

**VIRGIN ISLANDS EPSCOR
RESEARCH INFRASTRUCTURE IMPROVEMENT AWARD
FINAL REPORT**

A. Executive Summary

Vision

VI-EPSCoR's vision is to develop the territory's scientific capacity in support of economic development by drawing upon and strengthening the territory's physical and human resources by 1) integrating investments in capacity for marine and environmental research, policy and decision-making, education, and outreach, and 2) enhancing partnerships between researchers and policy and decision makers, educators, and the broader community—in order to address marine and environmental issues of vital importance to a healthy and sustainable future for the territory.

Brief report component descriptions

Research efforts

VI-EPSCoR provided grants for incubator research that significantly expanded the scope and breadth of research on Virgin Islands coral reef ecosystems. Over the course of the first RII grant, 17 funded incubator projects provided insights for addressing more comprehensive research questions in the areas of biodiversity, ecology and coastal oceanography. The VI-EPSCoR incubator grants program stimulated a significant increase in the number (33) of research proposals submitted to NSF and other agencies in the first grant, including many in collaboration with researchers at other universities and government agencies. Of these proposals, 16 have been funded with another 3 still pending.

Research during the first RII grant focused on several major thrusts including evolutionary and ecological patterns and processes. Examples of studies include assessing human impacts on reef fish communities and their reproductive ecology, identifying effective protection strategies necessary for enhancing local fisheries, and identifying the impacts of global climate patterns on coral bleaching. Another major thrust targeted ocean and coastal phenomena surrounding the US Virgin Islands with the goal of developing useful ocean circulation models to test new hypotheses. An important new focus was examining variations in population connectivity within marine systems and their importance to marine resource management. A key development of VI-EPSCoR's self-assessment in the latter half of the first RII grant was the identification of critical gaps in research: the influence of the oceanography and the land-sea interface. The next RII grant will therefore integrate an understanding of the influences of biotic, physical and human interactions in coastal ecosystems and the oceanographic and climatic forcing functions on coral reef ecosystems.

Diversity and Workforce Development

The US Virgin Islands is unique among EPSCoR jurisdictions, in that 89% of US Virgin Islands residents are non-white. The Virgin Islands EPSCoR program is housed at a member of the Historically Black Colleges and Universities (HBCUs), the University of the Virgin Islands. At the University, minority students make up 77% of the students in the Division of Science and Mathematics, and 75% of the Division's students are women. The University and VI-EPSCoR are committed to increasing the participation of nationally-underrepresented minorities in STEM research and education through investments in the University's STEM research and education programs. 46 UVI undergraduate researchers participated in VI-EPSCoR incubator projects, many of them funded by other federal grants, including the National Institutes of Health Minority Biomedical Research Support-Research Initiative for Scientific Enhancement and Minority Access to Research Centers. VI-EPSCoR supported the development of a master's degree in mathematics at UVI for local high school teachers, as well as the development of a new master's degree in marine and environmental science that provides Virgin Islanders with post-graduate education and local scientific career opportunities.

Cyberinfrastructure

VI-EPSCoR has worked with UVI Information Technology Services (ITS) on infrastructure investments to strengthen the university environment for research. VI-EPSCoR goals for cyberinfrastructure improvements at UVI include improvement of intranet and Internet capacity, establishment of DS3 connectivity to the Internet, and ultimately the acquisition of Internet2. With VI-EPSCoR assistance, UVI undertook significant planning efforts during the RII grant and made major investments to upgrade the basic network infrastructure. To prepare for the increase in network capacity, greater speed, and eventual increase in usage expected with access to Internet2, UVI made significant upgrades to the technology infrastructure of the University. A major challenge has been upgrading the University's bandwidth to provide faculty, staff and student access to high-speed, reliable networking. VI-EPSCoR also worked with ITS to support transitional solutions for increased bandwidth, while developing and implementing plans to deliver DS3 connectivity and Internet2 to both campuses.

Outreach and Communication

Through the creation of professional and community partnerships, education, and outreach activities, VI-EPSCoR has become an integral resource in the Virgin Islands for scientific research and education related to the BCCR research thrust. VI-EPSCoR supported and participated in a variety of professional and educational events in the Virgin Islands to promote partnerships and build collaborations with key local government agencies and private organizations. VI-EPSCoR also hosted a number of workshops and seminars that hosted a wide range of research scientists from other universities and research organizations who presented research on marine and environmental issues. VI-EPSCoR has also used its website, regular newsletter, local radio and television, and local print media to expand its outreach locally and beyond.

Management Structure

The VI-EPSCoR management structure consists of the Project Management Team, a Governing Committee with territory-wide representation, a Research Advisory Board for the thrust on Biocomplexity of Caribbean Coral Reefs, and an Education Advisory Board for K-12 STEM education.

Evaluation and Assessment

Major accomplishments have been achieved within the BCCR research focus area. Improvements to the overall research infrastructure, especially in terms of intellectual resources and facilities, have facilitated the development of new programs, significant research projects, and valuable partnerships. Progress within the BCCR research thrust has been significant, especially considering that UVI is primarily a teaching institution.

Key accomplishments

One of the key accomplishments has been the development of faculty research potential and integration of faculty research interests into the BCCR program's central theme. 17 UVI science faculty have been funded on at least one (or more) VI-EPSCoR incubator research projects, a five-fold increase in the number of faculty involved in research prior to VI-EPSCoR investments.

Another key accomplishment relevant to research was that VI-EPSCoR further increased capacity by providing start-up funds for new faculty hires for marine natural products, for marine mammal research, and for watershed processes, hiring a new research faculty position in biological oceanography and securing a post-doctoral scholar to augment research in coral genetics. Other funding by NOAA and NIH allowed UVI's Center for Marine and Environmental Studies to hire a new research faculty member to expand research on corals and a post-doctoral scholar to support lobster behavioral studies, respectively. Several of these research accomplishments were the result of VI-EPSCoR efforts to foster new collaborations and partnerships between UVI and numerous other universities, territorial and federal agencies, and NGO's. These partnerships enable the flow of fresh ideas between local and off-island researchers and policy-makers.

Some specific research accomplishments to date include significant progress in understanding coral reef function under variable levels of stress, evaluating the role of marine protected areas in rebuilding commercially important grouper populations, and identifying linkages between biological patterns and oceanographic processes that enhance predictability and management of fishery resources. The foundation for a Center of Excellence in marine and environmental science has been strengthened through VI-EPSCoR funding initiatives. The result was that 33 research grant proposals were submitted, with 16 of them funded for just over \$2 million in additional external funding. With this foundation VI-EPSCoR will continue to build strong and sustainable externally-funded research programs.

One of our most noteworthy accomplishments was the effective integration of research and education through the participation of 46 undergraduate students in research. This coupled with VI-EPSCoR being instrumental in the establishment of two new Master's programs in Marine and Environmental Sciences and in Mathematics for Secondary School Teachers

stand as truly tangible foundations for our new RII grant.

Intellectual Merit

Improvements to the overall research infrastructure, especially in terms of intellectual resources and facilities, have facilitated the development of new programs, significant research projects, and valuable partnerships. Progress within the BCCR research thrust has been significant, especially when one considers that UVI is primarily a teaching institution. Some key research results to date include significant progress in understanding coral reef function under variable levels of stress, evaluating the role of marine protected areas in rebuilding commercially important grouper populations, and identifying linkages between biological patterns and oceanographic processes that enhance predictability and management of fishery resources.

Broader Impacts

The BCCR program of research has built a foundation for greater research competitiveness in the Virgin Islands in marine and environmental sciences that will provide scientific support to local decision-makers in natural resource management. The VI-EPSCoR program supported training in STEM disciplines for students, many of whom are under-represented minorities and women, at both the undergraduate and graduate level. VI-EPSCoR developed the first two STEM graduate programs at UVI and created significant research opportunities for UVI faculty and undergraduates.

Response to issues raised in reverse site visit Sept 2007

Promoting outside linkages and collaborations

In the first grant VI-EPSCoR incubator grants provided strong incentives for collaboration between UVI faculty and other Virgin Islands research entities and with outside researchers. Such collaborations are critical to furthering our research competitiveness and long-term sustainability, given that we are a small primarily undergraduate teaching institution. A new visiting scholar program will bring faculty on sabbatical to UVI to develop research collaborations. Details of plans in the new grant are provided in the Collaborators section of the report.

Faculty recruitment and retention

Faculty recruitment and retention is an important challenge to sustaining a high level of faculty involvement in research. The five new VI-EPSCoR faculty positions to be recruited in the new grant will dramatically reduce the pressure on DSM faculty to teach so many classes, and will increase the University's ability to grant release time for research for both existing and new faculty. VI-EPSCoR will also offer start-up / incubator funds and release time for new and existing faculty on a competitive basis.

Broadening participation

One important diversity issue to be addressed is the lack of minority and Virgin Islands STEM faculty at UVI. In the next grant, efforts to improve faculty recruitment and retention will include targeted efforts to recruit minority and Virgin Islands faculty. VI-EPSCoR will also work with the UVI Emerging Caribbean Scientists program to strengthen linkages to NSF and other federal programs focused on increasing diversity of STEM students and faculty. Details of plans in the new grant are provided in the Broadening Participation section of this report.

Continuing improvement of connectivity issues

VI-EPSCoR will continue to aggressively support improvements to Internet2 and intra-island connectivity issues. Details of plans in the new grant are provided in the Cyberinfrastructure section of this report.

Program Evaluation

In the first RII grant, our program evaluation was not as fully developed and implemented as we would have liked. A new evaluation team will be recruited for the next RII grant.

B. Detailed Report

1. RII participants and participating institutions

This information may be found in FastLane and Appendix A.

2. Program/Project Description.

Research Accomplishments

The VI-EPSCoR incubator grants program has stimulated growth in research related to the BCCR research thrust. VI-EPSCoR investments have led to growth in the scope and breadth of coral reef research and in the volume of proposals for external research funding.

VI-EPSCoR has provided grants for incubator research that have significantly expanded the scope and breadth of research on Virgin Islands coral reef ecosystems.

In the first RII grant, VI-EPSCoR has funded 17 incubator research projects related to the BCCR research. Initial research was conducted by individual faculty researchers working independently within the focal areas on biodiversity, ecology, and coastal oceanography. As the research thrust has matured, incubator projects have provided insights for addressing more comprehensive research questions. Increasingly VI-EPSCoR researchers are working in interdisciplinary teams to address broader research. The incubator studies have led to a number of exciting new collaborations with external partners. The VI-EPSCoR incubator grants program has stimulated a significant increase in the number (33) of research proposals submitted to NSF and other agencies in the first grant, including many in collaboration with researchers at other universities and government agencies. Of these proposals, 16 have been funded with another 3 still pending.

VI-EPSCoR has an increasingly diverse portfolio of research related to the BCCR research thrust. In the first RII grant, VI-EPSCoR funding supported new research in genetics (Molecular phylogenetic analysis of Virgin Islands *Porites*, Genetic diversity of long-spined sea-urchins, Metabolic markers for bleaching in *Porites*), oceanography (Coastal oceanography, Data mining to analyze Caribbean oceanographic data, Mesoscale weather modeling, Integrating the effects of watershed activity patterns and coastal processes on near-shore coral reefs, Development of a regional tsunami warning system), ecosystem dynamics (Assessment of relationship between habitat and parasite infestation in reef fishes, Influence of coastal current patterns on disease susceptibility and connectivity of endangered coral *Porites*), and marine natural products (Novel anticancer metabolites from marine sponges, Biological interactions at the surface of advanced fouling-release marine coatings). VI-EPSCoR funding of key instrumentation has supported a number of important applied research projects including a study of grouper spawning aggregations, evaluation of marine protected areas as a management tool, assessment and monitoring of coral reefs and fish populations in the Virgin Islands, and measuring the effects of physical oceanographic parameters and land based erosion on patterns of coral disease, bleaching and mortality.

Research in evolutionary and ecological patterns and processes during the first RII grant has greatly advanced our knowledge in several key areas including 1) the effectiveness of marine protected areas for protecting spawning aggregations and enhancing local fisheries, 2) the direct and indirect effects of sedimentation on coral reef condition, 3) the impacts of global climate patterns on coral bleaching, 4) using molecular tools to understand the biodiversity of scleractinian corals, 5) diversity of symbiotic relationships among sea anemones, crustaceans and reef fishes, 6) the role of genetic diversity of *Acropora palmata* coral on its susceptibility to disease, 7) the functional relationship between grazing of *Diadema* urchins and algal abundance, and 8) testing the relationship between habitat quality on parasite load on reef fishes. These projects were enhanced through collaborative relationships with experts from local, national and international institutions and agencies, and have supported the training of post-doctoral associates and undergraduate students.

VI-EPSCoR funded research has also made great strides in revealing ocean and coastal phenomena surrounding the US Virgin Islands (Idrisi et al. in prep). The first RII also provided the means and resources to establishing significant partnerships for building an integrated ocean observing system for the wider Caribbean and began developing powerful ocean circulation models to test new and exciting hypotheses. Considerable research effort throughout marine systems is currently focused on examining variations in population connectivity and their importance to marine resource management (Cowen et al. 2006). In fluid ocean environments the two primary components driving connectivity are current patterns and animal behavior. Caribbean-specific studies have shown the complex nature of physical structure within the region (Corredor et al. 2004, Johns et al. 2002, Fratantoni et al. 1995). Recent empirical studies on living systems have realized the value of incorporating more comprehensive physical ocean dynamic modeling (Swearer et al. 1999) including the role the internal ocean climate has on recruitment patterns (Broitman et al. 2005). For example, the spatial and temporal patterns of larval dispersal of marine fishes and invertebrates are important for determining levels of connectivity among reefs and degrees of self-recruitment, planning networks of marine protected areas and for conservation of biodiversity (Palumbi 2003). However, most of these patterns and processes remain poorly understood, and this will continue as a major research focus in the next RII grant.

A key development of VI-EPSCoR's self-assessment program in the latter half of the first RII grant was the identification of a critical gap in the research thrust on biotic, physical and human interactions in coastal ecosystems and the underlying importance of socio-economics on successful natural resource management. VI-EPSCoR supported several incubator projects examining the influence of the land-sea interface on coral reef function in 2006 and 2007. The preliminary results have generated new ideas and considerable interest and excitement from potential collaborators at other universities and in local and federal agencies, and show great promise to be highly successful in the next RII grant. A new Environmental Analysis and Management team will facilitate communication among the components of the multi-disciplinary research theme to process, analyze and interpret information across systems and scales necessary in island ecosystems research.

Considerable progress was made in the first RII grant in establishing significant partnerships. As research progresses in the next RII grant, and scientists gain a better understanding of basic patterns and processes within their areas of expertise, multi-disciplinary teams will evolve to address more sophisticated and complex hypotheses. For example, work on the

spatial and temporal dynamics and behavior of spawning groupers has raised intriguing questions related to the importance of specific spawning aggregation sites to reproductive success. A basic understanding of this system has allowed ecologists to collaborate with oceanographers, larval biologists, geneticists and mathematicians to address new hypotheses regarding population connectivity and integrity of trophic food webs, develop models of larval transport and successfully compete for multi-disciplinary research grants (i.e. USGS partnership program).

The first RII grant built basic infrastructure and capacity to enable the Territory to support a growing research agenda on biocomplexity of Caribbean coral reefs (BCCR) and related ecosystems. As the BCCR research focus area developed and matured over the past four years two critical gaps in knowledge were identified within the three thematic areas: the influence of oceanography and the land-sea interface. The next RII grant will therefore integrate an understanding of the influences of biotic, physical and human interactions in coastal ecosystems and the oceanographic and climatic forcing functions on coral reef ecosystems.

Diversity and Broadening Participation, including Institutional Collaborations.

Broadening Participation

The US Virgin Islands is unique among EPSCoR jurisdictions, in that 89% of US Virgin Islands residents are non-white. The Virgin Islands EPSCoR program is the only EPSCoR program to be housed at a member of the Historically Black Colleges and Universities (HBCUs), the University of the Virgin Islands. At the University, minority students make up 77% of the students in the Division of Science and Mathematics, and 75% of the Division's students are women. The University and VI-EPSCoR are committed to increasing the participation of nationally-underrepresented minorities in STEM research and education through investments in the University's STEM research and education programs.

The VI-EPSCoR Leadership Team in the first grant was 50% African-American, 50% White; 50% female, 50% male. Faculty participants were 17% African-American, 83% White; 33% female, 67% male. Staff participants were 50% African-American, 1 Hispanic, 11/24 White; 50% female, 50% male. Student participants were 64% African-American, 4% Hispanic, 32% White; 48% female, 32% male. Advisory Board members were 53% African-American, 47% White; 44% female, 56% male.

VI-EPSCoR has collaborated with other federally funded programs to strengthen undergraduate research opportunities in STEM disciplines. 46 UVI undergraduate researchers have participated in VI-EPSCoR incubator projects, many of them funded by other federal grants, including the National Institutes of Health Minority Biomedical Research Support-Research Initiative for Scientific Enhancement and Minority Access to Research Centers. The advent of the new graduate program in marine and environmental science presents an exciting opportunity to link UVI graduate students with undergraduates in a peer

mentoring model designed to attract students from underrepresented groups to careers in marine and environmental science.

In response to an identified need arising from a reverse site visit in 2007, in the next RII grant, VI-EPSCoR will work with the Emerging Caribbean Scientists program at UVI to strengthen linkages to NSF and other programs focused on increasing diversity of STEM students and faculty. Among the programs of particular relevance are:

- **AGEP.** UVI receives funding under the AGEP program through the University of Florida's SEAGEP grant.
- **LSAMP.** UVI intends to submit a proposal to LSAMP in Fall 2009.
- **ADVANCE.** UVI is eligible to receive funding from the NSF ADVANCE program. Given UVI's STEM student demographics, and given that UVI is receiving generous funding from the NIH MARC and MBRS-RISE programs, there are no immediate plans to pursue ADVANCE funding.
- **CREST.** UVI does not currently have doctoral programs, so it is not eligible to apply for CREST funding either as a Center or under the HBCU-RISE program.
- **HBCU-UP.** UVI has a very active program funded by the NSF HBCU-UP program. This is part of UVI's Emerging Caribbean Scientist alliance, and VI-EPSCoR works closely with the program.

As mentioned elsewhere, UVI also receives generous support through the MARC and MBRS-RISE programs at NIH. Students participating in these programs have numerous opportunities to participate in research related to ICCE. VI-EPSCoR works closely with the coordinators of these programs to maximize undergraduate research opportunities, especially for students from underrepresented groups.

Institutional Collaborations

The Virgin Islands has only one institution of higher learning, the University of the Virgin Islands, which houses the Virgin Islands EPSCoR program. The University has been a primarily undergraduate teaching institution; in the first grant, VI-EPSCoR funded the development of a new UVI master's degree in marine and environmental science. The development of strong collaborations between UVI and external research universities, marine labs, federal agencies, etc. is vital to strengthening the Territory's research and teaching capacity. Equally important are strengthened partnerships between UVI and other territorial institutions involved in research and management activities related to VI-EPSCoR's research, education, and outreach focus on marine and environmental science.

VI-EPSCoR encouragement and support of UVI faculty has facilitated new collaborations with external researchers, and established stronger partnerships with federal and territorial resource management agencies. VI-EPSCoR investments in BCCR have created new opportunities for external collaborations. At the end of the first RII grant, VI-EPSCoR researchers had 84 collaborators from 39 different institutions. Institutional ties had been established with 29 academic research organizations, including two Hispanic-serving institutions (Univ. Miami and Univ. Puerto Rico, Mayaguez) and two Tribal / Native Hawaiian-

serving institutions (Univ. Hawaii and Univ. Guam). VI-EPSCoR researchers were collaborating with two national labs (Pacific Northwest National Lab and the Smithsonian) and three federal agencies (Dept. Energy, NOAA, and USGS), as well as two territorial agencies (V.I. Dept. of Planning and Natural Resources and V.I. Territorial Office of Emergency Management), and one industry group (Weber Research). Three collaborations were established with international partners (Geological Survey of Denmark and Greenland, Univ. Hong Kong, and Univ. South Pacific-Fiji) and one with a regional entity (Caribbean Regional Association-Coastal Ocean Observing System (CaRA-COOS)).

Major research partners include National Oceanographic and Atmospheric Administration (eight collaborators), US Geological Survey (three collaborators), Univ. Hawaii (four collaborators), Univ. Miami's Rosenstiel School of Marine and Atmospheric Science (eight collaborators), Univ. Puerto Rico, Mayaguez (eleven collaborators), Woods Hole Oceanographic Institution (five collaborators), Yale (two collaborators), and Caribbean Regional Association-Coastal Ocean Observing System (eleven collaborators). This interest in partnering with UVI on new research initiatives has resulted in several multi-year cooperative agreements being drafted with USGS, DPNR, NOAA, WHOI, and Yale, and the placement of a NOAA research scientist at UVI.

Coordinating and Enhancement of Regional Coral Reef Ecosystem Monitoring and Understanding of Fish Movement Patterns in the USVI. Collaboration between the University of the Virgin Islands and the National Oceanic and Atmospheric Administration (NOAA) Biogeography branch of the Center for Coastal Monitoring and Assessment has resulted in the opening of a NOAA office at UVI. Dr. Simon Pittman is the NOAA representative in that office, and his contributions have been invaluable to VI-EPSCoR and UVI research. Details of Dr. Pittman's research are highlighted elsewhere in this report. In addition to his contributions to research, Dr. Pittman has been actively involved in mentoring MMES students, and training CMES staff in GIS applications. He has now been awarded an Adjunct Faculty position at UVI. This is in itself testimony to UVI's commitment to VI-EPSCoR, as well as VI-EPSCoR's commitment to supporting UVI's human resource development needs.

VI-EPSCoR has also been reaching out to other EPSCoR jurisdictions. As one of the newest EPSCoR programs, VI-EPSCoR has benefited significantly from models developed by other EPSCoR jurisdictions. For example, the new Master of Marine and Environmental Science program has benefited from knowledge shared by Hawaii EPSCoR in terms of curriculum, policies, and funding strategies. New Mexico EPSCoR has shared experience in developing the state's science and technology and STEM education infrastructure. UVI scientists are developing collaborations with researchers from Hawaii EPSCoR to explore potential collaborative projects which could test hypotheses related to coral reef patterns and processes among Caribbean and Pacific ecosystems.

Workforce Development

VI-EPSCoR has invested in workforce development to support the BCCR research thrust by developing a new graduate program in marine and environmental science, as well as supporting undergraduate research opportunities. Because a significant

proportion of the Virgin Islands' population comes from groups underrepresented in science, technology, engineering, and mathematics (STEM), VI-EPSCoR has also made key investments to strengthen the pipeline of K-12 students in STEM fields, including the development of a new graduate program in mathematics for secondary teachers and an Educational Advisory Board for K-12 STEM education.

VI-EPSCoR led the development and implementation of a new UVI Master of Marine and Environmental Science Program (MMES). VI-EPSCoR initiated and guided university and academic planning discussions that defined a new master's degree program in marine and environmental science. The first cohort of students matriculated in August 2007, and includes employees of the VI Department of Planning and Natural Resources and the National Park Service. The program provides students with skills for planning, conducting, and evaluating scientific research. Caribbean ecology and environmental management are emphasized, as well as problem solving skills applicable well beyond the region.

Graduates of the program will assist policy and decision makers to inform natural resource management decisions in the Virgin Islands and the Caribbean. Potential employers, including government agencies and private organizations in the Territory, have expressed strong interest in hiring graduates of the MMES program. The new program meets the acute demand for science and resource management expertise in the Virgin Islands and the broader Caribbean region as evidenced by the financial support provided to students by local private donors and external partners, such as NOAA.

The program is a bridge between the territory's academic and resource management communities: core courses feature many local guest lecturers from the resource community. A workshop to broaden participation in the MMES program, modeled after a similar program at University of California-Berkeley, which was co-sponsored by UVI's Provost's Office and VI-EPSCoR, was held in October 2007 and was well received.

Regular program self-evaluations are conducted at the end of each academic year including inputs from students and faculty. In addition, VI-EPSCoR will fund a programmatic evaluation of the MMES program in the next RII grant as part of its overall evaluation efforts.

VI-EPSCoR strengthened UVI undergraduate STEM education by augmenting classroom learning with research opportunities for students and faculty. Prior to the first VI-EPSCoR grant, few teaching faculty had direct experience with research, and because few faculty were engaged in research, few UVI students had opportunities for hands-on laboratory or field research. As a result of VI-EPSCoR, 13 teaching faculty and 46 undergraduates became involved in research, with undergraduates supported from a combination of VI-EPSCoR incubator funds and other federal grants, including the National Institutes of Health Minority Biomedical Research Support-Research Initiative for Scientific Enhancement and Minority Access to Research Careers. Without VI-EPSCoR supported-faculty mentors and the numerous research opportunities created for undergraduates on VI-EPSCoR projects, these students would not have had an opportunity to try out hands-on research.

VI-EPSCoR organized and led the development of a UVI Master of Arts in Mathematics for Secondary Teachers (MMAT) Program. With support from VI-EPSCoR, in 2006 the University of the Virgin Islands established a new master's degree program in teaching

mathematics to meet the professional development and training needs of secondary school teachers. The Virgin Islands Department of Education is very supportive of the new program and has provided full scholarships for all public school teachers participating in the program. The first cohort began in June 2006, with eight high school teachers graduating in May 2008. A second cohort will begin in January 2009.

The new program is strengthening the teaching qualifications of mathematics teachers in the Territory's secondary schools and helping the public school system meet federal and territorial requirements. The first cohort provides an indication of the potential impact of this program. Two of the eight graduates are math department chairs at their respective high schools. Six are now part-time instructors at UVI. Four have expressed a desire to enter doctoral programs in a few years. Six have become full members of National Council of Teachers of Mathematics. Two have been invited to present their master's research at a meeting in Tennessee this June. Their collective interests in math teaching include curriculum reform, using technology to solve larger and more difficult problems, student research activities, math modeling through classroom activities, and building imagination.

The program coordinator, Dr. Vanere Goodwin, has been actively involved in developing linkages between the program and other HBCU's. Two HBCU's, Tennessee State and Stillman College, have already expressed an interest in the program.

VI-EPSCoR will fund a programmatic evaluation of the MMAT program in the next RII grant as part of its overall evaluation efforts.

VI-EPSCoR has facilitated the development of an Educational Advisory Board to link the Territory's K-12 and postsecondary educational institutions and the Virgin Islands community in a partnership to strengthen K-12 STEM education. In Fall 2006, VI-EPSCoR, the President and the Provost of UVI, and the Virgin Islands Commissioner of Education constituted a new educational advisory board. Members include representatives of the University, the Department of Education, and VI-EPSCoR, potential employers in the private and government sectors, and parents of secondary school students. The Educational Advisory Board is charged with identifying priority areas where K-12 STEM education can be strengthened, developing a plan of action, promoting collaboration and the formation of strategic alliances to make optimal use of existing and potential resources, and promoting private sector and community involvement.

Cyberinfrastructure

VI-EPSCoR has worked with UVI Information Technology Services (ITS) on infrastructure investments to strengthen the university environment for research. VI-EPSCoR goals for cyberinfrastructure improvements at UVI include improvement of intranet and Internet capacity, establishment of DS3 connectivity to the Internet, and ultimately the acquisition of Internet2. Specific objectives of the first RII grant were to:

- Participate in UVI's strategic planning of improvements to provide greater bandwidth throughout the university community, which will help support faculty research activities

- Support development of the necessary infrastructure at UVI to provide VI-EPSCoR researchers with high bandwidth internet access and access to high-performance computing capacity at partner institutions and facilities
- Support development of 'smart classroom' and video conferencing capability to support VI-EPSCoR research, teaching, and outreach activities.

With VI-EPSCoR assistance, the University undertook significant planning efforts during the RII grant and made major investments to upgrade the basic network infrastructure. It also invested in putting together a team and training it to manage and support this infrastructure.

To prepare for the increase in network capacity, greater speed, and eventual increase in usage expected with access to Internet2, UVI made significant upgrades to the technology infrastructure of the University. The first phase of the UVI technology infrastructure upgrade project included the replacement of most of the network electronics on both the St. Thomas and St. Croix campuses. VI-EPSCoR helped fund a security assessment of the UVI network and the development of a disaster recovery and business continuity plan, a new network design, and storage and recovery solutions for researchers. The network is now capable of supporting the current and near-future network loads, provided investments in equipment maintenance, upgrades and service agreements continue. A university-wide backup system is now in place securing data kept on all servers. The information technology infrastructure investments made in the past years have resulted in a stable system, with upgraded local area network speeds and upgraded servers. These efforts have built an excellent foundation to support current services and future expansion.

A major challenge has been upgrading the University's bandwidth to provide faculty, staff and student access to high-speed, reliable networking. One of the most significant steps taken during the RII grant period was the University's decision to bring Internet2 to the University and the territory. VI-EPSCoR provided analytical support to the decision process and worked collaboratively with ITS, which advocated successfully for UVI to commit to Internet2. The UVI connection to the Internet2 network is through AMPATH, the international exchange point in Miami for research and education networks. Connection to Internet2 will ultimately increase the University's connectivity by 15 times its current rate, with the prospect of lower connectivity costs in the long-term, as more university traffic is rerouted over the higher capacity and lower cost Internet2 network.

VI-EPSCoR has worked closely with ITS to leverage its resources with University and Department of Education Title III funds to support transitional solutions for increased bandwidth, while developing and implementing plans to deliver DS3 connectivity and Internet2 to both campuses. In the last two years of the grant, the University and the UVI Research and Technology Park solved a number of last mile issues to bring broadband connectivity to the St. Croix campus from the St. Croix Global Crossing fiber switching facilities. The major remaining hurdle to broadband connectivity on both campuses is the replacement of antiquated inter-island microwaves between the St. Croix and St. Thomas campuses. In the next RII grant, VI-EPSCoR and the University will partner to replace the microwaves with appropriate radio dishes on both islands and the installation of fiber from the radios to both campuses, increasing the current less than 10 megabytes of services passing between the islands to OC3 connectivity (155 mb).

VI-EPSCoR worked closely with ITS to leverage its resources with University and Department of Education Title III funds in developing university-wide smart classroom and videoconferencing capability. This is of particular importance because the university has campuses on both the islands of St. Thomas and St. Croix. This capability has enabled significant growth in videoconferencing of classes and meetings between the campuses, as well as with state-side institutions. This capability was extended to the MacLean Marine Science Center on the St. Thomas campus; VI-EPSCoR renovation funds for the MMSC conference room were leveraged with Title III funds for smart classroom and videoconferencing capability. The new conference room is heavily used for researcher meetings between campuses or with external colleagues, for enhanced teaching in the MMES graduate program and undergraduate marine science courses, and for educational outreach with territorial partners.

VI-EPSCoR has worked with UVI Libraries to upgrade library resources for BCCR research and MMES graduate education, with a particular focus on on-line access to electronic resources. VI-EPSCoR purchased full access to the Woods Hole Oceanographic Institute library collections including electronic resources for BCCR researchers and graduate students, a document delivery service that electronically delivers full-text articles on a fee-per-document basis, and a university license for EndNote. VI-EPSCoR funds were also leveraged with institutional and Title III funds to purchase books and periodicals to supplement journal collections and to increase electronic search capabilities related to BCCR research and the needs of the new MMES graduate program, including access to JSTOR.

Outreach and Communication

Through the creation of research, professional and community partnerships, education, and outreach activities, VI-EPSCoR has become an integral resource in the Virgin Islands for scientific research and education related to the BCCR research thrust.

As indicated in Appendix D: Outreach, VI-EPSCoR involved 25 UVI faculty and 46 UVI undergraduate students in research and education activities in the first grant. Of these, one-third of the faculty were female; about one fifth were from under-represented minorities. Almost half of the undergraduate students were female; two-thirds were from under-represented minorities

VI-EPSCoR supported and participated in a variety of professional and educational events in the Virgin Islands to promote partnerships and build collaborations with key local government agencies and private organizations. In the first RII grant VI-EPSCoR supported outreach initiatives including participation in the Marine Debris Removal and Monitoring Project of the Virgin Islands Mangrove Research and Conservation Coalition, the 2007 Virgin Islands Ecogenomic Symposium on Aquatic Cells and Molecules, the 33rd Scientific Conference for the Association of Marine Labs of the Caribbean, and the British and U.S. Virgin Islands' Ocean Youth Summit, in addition to the VI-EPSCoR annual conference. VI-EPSCoR also hosted a number of workshops for the local community such as a Workshop on Sustainable Land Development led by Dr. Gaboury Benoit of Yale's School of

Forestry and Natural Resources, which drew participants from the local natural resource management, legal, academic, and business communities.

To bring current research and findings to the attention of the UVI and Virgin Islands community, VI-EPSCoR established the VI-EPSCoR Research Seminar Series. The research seminar series hosted a wide range of research scientists from other universities and research organizations who presented research on marine and environmental issues. The seminars have been useful venues for local and visiting researchers to meet and discuss potential collaborations. Widely covered by local media, the seminars have also become an effective means of communicating scientific information to a broader general audience.

VI-EPSCoR used its website, regular newsletter, local radio and television, and local print media to expand its outreach locally and beyond. The website and newsletter provide information on research, education, and outreach activities and upcoming events, as well as funding opportunities. VI-EPSCoR staff, researchers, and students are regularly invited to appear on local radio and television shows, as well as interviewed in the local press.

The *Remarkable Big Trees in the USVI* book has been widely publicized and distributed within the local schools through VI-EPSCoR educational outreach activities. In conjunction with a Media Library Services Professional Development Workshop for school librarians, VI-EPSCoR provided over 30 copies of the book for participating librarians. With facilitation by VI-EPSCoR, *Big Trees* author Dr. Robert Nicholls and *Mountain Peaks and Coral Reefs* author Ms. Toni Thomas gave presentations on their books and discussed ways the two books could be used for K-12 environmental education.

Students in the Master of Marine and Environmental Science program are leading new efforts to communicate about the environment with the Virgin Islands public. They appear on local radio shows and in the print media to discuss environmental issues, and are formulating environmental awareness projects. The students are also taking the lead in organizing community workshops on natural resource management issues, such as a NOAA Coastal Services Center workshop on managing visitor use in protected areas in 2008.

Evaluation and Assessment

Major accomplishments have been achieved within the BCCR research focus area. Improvements to the overall research infrastructure, especially in terms of intellectual resources and facilities, have facilitated the development of new programs, significant research projects, and valuable partnerships. Progress within the BCCR research thrust has been significant, especially when one considers that UVI is primarily a teaching institution. Some key research results to date include significant progress in understanding coral reef function under variable levels of stress (Manzello et al. 2007), evaluating the role of marine protected areas in rebuilding commercially important grouper populations (Nemeth 2005), and identifying linkages between biological patterns and oceanographic processes that enhance predictability and management of fishery resources (Nemeth et al. 2007a, Nemeth et al. in press).

The foundation for a Center of Excellence in marine and environmental science has been strengthened through VI-EPSCoR funding initiatives. One of the key accomplishments has been the development of faculty research potential and integration of faculty research interests into the BCCR program's central theme. Seventeen UVI faculty (biology, marine biology, physics, chemistry, oceanography, computer science) have been funded on at least one VI-EPSCoR incubator research project, a five-fold increase in the number of faculty involved in research prior to VI-EPSCoR investments. VI-EPSCoR further increased capacity by providing start-up funds for new faculty hires for marine natural products, marine mammal research, and watershed processes, hiring a new research faculty position in biological oceanography and securing a post-doctoral scholar to augment research in coral genetics. Other funding by NOAA and NIH allowed UVI's Center for Marine and Environmental Studies to hire a new research faculty member to expand research on corals and a post-doctoral scholar to support lobster behavioral studies, respectively. The result was that 33 research grant proposals were submitted, with 16 of them funded for just over \$2 million in additional external funding. With this foundation VI-EPSCoR will continue to build strong and sustainable externally-funded research programs.

The VI-EPSCoR program effectively integrated research and education through the participation of 46 undergraduate students in research. Additionally, VI-EPSCoR was instrumental in the establishment of two new Master's programs in Marine and Environmental Sciences and in Mathematics for Secondary School Teachers. Of equal importance was the transition of several UVI faculty members from teachers with full course loads to teacher-researchers who balanced instruction and research, and dynamically integrated their research into relevant laboratory exercises for students. These faculty provide a model for the full integration of teaching and research faculty at UVI.

The VI-EPSCoR program also fostered new collaborations and partnerships including NOAA, USGS, Univ. Hawaii, Univ. Miami, Univ. Puerto Rico, Woods Hole Oceanographic Institution, Yale, and CaRA-COOS. From collaborative research projects between individual faculty members, to hosting visiting fellows, to joint educational offerings, these partnerships enable the flow of fresh ideas between local and off-island researchers and policy-makers. The wisdom of local experience combined with knowledge of cutting-edge methods are the key to addressing critical issues of sustainable development faced by the US Virgin Islands and other small island states.

Investments in research facilities and equipment enabled significant expansion of UVI research. VI-EPSCoR funds for renovations have been leveraged with over \$800,000 in additional UVI grants including \$400,000 in UVI Capital Project funds, \$135,000 in US Department of Education Title III institutional strengthening funds for the MacLean Marine Science Center (MMSC), \$185,000 from a NSF Field Station and Marine Lab grant for renovations and \$105,000 from US Geological Survey (USGS) to support operations and instrumentation at the Virgin Islands Environmental Resource Station (VIERS).

Four research laboratories were renovated at MMSC; a new sea table containment system, a teaching laboratory, office space for additional researchers, a video conference room and new dive facilities were all added. At VIERS, a new analytical laboratory, semi-wet and wet laboratories, a new sea table containment system, office and library, and a new structure to house the compressor tank filling station, workshop, generator and chemical storage were all constructed. A new research/dive vessel, a 30-foot Island Hopper with an inboard diesel

engine, hydraulic trap hauler and electronics was purchased, which has supported 900 hours to date. Oceanographic equipment to monitor coastal water conditions, such as current and temperature patterns, was purchased, and is being used in wide range of projects.

VI-EPSCoR was instrumental in developing and launching a new graduate program in marine and environmental science. The program has been very well received, with financial support for students coming from NOAA, National Park Service, Virgin Islands Fish and Wildlife, National Guard, UVI teaching assistantships, and private donors. There have also been numerous research opportunities created for undergraduates on VI-EPSCoR projects. These students have been supported financially by NIH MARC and MBRS-RISE, and NSF HBCU-UP, as well as VI-EPSCoR. Without VI-EPSCoR supported-faculty mentors, these students would not have had an opportunity to try out hands-on research. VI-EPSCoR also supported the creation of a graduate program in teaching mathematics for secondary school teachers. Major financial support for students in the program came from the Virgin Islands Department of Education. VI-EPSCoR was also the force behind the formation of an Educational Advisory Board, which links the territory's only university with its public school system to strengthen K-16 STEM education.

VI-EPSCoR has been a catalyst for cultural change within UVI. VI-EPSCoR participated in the University strategic planning process that produced a new strategic plan, Vision 2012. Vision 2012 defines the university's mission as a learner-centered institution engaged in education, innovative research, and responsive community service. VI-EPSCoR has worked to stimulate changes in administrative structures and systems, the creation of a conflict of interest policy, the creation of a transparent indirect costs policy, and the integration of teaching and research faculty and revision of faculty policies.

Increased involvement of teaching faculty in research has come about as a result of VI-EPSCoR offering incubator grants and mentoring for teaching-faculty turned researchers, the recruitment of new teaching faculty with complementary research interests and providing start-up funds for research. Infrastructure improvements in UVI Information and Technology Services, such as purchasing access to the electronic resources of the Woods Hole Oceanographic Institution, buying increased internet capacity for UVI until the university reconfigures and upgrades its IT network system, and purchasing a university-wide site license for geographic information systems (GIS) have also allowed UVI faculty to increasingly become involved in competitive scientific research and improved teaching and mentoring of students.

Synergistic and complementary changes have occurred as a result of US Department of Education institutional strengthening funds, which allowed for growth in Grants Accounting and the Office of Sponsored Programs to better support researchers who submit and win competitive grant proposals; the equipping of Chemistry laboratories with modern equipment that will allow students to learn the latest chemistry techniques and will allow the chemistry program to gain national accreditation; and the exploration of including GIS education in the undergraduate curriculum.

VI-EPSCoR investments have already produced positive impacts on the territory. The new graduate program in Mathematics for Secondary School Teachers is filling a key need to strengthen teacher qualifications in the territory. The Master of Marine and Environmental Science degree program is supplying trained personnel for local agencies, and will help the

territory move towards sustainable use of its natural resources.

VI-EPSCoR is in discussions with a private donor for a planning grant for the development of a new Science Complex at the University. The new complex is envisioned to include purpose-built classroom, office and laboratory space for the Division of Science and Mathematics and the Center for Marine and Environmental Studies, a Virgin Islands laboratory school for the sciences, and a science museum.

Due to VI-EPSCoR's approach in involving stakeholders in planning, VI-EPSCoR has built strong local support, as evidenced by the size of the Legislature's appropriation, generous donations to the program from local donors, and University contributions.

Sustainability and Project Outputs

Proposals/Grants/Contracts

In the first RII grant, VI-EPSCoR researchers submitted 33 proposals for external funding, of which 16 were funded for \$2,150,000. Three proposals are pending.

Publications

VI-EPSCoR researchers produced 26 publications with primary RII support.

New faculty

One new faculty member was recruited and retained in the first grant, a biological oceanographer (White, male).

VI-EPSCoR graduates

VI-EPSCoR supported one post-doctoral researcher in coral genetics (White, male).

Eight teachers graduated from the Master's in Mathematics for Secondary Teachers program. Of these, four were female and seven were under-represented minorities.

No students have yet graduated from the Master's in Marine and Environmental Science program; the first cohort should graduate in May 2009.

Among the 46 undergraduate researchers participating in VI-EPSCoR projects, 24 graduated by the end of the first RII grant, of which 11 were female and 15 under-represented minorities.

VI-EPSCoR has worked to ensure that human and fiscal resources will be available to sustain the VI-EPSCoR BCCR research thrust beyond the initial RII grant. In building and strengthening programs, VI-EPSCoR carefully considers sustainability. Its philosophy is that no activity should be continued long term on a subsidized basis. New positions, originally funded by VI-EPSCoR, have been shifted to regular University funding. New graduate degree

programs have been developed with attention to short, medium and long-term financial sustainability. VI-EPSCoR funds have been leveraged with university operating funds and funding from other external sources to sustain innovations created by VI-EPSCoR.

Some new activities, such as physical infrastructure upgrades, are, by their nature, of finite duration; when the task is completed, the activity ceases. Some new activities (such as incubator projects) represent venture investments. Applicants for VI-EPSCoR seed funding are required to explain their plans for seeking competitive funding upon successful completion of the incubator phase, and VI-EPSCoR works closely with the researcher and the UVI Office of Sponsored Programs to help them secure funding. It is expected that some new thrusts will succeed and obtain support through competitive grants, and others will not be continued.

In the case of VI-EPSCoR-funded faculty and staff positions, with the exception of core VI-EPSCoR staff, funding for these positions are being transitioned to University funding.

VI-EPSCoR's support for educational initiatives is similarly structured. The University's own procedures for approval of new programs requires the development of a business plan showing the program to quickly become at least revenue-neutral. VI-EPSCoR can provide assistance for a brief period to provide time to reach stability, but this assistance is usually stepped down gradually. This approach encourages activity leaders to work hard to achieve self-sufficiency.

VI-EPSCoR's approach is that it will provide appropriate funding and non-monetary support during the incubation phase of new initiatives, but long term viability of any activity will ultimately depend on its ability to attract funding in the competitive arena. To the extent that research activity successfully competes for funding, the growth of direct and indirect cost dollars will provide the resources needed to maintain healthy infrastructure without requiring continuing subsidies.

In the next RII grant, building on the foundation of the first RII grant, VI-EPSCoR will pursue a range of non-EPSCoR funding opportunities to support growth in research, strengthen STEM education, and further enhance the Territory's scientific infrastructure. These include:

- **National Science Foundation.** The primary Directorates for future research funding include **BIO** (including Research in Undergraduate Institutions (RUI), Assembling the Tree of Life (ATOL), Research Initiation Grants and Career Advancement Awards to Broaden Participation in Biology (RIG CAA BP), **OCE** (Biological Oceanography, Physical Oceanography), and other programs such as CAREER, Major Research Instrumentation (MRI), Research Experiences for Undergraduates (REU), and CISE.
- **National Institutions of Health.** MBRS-SCORE program.
- **NOAA.** These include National Marine Fisheries Service Saltonstall – Kennedy provides funding for Fisheries Research and Development, National Marine Fisheries Service Marine Fisheries Initiative (MARFIN) provides funding for applied fisheries, habitat and conservation research, Coral Reef Conservation Programs provides funds for coral reef research, habitat conservation and restoration and education and outreach, Puerto Rico Sea Grant College Program provides grants for applied research in the US Caribbean, education and outreach, Coastal services center provides funding for Coastal Resource Managers, and National

Centers for Coastal & Ocean Science of the National Ocean Service provides funding for coral reef monitoring programs in the Caribbean and Pacific.

- **USGS.** State Partnership Program; Virgin Islands Water Resources Research Institute.
- **OTHER.** Other research funding sources include: Virgin Islands Department of Planning and Natural Resources, Environmental Protection Agency, the Ocean Conservancy, the Nature Conservancy, and the Office of Naval Research.
- **Synergistic collaborations.** A new collaboration between UVI and Texas A&M University (TAMU) and the University of Miami (UM) will leverage VI-EPSCoR RII funding with significant private funding to pursue research and education initiatives of common interest. This collaboration offers opportunities to utilize the capacities of the three institutions to address critical research needs in the area of management of local and regional marine natural resources, as well as building local and regional technical capacity in marine and environmental science.
- **GK-12.** UVI will submit a GK-12 proposal in 2009. This project will be a collaborative effort primarily involving the UVI Master's in Marine and Environmental Science program, the Division of Science and Mathematics, the Division of Education, and the VI Department of Education. VI-EPSCoR will facilitate with collaboration, with the assistance of the Education Advisory Board.
- **LSAMP.** UVI receives funding under the AGEF program through the University of Florida's SEAGEP grant. UVI intends to submit a proposal to LSAMP in Fall 2009.
- **IGERT.** UVI will pursue partnerships with other universities to gain IGERT funding in support of the MMES graduate program. MMES partnered with Dr. Andrew Baker from the University of Miami (UM) last year in an IGERT proposal on "Coral Reef Ecosystem Science and Management." Although the team was not invited to submit a full proposal in 2007, there are plans for resubmission. The program would fund an MMES student stipend and enable MMES students to enroll in UM courses, while providing access to UVI facilities and field sites for UM faculty and students, and would enhance educational and research contact between students and faculty at UM and UVI.
- **ADVANCE.** UVI is eligible to receive funding from the NSF ADVANCE program. Given UVI's STEM student demographics, and given that UVI is receiving generous funding from the NIH MARC and MBRS-RISE programs, there are no immediate plans to pursue ADVANCE funding.
- **CREST.** UVI does not currently have doctoral programs, so it is not eligible to apply for CREST funding either as a Center or under the HBCU-RISE program.
- **HBCU-UP.** UVI has a very active program funded by the NSF HBCU-UP program. This is part of UVI's Emerging Caribbean Scientist alliance, and VI-EPSCoR works closely with the program.
- **Math and Science Partnership.** As discussed under sections 2.4.3 and 3.2.2, UVI will submit an MSP-Start proposal in 2008, in partnership with the VI Department of Education, with VI-EPSCoR playing a facilitating role.

As mentioned above, UVI also receives generous support through the MARC and MBRS-RISE programs at NIH. Students participating in these programs have numerous opportunities to participate in research related to ICCE. VI-EPSCoR works closely with the coordinators of these programs to maximize undergraduate research opportunities, especially for students from underrepresented groups.

Seed Funding and Emerging Areas

The VI-EPSCoR incubator grant program increased the number of inter-disciplinary research projects with multiple collaborators. The trend established by VI-EPSCoR incubator funding in Biocomplexity of Caribbean Coral Reefs is apparent from the number of new collaborations (84) that have been established by faculty preparing research proposals for external funding. VI-EPSCoR funded improvements to UVI marine research facilities and infrastructure have increased interest in collaboration from scientists who seek to establish study sites in the Caribbean. VI-EPSCoR funded pilot research to incorporate land-sea linkages into the BCCR research focus has also generated considerable interest from potential research partners both locally and nationally. The increased volume and scope of research activity is addressing issues critical to the social and economic viability of the U.S. Virgin Islands.

The VI-EPSCoR incubator grants program created opportunities for BCCR researchers to advance pilot projects to the point where they can attract competitive funding. VI-EPSCoR offers incubator research grants annually to develop new research directions related to the BCCR research thrust. The 17 VI-EPSCoR incubator projects funded to date have involved 17 UVI researchers (some on multiple projects) and 11 researchers from other universities and government agencies, as well as 1 post-docs, 2 graduate students, and 46 undergraduates. To date VI-EPSCoR incubator projects have produced 33 proposals for external funding, which included 84 collaborators from 39 other institutions. In June 2007 most of the incubator researchers, and a number of the student and post-doc researchers, presented their work at the international 33rd Scientific Conference of the Association of Marine Labs of the Caribbean.

VI-EPSCoR, working with the UVI Office of Sponsored Programs (OSP), used the incubator grants program to strengthen researchers' skills in project design, proposal writing, and grants management. OSP provided technical support and training for incubator researchers in the process of acquiring and managing grants, and also provided liaison with the UVI Grants Accounting Office to help VI-EPSCoR create a realistic simulation of post-award grants management for the successful incubator proposals. These activities have enhanced faculty researchers' abilities to seek, obtain and manage externally funded grants.

Human Resources Development

VI-EPSCoR invested in development of human resources to support the BCCR research thrust by increasing the participation of faculty in research, by developing a new graduate program in marine and environmental science, and by creating research opportunities for undergraduates. VI-EPSCoR also contributed to university efforts to strengthen the organizational environment for growth in research volume, increase involvement of faculty in research, and integrate research into the student learning experience. VI-EPSCoR played a leading role in improving project management practices and contributed to University strategic planning.

VI-EPSCoR support for the BCCR research thrust led to a substantial increase in the number of UVI faculty engaged in BCCR related research and in research collaborations with external partners. Since the inception of the VI-EPSCoR program, research faculty and staff in the UVI Center for Marine and Environmental Studies (CMES) have grown from one research faculty member, one post doc, three technicians and three undergraduates to three research faculty members, two post docs, seven technicians and seven undergraduates. More importantly, the involvement of UVI teaching faculty in research has increased substantially. Prior to VI-EPSCoR, only two UVI teaching faculty in marine science had a funded research grant. Because of VI-EPSCoR, 13 teaching faculty are involved in sponsored research projects.

VI-EPSCoR was also actively involved in recruitment of new STEM faculty at UVI. VI-EPSCoR funding opportunities for research have been instrumental in attracting new faculty with strong teaching and research interests in areas related to the BCCR research thrust. For example, in the last two years of the grant, the Division of Science and Mathematics hired a marine biologist working on marine mammals, a chemist working on marine natural products, an ecologist interested in watershed processes, and a coastal biologist. Three of the four received VI-EPSCoR incubator/start-up funding; the fourth brought EPA research funding with him.

The regular presence of 15-20 Master's students in marine and environmental science, due to the new UVI MMES graduate program, has significantly enhanced BCCR research capacity. Graduate students can be recruited for research assistantships. They are participating in research and resource management internships with local agencies. They act as mentors to undergraduate students, strengthening the pipeline of marine and environmental scientists. After they graduate, many will take up local positions in research and resource management.

BCCR research capacity was also significantly enhanced by the availability of undergraduate students to participate in research. The Division of Science and Mathematics is committed to undergraduate engagement in research. The VI-EPSCoR program provided research opportunities for 46 UVI undergraduates in the first grant. With the new MMES program, the involvement of undergraduates is being strengthened through aspirational peer mentoring by Master's students both in the classroom and in the research lab.

VI-EPSCoR participated in the University strategic planning process that produced a new strategic plan, *Vision 2012*. *Vision 2012* defines the university's mission as a learner-centered institution engaged in education, innovative research, and responsive community service. *Vision 2012* defines key roles and responsibilities for VI-EPSCoR in the development of a center of excellence in marine and environmental science, two new graduate programs, and an educational advisory board.

VI-EPSCoR worked within University academic and administrative units to strengthen research infrastructure, faculty research competitiveness, and academic programs related to the BCCR research thrust. For example, VI-EPSCoR was actively involved in an *ad hoc* Indirect Cost Review Committee to evaluate existing policy on indirect cost recovery and distribution of indirect cost funds. With participation from the University's Vice Provost for Research and Public Service and Vice President for Business and Administration, as well as

representatives of key administrative units, the faculty, and VI-EPSCoR, the Committee successfully produced a new set of policies, including distribution of some indirect cost funds to project PI's and to their administrative units.

VI-EPSCoR implemented project management software and training to support VI-EPSCoR staff and researchers. This is a pilot project for University-wide implementation of project management software.

Leveraging NSF Programs

In response to an identified need arising from a reverse site visit in 2007, VI-EPSCoR joined the Emerging Caribbean Scientists program at UVI in an effort to strengthen its linkages with other HBCU programs at the University in the area of student strengthening. This has been further addressed in the new RII grant:

Because of the predominance of underrepresented groups in the Virgin Islands population and among the UVI student body, VI-EPSCoR educational investments have a particular impact on enhancing recruitment and retention of minority students. VI-EPSCoR is a member of the Emerging Caribbean Scientists (ECS) program, an umbrella under which various federal grants that encourage minority participation in STEM careers are managed at UVI. ECS offers a comprehensive model for recruitment and retention of minority students, including funding for research opportunities at UVI and at other universities, mentoring, tutoring, travel, presentation, and workshop experiences.

In the next grant, two new efforts will focus on strengthening the ECS model for recruitment and retention of minority students in STEM. Although excellence in faculty instruction is paramount, peer mentoring is an important tool in the recruitment and retention of STEM undergraduates, especially of those from underrepresented backgrounds. With the presence of MMES graduate students as well as increasing numbers of post-doctoral scholars, a new model of research teams of faculty, post-docs, graduate, and undergraduate students will enable undergraduates to be motivated and guided by graduate students, and graduate students to be inspired and mentored by post-docs and faculty. In addition, the presence of graduate TA's in undergraduate science laboratories will provide peer mentoring in the classroom.

VI-EPSCoR will also work with the ECS program to develop the existing annual undergraduate research symposia at UVI into an annual student research conference within the VI-EPSCoR annual conference. The conference will showcase the work of both undergraduate and graduate students. Initially the research conference will be focused on US Virgin Islands students, with efforts to expand its reach within two to three years to regional student presenters. A career and recruitment component is also planned, where potential employers will have the opportunity to recruit UVI STEM students. This will also serve to inform students of the varied careers available to them upon graduation.

The Center for Marine and Environmental Studies received an NSF-FSML award, DBI-0331552 "Strengthening the Research and Educational Capabilities of the US Virgin Islands Environmental Research Station, St John US Virgin Islands" (\$185,000 01 Apr

2004 – 30 Sep 2007, PI = Dr. Richard Nemeth) for renovations of the field station to repair hurricane damage. Extensive renovations of the Virgin Islands Environmental Resource Station (VIERS) were initiated with an NSF-FSML award and leveraged with funding from VI-EPSCoR, USGS and private donations. The general laboratory space was reconfigured to contain an air conditioned analytical lab, semi-wet lab, wet lab, office and library, and a new structure to house the compressor tank filling station, workshop, generator and chemical storage and an outdoor covered conference area. The conference area allowed VIERS to host three international conferences including “50 Years of Marine and Terrestrial Research in the National Park”, the Ecogenomic Symposium on Aquatic Cells and Molecules, and an NSF funded Cnidarian Tree of Life workshop. Other significant improvements included renovation of a small computer lab with four work stations, installation of high speed internet service and local area network, new instrumentation (3 digital/video compound and stereo-zoom microscopes, 2 top loading balances, water still, fume hood), sea water system with two 600 gal and five 200 gal fiberglass tanks and 16 glass 20 gal aquaria, 14 ft boat with 25hp outboard engine, and dive compressor. These improvements have generated considerable interest from researchers and educators around the country. Use of VIERS by educational groups and research scientists has increased 25% over two years. More significantly, researchers represented only 3.3% of VIERS users in 2005, but this number increased to 16.2% in 2007. The five-fold increase in two years includes scientists from 16 different institutions and agencies, and includes an increasing number of graduate students who represent the future cohort of scientists to use VIERS.

Management Structure

The VI-EPSCoR management structure consists of the Project Management Team, a Governing Committee with territory-wide representation, a Research Advisory Board for the thrust on Biocomplexity of Caribbean Coral Reefs, and an Education Advisory Board for K-12 STEM education.

VI-EPSCoR Management Team

The Program is directed by Dr. Meri Whitaker (PI/PD). Dr. Whitaker has led VI-EPSCoR during the last three years of the grant, works full time on the Program, and is responsible for all aspects of the work, including strategic planning, implementation, and program management. The PI/PD reports to the VI-EPSCoR Governing Committee, and within the University administrative structure, reports to the Vice Provost for Research and Public Service.

The VI-EPSCoR program staff, who are based at the UVI St. Thomas main campus, includes a Program Coordinator, an Outreach Coordinator, and an Administrative Specialist. These are all full time positions reporting to the PI/PD.

The scientific program is led by Co-PI Dr. Richard Nemeth, who is Director of the University's Center for Marine and Environmental Studies (CMES).

The BCCR staff, who are based at the UVI CMES MacLean Marine Science Center on John Brewer's Bay on St. Thomas, includes a Research Manager and an Administrative Assistant. These are full time positions reporting to Co-PI Nemeth.

VI-EPSCoR relies on support from a variety of University offices, including the Vice Provost for Research and Public Service, Grants Accounting, the Office of Sponsored Programs, the Campus Executive Administrators, IT and Library Services, and the Public Relations Office.

The initial Management Team was led by Dr. Henry Smith, Prof. Roy Watlington, and Dr. Nemeth. Dr. Smith and Prof. Watlington stepped off the project due to other University obligations.

Currently the positions of Program Coordinator and Outreach Coordinator are vacant. These positions will be filled promptly upon beginning the new RII grant.

The VI-EPSCoR Management Team meets on an ad-hoc basis about once a week.

VI-EPSCoR Governing Committee

The VI-EPSCoR Governing Committee represents the greater Virgin Islands community as well as the broadest interests of the University in advising the Project Director and in garnering community support for the objectives of VI-EPSCoR. The Governing Committee meets semi-annually and serves to educate the Virgin Islands community about the immediate and potential impact of VI-EPSCoR, especially as it pertains to economic growth. Committee members represent an array of Territorial offices including the Virgin Islands Senate President, the Delegate to Congress, the Commissioner of the Department of Planning and Natural Resources, the Commissioner of Education, and the Chair of the Virgin Islands Economic Development Authority, as well as the President of the University of the Virgin Islands, the VI-EPSCoR Director, the Principal Investigator of the VI-EPSCoR research thrust, and representatives of the the private sector, the UVI faculty, and other EPSCoR jurisdictions.

The current demographics of the Governing Committee are 6 African-American and 8 White members; 3 female and 11 male members.

The Governing Committee meets on a quarterly basis.

BCCR Advisory Board

The BCCR Advisory Board assists in strategic planning and provide guidance for the research thrust on Biocomplexity of Caribbean Coral Reefs. Board members include local and national researchers of international repute in tropical coastal ecosystems. The BCCR Advisory Board consists of persons with expertise in 1) coral reef conservation at national or international level, 2) graduate programs in marine science, 3) implementing informal education and outreach programs linked to research activities, 4) writing major grant proposals, 5) local coral reef research and 6) setting up and/or directing a marine biological laboratory. Institutional affiliations include University of Georgia, University of Miami, University of South Florida, University of Hawaii, University of North Carolina Wilmington, Woods Hole Oceanographic Institution, US Geological Survey, Virgin Islands Division of Fish and Wildlife, and UVI.

The Advisory Board meets quarterly.

The current demographics of the Advisory Board are 2 African-American and 10 White members; 6 female and 6 male members.

VI-EPSCoR Education Advisory Board

In 2006 VI-EPSCoR, the President and the Provost of UVI, and the Virgin Islands Commissioner of Education constituted a new education advisory board. Members include representatives of the University, the Department of Education, and VI-EPSCoR, potential employers in the private and government sectors, and parents of secondary students. The Education Advisory Board is charged with identifying priority areas where K-12 STEM education can be strengthened, developing a plan of action, promoting collaboration and the formation of strategic alliances to make optimal use of existing and potential resources, and promoting private sector and community involvement.

The Advisory Board meets quarterly.

The current demographics of the Advisory Board are 8 African-American and 3 White members; 7 female and 4 male members.

Technical Assistance by Outside Consultants

To monitor progress in implementing the RII grant and to evaluate the broader long-term impact of the overall VI-EPSCoR effort, Dr. Paul Butler-Nalin was hired as external consultant for planning, monitoring and evaluation. Dr. Butler-Nalin had primary responsibility for implementing the program's Monitoring and Evaluation plan, working closely with the VI-EPSCoR Director. The Director and the Consultant met quarterly to review updated assessment data and annually to review summative data on progress to date.

Dr. Butler-Nalin will not be continuing in this role in the next RII grant. A new assessment team will be recruited promptly upon beginning the new grant.

Jurisdictional and Other Support

Existing jurisdictional resources that enhanced the Virgin Islands EPSCoR program during the first RII grant include:

- Two existing marine research facilities, the MacLean Marine Science Center on St. Thomas and the Virgin Islands Environmental Resources Station on St. John, enhanced by the recent renovations, research vessels, and equipment funded by the first RII grant, and to be further enhanced by planned University upgrades of boat dock, ramp, and storage facilities
- VI-EPSCoR offices provided by the University on the St. Thomas campus
- New University-funded natural resource management faculty position supporting the MMES program
- University-funded CMES staff (Director, Administrative Assistant, and Dive Captain)
- University-funded science librarian on St. Thomas campus

- University-funded Conservation Data Center technical staff
- Division of Science and Mathematics teaching labs equipped with new chemistry and biology equipment purchased in the last two years with Department of Education Title III funds
- UVI Information and Technology Services facilities, equipment, and staff
- Collaborations with federal agencies in the territory, in particular National Park Service, US Geological Survey, US Fish and Wildlife, and NOAA, including joint fieldwork and other research activities. A NOAA Resident Scientist in spatial ecology is based at CMES. Collaborations with territorial agencies, in particular Department of Planning and Natural Resources, Coastal Zones Management, Environmental Protection, Fish and Wildlife, and Waste Management, as well as the Department of Education, including joint research, educational, and outreach activities. (More details in Collaborations section)
- Collaborations with territorial outreach groups including the SeaGrant Virgin Islands Marine Advisory Service and the Virgin Islands Network of Environmental Educators, including joint outreach activities in informal marine and environmental education

Unobligated Funds

Unobligated funds:

All National Science Foundation RII grant funds were obligated as of 31 December 2008.

Budget details:

The budget details reported in Appendices F, G, and H are best approximations of expenditures in grant year 4 and cumulative of the first Virgin Islands EPSCoR grant. Because the new reporting structure was not in effect when the grant was awarded, our data were not broken down by the new budget categories. We have made our best effort to approximate the breakdown requested for year 4 and cumulative. All estimates include both direct and indirect costs.

As indicated in Appendix F, approximately one third of the budget was expended on research activities; one quarter of the budget on education and human resources; one eighth on experimental and computational facilities; one sixteenth on cyberinfrastructure; one thirty secondth on evaluation and assessment; and one sixteenth on RII administration. The last year of the grant included a six month no-cost extension to carry the project until the new RII grant began. In the last grant year, therefore, in some categories salary expenditures were higher to carry core staff through the no-cost extension.

As indicated in Appendix G, VI-EPSCoR received its cost-share funds of \$1,125,000 as follows: \$300,000 was provided by the Virgin Islands Legislature, \$334,520 was contributed from University funds, \$335,000 was received from a major local donor, and about \$155,000 was received from another local donor. The last donor contributed another \$79,422 above and beyond the cost share requirement in the last two years of the grant.

As indicated in Appendix H, cost share funds were used primarily to fund some incubator grants, for many community outreach activities, to support some of the costs of the science librarian and some of the costs of VI-EPSCoR core staff. The additional cost contributions funds were used for research equipment and MMES graduate student research funds.

3. Jurisdiction Specific Terms and Conditions

As per the Award Letter for the first RII grant:

The project's annual report must include a description of efforts, accomplishments, commitments, and plans to ensure that sufficient human and fiscal resources will be available in the future to sustain the project beyond the expiration of the NSF grant. These may include not only quantitative data (e.g., a record of proposals submitted to NSF competitions and an analysis of award success rates), but also a listing of programs and proposed policies implemented and/or resources sought or obtained.

Please see the section on Project Sustainability and Outputs for detailed response.

4. Experimental/Computational Facilities.

Key infrastructure improvements have built capacity to support and sustain the BCCR research thrust. VI-EPSCoR investments include renovations of research facilities on St. Thomas and St. John and acquisition of major equipment. RII funding has been leveraged with university capital funds and other external funding sources.

VI-EPSCoR investments in UVI's marine research facilities have enabled significant expansion of basic and applied research and monitoring programs. VI-EPSCoR has supported renovations of UVI marine research facilities, significantly increasing the Territory's ability to support competitive marine-related research. The physical renovations at the MacLean Marine Science Center on St. Thomas have included renovations of five research labs and a teaching lab. The renovations have allowed key specializations to emerge due to more efficient use of space. Four specialty research labs include: 1) ecological and environmental science, 2) coral genetics, 3) invertebrate neurobiology and 4) water resources and oceanography. A fifth research laboratory was renovated and retained for general marine biology research projects and has been made available to faculty funded with incubator grants and their collaborators and students. Research support service facilities include office space for additional researchers, videoconference room, workshop, expanded sea table system, and new dive facilities which include a new compressor and nitrox air system. These investments have generated interest in the Virgin Islands as a viable research location and have attracted a host of US and international researchers, including the Danish World Expedition of the Galathea3, NOAA's R/V *Nancy Foster*, and researchers from University of Rhode Island, Nova Southeastern University, and Woods Hole Oceanographic Institute.

VI-EPSCoR funds have also supported extensive renovations and modernization of the Virgin Islands Environmental Resource Station (VIERS), an important historical field

station located in the Virgin Islands National Park on St. John. The renovations at VIERS include a new air-conditioned analytical lab, semi-wet lab, wet lab, office and library, and a new structure to house the compressor tank filling station, workshop, generator and chemical storage. New instruments, computers and high-speed internet access have contributed to more sophisticated research at this remote facility. The renovations at VIERS are notable since VIERS has served as an important field station for marine scientists for 40 years. In 2001, a hurricane critically damaged the VIERS research facility. With new renovations VIERS is once again operational as a research station. In the past year, VIERS has hosted researchers from UVI, Virgin Islands National Park, USGS, NOAA, California State University at Northridge, Auburn University, University of Central Florida, Eckerd College, Murray State University, and others.

VI-EPSCoR investments in major research equipment have enabled new research directions and collaborations. An array of Acoustic Doppler Current Profilers (ADCPs) purchased by VI-EPSCoR has been used extensively in incubator and other projects and deployed in waters near St. Thomas, St. Croix, and St. John, as well as Saba in the Netherlands Antilles. In a collaboration between oceanographers and marine biologists, the ADCPs have been deployed at grouper and snapper spawning aggregation sites to collect baseline data on water temperature, current speed and direction at different depths, in order to predict patterns of current-driven transport of eggs and larvae from spawning aggregation sites. The use of the ADCPs has led to exciting new incubator research directions related to coastal processes, such as a collaboration with the Virgin Islands Coral Reef Monitoring Program and the Virgin Islands National Park in which the ADCPs are used to study coral spawning, genetic relatedness of colonies and transmission of coral diseases. BCCR researchers have particular comparative advantage in studying coastal processes because of the easy accessibility to coastal regions around the Virgin Islands. Because of the importance of the coastal processes studies, VI-EPSCoR has funded the acquisition of new tools specifically designed to monitor near-shore conditions. The purchase of an Acoustic Wave and Current Profiler and a high-resolution Conductivity-Temperature-Depth instrument with capabilities to measure photosynthetically active radiation, chlorophyll, pH and turbidity has enabled researchers to collect baseline data and to verify high resolution coastal modeling efforts. These instruments have greatly enhanced and increased the likelihood of success of several VI-EPSCoR incubator research projects focused on coastal and onshore-offshore processes. Results from these projects have already been presented at scientific conferences and are being prepared for publication in peer-reviewed journals.

VI-EPSCoR funded the purchase of a new research/dive vessel, a 30-foot Island Hopper with an inboard diesel engine, hydraulic trap hauler and electronics. Since October 2005, the new research vessel has supported nearly 900 hours of on-water research activity by UVI researchers and visiting research scientists. The research vessel has been used for studies on grouper spawning aggregations and for coral reef surveys during recent coral bleaching events.

VI-EPSCoR funds for physical infrastructure renovations have been leveraged with over \$800,000 in additional grants. The leveraged infrastructure improvement grants include UVI Capital Project funds (\$400,000), Title III funds (\$135,000), a NSF Field Station and Marine Lab grant (\$185,000), and US Geological Survey (\$105,000) to support operations and instrumentation to support the extensive renovations and modernization of the MacLean Marine Science Center and VIERS.

5. *Publications and patents*

This information may be found in FastLane.

6. *Honors and Awards*

Mr. Gaetan Gentius, VI-EPSCoR undergraduate researcher working with Dr. Tyler Smith (CMES) on a project entitled “Pilot study to integrate the effects of watershed activity patterns and coastal processes on near-shore coral reefs”, gave a poster presentation awarded Best Presentation Honors at the UVI Summer Research Symposium in July 2006.

Dr. Omar Christian (DSM), VI-EPSCoR researcher in natural products chemistry, served as mentor for three student winners at the UVI Spring Research Symposium in March 2008. First place went to Mr. Ali Kareem’s poster on the “Antihypertensive metabolites from *Atrocarpus altilis* (Breadfruit)” (Ali Kareem, Ms. Keisha R. Christian, Ms. Andrita Griffin, Dr. Omar E. Christian). Ms. Ophelia Wadsworth shared second prize for her poster titled “Antimicrotubule metabolites from *Ircinia strobilina* and other Virgin Islands Sponges” (Ms. Ophelia Wadsworth, Dr. Susan Mooberry, Dr. John Reed, Dr. Omar E. Christian) with Ms. Digna M. Washington for her research poster “Cytotoxic metabolites from *Pseudocerintina crassa*” (Ms. Digna M. Washington, Dr. Omar E. Christian, Dr. John Reed, Dr. Susan Mooberry).

C. *Highlights*

Three Virgin Islands EPSCoR highlights are attached separately.