

9 Hawai'i Institute of Marine Biology

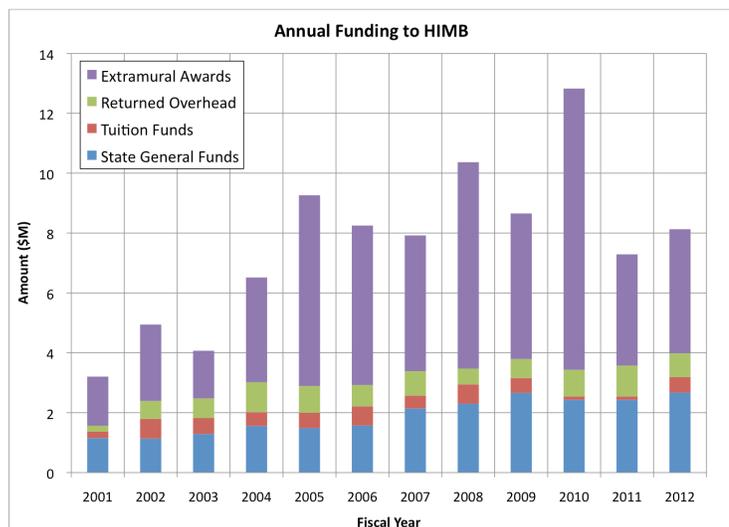
9.1 Introduction



The Hawai'i Institute of Marine Biology conducts multi-disciplinary research and education in all aspects of tropical marine biology. It is an organized research unit in the School of Ocean and Earth Science and Technology at the University of Hawaii at Mānoa. Its primary research objective is to understand and conserve tropical marine ecosystems by developing and implementing new technologies that advance the informed stewardship of Hawai'i's marine and coastal biodiversity. Located on Moku o Lo'e, a 28 acre island in Kāne'ohe Bay, HIMB scientists

have access to the 64 acres of fringing reef surrounding the island and easy access to the estuarine waters of the Bay. It is an extraordinary site for the study of coral reef ecosystems and the only location in the world that allows scientists to examine live coral reefs within 30 feet of a functional genomics laboratory. The site is also within easy access (less than two miles) to barrier reefs and deep ocean waters. Although Moku o Lo'e, also known as Coconut Island, is located 13 miles from the main campus of the University of Hawai'i at Mānoa, it is the research home for over 350 staff, students, faculty and visiting scientists.

HIMB has become a leading institution in the study of marine systems, integrating research from molecular to cellular to ecosystem to global scales. HIMB faculty are experts in the physiology, ecology, and ecosystem processes of coral reefs, the sensory processes and behavior of marine fishes and mammals, and the evolutionary and ecological genetics of marine organisms. The Institute houses 16 tenured/tenure track members, 7 faculty members supported by grant funds and at various times, it serves as a research site for 35 affiliate faculty members. HIMB retains 18 staff members to maintain its facilities and carry out its administrative

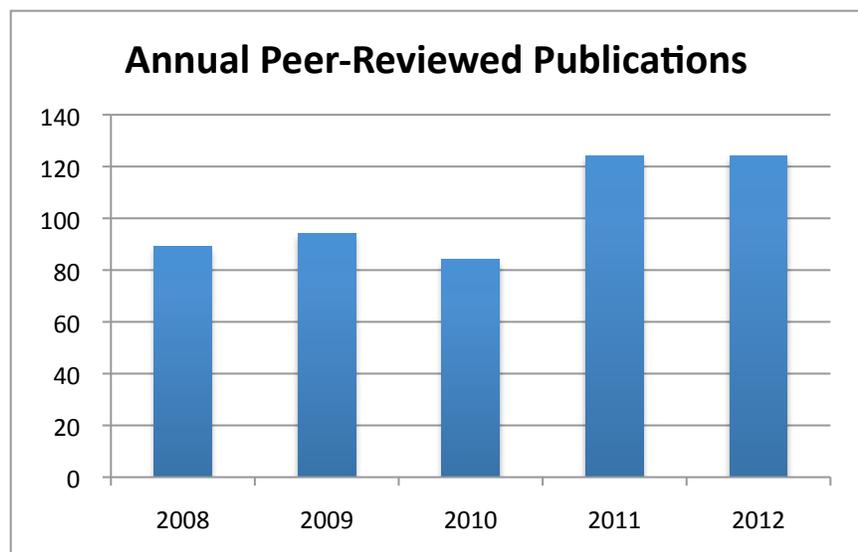


responsibilities, 4 resident graduate students and 3 research assistants who assist with diving and boating safety, hazardous waste disposal and seawater discharge analyses, as well as information technology support. Over the past 5 years, HIMB has brought \$33,547,517 in extramural funding to the University of Hawaii and published over 600 papers in peer-reviewed journals with total citations in excess of 50,000 and h-indices ranging from 4-55 (average = 27). A summary list of the citations that each faculty member has received for their work is included in the Appendix 9.9. The research funds have supported approximately 27-41 graduate students each year and 39 postdoctoral fellows over the five year period.

The extramural funding at HIMB is largely federal funding through the competitive grants programs at NSF, NOAA, EPA, Department of Energy, and Department of Defense. The image above shows funding received annually from 2001 to 2012. This table includes extramural funding, the general funds that support faculty and staff salaries, the S funds that support graduate research assistants, and operations, and the R funds which consist of the RTRF portion earned (25% returned to HIMB).

Although the HIMB faculty members are appointed primarily on research faculty positions, they participate in formal education classes in the College of Natural Sciences and in the Department of Oceanography in SOEST. HIMB faculty members are responsible for approximately 200 SSH per semester in such courses as “Physiology of Acoustics & Hearing”, “Physics and Underwater Acoustics”, “Seminar in Quantitative Ecology”, “Advanced Topics in Systematics and Genetics”, “Professional Development for Graduate Students”, and “Communicating Ocean Science.” HIMB faculty participates in public outreach activities and education at all levels. Since 2007, we have reached 4,400 K-8 students, 3,200 H.S. students, 2,600 UH system students, 600 other college students, 9,900 community members, and 1,800 members of government, teachers, and other professional organizations. The community education program blog, “Science Island” posts weekly information on UH/SOEST/HIMB research efforts in marine life ecology and other marine sciences. The blog receives over 15,000 hits annually and since 2010, has reached 45,000 hits. The volunteer program has trained over 130 community volunteers and actively mentors 3-5 high school students annually.

HIMB is the research partner for the Papahānaumokuākea Marine National Monument, the largest marine protected area in the United States. It is also the home for the Hawaiian Islands site for the Alliance for Coastal



Technologies, a NOAA-funded partnership of research institutions, resource managers, and private sector companies dedicated to fostering the development and adoption of effective and reliable sensors and platforms. The functional genomics facility is a core laboratory for the University of Hawaii system EPSCoR program of NSF and it provides next generation sequencing support for Hawaii's scientific community. A confocal microscope facility provided by a donation from Pamela Omidyar was designed to enable scientists to examine live coral under different environmental conditions and is a unique facility in the Pacific. All of this advanced instrumentation is housed in a modern lab facility made possible by generous donations from the Edwin W. Pauley Foundation.

Among the major issues facing island societies is global climate change. It will affect ocean and coastal environments in ways that will require new technologies to mitigate sea level rise, increased sea temperatures, and ocean acidification. There is an urgent need to understand how changes in ocean Ph and carbon will impact ocean and reef ecosystems. Conserving the biological diversity in these coral reefs is critically important for continued ocean productivity. In its second century of service to marine and conservation research, HIMB scientists are developing technologies that will enable breakthroughs in the understanding of coastal and oceanic ecosystem processes.

Strengths:

- Expertise in marine biology (coral reefs, conservation biology, animal behavior, and fisheries).
- Use and development of modern molecular biological tools and sensor technologies.
- Location on Moku o lo`e (Coconut Island) with ready access to coral reefs, protected bay waters, and open ocean within 2 miles.

Weaknesses:

- All facilities maintenance including trash removal, landscape maintenance, seawater and sewage outfalls are carried by RTRF.
- Overlapping federal/state jurisdictions complicate security, environmental permits, and boat channel maintenance.
- Lack of cohesive Institute vision to tie the collection of independent researchers together.
- University support is variable and HIMB suffers from not being on campus. We are "out of sight, out of mind".

Opportunities:

- HIMB is the only research laboratory within the United States that is located on a living coral reef.
- Well positioned to build a center of excellence based on coral reef studies.
- National Estuarine Research Reserve designation in Kaneohe Bay

Threats:

- Research funding in the future may decrease
- Research staff diversity/balance: In 2013, there may no longer be any Assistant Researchers at HIMB.
- Leadership needs to maintain its relationship with foundations, congressional representatives, and the state legislature.

9.2 Governance

HIMB has a permanent Director (Dr. Jo-Ann C. Leong) who holds an Executive/Management position within the University and has tenure as a Professor in the School of Ocean & Earth Science & Technology. The Director holds faculty/all hands meetings on a monthly basis. The majority of routine business and information is accomplished via email. The Institute maintains its own web site (www.hawaii.edu/HIMB).

The Director appoints faculty and staff to serve on a number of committees charged with providing recommendations to the Director regarding management policies at HIMB that include the Capital Improvement Program (CIP), Parking, Visitors and Sponsorship, Space allocation, Scholarship, and Diving/Boating.

The Assistant Director (Ms. Jane Ball) at HIMB is responsible for direct management of the fiscal issues such as budget preparation, oversight of the federal guidelines regarding allocable expenditures, and training of the fiscal staff, and ensuring that the personnel policies of the University of Hawaii and its bargaining agreements with its unions are aligned with those of HIMB's operations. Faculty promotion and tenure recommendations are made through the Departmental Personnel Committee (DPC) chaired by a faculty member appointed by the Director. Research Professor Brian Bowen is the current DPC chairman. Since 2003, HIMB has been fortunate in increasing its roster of faculty from 4.5 to 16 tenured/tenure-track faculty members, 2 faculty members on 3-year payroll commitments should extramural funding drop, and 9 faculty members supported by extramural funding. The extramurally funded faculty members are permitted, under the DPC HIMB guidelines to apply for grant support as principal investigators, and laboratory space is assigned by offer letter to tenured/tenure-track faculty.

The Institute provides routine training for its faculty, staff, and students in Laboratory Safety, Hazardous Waste Handling, and certification classes in Cardio-Pulmonary Resuscitation, First Aid, Dive Safety, and Boat Safety. Sexual harassment training is offered every two years; the last training took place at HIMB on May 21 and June 7, 2012. In addition, RCUH offers workplace violence training at HIMB. With the Institute's responsibility to provide a secure and safe environment for its members to conduct their business at HIMB, training for sexual harassment and workplace violence is required. The Institute has on staff a dive safety officer certified for the inspection of the compressed air tanks and approved by the University Dive Safety program to provide scientific diver training on site.



The HIMB Strategic Plan was developed at a faculty retreat and led by professional strategic planning facilitators. The 2010-2015 Strategic Plan is available on the HIMB web site where a copy of the plan can be downloaded at <http://www.hawaii.edu/about.html>. This plan outlines the objectives, strategies, and benchmarks for research

excellence, multidisciplinary teaching, and institutional development at HIMB.

9.3 Diversity of research foci within HIMB

HIMB is a research institute (an Organized Research Unit in UH terms) and its members have been providing the University of Hawaii, the citizens of Hawaii, and the nation with research findings that help guide public policies regarding the management of marine protected areas, the conservation of coral reefs, the management of global fisheries, and the adaptation of island societies in the face of global climate change. The research themes identified in the strategic planning retreat are:

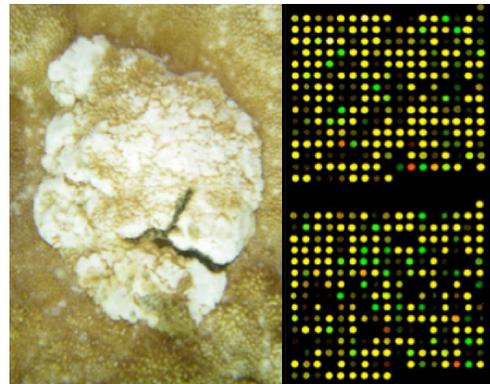
- **Coral Reef Ecology, Evolution, and Biodiversity:** Coral reefs cover less than 1% of the Earth, but with unknown millions of species, they are the rain forests of the sea, among the most biologically diverse habitats on the planet. Likewise, reefs are of enormous economic importance, with 2008 estimates being more than \$375 billion USD annually to the global economy and more than 200 million people world-wide dependent on coral reefs for their daily survival. Coral reefs contribute food, coastal protection, and tourism by forming the largest living structures on Earth, but upwards of 70% of the world's coral reef could be lost in this century. HIMB scientists are focusing their research efforts on coral bleaching and disease, symbiosis, mapping and characterization of the coral reef habitat, ocean acidification, apex predator ecology, and marine microbial ecology.
- **Foundation Reefs in the mesophotic zone:** Recent discoveries reveal that coral reefs extend to a depth of at least 165 m in the Pacific, yet only the upper 30 m has been explored because of the limits of SCUBA technology. The biodiversity at depths of 30-200 m, more than 75% of the depth range of coral reef habitat, remains almost completely unexplored. HIMB scientists have obtained funding from NOAA and the Seaver Institute to initiate the exploration of these reefs in the Hawaiian Islands using advanced rebreather deep diving technologies.
- **Marine Animal Sensory Processes and Ecology:** HIMB scientists are developing new technologies to monitor acoustic sensory processes in marine mammals and deploying new sensors to record natural sounds of the ocean environment. These efforts have measured the acoustic sensory range of cetaceans and determined the echolocation sensitivity of dolphins and false killer whales; these findings are important in developing strategies to reduce the impact of noise on dolphins and whales. Scientists at HIMB have determined that false killer whale and bottlenose dolphin can protect their hearing from loud sounds if given a warning sound.



- **Fisheries and Top Predator Ecology:** Currently, fisheries research at HIMB has four major components: 1) Field research focusing on the behavior, movements and distribution of species that support fisheries in Hawaii. 2) Field and *in situ* studies on the behavior, movements and physiology of sharks. 3) Studies with captive animals to explore their sensory physiology and bio-energetics. 4) Genetic surveys to define the boundaries of fishery stocks and coral reef ecosystems. In these research efforts, HIMB has become a leading institution in the development and deployment of electronic tags that telemeter the behavior of animals as they move through their natural world.
- **Aquaculture and Fish Physiology:** Researchers at HIMB are studying methods for captive culture and propagation of reef corals, fishes and invertebrates, as well as aquarium science to reduce captive mortality and increase sustainability of the trade. In addition to providing important scientific information about the reproductive biology, larval development and field identification of these species, this work aids in conservation efforts. Tilapia (*Oreochromis mossambicus*), one of the fish species under intensive culture at HIMB has been an excellent model for the study of osmoreception, osmoregulation, and neuroendocrine control of growth, development, and reproduction in euryhaline fish. HIMB investigators have characterized the cellular and molecular biology of osmoregulation in prolactin cells of the pituitary, and in the osmosensing cells of the gill and gut of tilapia.
- **Physiological Basis for Coral Reef Health:** Scientists have made great strides in the last decade to identify coral pathogens and stressors that might lead to disease and loss of coral cover in reefs around the world. In the Indo-Pacific, 28 different diseases affecting 97 species have been described. The basic processes that lead to coral disease have not been identified for a majority of the diseases. HIMB is pioneering the development of methods to control coral diseases, starting with the construction of a biocontainment facility several kilometers away from the ocean.
- **Biogeochemistry and Biophysical Analysis of Coral Reef Ecosystems:** Research at HIMB is focused on understanding the biochemical processes that govern the cycles of chemical elements, such as C, O, N, P, S, Fe and their interactions with and incorporation into the organisms that make a coral reef ecosystem. Basic questions of how changes in climate and climate related parameters influence the chemistry and physical structure of coral reefs are important and critical research directives. Interactions between physical, chemical, and biological processes that underlie the function of oceanic and coral reef ecosystems require sensors and molecular technologies that can be deployed to examine how organisms respond to a changing environment. HIMB scientists are developing those sensors and technologies.

These research themes are the continuing and future targets for HIMB's research foci. HIMB researchers have identified the following as the significant results of their work:

- Paul Jokiel and colleagues published the first report of large scale coral bleaching in Hawaii and described the sea temperature parameters that predict when corals will bleach.
- Ilsa Kuffner et al., 2008, discovered that ocean acidification leads reduced recruitment of coralline algae to coral reefs, an important component of the glue that holds the reef together and augments coral larvae recruitment.
- HIMB's Marine Mammal Group developed a technique to measure hearing during animal echolocation so that what the animal heard of its own outgoing signal as well as the echo return could be measured.
- Paul Nachtigall and colleagues found that the whale and bottlenose dolphin can protect their hearing from loud sounds because they have the ability to change their hearing sensation levels. If they are given a warning they can quickly internally 'plug their ears' and change their hearing by 15 dB.
- Investigations with adapted sonar technology have allowed HIMB scientists to: uncover the night-time coordinate behavior of spinner dolphins foraging on mesopelagic boundary community organisms; monitor the horizontal nightly migration of spinner dolphins towards shore and back to deeper waters; the emission of click signals by humpback whales foraging in the Stellwagen Bank National Marine Sanctuary (the first observation of broadband clicks by baleen whales); and the acoustic basis by which killer whales of British Columbia and Washington selectively forage for Chinook salmon using biosonar.
- Previous models regarding the evolution of Hawaiian marine biodiversity have suggested that marine life came to Hawaii from far off sites closer to continental land masses to the West, East, and South. Brian Bowen and his colleagues demonstrated that Hawaii naturally exports marine biodiversity as well (Eble et al. 2011). The Yellow Tang was the example.
- Scientists (Gaither et al., 2010) at HIMB have shown when the state introduced the blue-line snapper, *Lutjanus kasmiri*, the state resource managers also introduced parasites harbored by the snapper that have spread to Hawaiian native fishes.
- The aquaculture work at HIMB has resulted in completing the life cycle of marine species such as the 'opakapaka (*Pristopmoides filamentosus*, Hawaiian pink snapper), a highly prized species of the Hawaiian bottom fishery, the feather duster worm (*Sabellastarte santijosphi*), and culturing of marine shrimp, sea urchins, seaweed, and lobster.



- Biological responses to basin-scale climate forcing in the subtropical North Pacific Ocean were assessed based on temporal variations in plankton community structure observed at Station ALOHA and results of a coupled physical–biogeochemical model. Concurrent increases in microalgae, cyanobacteria and modeled and measured zooplankton biomass were also observed during this period. Bob Bidigare’s research provided evidence that these responses were a consequence of climate forcing that destratified the upper ocean, making it more susceptible to mixing events and nutrient entrainment.
- Gordon Grau and his associates identified the cellular and molecular basis for osmoreception.
- Using the tilapia model, Grau and associate demonstrated that ouabain, a toxic plant cardiac glycoside, is actually a vertebrate hormone that operates at much lower concentrations than is employed in pharmacological studies.
- The first multispecies study of Hawaiian marine connectivity (Toonen et al. 2011) highlights the limitations of traditional single species studies, and revealed unexpected restrictions to dispersal across the archipelago. Toonen and colleagues report that single species studies are rarely representative of the mean (Bird et al. 2007) and that ecosystem-based management must move beyond individual focal studies to survey a broad diversity of species in order to inform management (Toonen et al. 2011). This work has redefined our understanding of dispersal of marine species and fundamentally changed the way resource managers are thinking about archipelago-wide management in Hawai’i. As such this approach is now being advocated for other marine ecosystems across the globe.
- The SAR11 clade, an ancient and diverse clade of heterotrophic bacteria, is the most abundant group of marine microorganisms worldwide, making them key players in the global carbon cycle. Mike Rappe and colleagues isolated and sequenced genomes from diverse SAR11 cultures that encompass the full phylogenetic breadth of the clade, and have used this data to show that SAR11 and mitochondria share a common ancestor (Thrash et al. 2011), as well as reveal unusual genomic and metabolic features shared by all members of this group (Grote et al. 2012).
- Using *Pocillopora meandrina* as a model, Mike Rappe and colleagues provided some of the first evidence that corals select for specific marine microorganisms over the course of early development (Apprill et al. 2009, 2012).
- With student Kelvin Gorospe, Steve Karl has demonstrated that environmental heterogeneity on coral reefs can be over a very small scale (cm) and persistent (see Gorospe and Karl 2011)
- Judy Lemus was a contributing author of the Ocean Literacy Principles, which were subsequently the focus of at least six national and three international conferences, incorporated into numerous textbooks, curricula, and science center and aquaria exhibits, as well as referenced in the science and environmental education standards of

several states, and adopted by NOAA and NSF as required benchmarks for grant proposals addressing ocean education.

- In the temperate marine intertidal, mussels form a continuous band with a discrete lower boundary. Early, influential studies established the conventional wisdom that this lower boundary was the result of sea star predation and the tidal height of the boundary was determined by the tolerance of sea stars to aerial exposure at low tide: a fixed spatial refuge from predation. Megan Donahue and her colleagues developed a more realistic model of predator-prey interactions, in which predation risk depends on the size and density of the mussel prey and on tidal height. Although the model allows for no fixed refuge from predation, it still predicts a discrete mussel bed boundary: a spatially dynamic, rather than fixed, predator-prey equilibrium. The model also makes a critical prediction that departs from the conventional wisdom: prior field studies had demonstrated that the removal of sea stars resulted in a downward expansion of the mussel bed, but the new model also predicts (contra the conventional wisdom) that the addition of sea stars would result in an upward contraction of the mussel bed. This model prediction, and other predictions about the spatial characteristics of mussel bed boundaries, was validated in field experiments in British Columbia.
- A series of HIMB tagging projects has demonstrated that tuna that support coastal Hawaiian fisheries stay predominantly within the Hawaii/USA EEZ. That is, long distance movements are comparatively uncommon. This finding has important ramifications for resource management and could impact the USA's policy stance in discussions conducted by regional fisheries management organizations.
- The Thomas lab has a suite of environmental sensors set across the reef flat and slope. This set of sensors allows for collection of high frequency environmental data that provides a framework for genetic analysis of organism responses to the environment at time and spatial scales not possible with lower frequency data sets. This work has demonstrated that there is considerable variance in microhabitats across reefs at spatial scales of meters and time scales of minutes. This data is important to understanding drivers of local adaptation and small-scale variation in community composition.
- Thomas has also led the organization of an interdisciplinary team of researcher ranging from indigenous politics to biogeochemistry to explore the impact of community based restoration on the local ecosystem and human community.
- Deep diving odontocetes such as sperm whales, beaked whales and pilot whales that dive to depths greater than 500 m forage mainly in the dawn-dusk and night hours. Approximately 70% of foraging activities occur during the twilight-night hours.

- The songs of humpback whales in the Northwest Hawaiian Islands have slightly different characteristics than songs in the main Hawaiian Islands during the same winter season suggesting the possibility that the whales are from different populations that migrate from northern high latitude waters to Hawaii for the winter season.

HIMB Faculty	Male	Female	Minority*
Tenure Track Assistant	0	1	0
Tenure Track Associate	0	0	0
Tenured Associate	3	1	0
Tenured Full Researcher	3	1	0
Tenured Professor	3	1	1
Tenure Track Specialist III	1	0	0
Tenure Track Specialist IV	0	2	1
Annual Assistant	5	3	1
Annual Associate	0	0	0
Annual Full Researcher	2	0	1
Affiliate Faculty	27	8	0
Emeritus Faculty	3	0	0

* Asian, Hispanic, Filipino, Black, Native American, Hawaiian and/or Pacific Islander

- In the last decade, beta-N-methylamino-L-alanine (BMAA) has been identified as an 'emerging neurotoxin' in certain species of cyanobacteria, and has been implicated in the etiologies of several neurological diseases. Bidigare and co-researchers have recently developed a LC-MS/MS method for the measurement of BMAA, and have demonstrated that this toxin is bioaccumulated in seafood species sampled in Hawaii, Louisiana, Mississippi and Florida.

9.4 Faculty and Students

HIMB faculty members are all productive and contributing members of the University of Hawaii community. A majority serve as editors/associate editors of top tier professional science journals (Appendix 9.2) and all provide professional reviews for scientific journals ranging from Science, Nature, Marine Ecology Progress Series, Coral Reefs, Diseases of Aquatic Organisms to Global Change Biology, etc. Their research efforts were recognized in a special featured edition of the Journal of Marine Biology, "Ecosystem-Based Management in the Pacific". Their contributions in research and education has also been recognized with numerous awards including the Peter Garrod Graduate Mentorship Award in 2012 to Robert Toonen, the University of Hawaii Team Award for the Coral Relocation Project led by Paul Jokiel in 2009, University of Hawaii Excellence in Research Award to Robert Bidigare in 2007, and many more (see Appendix 9.4.) Although we are a small faculty with only 16 tenured/tenure track faculty members, the gender and ethnic diversity of our faculty reflect the HIMB commitment to create a diverse working environment for its faculty, staff, and students. Six of the 16 faculty are women

and two are members of the under-represented minority group (U.S. affirmative action definition).

The HIMB graduate students have all been outstanding. They have competed well in obtaining EPA Star Fellowships, research and travel awards, and won best paper, best poster, etc. at national and international meetings (See Appendix 9.5). They have also obtained significant funding for their own research efforts.

9.5 Notable Facilities

9.5.1 The Genomics Core Facility

The Genomics Core Facility at HIMB houses the Evolutionary Genetics Core Facility (EGCF), an NSF EPSCoR-supported Core Facility. It provides technical services for genomic and transcriptomic library preparations, and DNA fragment and sequence analyses on both ABI 3130 and Illumina GAIIx sequencing platforms. The support is available for HIMB faculty and students, the University of Hawaii system, and other institutions worldwide. The EGCF provides access to various instrumentation and equipment and offers fee-based genomic services including sequence and fragment analysis. The EGCF manager is available to provide services and assist with questions regarding lab instrumentation or protocols. A description of the facility and its services is described at <https://sites.google.com/site/himbcorelab/>.



9.5.2 The Pamela Omidyar Confocal Microscope Facility

The Pamela Omidyar Confocal Microscope facility houses a state of the art Zeiss LSM710 laser-scanning confocal microscope that is able to generate high-resolution images of fluorescent



specimens. It is especially suited for live cell imaging of samples up to approximately 100 μM thick. Its scanning unit has two sensitive PMT

detectors and a spectral separation module that can be continuously set over the entire wavelength range. It is equipped with lasers from violet to far red and has a motorized stage capable of tiling, multi-point mark, and find memory function. It is also equipped with an environmental chamber and full stage incubator for precise temperature and CO_2/O_2 control. It is capable of time lapse imaging of dynamic processes in living specimens, Fluorescence

Resonance Energy Transfer (FRET) measurements, Fluorescence Recovery After Photobleaching (FRAP) measurements, and spectral imaging for the separation of overlapping emission spectra. The funding for this microscope was made possible through a generous donation by Pamela Omidyar (also Founder of Humanity United & Hope Lab, Co-Founder of Omidyar Network & the Ulupono Initiative)

9.5.3 The Alliance for Coastal Technology

Alliance for Coastal Technology (ACT; www.act-us.info) is a NOAA-funded national program that supports innovation to better understand, predict, and manage coastal environments. ACT is a partnership of research institutions, resource managers, and private-sector companies dedicated to fostering the development and adoption of effective and reliable sensors and platforms. ACT has three services: 1) third-party test-bed



for technologies; 2) capacity building between manufactures and users, 3) information clearinghouse. New and existing instruments are quantitatively evaluated both in the laboratory and on coastal mooring. Participants at ACT technology-specific workshops review current state of instrumentation, build consensus on direction, and enhance communications between users, developers, and providers. The ACT online searchable data-base catalogues technologies and provides relevant standardized information to the user community. Hawaii Institute of Marine Biology (HIMB) is the Pacific Partner in ACT. Marlin Atkinson is the lead PI on testing of pCO₂ and pH sensors for in-situ moorings. In 2012-2013, pH sensors from companies will be tested for three months in a temperature, salinity and pH controlled calibration facility at HIMB. In 2013, these same pH instruments will be evaluated on moorings in coastal environments such as estuaries, coral reef, fjords, and lakes.

9.5.4 HIMB Ocean Acidification Facilities

HIMB has been the leader in research on how Ocean Acidification affects coral reef organisms and coral reef communities. In the late 1970s-80, outdoor mesocosms at HIMB were used to test the effects of aragonite saturation state on growth of coralline algae. In the 1990's, outdoor flumes were developed and used to test the effects of lowered pH on coral growth. In the early 2000's, an indoor wave flume was used to test the combined effects of ocean acidification, light, nutrients and food particles on coral physiology, and flow-through mesocosms were used to test competition between a variety of taxa under ocean acidification conditions. Most recently, a number of students and researchers at HIMB have collectively developed a facility to continually

grow organisms at different combinations of temperature, salinity and pH. High quality seawater, representing typical tropical water, is pumped from Kaneohe Bay into two 4000-liter storage tanks. There is a small diel signal in total alkalinity and dissolved inorganic carbon from tidal effects of the bay water and the metabolism of a reef near the intake pipes, creating diel changes in pH and pCO₂. In the large tanks, the water is well mixed and buffers the hourly changes in pH and total alkalinity. This water is then re-circulated between 4-8 separate header tanks for delivery to test 12-20 test aquaria. Each header tank is controlled for pCO₂ using a pCO₂ detector and a pCO₂ bubbler. Light, temperature and feeding is controlled in the experimental tanks. Experiments range from effects of OA on growth for species, to physiological responses associated with gene expression.

The facility also has an adjacent laboratory for the basic measurements for dissolved carbon dioxide system parameters, including total alkalinity (Automated Metrohm Titrator), pH using metra-cresol purple dye (Agilent Spectrometer 8453) and pH using a Ross combination electrode and associated pH buffers and certified reference material. The system is being developed to calibrate in-situ instruments for development of continuous monitoring of coral reef metabolism, and providing HIMB researchers with pH-calibrated seawater solutions.



9.5.5 Invasive Algae Removal Operations Support

Based at HIMB, the State Division of Aquatic Resources (DAR) in the Department of Land and Natural Resources has moored its “Super Sucker”, a giant underwater vacuum that is used to mechanically remove invasive marine algae that have spread throughout Kaneohe Bay. Since its development in 2005, this highly efficient underwater suction device has removed thousands of pounds of algae from Kaneohe Bay. This partnership between HIMB, DAR, and the Nature Conservancy has been highly effective in keeping the invasive algae from smothering the reefs and allowed the out planting of native collector urchin, *Tripneustes gratilla* (hawai) to keep the invasive algae from returning. HIMB houses two super suckers for these projects.

9.5.6 Boats, Diving, Seawater Operations

For work within Kaneohe Bay, HIMB maintains four 17' Boston Whalers with Honda 40hp outboard engines. For work outside Kaneohe Bay, HIMB has a 22' Boston Whaler Outrage with twin Yamaha 90hp outboards. Another 17' Boston Whaler, Hinalea, is maintained and operated by the UH marine biology undergraduate program. In addition, passengers and cargo are transported to and from HIMB on the 40' Honu Kai. The Honu Kai is capable of handling loads up to 10,000 pounds and is manned by designated HIMB employees. Groups of more than 20 are required to use the Honu Kai ferry. This vessel is also available for scientific research and educational project support.

HIMB facilitates scientific diving activities by UH faculty, students, and visiting scientists. Dive training courses are offered annually to UH scientists and students to support their research.

Combined with a small research fleet of boats, the training, services, and equipment of the HIMB Scientific Diving facility allow for the planning and completion of research projects in just about every ocean discipline. The HIMB dive locker maintains SCUBA, breathing air equipment, and DAN emergency oxygen kits for use by authorized divers in the program. The dive locker also has the necessary test equipment to provide the annual service required by the UH Diving Safety Program for buoyancy compensators, regulators, and computers/depth gauges.

9.5.7 Marine Mammal Facility

The Marine Mammal Research Program of the Hawai'i Institute of Marine Biology occupies the dolphin and whale research facility constructed by the Navy's marine mammal program. This program currently supports four whales and dolphins at Coconut Island, and the core facility for animal care and maintenance is located on the nearby Marine Corps Base Hawai'i - Kane'ohe. The facility once housed over 80 animals and includes a small hospital with surgical and laboratory facilities, two large freezers for maintaining frozen fish food, a large kitchen and food preparation area, storage and six office spaces, a conference room, animal transport equipment, six boats of various sizes, a 100 foot pier, and a fenced off small bay that is currently used as a quarantine facility for newly introduced marine mammals. The facility is inspected annually by the U. S. Animal Plant Health Inspection Service and has always received the highest ratings.

9.5.8 Pelagic Fisheries Research Facility

The Pelagic Fisheries Research Facility is comprised of on-shore tanks and in-water pens that allow the long-term maintenance and study of large top predators such as sharks and tuna. In fact, it is the only research facility in the world where tropical tunas can be obtained and brought into captivity year-round. Research vessels used to capture specimens or to study them in the wild complement these assets. In combination, these facilities support research into the behavioral ecology and sensory physiology of key components of coastal and pelagic ecosystems.

9.5.9 Marine Science Research Learning Center



In April of 2010, HIMB opened the new Marine Science Research Learning Center. The center features a laboratory-classroom, equipped with student laptops, digital microscopes, and associated scientific equipment and supplies. Students have quick access from the state of the art laboratory-classroom to field sites, being just footsteps away from the shoreline of Moku o Lo'e. The center is fully integrated with a sophisticated audio-visual system, high resolution

projector and high speed internet, where HIMB faculty and staff teach hands-on scientific inquiry curriculum developed by HIMB educational specialists and scientific researchers. HIMB also hosts related marine education programs and workshops in collaboration with partner organizations.

9.6 HIMB's Participation in National/International Research Programs.

HIMB is a founding member of the Genomics Observatories Network to monitor Earth (Nature 2012). Initiated in 2012, this network will use field stations, marine labs, museums, standards organizations, and sequencing centers, to integrate genomic information with environmental, socio-ecological and other biological data. As a member of the Western Association of Marine Laboratories, HIMB is working with other members in the organization to monitor ocean acidification at coastal sites and examine marine biological diversity using gene chips and genomic sequencing technologies developed at HIMB.

Marlin Atkinson is the Pacific regional partner for the Alliance for Coastal Technologies (ACT), a NOAA funded partnership of six institutions charged with testing and examining the sensor technologies and protocols that are used to monitor the nation's coastal, fresh, and open ocean waters. ACT has expanded internationally with developing partners in the UK (Britain, Ireland), Europe (Italy, Spain, Portugal, France, Germany), Japan and Australia. Atkinson also leads an international effort to monitor ocean acidification on coral reefs, with sites in the U.S., France (La Reunion, New Caledonia, Moorea), and Australia. Ruth Gates is part of the Moorea-Gump Station Long Term Ecological Research project, an NSF funded project to examine the variability in ocean forcing of coral reef function, community structure change and diversity.

Alexander Supin, director of the Severtzov Institute of the Russian Academy of Sciences in Moscow, is an affiliate HIMB faculty member who spends at least two months per year living on Coconut Island and working directly with the Marine Mammal Research Program. The collaboration between Paul Nachtigall and Professor Supin has resulted in new technologies to measure marine mammal hearing by picking up brain wave patterns measured from the surface of the skin, measuring hearing while an animal is echolocating and demonstrating hearing sensation level control by the animals in response to loud sound. Additionally, as former long term editor of the journal Aquatic Mammals, Dr. Nachtigall was elected, in 2012, to be the only living honorary member of the European Association for Aquatic Mammals. Dr. Nachtigall also was invited to spend a mini-sabbatical as a Velux Fellow of the University of Southern Denmark working at the Fjord and Belt Research Center on the echolocation of the harbor porpoise at Kerteminde Denmark during 2010 resulting in collaboration between graduate students from Denmark and HIMB. The Journal of Experimental Biology subsequently funded efforts for Danish student Meike Linnenschmidt to study at HIMB and Hawaii student Laura Kloepper to study in Denmark. Collaborations between Mats Amundine of the Kolmarden Djurpark in Sweden and members of the HIMB Marine mammal research program resulted in the first

measures of the hearing of any bear when Dr. Nachtigall and his students were invited to Sweden to measure the hearing of three polar bears. A collaborative program between the Marine Mammal Research Program and Professor Lee Miller from the University of Southern Denmark succeeded in capturing wild white beaked dolphins off Iceland, measuring their hearing on board ship, then tagging and releasing them. Unfortunately a similar, much larger attempt to capture and measure the hearing of the much larger Minke whale the following year failed to yield hearing measures.

Brian Bowen has a long-term collaboration with Michael Berumen at the King Abdullah University of Science and Technology (KAUST) in Saudi Arabia, to resolve the origins of Red Sea biodiversity. He is an advisor to the IUCN Species Survival Commission. In 2009 - 2010 he was a National Research Council panelist, and is currently a member of the International Steering Committee for the Indo-Pacific Fish Conference. Bowen organized a symposium at the 8th Indo-Pacific Fish Conference in Freemantle, Australia, and has recently delivered keynote addresses at international scientific meetings in French Polynesia (2008) and India (2009). He has lectured on conservation genetics in short courses in Panama (2009, 2012) and Brazil (2011). In the last five years he has provided invited lectures in the British Indian Ocean Territory (2008), Indonesia (2010), Malaysia (2011), Saudi Arabia (2011, 2012), the University of the South Pacific (2012), and many domestic university settings. During the same interval Bowen had collaborative projects with scientists in Great Britain (2), Australia (4), Brazil (4), Cameroon (2), Panama (2), Canada (2), Azores, Mexico, France, Seychelles, Saudi Arabia, Spain, and more. Bowen has done field work in the last five years in Cocos (Keeling), Christmas Island (Indian Ocean), French Polynesia, Chagos, Saudi Arabia, Cook Islands, Djibouti, and elsewhere.

Over the past ten years, Dr. Kim Holland and other members of HIMB's pelagic fisheries group have played integral roles in European Union funded projects investigating ways to improve industrial tuna fisheries and mitigate their environmental impact. This collaboration has involved HIMB researchers working in all the world's oceans and the Mediterranean and Bismarck Seas and collaborating with scientists from over a dozen countries.

Ruth Gates is an active participant in international programs. Since 2007 she has engaged in the following international activities: 1. Associate Investigator and Executive Committee Member on the NSF funded Moorea Coral Reef Long Term Ecological Research Site. In this capacity she have conducted three field trips in Moorea, each with a team of three researchers. 2. Collaborative work at the National Museum of Marine Biology and Aquarium and Academia Sinica in Taiwan. She has made six trips to Taiwan in the last four years in a variety of capacities: as an invited plenary speaker at two conferences, to develop a collaborative network, and to conduct research that capitalizes on the research excellence and setting in Taiwan. Her visits have been funded by Taiwanese collaborators and by the NSF through EAGER and international programs. 3. Collaborative work in Japan. She has been an invited participant in workshops in Tokyo and Okinawa and have most recently developed a research collaboration with scientists at Sesoku Marine Station and Okinawa Institute of Science and

Technology. Dr. Gates currently has an NSF IRES proposal in review to embed students in Moorea, Taiwan and Japan and has a supplement to an existing NSF award and funding from OIST to hold an international workshop on coral recruitment being held April 2013. 4. Ongoing collaborations with the Australian coral reef community: a) Dr. Gates was an invited member of the Scientific Advisory Committee for the 2012 International Coral Reef Symposium; b) In 2011 she facilitated a meeting at the University of Queensland for the Great Barrier Reef Foundation on genomic approaches with value in managing Coral Reefs; c) She was invited to give seminars at the Australian Coral Reef Center of Excellence at James Cook University and at the Australian Institute of Marine Science; d) She currently has two Australian Coral Reef Scientists as sabbatical visitors in my lab – Tracy Ainsworth and Bill Leggat; and has three active collaborative projects with Madeleine van Oppen (AIMS).

9.7 Contributions to “Applications and Public Outreach.”



HIMB has a vibrant program in education at the graduate, undergraduate, K-12, and public/community levels. Programs that embody the learning of science and the science of learning exemplify our education philosophy. Research and education faculty work collaboratively to utilize research as the basis for scientific education and training at all levels, while evaluating the efficacy of educational approaches and curricula. Three full-time education faculty, one staff educator, and several graduate students, part-time

assistants and volunteers work to create opportunities and pathways into careers for local students in the marine science research and management fields. HIMB is always working to further education through innovative projects and collaborations.

Formal programs for pre-college and college students include science labs in our new state of the art HIMB Marine Science Research Learning Center.

- Inquiry-based field trips at HIMB on topics including bioacoustics, ocean acidification, sea urchin fertilization, and fish larval development for high school classes. These developing programs are growing with 1,600 student participants since 2010.
- High school lessons that utilize robotics technology to explore the coral reefs of Kāneʻohe Bay.
- Continuing Education courses introduce students to Moku o Loʻe (Coconut Island), HIMB, Papahānaumokuākea Marine National Monument, and current research in coral disease, reef monitoring, fish studies, and alien species. Nearly 200 people have completed this course since 2006.

- Collaborative education programs with local fishponds integrate current science methods with traditional ecological knowledge.
- Research intensive summer courses for high school students provide college level have reached over 200 students in a partnership with the Pacific Center for Environmental Studies at Windward Community College.

HIMB offers many collaborative internship opportunities with partner institutions including NOAA, Hawai'i Youth Conservation Corps, the Windward Community College Pacific Center for Environmental Studies. HIMB faculty members host many students to work as interns on independent research projects. HIMB is also the lead institution for Hawai'i's COSEE Island Earth, one of thirteen NSF funded Centers for Ocean Sciences Education Excellence around the country, and a major partner in the NSF funded Pacific Islands Climate Change Education Partnership, part of a national network devoted to creating education programs and resources related to climate change science and adaptation.

HIMB currently administers the highly popular Marine Biology graduate specialization program in partnership with Zoology, Botany, Microbiology and Oceanography. The need for more focused marine biology graduate studies in Hawai'i has led to the recent approval of formal Marine Biology interdepartmental graduate program at both the M.S. and Ph.D. levels.

9.7.1 Community Outreach

HIMB is dedicated to enhancing scientific and ocean literacy among all of Hawai'i's citizens and visitors to help protect the marine resources of our islands. HIMB faculty members work with organizations to identify projects that are relevant to the community and to involve community members in that research. Several of our programs exemplify our commitment to this goal.

- The HIMB Community Education Program supports and trains an active group of college students and community volunteers who lead hands-on tours that showcase the importance of HIMB research to visiting schools, community members and organizations, as well as online audiences through its blog, "Science Island" with over 15,000 hits annually.
- Community Education volunteers and interns monitor visitor impacts on island resources and mentor high school students on science projects.
- Intensive science programs offer a chance for families and community groups to actively engage in science research at a marine biology station. Since the program was initiated in 2007, over 9,000 families and community group members have participated in science research at HIMB.
- Over 10,000 students (K-12 and college level) have participated in shipboard and island science discoveries via our Expedition to Moku o Lo'e program, our Marine Science Overnights, or focused science tour programs...

- Talks and presentations at schools and community events reach thousands more beyond those that can be accommodated on Moku o Lo'e (over 23,000 since 2007).
- The Eyes of the Reef Network increases public awareness by engaging community monitoring of coral bleaching and disease, marine invasive species and crown-of-thorns sea star outbreaks.
- Lāulima A 'Ike Pono is a participatory community research partnership with He'eia Fishpond. Community members learn about science research and careers by working as paid interns with HIMB researchers on projects that investigate the biogeochemical functioning of the pond.
- Ocean FEST (Families Exploring Science Together) offers free, fun, hands-on science events to elementary students and their families to promote careers in ocean science and related Science, Technology, Engineering and Mathematics (STEM).
- An emerging GIS web database and portal will allow public audiences to visualize research information on Kāne'ohe Bay dating back to 1968 in a user-friendly environment, as well as contribute to that information.
- The HIMB Northwestern Hawaiian Islands Research Partnership Outreach Program has reached over 27,000 people since 2007 through interactive displays, hands-on activities, and inquiry-based programs for schools and community members.
- Professional Development

Our location offers world-renowned research facilities to scholars and visiting researchers, and HIMB research faculty mentor graduate students and postdoctoral scholars from around the world. Faculty members provide students and postdoctoral researchers opportunities to work within a global context while studying local phenomena.

The Edwin W. Pauley Summer Program in Marine Biology draws faculty and graduate students from around the world. Topics reflect current and emerging questions in tropical marine science research. A faculty to student ratio of 1:1 ensures highly personalized instruction. Since 1983, over 300 students from 27 U.S. states and 28 countries on 6 continents have participated, 97% of which have gone on to pursue careers in marine science.

Research faculty, postdoctoral scholars, and graduate students all play an integral role in education and outreach through hands-on teaching of pre-college, undergraduate and community programs. HIMB education specialists are leading professional development efforts for young and mature scientists alike to hone their skills in outreach and communication through formal seminars, workshops, and mentoring, while enhancing the broader impacts of their science research.

HIMB engages with partner agencies such as NOAA and state resource managers to provide training for reef managers and other professionals around the globe. Past workshops have included histotechniques and coral disease, coral molecular biology techniques, microscopy for

plankton identification, coral bleaching response for management, and teacher training in ocean sciences.

9.7.2 International Collaboration

Education faculty are involved in a number of collaborations with international colleagues that extend the impact of HIMB research and education far beyond Hawaii. Judy Lemus has been an active participant and member of the organizing committee for the International Pacific Marine Educators Network conferences since 2008. She has also collaborated with education colleagues at the National Museum of Marine Biology and Aquarium (NMMBA) in Taiwan to interpret science discoveries from HIMB and NMMBA research partnerships to public audiences. In 2010 Dr. Lemus was a delegate of the National Science Teachers Association to an international forum on science education in Shanghai, China and an invited participant of the NSF Pacific Climate Change Partnership (PCEP) Workshop on climate change education and adaptation in Pohnpei. In 2014-15 she will be conducting teacher workshops on climate change science education for the PCEP program in the Marshall Islands and American Samoa.

With funding support from the Office of National Marine Sanctuaries (HIMB-NWHI Research Partnership), Malia Rivera worked with the American Samoa Community College and UH Sea Grant to develop an undergraduate marine science internship program in 2008. She has also hosted several international classes through the HIMB high school science inquiry program (Japan and Canada). In 2013, Dr. Rivera will work with collaborators from the PCEP to help disseminate marine science education programming developed at HIMB across the US Associated Pacific Islands.

Mark Heckman hosts 3 – 5 International college groups to review HIMB facilities and research each year. Groups include colleges from Korea, China, Japan and Canada. The Community Education Program also supports several international students as volunteer interns each year, providing them training in science education.

9.8 HIMB's vision for the next five to ten years.

9.8.1 Research Plan



HIMB faculty members have held strategic planning retreats at two-three year periods since 2003. At the HIMB retreat in February 2009 the following objectives and benchmarks were developed for 2010-2015. The main objective identified was global leadership in tropical marine biology. HIMB has become a leading institution in the study of marine systems, integrating research from molecular to cellular to ecosystem to global scales. HIMB faculty are experts in the physiology, ecology, and ecosystem processes of coral reefs, the sensory processes and behavior of marine fishes and mammals, and the evolutionary and ecological genetics of marine organisms. In the five years since the last Strategic Plan update, HIMB has

steadily increased the number of faculty, total grant funds, and annual publications in peer-reviewed journals. The unique resources of HIMB are critical for maintaining this momentum and include:

1. Proximity and access to living reefs and open ocean.
2. Location with an estuary/lagoon habitat that provides a model for land-sea interactions.
3. Dependable, high-quality seawater supply.
4. Feasibility (both logistically and legally) of collecting and safely maintaining marine organisms.
5. Advanced laboratory instrumentation.
6. Marine mammal and shark laboratories.

These assets are the foundation upon which we will expand our tradition of research excellence.

9.8.2 Development of integrated research areas that involve a majority of the faculty.

With recent hires, HIMB has assembled its full complement of faculty, and we expect little change for the period of this Strategic Plan. Therefore, further growth depends on synergies among existing faculty. To realize our full potential and global leadership role, HIMB will develop strategic research areas that encourage collaboration among the faculty, position the Institute for large federal and private grants, increase international recognition, and better serve the Institute's research mission for the State of Hawaii and the nation. Two potential areas of global leadership for HIMB are (i) the science of tropical marine protected areas and (ii) the ecology of deep reefs.

Benchmarks:

1. Establishment of a center of excellence in an integrated research area focusing on our access to a living reef and the Northwestern Hawaiian Islands.
2. Develop a greater capacity for coastal and deep reef exploration through an enhanced diving and boating program to support deep dive operations outside Kaneohe Bay.
3. Build a containment center to study coral physiology and coral health/disease.

9.8.3 Foster increased international collaboration.

Because of our mid-Pacific location, HIMB is uniquely situated as a hub of international collaborations that keep HIMB faculty at the forefront of their fields and contribute to HIMB's global leadership. Many HIMB faculty members have international collaborators throughout the Pacific Rim, the United Kingdom, and Europe. The Pauley Program, an intensive research course held annually at HIMB since 1983, has attracted students from all over the world. Aside from the Pauley Program, however, these collaborations are not formally recognized or supported by the Institute. There are many avenues for international collaboration that have not been fully exploited, including existing sister institution relationships, promoting HIMB as a conference center, offering HIMB as a desirable location for sabbaticals and scholarly retreats, and expanding international training and outreach.



Benchmarks:

1. Formalize existing and foster new collaborations with sister institutions and global partners.
2. Increase the number of faculty and student exchanges.
3. Enhance facilities for visiting scholars.

9.8.4 Develop diversified funding sources.

To maintain and expand the success of the Institution, we must diversify beyond the State and federal sources that comprise the majority of our current funding. Beyond the outstanding support we have enjoyed from the Pauley Foundation, we have not adequately explored funding from private foundations. Furthermore we have not developed a convenient avenue for private citizens to donate money to HIMB.

Benchmarks:

1. Increased number and diversity of funding sources, including the private sector.
2. Establish a "Friends of HIMB" donor fund, preferably accepting donations via credit card through the web site.
3. Establish communications with private foundations.

9.8.5 Improve public awareness of research efforts and results.

Communicating our research efforts and results to the citizenry is a central part of our mission and essential to continued public support. HIMB faculty produce headline-worthy research and outreach efforts, but current resources are inadequate to transmit our message: our web-presence is inadequate, campus media offices need to be engaged, and we lack basic promotional materials. Public awareness efforts could be facilitated and centralized with an HIMB public relations officer.

Benchmarks:

1. Increased number of press releases from HIMB
2. Updated our interactive web-presence
3. Hire of a public relations officer

9.8.6 Institutional Plan

HIMB faculty at the 2009 retreat identified four objectives and strategies that are part to HIMB's institutional responsibilities:

- Training Future Scientists
- Initiating a Program in Integrated Community Based Research and Education
- Providing a World-Class Research Facility for our Faculty and Visitors.
- Ensuring that All of Our Activities Reflect Our Conservation Values

The Institutional Plan is a living document and will be examined routinely as HIMB's research and education efforts develop and as funding streams for federal and state sources become available. In 2009, a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis was conducted on these four objectives. The faculty affirmed HIMB's need to develop these objectives more fully with appropriate metrics for success.

9.8.7 Training Future Scientists

K-20 Education

The mission of the HIMB Education Program is to recruit the next generation of ocean scientists, managers and stewards and educate the citizens of Hawai'i to help conserve our marine resources. Our goals are to improve scientific and environmental literacy and create opportunities and pathways into careers for local students in the marine science research and management fields. We have developed partnerships with numerous state and federal agencies, non-profit organizations and community groups whose contributions have been central to the success of our education programs.

HIMB supports this mission with outreach and informal science education, formal lesson and curriculum development, and research training for students and teachers. In 2006, HIMB hired its first education specialist and since then, has hired two additional faculty members whose responsibilities include outreach and education. These faculty members have designed and implemented education programs at three key levels: **formal science experiences for K-12 students, an informal school and community education program for class fieldtrips and public visits, and intensive internship programs for high school, post-high school, undergraduate, and graduate students.** The HIMB Education Program serves not just the students and community who take advantage of our offerings, but also HIMB researchers who work with the education specialists to develop the broader impacts of their NSF research proposals. The new Marine Science Research Learning Center is well equipped with interactive multimedia, laptops and digital microscopes and is dedicated to teaching marine science to student, teacher and public audiences.

Graduate Programs

HIMB and Biology is charged with administering the Marine Biology graduate program that was approved by the Board of Regents in 2012. HIMB and its partners in Zoology, Botany, Microbiology, and Oceanography have recruited its first class and organized a year long course for Marine Biology graduate majors. There are over 50 members of the graduate faculty with expertise in marine evolution, ecology, coastal and ocean resource management, marine ecosystem processes. At HIMB, faculty still train 50-60 graduate students in Zoology/Biology, Botany, Microbiology, Oceanography, Geography, Animal Sciences, Psychology, and Molecular Biosciences and Bioengineering.



Postdoctoral Programs

HIMB has many postdoctoral fellows present in its research laboratories. The HIMB faculty members identified a need to engage foundations in developing a fund for postdoctoral fellowships that would integrate research and education values and provide connections between these fellows and job opportunities in higher education, research institutes, and federal and state agencies.

Funding needs:

1. Space for postdoctoral and graduate student offices is needed.
2. Develop a program that will target diversity hires and seek foundation funds
3. Seek funds that will enhance the training of reef managers around the globe.

9.9 Initiating a Program in Integrated Community Based Research and Education

HIMB faculty members identified a need to engage local communities in the research efforts of the faculty and students on Coconut Island. As part of the 2009 Pauley program, HIMB scientists are developing a web accessible database on the research results of the Pauley programs since 1968. We have identified the following needs to initiate this program:

1. Develop a framework for information collection so that faculty are able to upload data easily.
2. Develop distance technology.
3. Develop website for distance education and outreach
4. Develop a public display area near the lighthouse where visitors make landfall on the island.
5. Create a real time experience for the community by wiring the bay for sensor input into classrooms.

9.10 World Class Research Facility

HIMB has worked with Facilities and Maintenance to recommission the 11 year old Pauley Laboratory Building. Its air-conditioning system is unsustainable and its building envelope requires remediation. In 2011-2012, a major renovation of this building has been initiated and is almost complete (December 2012). The older Marine Laboratory Building at the lagoon site facing the ocean is in need of major renovation and funds have been secured to repair and modernize this building. The repair and renovation of the building is scheduled to begin in January 2013. The state legislature and the Governor's office have provided funds to repair Lilipuna pier and fix the sewage line between Coconut Island and the Lilipuna line located across the channel and adjacent to the Lilipuna pier. Moreover, Hawaiian Telecom is working with UH Facilities and Maintenance to lay a fiber optic cable to the island. This and resources provided by NSF EPSCoR funding will enable HIMB scientists to secure their data and port real time data transfer from sensor and gene sequencing facilities.

9.10.1 Conservation Values

HIMB has laboratory facilities on a very special place. Faculty and staff recognize the sensitive environment of our facility, and the way we use our island's resources must reflect generational responsibility. HIMB needs to develop a Coconut Island Plan for sustainability. Faculty members are working to develop alternative energy fuels and the Center for Sustainable Future has identified HIMB for the installation of photovoltaic energy production. A power purchasing agreement through the Department of Transportation and the University of Hawaii with Solar City was signed in 2012 and photovoltaic will be part of HIMB's energy source in 2013.