab.
CREST-CATEC continues to provide critical computational support for integrating and managing hardware and software components of both facilities. Mr. Ruiz and Mr. Humberto Ortiz, from HPCF, continue to coordinate the network development and the programming of the system.
b) Coordination and technical support for the research fellows in the Center.
c) Coordination of the videoconferencing facility

4- Preparation of audiovisuals for presentations and symposia of CREST-CATEC and the faculty of Natural sciences:

a) Posters and flyers preparation
b) Photographing and maintaining a record of the Center activities

5 - Web Page Construction. The web page http://www.ites.upr.edu/~elvia) was re-designed using the Plone platform with the help of Mr. Joel Ruiz. The webpage in UPR-Humacao (www.uprh.edu/~crest) is administered by Dr. D. Fernandez and will be linked to the main website of the project. The main purpose of this webpage 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.

6 - Research references and information resources
The previous year problems in maintaining an up-to-date access of information of reference sources considerably improved. The ISIS Web of Science at the Library of Natural Sciences expanded the reference search. The Natural Science library is well equipped and has made considerable improvement in the electronic access to references for students and academics.

7 - We contracted a UPR Master's graduate in Bibliometry who is making a statistical evaluation of the publications, citations, and research collaborations of CREST-CATEC research fellows. This is to establish the basal metrics to
measure the effectiveness of the Center in the publishing and scientific awareness (citations) of the research carried out. Although there are variations on the citation index (number of citations/number of publications) among our researchers, the average was 17, similar to the average of the faculty of natural Sciences as a whole. Our goal is to increase this number as the research continues to be published in relevant journals.

Other issues:
As the Center continues to develop and become independent of CREST funding, it 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. CREST-CATEC also needs to develop community outreach. The matching funds do not provide for these persons, so identifying and following up on sources of funding has to be one of our goals for the next year.

I.4. Current Center advisors:

Executive Board Committee:
Executive Board Committee members:
Chancellor: Dr Gladys Escalona de Motta, Chairperson of the Board
Dean of Graduate Studies and Research: Dr. Ana Guadalupe
Dean of Administration: Mr. Juan José Estrada
Dean of Faculty of Natural Sciences: Dr. Brad Weiner
Director Department of Biology: Dr. Alberto Sabat, until December 2005, Dr. Jim Ackerman since January 2006
Director Institute of Tropical Ecosystems Studies: Dr. John Tomlinson, until December 2005; Dr. Elvia Meléndez-Ackerman since January 2006
Director Citizens of the Karts: Mr. Abel Vale
Director Casa Pueblo, Mr. Alexis Mayol.
External Scientific Advisory Committee

Dr. Deborah Clark asked to be eliminated from the scientific advisory committee for health reasons. Dr. Kuruvilla John, Director of CREST-RESSACA from University of Texas, Kingsville accepted to become part of the committee.

External Scientific Advisory Committee members:
- Robin Chazdon, PhD: University of Connecticut – tropical plant ecology – chazdon@uconnvm.edu
- Kuruvilla John, PhD: Texas A&M University - Kingsville, Texas - k-john@tamuk.edu
- 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 - Conservation biology and island biogeography dsimberloff@utk.edu
- Peter Vitousek, PhD: Stanford University - ecosystem processes and island ecosystems- vitousek@leland.stanford.edu

I.5. Biographical information of new investigators:

Dr. María Gloria Dominguez, Associate professor in the department of Biology was incorporated as research fellow of the center.

María Gloria Domínguez Bello, Ph.D.

Education
Undergraduate - Univ. Simón Bolívar (USB), Caracas, Venezuela, BSc, 1984 Biology.
Graduate - University of Aberdeen, Scotland, MSc Animal Nutrition, 1986
- University of Aberdeen, Scotland, PhD Microbiology, 1990
Appointments
-2003-present. Associate Professor, Dept. Biology, University of Puerto Rico, San Juan, PR.
-1990. EU Marie Curie Post-Doctoral fellow, Rowett Research Institute, Scotland (September-February).
-1990. EU Marie Curie Post-doctoral fellow, INRA- Theix, France (March-August).

Publications (selected from 45)


**Synergistic Activities**

-Vice-coordinator of Physiology and Biophysics Graduate studies, IVIC. 1994-1997

- Member of IVIC Commission of Human Rights 1996-1999
"Francisco de Venanzi" Prize for outstanding research career, UCV, Caracas, 2002
- Committee for Academic Promotions, IVIC. 1998-2000
- Member of IDSA, ASM, CNS (Comparative Nutrition Society).
- Member of the IDSA Research Committee 2005-2008

**Collaborators & Other Affiliations**

- **Infectious diseases:** Martin Blaser, New York University; Jeffrey Gordon, Washington University School of Medicine
- **Mathematics:** Luis Pericchi, Maria E Perez, Department of Mathematics at University of Puerto Rico,
- **Ecology:** Alberto Sabat and Edwin Hernández, Dept Biology UPR, Elvia Meléndez-Ackerman, ITES UPR-RP, Carolina Bastidas and Elia García from University Simon Bolivar in Caracas, Venezuela
- **Anthropology:** Francisco Salzano and M. Catira Bortolini, UFRGS, Brasil; Elisabetta Marini, Univ. of Cagliari, Italy).
I.6. Accomplishments

Indicators of progress:

CREST-CATEC has had excellent progress on the goals defined since the establishment of the Center. We understand that the external review committee (ESAC) plays a determinant role in the evaluation of the Center and as such we committed ourselves to hold yearly meetings. This year we made significant progress regarding our external evaluations and On March 31- April 1st of this year we held the review and at the same time held the first CREST-CATEC symposium. We consider indicators of progress to what level are we meeting the goals established in CREST-CATEC. Below are the results of this year accomplishments in each of them.

Goal 1: Increase the participation of our undergraduate and graduate students in research activities.

Being the University of Puerto Rico a Hispanic institution, we considered from the very beginning that increasing the participation of undergraduate and graduate students in research was a top priority. During the four years that the Center has been in existence, the amount of students doing research with our research fellows continued to increase. In the first year of the grant we had 25 students, fourteen graduate and 11 undergraduates, all Hispanic. Already in year three we have almost quintupled the original number (see table below). This year we have 143 students, doubling the amount of graduate students and quadrupling the amount of undergraduates. Of the 55 graduate students, 9 are non-US citizens or residents, and are paid from other sources than CREST, and the rest are US citizens or permanent residents. All the undergraduates are US citizens. Sixty six per cent (66%) of the students are female, with a lower percentage of males (31) in the undergraduate category.
STUDENT DIVERSITY IN CREST-CATEC

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<td>31%</td>
<td>61</td>
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Authoring and co-authoring of publications are excellent indicators of capacity building in science. The table shows the increased involvement of students in publications. About 35% of the publications have been either authored or co-authored by students. Of the 30 publications, four authored by students and 2 coauthored. There are 4 authors and 3 coauthors in the ones accepted for publication, and in the 21 submitted there are 5 students as authors and 6 as coauthors. Our goal for the coming year is to increase student authorship and co-authorship to more than 50%.

Presentations in meetings also are very good indicators of student involvement and training in research. For the first three years of CREST-CATEC, there were 90 presentations in Congresses and Symposia. Thirty-four (34) were presented by students and fifty-six (56) presented by researchers. This year we had 65 presentations in local, national and international meetings, congresses, symposia and seminars. Fifty nine percent (59%) were either presented or coauthored by students, a 21% increase over the total students presentations from year 1-3.

Students are being trained in experimental design, research methodology, and hand-on activities in both laboratory and field. They also are trained in how to make effective scientific presentations, and in writing scientific manuscripts. Therefore our students are receiving a very well rounded education in scientific research.
### Published

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<th>% Principal Author</th>
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### Submitted, Under Review

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<td><strong>6</strong></td>
<td><strong>30%</strong></td>
<td><strong>30%</strong></td>
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Goal 2: Increase the research productivity of our faculty in the field of applied ecology and conservation.
By providing the necessary infrastructure, research funding, an efficient Center administration, and a continuous development of inter- and trans disciplinary collaborations among our research fellows and with other scientists in other national and international institutions we have continued to improve our productivity. During the first three years, there were a total of 54 publications, 3 technical reports and 20 submitted manuscripts. This year we have 30 publications, 16 accepted for publication and 21 submitted for review.

With increased productivity comes the recognition of the Center members in the field of ecology and conservation. Here some examples of how CREST-CATEC research fellows are being recognized both nationally and internationally:

1) Dr. Elvia Meléndez-Ackerman was named interim Director of the Institute for Tropical Ecosystem Studies.

2) The symposium proposal prepared by Dr. Tugrul Giray and his collaborator from Michigan State University, Dr. Zachary Y. Huang for the August 2006 Ecological Society of America meeting has been selected as a program symposium by the ESA. This symposium entitled "Contribution of Social Insect Studies to Science and Society" address both scientific and applied contributions of social insect studies to people. Two of our UPR-RP students, Hermógenes Fernandez Marín, and Bert Rivera Marchand (CREST supported) are invited speakers to talk about ants and bees from Puerto Rico respectively.

3) Dr. Miguel García is a member of two specialist groups within the IUCN SSC (International Union for the Conservation of Nature: a) Iguana Specialist Group since 1996 and Deputy Chair since 2000, b) Invasive Species Specialist Group (ISSG) - the largest of the six volunteer commissions of IUCN since 2000 and re-invited in 2005. Membership to these prestigious groups is by invitation only.

4) Dr. Raymond Tremblay is Chair of the International Committee for In Situ Conservation of the Orchid Specialist Group, Species Survival Commission, IUCN. 2001 – active,
5) Dr. Eugenio Santiago initiated a project with scientists from Florida International University and Fairchild Tropical Garden (Miami). As part of this collaboration an updated revision on the systematic status of the Antillean-endemic plant genera is being prepared. This revision will allow the identification of future research routes and priorities, helping developing research for studies on the Antillean flora.

6) Dr. Tugrul Giray received a visiting scholar award ($25,000) for his sabbatical year from Middle East Technical University in Ankara-Turkey for research on three bee races found in Anatolia.

7) Dr. Eugenio Santiago was invited to be a member of the International Scientific Committee for the IX Latin American Congress of Botany, to be held in Santo Domingo (June 2006).

8) Dr. Eugenio Santiago was invited to be a member of the Species Survival Commission Caribbean Islands Plant Red Listing Authority (of the International Union for the Conservation of Nature (I.U.C.N.).

9) Dr. Elvira Cuevas, Center Director and PI of CREST, was invited to be a member the Editorial Board of Ecological Applications. She is a member since September 2005.

10) Dr. Elvira Cuevas is in the Scientific Advisory Committee of the Jobos Bay Natural Reserve, Puerto Rico funded by NOAA and the Government of Puerto Rico.

11) Dr. Elvira Cuevas is an Invited Scientist in the CRN project "Functional biodiversity effects on ecosystem processes, ecosystem services and sustainability in the Americas: an interdisciplinary approach" funded by the Inter American Institute of Global Climate Change Research. The Invited scientists will participate as advisors, invited speakers in symposia and professors in courses originating from this project.

12) Dr. Elvia Melendez-Ackerman participated as consultant of the Environmental Biology Panel in the NSF/BIO Quality Education for Minorities (QEM) Network Workshop, Lithicum, MD. The goal is to help researchers from underrepresented groups to submit successful proposals to NSF.
13) Dr. Elvia Melendez-Ackerman is a member of the Advisory Committee for Academic Diversity of the Organization for Tropical Studies (OTS). The committee meets twice a year to develop strategies to attract undergraduate students from underrepresented groups to the various OTS programs.

14) Dr. Carla Restrepo is the organizer of the first international symposium on Landslide Ecology that will be held as part of Association of Tropical Biology and Conservation annual meeting in Kunming China on July 2006.

15) Dr. Carla Restrepo gave a Mini-GIS Course for Biologists-Workshop at the XL Annual Meeting of the Association of Colombian Biologists in Cali, Colombia on October 2005.

16) Dr. Carla Restrepo was included as consultant of two proposals submitted to USAID and a National Competition by the Consejo Nacional de Areas Protegidas (CONANP)-Mexico to evaluate the impact of landslides in the El Triunfo Biosphere Reserve of Mexico.

Goal 3: Expand the research infrastructure of the University of Puerto Rico

- The Bioinformatics Satellite Laboratory facility headed this year by Dr. Tugrul Giray was established with funding from CREST-CATEC, NIH and UPR. We are providing financial and technical support by providing half the salary to the facilities manager, Dr. Pedro Alvarez, and the support of Mr. Joel Ruiz in the maintenance and problem solving of the servers.

- The new Biology professor, Dr. Jason Rauscher was provided with lab facilities in the Julio García Diaz building and CREST-CATEC provided most of the set-up money to make it functional. The laboratory is fully functional and active. CREST-CATEC also leveraged the setup funds of Dr. Tomas Hrbek, evolutionary geneticist, and he was also provided with renovated lab facilities in the Julio García Building.
- A new Gene sequencer replaced the outdated model in the shared genomics facilities in the department of Biology. CREST-CATEC provided nearly 50% of its cost (with CREST money and from indirect costs) as this facility is central to all the genomics work being done in CREST-CATEC.

- We have also helped in the infrastructure improvement in the UPR Humacao campus. The financial support of CREST-CATEC helped to leverage the remodeling of Dr. Denny Fernández laboratory at the Humacao campus.

Goal 4: Foster long-term research collaborations among scientists within Puerto Rico and with national and international governmental and academic institutions.

We maintain our strategic alliance-building partners: PR-EPSCoR, Department of Natural Resources and Environment, USDA Forest Service International Institute of Tropical Forestry, NOAA, UPR Mayagüez Experimental Station, US Fish and Wildlife Service and the Smithsonian National Zoological Park - Conservation Research Center. We have also expanded our national and international research partners. Our researchers are collaborating with eleven national institutions and seven international ones. We continue to collaborate with our research partners were the University of New Mexico, Department of Natural Resources and Environment and the USDA Forest Service International Institute of Tropical Forestry. As of today we have added Duke University, Institute of Tropical Ecosystem Studies of the University of Puerto Rico, Botanical garden of UPR, Fairchild Botanical Gardens, Florida International University, Cornell University, University of Minnesota and University of Washington. We are also collaborating with Citizens of the Karst, an NGO dealing with the conservation of the northern karst of Puerto Rico, a dominant source of water for the island and an area rich in both plant and animal biodiversity. Internationally we continue our collaborations with the Royal Botanical Garden in Melbourne, Australia, Universidade do Estado do Rio de Janeiro and Universidade do Vale de Itajai in Brazil, CENA Universidade de Sao Paulo also in Brazil, the National Botanical Garden Rafael Moscoso in the Dominican Republic. We also established other
research collaborations with researchers from Argentina, Colombia, Brazil and the Czech Republic (see list below).

As the ESAC pointed out, there is a need to establish more research collaborations within the Caribbean in order to have a better understanding of the area as a whole. This is one of our goals for the next year.

Goal 5: Ensure that funding continues after the CREST funding period:
Various researchers in CREST-CATEC had already gotten new awards and other have submitted or in the process of submitting new proposals.

I.6 Current collaborations and interactions:

CREST - CATEC collaborations document the important synergy between UPR researchers, local and federal agencies and national and international institutions and organizations. It has also documented the important synergy that can be developed among campuses within the UPR University system. The cooperative agreement between UPR-Rio Piedras and the Department of Natural Resources and Environment of the Government of Puerto Rico, is an important milestone in the recognition of synergic collaborative work between an academic institution and a government agency. CREST-CATEC is sponsoring visiting scientist Dr. Stephan Funk, wildlife conservation geneticist from Durrell Wildlife Conservation Trust (DWCT), a conservation organization in Jersey, England. CREST-CATEC and DWCT established collaboration in order to facilitate research in applied tropical ecology and conservation biology within the Caribbean, Central and South America.

Collaborative research activities:

1. CATEC research fellows have for the most part established research collaborations among themselves, one of the goals of the Center. This has established a synergism that is already showing the results. Some of the examples of the collaborations include: 1) strong collaborative ties
between the two groups (MEEG and PEG) working in Mona Island, where PEG provided all the vegetation structure information required for the Iguana project, 2) there are transdisciplinary areas of research where population questions are being analyzed also at the genetic level. Dr. Rauscher (plant geneticist from MEEG) is actively collaborating with Drs. Meléndez and Tremblay, 4) Dr. Santiago has been working in collaboration with Dr. Meléndez in the population aspects of Goetzea, and with Dr. McMillan and in the molecular genetics part of the work on Goetzea. 3) Dr. Giray is collaborating with Dr. Ackerman in the research of Charito Orengo regarding the invasive fire ant, 4) Dr. Dominguez-Bello is working in the microbial ecology of the rumen of goats and pigs from Mona Island, receiving collaboration from Drs. Meléndez and Fernández, 5) Dr. Fernández helped establish the geographically referenced points of trees being used for research in the Guánica forest by the Ecosystem functioning group of Dr. Cuevas.

2. Terrestrial-coastal linkages in the Caribbean. Dr. Jorge Ortiz from UPR-Río Piedras and Dr. Michael McClain from Florida International University. It involves regional collaboration between scientists and government officials from Cuba, Dominican Republic, Jamaica, and Puerto Rico.

3. Dr. Jorge Ortiz is the Coordinator of the Luquillo Mountains UNESCO’s Hydrology for the Environment, Life and Policy Program (HELP). This program promotes the dissemination of integrated water resources management principles among an international network of catchments of which the Luquillo Mountains were promoted to "Envolving Status" by UNESCO.

4. Effect of invasive species on the soil nutrient dynamics of wetlands in Puerto Rico. Dr. Elvira Cuevas UPR-Río Piedras, Dr. Ariel Lugo from USDA Forest Service International Institute of Tropical Forestry, Dr. Ernesto Medina from Venezuelan Institute from Scientific Research (IVIC) 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.

5. Downstream effects of plant species plasticity at the ecosystem level in a seasonally dry forest in Guánica, Puerto Rico. Dr. Elvira Cuevas UPR-Río Piedras, Dr. Ariel Lugo from USDA Forest Service International Institute of Tropical Forestry, Dr. Ernesto Medina from Venezuelan Institute from Scientific Research (IVIC) 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.

6. Morphological and physiological plasticity of tropical trees modulated by physicochemical stressors: nutrients, salinity and wind. Dr. Elvira Cuevas UPR-Río Piedras, Dr. Ariel Lugo from USDA Forest Service International Institute of Tropical Forestry, Dr. Ernesto Medina from Venezuelan Institute from Scientific Research (IVIC), Dr. Sandra Molina, Catholic University, Ponce PR, and Citizens of the Karst. 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.

7. 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. Dr. Elvira Cuevas UPR-Río Piedras, Dr. Ariel Lugo from USDA Forest Service International Institute of Tropical Forestry, Dr. Ernesto Medina from Venezuelan Institute from Scientific Research (IVIC). The research is allowing the understanding how sea level rise and paleoclimatic changes in the last 4500 years have occurred in the Caribbean region.

8. Puerto Rico Department of Natural and Environmental Resources/U.S. Fish & Wildlife Service: Dr. Eugenio Santiago’s main research project under CREST revolves around the reproduction and genetics of a Federally Endangered species, Goetzea elegans. After performing the
experimental phase on pollination, plant material propagated will be used for recovery activities outlined by the Fish & Wildlife Service. Some of the activities will include the establishment of ex situ populations of G. elegans in protected lands. In addition, the proposed research on genetic diversity of G. elegans will provide these agencies baseline data on genotypes that of top conservation priority.


10. Updated revision on the systematic status of the Antillean-endemic plant genera. Dr. Eugenio Santiago is collaborating with scientists from Florida International University and Fairchild Tropical Garden (Miami). This revision will allow the identification of future research routes and priorities, helping developing research for studies on the Antillean flora.

11. Propagation of Endangered Plants of Puerto Rico. Dr. Eugenio Santiago from UPR Rio Piedras and Puerto Rico Department of Natural and Environmental Resources/U.S. Fish & Wildlife Service. Dr. Santiago’s main research project under CREST revolves around the reproduction of a Federally Endangered species. After performing the experimental phase on pollination, plant material propagated will be used for recovery activities outlined by the Fish & Wildlife Service.

12. 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. Dr. Jorge Ortiz is the PI of this project. This work was expanded to include the repopulation of the crested toad in the northern karst area of the island. Dr. Ortiz and Dr. Ramírez have been in charge of monitoring the artificial ponds established for the release development and of the tadpoles brought from the Toronto Zoo.

13. Population biology of hawksbill turtles, an endangered species. UPR-Río Piedras and Department of Natural Resources and Environment of the


17. The developmental architecture of wing pattern variation in *Heliconius erato*. Dr. Owen McMillan, UPR Rio Piedras and NSF, Duke University. Provides attached undergraduate and graduate studentship. Mr. Félix Araujo, graduate student, is at present in an exchange program with North Carolina State University receiving training in molecular techniques. CREST-CATEC is administering the grant.

18. Metapopulation dynamics of an endangered riparian orchid. UPR-Rio Piedras and UPR-Humacao, Dr. Raymond Tremblay. Provides funding for molecular/field project on endangered riparian orchids. Many Puerto Rican undergraduate students from Humacao are actively involved in this project.

19. Evaluation of metapopulation dynamics. Dr. Raymond Tremblay from UPR-Humacao and Dr. Pavel Kindlmann from University of South Bohemia, Czech Republic. CREST-CATEC is supporting Dr. Tremblay research in this area.

20. Effects of Introduced Feral Ungulates on the native vegetation of Mona Island Reserve. UPR-Rio Piedras, Department of Natural Resources and Environment, USDA Forest Service International Institute of Tropical Forestry, UPR-Humacao, UPR-Bayamón and 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. The Humacao campus leveraged matching funds to Dr. Denny Fernández and Dr. Raymond Tremblay (CREST-CATEC research fellows) to complement research activities related to the CREST project. The project is generating data on the relationship between plant and insect diversity at the site. The following investigators are contributing with insect identification: Dr. Miguel García (Department of Natural Resources and the Environment), Dr. Michael Ivy (University of Minnesota), Dr. Alonso Ramirez (ITES-UPR), DR. Ariel Diaz (UPR-Humacao, and Dr. Juan Torres (UPR-Bayamón). The information generated addresses questions related to the indirect effects of introduced herbivores on trophic structure.

21. Use of High Resolution Imagery for vegetation analysis of Mona Island. UPR- Rio Piedras, UPR-Humacao, USDA Forest Service International Institute of Tropical Forestry and Smithsonian National Zoological park - Conservation Research Center, Front Royal, Va. Olga Ramos - GIS Analyst of USDAFS-IITF is collaborating as a consultant and in the GIS training of students. Dr. Peter Leimgruber from Conservation Research Center NZP-Smithsonian is collaborating in the study design and is contributing image analyses for remote sensing.


24. Honey Bee Genome Project. Dr. Tugrul Giray UPR-Rio Piedras and Dr. Gene E. Robinson, Univ. of Illinois at Urbana-Champaign.

25. Development of honeybee flight behavior. Dr. Tugrul Giray UPR-Rio Piedras and Dr. Zachary Huang Michigan State University.
26. Butterflies of Puerto Rico and the Caribbean and Caribbean. Dr. Carla Restrepo UPR-Rio Piedras and Dr. Stuart Ramos UPR - Mayagüez
27. Social organization of the St. Lucian Green Iguana - UPR-Rio Piedras and Durrell Conservation Trust, Jersey. CREST-CATEC is providing Dr. Funk’s partial salary, and student, technical and material support.
28. Conservation of the mountain chicken (Leptodactylus fallax) - UPR-Rio Piedras and Durrell Conservation Trust, Jersey. CREST-CATEC is providing Dr. Funk’s partial salary, and student, technical and material support.
29. Conservation of the St. Lucian whip-tailed lizard (Cnemidophorus vanzoi) - UPR-Rio Piedras and Durrell Conservation Trust, Jersey. CREST-CATEC is providing Dr. Funk’s partial salary, and student, technical and material support.
30. Molecular microbial diversity in the foregut of the hoatzin, Opisthocomus hoazin, a South American leaf-eating bird. Dr. María G. Domínguez and Drs. Ruth Levy, Washington State University and Dr. Jeff Gordon, Center for Genome Science, St Louis, MI.
31. Molecular microbial diversity in the foregut of the Hoatzin Opisthocomus hoazin, a South American leaf-eating bird. Dr. María G. Domínguez and DR. Martin Blaser, NYU.
32. Dr. Elvira Cuevas- Board of Directors AAAS, Caribbean Division (2003 - present).

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

- This year we held our First CREST-CATEC Annual Symposium on April 1st, 2006 where researchers and students presented their work in oral and poster presentations. A total of 100 persons attended this symposium.
- Use of PLONE for web page development - Mr. Joel Ruiz, informatics coordinator, April 2006. Training in content management system and development for graduate students from the Center for Information and Library Resources at the Rio Piedras campus.

Seminars sponsored by CREST-CATEC:
We sponsored two seminars that were given by Dr. William McClain, from Florida International University, and Dr. Inge Ambrecht from Universidad del Valle in Colombia. The two seminars were presented in the Biology Department seminar series.

I.7. International activities
The international activities carried out by CREST-CATEC fellows allow the recognition of the scientific work being carried out in Puerto Rico. It has also exposed students and researchers to other laboratories where collaboration can be developed. The proven expertise in conservation and applied ecology are being sought by international institutions to have a better understanding of research problems.

CREST-CATEC continues to develop international activities. In order to reach our landmark, we are developing plans to establish collaborations, student and faculty exchanges, publications and short courses.

- Dr. Owen McMillan helped develop a very fruitful collaboration between the Durrell Wildlife Conservation Trust (DWCT) and (CREST-CATEC). The two institutions launched collaboration in order to facilitate research in applied tropical ecology and conservation biology within the Caribbean, Central and South America. The collaboration is managed and maintained by Dr Stephan M Funk, Conservation Geneticists at DWCT. Dr Funk conducts research at CREST-CATEC for one year (starting May 2005) as visiting professor, jointly funded by CREST-CATEC and DWCT. Alongside
research projects specific to both organizations, the collaborative approach includes joint research in behavioral ecology and conservation genetics of several iguana populations across the Caribbean. Benefits for UPR include lectures and seminars in conservation biology and conservation genetics, supervision of UPR students associated with ongoing CREST-CATEC conservation genetics projects and several projects that are in the early stages of development, and further development and optimization of UPR molecular facilities. Benefits for DWCT include the use UPR state-of-the-art molecular laboratory. Both organizations hold unique positions within the Caribbean and Central and South America, with CREST-CATEC being particular strong in academic research and DWCT being particularly strong in applied conservation biology. The set of field sites is complementarily. The mutual collaboration will further both organizations’ goals to become dominant centers for research and conservation, respectively, in tropical ecology and conservation biology in the Caribbean region. DR. FUNK will continue the collaboration for another year.

- Elvira Cuevas has ongoing collaboration with Drs. Francisco Herrera, Ernesto Medina and Elizabeth Olivares from the 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 is also be involved.

- There are two presentations and one manuscript submitted for publication from this collaboration:


- Dr. Cuevas maintains collaborative interactions in Brazil with Dr. Mario Soares from State University of Rio de Janeiro and Drs. Monica Tognella and Simone Rabello Cunha from UNIVALE, Itajai. Two manuscripts are being prepared from the work done on mangrove adaptations to temperature and salinity in eastern South America.

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

- Drs. Jorge Ortiz and Elvira Cuevas from UPR-Rio Piedras are involved in a research network on Effects on the N Cycle in the Americas, A multinational research project within the Interamerican Institute from Global Climate Change Research (IAI) with researchers from USA, Brazil, Argentina, Venezuela, Canada, Chile and Puerto Rico.

- Dr. Eugenio Santiago has continued collaborations 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.

- Dr. Raymond Tremblay is Chair of the International Committee for In Situ Conservation of the Orchid Specialist Group, Species Survival Commission, IUCN – The World Conservation Union. This committee has a World Impact: to foster In situ conservation at the local level.

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

- Dr. Carla Restrepo collaborates with Universidad del Valle-Guatemala and Fundación Amigos Defensores de la Naturaleza.
• Dr. Jason Rauscher collaborates with Dr. Carlos Diaz from Universidad del Valle in Cali Colombia in an Espeletia sequencing project. He is also collaborating with Dr. Concepción Puerta, from Pontificia Universidad Javeriana in Bogotá, Colombia on Trypanosome molecular evolution.

• Dr. Tomas Hrbek collaborates with Dr. Izeni Pires Farias from Laboratório de Evolução e Genética Animal (LEGAL), Universidade Federal do Amazonas, Brazil. Their research relies on molecular data (DNA sequences, microsatellites and AFLPs) to study the architecture of genetic variation in freshwater taxa in an ecological context.

I.8 Description of Shared facilities within the CREST framework.

The Sequencing and Genotyping Facility, under the supervision of Dr. Owen McMillan, 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. The 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.

Bioinformatics Satellite Lab: It is already established and acts as a core data processing and storage center for all molecular based research activities associated with CREST projects. Permanent space for the facility has been secured in JGD 215. The facility was renovated and is fully functional. Dr.
Tugrul Giray is the Coordinator of the facility and Dr. Pedro Alvarez, partially supported by CREST-CATEC, is the facilities’ manager.

Both the **Sequencing and Genotyping Facility** and the **Bioinformatics Satellite Lab** are essential for the success of CREST- CATEC’s Molecular Ecology, Genetics, and Evolution Program. Although NIH provided the primary funding, NSF-CREST provides 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 hired Drs. Rauscher and Hrbek, both joined CATEC’s Molecular Ecology, Genetics, and Evolution Group. Neither researcher would have accepted the position without unimpeded access to a functioning sequencing and genotyping facility. Furthermore, we were able to secure NSF funding largely because we could document our ability to produce and manage a large sequencing and database project.

**I.9 Special equipment/facilities**

UPR Honey Bee Research Facility (Gurabo): It makes available the non-defensive Africanized bees for behavior, genetics, and genomics research.

Herbarium/Botany, lab and grounds, University of Puerto Rico Botanical Garden. The grounds of the Botanical Garden are very accessible from UPR main campus, providing a logistically easy-to-access experimental field to students. The proximity of the Herbarium/Botany lab and the Garden grounds allow outdoor as well as indoor research activities almost simultaneously.

Herbarium/Botany lab of the Department of Biology, UPR Rio, Piedras. In close collaboration with the Botanical Garden herbarium provides easy access and materials for plant identification. The Herbarium is in the process of digitalizing all
the collections in order to have on-line capability for web search. The NSF grant is being managed by CREST-CATEC.

The plant ecology and conservation laboratory of Dr. Raymond Tremblay in UPR-Humacao was established in part with the funds from CREST-CATEC. The equipment includes PCR, Centrifuge, Gel ridges, refrigerator, freezer (-20°C), pipette man and power pack. It is used for research and involves 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.

Virtual Herbarium/computers. It consists 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.

Insect collections. It will contain reference species of all insects collected in the island. Collections specimens preserved in alcohol with information on the date of collection, locality, collecting method as well as some complementary materials (i.e. digital photographs). All information is being digitized and placed in Lucid 3 for construction of taxonomic keys. It will also create an insect collection and inventories of Mona Island (now lacking) and will improve the state of insect inventories for tropical dry forest species. Information will be databased by our research group. This collection will provide better access to information on
Caribbean insect species to researchers and students not only in Puerto Rico but also in the Mainland since digitized data will be placed on our web site.

UPR-ITES computer server. It is used to maintain the "Tropical Plant Ecology and Evolution Laboratory page and an introductory Page on 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. It will also provide a better visibility for the CREST-program as well as collaborating departments, programs, institutions and agencies (i.e. Institute for Tropical Ecosystem Studies, The Biology Graduate Program at UPR, NSF-CREST CATEC) will facilitate the goals of the program including, faculty development, student training, dissemination of information to the public.

The UPR-Humacao computer server. It will house daily micro-climatic data as well as web page of Dr. Denny 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 Microbial Observatory laboratory. This 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 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.

Electromicroscopy Lab. Located at UPR-Humacao and directed by Dr. Carmen
Hernandez, is available for research activities of the local faculty. The CREST
personnel will be using 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 Server. Located at UPR-Central
Administration Facilities in the northern part of UPR Botanical Garden, it will be
used as the main platform for web collaboration and data depository.

I.10 Plans for future collaborations with other Centers.

There are plans for research collaboration with the CREST Center for Forest
Ecosystem Assessment from Alabama A & M University as both CATEC and
CFEA share similar research interests. Dr. Elvira Cuevas is already part of the
scientific external advisory committee. There are plans for researchers and
students exchange between the two Centers. We also established collaboration
with CREST RESSACA by accepting two graduate students to participate in the
GIS course in Puerto Rico. The GIS course is the first step towards furthering the
interaction and integration of the Centers and towards the development of a research alliance where mutual benefits will be enhanced.

II. ACTIVITIES AND FINDINGS

II.1. ACTIVITIES:

Thrust area 1: Molecular ecology, evolution and genetics. Component 1: Demography and population biology of Hawksbill turtles.

For 2005-2006, the Mona Island Hawksbill Turtle project achieved several milestones, accomplishing all of our major objectives. The research team is composed of CREST-CATEC investigators Carlos E. Diez, Robert P. Van Dam (in water work and ecology), graduate student Ximena Vélez (nesting and in-water molecular analysis), and CREST-CATEC Co-PI W. Owen McMillan, with the assistance of Durrell D. Kapan (now in the University of Hawaii at Manoa).

Over the past year the following was accomplished:
(1) Continued extensive in-water surveys of adult and juvenile hawksbill turtles on the foraging and breeding grounds around Mona and Monito Islands.
(2) Obtained sequence from a 740 base-pair piece of the mitochondrial control region for a temporal sample of 94 nesting females [2003 (n=48), 2004 (n=21), and 2005 (n=25)] and 59 breeding males [2001 (n=10), 2003 (n=38), and 2004 (n=11)]. In addition, we sampled 74 juveniles, including individuals that fell into the small [recruits, (n=18)] and intermediate (n=56) sized clusters from a single year.
(3) Genotyped all male hawksbills at Mona using four highly polymorphic loci.

Major results and findings include:
1. Over a 14-year period of in-water surveys, including the four-year period covered by this grant, a total of 275 adults and 668 juvenile hawksbills were sampled. Over this period, many individuals, particularly smaller sized turtles, were recaptured numerous times (Diez & van Dam, unpublished data). In our capture data, there were clearly three size classes of individuals (Figure 1). Size class 1 (n=281) consisted of small individuals that were captured for the first time. These individuals had SCLn-t between 20.0-34.9 cm and most likely reflect new recruits into the feeding aggregations. Size class 2 individuals were all recaptures (n=387) and had SCLn-t values between 35.0 and 65.0 cm and represent the standing juvenile feeding aggregation. The third size class composed of nesting females and breeding males consisting of individuals with SCLn-t values greater than 66.9 cm.

![Two-dimension comparison using smoothing curves of the logarithm of the straight carapace length (SCL-nt) and body mass of 14-year mark-recapture records of immature hawksbill sea turtles. The x axis represents the logarithm of the mass while the y axis represents the logarithm of the carapace length.](image)

2. Overall, there were clear differences in the haplotype diversity and frequency distributions among the different segments of the aggregation (Fig. 2) but little evidence for temporal heterogeneity between different groups sampled across years. Females showed the lowest haplotype ($\widehat{h}=0.53 \pm 0.04$) and nucleotide ($\widehat{\pi}=0.14 \pm 0.08$) diversity and 13 polymorphic sites...
identified five haplotypes. There was no evidence for temporal structure in the female mtDNA data and haplotype frequencies were not significantly different across the three years (2003, 2004 and 2005) that we sampled ($X^2 = 9.9433$, df= 10, $P = 0.454$).

3. Our data provide the first indication that adult males, similar to females, exhibit strong natal homing behavior. The distribution of mtDNA haplotypes was similar between males and females and our mixed stock analysis suggested between 60 and 80% or the breeding males we sampled likely originated on Mona.

4. However, about 20% of the males in the breeding aggregation must have originated from other rookeries. Interestingly these males were not obviously part of the feeding aggregation as they possessed mtDNA haplotypes that were not in the juvenile population.

5. Unlike what has recently reported for loggerhead turtles, we found no evidence for natal philopatry among either the newest recruits to the Mona aggregation or in the older, larger, and more established juveniles. Indeed, both the newest recruits and the standing juvenile foraging population on Mona were composed of individuals originating from rookeries across the Caribbean (Table 5b). These data reinforce a previous study and underscore the influence of developmental stage on the population genetic architecture of hawksbill turtle populations.

6. There was ample variation at microsatellite loci to distinguish all breeding males in the Mona mating aggregation.

7. Thus far, there is no completing evidence for multiple paternity in hawksbill turtles.
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 additional DNA samples from previously unmarked male turtles and to better estimate the size of the male breeding populations.

(2) Continue nesting survey and monitor hatching success on focal beaches on Mona.

(3) Optimize primers developed for Olive ridley turtles, and generate new hawksbill specific primers by constructing an enriched microsatellite library for future population analysis.

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(4) Complete molecular analyses of multiple paternity and male reproductive success in hawksbill turtles.

Thrust area 1: Molecular ecology, evolution and genetics. Component 2: Territoriality and Reproductive Biology of the Mona Rock Iguana.

For the 2005-2006 field season, the Mona Island Iguana Project achieved most of its targeted milestones and objectives. This is a collaboration between biologists at the Puerto Rican Department of Natural Resources (DRNA) and scientists (W. Owen McMillan and Alberto Sabat) and students (Nestor Perez and Keysa Rosas) at the University of Puerto Rico.

Over the following four years we have accomplished the following:

- Captured and collected key biological information (including tissue samples for genetic analysis) on over 203 adults iguanas and approximately hatchlings. 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. Moreover, we have re-captured and obtained key data on survival, growth rates, and dispersal information of some captive raised hatchling iguanas that were released into the wild after being in captivity for 36 months.

- Radio-collared and obtained territory information for 40 adult iguanas in three locations. Locations were chosen based on differences in human disturbance and habitat type. For all focal animals, we have gathered extensive (more than 20 GPS localities for each animal/period) information on home range across three time periods in 2003, 2004, 2005 (March, June-July and October-November). During our survey, we recorded the
activity of the iguana and its body temperature (using an infrared thermometer), as well as, basic environmental variables (air temperature, humidity).

- Tracked 22 females to their nesting grounds and collected information on clutch size and hatchling success in our three study areas on Mona across three reproductive seasons. All offspring hatchlings of those females were measured (SVL, tail length and body mass), sexed by using sex probes, tissue sampled and marked with pit-tags. Half of these hatchlings are kept in captivity as part of the Dare's “Headstart” Program.

- Produced detailed habitat maps of 42 adult territories identified in the three study areas. We are presently using GIS to quantify variables including land cover (vegetation, rock/sand forest/shrub) and human disturbance (exotic plants cover, and artificial feeding spots). Other information (plant vegetation and diversity, food availability, and shelter density) is being collected by additional field transects. Food availability will be determined as the proportion of food plants consumed by iguanas with respect to the total plant abundance and diversity in the area.

- Tested available microsatellite markers for *Cyclura* and developed an enriched library to generate.

- Submitted two papers on data generated over the past three years.

- Received funding from Iguana Conservation Trust with co-funding from the PR-DNER to continue field research and develop non-invasive genetic sampling techniques.

Major results and findings include:

- There was a very low representation of wild juveniles stages in natural populations. Nearly all mid size iguanas (73%) comes from captive raised iguanas (Fig. 1).
Figure 1. SVL and body relationship for all Mona iguanas captured since March 2003.

- Adult iguanas are highly territorial and showed a high degree of fidelity to their home ranges though time.
- Average home range for the adult Mona Iguana, 0.23 ha for females and 0.41 ha male, was considerably smaller than that estimated from other Iguana species (Fig. 2a).
• Home ranges of adult iguanas are organized such that there is no empty spaces for “new” iguanas and adults share space only with individuals of the opposite sex (Fig.2a)
• Juvenile iguanas move much more widely (Fig. 2b)
• Human activities strongly influence home ranges location and size. Artificial feedings spots generate abnormal high population densities and smaller home ranges, which might in turn influence social organization and demographic processes.

Figure 2a and 2b: Home ranges (Minimum Convex Polygon 95%) in two study areas. Yellow polygons are males, and blue lined polygons are females. Dotted circles represent non-captured animals (males or females depending of the circle color). a) Non-human disturbed area with continual human habitation (red dot); b) highly human disturbed area. The orange polygon in this area is the home range of an immature female.

For the upcoming year we will:
• Complete manuscript describing territoriality and movement of adult iguanas across three different habitat types. The key territory and landscape data is complete. We expect a first draft of the manuscript by July and the final version to be submitted by October 2006.
• Use GIS to quantify variables including land cover (vegetation, rock/sand forest/shrub) and human disturbance (exotic plants cover, and artificial feeding spots). Other information (plant vegetation and diversity, food availability, and shelter density) will be collected by field transects. Food
availability will be determined as the proportion of food plants consumed by iguanas with respect to the total plant abundance and diversity in the area.

- Focus radio-telemetry efforts on mid-size iguanas that we have identified in the wild or that will be released as part of the “Head-Start” program. These data are critical to estimate territoriality, reproduction, and survival in this size class of individuals.

- Obtain DNA fingerprints for all adults captured on Mona Island. Initial tests using available markers showed low levels of heterozigosity. We have now developed a new library and are developing additional loci. These initial data will provide key information on effective population size, possible small-scale genetic structure, and historical demographic parameters.

- Test new loci on fecal samples to develop non-evasive sampling techniques for future population sampling.

- Examine microsatellite fingerprints of hatchlings collected over the past three years and use this information to test the extent of monogamy and polygamy of the Mona iguana. We will complete initial screen of our sample archive by December 2005 and the final dataset will be complete by February 2006.


Laboratory work over this period was focused on the development of an enriched microsatellite library. 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 seven years of field research. With seven 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. The two manuscripts submitted last year dealing with the
ecological components of the metapopulation were published in Biological Conservation & Folia Geobotanica. Five more publications with student as authors or co-authors also came out. This year we incorporated a PhD student, Augusto Carvajal, to work in the project. We also established collaboration with Dr. Jason Rauscher who is playing a key role in advancing the genetic marker work. During this past year we achieved the following:

- A microsatellite library for *Lepanthes rupestris* was developed commercially and this library is available for identifying useful microsatellite loci (Tremblay & McMillan)
- Primer pairs for multiple loci are currently being tested and optimized for amplification
- Amplification products from multiple individuals will be sequenced to confirm the presence of repeat regions, characterize flanking sequence and screen for variation
- Ideally, 10-15 loci will be identified for population sampling and genotyped using the sequencing facility’s Li-Cor or ABI 3130xk machines.

Given the small size of these plants, the first challenge was to identify efficient methods of DNA extraction from small quantities of tissue. After testing several methods, including commercial kits, a modified CTAB extraction was determined to give the greatest yield of genomic DNA. Once the current goal of obtaining 10-15 variable microsatellite loci is achieved, these markers will be used to characterize genetic diversity and population structure within and among populations of *L. rupestris*. These markers may also be tested in other species of *Lepanthes* on Puerto Rico or other islands of the Caribbean. Chloroplast and/or nuclear loci may be sequenced to look for variation that may be useful in phylogeographic and/or higher taxonomic phylogenetic studies. Co-dominant marker systems such as AFLPs may also be used to describe patterns of genetic variation in the species.

In the coming year, we will 1) Continue to develop a database of plant tissue, 2) Continue data collection of population dynamics in the field. 5) continue to collect data on the spatial distribution of the metapopulation structure; and 6) continue the genomic analyses.
Thrust area 2: POPULATION ECOLOGY: Effects of exotic species on native insular biota. Component 1: Effects of exotic ungulates on the native vegetation of Mona Island Reserve, Puerto Rico

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 251 have been collected and processed; b) a digital replica of the voucher collection to be worked through the digitalization project of the UPRRP-Herbarium. This project is now being funded by an NSF grant proposal to JD Ackerman. To date 814 labels have been processed for 251 species out of 400 that are reported for Mona Island Reserve. Label data has been entered in Excel and is being transferred to BRAHMS, the software supporting web-based label information for the UPRRP herbarium. Mounted plant specimens are being scanned to complement label information for publication at the future UPRRP web site. A total of 600 specimens have been scanned 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 for 135 vouched species (the most common) with 50 more being added. d) a collection of digital photos of seeds/fruit of all plant species of Mona.

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, plant species composition and herbivory detection at the understory, reproductive and herbivory phenology at the canopy level around these points, canopy light environment by analysis hemispherical digital photos of canopy cover, continuous measurements of temperature and relative humidity and presence and absence of feces of the three large herbivore species (goats, pigs, endemic iguana). Three 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 for July 2003. Data analyses are underway and manuscript preparation and submission should be completed by the end of the summer of 2006. 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. We set up two additional transects in the platform forest sites for the vegetation analyses 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 along transects (102 photos). 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) was extended to July 2004 to be able to include a full year of monthly censuses for these sites. Currently these data are being gathered twice a year for assessment of variation from year to year. Data Management for these 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). Data collected includes plant diversity and density at the understory level at permanent points, vertebrate activity though 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.

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). Results were presented in the SCB (Society for Conservation Biology) in Brazil as part of a symposium on Biological Invasions in July 2005 and a manuscript was submitted for publication. Based on results from this study we have selected 24 species for bromatological analyses to help determine potential interspecific differences in plant nutritional values and presence of secondary compounds. Initial plant processing (leaf material drying and grinding) was finished. Samples will be sent to a commercially run laboratory for analysis. Dr. Denny Fernandez leads this study.

Of the 400 species on Mona, 88 were present in the goats’ stomachs with an overall percentage of woody (trees, shrubs, lianas) and herbaceous species (herbs and vines) of 53% and 47% respectively. Common species included the endemic orchid (Pshychilis monensis), the endangered cactus Harrisia portoricensis, two vines (Galactia dubia and Centrosema virginianum) and two woody species [Capparis flexuosa and Capparis cynophallophora]. Families known to produce toxic secondary compounds were underrepresented. Diet composition was associated to time of stomach collection but not to age or sex of goats using multivariate analyses. The combined results suggest that there are temporal changes in goat diets perhaps associated to changes in plant preferences. Such changes suggest that our sampling most likely underestimates the number of species eaten by these animals at the reserve. Morphological traits are a useful tool for studies of plant ecology and systematics. Numerous studies suggest that epidermal traits such as stomatal arrangements
and epidermal cell shape can be use to discriminate among plant functional
groups and plant families. For this study we carried a micromorphological
characterization of epidermal tissue and stomata of the most common plants of
Mona Island Reserve. Our main objective was to determine the usefulness of
morphological diversity in epidermal and stomatal traits to discriminate among
plant functional groups (trees, herbs, vines etc.) and different taxa. To that effect
we took impression of epidermal tissues of 120 plant species. Each impression
was observed under a compound microscope and photographed with a digital
camera. Preliminary results suggest that we can distinguish at least 45 different
species using a subset of our projected set of epidermal traits. This epidermal
collection will be used as a reference collection to microhistological studies of
diets of exotic mammals from Mona Island Reserve. This digital collection could
also be used in ecophysiological studies of morphological adaptations to dry
environments.

5. Set up of Meteorological Station. Transport and set up of an automated
meteorological station for Mona Island is almost completed recently. Final set
up (calibration and programming) is still underway. 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. DNRE personnel have been very helpful with the set up process and will
help with the monitoring of the station once it is completely running.

6. Insect Biodiversity at depression forest sites - We set up a seven month study
to characterize insect biodiversity at three of our permanent transects (two
depression and one platform forest sites) and to study the relationship between
herbivore diversity and plant composition (started in Jan 2004). This study is co-
directed by E. Melendez-Ackerman and Miguel Garcia and will include various
collaborators (see collaborative projects). 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. Five graduate students, six undergraduates have worked in sample processing and the construction of an entomological collection. Four of those students are working on the construction of a database for the collection in Lucid3 to develop interactive entomological keys. We have acquired a number of keys to aid in the identification process. We now have an insect reference collection with most individuals identify to family or subfamily. We have also acquired a new collaborator Dr. Jorge Santiago Blay (a researcher at the Smithsonian) who is helping with identification of Dipterans and Lepidopterans. Four student presented preliminary results in two local scientific meetings in March 2005 (PRISM, Symposium in Undergraduate Research at UPR-Rio Piedras) and the Annual Symposium of Caribbean Floral and Fauna at UPR-Humacao. Reference collection and resulting keys will be available for students and researchers interested in tropical dry forest insects especially within the Caribbean Region.

We have almost completed the experimental phase of determining pollinators and their success on flowers of Goetzea elegans. The main objective is to determine whether the Bananaquit (Coereba flaveola - a native bird) and the exotic Honeybee (Apis mellifera) pollinate G. elegans, and whether they exhibit differences in pollination efficiency. It is known that for many native plants, the Bananaquit robs nectar without carrying out pollination. To compare pollination efficiency, we have performed experimental studies of these two vectors, using over one hundred potted young trees that have reached reproductive stage, and over 2,000 flowers. The plants were established outdoors within the grounds of the Puerto Rico Botanical Garden, where the Bananaquit and the Honeybee are common residents. To test pollination, flowers were bagged the night before anthesis (to prevent pollen contamination of the stigma before performing
observations), and were then unbagged and presented to the visitors. Flowers were bagged again after they were visited. A visit was considered a successful pollination event if the flower set fruit. Besides presenting flowers to visitors, we performed different types of manual pollinations (e.g., outcrossing pollen, doing self pollination, etc.) to compare fruit set under different types of pollination. Our results indicate that C. flaveola is not robbing nectar but it is performing legitimate pollination of Goetzea elegans. The exotic Honeybee is also pollinating this tree species. Our current data indicate that both, the exotic and the native pollinators are exhibiting equal pollination efficiency. Furthermore, a study of the largest known population of G. elegans is being carried out to determine whether distance between reproductive trees is affecting reproduction. Given that this species exhibits a need to outcross pollen for successful fruit set, our objective is to determine what degree of isolation is compromising adequate reproduction of wild trees. In addition to pollination experiments, we initiated the sampling and processing of leaf tissue for an Amplification Fragment Length Polymorphism (AFLP) study on the genetic diversity of wild populations of G. elegans. This DNA-fingerprinting technique is especially advantageous when dealing with small or rare populations because very small genetic differences are revealed by the high resolution of the technique, and only minimal amounts of DNA are necessary for study. We have sampled individuals for three sites: North-western Puerto Rico, Vieques, and the Dominican Republic. Our preliminary results show that there is considerable gene diversity within populations, and that diversity between populations is similar. European genomic introgression is higher (~70%) in Africanized bees in Puerto Rico than any other population studied to date. Tropically evolved Africanized behavioral traits that may be advantageous, such as parasite resistance are conserved. However, defensiveness against vertebrate predators is reduced probably due to a trade-off in this population for allocation to defense vs. foraging for nectar and reproductive effort. We also found evidence for other potential life history changes such as plasticity in age at transition from nest jobs such as nursing to field jobs such as foraging and defense. These results support the
idea that Africanized bees will remain as a successful invasive species with potential impact on native plants (pollination) and animals (competition).

Thrust area 3: Landscape ecology: Multimodality in body size: an integrative approach to understand the effect of land-use change on tropical animal assemblages.

The main hypothesis addressed by this project was that multimodality in body size was related in important ways with developmental processes occurring at the individual level. In particular, species and individuals at the edges of each lump in body size should exhibit higher levels of developmental stability than those in the center. Interesting we discovered recently that a similar idea was proposed in the early 80’s by Soulé but the idea remained largely unexplored.

Our proposal 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. A synthesis paper summarizing hypothesis about multimodality in body size was published this year (Allen, C. R., A. S. Garmestani, T. D. Havlicek, P. A. Marquet, G. D. Peterson, C. Restrepo, C. A. Stowe, B. Week. 2006. Keystone processes and ecological organization: Evaluating alternative explanations for patterns in body size distribution. Ecological Letters) and represented a collaboration with scientists outside UPR.

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

The basic research for this component was completed last year by the UNM team (one of the Co-PI’s, Dr. Tim Hanson, moved to the University of Minnesota in 2004) and we have been working on the preparation of manuscripts. We are expecting to produce between 2-3 publications. The first paper coming out from this collaboration compares in a systematic way, and for the first time, the performance of 4 statistical methods to detect multimodal distributions in a well-known dataset published by C. S. Holling in 1992. Unlike previous work two
other authors, our research provides clear support for the existence of modes in body size but also indicates differences among the methods to detect these patterns. This paper has already been submitted to Ecology as a Statistical Report (Xu, L. E. Bedrick, T. Hanson, and C. Restrepo. Statistical tools for identifying modality in body mass distributions).

The second paper (the lead author is T. Hanson) will examine 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. This paper will make use of the data collected by the UPR-RP team to assess whether mixture distributions of body sizes from different fragmented habitats are identical, and if not, which features of the distributions (locations, spreads, or mixture probabilities) differ across groups. We have implemented reversible jump MCMC algorithms (Green, 1995) and Gibbs’s samplers to test simple hypotheses of this type within the Bayesian framework. We have successfully implemented these methods for comparisons of two populations and are currently extending these methods to 3 or more populations. There have been some delays in finishing up this “Methods” paper due to the job change of Dr. Hanson.

In collaboration with Dr. José Nieves from the Department of Physics at UPR-RP we worked on an algorithm to evaluate landscape complexity at multiple scales, using digital elevation data from Puerto Rico. Mr. Luis Villanueva has been working as GRA in the Tropical Landscape Ecology Lab and is implementing and refining this algorithm.

(2) The second component of this project involved the collection and assemblage of large datasets on body size and fluctuating asymmetry for birds (Colombia) and frogs (Puerto Rico) in fragmented habitats. Although we have not been able to test our general hypothesis relating multimodality in body size with fluctuating asymmetry in a systematic way (this is pending upon the work of the statisticians), we were able to examine other questions about the effect of forest
fragmentation on body size and/or fluctuating asymmetry. Currently there are two papers under review (Cuervo, A. and C. Restrepo. Assemblage and population level-consequences of forest fragmentation on bilateral asymmetry in tropical montane birds. American Naturalist and Delgado-Acevedo, J. and C. Restrepo. The effect of habitat loss on body size, allometry, and bilateral asymmetry in two Eleutherodactylus species of Puerto Rico. Conservation Biology). In addition to these two papers, we will be presenting a poster at this year’s ESA meeting (Delgado-Acevedo and Restrepo). We are expecting to complete the core paper linking body size and fluctuating asymmetry by the end of next year.

(3) The compilation of body size data for large-scale assemblages of birds and frogs is almost completed. The latter has been possible through a collaborative project with Dr. Fernando Castro and Ms. Maria Isabel Herrera of the Universidad del Valle-Colombia who are generating a list of Colombian frogs with their sizes. This data is being gathered from museum specimens, as well as from the literature.

As mentioned before, we have added two other projects to evaluate the role of landscape complexity in influencing the morphology of animals, and therefore the structure of animal assemblages. These new projects focus on butterflies and parasitoids, and are giving continuity to our initial research on multimodality, strengthening it at the same time. A paper describing the initial results of our study on butterflies in a highly heterogeneous landscape will be presented in June during the annual meeting of the Society for Conservation Biology (Rodriguez and Restrepo).

*Landslides and Tropical Landscapes-Core Project II:*

This second core project of LEG has been strengthened with an award made to Dr. Restrepo (NSF-PR-EPSCoR) in 2004 but postponed until 2005. This project investigates the role of landslides on land-cover change in Central America. The project, however, started with direct funding from CREST-CATEC and this
resulted in a paper being published this year (Restrepo, C. and N. Alvarez. 2006. Landslides and their impact on land-cover in the mountains of Mexico and Central America. Biotropica). Three main activities have been developed as part of this project: (1) the creation of landslide GIS for the mountains of Eastern Guatemala, (2) a reconnaissance trip to southern Mexico to evaluate the feasibility of conducting work in the Sierra Madre de Chiapas and making contact with researchers and government agencies, (3) the organization of the first international symposium on Landslide Ecology that will be held as part of ATBC annual meeting in Kunming China, July 2006 and (4) development of a web-GIS on landslides (http://ursula.cnnet.upr.edu/landslides/).

II.2: Outstanding accomplishments

Iguana study

1. Adult iguanas are highly territorial and showed a high degree of fidelity to their home ranges though time. Average home range for the adult Mona Iguana, 0.23 ha for females and 0.41 ha male, was considerably smaller than that estimated from other Iguana species.
2. Home ranges of adult iguanas are organized such that there are no empty spaces for “new” iguanas and adults share space only with individuals of the opposite sex
3. Juvenile iguanas move much more widely (Fig. 2b)
4. Human activities strongly influence home ranges location and size. Artificial feedings spots generate abnormal high population densities and smaller home ranges, which might in turn influence social organization and demographic processes.

Hawksbill turtle study

1. Our data provide the first indication that adult males, similar to females, exhibit strong natal homing behavior. The distribution of mtDNA haplotypes was similar between males and females and our mixed stock analysis suggested between 60 and 80% or the breeding males we
sampled likely originated on Mona. However, about 20% of the males in
the breeding aggregation must have originated from other rookeries.
These males were not obviously part of the feeding aggregation as they
possessed mtDNA haplotypes that were not in the juvenile population.

2. Unlike what has recently reported for loggerhead turtles, we found no
evidence for natal philopatry among either the newest recruits to the Mona
aggregation or in the older, larger, and more established juveniles.
Indeed, both the newest recruits and the standing juvenile foraging
population on Mona were composed of individuals originating from
rookeries across the Caribbean. These data reinforce a previous study
and underscore the influence of developmental stage on the population
genetic architecture of hawksbill turtle populations.

**Goetzea and africanized bees studies**

1. Fruit set of *Goetzea elegans*, an endangered endemic tree species, is
related to distance among wild reproductive trees: isolated trees will have
a lower fruit set that individuals that are close to each other.

2. There is considerable gene diversity in the extant populations of Goetzea
elegans.

3. The bananaquit, *C. flaveola*, is not a robber of nectar and is a pollinator of
the rare tree *Goetzea elegans*.

4. *Apis mellifera* carries out pollination, this being the first documentation of
the exotic Honeybee pollinating an endangered species in Puerto Rico.

5. Honeybee is showing same pollination efficiency of native pollinator. Both
visitors exhibit comparable pollination efficiency, this being a case where
the exotic species is not affecting reproduction negatively.

6. Fieldwork in *G. elegans* wild population has allowed the rediscovery of
another rare tree in the area (*Erythrina eggersii*).

7. All feral honeybees in Puerto Rico are Africanized.

8. Africanized honey bees in Puerto Rico are not "killers", they demonstrate
lower defensiveness, similar to European honey bees, probably a result
of trade-off between food acquisition in a situation of limited resources (an island) and defensiveness.

9. Africanized honeybees in Puerto Rico are maternally of African decent but do have high genomic contribution from European bees. **These combinations of results suggest that invasive species may change in the places they enter and also they may be beneficial in preserving native species, a result contradicting the paradigm of exotic species being deleterious to native species.**

**Multimodality studies**

1. Forest fragmentation, and more broadly speaking land-cover and land use-change, can have a profound impact on the development of organisms to yield variable phenotypes. This has profound implications for the evolutionary ecology of organisms in increasingly modified habitats.

**II.3. Educational and human resource related accomplishments**

All CREST-CATEC activities are geared towards the development of human resources in science at the postdoctoral, graduate, undergraduate, and pre-college levels. As the Center is based in Puerto Rico, a predominantly Hispanic region and in a predominantly Hispanic university system, all our efforts will benefit this group.

**OUTREACH ACTIVITIES**

Outreach activities are varied and go from k-12 school presentations, talks in community societies, presentations at other universities, participation as judges in k-12 science fairs, etc. We recognize that outreach is being done mostly on an individual basis, as the ESAC report pointed out. We will develop concerted efforts by the whole group, and incorporate the outreach office of the university to further our objectives in this area.
• Dr. Elvira Cuevas was participant professor in the ALACIMA summer program where university students majoring in science education carry out research during two summer months. Ms Yanci Rivera worked along with PhD student María Fernanda Barberena in sampling, separation and identification of soil arthropods.

• Dr. Elvira Cuevas is a member of the Masters’ thesis committee of Betzaida Ortiz, a graduate student from the Graduate School of Education of UPR-Rio Piedras. This collaboration is part of the intra campus interdisciplinary development that is part of the objectives of CREST-CATEC. Ms. Ortiz is working in developing study plans in ecology and ecosystem function for home-schooled children.

• Dr. Cuevas was also the Keynote speaker on August 23, 2005 at the Rotary Club, Rio Piedras chapter where she presented “Mangroves, their biology, distribution and the ecosystem services they can provide”.

• Dr. Cuevas, E. was invited to present the talk “Global climate change and the karst ecosystems of Puerto Rico” in the activity Planet Earth Week at Universidad del Este, Carolina, PR. April 24, 2006.

• Dr. Cuevas was invited to give talk in the Wetland symposium of the Eco-environmental Society, and association of students from the Environmental program in UPR, Rio Piedras. She presented a talk on Mangroves, their biology, distribution and the ecosystem services they can provide”. 15 February 2006.

• Dr. Jorge Ortiz is research mentor of ITES REU Program. An undergraduate student was mentored last summer to study the application of Rapid Bioassessment Protocols in Puerto Rican rivers. He is currently starting to mentor another student to study light-photosynthesis relationships in a rainforest river.

• Dr. Jorge Ortiz was a judge in the Science Fair, San Juan Archdioceses. March 2006.
• Dr. Jorge Ortiz presented the lecture “Water Resources in Puerto Rico” at the Juan Ponce de Leon School Environmental Research Center in the town of Florida PR. November 2005.

• Dr. Jorge Ortiz gave a presentation on “The Aquatic Ecosystems of El Yunque” Parkville School, Guaynabo, Puerto Rico. March 2006.

• Dr. Jorge Ortiz participated in the Boy Scouts of America Nature Patrol Training Program, Guajataca Camp-May 2006.

• Dr. Jorge Ortiz: gave the presentation "Limnology, water and Guajataca" to the Boys Scouts of America Summer Camp in Guajataca PR. Summer 2005


• Dr. Cuevas gave a talk to sixth grade students at Escuela Cristo Rey, Rio Piedras on: What are mangroves ecosystems and why are they important? October, 2005

• Dr. Eugenio Santiago offered four workshops to high school students, in coordination with the PR-LS-AMP program. Two were given in the fall of 2005 and spring on 2006. The workshops focused on career opportunities in the Life Sciences, and available study programs offered at UPR. The public schools impacted were Dr. Carlos González in Aguada, Josefina León in Jayuya, Luis Muñoz Rivera in Utuado and Marcelino Rodríguez in Moca.

• Dr. Eugenio Santiago was participant professor in the ALACIMA summer program where university students majoring in science education carry out research during two summer months. Mr. Wilmer Rivera worked in the floral morphology of two species of Tabebuia.

• Dr. Eugenio Santiago participated in the Program Recreational Enhancement Opportunities for Disabled Citizens at the San Patricio Urban Forest in San Juan, PR. He gave a hands-on workshop to
physically challenged children on the local flora of the urban forest. 11 June 2005.

- Dr. Eugenio Santiago's graduate student Marcos Caraballo was the keynote speaker in the inauguration of the ALACIMA center in the public school Ricardo Arroyo Laracuente in Dorado, PR. Mr. Caraballo gave a presentation on "The flora of the karst region of Northern Puerto Rico". 28 January 2006.

- Dr. Eugenio Santiago gave a presentation for the general public entitled "Origin of the flora of Vieques Island" as part of the traveling exhibition "Vieques Island: a 100 million years of natural history". This activity was sponsored by the Conservation Trust of Puerto Rico. José M. Lázaro Library, University of Puerto Rico, Río Piedras Campus. 16th March 2006.


- Dr. Eugenio Santiago gave a radio interview for the UPR radio station (WRTU, 89.7). Program: Agenda de Hoy, subject: The Botanical Garden of the University of Puerto Rico; date aired: Feb-2006, location: UPR radio station. host/coordinator: Norma Valle.

- Dr. Eugenio Santiago gave a radio interview for UPR radio station (WRTU, 89.7). Program: Hilando Fino, subject: Presentation of the exhibition by the Conservation Trust of Puerto Rico entitled “Vieques Island: a 100
II.4 Development of human resources

CREST-CATEC subsidized researchers, and graduate and undergraduate students presentations in Congresses and symposia. We also supported student’s attendance to short courses in which they train in methodology related to their research fields. We also provided financial support for visiting researchers that have presented seminars, conferences, short courses, participated in symposia, and established interactions for possible collaborations with members of CREST-CATEC. The effort has been highly successful with and increased attendance and presentations of both graduate and undergraduate students and researchers and in Congresses and Symposia.

CREST-CATEC provided support for the following activities:

a) Partial or total subsidies for nine undergraduate students to attend and make presentations in national meetings.
b) Partial or total subsidies for seven graduate students for presentations in congresses and symposia
c) Partial subsidies for seven graduate students to participate in national and international courses.
d) Seven research fellows presented their research findings in congresses and symposia both nationally and internationally.
e) Subsidized 4 visiting researchers that provided seminars, conferences, short courses, participated in students’ graduate committee meetings and established interactions for possible collaborations with members of CREST-CATEC.
f) CREST-CATEC also fostered graduate student research by providing research grants based on the relevance and merit of their proposed research.
Thrust area 1:

- Xaymara Serrano - Received her Bachelor’s degree. Accepted for graduate studies in marine sciences at the University of South Florida
- Willy Ramos Pérez - Summer 2005 internship at John Hopkins School of Medicine, MD
- Kareem Nieves - Received her Bachelor’s degree from UPR - Humacao
- José Velazquez Castro - Received her Bachelor’s degree from UPR - Humacao. He is now in graduate school at UPR - Rio Piedras
- Rafael Benítez - Received her Bachelor’s degree from UPR - Humacao. He is now in graduate school at UPR - Rio Piedras
- Vilmaliz Rodríguez Guzmán - Received her Bachelor’s degree from UPR - Humacao.
- María Agosto - Received her Bachelor’s degree from UPR - Humacao.
- Sarilveth Flecha - Received her Bachelor’s degree from UPR - Humacao.
- Noel Rivera Gómez - Received her Bachelor’s degree from UPR - Humacao.
- Francescika Ruiz - Received her Bachelor’s degree from UPR - Humacao.

Thrust area 2:

- Bert Rivera Marchand - Received his PhD. Hired as Assistant professor at the Interamerican University in Bayamón, Puerto Rico
- Paulina Calle - Received her Bachelor’s degree in Environmental Sciences from UPR Rio Piedras. She is doing an internship at the Conservation Research Center NZP-Smithsonian in Virginia.
- Alma Martínez - Received her Bachelor’s degree in Environmental Sciences from UPR Rio Piedras

Thrust area 3:

- Ling Xu) - Ph.D. student from UNM (graduated in June 2005). She is now an Assistant Professor at James Madison University
- Johanna Delgado-Acevedo - completed her MSC in December 2005. She is already working towards her Ph.D. at the Caesar Kleberg Wildlife Research Instute at Texas A&M-Kingsville
• Xiomara Sánchez - obtained bachelor’s degree in UPR-Rio Piedras. She was accepted at Bayamón School of Medicine, Universidad Central del Caribe, Puerto Rico

Thrust area 4.

• Arleen Vera - Received her Bachelor’s degree in Environmental Sciences from UPR Rio Piedras. Graduated with honors.

• Madeline Collazo - Received her Bachelor’s degree in Environmental Sciences from UPR Rio Piedras. Graduated with honors.

II.5 Curriculum Development:

- GIS-Conservation Course. In collaboration with Smithsonian National Zoological park -Conservation Research Center, Front Royal, Va. CREST PI’s (E. Cuevas, E. Melendez-Ackerman and D. Fernandez). As part of the course, there were two follow-up workshops with the students, November 2005 and May 2006, to evaluate the progress of the use GIS on their theses.

Dr. Denny Fernández is part of the Wildlife Management program in UPR-Humacao and teaches regularly General Ecology, Community Ecology and Plant Systematic for undergraduates.

Dr. Elvia Melendez-Ackerman teaches regularly General Ecology at UPR-Rio Piedras. Both PIs have been incorporating in his courses information on the background, design and results of this project. Dr. Melendez-Ackerman has also mentored graduate students through a graduate course called Rotation (Biol 8700) a two credit course were students spend one semester in a lab to learn new research techniques. Students do taxonomy work on Mona Island plant and insect collections learning curatorial and photographic techniques and working on the digitization of specimens.

Dr. Jorge Ortiz - taught an undergraduate course in Aquatic Resources (CINA 4157). Twenty-one students were exposed to the theoretical aspects of limnological research with emphasis on structure and function of
freshwater tropical ecosystems. The class included field trips to a hydrologic stream gage station, to several water intake structures and dams, and a visit to the Fajardo Regional Wastewater Treatment Plant. The course was developed using Blackboard as an electronic information dissemination tool among students.

Dr. Jorge Ortiz is a research mentor of ITES REU Program. An undergraduate student was mentored last summer to study the application of Rapid Bioassessment Protocols in Puerto Rican rivers. He is currently mentoring another student to study light-photosynthesis relationships in a rainforest river.

Dr. Elvira Cuevas taught Biol 3111 - Principles of Ecology, One of the objectives of the course is to explain the principles of ecology in a way that students can understand how these principles are ingrained in every aspect of life, and how important learning and applying them can be. She taught the class along with Nick Brokaw and Alonso Ramírez and also coordinated it in the second semester with 140 students of which 121 finished the course.

Dr. Elvira Cuevas also taught Biol 6995 - Structure and Function of Tropical Ecosystems whose main objective is for students to understand the integrated aspects of ecology, and how specific processes can direct ecosystem response at various hierarchical levels. The course had nine graduate students.

Dr. Elvira Cuevas has also been mentoring students via the undergraduate course Biol 4990 - Experiences in Research. Two students reviewed the role of ENSO in Puerto Rico and the Caribbean and the role of climate variability in vector diseases such as malaria. Eight students participated in research related to the role of tree species in soil arthropod dynamics.

Dr. Denny Fernandez collaborates as mentor of the NSF-ADVANCE Institutional Transformation program in UPR-Humacao. The program promotes the
participation and advancement of women in the natural and social sciences.

Dr. Fernandez is a Science and Mathematics Faculty Mentor for the McNair program at UPR-Humacao. The program helps students from first generation/low income families to continue studies at the doctoral level.

Laboratory Open House - E. Melendez-Ackerman participated in the annual open house activity sponsored by the Faculty of Natural Sciences that is designed to introduce early undergraduates to research in science. A total of 15 students visited the lab and talked to Dr. Meléndez-Ackerman and participating project staff about the Mona Project.

II. 6. Awards

RESEARCH FELLOWS:

Jorge Ortiz PI - Teaching Ecosystem Complexity. National Science Foundation.

  This project will develop ecological education materials to improve ecology education in schools. It will be based on information generated in the LTER Program. The University of Puerto Rico, in addition to provide support in the development of material related to climate in tropical forests, will assist in translation to Spanish all the didactic material developed. $145,000

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

Tugrul Giray - Muscle and behavioral development integration in the bee. NIH-SCORE. $389,000

  Behavioral Comparison of Anatolian Bee Races. Middle East Technical University-Ankara/Turkey. $25,000

Denny Fernández - Co-PI and Lillian Casillas (PI), UPR-Humacao.
   Instrumentation Grant. Department of Defense. $200,000

Miguel García - PR-Big Game Study. US Fish and Wildlife and Pitman-Robertson. $15,000

Alonso Ramírez - E. Melendez-Ackerman, Xioaming Zou, Jorge Ortiz, Nick Brokaw, James Ackerman (Co-PI’s) Research Experience for Undergraduates in Tropical ecology and Evolution at the El Verde Field Station. $338,164

Raymond Tremblay - Production and growth of seeds the orchid Lepanthes caritensis. Arizona Orchid Society. $5,000

Owen McMillan - An evolutionary database for Heliconiaceae, NSF, through the National Evolutionary Synthesis Center (NEScent) ($35,000)

STUDENTS:

Bert Rivera-Marchand - received in December 2005 the Robert Laurus Award in the First Congress of the American Association for the Advancement of Science Caribbean Division, for the best student scientific presentation. First CREST-CATEC sponsored Hispanic PhD graduate at the University of Puerto Rico, Rio Piedras. Dr. Rivera-Marchand is being hired in a tenure-track position as Assistant Professor at the Interamerican University, Bayamón campus in Puerto Rico.

Ivania Cerón - PhD student. Received the Alliance for Graduate Education and the Professoriate Pre-doctoral Fellowship (AGEP) for her research on Herato butterflies ($20,000). She also received a Smithsonian Short Term Fellowship ($6,000)
Néstor Pérez - PhD student. International Iguana Foundation. Co-PI with Dr. McMillan and Dr. Funk received a small grant for the development of a cost-efficient and effective monitoring program for the Mona iguana population ($5,000). Obtained a fellowship to participate the a GIS-Conservation course sponsored by a CRC-Smithsonian Fellowship and CREST-CATEC.

Rodney Rodriguez - Master’s student. Awarded a José M. Berrocal Fellowship for Environmental Studies-Ford Foundation and a travel award from the Society for Conservation Biology to present his work during their annual meeting in June, 2006

María Fernanda Barberena-Arias - Who’s who among students in American Universities and Colleges for the Academic year of 2005-2006. Obtained fellowship to participate in the GIS-Conservation course sponsored by a CRC-Smithsonian Fellowship and CREST-CATEC.

Elsie Rivera-Ocasio - PhD student. Received the Alliance for Graduate Education and the Professoriate Pre-doctoral Fellowship (AGEP) - August 2004-July 2005

José Fumero - Obtained fellowships to participate in the GIS-Conservation course sponsored by a CRC-Smithsonian Fellowship and CREST-CATEC.

Chamary Fuentes - Obtained fellowships to participate in the GIS-Conservation course sponsored by a CRC-Smithsonian Fellowship and CREST-CATEC.

Colibrí Sanfiorenzo - She was selected to participate in the SEEDS program sponsored by the Ecological Society of America. This program will fund her to develop an independent research project under the guidance of Dr. Luis Garcia Berrios, Neptali Ramirez-Marcial and Elvia Melendez-Ackerman. Here research proposal titled Bringing together conservation, community and agriculture: Assessing Possibilities for a Novel Agroforestry systems at the Los Angeles
community in La Sepultura Biosphere Reserve, Chiapas México has an approved budget of $6,700

Julianna Rodríguez - Was invited to participate in the 2005 meeting of the Ecological Society of America, in Montreal, Canada, as part of being accepted in the SEEDS program of ESA.

Ana María Noriega - Received a Competitive Scholarship Award from the Western Alliance to Expand Student Opportunities to attend and present a poster of her research work at the MGE@MSA/WAESO Conference (Minority Graduate Education-Western Alliance to Expand Student Opportunities) held in March, 2006 in Arizona State University, Tempe, Arizona

Vanessa Rodríguez - Was accepted to participate in the REU Summer Internship Program at RMBL Colorado.

Sara Rivera - Received a Competitive Scholarship Award from the Western Alliance to Expand Student Opportunities to attend and present a poster of her research work at the MGE@MSA/WAESO Conference (Minority Graduate Education-Western Alliance to Expand Student Opportunities) held in March, 2006 in Arizona State University, Tempe, Arizona.

II.6. Summary of minutes of external advisory group meetings:

Executive Board

In April 2005 the Executive Board Committee was established. Two meetings have already been held: one in August 2005 and the other in February 2006. The Executive Board is cognizant of the development of the Center, the results of the reverse site visit and the concerns established there. They are very pleased with the development of the center, and the commitment of the Dean of Natural Sciences, Dr. Brad Weiner, to follow-up on the commitment of reverting 18.75% of the matching funds to the Center. They also stressed the need to find a way to improve the administrative support of the university system to the center. The Board made an evaluation of the Center areas and pointed the strengths and
weaknesses that needed to be acted upon, and mandated the Director to comply with the recommendations of the External Scientific Advisory Committee.

**ESAC report**

The External Scientific Advisory Committee (ESAC) for CREST-CATEC met during March 31 and April 1, 2006 at the CREST-Center for Applied Tropical Ecology and Conservation (CATEC) located at the University of Puerto Rico – Rio Piedras, San Juan, Puerto Rico. On Friday March 31, the committee members visited various field facilities and laboratories at UPR-Rio Piedras as well as at partnering institutions. The center administration, faculty, staff and students provided a detailed overview of research projects and significant accomplishments during a day-long symposium on Saturday, April 1, 2006. The committee subsequently met following the symposium to deliberate on the progress and accomplishments of CREST-CATEC at UPR-Rio Piedras Campus. The overall assessment of CREST-CATEC at UPR-PR followed the People, Ideas-Tools, and Organizational Excellence (PITO) assessment model of NSF.

The committee provided the following overall comments during its assessment of the center capabilities -

1. CREST-CATEC provides a breadth of research in relevant areas.
2. Diverse opportunities for technical training are available to a wide diversity of students.
3. We observed an intense level of participation by all levels of students at partnering institutions
4. Director (Dr. Elvira Cuevas) has vision and motivation. She provides unselfish contribution and is desirous of significant changes within the institution.
5. Partnerships and collaborations with agencies, NGOs and other scientific research entities are strong and highly integrated with research goals.
6. Mona Island program is an excellent model for synthesis of research findings and applications in the field of ecology, evolution, wildlife
management, and conservation.

**PEOPLE**

**Strengths:**

- Students are aware of research and funding opportunities and are using these very well.
- Faculty members, researchers, graduate and undergraduate students at the main campus and at the UPR-Humacao campus were extremely motivated.
- We observed a high degree of collaboration between faculty members in most of the thrust areas.
- The center has dedicated faculty and staff.
- Good morale amongst the faculty, staff and students with respect to the center and its role in research.
- Recognition of the role of the center towards faculty development and for facilitating research opportunities.
- Strong leadership that ensures fair distribution of resources within the center.

**Concerns:**

- Heavy teaching load at branch campuses can be an impediment to continued research successes.
- Faculty expressed frustration regarding poor institutional support and commitment to the center.
- Full time dedicated technicians are needed for several core facilities supporting various center research initiatives.

**Weaknesses:**

- None

**Recommendations:**

- Provide teaching release for faculty at UPR-Humacao and for the Center Director.
- Increase institutional support and visibility of the center by the university administration.
Hire technicians to support labs and field facilities.

**IDEAS**

**Strengths:**
- Multi-disciplinary research was noted throughout the center.
- Most thrust areas are serving in a catalytic role to foster inter-disciplinary research.
- Strong faculty publications in peer-reviewed journals.
- Good track record of faculty, researcher and student presentations at various conferences.
- Collaboration between the Center and government agencies such as the Commonwealth Department of Natural Resources and the Environment and the USDA Forest Service.

**Concerns**
- Broader goals of the landscape ecology group have not been met, in particular the contributions of tools and techniques to study tropical landscapes beyond limited research agenda.
- A lack of cross-scale interactions as well as a lack of consistency in the quality of questions asked and hypothesis development, particularly, within the Landscape Ecology thrust area was noted.
- There were limited publications in peer-reviewed literature by student authors overall within the center.

**Weaknesses:**
- A disassociation of research was noted between the Landscape Ecology thrust area and other thrust areas within the center.

**Recommendations:**
- Center should articulate its applications and its vision for conservation should consistently be stated by faculty and students alike.
- Should increase peer-reviewed archival publications within the center using student authors.
- Center leadership should revisit the need and relevance of the landscape
ecology thrust area in a broader context.
De-emphasize landscape ecology as currently performed, and focus instead on ecosystem ecology and ecosystem processes as a better way to integrate the various research areas within the Center.

TOOLS
Strengths:
The availability of core multi-investigator facilities and centers within CREST-CATEC such as the molecular laboratory and technicians, herbarium, and informatics facilities.
A good web presence for the center.

Concerns:
Need for a centralized facility within the institution for GIS applications.

Weaknesses:
None

Recommendations:
The institution should commit to the development of a core GIS facility for utilization by center faculty, staff, and students alike.

ORGANIZATIONAL EXCELLENCE
Strengths:
The center is a catalytic agent in dealing with the university bureaucracy and improving efficiency while facilitating research.
The center is a model for other centers within the university system.

Concerns:
Lack of significant linkages with other Caribbean research programs.
University support of research faculty and development is limited. For example, the university has not yet provided the director of the center with a research laboratory.
Delays in receiving support from the institution for establishing other labs and infrastructure in a timely fashion for center use was noted.
The presence of bureaucratic inefficiencies and lack of trust of faculty and staff by the university administration was relayed to the committee.

Governance: Leadership team comprised of PI and Co-PIs should meet more frequently and make joint decisions that impact the center.

Scientific interaction: Definite need for improving communication amongst the PIs. The research groups and investigators should meet periodically, at least once in two months, to review research progress and center activities.

Needs public stakeholder group input to the center’s outreach and research initiative.

Limited and lopsided outreach program within the center.

The center research should be disseminated widely.

Full time dedicated technicians needed for several core facilities.

**Weaknesses:**
None

**Recommendations:**

Continue to host regular annual symposium and the external scientific advisory committee meetings.

Invite the public stakeholder to the annual conferences/symposium.

The center should hire an outreach coordinator.

### III. Publication and Products
Submitted directly VIA CREST-WEB

### IV. 1-3. Development of human resources
Submitted directly VIA CREST-WEB
### IV.4. Summary table of NSF support by thrust area and other activities

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During the reporting year 73% of CREST funds were spent or obligated, leaving 27% to remain un-obligated at the end of the current year. Participant support costs from year 1-4 were redistributed for travel, lodging, subsistence costs and materials for students as authorized by Dr. Santiago, CREST Program Officer. We did not use the authorized amount in its totality. It is projected in year five for the same objective. Non-federal matching funds were almost totally spent, leaving 9% to remain un-obligated for the following year.
IV.4 Level of complementary support for this year from collaborating institutions: estimated dollar equivalent

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The complementary support this year that triples the amount of the CREST is an indicator of the increased effectiveness of the Center in leveraging funds from other sources.

The total budget for the upcoming year remains as was specified in the proposal. Following the recommendations of the External Scientific Evaluation Committee, we proceeded with a programmatic restructuring of the Landscape Ecology thrust area to enhance the current training and research areas of the Center.