A Program Administered by the University of Hawai'i System

INVESTING *IN* MULTIDISCIPLINARY UNIVERSITY ACTIVITIES *THROUGH* HAWAI`I EPSCOR IMUA II: 2005 RII

A. Project Summary

The University of Hawaii (UH) System developed its Astronomy and Ocean & Earth Sciences programs with targeted and sustained resources, sense of purpose, and focused initiatives. As a result, Hawaii now possesses internationally recognized research enterprises in these fields. The current NSF EPSCoR proposal, IMUA II, will build on the success of the first EPSCoR RII program to advance specific research opportunities in ecology, evolution and cyberinfrastructure that are of high priority to the State and the UH System. Specifically, Hawaii's 2005 RII Plan presents a research agenda that promotes responsible stewardship of Hawaii's ecosystems while enabling its people to assume their roles as technologically literate, critically thinking citizens in a 21st century workforce. In partnership with the State Department of Business, Economic Development & Tourism (DBEDT), UH will leverage IMUA II to promote what Governor Lingle has emphasized as an "*opportunity for environmental responsibility to be an economic force*" for the State.

INTELLECTUAL MERIT: The Hawaiian Islands are renowned as ideal settings for evolution and speciation studies. A site of spectacular species radiations representing all stages of the diversification process, Hawaii provides an exceptional natural laboratory for investigating the ecological and genetic factors underlying speciation and adaptation to diverse natural and altered habitats. Moreover, because the geological evolution of the main islands is well documented, is possible to accurately date genetic divergence times with known geologic events. There is no other place on earth where this can be done as easily or comprehensively. On a different scale, understanding the functioning of ecosystems, interactions of species within them, and the links among terrestrial, aquatic, and marine systems in both intact and altered ecosystems is critical for sustaining the long-term health of our global environment. Hawaii offers unprecedented opportunities for comparative ecological studies in terrestrial, aquatic, and marine systems at many levels of disturbance. It has the greatest number of endangered and invasive species of any state in the nation, making it an ideal location to study impacts of habitat alteration and invasive species on endangered populations. Sound management of the Hawaiian Islands' rich biodiversity, including protection of rare and endangered species, will require an understanding of the evolutionary and ecological processes that generate and maintain this diversity.

A major goal of this NSF RII proposal is to improve Hawaii's research infrastructure under the overarching theme of *"Collaborative Research for Ecology, Evolution and Cyberinfrastructure"*. Consistent with this theme, our RII plan builds Focal Area Science & Technology (FAST) Teams to enhance the national competitiveness of these research fields. FAST Teams will bring together top scientific professional from around Hawaii and from mainland universities to collaborate on research programs. This cadre of faculty, researchers and Post-doctoral Scholars will develop innovative and compelling research programs that are highly relevant to Hawaii and of strategic national importance.

BROADER IMPACTS: During IMUA I, Hawaii enhanced its ability to expand national partnerships in ecology and evolution research, as well as to generate a diverse high tech workforce that can help protect and sustain its dynamic yet fragile environment. The addition of a cyberinfrastructure program integrating ecology and evolution in IMUA II will further expand the state's ability to train technologically competent technicians that can address critical agricultural, resource management, and cultural conservation challenges currently facing both Hawaii and the nation. The development strategies posed in this proposal are designed to augment Hawaii's research infrastructure to a level where the state will emerge as an internationally renown research center – enabling scientific investigators from Hawaii and mainland universities, federal and state agencies, and private industry to pioneer innovative research programs that can provide multiple environmental protection and economic diversification benefits to all participants. Building upon the significant infrastructure improvements of IMUA I, the current proposal will substantially enhance the understanding and protection of Hawaii's natural environment while establishing the state as a leader in ecology and evolution research, thereby serving as a model for environmentally sound research that provides proactive stewardship.

C. Project Description

I.0 OVERVIEW OF HAWAII SCIENCE AND TECHNOLOGY ENTERPRISE

> "I believe the goals of a strong economy and a protected environment can be compatible. There is tremendous opportunity for environmental responsibility to be an economic force, and for economic force to be environmentally responsible. "- Governor Lingle

Introduction. Governor Linda Lingle's commitment to developing a vigorous economy while protecting Hawaii's precious natural environment continues. This commitment is reflected in the University of Hawaii's values and mission statements (e.g. "*The Hawaiian concept of malama'aina, literally caring for or living in harmony with the land, demands conservation, sustainable use and enhancement of the local, regional and global environment"; "The University is positioned to take advantage of Hawaii's unique location, physical and biological environment, and rich cultural setting*"). These goals are being realized throughout the UH System – largely due to Hawaii's current NSF EPSCoR Research Infrastructure Improvement (RII) Program and associated administrative changes that are helping to integrate university-based research and science education across the Hawaiian Islands.

In the last two decades, the UH System developed its Astronomy and Ocean & Earth Sciences Programs with targeted and sustained resources, sense of purpose, and focused initiatives. As a result, Hawaii now possesses internationally recognized research enterprises in these fields. Hawaii's first NSF EPSCoR RII proposal – *Investing in Multidisciplinary University Activities (or IMUA,* meaning "to go forward" in the Hawaiian language) – initiated the development of a major new integrative research program in Evolutionary Genetics, Ecosystems Research, and Information Technology for Environmental Research. **The current NSF EPSCoR proposal, IMUA II, will build on the success of IMUA I to advance specific research opportunities of high priority to the State and the UH System. Specifically, Hawaii's 2005 RII Plan presents a research agenda that promotes responsible stewardship of Hawaii's ecosystems while enabling its people to assume their roles as technologically literate, critically thinking citizens in a 21st century workforce.** In partnership with the State Department of Business, Economic Development & Tourism (DBEDT), the University of Hawaii will leverage IMUA II to promote the "*opportunity for environmental responsibility to be an economic force*" for the State. IMUA II will continue to build capability in evolutionary genetics and ecosystems research by employing innovative strategy to strengthen Hawaii's collective focus theme areas to mirror highly competitive research groups in some of the most competitive universities in the nation.

2.0 RESULTS FROM PRIOR NSF EPSCoR SUPPORT

Hawaii has successfully used the first NSF EPSCoR RII award to begin developing nationally competitive programs in the three interrelated disciplines of Evolutionary Genetics, Ecosystems Research and Information Technology for Environmental Research. Over the last three years, NSF Hawaii EPSCoR has engaged and gained support from top-level UH System administrators, Hawaii State officials, and key business leaders through the development of the EPSCoR Statewide Committee. This Committee meets at least three times per year (in full membership) to discuss the progress of the IMUA Program and set the stage for further developments. Strategic discussions focus on the statewide relevance and impact of ongoing research, especially in relation to economic development. Committee members include the UH System President, three UH Chancellors, and the UH Vice President for Research; representatives from the Hawaii State Legislature and federal legislators' offices; the Governor's personal designate, members of her Cabinet; and top-level executives from the private sector. A complete list of Committee members is included with the supplemental documents of this proposal.

Hawaii's commitment to the EPSCoR Program is exemplified through the close interaction of its Co-Chairs, Dr. Rose Tseng, Chancellor of UH Hilo, and Mr. Maurice Kaya, Chief Technology Officer, DBEDT, and the Principal Investigator (PI) of the EPSCoR RII grant, Dr. James Gaines, UH System VP for Research. They meet monthly with the Project Co-Directors Drs. Donald Price and Kenneth Kaneshiro and Project Administrator, Terrilani Chong, and System Managing Director, Kevin Kelly, enable the Co-Chairs and PI to keep abreast of project developments and oversee its activities in a systematic and proactive manner.

The research supported by Hawaii's EPSCoR RII Program has been developed by the UH faculty at all institutions within the System, including: (1) the research-intensive Manoa Campus (UHM); (2) the comprehensive Hilo campus (UHH); and (3) the widely-distributed Community Colleges (UHCCs). This faculty-driven development of research initiatives, combined with an analysis of its impacts and outcomes by the EPSCoR Statewide Committee, ensures the infrastructural improvements will have long-lasting support at the highest administrative levels and will attain regional relevance and national prominence.

- **UH increase in federal funding of 80.2%.** General measures of UH's research success include the UH System's increase in total funding awarded – from $180.9M in 2000 to $326.0M in 2004 (a 80.2% increase). This general increase was demonstrated throughout the UH System: (1) UH Manoa awards rose from $170M to $297.2M (74.8%, Fig. 1); (2) UH Hilo awards from $3.2M to $9.9M (209.4%); and UHCC awards from $8.1M to $18.9M (133.3%, Fig. 2). This imparted momentum to the EPSCoR project in Hawaii and resulted in palpable impacts across the UH System.

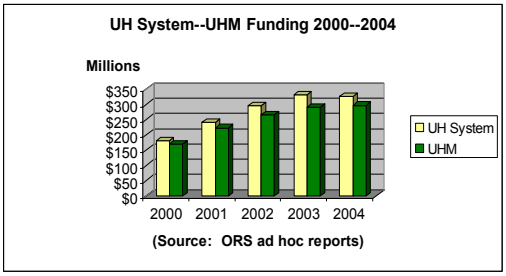


Figure 1

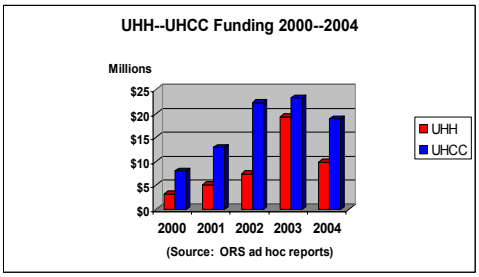


Figure 2

- **UH received most of its federal funding from DoD, NSF and NIH ($137M combined in 2004).** From 2000-2004, NSF funding to UH increased from $23.0M to $32.9M (+43.0%); DoD funding increased from $11.8M to $51.8M (+339.0%, Fig. 3); and NIH funding rose from $25.4M to $52.6M (+107.0%). This was, a period of active NIH BRIN and INBRE programs in Hawaii. The combined total of DoE, EPA, and USDA awards rose from $7.6M in 2000 to $18.4M in 2004 (+142.1%).

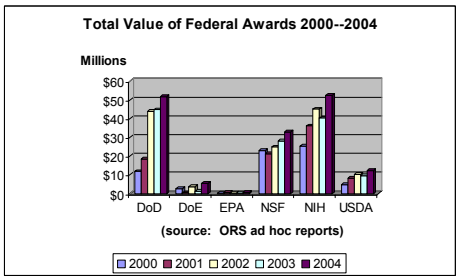


Figure 3

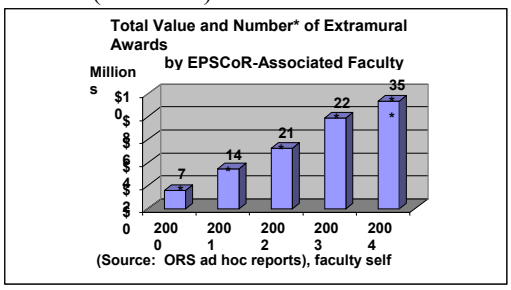


Figure 4

- **Faculty increased research funding from $1.6M to $9.4M (5.9 times) between 2000-2004.** The most significant impact of the NSF EPSCoR RII program in Hawaii has been the increase in the number of proposals submitted and funded by researchers associated with the Hawaii EPSCoR RII Program (as revealed in the second annual report of the current RII project). From 2000—2004, the number of research grants awarded to EPSCoR RII faculty increased from 7 to 35 (+400%), representing a funding increase from $1.58M to $8.39M (+430%, Fig. 4). The award rate of faculty submitted proposals during the period of EPSCoR's first RII in Hawaii is astonishing: (a) **2003 -** EPSCoR RII faculty submitted 31 proposals, of which 22 were funded; (b) **2004 -** 54 proposals were submitted, with 35 funded; and (c) **2005** - 14 proposals were submitted of which five are receiving awards and nine are pending review. The increase in funding and success rate in the EPSCoR focal areas far exceeds the national average.

2.1 Research and Development Thrusts Achievements

The main infrastructure improvement initiative of IMUA I focused on establishing three inter-related research thrusts incorporated under the umbrella of *biodiversity in an integrated island environment*. The three thrust areas include Ecosystems Research (ER), Evolutionary Genetics (EG), and Information Technology for Environmental Research (ITER). A coordinated approach at UHM and UHH developed core, shared-use

research facilities and hired new faculty and technicians which collectively formed the nucleus of a critical mass of researchers and facilities to enhance competitiveness within each thrust area.

Research Thrust Accomplishments

- ***13 Tenure-track Faculty Hired***. Five faculty at UHM: one in EG at Hawaii Institute of Marine Biology (HIMB), 2 in ITER and 2 in ER. Eight faculty at UHH: 3 in EG (Biology and Marine Science), 2 in ITER (Geography), 3 in ER (Biology, Marine Science). One final faculty search will conclude in Fall 2005 in ER (Tropical Forestry). These new faculty complement the current faculty at UHH and UHM who are engaged in IMUA I research thrusts and are supported by the Laboratory Managers in the shared facilities (see below).
- ***Shared-use Genetics Facilities Established:*** Functional Genomics and Evolutionary Genetics facilities at HIMB at UHM and at UHH are equipped for conventional molecular genetic analyses as well as microarray production and reading. The two facilities have provided a series of workshops in DNA techniques: the HIMB Coral Molecular Biology Techniques Workshop, the NSF Chemical Workshop in Molecular Genetics & Population Genetics at UHH in 2004 and Population Genetic and the Phylogenetic Data Analysis Workshop at HIMB in 2005. The facilities have developed partnerships with Oregon State University, Diversa Corporation, Hawaii Biotech Inc., Hollings Marine Laboratory, EnVirtue Inc., Chesapeake Biological Laboratory, U. Chicago, U. Guam, USDA, and USGS-BRD. A $1,478,485 contract from NOAA-National Ocean Service Marine Sanctuary Program was awarded to the genetics facility at HIMB for phylogenetic analysis of Northwest Hawaiian Islands marine species.
- ***Shared-use Analytical Facility Established****:* An Analytical Facility at UH Hilo is equipped with modern environmental analysis equipment and performs environmental analytical procedures (nutrient analyzer, elemental [CHN-S] analyzer, flame atomic absorption spectrometer, total organic carbon and nitrogen analyzer). The facility has developed partnerships with Federal and State agencies with representatives on Hawaii Island (e.g. the US Forest Service).
- ***Field Stations and Field Sites****:* The Waipa Project, on the northern section of the Island of Kauai, encompasses the ecoregions of Waipa, Lumahai, Wainiha, and Limahuli valleys. Several major instruments have been installed for the collection of real-time climatic and micro-habitat environmental data that is wirelessly transmitted to a computer server accessible to any researcher via the Internet. This equipment is enabling analyses of ecosystem status and assists in predicting habitat deterioration due to climatic change, anthropogenic activity, alien species invasions, the emergence of disease vectors such as mosquito populations that transmit dengue fever, or increased incidence of leptospirosis in the streams. The Ecosystems thrust is collaborating with: (1) Stanford School of Medicine, the Biocomputation Center, UCLA, and UH Manoa's Electrical Engineering Department to develop new environmental sensors; (2) Limahuli Gardens, the Nature Conservancy, and the Kamehameha Schools Bishop Estate for use of facilities and land; and (3) the US Fish and Wildlife Service and State Department of Land and Natural Resources for exchanges of information and database development.
- ***Informatics Core Facilities****:* Three computer core facilities have been established in association with EPSCoR and are virtually interconnected. The Information & Computer Science core facility at UH Manoa houses a 64 bit (192 node) processor Linux cluster computer system purchased by NSF EPSCoR, NIH/INBRE, and Dell Corporation purchased. This supercomputer has enhanced data analysis and visualization capabilities at UH. A GIS/Remote Sensing core facility at UHH has 20 departmental workstations in Geography with satellite stations in Biology, Marine Science, and Geology. The Hawaii Natural Heritage Program facility at UHM represents a third cooperative IT facility. These facilities provide satellite imagery for GIS/remote sensing analysis for ecosystems analysis and large data base and computing capabilities for evolutionary genetics research. They also provide services to the broader scientific community including Hawaii Community College, Maui Community College, and county and state agencies (e.g., DLNR, Office of Mauna Kea Management, Hawaii County Planning Office, and Hawaii County Police Department).

2.2. Education and Human Resources (EHR) Accomplishments

The EHR programs emerged as a fourth thrust of the EPSCoR program, building a pipeline of activities across the UH system in science, technology, engineering and math (STEM) disciplines. The overall goals of the EHR component are to increase the competitiveness of Hawaii's faculty and to train and retain more of Hawaii's youth and future workforce in studies and careers related to STEM disciplines.

- ***Faculty Development Programs*** at UHH & UHCCs funded approximately $500,000 to 25 researchers. These faculty members have secured $7.2 million in total extramural grants in the 2 years since the first awards where granted.
- ***An award to UH Hilo from NIH of $4.1 million,*** targeted toward improving research infrastructure at minority institutions, will enable the campus to conduct research into the causes and effects of Type II diabetes.
- ***Student research experience activities and curriculum development*** at UHH and UHCC are expanding the opportunities for local students to enter STEM disciplines as career paths and courses of post-secondary study.
- ***At UH Manoa, a renewal in a GK-12 grant*** enabled Dr. Ken Kaneshiro, EPSCoR Co-Director, to work with a second cohort of graduate students and DOE teachers to improve research-based experiences for K-12 students.
- ***At UH Hilo, a renewal REU-Site grant*** enabled Dr. Donald Price, EPSCoR Co-Director, to involve 10 undergraduates & 2 teachers per summer in environmental research with UHH faculty mentors.
- ***Both Dr. Kaneshiro and Dr. Price have submitted GK-12 proposals during the most recent competition***. A significant number of graduate students will be able to interact with in-service and pre-service teachers as well as students if these grants are awarded.
- ***At UH Manoa, a NSF grant to recruit and retain Native Hawaiians and Pacific Islanders into the Geosciences*** was received in 2005 by Dr. Gibson (EPSCoR hire), Ziegler and Sing for $150,692.
- ***A new Master of Science degree in Tropical Conservation Biology and Environmental Science*** at UH Hilo instituted in Fall 2004.
- ***The Doctor of Pharmacy Program at UH Hilo*** has become a reality, enabling new avenues in science education, careers, and research to be pursued from the Hilo campus.
- ***At Maui Community College, a Tribal Colleges and Universities Program (TCUP) grant*** of $2.5 M was awarded to allow Maui CC to evaluate its math and science curriculum and partner with King Kekaulike High School to become a more effective post-secondary choice for Maui students to pursue STEM courses of study.
- ***At Kapiolani Community College, a TCUP grant*** of $1.25 M was awarded to allow Kapiolani CC to increase the effectiveness of its environmental and physical science programs to enable more students to enter University-level degree programs. This grant will enable Kapiolani CC to interact directly with UH Manoa, UH Hilo, and several universities around the United States to expand articulation agreements in the sciences.
- ***At Kauai Community College a new Title III grant*** of $1.8 M was awarded to implement improved recruitment and strategies as tested the pilot Contextual Math and Science Program that was funded under auspices of Hawaii's first EPSCoR RII grant.
- ***An LSAMP grant*** is being developed that will target Native Hawaiian and Pacific Island students to increase the numbers and quality of these students earning degrees in the sciences.

2.3. Administrative Changes at UHH

During the IMUA I grant period, significant administrative changes were made at UHH. In the College of Arts and Sciences (CAS), UHH will provide new EPSCoR faculty a one-course per year reassignment and two-courses per year for those engaged in extramural research. This will allow new faculty to more completely develop their research programs and thereby increase the quality of research conducted at UHH. This increased emphasis on research at UHH is a direct result of EPSCoR and the hiring of three new university deans who support research. Dr. William Steiner, Dean of the College of Agriculture, Forestry and Natural Resource Management (CAFNRM), is the first Native Hawaiian dean at the UH System and was recently the Pacific Regional Director of USGS Biological Research Division. The combination of his extensive research experience and Native Hawaiian ancestry will be great assets to UHH. Dr. Randy Hirokawa, Dean of the College of Science (CAS), was recently hired from the University of Iowa. Deans Hirokawa and Steiner are both committed to supporting faculty research through "reassigned time" and providing additional laboratory space for research activities. Dr. Marcia Sakai, an Asian female, was recently hired as the Dean of the new College of Business and Economics. Dr. Sakai's focus on Ecotourism as an economic engine for workforce development makes her a valuable addition to the EHR Team described later in this proposal.

The Master of Science degree in Tropical Conservation Biology and Environmental Sciences was recently implemented at UHH. At present, there are 30 graduate students, 27 UHH faculty (8 current EPSCoR hires) and 15 affiliated faculty from federal and state agencies located on Hawaii Island participate in this program which is allowing a more robust research enterprise to flourish among both students and faculty.

3.0 OVERALL STRATEGY TO IMPROVE HAWAII'S S&T COMPETITIVENESS

3.1. Selection and Rationale for Hawaii's EPSCoR Focus. Hawaii's unique natural resources are integral to the state's cultural, economic, and scientific enterprises, and by extension, to those of the entire nation. The first EPSCoR RII Program in Hawaii (IMUA I) focused on evolutionary genetics, ecosystems research, and information technology for environmental research. In January 2005, the Hawaii EPSCoR Monitoring and Assessment Panel (MAP) indicated that while the progress made by IMUA I had been significant, this first three-year period was not sufficient to raise the program to national prominence. The EPSCoR Statewide Committee concurred with this conclusion in January and at the July 2005 meeting recommended that IMUA II: (1) continue to develop the research infrastructure in evolutionary genetics and ecosystems research to a level of national prominence; (2) build on the new faculty hires, campus laboratories and shared facilities and fields sites developed under the current RII; (3) establish innovative mechanisms to stimulate strength based partnerships with mainland scientists conducting research in Hawaii to enhance the UH's critical mass of investigators; (4) further advance the research culture at UHH and integrate Hawaii EPSCoR research focus areas into the curriculum across the System in a way that increases student retention and learning; and (5) reach out to the Hawaiian community and Hawaii's businesses to foster innovation. In accordance with the committee's mandate IMUA II will continue the research infrastructure improvement in ecology and evolution and add cyberinfrastructure as an integrating and support program. Our strategy is aligned with state priorities and exploits new avenues for research infrastructure improvements posed in the 2005 RII solicitation.

Through IMUA I, the UH system has enhanced its ability to expand national partnerships in the areas of ecology and evolution and generate a diverse high tech workforce that can meet Hawaii's need to protect and sustain its fragile and dynamic environment. The addition of a cyberinfrastructure program that integrates ecology and evolution will further enhance Hawaii's capacity for training technologically competent technicians that can address agricultural, resource management, and cultural conservation challenges currently facing the State. Our development strategies posed in this proposal are designed to ensure that the University of Hawaii will emerge with research investigators who are more fully engaged in activities that bring them to the "nationally competitive" level, where they can partner with other top universities, federal and state agencies, and private industry and become permanent collaborators to build Hawaii's knowledge base and increase in areas of national importance.

The Hawaiian archipelago exhibits three key characteristics: (1) exceptional habitat diversity due to a broad range of temperature (altitude effects), rainfall, (rain shadow effects), and substrate ages (volcanic effects); (2) significant connections among its terrestrial, coastal, and marine systems; and (3) a high abundance of both endemic and invasive species. The great diversity of habitats and endemic species in Hawaii is due to the exceptional geographic isolation and multitude of environmental zones. In fact, Hawaii possesses a broader range of climatic zones than any similarly-sized locale on Earth.

The Hawaiian Islands are renowned as ideal settings for evolution and speciation studies (Wagner & V.A. Funk1995). A site of spectacular species radiations representing all stages of the diversification process, Hawaii provides an exceptional natural laboratory for investigating the ecological and genetic factors that underlie speciation and adaptation to diverse natural and altered habitats. Moreover, because the geological evolution of the main islands is well documented, it has been possible to accurately date genetic divergence times with known geologic events. There is no other place on earth where this can be done as easily. On a different scale, understanding the functioning of ecosystems, the interactions of species within them, and the links between terrestrial and aquatic systems in both intact and altered ecosystems is critical for the long-term health of our global environment. Hawaii offers unprecedented opportunities for comparative ecological studies in terrestrial and aquatic systems at various levels of disturbance (Vitousek 2004). It also has the

greatest number of endangered species and invasive species of any state in the US, making it an ideal location in which to study the impacts of habitat alteration and invasive species on endangered populations. Sound management of the rich biodiversity of the Hawaiian Islands, including protection of rare and endangered species, will require understanding of the evolutionary and ecological processes that generate and maintain this diversity. The principles of ecology and evolution that are discovered in the Hawaiian Island can be applied to other regions.

In order to elevate Hawaii's researchers to a level of national competitiveness in the areas of ecology and evolution, while enhancing understanding and protecting Hawaii's natural environment, we will: (1) develop existing relationships between regional partners and accelerate our efforts to attract and incorporate new emerging scientists and established mainland investigators; (2) developing research mentoring programs; and (3) build linkages to the broader non-academic community through community outreach and university-industry partnerships.

3.2. Research Infrastructure Improvement Focal Areas

The unifying theme in the current RII Program (IMUA I) is Biodiversity in an Integrated Island Environment. Our goal is to establish multidisciplinary approaches to overlapping research programs related to the highly diverse biota and environments in the Hawaiian Islands.

In the proposed 2005 RII -IMUA II, the overarching theme is "***Research Collaborations in Island Ecology, Evolution and Cyberinfrastructure***". We will expand on the base created by IMUA I by combining cyberinfrastructure and environmental sensor technology with evolutionary genetics and ecosystems research. The research programs will range from analyses of evolutionary and ecological processes in diverse habitats and across the Hawaiian archipelago to the multidisciplinary problems of invasive species and ecological and environmental perturbations on urban and rural environments. The two overlapping research focal areas of IMUA II are Evolutionary and Ecological Genetics (EEG), and Ecosystem Responses to Environmental Change (EREC) with Cyberinfrastructure for Environmental Research and Education (CERE) as an integrating and support program. These research focal areas reflect the importance of understanding emergent global environmental stresses, as well as a national awareness that environmental changes will have a multitude of impacts on both natural and man-made environments. Developing proposals for major NSF programs such as STC, NEON, CUAHSI, Earthscope, NIH/NSF Ecology of Infectious Disease and others is a major goal of the project and will be reflected in the Hawaii NSF RII IMUA Program outcomes. NSF Hawaii EPSCoR will coordinate with and partner with national centers of excellences such as National Center for Ecological Analysis and Synthesis (www.nceas.ucsb.edu/fmt/doc?/frames.html), the National Evolutionary Synthesis Center (www.nescent.org/), and the Center for Embedded Networked Sensoring (www.cens.ucla.edu).

3.3. Organizing Principles and Strategies.

In IMUA II, Hawaii will build on the general organizing principals of the IMUA I program that have allowed us to build concentrated research focal areas and establish multidisciplinary research programs among the focal areas that span campuses and institutions. A major barrier to obtaining national prominence for Hawaii in EEG and EREC is building truly collaborative groups of researcher who work as a team on related projects. We propose an innovative and comprehensive strategy to build these collaborative teams through four interrelated programs.

(1) Build Regional Partnerships with UHM, UHH, UHCC Faculty and National Partnerships with Researchers from Mainland Institutions and Federal and State Agencies – An essential feature of IMUA II is to advance collaborative interactions among researchers within Hawaii and to build partnerships with investigators from mainland institutions that engage in research related to Hawaii's EPSCoR focal areas. We believe that the best strategy for achieving national competitiveness is to mirror US university programs that have most successfully established teams of researchers in related disciplines. These teams are generally composed of nationally recognized senior faculty, dynamic junior faculty, and talented post-doctoral scholars and graduate students. In the past several years, Hawaii has experienced a large turn-over of faculty in the EPSCoR focal areas and subsequently hired many talented junior faculty. As shown in Table 1, UH hired 14

EPSCoR faculty in the three focal areas. The UH administration embraced the Hawaii EPSCoR program by hiring an additional 14 faculty in the focal areas for a total of 28 faculty. In addition, UH plans to hire six more faculty in two of the focal areas over the next two years.

Table 1. New Faculty Hires in Focal Area Core Teams: EPSCoR hires in IMUA I; Other new UH hires in the last 4 years and planned UH hires in the next 2 years.

Evolutionary and Ecological Genetics	**Ecosystem Responses to Environmental Change**	**Cyberinfrastructure for Environmental Research and Education**
EPSCoR hires		
Karl – UHM Muir – UHH Stacy – UHH Takabyashi – UHH	Fukami – UHM Kido – UHM Hart – UHH Turner – UHH Weigner – UHH	Gibson – UHM Still – UHM Park – UHH Sherriff – UHH
	Forest Ecologist tbd - UHH	
Other new UH hires		
Bowen – UHM	Carlon – UHM	Poisson – UHM
Cowie – UHM	Beets – UHH	Erdogan – UHH
Gaidos – UHM	Weeks – UHH	Ivanova – UHH
Gates – UHM	Steiner – UHH (Dean)	
Rappe - UHM	**Hires in the next 2 years**	
Sherwood – UHM	Two Natural Products Chemists – UHM	Two Computer Scientists (computer modeling and data base) – UHM
Steward – UHM	One Environmental Chemist – UHH	Two Biostatisticians – UHH
Toonen – UHM		

These new faculty have joined the current faculty in these focal areas at UHM and UHH to form a "critical mass" of 44 faculty, including the new faculty in Table 1 and more senior faculty, that comprises our base for nationally competitive teams in ecology and evolution. Our goal is to populate these teams with a cadre of newly minted postdocs versed in collaborative research, and talented graduate students to grow our own strength-based collaboratives in Hawaii working on Hawaii relevant problems with national implications. In addition, we will nucleate these teams with nationally recognized senior scientists from mainland universities.

Our goal is to establish Hawaii as a center of collaborative research in evolutionary genetics, ecological analysis, and cyberinfrastructure research. To ensure that these partnerships continue beyond IMUA II, we will establish ***Focal Area Science and Technology (FAST) Teams*** comprised of: (1) faculty from UHM, UHH, and UHCC; (2) key senior researchers from mainland institutions; and (3) business leaders in Hawaii. These FAST teams will be organized in focal groups to facilitate the establishment of centers of excellence. A key component of these teams will involve dynamic post-doctoral scholars who will be recruited to bridge research among the three focal areas, the UH campuses, and scientists form the mainland. These post-doctoral Scholars will be trained in the emerging multidisciplinary research fields of ecology, evolution, and cyberinfrastructure. They will develop collaborative research programs with faculty from the three focal areas and will plan and implement technical workshops. UH has a tradition of developing post-doctoral fellows, visiting scientists and researchers into tenure-track faculty. IMUA I hires Gibson, Kido, Muir, and Stacy were all either post-doctoral or other temporary personnel at UH who were recruited to tenure track positions. It is the intent of IMUA II to create a pool of "first choice" candidates from among the post-doctoral scholars who will serve as the most likely source of new hires in the near future as UH anticipates a number of retirements in the EPSCoR-related areas. The nature of existing collaborations among faculty in different focal areas and institutions within Hawaii and other US institutions is illustrated in the Appendix II. The FAST Teams will

meet four times per year, once in association with the Statewide Annual EPSCoR Conference, once during the focal area regional workshop, and two additional times via polycom.

(2) Regional Workshops and Shared-used Facilities as Organizing Platforms – Another essential feature of the IMUA II Program is the utilization of the core research facilities to promote interaction among faculty within focal areas. The research facilities and equipment developed in IMUA I will provide technical support for individual faculty, as well as a venue for interaction. These shared-use facilities provide an organizing platform for research projects, workshops for faculty and student training, and support for other faculty and agencies outside the immediate focal areas and at other university campuses within Hawaii. The FAST Teams will utilize these facilities to develop regional science and technology workshops that bring together researchers from around Hawaii and investigators from the mainland US. One regional workshop will be held annually for each focal area. These workshops will be nationally advertised to attract scientists interested in building and participating in research partnerships. We will sustain these workshops beyond IMUA II. Specific technical workshops will also be conducted each year to enable faculty, post-doctoral associates, and graduate students to share and learn new technical skills. Post-doctoral researchers along with the graduate students and laboratory managers will work with the faculty in the FAST Teams to develop the regional and technical workshops.

(3) Research Enhancement Activities Program (REAP) – A third essential aspect of IMUA II will be to expand the REAP program to simultaneously enhance new faculty research activity, encourage current faculty to expand and build research projects in focal areas and, through carefully conceived guidelines, provide incentives for faculty to collaborate among the focal areas. This latter activity (promoting interdisciplinary research activities across focal area boundaries) has significant potential for maximizing EPSCoR's impact in Hawaii. In IMUA II, REAP resources will be targeted to stimulate research activities that can increase the collaboration among researchers within and outside Hawaii, as well as, build the momentum for larger-scale program development. In IMUA II, we will expand the REAP Program to include UHM along with UHH and the UHCCs. Faculty and EPSCoR Post-doctoral Scholars from the UH system, *who engage in research in the focal areas*, will submit proposals to a system-wide committee comprised of representatives from the each of the FAST Teams and the Research Coordinators at UHM and UHH. The overriding criteria for these REAP proposals will be to facilitate competitive research and education projects within and among the focal areas, build collaborations with faculty on all the campuses and with researchers from mainland institutions who will act as senior FAST team member in Hawaii. The REAP funds will establish a UHCC Faculty Research Program that promotes new opportunities for Hawaii's tribal community college faculty to expand their professional development and enrich the curriculum of their undergraduate courses.

(4) Integrate the FAST Teams with Educational and Business Outreach Activities. The FAST Teams will engage with faculty and students at the community colleges and science-related business in collaboration with DBEDT. Partnering with existing programs such as REU-Sites, NSF-funded GK-12, TCUP, and ATE is essential to sustainable and meaningful interaction among faculty and graduate and undergraduate students. This activity builds on the lessons learned from IMUA I and will be broadened to further the impact of research programs and educational activities. In addition, UH will collaborate with DBEDT to promote: 1) UH-private sector partnerships through University-Industry forums; 2) technology innovation workshops and seminars; 3) student internships with science-based companies; and 4) career-pathing materials for STEM disciplines.

4.0 SPECIFIC S&T INFRASTRUCTURE IMPROVEMENT INVESTMENTS AND ACTIVITIES

4.1 Focal Area 1 - Evolutionary and Ecological Genetics (EEG)

Through IMUA I, the evolutionary genetics focal area leaders: (1) hired four new faculty; (2) established core research facilities at UHH and UHM-HIMB; and (3) hired two laboratory managers. There are now at least nine faculty at HIMB and seven faculty at UHH who regularly utilize these facilities for research. These researchers interact with approximately 30 other technicians, post-docs, and students, both graduate and undergraduate, who also use the facilities on a regular basis. Research collaborations and contracts with the

USDA, USGS-BRD, U. of Guam, NMFS, USFWS, Oregon State U., Diversa Corporation, Hawaii Biotech Inc., Hollings Marine Laboratory, EnVirtue Inc., Chesapeake Biological Laboratory, and U. of Chicago are broadening the impact and contributing to the sustainability of these facilities and collaborations. IMUA II will expand this core group of personnel into a highly interactive and sustainable research team with expanded collaborations in evolutionary and ecological genetics. IMUA II resources will be channeled to the establishment and long-term success of this team principally through the hiring of multidisciplinary post-docs and graduate students to promote interaction among investigators, the awarding of REAP grants to stimulate novel research and undergraduate education, and the awarding of travel funds to facilitate greater interaction among investigators and travel to Hawaii for visiting senior scientists. Through these team-building activities, IMUA II will elevate UH's research programs in Evolutionary and Ecological Genetics to a position of national recognition and will position these programs well for the development of large program grants in collaboration with other focal areas.

Management of EEG Focal Area Science and Technology (FAST) Team. An energetic and highly interactive group of faculty forms the core of the EEG FAST Team. These faculty are dedicated to developing UH's competitiveness for large program grants. Dr. Jo-Ann Leong, Director of the Hawaii Institute of Marine Biology (HIMB) will lead the EEG team along with co-leader Dr. Cedric Muir (UHH), a recent EPSCoR hire in Evolutionary and Ecological Genetics. The EEG Team members include: Dr. Brian Bowen (Marine Evolutionary Genetics-UHM), Dr. Robert Cowie (Molluscan Evolution-UHM), Dr. Marta deMaintenon (Evolution and Development-UHH), Dr. Eric Gaidos (Marine Microbial Evolution-UHM), Dr. Ruth Gates (Coral Ecological Genetics-UHM), Dr. Susan Jarvi (Avian Disease Genetics-UHH), Dr. Steve Karl (Marine Evolutionary Genetics-UHM), Dr. Cliff Morden (Plant Ecological Genetics-UHM), Dr. Michael Rappe (Marine Microbial Genetics-UHM), Dr. Alison Sherwood (Algal Evolutionary Genetics-UHM), Dr. Elizabeth Stacy (Plant Evolutionary Genetics-UHH), Dr. Craig Steward (Microbial Evolutionary Genetics-UHM), Dr. Misaki Takabayashi (Coral Ecological Genetics-UHH), and Dr. Robert Toonen (Marine Evolutionary Genetics-UHM). Two faculty from UH community colleges will join the team: Dr. John Berestkey (Molecular Genetics-KCC) and Dr. Inge White (Plant Genetics-WCC). The mainland senior collaborators who have agreed to work on the FAST Team include: Dr. Michael Purugganan – an evolutionary and functional genomics researcher at North Carolina State University who works on evolutionary genetics of Hawaiian silversword plants and rice genomics; and Dr. Jonathan Stillman – an ecological physiology functional genomics researcher at San Francisco State University who works on thermal stress and adaptation in marine organisms.

Table 2. Milestones and Outcomes for EEG FAST Team

Milestones and Outcomes	Date
Hire laboratory managers	Summer 2006
Select graduate students	August 2006
Hire post-doctoral scholars	September 2006
Award REAP grants	November 2006 and each year thereafter
Submit research and training proposals	June 2007 and thereafter
Host technical workshops and seminars	Fall 2006 and each semester thereafter
Host regional workshops	2007, 2008, 2009
Host annual state-wide conference symposium	January 2007 and each year thereafter
Submit large program grants (see Section 8)	2008-2009

Regional Relevance and National Recognition: The EEG FAST Team will focus on two agendas that are of international importance and in which Hawaii is well positioned to become nationally recognized: (1) *Biogeography and Phylogenetics of Marine and Terrestrial Biota* and (2) *Evolutionary and Ecological Functional Genetics*. In the first agenda, the EEG FAST Team will investigate the origin of the spectacular and internationally known evolutionary radiations of plants and animals in Hawaii's marine and terrestrial environments (Wagner & Funk 1995). Their experimental approaches will involve a sophisticated combination of DNA-sequence-based phylogenies and statistical evolutionary models. In the second agenda, the EEG FAST researchers will focus on uncovering the unique genetic processes that underlie local adaptation to diverse environments, as well as changes in gene expression in wild organisms associated with

natural and human-induced environmental change. These problems will be addressed through DNA sequencing/genotyping, DNA and RNA microarray analyses, and real-time PCR. Below, we describe these two main agendas and discuss specific examples of research programs that will be initiated (see also Appendix).

EEG Agenda 1. Biogeography and Phylogenetics of Marine and Terrestrial Biota. The EEG FAST Team will integrate molecular phylogenetic techniques with statistical evolutionary models and knowledge of the geology and ecology of Hawaii to characterize the origin and diversification of marine and terrestrial taxa in the Pacific region, especially Hawaii. Understanding the processes that underlie the origin and dispersal of taxa is a major focus of evolutionary and ecological genetics today. In Hawaii, it is apparent that the pathways of colonization and diversification vary widely between the terrestrial and marine faunas. As a result, Hawaii provides an ideal setting for developing a comprehensive understanding of the processes of dispersal, colonization, and species diversification.

EEG team will elucidate the processes that have given rise to modern-day marine species assemblages in the Pacific region, and the Hawaiian Islands in particular. Since Darwin's time, oceanic island biodiversity has provided biologists with fundamental insight into the processes and patterns of evolution. The evolution of oceanic island biota is therefore of great interest and significance, but the major force that has shaped these biota – trans-oceanic dispersal – is poorly understood. Since Hawaii is not directly connected to the major Pacific currents, but lies between the easterly Kuroshio Current and the westerly Northern Equatorial Current, there are two dominant theories about the origin of Hawaiian coral reef species. The first hypothesis states that reef organisms colonized Hawaii from Japan via the warm Kuroshio Current that passes to the north of the islands. The second hypothesis posits that reef organisms colonized Hawaii from the South Pacific, likely by way of the Line Islands. Support for both of these colonization routes is provided by the existence of a community of coral and fish species in Hawaiian waters both affinities to either West or South Pacific fauna.

Glacial cycles and associated sea-level changes over the past million years have likely had profound effects on Hawaii's marine biota. Sea-level changes can alter the distribution and movement of species over long time periods due to associated changes in ocean currents and the availability of islands to serve as "stepping stones" for dispersal. EEG team will use modern molecular techniques and complex statistical models to examine the origin and diversification of a variety of marine species, including anemone fishes, groupers, snappers, marine snails, vermetid gastropods, porites and porcillopora soft corals, and Hawaiian opihi. They will test hypotheses on the extent to which sea-level changes and ocean currents have influenced the origin and dispersal of marine species. Knowledge of the geology and ecology of the Hawaiian Islands will be incorporated as well to determine the pathways for the colonization of the Hawaiian Islands. This characterization of the origin and diversification of the native biota will set the stage for the design of marine protected area reserves that can help conserve the biodiversity of Hawaii and the Pacific region.

The EEG team will also develop comprehensive phylogenies using modern molecular techniques to examine the biogeography and patterns of diversification of terrestrial taxa in Hawaii and the Pacific region. The terrestrial land areas of oceanic islands represent a miniscule fraction of the Earth's total land area, yet the terrestrial biota of these islands is immensely diverse. For example, the endemic Hawaiian insect fauna includes nearly one-quarter of the world's *Drosophila* species as well as the native Hawaiian crickets, a group which exhibits one of the fastest rates of speciation in the insect world. The land snail diversity of the Hawaiian Islands (about 750 species) is comparable to that of the whole of North America and exhibits unrivalled endemism, exceeding 95%. High rates of speciation and endemism (greater than 90%) are also seen in Hawaii's native terrestrial plants. EEG researchers will use phylogenetic approaches to test hypotheses on the origin and diversification of the Hawaiian and Pacific Island terrestrial taxa, which in turn will lead to major advances in our understanding of the biogeography of this important component of the Earth's biodiversity. Ultimately, the combined analyses of marine and terrestrial species by the EEG Team will allow refinement of general biogeographic theory, especially concerning the relative roles of dispersal, vicariance, and climate shifts in shaping biotic communities.

EEG Agenda 2. Evolutionary and Ecological Functional Genetics. The EEG team will exploit recent advances in molecular biology to investigate the genetics of adaptation and diversification within species and to study the effects of environmental change on gene expression in natural populations. A particularly exciting field that is emerging in evolutionary biology and ecology is the genetics of functional or adaptive traits in natural populations (i.e., molecular evolutionary ecology), and Hawaii is among the best sites for studies of adaptive or functional traits. Investigation of the genes associated with biologically meaningful characters in natural populations is made increasingly possible through the accumulation of information on functional trait genetics from model species as well as through recent developments in high through-put genetic analyses. The former helps to identify genes of adaptive significance, and the latter allows the comparative study of variation in both the sequence and expression of these genes in natural populations. EEG researchers will use these developments as well as microarray and real-time PCR techniques to conduct functional genetic studies of a broad range of Hawaiian taxa. These studies will be complemented by classic field- and neutral-marker-based studies of evolutionary problems in both marine and terrestrial populations.

The EEG team will investigate the genetic basis of adaptive divergence and speciation. Many Hawaiian taxa are still in the process of diversification and as such offer unique opportunities for investigating the process of speciation as it occurs. The Hawaiian *Drosophila* species complex is a well known example of speciation by adaptive radiation associated with host-plants, environmental gradients, and sexual selection. The genetic bases of these adaptations are largely unknown but have been documented to exhibit some simple and quantitative/complex genetic factors. Several Hawaiian plant groups also exhibit a complex of morphological and ecological adaptations. Hawaii's *Metrosideros* and *Chamaesyce* species complexes radiated from single colonists into spectacular assemblages – the former into five species and eight ecotypes, and the latter into 16 endemic species. The Hawaiian *Metrosideros* species complex appears to be in the early stages of diversification and provides an excellent model for studying adaptation and speciation in plants. The ecological breadth of the Hawaiian *Chamaesyce* species is remarkable with plants occurring in coastal strand habitats and dry shrubland, montane mesic and rain forests, and upper elevation zones. Leaf morphology associated with these species is similarly variable, and adaptations to specific environments have been noted. EEG researchers will undertake a multi-disciplinary approach to investigate the process of speciation in these and other species complexes. DNA-based studies of phylogeography and gene flow will address current and historical patterns of diversification. Also, field- and lab-based studies of natural selection will be done to illuminate the biotic and abiotic factors that drive speciation and the temporal scales over which speciation occurs. Lastly, quantitative-trait-locus and candidate-gene analyses will be performed to determine the genetic bases of the adaptations characteristic of these species complexes.

EEG researchers will also use the latest functional genetics techniques to uncover the effects of natural and anthropogenic environmental change on gene expression in marine organisms. Hawaii's near-shore reefs represent over 80% of all coral reefs under U.S. jurisdiction. Hawaii's coral reefs are restricted to fringing reef around seamount islands because of the deep ocean immediately surrounding the islands. Because of the steep topography of the volcanically formed islands, these reefs are heavily influenced by other environments, ranging from the alpine ecosystem to coastal zones. Thus, what happens in Hawaiian terrestrial environments readily affects the fringing coral reefs, and sessile organisms on these fringing reefs naturally experience extreme fluctuations in their physicochemical environment. Added to the anthropogenic threats that Hawaii's coral reefs have sustained to date (e.g., land-based pollution, recreational overuse) are the more imminent threats from coral bleaching, disease, and competition from alien species. Will Hawaii's coral reefs, already under long-term stress from anthropogenic pressures, collapse under these new threats? Or have they evolved sufficient physiological tolerance through long-term exposure to the broad environmental fluctuations characteristic of tall sea mounts? EEG researchers will examine the genetic basis of stress resistance and the role of endosymbiotic zooxanthellae on the resilience of coral to environmental changes. Their approaches will involve DNA sequencing, microarray analysis, and real-time PCR to investigate candidate genes and gene expression.

4.2 Focal Area 2 - Ecosystem Responses to Environmental Change (EREC)
Through IMUA I, the ecosystems research focal area leaders: (1) hired five new faculty; (2) established an analytical laboratory at UHH; and (3) constructed remote field stations on the Island of Kauai. These infrastructure improvements have dramatically enhanced the research capabilities of UH researchers (i.e., analytical capabilities are no longer centered solely at UHM) and have facilitated collaborative projects. Hawaii-based researchers (UH and others) in ecosystems ecology are now equipped to address more complex questions (e.g., terrestrial and aquatic coupling). Through IMUA II, in addition to the benefits of the team-building measures mentioned in Focal Area 1, the EREC focal area will benefit significantly from the acquisition of weather stations, environmental sensors, and growth chambers. Having the necessary infrastructure in place will allow UH to develop a nationally-renowned research program in ecology capable of competing for large program grants in collaboration with other focal areas.

Management of EREC Focal Area Science and Technology (FAST) Team. The EREC Team comprises a large group of researchers committed to the growth of UH's national reputation. Dr. Michael Parsons (Marine Plankton Ecology-UHH) will lead the EREC Team along with co-leader Dr. Lawren Sack (Plant Physiological Ecology-UHM). They will be responsible for organizing the highly interactive EREC Team members: Dr. James Beets (Coral Reef Ecology-UHH), Dr. Robert Bidigare (Marine Plankton Ecology-UHM), Dr. David Carlon (Marine Ecology-UHM), Dr. Kaeo Duarte (Ecohydrology-UHM), Dr. David Duffy (Community Ecology-UHM), Dr. Tadashi Fukami (Microbial Community Ecology-UHM), Dr. Patrick Hart (Avian Ecology-UHH), Dr. William Mautz (Physiological Ecology-UHH), Dr. Will McClatchey (Ethnobotany-UHM), Dr. Jon-Pierre Michaud (Environmental Chemistry/Toxicology-UHH), Dr. Rebecca Ostertag (Ecosystems Ecology-UHH), Dr. Celia Smith (Coral Reef Physiological Ecology-UHM), Dr. William Steiner (Natural Resource Ecology-UHH), Dr. Jason Turner (Aquatic Trophic Ecology-UHH), Dr. Debra Weeks (Environmental Chemistry-UHH), and Dr. Tracy Wiegner (Biogeochemistry-UHH). Two faculty from UH Community Colleges, Dr. David Krupp (Marine Ecology-WCC) and Dr. Fred Stone (Terrestrial Ecology-HCC) will join the team. Three new faculty hires (two in Chemistry at UHM; 1 in Chemistry at UHH) that have natural products and environmental chemistry expertise will join the EREC Team. Regional collaborators who have agreed to work on the FAST Team include: Dr. Peter Vitousek, an ecosystems ecologist from Stanford U., Dr. Brain Tissot, a marine ecologist from Washington State U., Dr. Peter Moeller from NOAA HML, and Dr. Boone Kaufman, Dr. Flint Hughes, and Dr. Susan Cordell from the US Forestry Service in Hawaii.

Table 3. Milestones and Outcomes for EREC FAST Team

Milestone and Outcomes	Date
Hire laboratory managers	Summer 2006
Select graduate students	August 2006
Hire post-doctoral scholars	September 2006
Purchase and install weather stations & environmental sensors	Fall 2006, Fall 2007
Award REAP grants	December 2006 and each year thereafter
Submit research and training proposals	June 2007 and thereafter
Host technical workshops and seminars	Fall 2006 and each semester thereafter
Host regional workshops	2007, 2008, 2009
Host annual state-wide conference symposium	January 2007 and each year thereafter
Submit large program grants (see Section 8)	2008-2009

Regional Relevance and National Recognition: The EREC team will concentrate on two research agendas that are of national importance and in which Hawaii is well positioned to become nationally competitive: (1) *Ecological Analyses in Altered Environments*, and (2) *Biogeographic and Landscape Ecological Analyses*. In the first agenda, EREC researchers will take advantage of the highly diverse marine and terrestrial environments that comprise the Hawaiian Islands. They will estimate the impact of natural and anthropogenic habitat changes on the abundance and community composition of native and introduced species (Vitousek 2004). In the second agenda, EREC researchers will examine the impacts of large-scale ecosystem changes that are brought about through climatic variability, species introductions, and landscape alteration (human-

induced and natural). These agendas are discussed below, with specific examples of research programs that will be initiated through IMUA II (see also Appendix).

EREC Agenda 1. Ecological Analyses in Altered Environments. The EREC team will test the hypothesis that nutrient limitation in the Hawaiian aquatic biota parallels patterns observed in terrestrial ecosystems. In terrestrial systems, the EREC team will examine how terrestrial productivity and other biological processes change during ecosystem development. Terrestrial ecosystem theory predicts that large differences in the sources, losses, cycling, and availability of nutrients occur as raw rock develops into ancient, deeply leached soils. EREC researchers will examine the availability of phosphorus (P) and nitrogen (N), because they are the two elements that most commonly limit plant growth. Over time, the quantity of P in soils declines as PO_4^{3-} and organic P are either leached from the soils or transformed into insoluble/physically protected forms. In contrast, N is absent from most geologically young rocks, and biologically available N is generally in short supply during early soil development. It has been proposed that N should accumulate in the ecosystem until it reaches equilibrium with the supply of P, at a stoichiometric ratio equivalent to organisms' requirements for N and P, generally 15 N: 1 P. Accordingly, plant growth should be limited on young soils by N and on older soils by P; at intermediate-aged sites, neither N nor P should limit plant production. Understanding the dynamics of N and P in soils is critical for understanding ecosystem structure and function.

The EREC team will expand this research to determine the effects that nutrients lost from the forests have on the biota of streams and estuaries in Hawaii. It is generally known that streams carry much of the nutrients lost from terrestrial ecosystems to the coastal zone. These nutrients enter streams from the leaching of dissolved and colloidal material from soils to streams or groundwater and through water erosion of particulate material. However, the effects of terrestrially derived nutrients on aquatic ecosystems are not well understood. This area of research is of great concern worldwide because of the heavy reliance of coastal economies on the quality and health of their waters.

In addition, the EREC team will examine how humans have modified ecosystem processes across Hawaii's environmental gradients. They will determine how invasive species alter ecosystem processes in marine and terrestrial environments, especially in relation to nitrogen and phosphorus. The researchers will also determine the impact of high surface and groundwater flow on the eutrophication of coastal environments. The researchers will determine if changes in nutrient regimes entering coastal environments alter coastal ecosystem dynamics. These impacts may promote microbial and macroalgal blooms and potentially affect marine community stresses or diseases (e.g., coral bleaching). Elevated nutrient flows to estuaries have induced nuisance and toxic algal blooms, fish and shellfish kills, hypoxic and anoxic water, and habitat degradation. Nutrients can also shift the balance between organic matter production (photosynthesis) and destruction (respiration) in an ecosystem. This balance in turn determines whether a coastal area serves as a sink or source for atmospheric carbon dioxide, which further determines the amount of carbon available for organisms and food web dynamics. All of these changes can have severe consequences for coastal economies ranging from water quality issues to loss of commercially important fisheries.

To examine the above problems, the EREC team will: 1) examine how terrestrial productivity and other biological processes change during ecosystem development, 2) determine the quantity and quality of terrestrial-derived nutrients delivered to the coastal ocean, and 3) evaluate the response of coastal waters to these inputs across trophic levels (microbes to tertiary consumers) and across the established terrestrial age gradient. They will initiate this research program with the youngest and oldest of Hawaii's high islands - Hawaii and Kauai, respectively. To determine the quantity and quality of terrestrial-derived nutrients to the coastal zone, researchers will equip watersheds on the islands of Hawaii and Kauai with *in situ* sensors that monitor physical, chemical, and biological parameters. Through IMUA I, the Hanalei Bay watershed in Kauai was equipped with sensors to measure most of the previously mentioned parameters. In IMUA II, we will equip a watershed on Hawaii with similar sensors. Sensors at the mouth of these watersheds and in the receiving estuaries will monitor the effects of the freshwater inputs to coastal areas. Sensors will monitor nutrient levels (i.e., nitrate and phosphate), as well as physical and biological parameters (i.e., temperature, salinity, pH, dissolved oxygen, turbidity, chlorophyll-a). Researchers will evaluate trophic responses using

standard benthic characterization and fish/invertebrate survey methods, stable isotope and fatty acid studies, and standard microbial quantification techniques.

EREC Agenda 2. Biogeographic and Landscape Ecological Analyses. The EREC team will also examine how long-term patterns of climate variability affect ecosystems globally. These impacts are highly contested in the international scientific community. For example, there is an ongoing debate over the role of anthropogenic activities in global warming, as well as the environmental effects of such warming (e.g., more frequent and intense El Niño events and hurricanes). The EREC team will examine long-term patterns of climate variability, coupled with the responses of tropical ecosystems to this variability. Specifically, they will determine the influence of seasonal and longer-term climate variation on the growth, phenology, and survivorship of tropical trees – information that to date has been limited by the short duration of instrumental climate records. The relationship between climate variation and tree growth will be assessed through correlation of local and regional climate records and tree-ring chronologies across a broad gradient of habitat types (inferred from elevation, site conditions, and climate gradients). Variation in these parameters will be contrasted among multiple species and environmental conditions in Hawaii. This work will improve our understanding of current and future climate trends and their effects across local and global scales.

The EREC team will also evaluate the importance of large-scale environmental factors on the connectivity and dispersal of marine organisms. Numerous factors, such as current direction and speed, salinity, and eddy formation, are known to affect the dispersal of larvae. Larval settlement and recruitment are influenced by several factors such as substrate type, water quality, and biotic interactions. The EREC team will assess the relationship between water quality and environmental factors in streams, groundwater, and coastal waters to which marine larvae are exposed. They will develop a biological/environmental model of conditions necessary for successful recruitment. The National Oceanic Atmospheric Association has developed benthic habitat maps for most of the coastal areas of Hawaii, but fine-scale mapping which integrates coastal currents, water quality, freshwater input, and other characteristics, is required for the production of dynamic landscape models. By coupling terrestrial and marine monitor networks, the EREC team will be able to make important correlations between phenomena in both environments and population structure of marine organisms.

4.3 Focal Area 3 – Cyberinfrastructure for Environmental Research & Education (CERE)

The Information Technology for Environmental Research focal area in IMUA I: (1) hired three new faculty; (2) established a GIS/Remote Sensing Laboratory at UHH; and (3) instituted a core facility at UHM that maintains a 64-bit (192-node) processor Linux cluster computer system with enhanced data analysis and visualization. Both facilities collaborate with the Hawaii Natural Heritage Program facility at UHM. The partnership, developed with the support of EPSCoR, enabled the UH System to join the Hawaii Statewide IKONOS (remote-sensing) Consortium. UH faculty participating in Hawaii's EPSCoR program, along with other researchers, utilize these facilities to conduct ecosystem and genetic research (e.g., land cover/land use change analysis). In sum, EPSCoR-supported infrastructure improvements have enhanced the research capabilities of UH researchers and facilitated collaborative projects in the ecosystems and evolutionary genetics focal areas of the EPSCoR program. Through IMUA II, the CERE researchers will be poised to apply the computer systems and sensors to build an innovative cyberinfrastructure system for environmental research and education throughout Hawaii and the Pacific region.

CERE Focal Area Science and Technology (FAST) Team: Mike Kido (Stream Ecology and Sensor Development-UHM) and Dr. James Juvik (Biogeography and Climate-UHH) are co-leaders of the CERE Team. They will be responsible for organizing the CERE team members: Dr. Sevki Erogdon (Computer Science-UHH), Dr. Barbara Gibson (Geographic and Remote Sensing-UHM), Dr. Raina Ivanova (Statistics-UHH), Dr. Steve Itoga (Computer Science-UHM), Dr. Josh Kaakua (Engineering-UHM), Dr. Jene Michaud (Geohydrology and Remote Sensing-UH,), Dr. Sun Park (Remote Sensing and Climate-UHH), Dr. Rosemary Sherriff (Geographic and Remote Sensing-UHH), Norman Okamura and Christina Higa (Satellite UH PEACESAT), and David Lassner and Garret Yoshimi (Information Technology Systems and Internet2). Two faculty from UH Community Colleges will be on the team: Dr. Robert Moeng (Computer Science-KCC) and Dr. John Rand (Physics and Engineering-KCC). Four new faculty hires (two in Information and Computer

Science at UHM; two in Mathematics at UHH) that have statistical modeling and data base expertise will join the CERE Team. Outside Hawaii members will include Drs. Kevin Montgomery and Carsten Mundt (InteleSense Technologies & Stanford's National Biocomputation Center); both are experts in wireless sensor technology and data-base cyberinfrastructure.

Table 4. Milestones and Outcomes for CERE FAST Team

Milestone and Outcomes	Date
Hire laboratory managers	Summer 2006
Select graduate students	August 2006
Hire post-doctoral scholars	September 2006
Implement sensors network & integrate other weather stations and environmental sensors	Fall 2006- 2008
Award REAP funds	December 2006 and each year thereafter
Submit research and training proposals	June 2006 and thereafter
Host technical workshops and seminars	Fall 2006 and each semester thereafter
Host regional workshops	2007, 2008, 2009
Host annual state-wide conference symposium	January 2007 and each year thereafter
Submit large program grants (see Section 8)	2008-2009

Regional Relevance and National Recognition: The overarching objective of the CERE FAST Team is to develop an innovative cyberinfrastructure network for environmental research and education that can serve as an integrator of the IMUA II EPSCoR program (NCAR 2002). The CERE team will focus on two interrelated research agendas: 1) *Wireless Sensor Networks and Interactive Data Systems & Repositories for Environmental Monitoring,* and 2) *Hawaiian Socioecological Systems (SES) Research Sites & Collaboration.* In the first agenda, the CERE team recognizes the need to develop innovative solutions to real-time sensor-based environmental monitoring that can be used to track a range of environmental variables in both natural and human-altered environments. The wireless (radio-frequency devices) and satellite-based systems can be linked together, with data stored in large computer systems for access by IMUA II and other university researchers to support a diversity of analyses and complex data visualizations. In the second agenda, the CERE team will develop enhanced collaboration tools for geographically separated researchers. This system will be developed in collaboration with the UH Department of Information Technology Services' NSF-funded "High Performance Connectivity" Program, and PEACESAT (a UH satellite-based communications network linking educational institutions, health care organizations, governments, and non-profit organizations throughout the Pacific).

CERE Agenda 1. Wireless Sensor Networks and Interactive Data Systems and Repositories for Environmental Monitoring. The scientific and engineering breakthroughs required to deal with humanity's expanding impacts on the Earth's environmental systems such as rapid climate and ecological change, degradation of freshwater resources, and the globalization of disease will in large measure depend upon our ability to advance environmental research and education through the development of "cyberinfrastructure." (Kinzig et al. 2000) In order to address these issues the CERE team will collaborate with InteleSense Technologies, the National Biocomputation Center at Stanford University, the Maui High Performance Computing Center, and UCLA's Center for Embedded Networked Sensors. The CERE researchers and partners will: 1) test new sensor types, particularly commercial products for monitoring soil physiology and dynamics in riparian areas; 2) continue to build test bed sites as new sensors become available to enhance inter-operability and field deployment issues; 3) integrate ocean-observing sensors in collaboration with NOAA/Pacific IOOS with its sustained network of ocean sensors on buoys, ships, satellites, and underwater vehicles; 4) develop application software for small- and medium-scale model advanced sensor webs and information systems as a prelude to predictive forecasting and; 5) develop standards and specifications as a basis for the commercial production of hardware for environmental monitoring.

The core environmental monitoring technology developed through IMUA II will provide the capacity to stream large quantities of environmental data for terrestrial, freshwater, and marine ecosystems to a central geodatabase server, provide basic analysis and visualization capabilities, and distribute data real-time via the

Internet. However, these data will need to be integrated with other data types residing in independent databases in order to address important societal and scientific questions. Therefore, the CERE team will develop or establish: (1) innovative methods for data analysis, storage, and manipulation to include data grids and federation of all classes of databases for community sharing (based on best practices for the systems, the services, and their federation); (2) new tools for handling special data types (e.g., 3D data; structured vs. unstructured data; relational vs. flat data sets); (3) methods and protocols for data security, interface standardization, real-time availability, and preservation; (4) enhanced analysis and visualization tools to support transparent distributed data access and flexible coupling with collaborative environments; and (5) digital libraries with a distributed system of permanent archives, including more comprehensive links among existing digital library projects and federations that would address education requirements of environmental research programs beyond their current discipline-specific foci.

To realize this complex and ambitious endeavor in a cost-effective manner, the research infrastructure improvement programs of IMUA II will dovetail with the ongoing enhancement of core technologies developed by InteleSense Technologies (an EPSCoR-initiated company), as well as the activities of the Pacific Integrated Ocean Observing Systems (IOOS) Data Management and Information Services Program at the East West Center in Honolulu. In addition, the Hawaii Natural Heritage Program, which integrates geodatabase-server and remote-sensing capabilities with UH IT expertise, will participate in a partnership with InteleSense and Pacific IOOS to develop a prototype for a new, holistic, distributed knowledge environment that will provide a "roadmap" for the application of cyberinfrastructure in information management and distribution.

CERE Agenda 2. Hawaiian Socioecological Systems (SES) Research Sites & Collaboration. The second major focus of cyberinfrastructure in IMUA II will be to develop and deploy enhanced collaboration tools to facilitate broader cooperation among researchers and community partners, including businesses, schools, and residential areas at widely dispersed locations in Hawaii and on the Mainland. This will help to further "democratize science" and remove barriers for underrepresented groups. Efficient acquisition, storage, and access to vast and varied types of digital content provide the raw ingredients for the discovery and dissemination of knowledge. When combined with a cyberinfrastructure enabling communications networks among people separated by geographical and/or institutional barriers, efficient data management systems have the potential to create virtual laboratories and technology-enabled research environments that can offer a full spectrum of opportunities in scientific education and research.

Four additional collaborations will be developed to extend cyberinfrastructure networking/access capability to address "last mile" communications issues and promote global connectivity in the State of Hawaii: (1) Internet2 national and international networks will be established through coordination with UH Department of Information Technology Services' NSF-funded "High Performance Connectivity" Program to connect the islands to a national, high-speed Internet2 "backbone" network; (2) PEACESAT's (a program of the UH Social Science Research Institute) satellite-based communications networks will link community college campuses (Kauai, Maui, and Hawaii Islands) with U.S-affiliated Pacific island nations (Palau, Samoa, Fiji, Guam, Federated States of Micronesia, Marshall Islands) to interconnect the environmental cyberinfrastructure Pacific Region-wide; (3) a "Learning Center" on the north shore of Kauai will provide cyberinfrastructure-enabled education and training to native Hawaiians and other disadvantaged clientele to enhance their workforce skills and thereby stimulate new employment opportunities by linking native Hawaiian communities on lands privately owned by The Kamehameha Schools (Waipa and Lumahai) to the academic community through the Internet2 backbone; and (4) a prototype network of InteleNet Weather Watch stations will be established in five public schools on Kauai, Oahu, Maui, and Hawaii which will provide real-time climate information to Hawaii public schools and open the door to new opportunities for elementary and secondary school students to engage in science and technology learning and discovery.

The Socioecology System (SES). Research infrastructure development in IMUA I resulted in the establishment of "SES Research Sites" on Kauai and Maui, forging new partnerships with community organizations such as The Kamehameha Schools, Waipa Foundation, Maui Land & Pineapple Company, Inc., and National Tropical Botanical Garden. In their respective regions, these groups are actively involved in various projects aimed at

balancing sustainable economic activity with responsible resource management, conservation, and native Hawaiian cultural protection programs. Learning communities established around EPSCoR-funded cyberinfrastructure are aimed at increasing their capacity to understand the nature of Hawaiian socio-ecological systems and to help guide decision-making.

In IMUA II, SES Research Sites will be expanded to include locations on the Island of Hawaii. Collectively, these sites will continue to serve as testbeds for technological innovation, as well as "collaboratories" for environmental education and training, workforce development, and community outreach. The objective of this component of the CERE focal area will be to develop the social and academic capacity of learning communities to better understand the relationship between humans and the natural world. Utilizing currently-funded EPSCoR facilities and staff, this effort will be project-oriented and synergize with existing community-based programs.

In collaboration with an ongoing effort in the Waipa / Lumahai SES Research Site on Kauai (focused on understanding the social, cultural, ecological, and biophysical evolution of the region as a basis for long-term planning and management), cyberinfrastructure will be developed to provide the technological and conceptual frameworks required to understand the dynamics of a socioecological system. To achieve this, an interdisciplinary team of CERE researchers, providing expertise in the disciplines of archaeology, ethnobotany, sociology, economics, engineering, marine/freshwater ecology, ecosystem health, GIS technology, and ecoinformatics will engage with learning communities to help define the types of social and ecological factors that impact these communities, determine how they can be measured on spatiotemporal scales, and then assess how they can be translated/communicated to the general public in useful ways. In addition to developing publishable guidelines for studying the biophysical and social components of an SES, this project component will promote technological innovations in distance learning and in the storage, translation, dissemination, and visualization of disparate data types (e.g., cultural, ecological, social, economic, GIS). The exportable models and technologies developed through these initiatives will facilitate a more comprehensive understanding of the spatiotemporal impact of humans on the environment.

5.0 OUTREACH, EDUCATION AND HUMAN RESOURCES DEVELOPMENT

From an ethnic, cultural, linguistic, and socioeconomic perspective, Hawaii's population base is clearly among the most diverse in the nation. Yet as with the Islands' multifaceted ecosystem, Hawaii's socio-cultural diversity affords both opportunities and challenges to local communities. The proposed HI-EHR program builds on the most promising recruitment and retention activities implemented under the current EPSCoR grant (see EHR Accomplishments) to develop structured interdisciplinary courses as a means of integrating interdisciplinary environmentally-focused research into the curriculum and to increase STEM student performance that results in higher numbers of STEM graduates prepared to meet changing needs in science fields. The FAST collaborative model provides the anchor for UH system's shared commitment and vision to provide students with interdisciplinary courses supported by research experiences and career exploration.

Despite widespread concern for the often disastrous biological, economic, social and cultural consequences of both natural and man-made disturbances to Hawaii's ecosystem, especially among people native to the islands, a declining number of Hawaii's youth are pursuing educational programs in STEM-related fields. Failure rates in undergraduate "gate-keeper" courses (e.g., math, chemistry and physics) are high, and retention of STEM majors in the University System is low. This has led many students to abandon any long-term prospects for STEM-related careers. These issues are being addressed throughout the UH System by a number of projects, some of which include the four Tribal Colleges and Universities (TCUP) implementation grants in varying stages of completion, and others of which are more concentrated at the community college level such as Title III and NSF ATE grants designed specifically to attract and retain more students, particularly Native Hawaiians, to the STEM disciplines. These projects are complemented by NSF REU grants as well as a very successful NSF GK-12 grant at

UHM. Both UHM and UHH await the reviews of further GK-12 proposals. UHM participates in a LSAMP project, and there is a pending LSAMP proposal that UHH will be the lead institution.

The proposed HI-EHR program builds on the most promising recruitment and retention activities implemented under the current EPSCoR grant (see EHR Accomplishments) to develop structured interdisciplinary courses as a means of integrating interdisciplinary research into the curriculum and to increase STEM student performance that results in higher numbers of STEM graduates prepared to meet the changing needs in science fields. The FAST collaborative model provides the anchor for UH system's shared commitment and vision to provide students with interdisciplinary courses supported by research experiences and career exploration. At the heart of the HI-EHR activities is: (1) industry/university partnerships, (2) education activities that integrate IMUA interdisciplinary research into courses to support student recruitment and retention; and (3) HRD activities that increase faculty and FAST Team engagement in educational improvement at the undergraduate and graduate level. **The following activities will be supported by DBEDT and the University System at a level of $500,000 per year.**

Outreach

University-Industry Partnerships. The legislative and administrative branches of Hawaii's State government recognize the significant potential of science and technology as drivers for economic development. As such, the State is committed to promoting statewide programs that can: (1) help expand existing and establish new businesses in Hawaii's technology sectors; and (2) enhance economic competitiveness in traditionally non-tech sectors through innovative applications of science and technology. The Hawaii State Government and the UH System have each committed $250,000 in 2006 and an additional $250,000 in 2007 for the Hawaii IMUA II EPSCoR program to help develop such programs through university-industry partnerships (see support letters).

A successful technology-based growth strategy is reliant upon several factors, including but not limited to: (1) a resilient and competitive research infrastructure; (2) the ability to transfer spin-offs from basic research to the private sector for commercialization; and (3) a workforce trained in critical research and technological skills. However, a lack of sufficient collaboration between Hawaii universities and private industry to date has impeded the commercialization of new technologies, as well as the economic growth and diversification that would result from technology transfer to the private sector.

Hawaii's EPSCoR program can directly address these concerns by enhancing and diversifying the State's research infrastructure, facilitating technology transfer, and expanding workforce development and training opportunities. While federal EPSCoR funding will be used to augment UH's research and education infrastructure, State funds will be targeted to support projects that can help: (1) forge collaborative university-industry partnerships to augment technology transfer and commercialization and (2) expand and diversify workforce development activities statewide, with an emphasis on programs that support the RII focal areas identified in this proposal.

In concert with these goals, as well as the State Administration's economic development priorities, UH's research/technology innovation potential, and the overall ecology/evolution research focus of IMUA II, university-industry partnerships and workforce development programs will be developed in the areas of marine and environmental science, biotechnology, and cyberinfrastructure. Marine/environmental science projects will emphasize applications in aquaculture, remote sensing of ocean environments, and conservation biology. Biotechnology programs will support activities involving evolutionary/ecological genetics, biogeographical analysis, and transgenic research for bioinnovation. Cyberinfrastructure projects will integrate the disciplines of ecology and engineering to train technologically competent technicians who can address agricultural, resource management, and cultural conservation challenges currently facing the State (e.g., through the development of new environmental sensors and web-based delivery, visualization and analysis of real-time environmental data).

Four types of projects will be supported in each technology area:

1. ***University-Industry Forums.*** The Hawaii Department of Business, Economic Development & Tourism (DBEDT) is working with UH to identify and promote new opportunities to commercialize innovative spin-offs from basic research. Recognizing that university-industry partnerships are key to both identifying and realizing such opportunities, the department and university co-founded a University-Industry Forum (UIF) to provide a venue for university faculty/students and local technology entrepreneurs to discuss their mutual research interests and explore potential areas for long-term collaboration. The goal of UIF is to facilitate expanded education and training programs, cooperative research agreements, and ultimately commercial product development in strategic technology sectors (those with "high growth potential").

Initially focusing on the field of Applied Optics, the UIF sponsored a technology sector planning meeting, followed by a series of monthly seminars, during which university researchers and industry have exchanged information concerning their respective research interests/programs and explored opportunities for collaboration. This prototype activity is helping establish: (1) a degree program in Applied Optics at the University; (2) new research alliances between university laboratories and technology-based companies in Hawaii; and (3) innovative opportunities for workforce training in high-demand technology skills. In collaboration with UH, DBEDT will utilize EPSCoR State funds to expand the scope of UIF to EPSCoR-related technology sectors, with emphasis on marine and environmental science, biotechnology, and the development of cyberinfrastructure.

2. ***Technology Innovation Workshops and Seminars.*** Complementing the UIF initiative, EPSCoR State funding will be used to develop and facilitate community seminars and workshops introducing university researchers and business entrepreneurs to strategies/best practices for building public-private partnerships to support technology transfer and commercialization.

3. ***Student Internships.*** Summer/year-round internship programs, sponsored by both university laboratories and Hawaii-based companies, enable college students to gain practical hands-on experience in applied research including the design, development, and/or utilization of research equipment and protocols, as well as to make invaluable professional contacts for developing their careers. Technology certification programs at universities and community colleges also provide students with specific knowledge/skills in high demand by local technology companies. EPSCoR State funds will be used to hire a full-time coordinator for student internship/certification activities to: (1) research "model" programs (statewide and nationally); (2) identify technology training/ certification needs within local industry; (3) seek both university and industry support to expand student internship and certification programs – building upon existing training programs that have proven highly successful (e.g., INBRE, EARDA, USDA/NASA programs), and broadening the variety of university-industry partnerships to diversify their scope (in concert with local technology skill demands); and (4) develop community outreach activities to publicize these programs and promote their growth and diversification.

4. ***Career Pathing Activities.*** Providing K-12 and college students with "real-world" insights into options for future employment in science and technology can both inspire student interest in related fields and assist with career choices. EPSCoR State funds will be used to facilitate collaborative efforts among the Dept. of Education, UH and DBEDT to (1) build more effective linkages between K-12 and community college/university career pathway programs; (2) develop career-pathing materials (e.g., video presentations; CD-Rom programs; websites) that enable students to identify their vocational aptitudes/interests and explore opportunities for pursuing same in both collegiate and vocational settings; and (3) support K-12 professional workshops bringing government, university, and industry representatives to both public and private schools to discuss technology-related careers.

Education

UH Programs for STEM Education and Human Resource Development. To address this growing concern, IMUA II will support proven EHR initiatives with strong potential for promoting the development of a Hawaii-based workforce that is scientifically and technologically proficient. Examples of such initiatives currently operating through the UH System include the *Contextual Math and Science project* at Kauai Community College, the System-wide *Marine Option Program* and *Pacific Internship Programs for Exploring Sciences*, and the *Hui Konohiki* at UHM that strongly combines Hawaiian culture and sciences with traditional academic sciences. The long-term key to developing and sustaining a scientifically and technologically trained workforce as well as a robust economy fueled by scientific and technological innovation, lies with university-industry partnerships.

Integrating Education and Research

IMUA II will use REAP awards to support individual faculty and post-docs as well the FAST Teams to integrate their research results into the curriculum for undergraduate students so that the knowledge in the Ecology and Ecosystems is imparted to the students.

Human Resource Development

A major goal of the IMUA II is to embrace the community colleges in the program by making community college faculty members of the FAST teams. The faculty are eligible for REAP awards and it is expected that they will use their research experience to apply for REAP awards to incorporate their research programs into the community college curriculum. In addition, these faculty, as part of the Teams, will acquire both content knowledge in Evolutionary Genetics and Ecosystems, and understand the value and importance of these areas to the Island, and acquire a better understanding of the collaborative contemporary science. In addition, a considerable portion of the IMUA II effort is directed at supporting post-docs, graduate students, and undergraduates, with an emphasis on Hawaiian native students.

6.0 MANAGEMENT PLAN

IMUA II recognizes the importance of a cohesive management team that works in concert with the Statewide Committee. The PI, PDs, and the PA are *ex-officio* members of that Committee and attend all its meetings. The Administrator acts as Executive Secretary of the Committee in order to ensure that communications between it and project operations are seamless.

6.1 Governing Committee: The Statewide Committee in Hawaii is a high-level administrative body composed of the University President, three Chancellors (one of whom serves as co-Chair), a Vice Chancellor for Academic Affairs, the Dean of the College of Natural Sciences, Department Chairs and a Research Council Director, and prominent research faculty from the university community. Government sector representatives include a member of the Governor's Cabinet and several Executive Chambers staff, with the Chief Technical Officer of DBEDT serving as co-Chair. Several members of the Hawaii State Legislature and staff members from Hawaii's federal legislative offices also serve on the Committee, along with top executives from Hawaii's private sector, including a Vice President of Morgan Stanley, the CEO of Hawaiian Electric Company, and the CEO of Hawaii Biotech. See the supplemental document titled Statewide EPSCoR Committee for a list of the current committee.

The primary responsibility of the Committee is to act as an independent organization on behalf of the research and technology transfer interests of the State of Hawaii. The Committee is specifically charged with providing policy guidance and coordinating administrative functions for the EPSCoR program in Hawaii, and serves as the primary advocacy group for this initiative.

The Committee is organized into three subcommittees: (1) Federal Agency Advocacy; (2) Meetings and Workshops; and (3) Outreach. The Federal Agency Advocacy subcommittee's specific charge, as stated in the by-laws of the Statewide Committee, is to, "*identify federal EPSCoR funding opportunities for which Hawaii qualifies and advise the Hawaii EPSCoR administration to develop strategies to identify and promote*

collaborations within the education, research and industry sectors of the state." This subcommittee coordinates briefings across the State regarding the DEPSCoR program, and serves as the point of contact and coordinator for the DoE EPSCoR competition. Communications between NSF EPSCoR and NIH IDeA INBRE projects are also coordinated by this subcommittee, which is chaired by Dr. James R. Gaines, NSF EPSCoR RII PI and Vice President of Research for UH.

The Meetings and Workshops subcommittee is charged with organizing and publicizing major events, such as Hawaii's annual EPSCoR conference, and eventually will submit a proposal to host the EPSCoR National Conference. This subcommittee will work to ensure that Hawaii's EPSCoR story is broadly and effectively publicized among local communities. This subcommittee is chaired by Dr. Peggy Cha, Chancellor of Kauai Community College.

The Outreach subcommittee is responsible for conducting and coordinating all outreach sessions by visiting NSF program and other federal agency officials. They coordinate with the PA to ensure all UH System campuses participate in the informational sessions. Agency representatives present their briefings on all major neighbor islands or researchers and business partners from the islands are given the opportunity to attend the workshops at a nearby island of their choice. During IMUA II, the Outreach subcommittee will continue to work closely with the Communications team to ensure that information flows freely and effectively. This subcommittee is headed by Mr. Theodore Liu, Director, DBEDT. In order to ensure this subcommittee can achieve its goals in the most effective manner, the following Communications Plan will be implemented in conjunction with the UH System Office of External Affairs and University Relations and the DBEDT Public Relations Office.

6.2 IMUA II Management Team is comprised of the PI, Dr. James R. Gaines, Vice President for Research of University of Hawaii, who will provide scientific and technical leadership and Project Co-PDs, Dr. Donald Price, Director of the Master of Science in Tropical Conservation Biology and Environmental Sciences and Dr. Kenneth Kaneshiro, Director of the Center for Conservation Research and Training. They are assisted by PA, Ms. Terrilani Chong. Dr. Price and Ms. Chong will act as the day-to-day Operations leads. They will work across UH and report to Dr. Gaines. Dr. Price will provide overall program management including: external relations; program and strategy development; fiscal administration; and communication with NSF EPSCoR, researchers, the legislature and other audiences, and other program initiatives. He will ensure that EPSCoR research, education and outreach project initiatives are carried out in accordance with proposed timelines, monitoring and evaluation plans. The Co-PDs will meet with the FAST leaders three times per year to assess progress in meeting timelines and milestones in each of the research areas. The Co-PDs will prepare the annual report for submittal to NSF, the base document for Hawaii's EPSCoR Annual Report. This report will be distributed to the Statewide Committee and to the Governor directly.

Milestones and Timelines. The specific milestones and timelines for each focus area science team are included under the science discussions.

The Project Administrator's office will employ a 0.5FTE dedicated Fiscal Officer. The FO will be entirely conversant with the issues of this project and address concerns of the many sub-accounts. Ms. Judith Rubano, Acting Director of Administration of the School of Ocean & Earth Sciences & Technology will serve as the Program Funding Manager on a consultancy basis, contracted through the Vice President for Research's office.

The FAST leaders, reporting to Drs. Price and Kaneshiro, will be responsible for managing their respective areas, facilitating collaboration and interactions within and across the respective UH campuses, and ensuring EPSCoR is an integral component of each institution's R&D plan. Quantitative and qualitative methods will be employed in the evaluation process to assess and measure appropriate indicators of goal achievement. The evaluation methods and measures are discussed in detail in section 7.

6.3 Technical Assistance: The Operations team will work in concert with FAST leaders and their Laboratory Managers to ensure proper levels of technical assistance are made available to local researchers as they

continue to develop their research portfolios. Workshops featuring visiting NSF program officers will be included in IMUA II's technical assistance activities, along with timely informational sessions on upcoming research opportunities at NSF and other federal agencies. These activities will ensure EPSCoR participants across the State are aware of each other's research interests as well as federal agency program deadlines, thereby increasing both interactions among researchers and their competitiveness in national grant competitions. Operations staff will: (1) assist with proposal planning and development; (2) conceptualize frameworks for university-industry-government collaboration; (3) bring experts to Hawaii in a mentoring capacity, both individually and through professional workshops (e.g., Outreach visits by NSF Program Officers and Visiting Scientist Program); (4) enable new cross-disciplinary and/or multi-jurisdictional collaborations in relevant research areas; and (5) work with the Evaluator to design effective program assessment tools.

IMUA II COMMUNICATIONS PLAN

Objectives.

1. Generate awareness of the IMUA II program as an integral and prime motivator for improving research infrastructure and development in the state of Hawaii.
2. Communicate effectively with all interested audiences about the purpose and benefits of the project.
3. Provide continuous updates to interested audiences on EPSCoR Hawaii's research initiatives.
4. Recognize the outstanding work of participating researchers and educators from the UH and State.

Target Audiences – Many groups will benefit from IMUA II by participating in this effort to improve the research, education, and workforce development climate in Hawaii, including: Project partners, scientific communities, other EPSCoR jurisdictions, NSF EPSCoR Office, UH faculty, staff and students, K-12 students, State administration and agencies, Legislature, Private sector, Military, General public, Media.

Communications Activities. The following activities will increase awareness of IMUA II in Hawaii:

Announcement of Grant Award: A news release will be distributed to local media and target audiences to announce the renewal of further funding for the EPSCoR RII Hawaii program, pending grant award.

Web site: Frequently updated information will be made available via the Internet on the EPSCoR Hawaii Web site (www.epscor.hawaii.edu). Links to the site will be included on the UH system and project partners' sites. Project participants and others will be able to obtain information about the progress of the project, newsletters, fact sheets, annual reports, announcements, and other pertinent information.

Newsletter: A quarterly newsletter will inform and update key groups and individuals. Newsletter items will include messages from the Project Directors, updates on specific programs, spotlights on faculty/researchers, meeting notices, announcements, and other timely news and updates.

Media relations: A media relations plan will be developed to maintain communications and keep Hawaii EPSCoR in the media for the duration of the project by use of news releases, calendar announcements, story pitches, guest interviews on broadcast programs, letters-to-the-editor, etc.

Development of informational materials: Educational materials and publications such as brochures, fact sheets, press kits, annual reports, CDs, DVDs, videos, etc. will be developed and distributed to target audiences. These materials will include useful information regarding the project and related issues, such as the value of research and higher education, and discussions of biodiversity and biotechnology.

Site visits: Visits to research facilities will be conducted for key audiences to give them a first-hand look and provide them with a better understanding of the EPSCoR research areas. Researchers will describe the current situation and explain the outcome and benefits to society of their work.

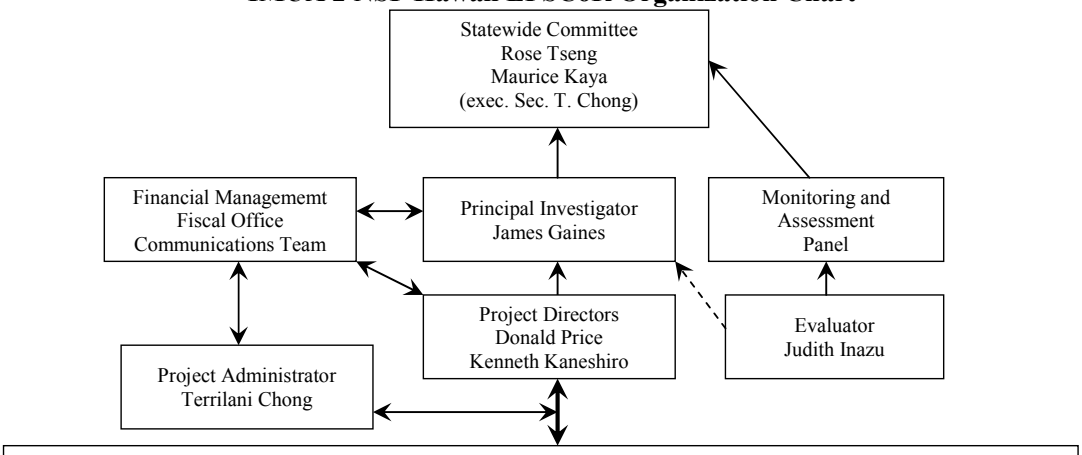
Briefings for key individuals/groups: Hawaii EPSCoR representatives will provide informational briefings to elected officials, including county, state and federal representatives, business leaders, university administrators, public meetings, etc. and offer background on the project and updates.

Special events: EPSCoR Hawaii will hold or participate in various events to build relationships and increase awareness of IMUA II and its partnership collaborations locally and on the Mainland. These events might include receptions, lectures, conferences, open house events, "Research Day" at the State Capitol, blessing and dedication ceremonies for new facilities, and others.

6.4 The Role of the Evaluator and the Monitoring and Assessment Panel (MAP): The Evaluator will conduct interviews of IMUA II participants and design survey instruments that will inform the MAP

Committee of program progress to date. MAP will use the surveys as a basis for preparing its own set of interviews. The Evaluation Plan is discussed in greater detail in Section 7.

IMUA 2 NSF Hawaii EPSCoR Organization Chart



7.0 EPSCoR EVALUATION PLAN

A combination of formative and summative evaluation approaches will be used to monitor IMUA II inputs and resources, assess activities, identify implementation difficulties, and document program outputs and outcomes. The evaluation will address the extent to which: (1) research providing solutions to problems of regional and national significance; (2) "innovation" being pursued; (3) Hawaii's STEM workforce is being enhanced; (4) research collaborations are being formed; (5) targeted research areas are becoming nationally competitive and sustained without EPSCoR support; and (6) lasting improvements are being made to research infrastructure? These questions will be addressed within the following framework:

- **Formative Evaluation.** To monitor project planning, startup, and implementation. Were the intended strategies implemented, and with what quality?
- **Summative Evaluation**. To assess the overall effectiveness of the program. Were the intended outcomes achieved? What indicators suggest the program was successful? What unintended consequences occurred?

Formative Evaluation. Evaluators will work with project administrators to document grant implementation and provide feedback to project administrators. The formative evaluation will assess progress towards goal achievement and highlight problems/issues that warrant attention. The primary purpose is to document what was implemented and provide feedback for improvement. A Gantt chart displaying a checklist of activities will be developed by program evaluators/administrators and completed weekly by administrators. The checklist will include tasks, deadlines, difficulties encountered, and how problems are being addressed. Evaluators will review charts weekly and report any problems to the PI and Management Team.

Interviews with faculty, observations of workshops/seminars, student interviews/surveys, and document analyses will be conducted. Faculty/student surveys will be administered at project inception to establish baseline data and during the grant, to assess program satisfaction and identify problems, barriers, conflicts, and other mid-term difficulties. Assessments will be administered during grant events (e.g. at workshops/colloquia, or via e-mail). Similarly, surveys/interviews with private sector partners will be conducted to identify issues/problems for mid-stream adjustments.

Summative Evaluation. The effectiveness of IMUA II will be measured in terms of short-term outputs and longer-term outcomes.

Research Questions

1. To what extent is research providing solutions to important problems of regional and national significance? A major goal of IMUA II is the creation of innovative, productive core research facilities. Evaluators will track indicators of research and grant productivity by documenting the number of grant proposals submitted and awarded, and the number of research and conference papers submitted and published in peer reviewed journals. Nationally and internationally renowned researchers in targeted areas and the MAP will be asked to respond to a survey assessing the extent to which EPSCoR-related research activities are regionally relevant and nationally significant.

2. To what extent is the workforce in STEM being developed and enhanced? An anticipated outcome of IMUA II is an increase in student enrollments, majors, and graduates in STEM fields, and in the quality of applicants (based on GPA/GRE scores) in graduate programs. Another anticipated outcome is an increase in the *diversity* of students who major/receive degrees in STEM fields, especially women, persons with disabilities, and underrepresented groups in Hawaii.

3. To what extent are research collaborations being formed? Evaluators will monitor formation of collaborations among researchers from different UH campuses, especially among faculty of traditionally disparate disciplines and faculty at both research and non-research-intensive campuses. Increases in the number of multi-institutional proposals, research centers, and research events will be measured, along with increases in the number of partnerships forged by EPSCoR participants and the private sector that support student internships and faculty research.

4. To what extent are targeted research areas becoming nationally competitive and sustained without EPSCoR support? To what extent are lasting improvements being made to research infrastructure? Permanent changes to facilitate research at both research and non-research campuses require changes in policies, procedures, and practices. Thus, changes to tenure and promotion criteria, researcher award structures, teaching loads, and allocations of research overhead will be documented throughout UH. Additionally, improvements/additions to physical infrastructure, such as increases in research space, will be measured over time.

Additional Evaluation Criteria

1. Reports. Status reports will be prepared for review by the MAP and program administrators every six months. Reports will include output data, progress towards achieving goals/objectives, and challenges to be addressed.

2. Capacity-Building in Evaluating STEM Programs. The evaluation effort will incorporate the Hawaii EPSCoR themes of innovation, sustainability, workforce development, and research capacity-building in STEM disciplines. Graduate students from STEM disciplines will assist in the evaluation. These students will be trained in evaluation theory, concepts, strategies and techniques, thereby contributing to the State's overall capacity to evaluate STEM-related programs. Preference will be given to recruiting students from underrepresented represented groups, increasing the diversity of workers in Hawaii with professional expertise in STEM program evaluation.

Ensuring Objectivity To ensure program evaluation is adequately addressed in planning/implementing IMUA II, the lead evaluator, Dr. Judith Inazu, will join the Management Team and oversee the evaluation's design/implementation. To ensure objectivity and validity of the results, an external review will be conducted by the MAP. The MAP will be chaired by Dr. Conrad Katzenmeyer, an expert in program evaluation of STEM disciplines (bio included in Appendix III). The MAP and Evaluation Team will consult throughout the grant period.

Evaluation Office. The Office for Evaluation and Needs Assessment Services (OENAS) will provide grant evaluation support. OENAS is part of the Social Science Research Institute at UHM. SSRI has no organizational or academic ties to the universities and departments involved in IMUA II.

Evaluation Staff. Dr. Judith Inazu, lead evaluator, directs OENAS and serves as SSRI Associate Director. She has worked for more than 25 years as a researcher, instructor, and administrator. Inazu is the lead evaluator for the biomedical research infrastructure capacity-building grant funded by the NIH BRIN/INBRE. Two part-time graduate research assistants (one at UHM and one at UHH) will complete the evaluation team,

assisting with instrument development, data collection/analysis, and report writing. Preference will be given to graduate students from disadvantaged groups in STEM disciplines. .

8.0 SUSTAINABILITY PLAN

As mentioned in the introduction, HI State officials, top-level UH System administrators, and key business leaders have pledged their continued support to the second phase of HI EPSCoR RII project (see letters of support). The State's involvement in UH EPSCoR's success is exemplified through the hands-on management of the EPSCoR Statewide Committee, which is co-chaired by the Chancellor of UH Hilo, and Chief Technology Officer DBEDT, and includes the President of the University System and other leading officials who have all committed to sustain the personnel and activities initiated by this project.

UH will continue to build its research competitiveness and infrastructure through proposed project activities and milestones (see below) to ensure long-range sustainability. Faculty CAREER grants, REAP grants, hiring of appropriate post-doctoral student, and training and mentoring of young faculty will ensure a period of developmental support that will allow access to large-scale NSF and other agency research programs. As junior faculty competitiveness grows through mentoring by senior, competitive faculty, a self-sustaining program will be achieved.

Table 5. Milestones and Outcomes

Source of Funding Research	Benchmarks/Milestones	Amount
NSF ADVANCE	Year 1: UH Hilo Institutional Transformation Award	$2 M over 5 years
NSF ATE	Multiple CC submissions	$900 K over 3 years
NSF CAREER Grants	Multiple Faculty submissions	$500 K over 5 years
NSF Center for Research Excellence in Science and Technology	Year 1: UH Hilo CREST proposal	$1-2 M over 5 years
NSF Cyberinfrastructure Team	Year 2	$ 250 K over 2 years
NSF CCLI	Multiple Phase 2 & Phase 3	Varying amounts,
NSF Dynamic Data Driven Applications Systems	Year 3 for Cyberinfrastructure Data networks	$600 K to $2 M over 3 years
NSF IGERT	Year 2: System-wide	$2-3 M over 5 years
NSF Major Equipment grant	Year 2: establish a wireless climate monitoring network	$450 K over 5 years
NSF MIP	(with M. Lesser UNH) N fixing cyanobacteria and corals	$500 K over 4 years
NSF NEON grant	Year 3: Cyberinfrastructure and environmental sensing systems	$30 M in year 1 and $1-2 M per year for 30 years
NSF Next Generation Cybertools	Year 3	$ 2 M over 3 years
NSF	Microbial consortia on coral reefs	$800 K over 4 years
NSF EPSCoR SBRC or STC	Year 3 – establish National Center in Evolutionary genetics and ecosystems research	$5M over 5 years to $50 M over 10 years.

REFERENCES CITED

References Cited

Kinzig, A and 43 coauthors. 2000. Nature and society: an imperative for integrated environmental research [Online: URL: http://lsweb/la/asu/edu/akinzig/report.htm.]

National Center for AtmosphericResearch (NCAR) and National Science Foundation. 2003. Workshop report of cyberinfrastructure for environmental research and education, October 30-November 1, 2002.

Vitousek, P.M. 2004. Nutrient Cycling and Limitation: Hawai'i as a Model System. Princeton University Press
Wagner, Warren L., and V.A. Funk, eds. (1995). Hawaiiian Biogeography: Evolution on a Hot Spot Archipelago. Washington, DC: Smithsonian Institution Press.

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of Hawaii**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **James R Gaines**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **James R Gaines - Principal Investigator**	0.00	0.00	0.00	$	$
2. **Terrilani J Chong - Project Administrator**	12.00	0.00	0.00		
3. **EHR Coordinator - To be Determined**	6.00	0.00	0.00		
4. **Judith K Inazu - Evaluator**	1.20	0.00	0.00		
5. **James O Juvik**	0.00	0.00	0.00		
6. (**7**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	12.00	0.00	0.00		
7. (**12**) TOTAL SENIOR PERSONNEL (1 - 6)	31.20	0.00	0.00		
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	0.00	0.00	0.00		
2. (**7**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	84.00	0.00	0.00		
3. (**14**) GRADUATE STUDENTS					
4. (**11**) UNDERGRADUATE STUDENTS					
5. (**2**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. (**0**) OTHER					
TOTAL SALARIES AND WAGES (A + B)					
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				1,202,069	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
Growth Chambers (2) $ 40,000					
Sontek ADCPs 42,000					
Weather Stations (10) 30,000					
TOTAL EQUIPMENT				112,000	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				109,320	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 266,000					
2. TRAVEL 22,000					
3. SUBSISTENCE 0					
4. OTHER 29,880					
TOTAL NUMBER OF PARTICIPANTS (**40**) TOTAL PARTICIPANT COSTS				317,880	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				264,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				15,000	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				30,000	
5. SUBAWARDS				0	
6. OTHER				381,000	
TOTAL OTHER DIRECT COSTS				690,000	
H. TOTAL DIRECT COSTS (A THROUGH G)				2,431,269	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **MTDC (Rate: 27.5000, Base: 2001388)**					
TOTAL INDIRECT COSTS (F&A)				550,382	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				2,981,651	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 2,981,651	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **James R Gaines**

ORG. REP. NAME*: **Linda Iau**

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

Other Senior Personnel Name - Title	Cal	Acad	Sumr	Funds Requested
Kaneshiro, Kenneth Y -				
Kido, Michael -				
Leong, Jo-Ann C -				
Muir, Cedric C -				
Parsons, Michael L -				
Price, Donald K - Proje				
Sack, Lawren -				

SUMMARY PROPOSAL BUDGET YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of Hawaii**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **James R Gaines**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **James R Gaines - Principal Investigator**	0.00	0.00	0.00	$	$
2. **Terrilani J Chong - Project Administrator**	12.00	0.00	0.00		
3. **EHR Coordinator - To Be Determined**	6.00	0.00	0.00		
4. **Judith K Inazu - Evaluator**	1.20	0.00	0.00		
5. **James O Juvik**	0.00	0.00	0.00		
6. (**7**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	12.00	0.00	0.00		
7. (**12**) TOTAL SENIOR PERSONNEL (1 - 6)	31.20	0.00	0.00		
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	0.00	0.00	0.00		
2. (**7**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	84.00	0.00	0.00		
3. (**14**) GRADUATE STUDENTS					
4. (**11**) UNDERGRADUATE STUDENTS					
5. (**2**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. (**0**) OTHER					
TOTAL SALARIES AND WAGES (A + B)					
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				1,227,672	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
EC Salinity Sensor (2) $ 6,000					
Growth Chambers (2) 40,000					
MicroLAB Compact Nutrient Monitor 10,000					
Others (See Budget Comments Page…) 25,000					
TOTAL EQUIPMENT				81,000	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				109,820	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 266,000					
2. TRAVEL 23,500					
3. SUBSISTENCE 0					
4. OTHER 29,880					
TOTAL NUMBER OF PARTICIPANTS (**40**) TOTAL PARTICIPANT COSTS				319,380	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				281,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				15,000	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				30,000	
5. SUBAWARDS				0	
6. OTHER				375,750	
TOTAL OTHER DIRECT COSTS				701,750	
H. TOTAL DIRECT COSTS (A THROUGH G)				2,439,622	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **MTDC (Rate: 27.5000, Base: 2039242)**					
TOTAL INDIRECT COSTS (F&A)				560,792	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				3,000,414	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 3,000,414	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **James R Gaines**

ORG. REP. NAME*: **Linda Iau**

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET COMMENTS - Year 2

Other Senior Personnel

Name - Title	Cal	Acad	Sumr	Funds Requested
Kaneshiro, Kenneth Y - P				
Kido, Michael -				
Leong, Jo-Ann C -				
Muir, Cedric C -				
Parsons, Michael L -				
Price, Donald K - Project				
Sack, Lawren -				

**** D- Equipment**

Terrestrial Sensors (4) (Amount: $ 10000)

Weather Stations (5) (Amount: $ 15000)

SUMMARY PROPOSAL BUDGET YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of Hawaii**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **James R Gaines**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **James R Gaines - Principal Investigator**	0.00	0.00	0.00	$	$
2. **Terrilani J Chong - Project Administrator**	12.00	0.00	0.00		
3. **EHR Coordinator - To Be Determined**	6.00	0.00	0.00		
4. **Judith K Inazu - Evaluator**	1.20	0.00	0.00		
5. **James O Juvik**	0.00	0.00	0.00		
6. (7) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	12.00	0.00	0.00		
7. (12) TOTAL SENIOR PERSONNEL (1 - 6)	31.20	0.00	0.00		
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL ASSOCIATES	0.00	0.00	0.00		
2. (7) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	84.00	0.00	0.00		
3. (14) GRADUATE STUDENTS					
4. (11) UNDERGRADUATE STUDENTS					
5. (2) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. (0) OTHER					
TOTAL SALARIES AND WAGES (A + B)					
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				1,254,428	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
Nitrate Sensor $ 30,000					
Weather Stations (10) 30,000					
TOTAL EQUIPMENT				60,000	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				110,330	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 266,000					
2. TRAVEL 25,000					
3. SUBSISTENCE 0					
4. OTHER 29,880					
TOTAL NUMBER OF PARTICIPANTS (40) TOTAL PARTICIPANT COSTS				320,880	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				287,500	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				15,000	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				30,000	
5. SUBAWARDS				0	
6. OTHER				371,000	
TOTAL OTHER DIRECT COSTS				703,500	
H. TOTAL DIRECT COSTS (A THROUGH G)				2,449,138	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **MTDC (Rate: 27.5000, Base: 2068259)**					
TOTAL INDIRECT COSTS (F&A)				568,771	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				3,017,909	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 3,017,909	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **James R Gaines**

ORG. REP. NAME*: **Linda Iau**

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET COMMENTS - Year 3

Other Senior Personnel Name - Title	Cal	Acad	Sumr	Funds Requested
Kaneshiro, Kenneth Y - P				
Kido, Michael -				
Leong, Jo-Ann C -				
Muir, Cedric C -				
Parsons, Michael L -				
Price, Donald K - Project				
Sack, Lawren -				

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Hawaii

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
James R Gaines

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **James R Gaines - Principal Investigator**	0.00	0.00	0.00	$	$
2. **Terrilani J Chong - Project Administrator**	36.00	0.00	0.00		
3. **EHR Coordinator - To Be Determined**	18.00	0.00	0.00		
4. **Judith K Inazu - Evaluator**	3.60	0.00	0.00		
5. **James O Juvik**	0.00	0.00	0.00		
6. (**7**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	36.00	0.00	0.00		
7. (**12**) TOTAL SENIOR PERSONNEL (1 - 6)	93.60	0.00	0.00		
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	0.00	0.00	0.00		
2. (**21**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	252.00	0.00	0.00		
3. (**42**) GRADUATE STUDENTS					
4. (**33**) UNDERGRADUATE STUDENTS					
5. (**6**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. (**0**) OTHER					
TOTAL SALARIES AND WAGES (A + B)					
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)					
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) **$ 253,000**					
TOTAL EQUIPMENT				**253,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**329,470**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **798,000**					
2. TRAVEL **70,500**					
3. SUBSISTENCE **0**					
4. OTHER **89,640**					
TOTAL NUMBER OF PARTICIPANTS (**120**) TOTAL PARTICIPANT COSTS				**958,140**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**832,500**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**45,000**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**90,000**	
5. SUBAWARDS				**0**	
6. OTHER				**1,127,750**	
TOTAL OTHER DIRECT COSTS				**2,095,250**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**7,320,029**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**1,679,945**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**8,999,974**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.C.6.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **8,999,974**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
James R Gaines

ORG. REP. NAME*
Linda Iau

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

C ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

BUDGET JUSTIFICATION

A. Senior Personnel:

- Operations, 2 personnel: Co-Project Director and Project Administrator both at 1.0 FTE.
- Evaluation, EHR, and REAP, 2 personnel: EHR Coordinator at 0.5 FTE and Evaluator at 0.1 FTE.

B. Other Personnel:

Post Doctoral Associates:

- Post Doctoral Associates are paid using a Stipend. Therefore, although this line item is set at zero, please refer to the stipends line item. Each Focal Area Science Team has its own Post-Doctoral Associate who will act as the catalyst for collaboratory research. University of Hawaii anticipates these Associates will become the candidates of first choice for recruitment in the future of tenure tracked faculty in EPSCoR-related positions.

Other professionals/technicians:

- Seven Technicians:
  - One in Operations at 0.5 FTE for web site development and maintenance.
  - One Laboratory Manager in each Focal Area at each of the Manoa and Hilo campuses at 1.0 FTE: total 6. These Laboratory Managers are responsible for maintaining the existing shared use facilities established through IMUA; coordinating workshops for University faculty, staff, students, and outside researchers; and ensuring equipment is kept in appropriate condition.
- Administrative support personnel salaries are requested for one at 1.0 and one at 0.5 FTE.

Graduate Students:

- 14 graduate students are requested:
  - Two in Evaluation, EHR, and REAP to conduct periodic evaluation surveys, at 0.5 FTE. These graduate students will become the nexus of a cadre of STEM-
  - Two in each Focal Area at each of the Manoa and Hilo campuses at 1.0 FTE: total 12.

Undergraduate students:

- 11 undergraduate students will be supported:
  - One in Operations at 0.5 FTE.
  - 10 in Evaluation, EHR, and REAP, each at 0.5 FTE. These students will participate in the science and industry activities and be recruited and supervised through the Evaluation, EHR, and REAP component of the project as interns and undergraduate research associates. IMUA II expects these students will be the candidates from whom the future graduate student interns and research associates will be chosen.

D. Equipment:

Manoa requests funds for equipment in the following focal areas:

- Ecosystem Responses to Environmental Change:
  - Growth Chambers: (2) at $20,000 each in year one
  - Growth Chambers: (2) at $20,000 each in year two
- Cyberinfrastructure for Environmental Research and Education:
  - Weather Stations: (5) at $3,000 each in year one*
  - A MicroLAB Compact Nutrient Monitor at $10,000 in year two
  - Weather Stations: (5) at $3,000 each in year three*

Hilo requests funds for equipment in the following focal areas:

- Ecosystem Responses to Environmental Change:
  - Six Sontek ADCPs at $7,000 each in year one

  - Two EC Salinity sensors at $3,000 each in year two*
  - Four Terrestrial sensors at $2,500 each in year two*
  - A nitrate sensor at $30,000 in year three
- Cyberinfrastructure for Environmental Research and Education:
  - Weather Stations: (5) at $3,000 each in year one*
  - Weather Stations: (5) at $3,000 each in year two*
  - Weather Stations: (5) at $3,000 each in year three*

*Weather Stations and other pieces of equipment noted with this asterisk are part of an overall system of data gathering equipment that will be linked throughout the state. As such, these components comprise parts of a whole and must be considered as such. Costs associated with this system include the sensors, weather stations, and associated expenses related to deployment of the components of the system and its connectivity.

E. Travel:

Funds are requested to facilitate travel to national meetings for EPSCoR and adjunct personnel. Travel for students to attend state, regional and national meetings. Inter-Island travel to facilitate meetings among EPSCoR collaborators in Hawaii. All travel is considered domestic: including travel to Canada and U.S. Possessions.

F. Participant Support:

Support is requested to support participants in the following categories:

- Stipends: Each Focal Area will support one post-doctoral fellow per campus in each year, total of (6). University of Hawaii standard practice is to pay these personnel using a stipend.
- Travel: Funds to support Statewide Committee, Annual Conference, and National Conference travel in each year, and for the Monitoring and Assessment Panel site visits. ($22,000 in year one, $23,500 in year two, and $25,000 in year three).
- Other: Funds to support Visiting Scientist workshops, Annual Conference, and associated charges, in the amount of $29,880 per year.

G. Other Direct Costs:

Materials and supplies

Operations: In year one and two, $22,500 is requested for conduct of EPSCoR office business to include supplies and expenses associated with facilitation of meetings. In year three, the amount requested is $20,000.

Evaluation, EHR, and REAP: In each of the three years $15,000 is requested for conduct of business to include supplies and expenses associated with evaluation and EHR activities. REAP does not generate such expenses within this category.

Evolutionary and Ecological Genetics:

Manoa:

In each year Materials and supplies are requested for laboratory supplies in the shared use facility in the amount of $31,250.

Hilo:

In each year Materials and supplies are requested for laboratory supplies in the shared use facility in the amount of $61,250.

Ecosystem Responses to Environmental Changes:

Manoa:

Materials and supplies are requested for laboratory and field supplies in the amount of $31,250 in year one; $31,250 in year two; and $51,250 in year three.

Hilo:
Materials and supplies are requested for laboratory and field supplies in the amount of $31,250 in year one; $46,250 in year two; $36,250 in year three.

Cyberinfrastructure for Environmental Research and Education:
Manoa:
Materials and supplies are requested for laboratory and field supplies in the shared use facility in the amount of $30,250 in year one; $32, 250 in year two; and $31,250 in year three.

Hilo:
Materials and supplies are requested for laboratory and field supplies in the shared use facility in the amount of $41,250 in each year.

Publications:
Operations requests funding for costs associated with publishing research and scholarly manuscripts in peer-reviewed journal for faculty and students throughout the UH system in EPSCoR focal areas; for publication material to promote NSF EPSCoR activities ($15,000 per year)

Computer Services:
Funding is requested to data acquisition in the focal area of Cyberinfrastructure for Environmental Research and Education in the amount of $30,000 per year in each year.

Other:
A competitive seed grant program will be coordinated in conjunction with the Manoa School of Graduate Studies, the Hilo Research Council, open to Faculty, staff, graduate and undergraduate students, and EPSCoR Post-doctoral Scholars from through-out the ten-campus UH system. Approximately equal proportions will be allocated to the UHM, UHH, and UHCCs as three respective units from this fund. Research must be in one of the EPSCoR-related focal areas. This fund will include $330,000 in year one; $324,750 in year two; and $320,000 in year three.

General support for post doctoral scholars which may include such things as medical insurance, budgeted at $5,000 each.

In Cyberinfrastructure for Environmental Research and Education, $7,000 per year is requested to support database development. Cyberinfrastructure for Environmental Research and Education also requests Helicopter fees in the amount of $14,000 per year for each year.

H. Total Direct Costs = $7,320,029.

I. Indirect Costs are computed on Modified Total Direct Costs, using the rate of 27.5% for Other Sponsored Activities. Base = $6,108,889. Therefore Indirect Costs = $1,679,945.

H. Total Direct and Indirect Costs = $8,999,974.

FACILITIES, EQUIPMENT & OTHER RESOURCES

FACILITIES: Identify the facilities to be used at each performance site listed and, as appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Use "Other" to describe the facilities at any other performance sites listed and at sites for field studies. USE additional pages as necessary.

Laboratory: **EEG Focal Area:**
Manoa:
Genetic Analysis:
Housed in a shared use facility open to faculty, staff, and outside

Clinical: **N/A**

Animal: **N/A**

Computer: **For purposes of this project, computer equipment is listed in the Laboratory inventory as it is in support of the research projects being conducted. See ?Laboratory.?**

Office: **Space available at University of Hawaii at Hilo for Operations staff. This space also enables meetings among collaborators and off-island project members. Space at other Campuses is made available on an as-needed basis.**

Other: **N/A**

MAJOR EQUIPMENT: List the most important items available for this project and, as appropriate identifying the location and pertinent capabilities of each.

See "Laboratory.?

OTHER RESOURCES: Provide any information describing the other resources available for the project. Identify support services such as consultant, secretarial, machine shop, and electronics shop, and the extent to which they will be available for the project. Include an explanation of any consortium/contractual arrangements with other organizations.

Space available in USFS Pacific Basin Agricultural Research Center (BPARC) as lease for visiting scientists related to EPSCoR program. See Supporting Documents for letter.

LABORATORY FACILITIES (continued):

researchers: ABI 3100 Genetic Analyzer, Beckman Coulter 8000 Genetic Analysis System, Beckman Coulter refrigerated centrifuge, (2) Bio-Rad 96-well thermal cyclers, Bio-Rad VersArray ChipWriter Pro System (microarrayer), Bio-Rad Colony Picker Arrayer System (macroarrayer), Beckman spectrophotometer, Molecular Devices plate-reader, incubator shaker, hybridization oven, VersArray ChipReader, DNA freeze dry system, UV crosslinker, (2) plate shakers, speed vacuum, large incubator, tissue lyser, hydroshear.

Hilo:
Genetic Analysis:
Housed in a shared use facility open to faculty, staff, and outside researchers: Beckman Allegra 25R, Beckman Biomek 2000, Beckman CEQ8000, (2) Microfuge 18s, Thermo SpeedVac, Agilent 2100 Bioanalyzer, BioRad iCycler iQ PCR, SpectraMax 190, Axon GenePix 4200A, LiCor 4300, LiCor Odyssey, NanoDrop, (4) MJ Research PCRs, (2) UV Transilluminators, FotoDyne Apprentice System, ABI Thermocycler, Alpha Gigi Doc, Biofuge Fresco, Vacuum Concentrator, Apple Power Mac G5.

EREC Focal Area:
Hilo:
Analytical Equipment:
Housed in a shared use facility open to faculty, staff, and outside researchers: Pulse AutoAnalyzer System - Nutrient analysis of water; Costech Elemental Analyzer - Carbon & Nitrogen analysis (solid samples); Shimadzu TOC-V - Total Carbon & Nitrogen Analyzer- water samples; Varian Vista ICP Optical Emission Spectrometer -elemental analysis; Finnegan Delta-V Advantage Isotope Ratio Mass Spectrometer; Nitrox Air-Fill Station -for filling Scuba tanks; New Center Laboratory Bench; Varian Specta AA 55B, Atomic Absorption Spectrometer -elemental analysis; Sherwood Instr. 4-channel Flame Photometer -elemental analysis; Ocean Optics Spectrophotometer -fiber optic field instrument; Surface Tensiometer - Physical chemistry; Varian Vista ICP Optical Emission Spectrometer -elemental analysis; Muffle Furnace; Orbital Shaker; E-Pure & B-Pure Water purification system; Perkin Elmer Clarius 500 GC-MS (Gas Chromatogrpahy-Mass Spectometer); Turner Fluorometer (3); Thermo-Orion Automatic Titrators (3) - for tirations and Ion selective electrode methods; Beckman DU UV-Vis Spectrophotometer; Shimadzu LC-10 AT HPLC System; Scanning Electron Microscope - Topcon (ISI) WB-6; Ultra Low Temp Freezer; Freeze Dryer; Leica Tissue Processing System; Autoclave; Incubator (2).

Manoa:
Field Stations/Research Sites: On Kauai island in collaboration with Kamehameha Schools, The Waipa Foundation, and the National Tropical Botanical Garden (NTBG), catchment-to-sea scale research sites (~50 sq miles) equipped with real-time environmental monitoring of weather

LABORATORY FACILITIES (continued):

parameters (wind speed and direction, temperature, humidity, rainfall, and light), stream discharge (ultrasound above-stream sensor), and water quality (YSI 6920 multiprobe) are available on the northern (Limahuli, Waipa, Lumahai Valleys) and southern (Lawai Valley) regions of the island. A similar site (~2300 acres) was developed on leeward Maui island on the slopes of Puu Kukui in collaboration with the Maui Land and Pineapple Company, Inc. Real-time data from weather stations and other environmental sensors deployed are available on the Internet through a custom website developed by InteleSense Technologies, Inc.

On Kauai, a joint UH-NTBG field station equipped with wireless internet, two bathroom/shower facilities, large sleeping quarters with bunkbeds, and kitchen was developed in Limahuli Garden within one of the technology test-bed sites. The UH Center for Conservation Research and Training (UH-CCRT) also maintains a stream ecology research field lab in the Wailua Agricultural Experiment Station on Kauai that is fully equipped with wireless internet, a Leica stereo dissecting microscope, assorted fish / invertebrate / plant sampling equipment, a Swoffer Flow Meter, Smitt-Root 12-volt backpack electroshocker and a synoptic collection of native / alien aquatic animals and plants. UH-CCRT also maintains a cabin to support field researchers in the Kilauea Volcano region of Hawaii island equipped with bunk beds, bathroom / shower, and kitchen. UH-CCRT also maintains three plant propagation green houses on Kauai (Waipa), Maui (Olinda), and Hawaii (Kilauea) islands that are able to supply large numbers of native plant seedlings for out-planting in large-scale restoration projects.

CERE Focal Area:
Hilo:
Spatial Data Analysis Instructional Facility
Hardware: (20) Gateway Intel Pentium IV E-6100 2.4 GHz PCs with 15? LCD Flat Panel monitors.
(2) Lexmark E320 printers, HP DesignJet ColorPro GA printer, HP DeskJet 870Cxi printer, HP ScanJet 6300c scanner, and NEC VT540 Projector.
Software: (20) ESRI ArcGIS 9.1 ArcInfo level fixed licenses, (20) Leica ERDAS Imagine 8.7 floating licenses, (20) ERDAS Image Analyst & Stereo Analyst ArcGIS 9.x extension floating licenses, (20) SPSS 13.0 fixed licenses, twenty Stella 8.1 fixed licenses, (20) WinZip 9.0 fixed licenses, (1) EndNote 9.0 license. (11) ArcView 3.x fixed licenses, (25) ArcView 3.x 3D Analyst extensions, Spatial Analyst extensions and Network Analyst extensions licenses, and (11) Jasc PaintShop Pro 7 licenses.

Spatial Data Analysis Research & Remote Facilities
Hardware: (10) Gateway Intel Pentium IV E-6300 3.4 GHz PCs with 19? LCD Flat Panel monitors, (1) Lexmark E321 printer, (2) HP designjet 5500ps large format printers, (2) Dell Precision Workstation M70 Intel Pentium M processor 730/1.60 GHz, (3) Xplore Technologies iX104C2D Fully Rugged

LABORATORY FACILITIES (continued):

Tablet PC Intel Pentium M processor 1.1 GHz, (2) HP iPAQ pocket PCs, (1) ASD FieldSpec Pro Jr. and field accessories, ASD FieldSpec Pro Jr. laboratory accessories: Turntable & MugLight, Trimble GPS Pathfinder Pro XRS backpack system, (2) Trimble GeoXT GPS systems, (2) Garmin Rino 130 Handheld/2-way Radio and GPS units, (1) Garmin GPSMap 60C Handheld/Color Map Navigator GPS Unit, (1) Leica GS20 with High Precision WoRCS RTB external antenna and Leica Laser Locator Rangefinder, (1) Iomega SuperDVD DVD-RW, (2) Universal Smart battery chargers and twenty-four AA batteries, and (1) Sony DCS-P10 5.0 MegaPixel Digital Camera. (1) HP DeskJet 1220c printer, (1) UMAX PowerLook 2100XL scanner, (1) HP ScanJet 4100c scanner, (1) Nikon Super Coolscan 4000 Slide Scanner, and (2) Garmin GPS III Plus units.

Software: (5) ESRI ArcGIS 9.1 ArcInfo level fixed licenses, (14) ESRI ArcGIS 9.1 ArcInfo level floating licenses, (1) ESRI ArcGIS 8.3 ArcInfo level fixed license, (10) Leica ERDAS Imagine 8.7 floating licenses, (5) ERDAS Image Analyst & Stereo Analyst ArcGIS 9.x extension floating licenses, (11) SPSS 13.0 fixed licenses and (9) SPSS 13.0 fixed faculty licenses, (10) Stella 8.1 fixed licenses, (11) WinZip 9.0 fixed licenses, (10) EndNote 9.0 licenses, ESRI ArcPad 6.0, Dreamweaver MX2004, (2) PRIMER v 5.2 license, (1) LF Linux Express v 6.2 floating license, (6) Adobe Acrobat 6.0 Professional licenses, (10) ENVI+IDL with FLAASH floating licenses, (1) AutoDesk AutoCad 2000i LT license and (1) Adobe Publishing Collection v 9.0 license.

Data: DigitalGlobe QuickBird imagery, Space Imaging IKONOS imagery, Analytical Laboratories of Hawaii raw 72 band AURORA hyperspectral imagery and Sure!Map USGS Main Hawaiian Island Raster Topo Maps.

SDAL Server Complex
Hardware: Dell PowerEdge 650 WebServer, Dell PowerEdge 2650 SQLServer, Dell PowerEdge 2850 InstructionalServer, PowerVault 220S with 1.6 TB storage, PowerVault 122T, two spare harddrives, twenty tape cartridges and one Short Rack for Server Complex.

Software: ESRI ArcIMS 9.0, ESRI ArcSDE 9.0, Servlet Exec v 5.x, Thawte 40-bit Webserver Certificate, fifteen Microsoft SQL 2000 Server client access licenses

Manoa:
University of Hawaii Dell Cluster A high performance computing environment comprised of 99 computer nodes each equipped with dual 3.2 GHz Xeons and 2GB of RAM. This facility allows EPSCoR researchers the ability to expedite computational work by leveraging computing resources and personnel of the cluster to their particular investigation. Part of the cluster's efforts have been to support EPSCoR participants such as Dr. Robert Toonen with his work which includes marine wildlife conservation research. His efforts are being supported both by the UH Dell Cluster's

Continuation Page:

LABORATORY FACILITIES (continued):

equipment and personnel for user support and training. Also, this is a system wide resource available to all UH researchers which currently includes Marine Biology, Meteorology, Chemistry, Medicine, Civil and Electrical Engineering, and Information and Computer Sciences.

UNIVERSITY OF HAWAI'I

JAMES R. GAINES
INTERIM VICE PRESIDENT FOR RESEARCH

September 15, 2005

Dr. B. Jane Harrington
National Science Foundation
EHR/EPSCoR
4201 Wilson Boulevard, 1122S
Arlington, VA 22235

Dear Dr. Harrington:

I am pleased to write this letter in support of the continued efforts here in Hawaii with respect to the Experimental Program to Stimulate Competitive Research.

The Department of Business, Economic Development & Tourism (DBEDT) has been allocated $250,000 in each of FY 06 and FY 07, for purposes of working with the University of Hawaii System to promote programs statewide that can help expand existing and establish new businesses in Hawaii's technology sectors, and enhance economic competitiveness in traditionally non-tech sectors through innovative applications of science and technology.

It is my intent to match that allocation in both dollar amount and focus of effort. I look forward to working with DBEDT to augment the research infrastructure in Hawaii by increasing the opportunities for University/Industry partnerships and developing programs throughout the UH System that train both students and incumbent workers in technical skills that are (or are projected to be) in high demand within Hawaii's business and research communities.

Sincerely,

James R. Gaines

James R. Gaines
Interim Vice President for Research

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

LINDA LINGLE
GOVERNOR
THEODORE E. LIU
DIRECTOR
MARK K. ANDERSON
DEPUTY DIRECTOR

No. 1 Capitol District Building, 250 South Hotel Street, 5th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804
Web site: www.hawaii.gov/dbedt

Telephone: (808) 586-2355
Fax: (808) 586-2377

September 15, 2005

Dr. James R. Gaines
Interim Vice President for Research
University of Hawaii
2440 Dole Street
Honolulu, Hawaii 96822

Dear Dr. Gaines:

We are pleased to confirm that the State of Hawaii has allocated $250,000 per year for FY 06 and FY 07 to support the NSF EPSCoR RII proposal being submitted by University of Hawaii System in response to NSF 05-589.

The legislative and administrative branches of Hawaii's State government recognize the significant potential of science and technology as drivers for economic development. As such, the State is committed to promoting programs statewide that can (1) help expand existing and establish new businesses in Hawaii's technology sectors, and (2) enhance economic competitiveness in traditionally non-tech sectors through innovative applications of science and technology.

Hawaii's EPSCoR program can directly support these goals by enhancing and diversifying the State's university research infrastructure, facilitating technology transfer to the private sector, and expanding workforce development and training opportunities. Complementing federal EPSCoR funds, which we understand will be used to augment the University of Hawaii's research infrastructure, our State funds are targeted to support projects that can help (1) forge collaborative university-industry partnerships to augment technology transfer and commercialization; and (2) expand and diversify workforce development activities statewide, with an emphasis on programs related to the Research Infrastructure Improvement Focal Areas identified in the University of Hawaii's RII proposal. These projects will be coordinated with the Hawaii EPSCoR Statewide Committee, the University of Hawaii Internships Program, and community college activities on all islands.

We appreciate this opportunity to collaborate with the University of Hawaii in your effort to expand and diversify the State's scientific research endeavors, and look forward to working with you on this truly innovative program.

Sincerely,

Theodore E. Liu

UNIVERSITY OF HAWAI'I AT HILO

UH Hilo Administration
Office of the Chancellor

September 16, 2005

Dr. B. Jane Harrington
Program Director
National Science Foundation
EHR/EPSCoR
4201 Wilson Boulevard, 1122S
Arlington, VA 22230

RE: NSF 05-589

Dear Dr. Harrington:

I am writing to enthusiastically endorse Hawai'i's participation in the NSF EPSCoR program.

In my capacity as Chancellor of University of Hawai'i at Hilo, I can inform you that the impact of the first RII grant has been palpable throughout the University of Hawai'i System and especially at UH Hilo. This second RII program will result in more improvements to our research infrastructure and the entire research endeavor within the UH system. It is in line with the State of Hawai'i's direction to strengthen use of natural resources and improve workforce development in science & technology fields.

Recognizing that we must improve our physical infrastructure, the University requested and received funding from the Hawai'i State legislature for construction of a new "Science and Technology" building on UH Hilo's campus. This new facility will result in the relocation of many of our faculty and staff to new classrooms and labs. Subsequent renovations to the Wentworth Building on the UH Hilo campus will reconfigure that building from a primarily classroom building to a facility that provides office and laboratory space for many of our best EPSCoR researchers in the Biology and Marine Sciences Departments. These renovations will allow UH Hilo to ensure the most modern space is available for faculty, students and visiting scientists.

In addition, UH Hilo has an agreement with the US Forest Service to lease space in that agency's newest building in the University Park adjacent to UH Hilo. This space will not only allow more research space but also will increase our interaction with this very active research-based agency.

A further improvement to the research endeavor at UH Hilo is the engineering curriculum modules planned for the Hawai'i Community College campus that will be developed into a planned 2 + 2 engineering curriculum for UH Hilo. We anticipate that

200 W. Kawili Street, Hilo, Hawai'i 96720-4091
Telephone: (808) 974-7444, Facsimile: (808) 974-7622, www.uhh.hawaii.edu

we will offer such a degree in a timely fashion so as to allow students matriculated to the Hawai'i Community College program to continue to the baccalaureate at UH Hilo.

As Co-Chair of the Statewide Committee with Mr. Maurice Kaya of the Department of Business, Economic Development &Tourism, State of Hawai'i; I work closely with the Governor's office and leaders of the State Senate and House of Representatives. The EPSCoR Statewide Committee is representative of the educational, governmental, and private industry sectors of Hawai'i. This has brought greater awareness of the programs and benefits of the EPSCoR program to the state of Hawai'i and greater ability to form effective partnerships between government, business, and academia to maximize Hawai'i's intellectual, cultural, and economic strengths.

As Co-chair of the Hawai'i Statewide committee, I would like to express confidence in the leadership of Dr. Donald Price, EPSCoR Co-Project Director; Terrilani Chong, EPSCoR Project Administrator; and their staff. I am confident of their ability to effectively meet goals of the second RII grant.

I look forward to continuing the productive relationship we have established with the National Science Foundation during the first RII grant period.

Yours sincerely,

Rose Tseng

Rose Y. Tseng
Chancellor

UNIVERSITY OF HAWAI'I AT HILO

Office of the Dean
College of Arts and Sciences

September 14, 2005

Dr. B. Jane Harrington
National Science Foundation
EHR/EPSCoR
4201 Wilson Boulevard, 1122S
Arlington, VA 22230

RE: NSF 05-589

Dear Dr. Harrington:

I write to express my enthusiastic support of the NSF's EPSCoR program. Our participation in EPSCoR has resulted in the development of a strong focus on environmental sciences at UH Hilo. This focus fits perfectly with our strategic plan to take advantage of Hawaii Island as a living laboratory, and emphasize academic programs that have special relevance to Hawaii. The impact of EPSCoR on stimulating research and scholarship at UH Hilo is already very evident, and I am convinced that our continued participation in the program will yield even more dramatic educational benefits for our College and the University at large.

The College of Arts and Sciences, which has been the primary beneficiary of the EPSCoR program, is committed to supporting the program in the following ways:

New Faculty Positions. In the coming years, we expect to make a number of new hires in the College of Arts and Sciences. Whenever possible, these new hires will support and enhance the environmental sciences focus at this university. For example, we expect to hire two new hires in Mathematics and a new hire in Chemistry this year. We hope that both hires in Mathematics will bring expertise such as biological mathematics or bio-informatics and statistics that support research efforts in the environmental sciences. Likewise in Chemistry, we hope to hire someone who will bring a strong background in environmental chemistry. In short, whenever possible, we intend to hire new faculty with an eye toward complementing and supporting the EPSCoR hires we made during the first RII grant, as well as enhancing the environmental sciences focus that these EPSCoR hires have allowed us to develop here at UH Hilo

Reduced Teaching Load. In the College of Arts and Sciences, we are working to reduce the teaching load of our junior (untenured) faculty by one course per year. For faculty –

200 W. Kawili Street, Hilo, Hawai'i 96720-4091
Telephone: (808) 974-7300, Facsimile: (808) 974-7690, www.uhh.hawaii.edu/academics/cas/

such as our EPSCoR hires – who are engaged in externally funded research projects – we hope to reduce their teaching loads by two courses per year to facilitate their scholarship. This will enable them to develop their research more quickly and with higher quality. In addition, the EPSCoR Focal Areas Science Team leaders will be given reassignments so they, too, can continue to build their own research portfolios and, in the process, bring even greater distinction to UH Hilo.

Research Facilities. We are working on short-, medium-, and long-range plans to increase and enhance research facilities for EPSCoR faculty and others associated with the environmental sciences emphasis at UH Hilo. The short-term plan is to rent 2,000 square feet of new, state-of-the-art laboratory space from the U.S. Department of Agriculture's Tropical Forestry Division to support the research efforts of faculty in the Biology and Marine Sciences departments. The mid-range plan is to build a 17,500 square foot Science and Technology Building, then move the Departments of Chemistry and Physics/Astronomy from their existing home in Wentworth Hall, to the new Science and Technology Building. Once the S & T Building is completed, we would begin an immediate multi-million dollar renovation of Wentworth Hall to provide about 10,000 square feet of teaching and research lab space for EPSCoR faculty in Biology and Marine Sciences, as well as others involved in environmental sciences research. The long-range plan is to hopefully build a 12,500-15,000 square foot building that would house faculty from Biology, Marine Sciences, and other departments whose work focuses on life and environmental sciences.

Inter-College Collaboration. The College of Arts and Sciences and the College of Agriculture, Forestry and Natural Resource Management aspire to forge a mutually beneficial, cross-institutional dialog that will result in the active integration of research efforts within the two colleges. The Deans of both colleges recognize that some of the most interesting and exciting work in the environmental sciences is occurring in the interstices between the departments that comprise our two separate colleges. We are therefore making deliberate efforts to integrate the research conducted in the basic sciences with that of the other units so as to have a more balanced and well-rounded approach to our entire research endeavor.

I am grateful for the support of NSF's EPSCoR program look forward to the new RII project.

Sincerely,

Randy Y. Hirokawa, Dean
College of Arts and Sciences

UNIVERSITY
OF HAWAI'I
HILO

Dr. B. Jane Harrington
National Science Foundation
EHR/EPSCoR
4201 Wilson Boulevard, 1122S
Arlington, VA 22230

September 15, 2005

RE: NSF 05-589

Dear Dr. Harrington:

Greetings from the University of Hawaii, Hilo! I am writing to express my enthusiastic support of the NSF's EPSCoR program. The effects of this program at University of Hawaii at Hilo are just beginning to make their true measure known and we feel that continuing to participate in the program will dramatically increase benefits to UH Hilo and the community we serve.

As a new Dean (effective September 1, 2005) to the College of Agriculture, Forestry and Natural Resource Management (CAFNRM) I am challenged to put a common vision together that will bring my faculty focus across different fields of endeavor. I plan to hinge that vision on developing sustainable approaches to provide support to the communities of our isolated islands. In the light of continually increasing energy costs and because some experts are saying we have surpassed peak oil production, the ramifications for our islands are huge, and go far beyond the immediate impact of high energy costs (e.g., tourism which has been the islands economic driver may be frustrated and decline; the cost of importing 90% of our food and 80% of our fiber may become prohibitive; natural disasters and threats to national security can displace Pacific islander needs). These examples serve to underscore the importance of developing alternatives to present paradigms for island living and for conserving resources our isolated societies depend on. With this in mind, the CAFNRM plans to make several faculty hires. Because of participation in the EPSCoR program and the resultant emphasis on environmental sciences, these faculty positions will be targeted toward those that will support and enhance our vision. In the CAFNRM we plan to hire a Forester to enhance our forest studies and research into sustainable and conservative forest practices. We plan to use some of your funding to hire a Plant Pathologist with biological control expertise to aid in reducing impacts of invasive species. As other positions come open, those will be filled with an eye toward complementing the EPSCoR hires made during the first RII grant. We have commitments from the Hawaii State Legislature to make these positions permanent when EPSCOR finishes which emphasizes the impact EPSCOR will have had on helping UHH build a permanent faculty in these arenas of education that complement our vision.

College of Agriculture, Forestry & Natural Resource Management

200 W. KAWILI STREET
HILO, HAWAI'I 96720-4091
PHONE: (808) 974-7393
FAX: (808) 974-7674

http://www.uhh.hawaii.edu

At the CAFNRM, faculty we hire will be expected to build research programs requiring us to give reassigned time to reduce the teaching loads of new appointments. This will enable new appointees to develop their research more quickly and with higher quality. We are told the EPSCoR Focal Areas Science Team leaders will be given reassignments so they too can continue to build their own portfolios and so enhance recognition of UH Hilo overall.

You may be interested to know we have instituted a cross-institutional dialog between the College of Arts and Sciences and the CAFNRM. This inspiring dialog will result in actively integrating research efforts across campus. As Deans of these two colleges we are making deliberate efforts to integrate the research conducted in the basic sciences so as to have a more balanced and well rounded approach to our entire research endeavor. We anticipate attracting more and better students to research and to broaden the pool of potential degree candidates. Our intent is to also work with the College of Hawaiian Language (Ka Haka `Ula O Ke`elikōlani) to help identify native Hawaiian students who have an interest in participating in and receiving training from our programs. As the first Dean of Hawaiian descent ever in the University of Hawaii system, this is especially important to me.

We look forward to the new RII project. Please feel free to call on me should you have any questions. My aloha and mahalo,

Bill

William Wallace Mokahi Steiner, Ph.D.
Dean, CAFNRM

United States Department of Agriculture
Forest Service
Institute of Pacific Islands Forestry
60 Nowelo St., Hilo, HI 96720
(808) 933-8121 FAX (808) 933-8120

September 12, 2005

Dr. Dr. Donald K. Price
Co-Project Director - Hawaii NSF EPSCoR Program
200 W. Kawili Street
University of Hawaii
Hilo, HI 96720

Dear Don,

I have read the proposal and am writing to express my vigorous support of your EPSCoR Research Improvement Proposal for Hawaii. I fully expect that this proposed research will advance the ecological, biological and environmental sciences across the heterogeneous landscapes of Hawaii. Research and education programs such as this EPSCoR Proposal are filling a great need for the people of Hawaii and the Pacific. I strongly endorse the proposal as well as the participation of our research scientists who will collaborate with UH faculty and students. This collaboration represents tangible and important progress in the development of desired long-term scientific collaborations between USFS-Institute of Pacific Islands Forestry (IPIF), the University of Hawaii, and other researchers to address a multitude of ecological issues in Hawaii and elsewhere in the Pacific. I am happy to commit the IPIF personnel, and contribute equipment, laboratory, and office space to help fulfill the goals and objectives of this proposed research.

We have recently completed our new $12 million research complex on the campus of the University of Hawaii, Hilo. We are quite willing to share office and laboratory space with UH faculty and students as well as provide space for visiting scientists associated with the EPSCoR Proposal. Also of great mutual interest is the soon-to-be establishment of the Hawaii Experimental Tropical Forest. There will be 2 units to be established on the Big Island. Our vision is to create a research forest dedicated to research, education, and demonstration addressing the important environmental, cultural, and economic values of all Hawaiians. This new experimental forest will provide researchers from all over the world a place to conduct research in tropical dry, wet and rainforests of Hawaii.

Again, I strongly endorse the EPSCoR Proposal for Hawaii and I look forward to a strong participation by Institute of Pacific Islands Forestry researchers. Please let me know how we can assist.

Sincerely,

J. Boone Kauffman

Dr. J. Boone Kauffman
Director, Institute of Pacific Islands Forestry

NATIONAL TROPICAL BOTANICAL GARDEN
Chartered by Congress To Create A National Resource In Tropical Botany

September 12, 2005

Dr. Kenneth Y. Kaneshiro
University of Hawai`i
Center for Conservation Research and Training
3050 Maile Way, Gilmore Hall 406
Honolulu, HI 96822

Subject: Commitment of Support for NSF Experimental Projects to Stimulate Competitive Research (EPSCoR) Program (Phase II) Proposal.

Aloha Dr. Kaneshiro:

The National Tropical Botanical Garden (NTBG) offers this letter as a statement to our commitment to provide logistical support, field site location, and on-site server location for your NSF Experimental Projects to Stimulate Competitive Research (EPSCoR) Program (Phase II) proposal. This is a very exciting project that is the culmination of over 10 years of collaborative research between the NTBG's Limahuli Garden and Preserve and the Hawaii Stream Research Center at the University of Hawaii. Ken, it is under your visionary leadership, along with that of Mike Kido, that our important stream research project has grown to become a cutting edge project that is pioneering state-of-the-art environmental monitoring technology that is advancing our understanding of watershed dynamics at a very advanced rate.

The NTBG looks forward to participating in, cooperating with, and learning from the results of your environmental data-collecting research on the extensive gardens and natural areas that we manage (1,000-acre Limahuli Garden and Preserve on the North Shore; as well as 300-acre Allerton and McBryde Gardens on the South Shore). For us, to be able to continue our existing partnership in the ongoing Hawai`i EPSCoR program in which the University of Hawai`i and Intelesense Technologies are testing hardware applications in all three of our garden sites on Kaua`i is an amazing opportunity – one that we are proud to support.. We feel that the conclusions gained from these projects will provide us with better tools with which to manage our lands in a responsible and sustainable manner for future generations.

Thank you for the opportunity to be involved in your NSF research. We also look forward to collaborating with the University of Hawai`i system on this and future projects.

Me ke aloha no,

Chipper Wichman
CEO, National Tropical Botanical Garden

KAMEHAMEHA SCHOOLS

September 12, 2005

Dr. Kenneth Y. Kaneshiro, Director
Center for Conservation Research and Training
University of Hawai'i
3050 Maile Way, Gilmore 406
Honolulu, Hawai'i 96822

Re: Proposed NSF EPSCoR Program (Phase II)

Aloha Dr. Kaneshiro,

The Kamehameha Schools (KS) offers this letter as a statement of its willingness to provide the Center for Conservation Research and Training access to KS' properties (10,000 acres in Lumaha'i, Kaua'i and 1,500 acres in Waipā, Kaua'i) to perform its proposed NSF Experimental Projects to Stimulate Competitive Research (EPSCoR) Program (Phase II).

KS recognizes: (1) the importance of the data to be collected; (2) the importance of the conclusions which will be reached by way of this research; and (3) the need to have this information available for use by the general public. KS understands, recognizes, and acknowledges that the information obtained is not intended to benefit KS alone, but is intended to benefit the general public.

Please note that KS' support of this proposal is premised on an understanding that it will not receive any federal financial assistance as that term is defined in Title VI of the Civil Rights Act of 1964. Therefore, by authorizing its land to be used for the proposed program, it is KS' understanding that KS will not be receiving any federal financial assistance. KS supports this proposal voluntarily and is not acting at the direction or compulsion of any governmental agency. Additionally, KS is not performing a public function that a government agency would otherwise be required to perform, such that KS is not acting under color of state or federal law in supporting the proposal.

We are excited about our involvement with your project and with to thank you for this opportunity. If you have any questions, please feel free to contact me either by phone at (808) 322-5305, or by email at nawhiteh@ksbe.edu.

Mahalo,

Amber Nāmaka Whitehead
Ecologist
Land Assets Division – Hawai'i Island

MAUI LAND & PINEAPPLE COMPANY, INC.

September 9, 2005

Dr. Kenneth Y. Kaneshiro
University of Hawaii
Center for Conservation Research and Training
3050 Maile Way, Gilmore 406
Honolulu, HI 96822

Re: Commitment to NSF Experimental Projects to Stimulate Competitive Research (EPSCoR) Program (Phase II) Proposal

Aloha Dr. Kaneshiro:

By way of this letter, please accept this commitment from Maui Land & Pineapple Company, Inc. (ML&P) to provide logistical assistance, field site location, and on-site server location for your anticipated EPSCoR Phase II research efforts for the duration of your proposed study period.

ML&P looks forward to participating in, cooperating with and learning from the results of your environmental data-collecting research efforts on our lands on West Maui (Mauna Kahalawai). We hope that the conclusions gained from the results of your project will provide us with better tools with which to manage our lands in a responsible and sustainable manner for future generations.

Thank you very much for the opportunity to be involved in your EPSCoR Phase II research project. We look forward to collaborating with the University of Hawai`i system on this and future projects.

Me ke aloha a hui hou,

Randal T. Bartlett
Pu`u Kukui Watershed Manager
Community Development

Cc: Ryan Churchill, VP/Community Development
Claire Sullivan, Manager/Sustainable Living Institute of Maui

4900 Honoapi'ilani Highway • Lahaina, Maui, Hawai'i • 96761-9183
Ph/Fax: (808) 669-1687 • Cell: (808) 870-6443 • crbartlett@mlpmaui.com

Waipā Foundation

P.O. Box 1189, Hanalei, HI 96714
Email s_sproat@hotmail.com
Phone (808) 826-9969
Fax (808) 826-1478

September 12, 2005

Dr. Kenneth Y. Kaneshiro
University of Hawaii, Center for Conservation Research and Training
3050 Maile Way, Gilmore 406
Honolulu, HI 96822

Aloha Dr. Kaneshiro,

Thank you for the opportunity to review your proposal to the National Science Foundation for an EPSCOR grant. First let me state how pleased we are with our current partnership and projects. You and your staff continuously display the cultural sensitivity, patience and commitment to a learning community that this process requires.

Your new proposal would build upon our existing relationship and environmental monitoring projects. In particular, it would bring needed opportunities for training and employment to our community that would be linked to the understanding and management of our resources. We fully support this proposed work and look forward to being a partner in this venture.

Please let me know if I can provide assistance in any way.

Most sincerely,

Stacy Sproat-Beck
Executive Director

LINDA LINGLE
GOVERNOR

PATRICIA HAMAMOTO
SUPERINTENDENT

STATE OF HAWAII
DEPARTMENT OF EDUCATION
PRINCE DAVID KAWANANAKOA MIDDLE SCHOOL
49 FUNCHAL STREET
HONOLULU, HAWAII 96813

September 13, 2005

Dr. Kenneth Y. Kaneshiro
University of Hawaii
Center for Conservation, Research and Training
3050 Maile Way, Gilmore 406
Honolulu, HI 96822

Re: NSF Experimental Projects to Stimulate Competitive Research (EPSCoR) Program (Phase II) Proposal

Dear Dr. Kaneshiro,

Kawananakoa Middle School's Science Department is very pleased that this proposal is including the participation of Hawaii State Dept. of Education schools. As with your previous NSF GK12 Project, the involvement of schools is crucial in the development of learning communities that establish partnerships and collaboration of many.

The GK12 Project at Kawananakoa involved two years of field data collection at multiple watershed sites by 300 seventh graders. We are excited about the EPSCoR Project because it will provide an opportunity for us to develop our environmental curriculum to a higher level through the inclusion of sensor data collection, wireless data transmission and reception, and statistical data analysis. We believe that this project will enable the development of some models of technology driven environmental curriculum.

Last year, we were involved in a NSF Wireless Project. This project made possible the installation of some wireless infrastructure at our school. We look forward to extending the application and use of our existing systems.

We appreciate your keen awareness of what classroom teachers desire and wish you continued success in the procurement of resources that will allow our ideas and plans to become a reality.

Sincerely yours,

Judith S. Inouye

Judith S. Inouye, Retired (6/05) Kawananakoa Science Teacher

Raedelle Van Fossen

Raedelle Van Fossen, Kawananakoa Science Dept. Chair

Aric Oumi, Kawananakoa NSF Wireless Project Teacher

Hawaii Statewide EPSCoR Committee

Co-Chairs

Dr. Rose Tseng	Chancellor, University of Hawai`i at Hilo
Mr. Maurice Kaya	Chief Technical Officer, Dept. of Business, Economic Development and Tourism

Members

Ms. Amy Asselbaye	Deputy Chief of Staff, Congressman Neil Abercrombie
Dr. Dan Brown	Interim PD, Research Infrastructure at Minority Institutions. UHH
Ms. Peggy Cha	Chancellor, Kaua`i Community College
Rep. Jerry Chang	State of Hawaii House of Representatives
Mr. Richard Cox	Office of Technology Transfer and Economic Development
Dr. James Gaines	Interim Vice President for Research , University of Hawai`i System
Ms. Jennifer Goto-Sabas	Chief of Staff, Senator Daniel Inouye, Hawaii Office
Mr. Neil Hannahs	Kamehameha Schools Land Assets Division
Dr. Charles Hayes	University of Hawai`i at Manoa
Sen. Clayton Hee	Hawai`i State Senate
Dr. Don Hemmes	Natural Sciences Department Chair
Dr. Paul Hill	Project Director, West Virginia EPSCoR
Dr. Steven Hora	Interim Vice Chancellor for Academic Affairs
Dr. David Karl	University of Hawai`i at Manoa
Dr. Alec Keith	CEO, Nextlabs, Inc.
Dr. Richard Lim	President and Chief Operating Officer, City Bank Hawaii
Mr. Ted Liu	Director, Hawaii Department of Business, Economic Development and Tourism
Rep. Sylvia Luke	State of Hawaii House of Representatives
Mr. David Matsuura	Umikoa Ranch
Mr. Keith Mattson	University Connections, University of Hawaii
Dr. David McClain	Interim President, University of Hawai`i
Mr. James Nakatani	District Director, Congressman Ed Case
Dr. Gary Ostrander	Vice Chancellor for Rsch and Grad Education, University of Hawai`i at Manoa
Mr. David Pendleton	Senior Policy Advisor to the Governor Lingle
Dr. Richard Rocheleau	Director, Hawai`i Natural Energy Institute
Sen. Norman Sakamoto	Hawai`i State Senate
Dr. T. Samuel Shomaker	Acting Dean, John A. Burns School of Medicine
Ms. Jeanne Skog	President and CEO, Maui Economic Development Board
Dr. Karl Stahlkopf	Chief Technical Officer, Hawaiian Electric Company
Rep. Dwight Takamine	State of Hawaii House of Representatives
Rep. Tommy Waters	State of Hawaii House of Representatives
Mr. David Watumull	CEO, Hawai`i Biotechnology Group
Mr. Douglas Yee	First Vice President and Financial Advisor, Morgan Stanley Dean Witter

Ex-Officio Members

Dr. Don Price	NSF Hawai`i EPSCoR Co-Project Director
Dr. Kenneth Kaneshiro	NSF Hawai`i EPSCoR Co-Project Director
Mr. Kevin M. Kelly*	NSF Hawai`i EPSCoR UH System Managing Director
Ms. Terrilani J. Chong	NSF Hawai`i EPSCoR Project Administrator

**Mr. Kelly will become a member of the Workforce, Education, and Human Resources Development Team in*

Focal Area	Collaborators Across the Disciplines: (*EPSCoR hires), Institution, and Brief Project Title
G,E,C	**Asquith (UHM), Miike (Waipa Foundation), Moriyasu & Palomino (State Rare Plant Propagation Facility), Koob (USFWS), Caraway (DoFAW).** Genotype-environment interaction of native plant populations.
E,C	**Beets, Hallacher (UHH), Brown (NPS), Friedlander (NOAA), Hixon (OSU), Tissot (WSU), Walsh (Hawaii-DAR).** Marine Protected Areas in Hawaii and their influences on community structure and ecological processes & the factors influencing recruitment of marine organisms.
G,E,C	**Birkeland, Gates, Rappé & Toonen (HIMB), Stillman (SFSU), Baker (RSMAS), Garrison & Kellogg (USGS-FL), Piniak (USGS-CA) & van Woesik (James Cook U.)** Extrinsic & intrinsic factors affecting the resilience of native corals to climate change and designing marine reserves.
G,E	**Cowie, Faucci (UHM), Tim Collins (Florida Int, U.), deMaintenon (UHH).** Systematics and geographic origins of invasive freshwater snails & Hawaiian land snail radiations in Hawaii.
G.E	**deMaintenon, Takabayashi* (UHH).** Pylogeographic research on near shore nondispersing Hawaiian marine snails.
G,E	**Drake, Morden (UHM), Caraway (DLNR).** Plant pollinator interactions: lobeliads and honeycreepers.
G,E	**Jarvi (UHH), Atkinson (USGS-BRD), Fleisher (Smithsonian).** Evolution of resistance to introduced diseases in Hawaiian Honey Creepers
E,C	**Kaneshiro, Kido, Gibson (UHM), Juvik, Muir, and Erdogan (UHH).** Spatially high resolution accounting of climate changes that exist over the islands.
E,C	**Mackenzie, (UHM), Vitousek, (Stanford U), Hughes, (USFS).** Soil and stream chemistry analyses, forest ecological analyses, estuarine ecology and chemistry, coastal water quality analyses.
E,C	**Mautz, Ostertag (UHH), Hughes (U.S. Forest Service), Klawinski (William Jewell College).** Effects of multiple species invasions: coqui frogs and Albizia in Hawaii.
C	**Kido, Kaneshiro, Shea, Sugimura, Rundel, Hamilton (UHM) Montgomery, Mundt (Standford), Estrin (UCLA)** Testing and integration of new sensor types in Hawaii.
G,E,C	**Morden (UHM).** Phylogeography & adaptation radiation of Hawaiian *Chamaesyce* species along an environmental gradient.
G,E,C	**Muir* & Price (UHH), Foote (USGS BRD).** Population genetics, gene flow, local adaptation and speciation in Hawaiian Drosophila.
G,E	**Muir* (UHH), Fitzsimons & McRae (Louisiana State U.), Santos (Auburn U.)** Ecology and genetics of endemic Hawaiian godidae species and anchialine pond shrimp species.
E,C	**Ostertag (UHH), Asner (Stanford U), Cordell, Hughes (USFS).** Remote sensing & competitive effects of invasive species in lowland wet forests in Hawaii.
E	**Ostertag (UHH), Sack (UHM), Litton, Sandquist (Cal State Fullerton), Cordell, Hughes (USFS), Montgomery (U Minnesota).** Invasive species, carbon cycling and functional groups.

E,C	**Parsons - (UHH), Bienfang Bidigare (UHM), Moeller (NOAA)**. Ecological Studies of Ciguatera.
E,C	**Parsons, Michaud, Wiegner (UHH), Duarte (UHM), Grossman (USGS PSC), Green (UHM), Burnett (FSU).** Water quality and circulation in the Wai Opae tidepools and Hilo Bay.
G,E	**Price (UHH), Hu- (US-NPS), Jefferies- (USFWS).** Hawaiian Goose inbreeding genetics.
E,C	**Sack (UHM), James (Bishop Museum), Gon (TNC), Duarte (Kamehameha Schools).** Ecohydrology of native Hawaiian and invasive plants and their role in watersheds.
G,E	**Sack, Drake (UHM), Yoshinaga (Lyon Arboretum).** Seed size in the Hawaiian flora: evolution, ecology and functional significance.
G,E	**Sack, Morden, Drake, Smith, Sherwood (UHM), Cordell (USDA Forest Service).** Physiology, systematics and evolutionary ecology of Hawaiian native terrestrial and marine species.
E,C	**Sherwood (UHM), Englund (Bishop Museum), DLNR, Louisiana State University.** Waipio stream restoration & population genetics of invasive seaweeds in Hawaii.
G, E	**Sherwood, Smith, Presting (UHM), Vroom (NOAA).** Hawaiian Rhodophyta biodiversity project.
E	**Smith, Hunter (UHM), TNC.** Cooperative conservation of Hawaiian coastal reef.
G,E	**Stacy*, Price (UHH), Michael Purugganan (North Carolina State U.).** Genetic basis of complex traits & regulartory genes in *Metrosideros polymorpha.*
G,E,C	**Stacy* (UHH), Susan Cordell (USFS).** Diversifying selection in natural populations of *Metrosideros polymorpha*
G,E,C	**Takabayashi*(UHH), Lesser (UNH), Gates, Cox (HIMB).** Evolution of symbiosis between nitrogen-fixing cyanobacteria and scleractinian corals & molecular analysis of eutrophication and increased temperature on coral species
G	**Toonen, Bowen, Losey (HIMB)** Population structure of Hawaiian reef species for the Northwest Hawaiian Islands sanctuary & genetic relatedness in social interactions in tropical reef fishes.
G, E	**Toonen & Bowen (HIMB), Bird & Holland (UHM).** Comparing the systematics, ecology and stock structure of Hawaiian opihi
G,E,C	**Toonen, Cox (HIMB), Grigg (UHM), Coles (Bishop Museum), Benayahu (Tel Aviv U.), Takabayashi*(-UHH).** Population genetics, phylogeography and ecology of coral species in Hawaii.
E,C	**Wiegner (UHH), Hughes (USDS FS), MacKenzie (USDA FS). Asner (Stanford).** Effects of an invasive nitrogen-fixing on stream chemistry and ecological processes
E,C	**Wiegner, Michaud, Ostertag, Parsons (UHH), MacKenzie (USDA FS).** Land cover, water quality hange in stream organic matter dynamics across an ecological succession gradient

APPENDIX II. EPSCoR Projects to be performed during IMUA II. Projects that span more than one focal area are represented by G – Evolutionary and Ecological Genetics focal area, E – Ecosystem Responses to Environmental Change focal area, and C – Cyberinfrastructure for Environmental Research and Education focal area. Collaborations with researchers outside Hawaii are also indicated.