UH Hilo Marine Science Program Review

I. Mission Statement and Goals of the UH Hilo Marine Science Program

Mission Statement:

The marine science program at UH Hilo inspires and enlightens all learners about the ocean through interactive hands-on learning, research involvement, and community outreach centered on the natural and cultural environment of Hawai‘i Island. This is supported by a broad background in the marine sciences, including fundamental knowledge of biology, chemistry, physics, geology, and mathematics.

Vision Statement

We will be an international leader in marine science education and research. Our *kuleana* (responsibility and privilege) is to provide student-focused, transformative, authentic science experiences, drawing from the unique natural and cultural environment of Hawai‘i. Our graduates will be broadly equipped to become innovative members of the global workforce, successful life-long learners, and engaged stewards of the marine environment. Faculty, staff, and students will collaborate and draw upon each other’s strengths and diversity to achieve our shared vision of student success.

II. Secondary Accreditation

N/A

III. Executive summary by Dept. Chair

In this self-study we consider the historical and current Marine Science Program structure and organization (including staffing and student population profiles); the facilities, equipment and infrastructure that are critical to the program; evidence of program quality (including curriculum and student learning assessments); evidence of faculty quality; and future program goals and resource requirements.

From 1992, when the BA in Marine Science was first established with two faculty members, Marine Science has grown into a flagship program at UHH run by ten full-time faculty, three academic support specialists (APTs) and a pool of lecturers. The Marine Science program averages 200 undergraduate majors per year, representing about half of the Natural Science Division, and graduates around 30 students per year. The UHH Marine Science Program attracts a relatively high number of mainland and transfer students compared to UHH in general. Presently Marine Science (MARE) offers BA and BS degrees in Marine Science, with the students split between these two degree options approximately 50/50. A minor in Marine Science is also offered. The UHH Marine Option Program (MOP) is housed within the Marine Science Department, offering a popular subject certificate that attracts majors and non-majors alike. MOP also coordinates the QUEST field courses, which are extremely popular within the Marine Science Program. Marine Science routinely offers classes during the UH Hilo Summer Session, requiring support by the Chair, APTs, boat staff, and other faculty.

Within the Marine Science program, there is a lot of infrastructure and equipment that sets our program apart from other similarly-sized undergraduate academic programs. The R/V *Makani*

Aha and our fleet of small boats; the successful and well-instrumented Analytical Laboratory; Scanning Electron Microscope Lab; vehicle fleet consisting of two 12-passenger vans and a Ford F-250 truck, and the diving equipment are good examples. All of these facilities are used to support both teaching and research. Oversight of UHH MARE boats and terrestrial vehicles was shifted from the Kalakaua Marine Education Center (KMEC) to the department chair in 2013, representing a major shift in departmental organization. KMEC had previously been a separate center program with its own director and budget. The analytical lab is overseen by a separate MARE faculty member (Wiegner) and is managed by a full time employee. Dive equipment, although purchased by MARE and MOP funds initially, is overseen by a Unit Dive Safety Coordinator under the Environmental Health and Safety Office (EHSO).

Program quality is evidenced by the fact that Marine Science, as an instructional unit, is a relatively independent program that survives predominantly on its own majors. The Marine Science Program is similar in size and scope to the College of Agriculture, Forestry, and Natural Resource Management. The majority of instructional output (61 to 70% of the SSH) targets Marine Science majors, however the program has a few lower division GE courses taken by a wider array of students including Marine Science majors. Two thirds of the SH are taught by tenure-track faculty.

The quality of the MARE faculty is evidenced by the range of expertise represented, including specialization in Marine Biology and Oceanography, as well as by the types of learning experience offered to students. Two of our faculty (Lisa Parr and Jason Turner) have been recipients of the Frances Davis Award for Excellence in Undergraduate Teaching, and Karla McDermid has received the UH BOR Medal for Excellence in Teaching. Aggregate data collected for this self-study quantifies how well our faculty adhere to the MARE mission statement regarding education, research, and outreach. For instance, on average (2007–2014) 33 MARE classes per year contained hands-on learning experiences; faculty and students co-authored an average of 28 publications or presentation per year, reflecting the high level of faculty-student research collaboration in the department; and MARE faculty and / or students participated in an average of 29 education-related outreach events per year.

The MARE curriculum focuses on Marine Science, including Oceanography and Marine Biology, emphasizing face to face courses, and small class sizes. Departmental learning objectives are organized as Content Goals, General Goals, and Technical Goals, and a curriculum map summarizing where Student Learning Objectives (SLO) are ‘Introduced’, ‘Practiced with Feedback’, and ‘Mastered’ was updated for this study. In general, SLOs (such as SLO #5, ‘Access the primary literature to find scholarly articles that discuss the results of experiments. *(Application)*’) tend to be introduced and practiced in lower division classes, and mastered in upper division classes. In other words, students see these SLOs repeated in more than one class during their academic career at UHH MARE. Faculty/student research collaborations are common in Marine Science, representing an important component of the education of our majors. For the students, this provides invaluable experience in real-world, experiential learning and exposure to the research process. Undergraduate interns become heavily involved in research projects, particularly in summer, often working directly with graduate students under faculty supervision. For the faculty, undergraduate/faculty research collaborations are probably more of a teaching exercise than a gain in research productivity, but at the same time many research projects rely heavily on undergraduate assistants.

We assessed four Student Learning Objectives (SLO) and two Institutional Learning Objectives (ILO) as a part of this self-study. Student Learning Objectives relating to lab techniques, literature reviews, oral presentations, and applied knowledge were assessed based on grades received on representative upper division course assignments. Institutional Learning Objectives relating to written communication and quantitative reasoning were assessed using upper division course assignments and an instrument developed by the UHH Assessment committee, respectively. Results of the assessments (detailed in this document) showed that our students are learning what we intend them to learn. However, the experience of undertaking this exercise, and the results, raised questions about the mechanisms used for assessment, and in particular how we can assess our students in a more meaningful and consistent manner.

Future goals of the Marine Science program at UH Hilo, and the resources required to achieve them, need to focus on maintaining and refining what we do best (undergraduate education), and thoughtfully preparing for the transformative changes that we are likely to see in the next decade. Our undergraduate education program has been very successful at UH Hilo, but could be improved through better recruitment and retention efforts, a revitalization of the MARE Summer Session, and better integration of faculty research with the MARE curriculum. We are addressing recruitment and retention through a number of activities discussed in this report. Maintaining existing support for programs such as the UH Hilo Marine Option Program is also key to student retention. Infrastructure of MARE needs some investment, including our fleet of vans / truck and boats. Perhaps the most transformative change on the horizon for MARE is the development of the Puakō Marine Laboratory, which will expand both our teaching and research activities.

IV. Program History and Organization

The Marine Science department and the associated undergraduate degree programs grew out of establishment of the UH Hilo Marine Option Program (MOP) in 1980. Two faculty members were originally involved in marine science education at UHH: the Geology Department hired Dr. Walter Dudley in 1979 as an Assistant Professor of Oceanography, and in 1981, Dr. Leon Hallacher was hired by the Biology Department as a marine biologist and ichthyologist. Before the establishment of the BA in Marine Science, UHH MOP saw growth from about 20 to 200 students between 1980 and 1989. In 1990, Professor Walter Dudley proposed to the UH BOR the creation of the Kalakaua Marine Education Center (KMEC), with development of the BA in Marine Science among its goals, recognizing the great potential for undergraduate marine science education at UH Hilo. KMEC was approved by the BOR in 1991, and the BA in Marine Science approved by the BOR in 1992, with two faculty positions associated with this new degree program.

Faculty

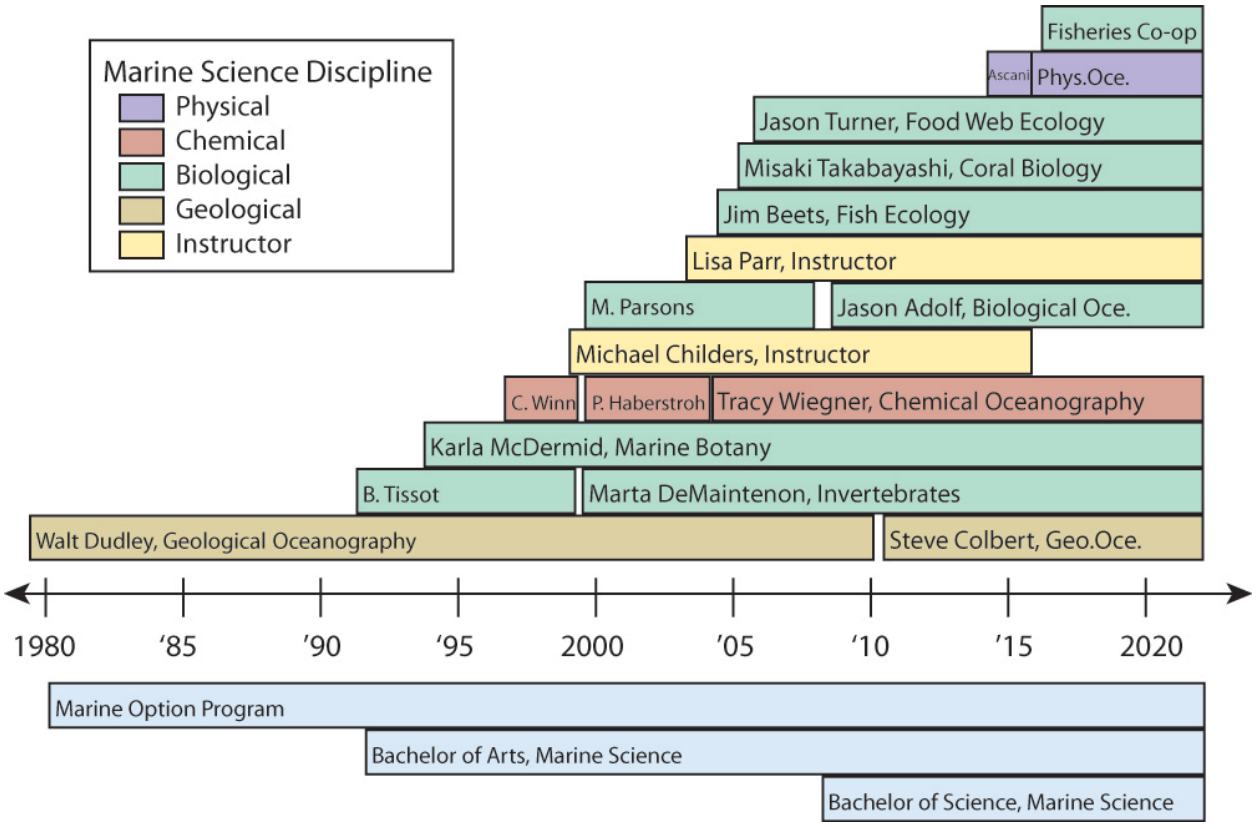


Figure 1. History of faculty hires and degree programs at UH Hilo Marine Science

The first faculty members in Marine Science were Dr. Brian Tissot, hired as a Marine Invertebrate Zoologist, and Dr. Dudley, transferred from his position in the Geology Department to a new Geological Oceanographer position in the Marine Science Department (Fig. 1). Over the years, as the number of majors in the Marine Science Department grew, new faculty positions were allocated to broaden the strengths of the department: a Marine Botanist was hired in 1994, a Chemical Oceanographer in 1997, and a Biological Oceanographer in 1999. By 2000, the department included five tenure-track faculty, an instructor, and an education specialist (APT). Another instructor position was filled in 2003. In 2004, two new faculty members came on board, one as a Chemical Oceanography NSF-EPSCoR hire, and one in a new Fish Biologist/Ecologist position. Two additional tenure-track faculty members were hired in 2005, a Coral Geneticist/Molecular Ecologist and a Food Web Ecologist. Since both of these positions were initially supported by the NSF EPSCoR grant to UH Hilo, the expertise of both of these positions was determined by the research needs identified by EPSCoR. Just last year (2014), we were finally able to hire a Physical Oceanographer, to round out our oceanography expertise within the department. Unfortunately, this individual decided to leave for another job and we are currently anticipating a search during AY 2015–2016. At present, the Marine Science Department has nine tenure-track faculty, two instructors, and two educational specialists. The faculty expertise is composed of five marine biologists and four oceanographers. There are also part-time lecturers who play an important role in providing necessary course offerings to cover for faculty with reduced loads due to research or administrative re-assignments, or in areas where the department lacks a needed specialist. In 2015, the USGS Cooperative Research Unit Program will fund a Cooperative Unit Leader position, which will have a university faculty appointment in Marine Science.

As demands for cross-disciplinary approaches in science increase, many academic programs around the globe are evolving to offer more applied experiences, moving away from theoretical sciences. The faculty expertise in Marine Science needs to keep up with such change either by professional development of existing faculty or hiring new faculty. Areas of future students' interest that are not currently covered by our faculty includes marine environmental policy relating to fisheries, development, and global climate change issues.

In addition to the faculty in MARE, our program depends heavily upon Academic Specialists and student workers. Presently, we have two full-time, 11-month appointed APTs, one of whom focuses primarily on MARE academic program support, and the other of which splits time between MARE academic support and Marine Options Program activities including the QUEST summer courses. A third APT position, Boat Program Coordinator, was authorized and we are in the process of hiring an individual as this document is being written. Our need to maintain a ratio of one staff for every six students for any field-based activity necessitates the hiring of student workers during the academic year and summer – our lab classes have up to 18 students per section requiring the instructor and two additional staff members on each trip. Providing these hands-on, experiential learning opportunities to MARE students is a shared value among our faculty and University of Hawai‘i Hilo, yet it has been challenging every semester to find adequate funds to pay student workers to help with field classes. This results in our APT staff covering these hours, which is much more expensive and takes time away from their stated duties.

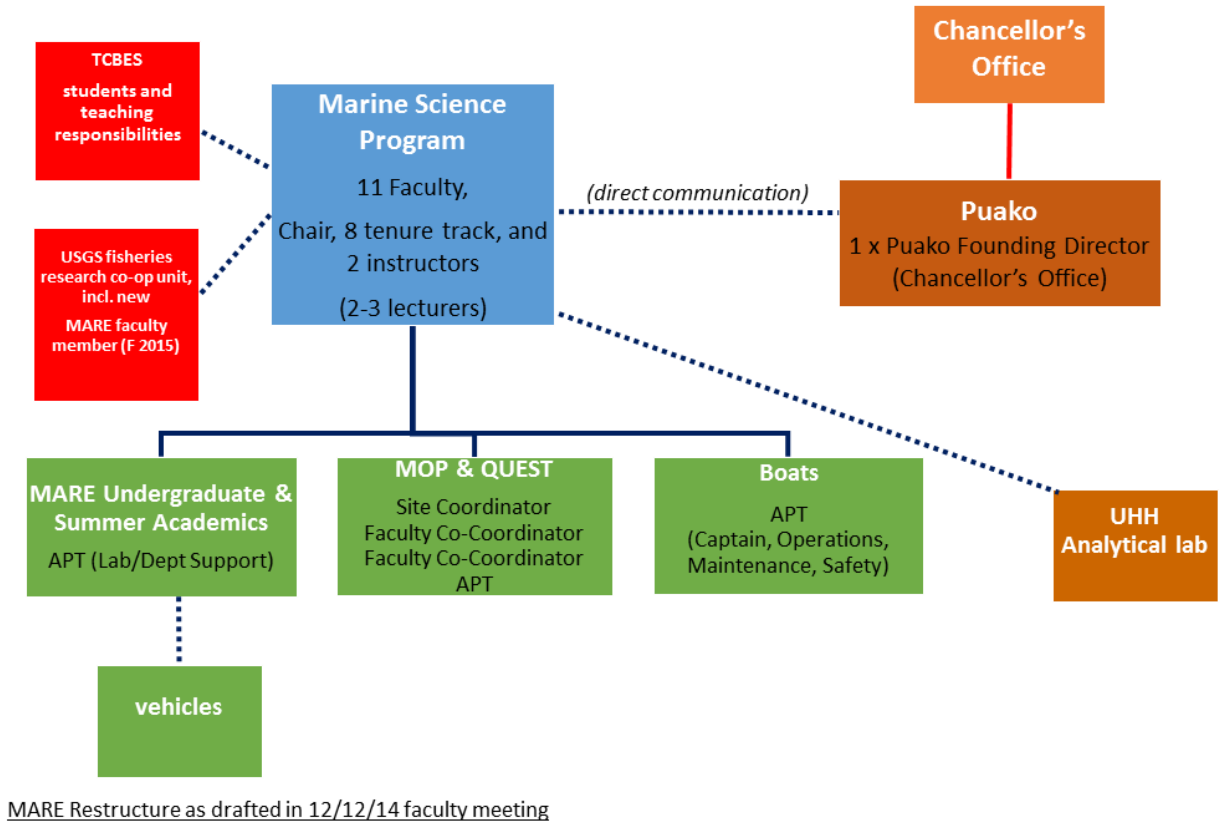


Fig. 2. Present day organization of the Marine Science Program at University of Hawai'i Hilo. Solid lines indicate direct responsibilities, dashed lines indicate strong cooperative ties with various programs.

The current organization of the Marine Science Program at UH Hilo is complex (Fig. 2) and reflects a relatively independent program whose success is dependent on many components. The undergraduate and summer academic programs, MOP & QUEST, and the MARE Boat Program are each under the direct responsibilities of Marine Science, and each has MARE faculty and staff to support its daily operations. Although Puakō Marine Lab development sits under the responsibility of the Chancellor's office, a MARE faculty member has been tasked as the 'Founding Director' working with the Chancellor's Office to drive development and assist with fund raising. The UHH analytical lab is housed within the Marine Science Building, is managed by a MARE faculty member, and has become an important component of our academic program in addition to functioning as a successful fee-for-service laboratory. MARE faculty also regularly mentor graduate (MS) students from the UH Hilo Tropical Conservation Biology and Environmental Science (TCBES) graduate program, and teach courses in the program as part of our regular teaching load. When the USGS Fisheries Cooperative Unit opens (AY 2015-2016) we will have an additional faculty member and a new relationship involving teaching (graduate level) and research.

Degrees and Certificates Offered

Marine science education at UH Hilo began with the system-wide Marine Option Program, which was established here in 1972, and still offers a subject area certificate available to undergraduate students of any major. Demand for a Marine Science degree program led to the development of the B.A. program, which was provisionally approved by the BOR in 1992, and the first B.A. degrees in Marine Science were granted in spring of 1994. A minor in Marine Science was also established, and the Marine Option Program Certificate has continued as a system-wide certificate program, working in partnership with the MARE department to provide students with experiential and applied learning opportunities in marine science.

The Marine Science program grew steadily in the number of majors through the 1990s, and by the year 2000 had reached close to 200 majors. Students over the years regularly expressed an interest in having a B.S degree available in Marine Science, to prepare students who wanted to continue their education towards Masters and Doctoral degrees. The department, by 2007, increased to eight full time faculty and two instructors, with sufficient infrastructure to support offering two bachelor's degrees. The B.S. degree in Marine Science was developed in 2007 and began in fall 2008, and was granted permanent status BOR in 2013. Many current students at the time switched from the B.A. to the B.S., and the first B.S degrees in Marine Science were awarded in spring 2010. Since 2008 the number of B.S. candidates in Marine Science has increased relative to the number of B.A. degree candidates. At present, the bachelor's degrees awarded in Marine Science are typically about half B.A. and half B.S. degrees. Currently Marine Science awards about 30 bachelor's degrees and 10 Marine Option Program Certificates each academic year, and maintains a population of about 200 undergraduate majors.

Demographic data for Marine Science

Number of majors

The number of undergraduate majors in Marine Science has increased slightly since 2007, from 183 in Fall 2007 to 218 in Fall 2014. The number of minors varies from 6 to 17, with an average of 12. Marine Science typically has a few (less than ten) exchange students. The faculty also mentor graduate students in the TCBES program, and there are typically 11 to 18 (avg. 14) graduate students whose primary advisor is a faculty member in Marine Science.

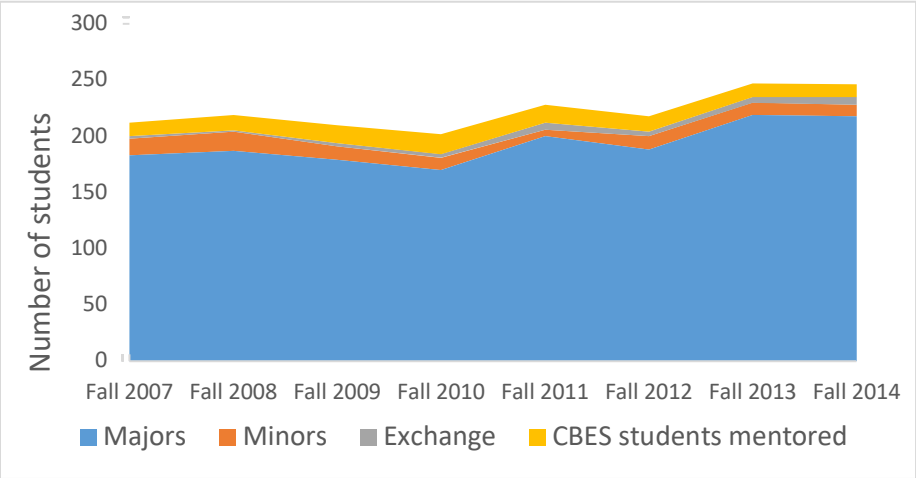


Fig. 3. Number of students (headcount) in MARE since 2007. Data from UH IRO (majors, minors) and STAR (exchange and graduate students).

New students

New students in the program are regional in origin; whereas other Natural Science majors tend to have proportionately more resident students, Marine Science has about 30% each resident, non-resident and WUE students, with an additional 10% from other categories, the most common of which is Pacific Islanders (res. Class J). Recruitment into the program remains relatively flat or slightly increasing overall, however there were pulses of non-resident and WUE students that entered in Fall 2011 and 2013.

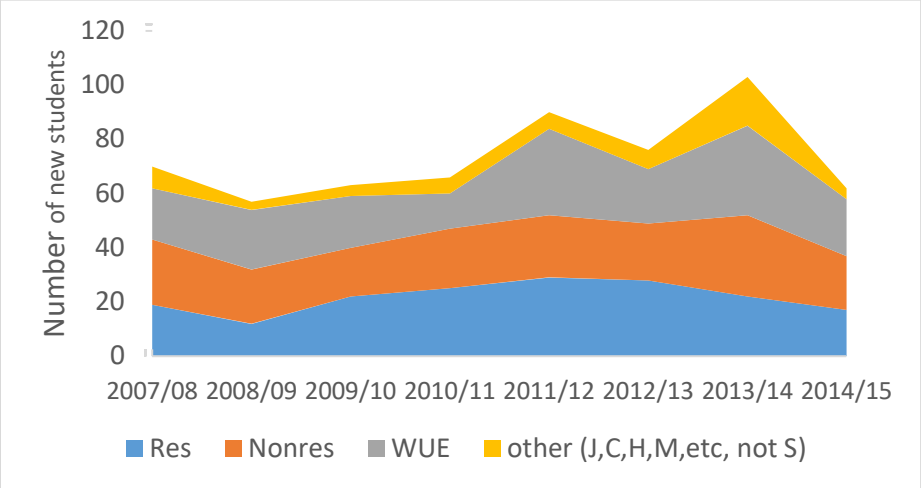


Fig. 4. Number of new students per academic year in MARE since 2007. Data from UH IRO (majors, minors) and STAR (exchange and graduate students).

New students in the program enter predominantly as freshmen (56.6%), slightly less than half as transfers. Since the BS degree was offered, an increasing majority of the new students have declared the BS degree.

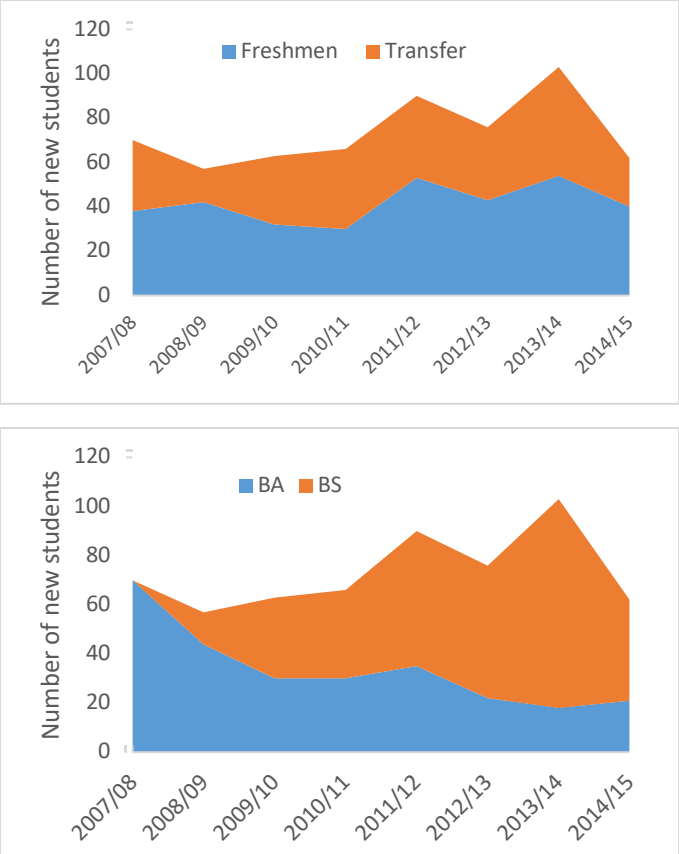
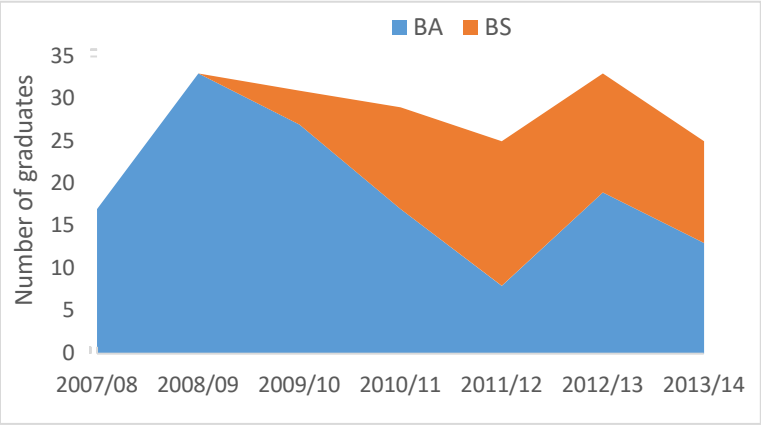


Fig. 5. Number of new students per academic year in MARE since 2007, by freshman / transfer status (top) and BA vs. BS degree (bottom). Data from STAR.

Graduates

An average of 27.6 students graduate with a BA or BS degree in Marine Science annually. Since the BS degree was instituted, an increasing percentage has earned the BS. At this point a little over half on average earn a BA degree.



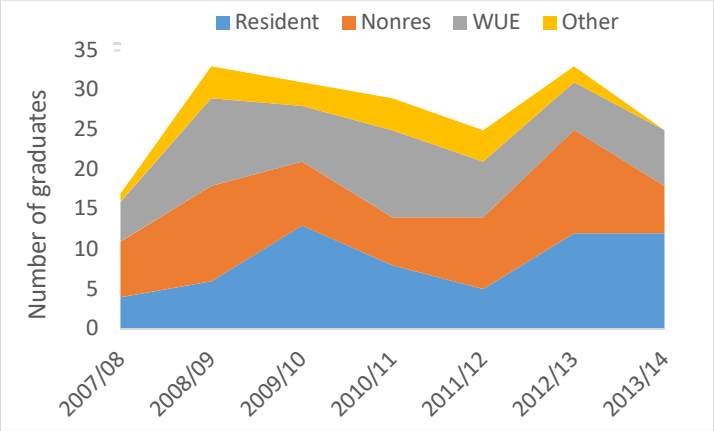


Fig. 6. Degrees awarded (top) and residency profile of MARE graduates (bottom). The residency profiles of these students matches that of the incoming students, with about 30% each resident, non-resident and WUE, and 9% other.

Retention

Based on data from STAR reports, on average 57% of students entering Marine Science as freshmen or transfers return the following fall. 78% of those return the second year. After that over 90% of the remaining students come back. The average is generally higher for transfers than freshmen, and higher for BS candidates than BA candidates. The two cohorts from 2007/08 and 2008/09 have finished and been analyzed. In these two cohorts, 33% and 40.7%, respectively, graduated. The 2007/08 cohort entered as BA students and some switched to the BS track, whereas the following year's cohort entered as a combination of BA and BS degree seeking students. Freshmen took 4 to 5 years on average to graduate with a Marine Science degree, and transfers graduated in 3 to 3.5 years on average.

Buildings and Infrastructure

Marine Science faculty, lecturers and staff occupy the Marine Science Building and a portion of the adjacent Wentworth Building. The UH Hilo MOP occupies a building on campus, in the life sciences quad. The Marine Science Building (10,309 sq. ft.) was completed in 2001 (Cost: $3M), and currently houses eleven offices (1829 sq. ft.), two classrooms (one of which is a computer classroom), a seminar room, one teaching (wet) lab, Analytical Lab, Marine Biology Lab (converted from a computer lab in 2006), and Scanning Electron Microscopy Lab. In 2011, Marine Science occupied renovated facilities in the Wentworth Building, including two teaching labs, three offices, and one small shared research lab. Faculty share laboratory space, and several faculty members conduct research in their offices, on other campuses, and at off-campus locations. Faculty members store a majority of their research supplies in their offices, laboratories, and 40' storage container. Additional storage space was made available at the old Armory Building across Lanikaula Street, when the university acquired the facility in 2013. Marine Science stores four boats, two rigid-hull inflatable boats (RIBs), kayaks, and diving equipment in a locked compound at the old Armory. Material that was previously stored in the American Trading Warehouse was moved to the old Armory facility in 2013.

In the fall of 2004, the UHH Tropical Conservation Biology and Environmental Science (TCBES) Master's program was established. Marine Science faculty have advised numerous graduate students since 2004. Laboratory space is shared with graduate students, as well as undergraduate students working on research and senior thesis projects. Currently, there is limited laboratory and office space available to graduate students. A shared graduate office/lounge is available in the Wentworth Building, and a few students utilize space available in the Marine Biology Lab.

The UH Board of Regents approved a Marine Laboratory for Puakō (state land on the western [Kona] coast of Hawai'i Island) in 1989. After several years of effort, the Conservation District Use Permit and the Special Management Area Use Permit were obtained in 2012. The state lease was finally obtained from DLNR in March, 2014. Construction plans were partially completed (10% of total cost as required for state permits) with a total cost estimate of $35M (2012 estimate). UH Hilo and Marine Science is working with the UH Foundation to secure funding for the project. The Puakō Marine Field Station is the top priority for Marine Science and will greatly expand our education, research and community engagement in Hawai'i.

Facilities and major equipment

Facilities and major equipment associated with the Marine Science Program support both teaching and research.

R/V Makani 'aha and small boats

Prior to the late 1980's, UHH marine research was conducted from a 12' Sears's flat boat and an old donated wooden boat that was soon deemed unseaworthy. At that time an 18' powerboat was acquired from a grant for a study of Hilo Bay. This boat is still in active service today. These initial vessel acquisitions allowed Oceanography Labs (MARE 201L) to be offered.

In 1998, UHH received the 53-foot catamaran, *Four Winds*, as a donation from Maui Classic Charters. The *Four Winds* was retired from service in 2010 due to deteriorating condition.

Currently, our primary teaching vessel is the *R/V Makani ʻaha*, which was purchased new by CAS and launched for use in 2010. This 38' Force catamaran with twin Cummins diesel engines serves as the platform for majors classes including MARE 171L, MARE 201L, MARE 353L, as well as several electives. It is moored at Radio Bay, Port of Hilo, adjacent to a facility that supports operations and maintenance, and includes equipment storage.

In addition to the *Makani ʻaha*, MARE operates and maintains a fleet of small boats including a 26' Glacier Bay catamaran with twin 115 HP outboard motors, a 25' Force Marine (*April Maru*) with an inboard/outboard motor, an 18' Larson (*Kaimi*) with a 115 HP outboard, 2 Apex RIBs (12' & 15') each with 40 HP outboard motors, and several kayaks. The fleet of boats that MARE maintains is essential to our academic program, but is also necessary for research conducted by faculty in MARE and other programs. Dean Randy Hirokawa organized and MARE participated in a review of our boat program during summer 2014, conducted by the Scientific Boating Safety Association (SBSA), with representatives from NOAA and the UH Marine Center (SOEST). The review and associated workshops underscored the liability and risk associated with our present boat program, particularly regarding small boat usage, but also provided solutions which would allow us to continue giving our students, faculty and staff access to boats, while ensuring measures are in place to ensure adequate training, vessel maintenance, and safety for all users. A major outcome of this review was the authorization for MARE to hire a full time Boat Program Coordinator (summer 2015).

A number of important administrative changes in vessel operations have also occurred over the last two years. Previously, the KMEC director shouldered overall responsibility for the safety of all vessel operations, and this was partially delegated to the Ships Master. In 2013, this responsibility was shifted to the MARE Chair. Further, the long-standing Master of our teaching vessel opted not to continue service in that position as of Dec 2014. Presently, the MARE chair oversees vessel operations, while a temporary hire USCG-licensed captain drives the boat and provides immediate supervision of crew and students at sea. This temporary hire is also first on the list for emergency operations, including tsunami evacuations from Hilo Harbor, until a permanent Boat Program Coordinator is hired.

Analytical laboratory

The Analytical Laboratory at UH-Hilo was established during the first NSF EPSCoR award to Hawaiʻi State in 2003 [(1) EPS 0237065, 2003-2006] to increase research and training infrastructure at UH Hilo, and is housed in the Marine Science Building (MSB). During this grant, funds were used to renovate rooms in MSB for the Analytical Laboratory and for student and faculty research. Renovations included: benches in MSB 109 (2004: $37,000) and MSB 112 (2005-2006: $40,000), as well as a fume hood in MSB 112. This grant and the two other EPSCoR grants that followed [(2) EPS- 0554657, 2006-2010; (3) EPS-0903833, 2009-2014] also provided funding to purchase analytical chemistry instrumentation used for research and student training (Appendix A,Table A1). This instrumentation is primarily used for environmental samples (i.e., water, sediments, soils, plants, animal tissue). Since its establishment, the UH-Hilo Analytical Laboratory has become increasingly successful with over 107 clients, and is now almost fully self-sustaining from its service fees (http://hilo.hawaii.edu/~analab), except for the manager's salary, which is supported by UH-Hilo.

The facility is open to students (undergraduate and graduate), faculty, and researchers for sample preparations, analyses, and laboratory experiments. They use the Laboratory's instrumentation for projects and student training. Typically, samples are submitted to the Laboratory for analysis, but space and instruments can also be used. The Laboratory staff provides tours, laboratory safety training orientations, and teaches laboratory techniques to groups working on research projects. Over the past ten years, the Laboratory has expanded with new equipment for its users to develop cutting-edge methods for analyzing environmental samples and gain important, hands-on, employable skills utilizing state-of-the-art instrumentation. Over 20 UH-Hilo courses use the facility, and at least seven are MARE (Appendix A, Table A2). The Laboratory provides about $30,000 annually in supplies to UH Hilo for classes and research projects (Appendix A, Table A3).

Scanning electron microscope

Historically, the Marine Science department at UH Hilo had a scanning electron microscope (SEM) that was operated and maintained by KMEC. In 2009–2010, Marine Science faculty and staff collaborated with other UHH faculty, as well as external researchers, to write a proposal to the National Science Foundation Major Research Instrumentation (NSF-MRI program), with the goal of replacing the then 20 yr. old ISI-W-6 SEM with a new Hitachi S-3400N-II Variable Pressure SEM with an Oxford X-Max quantitative element detector. This proposal was successful, and the main components, including the SEM and Oxford EDS detector, were installed at the end of May, 2011. A course was developed to train students on the use of this instrument, and it has been used for demonstrations or modules in existing classes including MARE 353L, MARE 201L, MARE 172, and MARE 446.

Vehicle fleet

University of Hawai‘i Hilo MARE has always maintained its own fleet of vehicles to support the undergraduate academic program. Before 2013, KMEC handled the acquisition, inspection, maintenance and scheduling of vehicles serving the teaching and research needs of MARE. Presently, this responsibility falls under the Marine Science department and MARE chair. The present fleet includes two 12-passenger Ford vans (2009 and 2013), and a Ford F-250 4x4 pickup truck (2007). Last year (2014), the UH Hilo business office forbade MARE from taking income from renting its vehicles because we are not a motor pool in the eyes of the UH system, presenting the department with a serious problem of generating funds for vehicle upkeep and replacement. The existing vehicles are not sufficient to support teaching lab field trips, so the department also regularly borrows UHH Motor Pool vans.

Diving operations

Historically, KMEC oversaw all dive operations and maintained university-owned diving equipment, and served as the Unit Diving Coordinator for UH Hilo, with an APT serving as the UH Hilo representative to the UH Diving Safety Control Board. In 2010, UH Hilo hired a Unit Dive Coordinator (Mauritius Bell). The University of Hawaii at Hilo Diving Safety Program (UHHDSP), under the UHH Environmental Health and Safety Office (EHSO), is part of the greater University of Hawaii Diving Safety Program, under EHSO at UH Manoa. The UHHDSP is responsible for the safe conduct of occupational diving operations as outlined in the UHDSP Diving Safety Manual.

The UHHDSP is responsible for the operation, maintenance, and administration of all UHH-owned diving assets, most of which were purchased by the UHH Marine Science Department and Marine Option Program. Such assets include diver life-support equipment sets, accessory equipment, diving cylinders, breathing gas compressor, and safety equipment sets. This equipment is utilized for the training of faculty, staff and students as scientific divers and for the research these divers conduct.

V. Evidence of Program Quality

Quantitative data and tables (Please see Appendix F)

Marine Science, as an instructional unit, is a relatively independent program. The program survives primarily on its own majors, and is similar in size and scope to the College of Agriculture, Forestry, and Natural Resource Management. Marine Science has an average of slightly over 200 majors and graduates close to 30 students per year. The majority of the instructional output (61 to 70% of the SSH) targets Marine Science majors, however the program has a few lower division GE courses taken by a wider array of students including Marine Science majors.

Marine Science focuses on face to face courses, and class sizes tend to be small, but not unusually so for the Natural Sciences. Two thirds of the SH are taught by tenure-track faculty.

Evidence of Student Learning

Student Learning

The Marine Science Program covers the fields of oceanography, marine biology, and marine ecology. Traditionally, oceanographers study the sea's systems and processes, whereas marine biologists focus on marine organisms and their taxonomy, phylogeny, anatomy, physiology, and behavior. Marine ecology combines these views of the ocean to find patterns, relationships, and interactions among environmental parameters and organisms. The department offers a diverse array of introductory and advanced courses in marine science, as well as techniques courses in statistics, analytical methods, and capstone courses involving independent research, internships, and seminars to cover all aspects of marine science.

Departmental learning objectives are stated with the department's Mission Statement as Content Goals, General Goals, and Technical Goals (See Mission Statement). Some of the learning objectives are addressed and assessed in specific courses; for example, "Proficiency in the use and applications of biostatistical techniques" is the focus of Statistical Applications in Marine Science (MARE 250). The final grade in this course is a measure of the student's learning and mastery of this learning objective. Other departmental learning objectives are integral to courses throughout the marine science curricula, i.e., "Ability to analyze primary scientific literature or presentations." The aim of the capstone courses is to provide a cumulative measure of the departmental learning objectives (Table 1).

The diversity of fields of study within marine science requires great variety in teaching approaches; however, "active learning" and "hands-on" are the watchwords for most courses in this department, whether lecture or laboratory-based. In Oceanography (MARE 201), Marine Biology: Diversity (MARE 171), Marine Biology: Cellular Processes (172), and Current Issues in

Marine Science (MARE 110), faculty use group discussions, “hot topic” articles, organism charades, poetry contests and other writing assignments, in-class demonstrations, debates, videos, and guest speakers, to augment the lecture format. In the laboratories that accompany these courses (MARE 201L and MARE 171L), units or activities are centered around specific learning objectives and their application, such as “the ability to calculate the diameter of the field of view on a compound microscope and estimate the size of a microscopic organism in μm” or “the ability to interpret a phase change diagram for water in terms of latent heat.” These courses include activities that develop the students’ power of observation in the classroom, aboard ship, in the intertidal zone, and often underwater with masks and snorkels. Examples include:

- In Marine Biology Laboratory (MARE 171L), a group research project on osmosis lab and the comparison of fish communities or other topics is included to emphasize the role of investigation and the scientific method in marine science.
- In Marine Option Program Project (MARE 104), students are completing an internship or a self-defined skills project that they defined and developed during the Marine Option Program Proposal (MARE 103) class.
- In upper-division lecture courses, faculty use discussions, group and individual projects, group critiques, primary literature readings, reaction papers, oral presentations, and journals to provide a variety of learning opportunities.
- In the Marine Invertebrates course (MARE 371 and 371L), students keep an Invertebrate-Watcher’s List, much like a bird watcher’s life list: what species they see, description, when, where, how many, behavior, etc.
- In Marine Plants (MARE 372 and 372L), in addition to traditional lectures and laboratories, students collect and identify field specimens for their personal herbaria, prepare a meal of seaweed dishes, and work in groups on a different marine plant research topic each semester, i.e., Bioactive Compounds in Hawaiian Seaweed Extracts, Culture Conditions for Growth of Local Seaweeds, Analysis of Seaweeds on Turtle Foraging Reefs and in Turtle Stomach Contents, etc.
- In the two Marine Methods and Analyses courses (MARE 350 and 353), most learning is hands-on and project-based. Students design experiments that require collecting data either from the shore or from a boat, analyze samples, statistically analyze the results, write papers in scientific manuscript-style, and give oral presentations.
- Two of the upper division MARE electives, 434 (Teaching Marine Science) and 435 (Marine Field Experience for Teachers), are entirely project based. Students learn lesson planning and classroom management skills and go out to teach lessons they’ve developed in local classrooms (MARE 434), or work as a team to develop a Marine Science workshop that they present at the end of the semester to area teachers.
- This independent project-based approach is continued in the capstone courses: Senior Thesis (MARE 470 and 471), Senior Internship (MARE 480), and Senior Seminar (MARE 495A and B). In Senior Thesis and Senior Internship, students begin with proposal writing for their individual project, read and review the pertinent literature, carry out the project, interpret the results, write scientific papers or compile portfolios, and present their work orally.

Student products in marine science courses are as varied as the topics and teaching approaches. Faculty members assess student learning through traditional means: exams, quizzes, term papers, write-ups of assigned readings, laboratory worksheets and laboratory

practical examinations, as well as through discussions, oral presentations, problem sets, journals, and concept diagrams (e.g. food web drawings) and authentic assessment. Class attendance is used as a grading criterion in some courses, especially laboratories. Some faculty members check and reward attendance by using in-class worksheets to accompany in-class videos or other in-class activities in lecture classes. Scientific-format papers are used to assess student learning in several courses: a scientific review paper in MARE 171 and MARE 172, statistical analyses papers in MARE 250, group project papers in MARE 350 and MARE 353, term papers in MARE 371 and 372, and the individual thesis in MARE 471. In writing-intensive courses, such as Senior Thesis (MARE 470 & 471), and Senior Internship (MARE 480), students submit several types of written work: draft proposals, re-written proposals, progress reports, abstracts, résumés, cover letters, reaction papers, journals, draft and final theses (in scientific style), or internship portfolios. In Teaching Marine Science (MARE 434), which is also a writing-intensive course, student products include lesson plans, an application project, a portfolio and response papers based on readings.

The Marine Science Department excels in another area of student learning: collaboration between undergraduates and faculty on research projects, including underwater habitat characterization, resource utilization sampling, GIS mapping, genetic diversity of zooxanthellae, water quality, submersible dives, macroalgal reef surveys, Northwestern Hawaiian Islands research cruises, analyses of nutritional content of edible Hawaiian seaweeds, and molecular genetics of marine snails. Being directly involved in real marine science research as an undergraduate is one of the experiences and strengths that we encourage our students to obtain. Marine Science Department faculty often co-author symposium talks, posters, and journal articles with their undergraduate collaborators. Within Marine Science, students at all levels are encouraged to collaborate with faculty, and we have formalized several different mechanisms to support these collaborations. Beginning with their first year at UH Hilo, students are encouraged to complete a Marine Option Program (MOP) certificate, which includes a skills-based project.

For any grade level, students who take on unpaid research opportunities can count their experience as Directed Studies (MARE 299, 399, 499) courses. For seniors, the Senior Thesis capstone requires that the student work with a faculty advisor to develop and complete their research project. Finally, faculty also work with students as volunteers or paid student assistants, or via paid internships such as C-MORE (NSF & Kamehameha Schools supported), Keaholoa STEM program (NSF-supported), and the summer REU program (NSF-supported).

In addition to undergraduate education, which has long been the focus of UHH MARE, faculty participate in mentoring graduate and undergraduate students.

Student Learning Outcomes:

I. Program Learning Goals

Content Goals: Students in both B.A. and B.S. programs will be provided with a solid background in:

- The primary sciences and mathematics, including proficiency in biology, chemistry, physics, calculus, computer applications related to the natural sciences, and laboratory techniques;
- Marine science, including proficiency in marine biology, oceanography, and marine

ecology; and
- Advanced multidisciplinary undergraduate training in a variety of focal areas, including but not limited to geography, geology, biology, ecology, oceanography, fisheries and aquaculture.

General Goals: Students in both B.A and B.S. programs will be provided with knowledge of and experience in:

- The scientific method and critical thinking, including the ability to design and carry out an inquiry-based research or internship project, analyze primary scientific literature, write a scientific proposal, and write a research paper or compile a portfolio; and
- Scientific presentations and discussion, including the ability to formally present a science project and discuss scientific issues

Technical Goals: Students in both B.A and B.S. programs will be provided with an understanding of and proficiency in:

- Laboratory practices and safety;
- Oceanographic and marine biological laboratory methods and field techniques;
- The use and application of biostatistical and microcomputer techniques; and
- Experimental design, data management and analysis, and interpretation of results, particularly in the use and application of marine monitoring techniques.

Table 1: *Marine Science B.S. Program Student Learning Objectives with Bloom's taxonomy of educational objectives in parentheses.*

SLO1	Explain core concepts in Marine Biology and Oceanography. *(Comprehension through Evaluation)*
SLO2	Examine and discuss current scientific issues using information from the primary literature and from class content. (*Analysis and Synthesis*)
SLO3	Describe, and apply, key concepts of lab and field safety. *(Application)*
SLO4	Perform core oceanographic and marine biology-based lab techniques. *(Application)*
SLO5	Access the primary literature to find scholarly articles that discuss the results of experiments. *(Application)*
SLO6	Summarize scholarly articles from the primary literature, and synthesize summarized information into a literature review. *(Synthesis)*
SLO7	Write a testable hypothesis. *(Application)*
SLO8	Design and carry out a controlled scientific experiment. *(Synthesis and Evaluation)*
SLO9	Choose and use appropriate statistical methods to analyze experimental data. *(Analysis and Evaluation)*
SLO10	Report experimental results in graphs and tables. *(Synthesis)*
SLO11	Interpret graphically presented data *(Evaluation)*
SLO12	Draw conclusions from experimental results. *(Evaluation)*
SLO13	Write a scientific paper that reports the results of an experiment, following accepted guidelines for publication in a scientific journal. *(Synthesis and Evaluation)*

SLO14	Create and deliver an oral presentation appropriate for a scientific conference or symposium. *(Synthesis and Evaluation)*
SLO15	Apply knowledge gained from courses by interacting with global and/or local communities. *(Synthesis)*

Table 2: Curriculum Matrix. *Marine Science Curriculum Map summarizing where Student Learning Objectives are introduced (**I**), practiced with feedback (**P**), and mastered (**M**)*

Courses for Majors	**Required or Elective**	**SLO 1**	**SLO 2**	**SLO 3**	**SLO 4**	**SLO 5**	**SLO 6**	**SLO 7**	**SLO 8**	**SLO 9**	**SLO 10**	**SLO 11**	**SLO 12**	**SLO 13**	**SLO 14**	**SLO 15**
MARE 100 – Marine Option Program Seminar	**E**		I													I
MARE 103 – Marine Option Program Proposal	**E**					I	I/P								I/P	
MARE 104 – Marine Option Program Project	**E**					P	P									P
MARE 105 – Marine Option Program Presentation	**E**					P	P				I/P	I/P		I/P	P	P
MARE 140/L - Intro to Hawaiian Coral Reefs	**E**	I	I			I	I	P				I	I	I/P	I/P	
MARE 171 - Marine Biology Diversity	**R**	I	I			I	I	P				I	I	I/P	I/P	
MARE 171L - Marine Biology Laboratory	**R**	I		I	I			I	I		I	I	I			
MARE172 – Marine Biology Cellular Process	**R**	I	I			I	I	P			I	I	I	I/P	I/P	
MARE 201 - Oceanography	**R**	I	I			I	I						I		I/P	

MARE 201L - Oceanography Laboratory	**R**	I	I	I/P	I/P			I	I		I/P	I/P	I			
MARE 240 - Small Boat Operations/ Research	**E**			I												
MARE 250 - Statistical Apps. in Marine Science	**R**			P	P			P	P	I	P	P	P	I/P	P	
MARE 264 – QUEST	**E**		P	M	M	M	M	P	P	P	P	P	P	P	P	P
MARE 265 – Marine Ecology & Evolution	**R**	P	P			I/P	P					P				
MARE 282 - Global Change	**E**	I	I									I				
MARE 310 - The Atoll Ecosystem	**E**	M	M			P	P					P				
MARE 325 – Coral Reef Ecology	**E**	P	P			P	P									
MARE 350/ 353 – Coastal or Pelagic Methods and Analysis and Lab	**R**	M	M	P	M	P	P	P	M	P	P	P	P	P	P	
MARE 360 – Marine Resources	**E**															
MARE 364 – Advanced QUEST	**E**		P	M	M	M	M	P	P	P	P	P	P	P	P	P
MARE 371/L – Biology of Marine Inverts. and Lab	**E**	P	P	P			P				P	P				
MARE 372/L – Biology of Marine plants and Lab	**E**	P	P	P	P	P	P	P	P	P	P	P	P	P		
MARE 380/L – Natural History of Sharks and Rays and Lab	**E**	P	M	P	P	M	M					M	M			

MARE 390/L – Biology of Marine Mammals and Lab	**E**	P	M	P	P	M	M					M	M			
MARE 405 – Watersheds	**E**	M	M				M					M				
MARE 410 – Marine Debris	**E**	M	M	M	P	P	P	P	P	P	P	P	P	P	I	
MARE 425 – Chemical Oceanography	**R/E**	M	M									M				
MARE 434 – Teaching Marine Science	**E**	M	P/M	M	P/M	P/M	P	P	P		P/M	P/M	P/M	P	M	M
MARE 435 – Marine Field Experience for Teachers	**E**	M	P/M	M	P/M	P/M	P	P	P		P/M	P/M	P/M	P	P	M
MARE 440 – Physical Oceanography	**R/E**	M	M			M	M					M			P	
MARE 444 – Biological Oceanography	**E**	M	M			M	M					M			P	
MARE 460 – Marine Conservation	**E**	M	M			M	M					M			P	
MARE 461 – Geological Oceanography	**R/E**	M	M			M	M					M			P	
MARE 466 – Phytoplankton	E	P	P	P	M	M	M	M	M	P	M	M	M	P	P	P
CAPSTONE MARE 470/ 471 – Senior Thesis Research & Report	**R/E**	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
CAPSTONE MARE 480 – Senior Internship	**R/E**	M	M	M	M	M	M				M	M	M	M	M	M
MARE 484/L – Biology of Fishes	**E**	M	M	M	M	M	M	M	M	M	M	M	M	M	P	

MARE 488 – Kūʻula Integrated Science	**E**		M	P	P	P	P	P	P	P	P	P	P	P	P	
MARE 490/L – Sea Turtle Cons. & Ecology & Lab	**E**	P	M	P	P	M	M					M	M			
MARE 495 - Senior Seminar	**R/E**	M	M				M					M				

III. Evaluating Student Performance

We chose to evaluate student performance based on a variety of metrics, including direct assessments of a subset of SLOs and two Institutional Learning Objectives (ILOs), and indirect assessment based on a survey of students completing the capstone course and recent graduates.

We have Picked 4 SLO's to examine:

SLO4 Perform core oceanographic and marine biology-based lab techniques, including *…("core" should be techniques that 350/353 and 470/471 require students to have).(Application)*

SLO6 Summarize scholarly articles from the primary literature, and synthesize summarized information into a literature review. (Synthesis)

SLO14 Create and deliver an oral presentation appropriate for a scientific conference or symposium. (Synthesis and Evaluation)

SLO15 Apply knowledge gained from courses by interacting with global and/or local communities. *(Synthesis)*

These were chosen because they are 1) application, emphasizing the department's "hands on" teaching of laboratory and field methods, and 2) synthesis, capturing several of the other SLOs in one assignment.

The curriculum matrix shows where each SLO is introduced to students in lower-division courses, practiced, and finally mastered in the upper-division courses. To capture that students are completing assignments that are at the appropriate level as indicated by the matrix, we have assembled a series of assignments that addresses each SLO at level. To assess mastery, we compiled the grades on relevant assignments for each SLO:

SLO4: Lab Techniques. Several classes focus specifically on lab techniques including but not limited to Marine Biology Lab (171L), where techniques are introduced, Oceanography lab (MARE 201L) where introduced techniques are practiced, and Coastal or Pelagic Methods and Analysis Lab (350L or 353L, respectively) where mastery of lab techniques are evaluated (Fig 7). Of the required courses (that is, excluding electives), 8 of 53 (15%) and 11 of 81 (14%) credit hours for the BA and BS, respectively, are laboratory courses that provide hands-on experiences to help students gain technical expertise. This is a lower limit, since many "lecture" courses include hands-on experiences. The most significant are the project-based capstone classes.

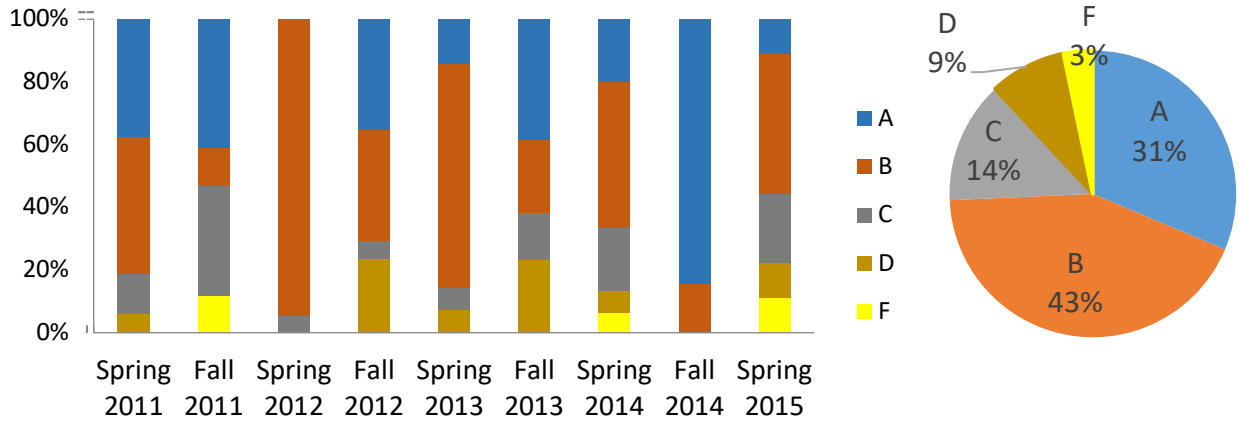


***Figure 7**. Assessment of the Marine Science Methods and Analysis MARE 350 / MARE 353 Nutrients assignment, over AY 2011–15. A = Mastery of Task; B = Exceeds Proficiency at Task; C = Proficiency at Task; D = Below Proficiency at Task; and F = Well Below Proficiency at Task. The assignment evaluated here includes spectrophotometric determination of dissolved nutrients in seawater using HACH kits, including generation of a standard curve. The pie graph at right shows the averages over the time period. No trends vs. time were apparent in the data.*

SLO6: Literature Review. Several classes incorporate a review of relevant scientific literature into their syllabi; including but not limited to Marine Biology: Diversity (171), where literature reviews are introduced; Coastal or Pelagic Methods and Analysis Lab (350L or 353L, respectively) where literature reviews are practiced; and Senior Thesis or Senior Internship (MARE 470, MARE 480, respectively) where mastery of literature reviews are evaluated (Fig 8)

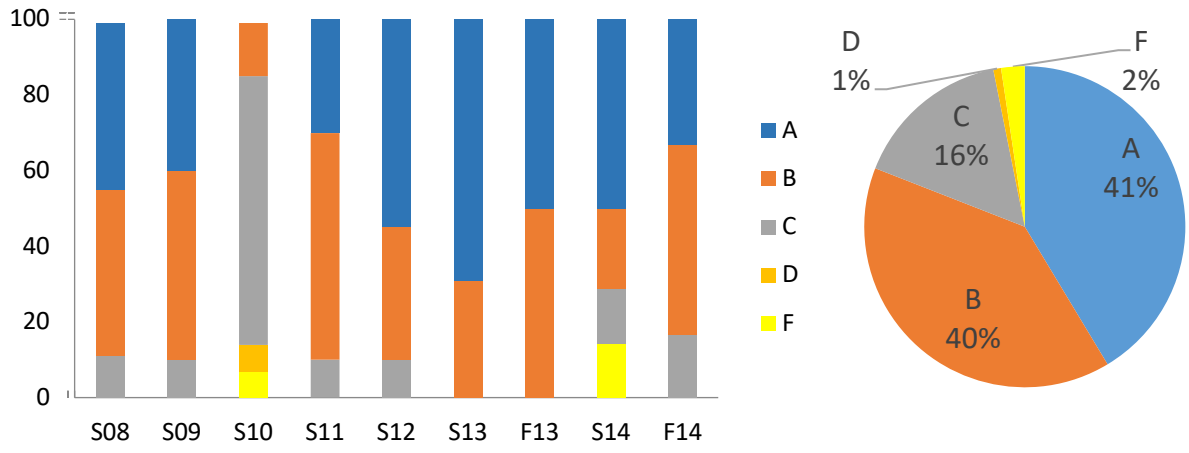


***Figure 8**. Assessment of the Marine Science capstone Senior Thesis Research MARE471 Final Manuscript assignment, over AY 2008-12. A = Mastery of Task; B = Exceeds Proficiency at Task; C = Proficiency at Task; D = Below Proficiency at Task; and F = Well Below Proficiency at Task. Pie graph at right shows the average over time. There were no trends over time for these data.*

SLO14: Oral Presentation. Several classes incorporate oral presentations into their syllabi; including but not limited to Marine Biology: Cellular Processes (172), where oral presentations are introduced, Coastal or Pelagic Methods and Analysis Lab (350L or 353L, respectively) where oral presentations are practiced, and Senior Thesis or Senior Internship (MARE 471, MARE 480, respectively) where mastery of oral presentations are evaluated (Fig 9)

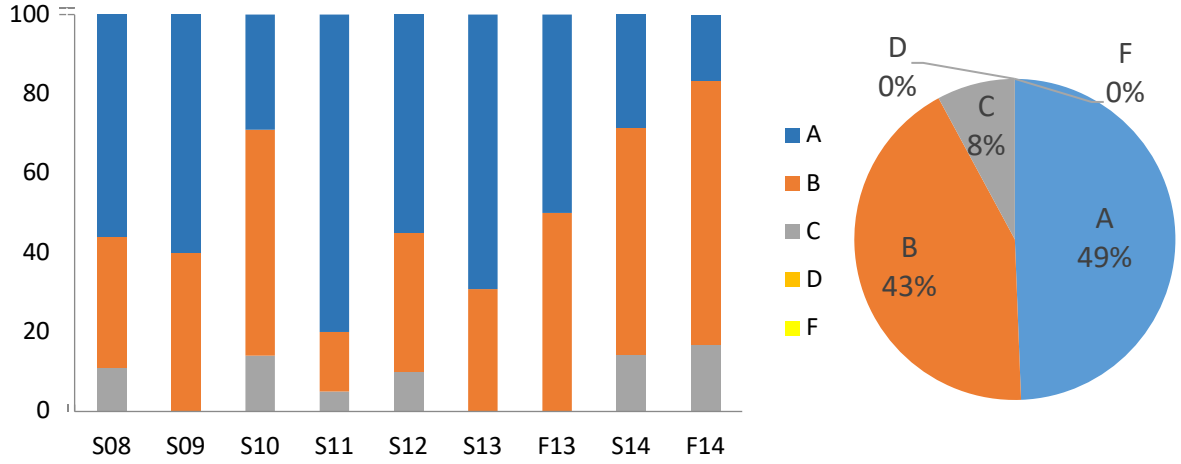


***Figure 9**. Assessment of the Marine Science capstone Senior Thesis Research MARE471 Final Presentation assignment, over 2008-12. A = Mastery of Task; B = Exceeds Proficiency at Task; C = Proficiency at Task; D = Below Proficiency at Task; and F = Well Below Proficiency at Task. The pie graph at right shows overages over time. There were no trends over time in the data.*

SLO15: Applied Knowledge. Because of the UHH GCC requirement, all students are expected to apply their knowledge to the broader community at some level. However, our students excel at this, spending extended periods of time working in marine science outside of campus. Between 2007 and 2014, 81 students completed an internship in the 480 Internship class. In addition, many other students completed internships for their MOP project. Several students each year spend the summer working on research projects at different universities as interns (REUs).

Institutional Learning Objective Evaluation

We have chosen two ILOs to evaluate: Written Communication (Fig. 10) and Quantitative Reasoning. For Written Communication, the standard university rubrics were applied to the final papers in the MARE capstone courses: MARE 480, 471.

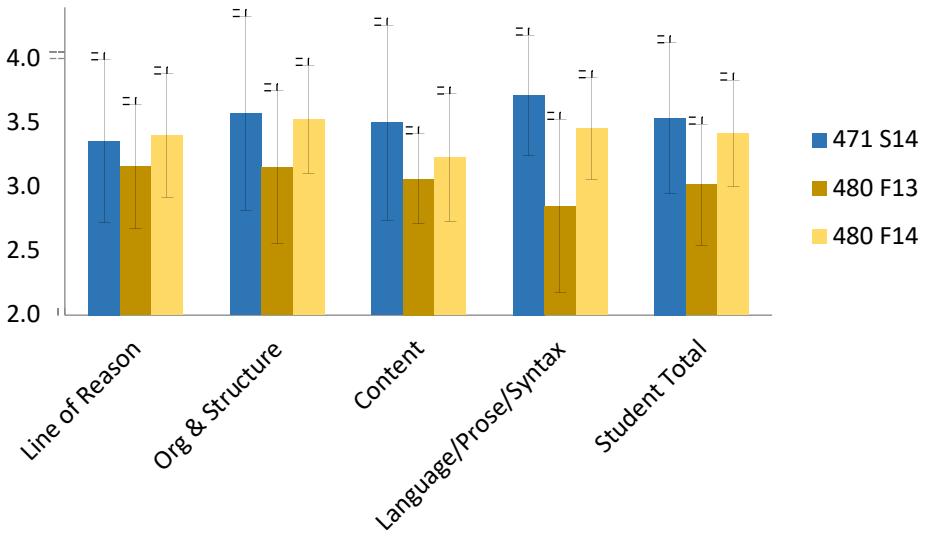


Figure 10. Average Written Communication score (±SD) for MARE 471 Senior Thesis Report (Spring 2014, n=12) and MARE 480 Senior Internship (Fall 2013, n=12; Fall 2014, n=11). 4=Advanced, 3=Competent, 2=Emerging, 1=Beginning.

Overall, students performed well on this assessment and generally scored “competent” to “advanced” in all four categories defined by the rubric. These high scores are likely due to several factors. The structure of the writing assignment, based on the format of a manuscript to be submitted to a scientific journal (Marine Ecology Progress Series), helped the organization by requiring students to develop separate sections (Introduction, Methods, Results, Discussion). Students have mastered this since MEPS is used for formatting at all levels of scientific writing in the Marine Science Department. In addition, students have had experience with both reading articles and writing papers in this format in prerequisite classes (MARE 350, MARE 353).

Finally, with additional feedback in MARE 471, students had significant opportunities to improve the organization, content and syntax of the final manuscript.

While all students scored at least "competent" for their line of reasoning, few were advanced. Students were competent largely because they identified a thesis, presented original data, and stated how their data supported their thesis. A smaller fraction of students were able to take this to the next level, and analyze their results within the larger framework of other published studies. While some of this comes down to the ability of the individual student, some students were focused on completing other aspects of the assignment (mainly the Quantitative Reasoning portion of the assignment, including data presentation and analysis), and simply ran out of time to make these connections.

During Spring 2015, the university-wide Quantitative Reasoning assessment (Please see Appendix G) was completed by students in the Physical Oceanography (MARE 440) class.

Table 3. Percentages of Marine Science students answering introductory math questions 1–3 correctly as compared with all UH-Hilo Students

Questions Correctly Answered	MARE Students	All UHH Students
Q1	80%	73%
Q2	20%	18%
Q3	25%	35%
All 3	5%	6%

Table 4. The overall mean (all three questions combined) for students taking an introductory math course. Scores are the average. The instrument used for this assessment was developed outside of MARE and is shown in Appendix G.

Class level	Score
Freshmen	1.18
Sophomore	1.25
Junior	1.33
Senior	1.39
MARE	**1.25**

Student Learning Assessment Conclusions

Here, some issues discussed in faculty meetings regarding annual assessments in MARE are presented. **A better defined and more consistently executed annual assessment plan is needed for MARE.** In the assessments presented above (Figs 7–10), we chose to use grades on assignments in upper-division courses to assess mastery of SLOs, but it is unclear whether or not those grades accurately assess that SLO. For example, does a lab assignment assess proficiency of working in a lab? Should we create a separate instrument for assessing SLOs? The quantitative reasoning assessment we administered (Table 3 and 4) was poorly fit to science majors, had some unclear wording and only consisted of three questions. The

meaningfulness of the results is difficult to determine. Regarding the consistent implementation of annual assessments, faculty members presently have to remember each semester what evaluation is being done and in what class. A solution to this would be a ‘gatekeeper of evaluations’, an assignment that currently does not exist in the department. Another consideration regarding writing assignments is whether or not the department should define a default manuscript format that is used across all courses. Some faculty expressed support for this because if students master a format early in their career at UH MARE, they will be better able to focus on the tasks of information gathering, content analyses, and synthesis. Having mastered one format, it will be easy for them to change to other formats if and when they are ready to publish. Currently, MEPS is widely used in the department, but this is not officially mandated or told to the students when they enter. One faculty member suggested to change the default format to "Journal of Young Investigators". Further discussion resulting in a final decision is needed on this topic.

Evidence of Faculty Quality

Marine Science Faculty

All faculty, lecturers, and staff in the Marine Science Department are involved in our undergraduate degree programs (BS and BA), as well as in the TCBES graduate program. Currently, department teaching personnel include: seven tenured and two tenure-track faculty, two instructors, and two to five lecturers. Department support staff includes two APTs who assist with teaching and MOP, and will be increasing to three with the hiring of a director of boat operations. All tenure and tenure-track faculty have PhDs in marine science disciplines (Table 6).

Table 5: *Qualifications and expertise of Marine Science faculty and lecturers in alphabetical order. Course titles and descriptions can be found at http://hilo.hawaii.edu/catalog/mare-courses.html or http://hilo.hawaii.edu/catalog/cbes-courses-gr. MARE = Marine Science undergraduate courses; CBES = TCBES graduate courses.*

Name & Title	Education	Expertise	Courses Taught
Adolf, Jason Associate Professor *Department Chair	Ph.D. 2002 Marine Estuarine and Environmental Science Program, University of Maryland, College Park	Coastal phytoplankton ecology, real-time continuous water quality monitoring	MARE: 172, 201, 201L, 350, 350L, 353, 353L, 444, 470 & 471 CBES: 615, core courses

Beets, James Professor	Ph.D. 1991 Zoology, University of Georgia	Marine ecology, fish/fisheries ecology, ecological monitoring	MARE: 171, 264, 265, 350, 350L, 325, 460, 470, 471, 484, 484L CBES:
Childers, Michael Instructor	M.Ed. 2012 College of Education, University of Hawai‘i at Mānoa	Distance education	MARE: 171L, 201, 201L, 240
deMaintenon, Marta Professor	Ph.D. 1996 Integrative Biology, University of California at Berkeley	Gastropod evolution and taxonomy; marine invertebrate biodiversity	MARE: 171, 171L, 250, 265, 371, 371L, 470, 471
McDermid, Karla Professor	Ph.D. 1988 Botany, University of Hawai‘i at Mānoa	Seaweed and seagrass: taxonomy, ecology; marine debris	MARE: 171, 171L, 265, 310, 372, 372L, 410, 470, 471 CBES:
Muehlstein, Lisa Lecturer	Ph.D. 1991 University of Georgia	Seagrass diseases; microbial water quality	MARE: 110, 282, 325, 445 CBES:
Parr, Lisa Instructor	M.S. 1989 Environmental Studies, University of Tasmania, Australia	General oceanography and marine biology	MARE: 171, 171L, 172, 201, 201L, 434
Sims, Jennifer Lecturer	M.S. 2001 Environmental Biology, University of Houston Clear Lake	Population genetics; molecular ecology	MARE: 140, 140L, 171, 171L, 172, 390, 390L

Takabayashi, Misaki Associate Professor	Ph.D. 2000 Centre for Marine Studies, The University of Queensland, Australia	Coral reef molecular and microbial ecology and biology	MARE: 171, 172, 264, 265, 353, 353L, 470, 471, 488 CBES: 600, 601, 602, 620, 660
Turner, Jason Associate Professor	Ph.D. 2004 Wildlife and Fisheries, University of Texas A & M	Marine food web ecology, marine mammal biology	MARE: 171, 250, 264, 353, 353L, 390, 390L, 490, 490L
Wiegner, Tracy Professor	Ph.D. 2002 Oceanography, Rutgers University	Freshwater/coastal biogeochemistry and nutrient and microbial water quality	MARE: 282, 350, 350L, 405, 425, 470, 471

5.2 Extramural Funding Attracted by Marine Science Faculty

All of the tenured and tenure-track faculty are active in pursuing funding to support research, teaching, and University development. Extramural funds come from country, state, and federal agencies, as well as foundations, nonprofit organizations, and donors. This funding provides indirect cost revenue to the institution supporting further supporting scholarly activities. Faculty activities are also supported by internal funding, much of which is generated from returned overhead from extramural grants and larger system-wide grants with sub-awards to groups and individuals.

Year	**Amount**	**#Grants Funded**	**Agencies**
2015	0	0	None yet.
2014		8	External: NSF CREST, NSF DUE, National History Museum UK, NOAA CRCP, HI State DAR Internal: UHH Seed, UHH-NSF EPSCoR,
2013		4	External: PICSCC, NOAA CSP, NOAA PIRO Internal: UHH-NSF EPSCoR

2012		5	External: NOAA UH Sea Grant, NSF HRD, NOAA PIRO Internal: UHH Seed, UHH-NSF EPSCoR,
2011		3	External: IOOSP, NOS, NOAA, DOC; CTSA, NOAA NMM
2010		1	External: NSF MRI
2009		8	External: NSF EPSCoR; Reid Foundation, NOAA UH Sea Grant, NOAA NMM, NOAA PIRO; NOAA MM; CSREES ANNH Internal: UHH Seed
2008		10	External: NSF, HRD CREST, Fairmont Orchid Resorts; NOAA NMM; NOAA PIRO; CSREES ANNH, NPS Internal: UHH Seed; UHH-EPSCoR

To assess how well our faculty activities adhere to the mission of the Marine Science Program (see page 1), we collected aggregated data on education (Table 7), research (Table 8), and outreach (Table 9) that directly pertain to our mission. Data from all tenured and tenure-track faculty and one instructor (Parr) over the review period (2007–14) are included.

Education: We have been involving students in a wide array of experiential learning, ranging from hands-on learning and service-learning activities in catalog courses, MOP activities, and participation in faculty research (Table 7). We also graduate a number of Master's students through the Tropical Conservation Biology and Environmental Science Program each year.

Table 7: Aggregated data on Faculty activities that pertain to the educational component of the Marine Science Department Mission

	2007	2008	2009	2010	2011	2012	2013	2014
# MARE classes with hands-on learning activities	22	28	33	37	45	34	32	33
# MARE classes with service learning requirements	1	2	1	2	1	4	3	7
# student interns[1] examining "the natural and cultural environment of Hawaii Island"	27	24	31	28	42	48	40	47
# participants on MOP trips	181	181	181	181	181	181	181	175
# peer-reviewed publications that include student authors	2	1	4	9	7	4	9	3
# presentations that include student authors	13	15	15	20	28	14	20	31
# mentees receiving awards	5	3	3	7	8	6	7	11
# Master's students **graduated**	2	7	5	5	5	7	2	3
Teaching awards	1	0	1	1	0	0	0	1
Mentoring awards	0	0	0	0	0	0	0	0

[1]Includes Senior Thesis/Internships, grant-funded Interns, non-grant-funded interns, volunteers

The following examples (direct quotations) from student evaluations of Marine Science faculty speak to our abilities to "inspire" and "enlighten" our students;

> "I will never forget your generosity and genuine concern for the perpetuation of Marine Science education. Thanks for believing in me. I couldn't have achieved this much without your guidance"
>
> "QUEST allowed me to actually experience the field I want to pursue with my life. I learned more about career opportunities and the Marine Biology field in the last 2 weeks than I did in the last 2 years. QUEST also made me work to become a better community member and team member"
>
> "Meets with students, willing to stay late, find outside box solutions. Forces students to think and form their own conclusions."
>
> "She got me hooked on her topics that I ditched work just to go to her class."
>
> "Thank you for making this a fun and eye opening course."

Research: We are very active in research activities, from successfully securing extramural funding ($387K–$22.1M each year) (Please see Appendix B) to publishing in peer-reviewed journals. Student engagement and collaboration among colleagues in the department in research is also evident from the high proportion of our publications and presentations that are co-authored by students and department colleagues (Table 8).

Table 8: Aggregated data on Faculty activities that pertain to research

	2007	2008	2009	2010	2011	2012	2013	2014
# peer-reviewed papers published	5	13	8	11	10	6	12	5
# peer-reviewed papers published co-authored by other MARE faculty or students	1	3	4	10	8	4	11	3
# presentations	20	27	26	33	38	16	24	40
# presentations co-authored by other MARE faculty or students	15	18	20	23	32	15	22	36
# invited presentations	6	5	4	7	3	1	5	4
# extramural research grants submitted	25	18	19	13	14	18	17	22
# extramural research grants submitted for collaborations with other MARE faculty and students	16	14	12	11	12	14	15	20
# extramural research grants awarded	16	10	11	6	5	8	7	10
# extramural research grants awarded for collaborations with other MARE faculty and students?	5	7	5	3	6	6	5	8
Total $ (K) extramural research grants awards	1,522	5,344	22,147	1,266	387	773	640	6,196

We also serve the professional communities by serving as reviewers and editors for numerous journals and NSF review panels.

Outreach: Our commitment to serve the community outside of the University is evident from the great number of outreach events our faculty participate in (Table 9). Examples of such outreach events include Onizuka Science Day, Ocean Day, DOE Teacher Workshops, NOAA public lectures, K-12 field study days, etc.

Table 9: Aggregated data on Faculty activities that pertain to the outreach component of the Marine Science Department Mission

	2007	2008	2009	2010	2011	2012	2013	2014
# public education-related outreach events you or your students participated	25	28	30	31	20	33	32	33
# public research-related outreach events you or your students participated	11	14	9	12	10	11	15	15
# secondary school students mentored	4	4	5	7	5	8	3	4

5.3 Faculty Teaching Awards

Three faculty members from marine Science have received teaching awards since 2007:

- Lisa Parr received the Frances Davis Award for Excellence in Undergraduate Teaching in 2009, and was nominated the previous year for the Frances Davis Award as well as the Chancellor's Award for Teaching Excellence.
- Karla McDermid received the 2010 University of Hawai'i Board of Regents Medal for Excellence in Teaching as a tribute to faculty members who exhibit an extraordinary level of subject mastery and scholarship, teaching effectiveness and creativity and personal values that benefit students.
- Jason Turner received the Frances Davis Award for Excellence in Undergraduate Teaching in 2007.

5.4 Externally recognized student achievements

Marine Science students consistently earn scholarships and awards every year. Among our regular achievement, we can mention the MOP Best Research Project award, which has been won by one of our students almost every year since 1985. Also, at least one and as many as three of our students every year receive a NOAA Hollings Scholarship, a remarkable result given that there are only 100 such scholarships available every year to be distributed among a pool of applicants that regularly reach 1000 to 3000.

Table 10: Number of scholarships, internships, awards and travel awards received by Marine Science students since 2008. A detailed list can be found in Appendix C.

Year	Number of Scholarships/ Internships	Number of Awards	Number of Travel Awards
2014	5	4	2
2013	3	2	0
2012	10	3	1
2011	6	4	0
2010	11	5	2
2009	6	6	0
2008	4	3	0

5.5 Peer-reviewed publications by MARE faculty and students

Table 10. Summary of peer-reviewed publications by MARE faculty and students. A detailed list of publications can be found in Appendix D.

Year	#of publications	Journals
2015	4	Harmful Algae; Marine and Freshwater Research; Estuarine, Coastal & Shelf Sciences; Pacific Science
2014	3	Zootaxa; ISME Journal; The Veliger
2013	10	Pacific Science; PloS ONE; Marine Environmental Research; Journal of Coastal Conservation; Ecological Applications; Estuaries and Coasts; Journal of Freshwater Science; Disease of Aquatic Organisms; Biotropica
2012	4	Oikos; Marine Drugs; Marine Ecology Progress Series; Coral Reefs
2011	9	PLoS ONE; Coral Reefs; Marine Pollution Bulletin; Marine Biology; Pacific Science; Journal of Experimental Biology; Harmful Algae;

		Journal of Marine Biology
2010	9	Pacific Science; PLoS ONE; Marine and Freshwater Research; Estuaries and Coasts; Proceedings of the 11th International Coral Reef Symposium; Journal of Phycology; Proceedings of the National Academy of Sciences
2009	8	Marine Ecology Progress Series; Journal of Phycology; Proceedings of the 11th International Coral Reef Symposium; Journal of Experimental Marine Biology and Ecology; Current Biology; Limnology and Oceanography
2008	17	Harmful Algae; Proc. of the 12th International Conf. on Harmful Algae; Journal of Shellfish Research; Zoologische Mededelingen Leiden; Fisheries; Landscape Ecology; Estuaries and Coasts; Freshwater Biology; Fisheries Management and Ecology; European Journal of Phycology; Marine Biology; Coral Reefs; Gulf and Caribbean Fisheries Proceedings

5.6 Presentations by MARE faculty and students

MARE faculty give 15 to 29 presentations each year with at least half of them in collaboration with an undergraduate or graduate student.

Table 11. Number of presentations (total and those including students) given by MARE faculty and students between 2008 and 2015.

Year	# Total	# Including students (%)
2015	4	1 (25%)
2014	22	13 (59%)
2013	15	9 (60%)
2012	16	15 (94%)
2011	27	20 (74%)
2010	29	20 (69%)
2009	25	14 (56%)
2008	23	12 (52%)

VI. Future Program Goals and Resource Requirements

Academic Degree Programs

The BA and BS degree programs in Marine Science form the backbone of our program and we have discussed several ways that we think they can be improved. These include increasing the career skills of our students earlier in their academic careers; improving our ability to advise transfer students; being able to hire more student aides to support lab classes that require a ratio of one staff to every six students in the field; and improving communications with students (events, scheduling needs, advising). At least one of our courses (MARE 282 Global Change) is suitable for the S-designation that is presently used at Kapiolani Community College (http://kccsustainability.com/Sustainability/S-designation.html) to indicate emphasis on sustainability in the curriculum.

The Marine Science department website is probably the first impression most prospective students have of UHH MARE, and an important source of information for existing students, so we are very interested in improving it (and its day-to-day maintenance) to better serve both recruitment and retention of students. We are in the process of re-vamping our webpage, but the issue of maintenance and upkeep are not fully resolved. A potential solution is to make webpage maintenance part of the responsibility of a department APT, although in order to do this, some of their time would need to be freed. Unfortunately, a lot of our APT time is spent accompanying field classes each semester, a job that can easily be done by student aids. Although our student aid budget is set by College of Arts and Sciences, if we are permitted to hire more student aids each semester, then our APTs would not need to attend field labs just to meet the one staff to every six students ratio mentioned above. This also makes economic sense: last spring (2015), APTs spent 252 hours (average 15.8 per week) with lab classes, equating to $6,105.96 in salary costs. This same service could be provided by safety-trained student aides, which would have cost $2671.20. Freed APT time could be used for more productive activities relating to webpage maintenance and updating.

As the UHH Marine Science program grows, it is very important that we plan for new faculty positions, including new hires and replacements for retirees. One retirement between now and our next program review is likely (Professor Jim Beets), and we anticipate the need for a replacement faculty member in the same (or similar) discipline. Other disciplines that have been discussed as potentially beneficial to add to UHH MARE include ‘Marine Policy’.

Although hands-on learning is a cornerstone of UHH MARE, one of our capstone classes in which students do independent research with MARE faculty (MARE 470/471 Senior Thesis Research) is effectively unfunded (estimated $50 is currently used each semester), limiting the sorts of experiments and analyses that students can do. The operating (B) budget of UHH Marine Science has been approximately $14k for the last several academic years. We have been steering students to different funding sources (NSF C-MORE scholars program, joining faculty with extramural research funding), but ideally we would be able to offer our students funding through the department for these project, even if on a competitive basis, which would serve the dual purpose of sharpening students’ grant writing skills.

The Marine Science Summer Session has traditionally been a large draw, attracting students from Hawaii and the mainland. In the last seven years, however, enrollments have been dropping, suggesting that we need to consider change. Presently, the summer session courses in MARE are offered ‘a la carte’, providing students with opportunities to take required and / or elective courses to expedite progress toward their degree. Alternative models for a MARE

summer session would be to offer thematically packaged / integrated courses that take full advantage of the natural environment in which we are located. A more robust recruitment plan would be necessary to go with this, which could include simplified housing applications and opportunities for weekend excursions through the University.

We feel as a department that our present course offerings are very strong, but we have discussed the possibility of offering additional courses including:

- Paleo-oceanography
- Marine Policy and Planning
- Marine Invasive Species
- Ocean Observations
- More Issue-oriented courses
- More Applied science-oriented courses
- Focused Climate Change courses, e.g. Ocean Acidification
- Communicating Science: outreach, bridging

Additionally, there are several existing courses that we would like to see offered on a more regular basis, including:

- Marine Conservation
- Watersheds
- Atoll Ecosystems
- Marine Debris in the Pacific
- Electron Microscopy

Marine Science faculty have discussed the possibility of offering additional degrees, including a pending interdisciplinary BS in Aquaculture and Fisheries and an MS degree. The BS in Aquaculture and Fisheries will be associated with the installment of a USGS Fisheries co-operative station in AY 2015-2016. The director of this station will be considered a MARE faculty member. We have discussed briefly the idea of a co-terminal MS degree with MARE, wherein students would enroll in a five year accelerated program from which they would gain a BS and MS in Marine Science. Discussions of this plan are just beginning.

There is a lot of attention (and deservedly so!) being given to recruitment and retention at UHH, and this interest is paralleled within the Marine Science department. Presently, as a department we do several activities targeting recruitment:

- Current website upkeep (Colbert)
- Many tours with prospective students / families
- Visits to local schools, recruitment events, distribution of existing brochures
- Extracurricular activities, particularly through MOP
- Individual advertising and outreach (esp. summer session, letters to prospective students)

and retention:

- Heavy emphasis on advising
- Maintain small class sizes, attention of instructors
- Extracurricular activities, particularly through MOP

- Pa‘ina and student mentoring program – develop greater sense of community at MARE

Since student attrition after year one of enrollment is high (43%) in our program, but declines to 22% after two years and less than 10% thereafter, it stands to reason that targeting retention for new students can have a big impact on program headcounts and graduation rates. To this end, we will begin a new student mentoring program in MARE this year, wherein established junior/senior standing students take incoming students ‘under their wing’ to help ease the transition to our program and increase the likelihood that 1st year students will return. Maintaining (and increasing) support for the very popular Marine Option Program (MOP) could also help with retention (please see below).

Research activities

According to our faculty contracts, tenure-track MARE faculty (ranks I-3 through I-5) teach 9 credit hours per semester and are given a 3 credit hour course ‘re-assignment’ for scholarly activities. This model was developed in the context of a full-time teaching load of 12 credits per semester (which is carried by our faculty Instructors (rank I-2), who have no requirement of scholarly activities). Thus, the research productivity of MARE faculty is expected to come from this 3 credit release unless faculty get extramural funding that includes course-reassignments. University of Hawaii at Hilo provides some opportunities for course re-assignments through the Research Council, and as incentive for graduating MS students, and MARE faculty have historically done well at taking advantage of these opportunities. However, there is still a strong feeling in the department that our research productivity is limited by the teaching loads carried (in addition to the other responsibilities associated with a program of this nature), despite the intermittent availability of course re-assignments as mentioned above. Ideas for improving the consistency of the availability of course re-assignments include starting a departmental release program (rotating assignments to research-active faculty), implementing reduced teaching loads on a basis similar to that used by San Diego State University, and using MS students’ time and tuition to support further course re-assignments. Support for these programs would be necessary in the form of lecturer hires to teach the (ideally lower division) courses from which faculty have been re-assigned.

Academic support programs

Until Fall 2015, UHH never had a full time boat captain or Boat Program Coordinator (BPC) on staff, despite having run boating-intensive classes for the last two decades. Recent staffing changes, particularly the authorization to hire a full time Boat Program Coordinator, are a very welcome change to this situation. Following a search completed spring 2015, we expect to have a new hire on staff as BPC starting Aug. 3. The general plan for this position, in addition to driving the *R/V Makani Aha* for classes, is to help us develop a boating program at UH Hilo MARE that will improve the safety and efficiency of operations, and student / staff training in the use of boats for academic purposes. This includes developing and implementing standardized protocols for operations, safety, and maintenance of boats and developing a Motor Boat Operators Certification Course (MOCC) to be taught on Hawaii Island.

The Puakō marine lab is being developed, guided by the vision statement:

UHH is developing a learning center at Puakō, Hawai'i that will promote sustainability of coastal communities and marine ecosystems through integration of education, research and community engagement.

Although Puakō Marine Lab has been planned for more than two decades, the March 2014 acquisition of the lease by UH Hilo has moved the process closer than ever before to completion. UHH is currently in need of approximately $100k by the end of calendar year 2015 to show sufficient progress to maintain permits. A fundraising effort, led by the Puako Founding Director, Jim Beets (MARE faculty), is being undertaken with the University of Hawaii Foundation. We need continued support from UHH to ensure Puako Marine Lab gets built and set up to be successfully and sustainably maintained and operated.

Marine Option Program (MOP)

The Marine Science Program at UH Hilo would benefit greatly from better integration of the UHH Marine Option Program (MOP) and the MARE academic program, including reduced redundancy in student training (projects, career skills), better sharing of resources (equipment), and increased faculty participation. The Marine Option Program at UH Hilo is an established and indispensable arm of the UH Hilo Marine Science Program, providing authentic, hands-on experiences that complement and expand on the academic degrees offered by the MARE academic program.

Programs and activities sponsored/carried out by MOP include the QUEST field school (strongly supported by NOAA with an annual MOA including $40,000 of support for student stipends and internships); over 40 years of collaboration with NOAA through UH Hilo's Marine Sea Turtle Response program; and the Motor Boat Operators Certification Course (MOCC) on Oahu. UHH MOP has developed strong affiliations with agencies including the National Oceanic and Atmospheric Administration (NOAA), the Hawaii Department of Aquatic Resources (DAR), and The Nature Conservancy (TNC), and opportunities for students to become involved early in their careers with skills, service, and research projects are all hallmarks of UH Hilo MOP. State and federal agencies in Hawaii are staffed with a large number of MOP & MARE alumni, and these same agencies consistently recruit MOP students for employment as well as once-in-a-lifetime research opportunities like participation in Pacific Reef Assessment and Monitoring Program (RAMP) cruises in the Papahānaumokuākea National Monument. The opportunity to present project results at the annual UH System MOP symposium is an additional highlight for MOP students at UH Hilo, and the past track record (UHH has won the Best Research category 24 out of 27 years, in addition to other awards) is a testament to the success of our program.

Until the 2013–2014 academic year, UHH MOP was overseen by the Director of KMEC, with an APT (2/3 MOP & QUEST and 1/3 MARE) and two MOP Faculty Co-coordinators, each compensated by 6 credits per academic year. Upon the dissolution of KMEC, many of the roles and responsibilities of KMEC (particularly regarding boating operations and the summer session academic program) were transferred to the Marine Science Department chair, and Lisa Parr was appointed to the newly established position of MOP Site Coordinator, fulfilling the role of the KMEC Director's responsibilities with MOP. At present, there is a 2/3 MOP-QUEST APT, but only one MOP Faculty Co-coordinator position. A proposal is being prepared to increase

support for UHH MOP, re-instating support for the 2nd faculty coordinator (6 credits per academic year) and a 1.5 credit equivalent stipend for the QUEST director duties.

Infrastructure investment needs

Several needs were identified during a discussion at a MARE faculty meeting, including new passenger vans for field trips; requirement for an addition tow-vehicle for the program's small boats (would be necessary for doing the MOCC boating safety course); setting up a dive locker for student academic diving operations; computer upgrades for faculty, and investment in teaching gear. The University is also in the process of designing and installing new air conditioning for the Marine Science Building, which is currently underpowered and breaks periodically (every few months), threatening lab equipment and halting productivity. One of our classrooms, MSB 101, was built as a concrete room without windows and has become one of the less-favored classrooms we have, although we need it because of its seating capacity. Windows need to be installed in the MSB 101 classroom. As faculty research grows, we will need more research space. Currently, faculty have some bench space in a shared research lab (MSB 115 or WW 6), and this must be shared with undergraduate and graduate students. We anticipate research space needs to at least double in the near future.

VII. External Reviewer's Report

External reviewer will visit Fall semester 2015

VIII. Memorandum of Understanding

Still developing

Appendix A

Table A1. Instruments in the UH-Hilo Analytical Laboratory purchased with NSF EPSCoR funding.

Instrument	Year	Use	EPSCoR Grant	Cost
Costech Elemental Analyzer	2003	Measures carbon, nitrogen and hydrogen in solid tissue samples	EPSCoR I	$33,990
Technicon AutoAnalyzer (2003)	2003	Measures inorganic nutrients in water samples	EPSCoR I	$39,900
Flame Photometer (2003)	2003	Measures 4 elements in liquid samples	EPSCoR I	$11,190
Shimadzu TOC/TN (2003)	2003	Measures carbon and nitrogen in liquid samples	EPSCoR I	$43,581
Digital Photomicroscopy System for Olympus Microscope	2003	Takes pictures of slides on the microscope	EPSCoR I	$8,000
Muffle Furnace	2003	Used to clean glassware and ash samples for analyses	EPSCoR I	$2,500
Orbital Shaker	2003	Shakes samples at a constant rate and aids in digestions	EPSCoR I	$2,000
E-Pure and B-Pure Water Purification System	2003	Provides the laboratory with clean, nutrient free water	EPSCoR I	$2,500
Computers	2003	Used for office and instruments	EPSCoR I	$4,000
Varian ICP	2004	Measure elements in liquid samples	EPSCoR I	$146,332
Thermo Ion-Ratio Mass Spectrometer	2005	Measure δ13C and δ15N isotopes in solid tissue samples	EPSCoR I	$114,985
Costech Zeroblank Autosampler	2005	Helps minimize atmospheric nitrogen	EPSCoR I	$4,364
Microwave Digester	2005	Aids in sample preparation for analysis on the ICP	EPSCoR I	$10,752
Centrifuge	2006	Spins the particles in a sample to the bottom of vial.	EPSCoR II	$6,400

Flow Cytometer	2010	Counts cells based on size and fluorescence at different wavelengths	EPSCoR III	$ 60,000
HPLC autosampler	2010	Allows many samples to be loaded for a run without supervision	EPSCoR III	$20,000
Fluorometer	2011	Used to measure fluorescence, absorbance and turbidity	EPSCoR III	$6,500
Lachat Quickchem (2013)	2013	Measures inorganic nutrients for water quality data	EPSCoR III	$81,500
pH meter	2013	Replaced an old and outdated pH meter	EPSCoR III	$2,000
Total				**$600,494**

Table A2. Courses at UH-Hilo that utilized UH-Hilo's Analytical Laboratory from 2009-2013. Spring (S) and Fall (F) are indicated, as well as if that class is required or an elective and the course enrollment.

College of Arts and Science

Course	***Requirement***	***Enrollment***	***Service***
Mare 350 Coastal Methods and Analyses	Required for Marine Science BA/BS	F 09- 12 F 10- 24 F 11- 18 F 12- 18 F 13- 13	Trained students to acid wash, provided supplies for experiments, analyzed samples, led laboratory safety tour.
Mare 353 Pelagic Methods and Analyses	Required for Marine Science BA/BS	S 09- 18 S 10- 16 S 11- 16 S 12- 18	Trained students to acid wash, provided supplies for experiments, analyzed samples, led laboratory safety tour.
MARE 410 Marine Debris in the Pacific	Elective	F 11- 26 F 12- 19	Provided space and equipment for students to work on projects
Mare 470 Senior Thesis Research	Required for BS Marine Sci.	F 09- 14 F 10- 17 F 11- 20 F 12- 14 F 13- 14	Mentored students with projects, helped with methods, laboratory techniques, and analyzing data

Mare 471 Senior Thesis Report	Required for BS Marine Sci.	S 09- 10 S 10- 14 S 11- 17 S 12- 20 F 13- 3	Mentored students with projects, helped with methods, laboratory techniques, and analyzing data
Mare 480 Senior Internship	Required for BA Marine Sci.	F 11- 8 F 10-15 F 12- 14 F 13- 12	Mentored students with projects, helped with methods, laboratory techniques, and analyzing data
Mare 488 Ku`ula, Integrated Science	Elective	S 10- 11 S 12- 12	Analyzed samples submitted by students
Chem351L Phys Chem for Life Sci Lab	Required for BA Chemistry	S 09- 8 S 10- 12 S 11- 19 S 12- 21	Laboratory tour and instrument introduction
BIOL 481L Research Methods in Ecology and Evolution	Required for BS Biology	F 09- 7 F 10- 9 F 11- 8 F 12- 6 F 13- 8	Taught sample preparation and analyzed samples submitted by students

College of Agriculture, Forestry, and Natural Resource Management (CAFNRM)

Course	*Requirement*	*Enrollment*	*Service*
Ag215 Agro-Environmental Chemistry	Elective	F 11- 15 F 12- 9	Analyzed samples and led lab tour
Ag 304 Applied Microbiology	Elective	S 11- 10 F 12- 5 F 13- 20	Lab tour, measured soil samples
Aqua 425L Water Qual. & Aquatic Prod. Lab	Required for BS in Ag.-Aquaculture Specialty	S 09- 10 S 10- 19 S 11- 15 S 12- 6	Auto-analyzer demonstration and water quality sample analysis
SOIL 304 Tropical Soils	Require for BS in Trop. Horticulture	S 09- 15 S 10- 17 S 11- 14 S 12- 14 F 12- 15 F 13- 24	Lab tour, instrument introduction, and sample analysis

SOIL 350 Soil Fertility	Elective	S 10- 9	Lab tour, instrument introduction, and sample analysis
AGRN 310 Agronomic Crop Production	Elective	F 10-12 F 11- 14	Lab tour, instrument introduction, and sample analysis

Tropical Conservation Biology and Environmental Science

Course	***Requirement***	***Enrollment***	***Service***
CBES 601 Field and Lab Methods	Required for MS in TCBES	F 09- 19 F 10- 21 F 11- 17 F 12- 12 F 13- 13	Gave lab tour, teach lab techniques, help with method development, analyze samples submitted by students
CBES 690 Internship	Required for MS in TCBES Plan B	F 11- 3 S 12- 2	Help with project set up
CBES 694 Isotope Seminar	Elective	S 10- 6 S 12- 7	Set up a semester long experiment monitoring N in `*opae*` *ula*, analyze isotope samples
CBES 699 Directed Study	Elective	1. S 09-1 2. F 11-1 3. S 12-1 4. F 13-1	1. Train how to use the TOC 2. Train how to use auto analyzer 3. Method development for soil analysis 4. Training on IRMS, applications paper for new methods.
CBES 700 Thesis Research	Required for MS in TCBES Plan A	S 09- 19 F 09- 21 S 10- 24 F 10- 16 S 11- 32 F 11- 18 S 12- 19 F 12- 22	Teach lab techniques, help set up experiments, method development, analyze submitted samples, discuss results

Table A3. Consumables purchased by UH-Hilo Analytical Laboratory used for courses and student and staff research.

Supply	**Price**	**Annually**
Gloves	$150.44/case	~$1,500
Tin capsules for isotope and %C, %N analysis	$26.00 /250	~$1,300

Acetone	$79.71 /4L bottle	~160
HCl for acid washing	$155.15 /2.5L bottle	~$1,550
Reagent water	DI: $142.59 /each RGW Filter kit: $695.13 /each-need every 6 months	~$2,000
Chemicals for extractions, solutions and standards	Prices are variable and commonly used chemicals are kept in stock.	~$8,000.00
Pipette tips	2-200ul $54.57 /1000 1000ul: $450.30 /9,600 1-5ml $94.50 /500 1-10ml $59.67 / 200	~$3,600
Centrifuge tubes (15mL and 50mL)	15ml: $135.36 /500 50ml: $164.89 /500	~$3,700
Methanol	$52.13 /4l bottle	~$100
Weigh boats	$122.79 /500	~$350
Glass vials	$111.03 /144 vials	~$1200
Chlorophyll a tubes	$144.32 /72 vials	~$300
GFF for water analysis	25mm: $102.32/ 100 47mm: $140.62 /100	~$,2400
Filter caps for water analysis	$154.00/ 12 filters	~$300
Parafilm	$45.53/ roll	~$120
Tissue wipes	$5.05/box	~200
Label tape	$121.79/case of 24	~$360
	Total	**~$27,140**

*This table represents an approximation of laboratory consumables. The annual total is highly variable, depending upon laboratory use by students and faculty. All laboratory supplies are ordered from Fisher Scientific or VWR using the University discounts.

Appendix B

Faculty funding from 2008 to 2014 listed in reverse chronological order. MARE faculty are underlined. In order to minimize space, and to highlight MARE faculty, most PIs, Co-PIs, and participants outside of the MARE department are not listed.

2014

1. NOAA. Domestic Coral Reef Conservation Grant Program. Spatial distribution and effects of sewage on Puako's (Hawai'i) coral reefs. 2014–2015. ($79,877 (grant), $53,000 private matching for graduate student). PI: T. Wiegner, Co-PIs: J. Beets, S. Colbert, J. Adolf.

2. UHH SEED Grant: Phytoplankton biomass - composition relationships at contrasting sites (wet vs. dry) around Hawai'i Island. 2014. ($13,000). PI: J. Adolf.

3. Natural History Museum UK Special Funds Project. Using External Taxonomic Expertise for the Enhancement of the NHM collection of the Family Columbellidae. 2014. (£2500). PI: M. deMaintenon.

4. NSF DUE SCHLR SCI TECH ENG&MATH. S-STEM Scholarship Program at the University of Hawai'i at Hilo. YRS? ($606,000). PI: R. Ivanova; Co-PI: M. Takabayashi.

5. NSF HRD. Center for Research Excellence in Science and Technology (CREST). Understanding Biotic Response to Environmental Change in Tropical Systems Through a Place-based Context. 2014–2018. ($5,000,000). PI: D. Price; Co-PI: M. Takabayashi.

6. UHH NSF EPSCoR. Post-Tropical Storm Iselle assessment in Puna. 2014–2015. ($50,000). PI: M. Takabayashi; Co-PIs: T. Wiegner, S. Colbert.

7. University of Hawai'i Student Equity, Excellence and Diversity Grant. Support for Kū'ula students to attend and present at Hawai'i Conservation Conference. 2014. ($1,460). PI: M. Takabayashi.

8. Hawai'i State. DLNR. Ecological Monitoring of Proposed Mooring Buoy Sites in Hilo Bay, Hawai'i. 2013–2018. ($202,603). PI: J. Turner.

2013

1. Pacific Islands Climate Science Center. Real-time observations of benthic ocean chemistry on two coral reefs in West Hawai'i. 2013–2015. ($158,000).Co-PIs: S. Colbert, J. Beets.

2. NOAA Coastal Storms Program. Installation of coastal high frequency radar arrays to monitor ocean currents and improve community storm preparedness: Hilo Bay, Hawai'i Island. 2013–2015. (200,000). PI: J. Adolf, Co-PI: S. Colbert.

3. UHH NSF EPSCoR collaboration. 2013. ($30,000). PI: M. Takabayashi.

4. NOAA PIRO. Hilo Marine Mammal Response Network (HMMRN) 2013/2014. 2013–2014. ($9,926.40). PI: J. Turner.

2012

1. NOAA. Hawai'i Sea Grant. Microbial pollution source tracking and prediction in Hilo Bay: a spatial and temporal analysis. 2012–2014. ($59,710 + $61,064 graduate assistant). PI: T. Wiegner, Co-PI: J. Adolf.

2. UHH Research Council Seed Grant. Increased ocean acidification in Kiholo Bay, HI, by submarine groundwater discharge. 2012. ($15,000). PI: S. Colbert.

3. UHH NSF EPSCoR Cross Cutting Project. 2012. ($50,000). PI: M. Takabayashi.

4. NSF HRD ADVANCE-IT-START. Exploring Diversity and Gender Equity (EDGE) at UH Hilo. 2012–2015. ($200,000). PI: D. Straney; Co-PI: M. Takabayashi.

5. NOAA PIRO. Hilo Marine Mammal Response Network (HMMRN) 2012/2013. 2012–2013. ($32,470). Co-PI: J. Turner.

2011

1. Integrated Ocean Observing System Program, NOS, NOAA, Department of Commerce, through the National Oceanographic Partnerships Program. Pacific Island Ocean Observing System (PacIOOS). 2011–2016. $20,000,000 ($90,000 for Hilo Bay buoy. PI: B. Taylor, Participants: J. Adolf, T. Wiegner.

2. Center for Tropical and Subtropical Aquaculture, Culturing native species of macroalgae in Hawai`i and the U.S. Affiliated Pacific Islands. 2011–2014. ($50,000). Co-PI: K. McDermid.

3. NOAA. Papahānaumokukea National Marine Monument. Charter flight to Midway, and visitor and entrance fees for National Fish and Wildlife Refuge for MARE 488 students. 2011. ($50,000). PI: M. Takabayashi.

2010

1. NSF Major Research Instrumentation. MRI: Acquisition of a Hitachi S-3400N-II Variable Pressure Scanning Electron Microscope with an Analytical Quantitative Element Detector for the University of Hawai'i at Hilo. 2010–2013. ($396,208). PI: J. Adolf, Co-PIs: M. deMaintenon.

2009

1. NSF EPSCoR RIII. IMUA III: Pacific high island evolutionary biogeography: Impacts of invasive species, anthropogenic activity and climate change on Hawaiian focal species. 2009–2014 ($20,000,000). PI: J. Gaines, Environmental Dynamics and Ecosystem Responses team (ENDER): J. Beets, T. Wiegner, J. Adolf, S. Colbert, M. Takabayashi.

2. UHH Seed Grant. Development of a real-time PCR assay for the toxic dinoflagellate, *Gambierdiscus toxicus*. 2009. ($7,000). PI: J. Adolf.

3. Reid Foundation, W.J. Reid Post-Doctoral Position for the Study of Marine Debris. 2009–2011. ($200,000). PI: K. McDermid.

4. NOAA. Hawai‘i Sea Grant. Skeletal growth anomalies in corals of genus *Montipora*: Physiological and ecological consequences and correlations with water quality. 2009–2012. ($143,000 and $78,000 for graduate student support). PI: M. Takabayashi.

5. NOAA. Papahānaumokuākea National Marine Monument. Charter flight to Midway, and visitor and entrance fees for National Fish and Wildlife Refuge for students in MARE394 Kū`ula Hawai`i Marine Resource Management. 2009. ($50,000). PI: M. Takabayashi

6. NOAA PIRO. Support for University of Hawai‘i at Hilo to carry out Monk Seal and Cetacean Stranding Response Program needs. 2009–2010. ($50,000). PI: J. Turner.

7. NOAA John H. Prescott Marine Mammal Rescue Assistance Grant Program. Developing a Cetacean Rehabilitation Center in Hilo, Hawai‘i: Establishing response teams and facilities. 2009. ($100,000), PI: J. Turner.

8. CSREES ANNH. Strengthening Alaska and Hawai’i Student and faculty Partnerships through Experiential Learning. 2009–2010. ($60,500). Co-PI: J. Turner.

2008

1. NSF, HRD-Centers for Research Excellence in S&T (CREST). Center in Tropical Ecology and Evolution in Marine and Terrestrial Environments. 2009–2013. ($4,999,988). PI: D. Price; Co-PI: M. Takabayashi; Participants: T. Wiegner, J. Turner.

2. UHH NSF EPSCoR REAP. Phytoplankton ecology of Hilo Bay: Real time continuous monitoring to detect changes in phytoplankton biomass and community composition due to natural and anthropogenic factors. 2008. ($25,000). PI: J. Adolf, Co-PIs: T. Wiegner, J. Turner.

3. Fairmont Orchid Resorts Green Committee Grant. Monitoring water quality in Pauoa Bay. 2008 – 2009. ($10,000). PI: J. Adolf.

4. UHH NSF EPSCoR REAP. Assessing the environmental impact of invasive poeciliid mosquitofish on Hawaiian stream ecosystems. 2008–2009. ($23,720). PI: K. McDermid.

5. UHH Seed Money Grant. Assessment of prevalence of coral diseases and their ecological impacts at Wai‘ōpae tide pools ($15,000). PI: M. Takabayashi.

6. UHH NSF EPSCoR REAP Grant. Molecular pathology of coral skeletal growth anomaly ($ 25,000). PI: M. Takabayashi.

7. NOAA. Papahānaumokuākea National Marine Monument Charter flight to Midway, and visitor and entrance fees for National Fish and Wildlife Refuge for 14 students enrolled in MARE 394 Kū`ula Hawai`i Marine Resource Management course. 2008. ($49,643). PI: M. Takabayashi.

8. CSREES ANNH, Strengthening Alaska and Hawai’i student and faculty partnerships through experiential learning. 2008–2009. ($60,500). Co-PI: J P. Turner. Grant run through UAS.

9. NOAA PIRO, Monk Seal Recovery Team. 2008–2009. ($10,000). PI: J. Turner

10. NPS. Spatial distribution and nursing behavior of monk seals at Kalaupapa National Historical Park. 2008–2011. ($50,000). PI: J. Turner.

Appendix C

Marine Science student scholarships, internships and awards from 2008 to 2014 are listed in reverse chronological order. Numbers in parentheses are the number of that specific scholarship, internship or award obtained that year.

2014

Scholarships and internships: NOAA Hollings Scholarship (2), NOAA Educational Partnership Program (1), NSF C-MORE Research Fellowship (1),Pacific Internship Program for Exploring Science (PIPES) REU (1)

Awards: MOP Best Internship (1), MOP Best Research Paper (1), MOP Best Poster (1), MOP PACON Award (1)

Travel Awards: Ocean Science Meeting travel award (2)

2013

Scholarships and internships: NOAA Hollings Scholarship (1), NSF C-MORE Research Fellowship (2)

Awards: MOP Anna Toy Ng Award (1), MOP Best Research Paper (1)

2012

Scholarships and internships: NOAA Hollings Scholarship (3), NSF C-MORE Research Internship (4), Ka‘imi‘ike Program Scholarship (3)

Awards: EPSCoR Statewide Conference Best Poster (1), MOP Best Research Paper (1), UHH College of Arts and Sciences Dean’s List (1)

Travel Awards: American Society of Limnology and Oceanography travel award (1)

2011

Scholarships and internships: Barry M. Goldwater Scholarship (1), Liko A‘e Leadership Scholars Program (1), NOAA Hollings Internship (1), NOAA Hollings Scholarship (1), NSF C-MORE research internship (1), Second Century Scholarship (1)

Awards: MOP Best Research Paper (1), MOP PACON Award (1), TCBES Symposium Best Poster (1), UHH College of Arts and Sciences Dean’s List (1)

2010

Scholarships and internships: Liko A‘e Leadership Scholars Program (1), National Sea Grant College Program Dean John A. Knauss Marine Policy Fellow (1), NMFS Population Dynamics Internship (1), NMFS Population Dynamics Modelling Workshop (1), NOAA Hollings Scholarship (3), NOAA Educational Partnership Program (1), NSF C-MORE research internship (1), UHH College of Arts and Science Dean’s Scholarship (1), UHH Opportunity Grant (1)

Awards: MOP Anna Toy Ng Award (1), MOP Best Poster (1), MOP John P Craven Award (1), MOP PACON Award (1), UHH College of Arts and Sciences Dean’s List (1)

Travel Awards: Wildlife Society National Conference travel scholarship (1), Hawai‘i Conservation Conference travel scholarship (1)

2009

Scholarships and internships: Kamehameha Schools Na Ho‘okama a Pauahi (1), Liko A‘e Leadership Scholars Program (1), NOAA Hollings Scholarship (1), OHA Scholarship (1), University of California Davis Bodega Marine Lab REU Internship (1), UHH Opportunity Grant (1), UHH Opportunity Grant - Hawaiian Ancestry (1)

Awards: MOP Anna Toy Ng Award (1), MOP Best Poster (1), MOP Best Research Paper (1), MOP PACON Award (1), TCBES Symposium 2nd Place Research Presentation (1), UHH College of Arts and Sciences Dean’s List (1)

2008

Scholarships and internships: American Society of Microbiology Undergraduate Research Fellowship (1), Kamehameha Schools Na Ho‘okama a Pauahi (1), NOAA Hollings Scholarship (1), UHH Opportunity Grant (1)

Awards: MOP Best Poster (1), MOP Best Research Paper (1), UHH College of Arts and Sciences Dean’s List (1)

Appendix D

MARE faculty publications from 2008 to 2015 are listed in reverse chronological order. MARE faculty names are underlined, while *UHH MARE undergraduates and †UHH TCBES graduate students are denoted with the previous symbols.

2015 = 4

1. Adolf, J.E., Bachvaroff, T.R., Deeds, J.R. & Place, A.R. Ichthyotoxic *Karlodinium veneficum* (Ballantine) Moestrup in the Upper Swan River Estuary (Western Australia): Ecological conditions leading to a fish kill. Accepted in Harmful Algae, March 2015.

2. *Claar, D.C. & Takabayashi, M. The effects of growth anomaly on susceptibility of *Montipora capitata* to turf algal overgrowth. Accepted for publication in Marine and Freshwater Research

3. Harding, L.W. Jr., Adolf, J.E., Mallonee, M.E., Miller, W.D., Gallegos, C.L., Perry, E.S., Johnson, J.M., Sellner, K.G. & Paerl. H.W. 2015. Climate effects on phytoplankton floral composition in Chesapeake Bay. Estuarine, Coastal & Shelf Sciences. In Press, published online January 6, 2015

4. McDermid, K.J., * Lefebvre, J.A. & Balazs, G.H. 2015. Non-native seashore paspalum (*Paspalum vaginatum*: Poaceae) consumed by Hawaiian green sea turtles (*Chelonia mydas*): evidence for nutritional benefits. Pacific Science 69(1): tba

2014 = 3

1. deMaintenon, M.J. 2014. Taxonomic revision of the species of *Parvanachis* Radwin, 1968 (Gastropoda: Columbellidae) from the Gulf of Panama. Zootaxa 3753: 201–225.

2. Robidart, J., Church, M.J., Ryan, J., Ascani, F., Wilson, S., Bombar, D., Marin III, R., Richards, K., Karl, D.M., Scholin, C. & Zehr, J. 2014: Ecogenomic sensor reveals controls on N_2-fixing microorganisms in the North Pacific Ocean. ISME Journal, 1–11.

3. *Strohl, R.D. & deMaintenon, M.J. 2014. Effects of the invasive alga *Gracilaria salicornia* on molluscan species abundance, richness, and diversity in sheltered shoreline pools in East Hawai‘i. The Veliger 51: 255–260.

2013 = 10

1. Beets, J., Brown, E., & Friedlander, E. In press. Comparison of fish assemblages and habitat characteristics between two Hawaiian national parks with different levels of human influence. Pacific Science

2. †Burns, J.H.R., †Gregg, T.M. & Takabayashi, M. 2013. Does coral disease affect *Symbiodinium*? Investigating the impacts of growth anomaly on symbiont photophysiology. PLoS ONE. http://journals.plosone.org/plosone/article?1d=10.1371/journal.pone.0072466

3. Carson, H.S., *Lamson, M.R., Nakashima, D., *Toloumu, D., Hafner, J., Maximenko, N. & McDermid, K.J. 2013. Tracking the sources and sinks of local marine debris in Hawai‘i. Marine Environmental Research 84:76–83.

4. DeMartini, E.E., Jokiel, P., Beets, J., Stender, Y., Minton, D., Conklin, E. & Storlazzi, C. 2013. Terrigenous sediment impact on coral recruitment and growth affects the use of coral habitat by recruit parrotfishes (F. Scaridae). Journal of Coastal Conservation 17: 417–429.

5. †Holitzki T.M., MacKenzie, R.A., Wiegner, T.N. & McDermid, K.J. 2013. Invasive poeciliid fish alter ecological structure, function, and native biodiversity of Hawaiian streams. Ecological Applications 26(6): 1367–1383.

6. †Johnson, E., & Wiegner, T.N. 2013. Potential surface water metabolism in groundwater-fed coastal waters of West Hawai'i. Estuaries and Coasts 10.1007/s12237-013-9708-y.

7. MacKenzie, R.A., Wiegner, T.N., *Kinslow, F. Cormier, N. & Strauch, A.M. 2013. Leaf litter inputs from an invasive nitrogen-fixing tree influence organic matter dynamics and nitrogen inputs in a Hawaiian river. Journal of Freshwater Science 32(3): 1036–1052.

8. †Spies, N.P. & Takabayashi, M. 2013. Expression of galaxin and oncogene homologs in growth anomaly in the coral, *Montipora capitata*. Diseases of Aquatic Organisms 104: 249–256.

9. Wiegner, T.N., Hughes, R.F., *Shizuma, L.M. & *Bushaw, D.K. 2013. Impacts of an invasive nitrogen-fixing tree on Hawaiian stream water quality. Biotropica 45(4): 409–418.

10. Wiegner, T.N., †Mead, L.H. & Molloy, S.L. 2013. A comparison of water quality between low- and high-flow river conditions in a tropical estuary, Hilo Bay, Hawai'i. Estuaries and Coasts 36(2): 319–333.

2012 = 4

1. †Atwood, T., Wiegner, T.N. & MacKenzie, R.A. 2012. Effects of hydrological forcing on the structure of a tropical estuarine food web. Oikos 121(2): 277–289

2. Kelman, D., *Kromkowski Posner, E., McDermid, K.J., Tabandera, N.K., Wright, P.R. & Wright, A.D. 2012. Antioxidant activity of Hawaiian marine algae. Marine Drugs 10(2): 403–416; doi:10.3390/md10020403

3. Kulbicki, M., Beets, J., Chabanet, P., Cure, K., Darling, E., Floeter, S., Galzin, R., Green, A., Harmelin-Vivien, M., Hixon, M., Letourneur, Y., Lison de Loma, T., McClanahan, T., McIlwain, J., MouTham, G., Myers, R., O'Leary, J.K., Planes, S., Vigliola, L., & Wantiez, L. 2012. Distributions of Indo-Pacific lionfishes *Pterois* spp. in their native ranges: implications for the Atlantic invasion. Marine Ecology Progress Series 446:189–205.

4. Takabayashi, M., †Adams, L.M., Pochon, X. & Gates, R.D. 2012. Genetic diversity of free-living *Symbiodinium* in surface water and sediment of Hawai'i and Florida. Coral Reefs 31: 157–167.

2011= 9

1. †Burns, J.R. & Takabayashi, M. 2011. Histopathology of growth anomaly affecting the coral, *Montipora capitata*: Implications on biological functions and population viability. PLoS ONE 6(12): e28854. doi:10.1371/journal.pone.0028854

2. †Burns, J.R., *Rozet, N.K. & Takabayashi, M. 2011. Morphology, severity, and distribution of growth anomalies in the coral, *Montipora capitata*, at Waiʻōpae, Hawaiʻi. Coral Reefs 30: 819–826.

3. Carson, H.S., Colbert, S.L., *Kaylor, M.J. & McDermid, K.J. 2011. Small plastic debris changes water movement and heat transfer through beach sediments. Marine Pollution Bulletin 62: 1708–1713.

4. DeMartini, E.E., Anderson, T.W., Friedlander, A.M. & Beets, J.P. 2011. Predator biomass, prey density, and species composition effects on group size in recruit coral reef fishes. Marine Biology 158: 2437–2447.

5. Michaud, J. & T.N. Wiegner. 2011. Stream nutrient concentrations on the windward coast of Hawai`i Island and their relationship to watershed characteristics. Pacific Science 65(2): 195–217.

6. Pacini, A.F., Nachtigall, P.E., Quintos, C.T., Schofield T.D., Look, D.A., Levine, G.A. & Turner, J.P. 2011. Audiogram of a stranded Blainville's beaked whale (*Mesoplodon densirostris*) measured using auditory evoked potentials. Journal of Experimental Biology 214: 2409–2415.

7. Place, A.R., Bowers, H.A., Bachvaroff, T.R., Adolf, J.E., Deeds, J.R. & Sheng, J. 2011. *Karlodinium veneficum* – the little dinoflagellate with a big bite. Harmful Algae 14: 179–195.

8. Stat, M., Bird, C.E., Pochon, X., Chasqui, L., Chauka, L.J., Concepcion, G.T., Logan, D., Takabayashi, M., Toonen, R.J., & Gates, R.D. 2011. Variation in *Symbiodinium* ITS2 sequence assemblages among coral colonies. PLoS One http://dx.plos.org/10.1371/journal.pone.0015854

9. †Timmers, M., Andrews, K., Bird, C.E., deMaintenon, M.J., Brainard, R. & Toonen, R.J. 2011. Widespread dispersal of the Crown-of-Thorns sea star, *Acanthaster planci*, across the Hawaiian Archipelago and Johnston Atoll. Journal of Marine Biology 2011, doi: 10.1155/2011/934269, 10 pp.

2010= 9

1. *Atwood, T., Wiegner, T.N., Turner, J.P. & MacKenzie, R.A. 2010. Potential effects of an invasive nitrogen-fixing tree on a Hawaiian stream food web. Pacific Science 64(3): 367–379.

2. Christie, M.R., Tissot, B.N., *Albins, M.A., Beets, J.P., Jia, Y., Ortiz, D.M., Thompson, S.E. & Hixon, M.A. 2010. Larval connectivity in an effective network of marine protected areas. PLoS ONE 5(12): e15715.

3. DeMartini, E.E. Anderson, T.W., Kenyon, J.C., Beets, J.P. & Friedlander, A.M. 2010. Management implications of juvenile reef fish habitat preferences and coral susceptibility to stressors. Marine and Freshwater Research 61: 532-540. doi: 10.1071/MF09141-1323-1650/10/050532

4. †Mead, L.H., & Wiegner, T.N. 2010. Surface water metabolism in a tropical estuary, Hilo Bay, Hawaiʻi, USA, during storm and non-storm conditions. Estuaries and Coasts 33(5): 1099–1112.

5. †Pagarigan, L.K., Takabayashi, M. 2010. Reference gene selection for qRT-PCR analysis of the Hawaiian coral Pocillopora meandrina subjected to elevated levels of temperature and nutrient. Proceedings of the 11th International Coral Reef Symposium: 169–173.

6. Pochon, X., Stat, M., Chasqui, L., Jones, L., Logan, D.K., Takabayashi, M. & Gates. R.D. 2010. Comparison of endosymbiotic and free-living *Symbiodinium* (Dinophyceae) diversity in a Hawaiian reef environment. Journal of Phycology 46: 53–65.

7. Sheng, J., Malkiel, E., Katz, J., Adolf, J., & Place, A.R. 2010. A dinoflagellate exploits toxin to immobilize prey prior to ingestion. Proceedings of the National Academy of Sciences 107: 2082–2087.

8. Takabayashi, M., *Gregg, T.M., Farah, E., †Burns, J., Teves, K. & Cody, N.H. 2010. The prevalence of skeletal growth anomaly and other afflictions in scleractinian corals at Wai‘ōpae, Hawai‘i. Proceedings of the 11th International Coral Reef Symposium: 820–824

9. Wiegner, T.N. & †Tubal, R.L. 2010. A comparison of dissolved organic carbon bioavailability from native and introduced riparian vegetation along a Hawaiian river. Pacific Science 64(4): 545–555.

2009=8

1. †Adams, L.M., Cumbo, V.R. & Takabayashi, M. 2009. Exposure to sediment enhances primary acquisition of *Symbiodinium* by asymbiotic coral larvae. Marine Ecology Progress Series 377: 149–156.

2. Adolf, J.E., Bachvaroff, T.R. & Place, A.R. 2009. Environmental modulation of Karlotoxin levels in strains of the cosmopolitan dinoflagellate, *Karlodinium veneficum* (Dinophyceae). Journal of Phycology 45: 176–192.

3. Bachvaroff, T.R., Adolf, J.E. & Place, A.R. 2009. Strain variation in *Karlodinium veneficum* (Dinophyceae): toxin profiles, pigments, and growth characteristics. Journal of Phycology 45: 137-153.

4. Boulon, R.H., Monaco, M.E., Friedlander, A.M., Caldow, C., Christensen, J., Rogers, C., Beets, J., Miller, J. & Hile, S.D. 2009. An ecological correction to marine reserve boundaries in the US Virgin Islands. Proceedings of the 11th International Coral Reef Symposium, Ft. Lauderdale, Florida, 7–11 July 2008.

5. *Olson, N.D., Ainsworth, T.D., Gates, R.D. & Takabayashi, M. 2009. Diazotrophic bacteria associated with Hawaiian *Montipora* corals: diversity and abundance in correlation with symbiotic dinoflagellates. Journal of Experimental Marine Biology and Ecology. 371: 140–146. (60%)

6. Paddack, M. Reynolds, J., Aguilar, C., Appeldoorn, R., Beets, J., & others. 2009. Recent region-wide declines in Caribbean reef fish abundance. Current Biology 19: 590–595.

7. Turner, J.P. & Rooker, J.R. 2009. A review of trophic ecology of *Sargassum* communities in the northwestern Gulf of Mexico: Implications for pelagic fisheries. Gulf and Caribbean Fisheries Proceedings. Pgs?

8. Wiegner, T.N., †Tubal, R.L. & MacKenzie, R.A. 2009. Bioavailability of dissolved organic matter from a tropical river during base- and storm flow conditions. Limnology and Oceanography 54(4): 1233–1242.

2008 =17

1. Adolf, J.E., Bachvaroff, T.R. & Place, A.R. 2008. Can cryptophyte abundance trigger toxic *Karlodinium veneficum* blooms in eutrophic estuaries? Harmful Algae 8: 119–128.

2. Adolf, J.E., Bachvaroff, T.R. & Place, A.R. 2008. Manger à trois: Toxic vs. non-toxic *Karlodinium veneficum* strains with a predator, *Oxyrrhis marina*, and prey, *Storeatula major*. Proceedings of the 12th International Conference on Harmful Algae, Copenhagen Denmark. pp. 107–110

3. Bachvaroff, T.R., Adolf, J.E. & Place, A.R. 2008. Phylogeography of Atlantic coast *Karlodinium veneficum* strains: A genetic marker correlates with toxin type. Proceedings of the 12th International Conference on Harmful Algae, Copenhagen, Denmark, pp. 55–58

4. Brownlee, E.F., Sellner, S.G., Sellner, K.G., Nonogaki, H., Adolf, J.E., Bachvaroff, T.R. & Place, A.R. 2008. Responses of *Crassostrea virginica* (Gmelin) and *C. ariakensis* (Fujita) to bloom-forming phytoplankton including ichthyotoxic *Karlodinium veneficum* (Ballantine). Journal of Shellfish Research 27(3): 581–591.

5. deMaintenon, M.J. 2008. Results of the Rumphius Biohistorical Expedition to Ambon (1990). Part 14. The Columbellidae (Gastropoda: Neogastropoda) collected at Ambon during the Rumphius Biohistorical Expedition. Zoologische Mededelingen Leiden 82: 341–374.

6. Friedlander, A., Beets, J., Caselle, J., Lowe, C. & Bowen, B. 2008. Biology and ecology of the recreational bonefish fishery at Palmyra Atoll National Wildlife Refuge with comparisons to other Pacific Islands. Chp. 2, pp. 27–56 in J. Ault. (Ed.) Biology and Management of the World Tarpon and Bonefish Fisheries. CRC Press, Boca Raton, FL.

7. Grober-Dunsmore, R, Wooninck, L., Field, J., Ainsworth, C., Beets, J. & others. 2008. Vertical zoning in marine protected areas: Ecological considerations for balancing pelagic fishing with conservation of benthic communities. Fisheries 33: 598–610.

8. Grober-Dunsmore, R., Frazer, T.K., Beets, J., Zwick, P., Funicelli, N.A. & Lindberg, W.J. 2008. Influence of landscape structure on reef fish assemblages. Landscape Ecology 23:37–53.

9. Hall, N.S., Litaker, R.W., Fensin, E., Adolf, J.E., Place, A.R. & Paerl, H.W. 2008. Environmental factors contributing to the development and demise of a toxic dinoflagellate (*Karlodinium veneficum*) bloom in a shallow, eutrophic, lagoonal estuary. Estuaries and Coasts DOI 10.1007/s12237-008-9035-x

10. Kaplan, L.A., Wiegner, T.N., Newbold, J.D., Ostrom, P.H. & Gandhi, H. 2008. Untangling the complex issue of dissolved organic carbon uptake: a stable isotope approach. Freshwater Biology 53:588–864.

11. Monaco, M.E., Friedlander, A.M., Caldow, C., Christensen, J.D., Rogers, C., Beets, J., Miller, J. & Boulon, R. 2007. Characterising reef fish populations and habitats within and outside the US Virgin Islands Coral Reef National Monument: a lesson in marine protected area design. Fisheries Management and Ecology 14: 33–40.

12. Place, A.R., Brownlee, E.F., Sellner, S.G., Sellner, K.G., Nonogaki, H., Adolf, J.E. & Bachvaroff, T.R. 2008. Bivalve responses to ichthyotoxic *Karlodinium veneficum* (Ballantine). Proceedings of the 12th International Conference on Harmful Algae, Copenhagen Denmark pp. 5–8.

13. Rogers, C.S., Miller, J., Muller, E.M., Beets, J. & others. 2008. Ecology of coral reefs in the U.S. Virgin Islands. Chp. 9 in Riegl, B.M. & Dodge, R.E. (eds.). Coral Reefs of the World Vol. I. Coral Reefs of the USA. Springer.

14. Runcie, J.W., Gurgel, C.F.D. & McDermid, K.J. 2008. In situ photosynthetic rates of tropical marine macroalgae at their lower depth limit. European Journal of Phycology 43(4):377–388. Recipient of Kathleen Drew Baker prize for best paper in 2008 in European Journal of Phycology.

15. Stoecker, D.K., Adolf, J.E., Place, A.R., Glibert, P.M. & Meritt, D.W. 2008. Effects of the dinoflagellates *Karlodinium veneficum* and *Prorocentrum minimum* on early life history stages of the Eastern Oyster (*Crassostrea virginica*). Marine Biology. 154: 81–90.

16. Smith, J.E., Kuwabara, J., Coney, J., Flanagan, K., Beets, J., Brown, D., Staton, F., Takabayashi, M., duPlessis, S., Griesemer, B.K., *Barnes, S. & Turner, J. 2008. Unusual cyanobacterial bloom in Hawai`i. Coral Reefs 27(4): 851.

17. Turner, J.P. & Rooker, J.R. 2008. A review of trophic ecology of *Sargassum* communities in the northwestern Gulf of Mexico: Implications for pelagic fisheries. Gulf and Caribbean Fisheries Proceedings.

Appendix E

Faculty presentations given by Marine Science faculty, staff, and students at scientific conferences (faculty/ staff, *undergraduate student, †graduate student) from 2008 to 2014.

2015

*Abaya, L., Wiegner, T.N., Colbert, S.L., *Aiwohi, M., *Braun, E. & *Tabandera, R. 2015. Spatial distribution and effects of sewage in coastal Hawaiian waters. ASLO Aquatic Sciences Meeting, Granada, Spain.

Adolf, JE. 2015. Responses of coastal phytoplankton communities to terrigenous water inputs around Hawaii Island. The Third University of Hawaii and University of Tokyo Joint Symposium on Ocean, Coastal, and Atmospheric Sciences.

Colbert, S.L. 2015. Nearshore and groundwater variability of dissolved inorganic carbon and alkalinity in Hawai'i. Pacific Island Climate Science Center, Honolulu, Hawai‘i.

deMaintenon, M.J. & Strong, E.E. 2015. Molecular phylogeny of Columbellidae. Invited to present at the annual meeting of the American Malacological Society, August 28–31, 2015, Pellston, Michigan.

2014

*Abaya, L., Wiegner, T.N., *Weisz, C. & Adolf, J. 2014. A geospatial analysis of microbial pollution within Hilo Bay, Hawai‘i. Ocean Science Meeting, Honolulu, Hawai‘i.

Adolf, J., Wiegner, T.N., *Walker, J.K., *Johnson, E. & *Gamiao, S. 2014. Submarine groundwater discharge (SGD) modifies distributions of phytoplankton and bacteria along the west coast of Hawai‘i Island. Ocean Science Meeting, Honolulu, Hawai‘i.

Ascani, F. 2014. Climate modulation of juvenile recruitment of loggerhead sea turtles via ocean circulation in the North Pacific Ocean. TCBES Graduate Program. UHH, Hilo, Hawai‘i.

Ascani, F. 2014. Effect of ocean currents on the survival of loggerhead (*Caretta caretta*) neonate sea turtles in the North Pacific Ocean. NOAA Fisheries/Pacific Islands Fisheries Science Center seminar, Honolulu, Hawai‘i.

†Burns, J.H.R., Gates, R.D., Takabayashi, M. & Delparte, D. 2014. Utilizing structure-from-motion photogrammetry as an innovative technique for quantifying 3-dimensional characteristics of coral reefs. Ocean Sciences Meeting, Honolulu, Hawai‘i.

Colbert, S.L. 2014. Environmental Variability on a Coral Reef: Kiholo Bay & Wai ‘Opae, Hawai‘i. Hawaii Conservation Conference, Honolulu, Hawai‘i.

Colbert, S.L. 2014. Nearshore dynamics of an SGD plume, Kiholo Bay, Hawai‘i. AGU/ASLO Ocean Science Meeting, Honolulu, Hawai‘i.

*Economy, L. & Colbert, S.L. 2014. Submarine groundwater discharge and CO_2 dynamics at Kiholo Bay, Hawai‘i. AGU/ASLO Ocean Science Meeting, Honolulu, Hawai‘i.

†Frazier, M., Geib, S. & Takabayashi, M. 2014. Assessing the biological effects of growth anomaly in the coral *Montipora capitata* using RNA-seq. Ocean Sciences Meeting, Honolulu, Hawai'i.

*Holitzki, T.M., *Johnson, E.E. & Wiegner, T.N. 2014. Submarine groundwater impacts on benthic macroalgal C:N:P in Hawaiian waters. Ocean Science Meeting, Honolulu, Hawai'i.

*Johnson, E.E. & Wiegner, T.N. 2014. Water column metabolism of milo and kiawe dominated anchialine ponds in leeward Hawai'i. Ocean Science Meeting, Honolulu, Hawai'i.

*Kiili, S.H., Colbert, S. & Wiegner, T.N. 2014. Effects of geothermally heated groundwater on the dissolved inorganic carbon system at Wai'Opae, Hawai'i Island. Ocean Science Meeting, Honolulu, Hawai'i.

*Leu, H.I., Lamar, *F. *Jennings-Kam, D.K., Wiegner, T.N. & Adolf, J.E. 2014. Experimental investigation of the effects of nutrient enrichment of microbial biomass and class structure in tropical oligotrophic waters off West Hawai'i. Ocean Science Meeting, Honolulu, Hawai'i.

*Pihana, H., *Steward, K., *Crocket, C. & Takabayashi, M. 2014. How invasive are the upside-down jellyfish in Hawai'i? An ecological and molecular study. Ocean Sciences Meeting, Honolulu, Hawai'i.

*Quiocho, V.K., Lemus, J. & Takabayashi, M. 2014. Understanding fishpond ecology through Hawai'i science. Ocean Sciences Meeting, Honolulu, Hawai'i.

Takabayashi, M. 2014. Science of water: Where worldviews mix. WinGS International Symposium. Hokkaido University, Japan.

*Weisz, C.J., Wiegner, T., *Abaya, L., Adolf, J. & Awaya, J. 2014. Temporal geospatial analyses of microbial pollution patterns: A tool for improved water quality monitoring and watershed management. Ocean Science Meeting, Honolulu, Hawai'i.

Wiegner, T.N., *Carlson, K., *Johnson, E., Adolf, J. & *Mokiao-Lee, A. 2014. Submarine groundwater discharge elicits a biological response in Hawai'ian coastal waters. Ocean Science Meeting, Honolulu, Hawai'i.

Wiegner, T.N., Colbert, S., Braun, E., *Aiwohi, M., *Tabandera, R. & Beets, J. 2014. Spatial distribution and effects of sewage on Puakō's coral reefs. Hawai'i Department of Health, Clean Drinking Water Branch, Inter-government Water Conference, Kona, Hawai'i.

Wiegner, T.N. & Genz, A. 2014. Sea level rise in the Pacific: Causes, effects, and responses. United Nations Association of the U.S.A., Hawai'i Island Branch, Annual Meeting, Hilo, Hawai'i.

Woodworth-Jefcoats, P., Jia, Y., Adolf, J.E. & Colbert, S.L. 2014. A multidisciplinary overview of the Kona marine ecosystem. NOAA Kona Region Integrated Ecosystem Assessment Meeting, Kailua-Kona, Hawai'i.

2013

Beets, J., Adolf, J.E., Colbert, S. & Wiegner, T.N. 2013. Ecosystem responses to groundwater discharge on leeward Hawai'i Island. Big Island Water Resources Meeting, Hilo, Hawai'i.

*Carlson, K. & Wiegner, T.N. 2013. Bacterial growth efficiency in groundwater plumes on the east and west shores of the Island of Hawai'i. Hawai'i Ecosystems Meeting, Hilo, Hawai'i.

Colbert, S.L. 2013. Submarine groundwater discharge and carbon dioxide dynamics at Kiholo Bay. Hawai'i Ecosystems Meeting, Hilo, Hawai'i.

Colbert, S.L. 2013. Real-time observations of benthic ocean chemistry on two coral reefs in west Hawai'i. Pacific Island Climate Science Center, Honolulu, Hawai'i

*Economy, L. & Colbert, S.L. 2013. CO_2 dynamics at Kiholo Bay, Hawaii. ASLO 2013 Aquatic Science Meeting, New Orleans, Louisiana.

*Johnson. E. & Wiegner, T.N. 2013. Water column metabolism of anchialine ponds in leeward Hawai'i. Big Island Water Resources Meeting, Hilo, Hawai'i.

*Weisz, C., Wiegner, T.N., *Loretero, J., Adolf, J. & Awaya, J. 2013. Microbial pollution prediction in Hawaiian coastal waters: a temporal and spatial analysis. 5th Annual TCBES Symposium, Hilo, Hawai`i.

*Weisz, C., Wiegner, T.N., *Loretero, J., Adolf, J. & Awaya, J. 2013. Microbial pollution prediction in Hawaiian coastal waters: a temporal and spatial analysis. Hawai'i Ecosystem Meeting, Hilo, Hawai'i.

*Weisz, C., Wiegner, T.N., *Loretero, J., Adolf, J., Molloy, S. & Awaya, J. 2013. Microbial pollution prediction in Hawaiian coastal waters: a temporal and spatial analysis. Big Island Water Resources Meeting, Hilo, Hawai'i.

Wiegner, T.N. & Camara, L. 2013. Ka Muliwai o Hilo. NERRS Site Proposal. Three Mountain Alliance Meeting, Hilo, Hawai'i.

Wiegner, T.N., *Carlson, K., *Johnson, E., Adolf, J., *Heu, L., *Jennings-Kam, D., *Walker, J. & *Mokiao-Lee, A. 2013. Groundwater inputs elicit a biological response in Hawaiian coastal waters. Hawai'i Ecosystem Meeting, Hilo, Hawai'i.

Wiegner, T.N., *Stewart, R. & Camara, L. 2013. Ka Muliwai o Hilo. NERRS Site Proposal Presentation. Hawai'i State Office of Planning, Honolulu, Hawai'i.

Wiegner, T.N., *Weisz, C., Adolf, J.E., Awaya, J. & Molloy, S.L. 2013. Microbial pollution prediction in Hawaiian coastal waters: a temporal and spatial analysis. US Recreational Water Quality Criteria: A Vision for the Future, Honolulu, Hawai'i.

Wiegner, T.N. & Ziegler-Chong, S. 2013. Malama ia Hilo Bay. Proposed designation for a National Estuarine Research Reserve System Site. UHH, Hilo, Hawai'i.

2012

Adolf, J.E., *Gamiao, S., Walker, J.K., Bachvaroff, T., Harding, L.W. Jr. & Place, A.R. 2012. Linking phytoplankton to environmental variability in the coastal ocean. National Academies of Science Kavli Frontiers of Science symposium, July 2012, Solo, Indonesia (Poster).

†Burns, J.H.R, *Gregg, T.M. & Takabayashi, M. 2012. Comprehensive examination of growth anomaly impacts on organismal and population viability of the coral, *Montipora*

capitata, in Hawai‘i. 12th International Coral Reef Symposium, Cairns, Queensland, Australia.

†Burns J.H.R., *Gregg T.M. & Takabayashi M. 2012. Comprehensive examination of growth anomaly impacts on organismal and population viability of the coral, *Montipora capitata,* in Hawai’i. 37th Annual Albert L Tester Memorial Symposium, Manoa, Oahu, Hawai‘i.

*Carlson, K. & Wiegner, T.N. 2012. Bacterial growth efficiency in groundwater plumes on the east and west shores of the Island of Hawai‘i. Hawai‘i Ecosystems Meeting, Hilo, Hawai‘i.

Colbert, S.L. & *Economy, L. 2012. Groundwater discharge and CO_2 dynamics at Kiholo Bay. Pacific Congress on Marine Science and Technology, Keauhou, Hawai‘i.

DeRego, K., Chang, M. & *Tobin, H. 2012. Ho‘omeheu nā hulu: Following our ancestral path. Hawai‘i Conservation Conference, Honolulu, Hawai‘i.

*Economy, L., *Cadiz, E. & Colbert, S.L. 2012. Submarine groundwater discharge and CO_2 dynamics at Kiholo Bay, Hawai‘i. Hawai‘i EPSCoR Statewide Conference, Hilo, Hawai‘i.

*Frazier, M., *Olson, N.D., & Takabayashi, M. 2012. Diazotrophs associated with an endemic Hawaiian coral, *Montipora capitata*, Hawai‘i. 12th International Coral Reef Symposium, Cairns, Queensland, Australia.

*Gregg, T.M., †Burns, J.H.R. & Takabayashi, M. 2012. Environmental and ecological cofactors of coral growth anomalies in Hawai‘i. 12th International Coral Reef Symposium, Cairns, Queensland, Australia

*Johnson, E. & Wiegner, T.N. 2012. Potential surface water metabolism in groundwater-fed coastal waters of West Hawai‘i. Hawai‘i Ecosystems Meeting, Hilo, Hawai‘i.

*Ortiz-Santiago, V.M. & Colbert, S.L. 2012. *Holothuria* (Sea Cucumbers) distribution based on the physical-chemical properties of sediments. ASLO Ocean Sciences Meeting, Salt Lake City, UT.

*Pascua, P., Dudley, M. & *Pihana, H. 2012. He hua nō ma o ka noi‘i noelo: the application of Hawaiian place names in scientific inquiry. Hawai‘i Conservation Conference, Honolulu, Hawai‘i.

Pilago, K., Kim, K. & *Bauers, L. 2012. Kama‘āina i nā kino lau, hō‘ike ‘ia nā akua: Understanding kino lau of Hawaiian akua in resource management. Hawai‘i Conservation Conference, Honolulu, Hawai‘i.

†Spies, N.P. & Takabayashi, M. 2012. The effect of skeletal growth anomalies on the expression of organic matrix gene galaxin and oncogene homologs, in the coral *Montipora capitata.* 12th International Coral Reef Symposium, Cairns, Queensland, Australia.

Takabayashi, M. & *Bertelmann, P. 2012. Kū‘ula: Integrating western and indigenous sciences in Hawai‘i. Session chair, Hawaii Conservation Conference, Honolulu HI.

Wiegner, T.N., Adolf, J.E., Molloy, S. & Awaya, J. 2012. Microbial pollution source tracking and prediction in Hilo Bay: a spatial and temporal analysis. Hawai‘i Ecosystems Meeting, Hilo, Hawai‘i.

2011

Adolf, J.E. Phytoplankton in SGD plumes of West Hawaii. EPSCoR Science Meeting, April 2011

Adolf, J.E. & *Walker, J.K. 2011. What can phytoplankton and bacteria tell us about coastal water quality of Hawaii Island? Presented at Big Island Water Resources 1st Annual Meeting, March 21, 2011

Adolf, J.E., *Walker, J.K. & *Gamiao, S. 2011. What happens to SGD nutrients in the surface ocean at Kiholo and Kaloko Bay? EPSCoR Science Retreat, Kilauea Military Camp July 2011

Adolf, J.E., *Walker, J.K. & Gamiao, S*. 2011. What happens to SGD nutrients in the surface ocean at Kiholo and Kaloko Bay? NOAA-sponsored Symposium on Kona's Marine Ecosystem. King Kamehameha Hotel Sept 2011.

*Gregg T.M., †Burns J., Mokiau-Lee A., Carlson K. & Takabayashi M. 2011. The effects of community structure and water quality on coral affliction prevalence and severity around Hawaii Island. November 14–16th: Water Resource SustAINAbility on Tropical Islands Conference, Oahu, Hawai`i.

Carson, H.S., Colbert, S.L., *Kaylor, M.J. & McDermid, K.J. 2011. Welcome to the beach of the future: the physical properties of plastic sediment. 5th International Marine Debris Conference, Honolulu, Hawai'i.

Colbert, S.L. 2011. Pumping seawater through sandy sediments: Mechanisms, rates and ecological implications. UHH, Hilo, Hawai'i.

Colbert, S.L., Mari, X., Stemmann, L. & Burd, A. 2011. Ecological processes in the New Caledonia Lagoon based on a particle coagulation model. AGU Fall Meet. Suppl., Abstract OS33C-1693.

*Guitard, M. & Colbert, S.L. 2011. Indicators of a changing environment: a study of microfossil assemblage in Hilo Bay, Hawai'i. Smithsonian Conference on Evolution of Life on Pacific Islands and Reefs, Honolulu, Hawai`i.

*Holitzki, T., MacKenzie, R.A., McDermid, K. & Wiegner, T.N. 2011. Environmental impacts of invasive poeciliid fish on Hawaiian streams. 1st Annual Big Island Water Resources Meeting, Hilo, Hawai`i.

*Johnson, E. & Wiegner, T.N. 2011. Potential surface water metabolism in groundwater-fed coastal waters of West Hawai'i. 1st Annual Big Island Water Resources Meeting, Hilo, Hawai`i.

*Johnson, E. & Wiegner, T.N. 2011. Potential surface water metabolism in groundwater-fed coastal waters of West Hawai'i. 3rd Annual TCBES Symposium, Hilo, Hawai`i.

*Johnson, E. & Wiegner, T.N. 2011. Potential surface water metabolism in groundwater-fed coastal waters of West Hawai'i. Coastal and Estuarine Research Federation Conference, Daytona Beach, Florida.

*Johnson, E. & Wiegner, T.N. 2011. Potential surface water metabolism in groundwater-fed coastal waters of West Hawai'i. Hawai'i Ecosystems Meeting, Hilo, Hawai'i.

*Johnson, E. & Wiegner, T.N. 2011. Potential surface water metabolism in groundwater-fed coastal waters of West Hawai'i. NOAA's Symposium on Kona's (West Hawai'i) Marine Ecosystem: Past, Present, and Future. Kailua, Kona, Hawai'i.

Kimura, M., Adolf, J.E. & Binder, P. 2011 Update on Primary Production Simulation Model. Presented at EPSCoR statewide meeting.

*Mokiao-Lee, A., *Johnson, E. & Wiegner, T.N. 2011. Identifying nitrogen inputs to thermal tide pools on Hawai'i Island, using a multi-stable isotope approach. 3rd Annual TCBES Symposium, Hilo, Hawai`i.

*Mokiao-Lee, A., *Johnson, E. & Wiegner T.N. 2011. Identifying nitrogen inputs to thermal tide pools on Hawai'i Island, using a multi-stable isotope approach. Hawai'i Ecosystems Meeting, Hilo, Hawai'i.

*Mokiao-Lee, A., Wiegner, T.N. & *Johnson, E. 2011. Identifying nitrogen inputs to thermal tide pools on Hawai'i Island, using a multi-stable isotope approach. Coastal and Estuarine Research Federation Conference, Daytona Beach, Florida.

†Spies, N.P. & Takabayashi, M. 2011. Galaxin expression in the endemic Hawaiian coral *Montipora capitata*, afflicted with skeletal growth anomalies. The Wildlife Society National Conference Waikoloa, Hawai`i.

*Strohl, R.D. & deMaintenon, M.J. 2011. Effects of the invasive alga *Gracilaria salicornia* on coastal benthic molluscan species diversity in east Hawai'i. Society of Integrative and Comparative Biology 2011 Annual Meeting, 3–8 January 2011, Salt Lake City, Utah (poster).

*Walker, J.K. & Adolf, J.E. 2011. The influence of submarine groundwater discharge on vertical structure of phytoplankton communities in West Hawaii. NOAA-sponsored Symposium on Kona's Marine Ecosystem. King Kamehameha Hotel.

Wiegner, T.N., Adolf, J., Beets, J., *Johnson, E. & *Walker, J. 2011. Identifying hot spots of biological nitrogen transformations in coastal waters with groundwater inputs. NOAA's Symposium on Kona's (West Hawai'i) Marine Ecosystem: Past, Present, and Future. Kailua, Kona, Hawa'ii.

Wiegner, T.N., Adolf, J., Beets, J., *Most, R., *Johnson, E. & *Walker, J. 2011. Spatial and temporal nutrient patterns in coastal waters of Kaloko-Honokōhau. 1st Annual Big Island Water Resources Meeting, Hilo, Hawai`i.

Wiegner, T.N., Adolf, J., Beets, J., *Most, R., *Johnson, E. & *Walker, J. 2011. Spatial and temporal nutrient patterns in coastal waters of Kaloko-Honokōhau. Hawai'i Ecosystems Meeting, Hilo, Hawai'i.

Wiegner, T.N., †Mead, L. & *Atwood, T. 2011. Estuaries: linking streams to the sea. Hawai`i Association of Watershed Partnerships, Wailuku, Hawai'i.

2010

†Adams, L.M. & Takabayashi, M. 2010. Free-living *Symbiodinium* biogeography at habitat and regional spatial scales. Pacific Congress on Marine Science and Technology conference. Hilo, Hawai'i.

Adolf, J.E. 2010. Coastal phytoplankton dynamics around Hawaii Island. Hilo Seminar Series, hosted by the Institute for Pacific Island Forestry, Hilo, Hawai`i.

Adolf, J.E, Beets, J., Dulaiova, H., Glenn, C., Takabayashi, M., Wiegner, T.N., *Holleman, K., *Johnson, E., *Most, R., *Walker, J. & *Waters, C. 2010. Environmental dynamics and ecosystem responses (ENDER) agenda 3: Marine ecosystem responses to environmental changes. Hawai`i State-wide EPSCoR Meeting, Honolulu, Hawai`i.

Adolf, J.E., *Collins, T.P. & *Walker, J.K. 2010. Comparing nutrient-groundwater-phytoplankton relationships in coastal waters of East and West Hawai'i Island. ASLO – NABS 2010, Santa Fe, NM.

Adolf, J.E., *Collins, T.P. & *Walker, J.K. 2010. Comparing nutrient-groundwater-phytoplankton relationships in coastal waters of East and West Hawai'i Island. PACON conference. UHH, Hilo, Hawai'i.

Adolf, J.E. & Wiegner, T.N. 2010. The Hilo Bay water quality buoy: A new community resource. Presentation to the Big Island Water Garden Club.

Adolf, J.E. & Wiegner, T.N. 2010. The Hilo Bay water quality buoy: A new community resource. Presentation to the UHH / CCECS Lectures series (coordinator Seabe Calhoun).

deMaintenon, M. 2010. Systematics and evolution of Panamic *Anachis* and related taxa (Neogastropoda: Columbellidae). Society of Integrative and Comparative Biology 2010 Annual Meeting, 3–7 January 2010, Seattle, Washington.

Gessner, M.O., MacKenzie, R.A., Wiegner, T.N., Farrington, H. & Vitousek, P.M. 2010. Litter quality effects on decomposition across a nutrient gradient in Hawaiian streams. North American Benthological Society 58th Annual Meeting, Santa Fe, New Mexico.

Francisco, K., *Frazier, M. & Fu K. 2010. Nā wahi pana o Hawai'i. Resource management from a Hawaiian consciousness. Hawai'i Conservation Conference, Honolulu, Hawai'i.

*Holitzki, T., MacKenzie, R.A., McDermid, K. & Wiegner, T.N. 2010. Environmental impacts of invasive poeciliid fish on Hawaiian streams. Hawai`i Conservation Conference, Honolulu, Hawai`i.

*Holitzki, T., MacKenzie, R.A., McDermid, K. & Wiegner, T.N. 2010. Environmental impacts of invasive poeciliid fish on Hawaiian streams. Hawai`i Ecosystem Meeting, Hilo, Hawai`i.

*Holitzki, T., MacKenzie, R.A., McDermid, K. & Wiegner, T.N. 2010. Environmental impacts of invasive poeciliid fish on Hawaiian streams. North American Benthological Society 58th Annual Meeting, Santa Fe, New Mexico.

*Johnson, E. & Wiegner, T.N. 2010. Potential surface water metabolism in groundwater-fed coastal waters of West Hawai`i. Hawai`i Ecosystem Meeting, Hilo, Hawai'i.

Ka'uhane, 'I, *Rozet, N.K. 2010. Manini a ka 'oia'i'o o ke 'ano lani: Trusting our celestial environment. Hawai'i Conservation Conference, Honolulu, Hawai'i.

†Mead, L. & Wiegner, T.N. 2010. University of Hawai'i Analytical Laboratory. Hawai'i State-wide EPSCoR Meeting, Honolulu, Hawai`i.

*Mokiao-Lee, A., *Johnson, E. & Wiegner, T.N. 2010. Tracing sewage inputs into the Wai`Opae Tide Pools, Kapoho, Hawai'i, using stable isotopes. 2nd Annual TCBES Symposium, Hilo, Hawai`i.

*Mokiao-Lee, A., *Johnson, E. & Wiegner, T.N. 2010. Tracing sewage inputs into the Wai`Opae Tide Pools, Kapoho, Hawai'i, using stable isotopes. Hawai'i Conservation Conference, Honolulu, Hawai`i.

*Mokiao-Lee, A., *Johnson, E. & Wiegner, T.N. 2010. Tracing sewage inputs into the Wai`Opae Tide Pools, Kapoho, Hawai'i, using stable isotopes. Hawai`i Ecosystem Meeting, Hilo, Hawai`i.

*Mokiao-Lee, A., *Johnson, E. & Wiegner, T.N. 2010. Tracing sewage inputs into the Wai`Opae Tide Pools, Kapoho, Hawai'i, using stable isotopes. Pacific Congress on Marine Science and Technology, Hilo, Hawai`i.

Patterson, M., Puniwai, N. & *Sagum, N.K. 2010. Pua ka wiliwili, nanhu ka manō: When the wiliwili tree blossoms, the sharks will bite. Hawai'i Conservation Conference, Honolulu, Hawai'i.

*Rozet, N.K., †Burns, J., *Gregg, T.M. & Takabayashi, M. 2010. Coral disease: skeletal growth anomalies (SGA) afflicting *Montipora capitata* at Wai'ōpae, Hawai'i Island and the concerns for Kanaka (Hawaiian people).

†Spies, N., *Aiona, K. & Maioho, I.N. 2010. E waele a e ho'okīpulu: to weed and to fertilize. Combining traditional methods with nutrient analysis to apply to modern agricultural practices. Hawai'i Conservation Conference, Honolulu, Hawai'i.

Takabayashi, M. 2010. Gene expression patterns in coral diseases. American Genetics Association. Hawai'i.

Takabayashi, M. 2010. Forum moderator: Hawaiian Science in 2010: Lessons from the Ku'ula class at UH-Hilo Hawai'i Conservation Conference, Honolulu, Hawai'i July 2010.

Takabayashi, M., Nu'uhiwa, K., Francisco, K. & *Gregg, M. 2010. Forum: Moving forward with indigenous science at university: An example from Hawai'i. International Conference on Science in Society. Madrid, Spain. November 2010.

Wiegner, T.N., Beets, J., Adolf, J., Takabayashi, M., Glenn, C., Dulaiova, H. & MacKenzie, R. 2010. Groundwater in West Hawai`i: How is it changing near shore water quality and productivity? Hawai`i Ecosystem Meeting, Hilo, Hawai`i.

Wiegner, T.N., Kaplan, L.A., Ziegler, S.E. & Findlay, R.H. 2010. Fate of terrestrial dissolved organic carbon within a stream biofilm community: a stable isotope approach. American Geophysical Union Fall Meeting, San Francisco, California.

Wiegner, T.N. & †Mead, L.H. 2010. Storm effects on water quality and productivity of a tropical Hawaiian Estuary. American Society of Limnology and Oceanography, Santa Fe, New Mexico.

2009

†Adams, L.M. & Takabayashi, M. 2009. Genetic diversity of free-living *Symbiodinium*. Hawai'i Conservation Conference, Honolulu, Hawai'i July 2009.

Adolf, J.E. 2009. Phytoplankton ecology of Hilo Bay. Hawai'i Ecosystems Conference, UHH, Hilo, Hawai`i.

Adolf, J.E. & Wiegner, T. 2009. Phytoplankton ecology of Hilo Bay: Real-time continuous monitoring and high resolution spatial mapping. Statewide EPSCoR Conference, Jan 9–10, 2009, Waikiki, Hawai`i (poster).

*Atwood, T., Wiegner, T.N. & MacKenzie, R. 2009. Effects of hydrological forcing on the structure of a tropical estuarine food web. 1st Annual TCBES Symposium, UHH, Hilo, Hawai`i.

*Atwood, T.B., Wiegner, T.N., Turner J.P. & MacKenzie, R.A. 2009. Importance of terrestrially-derived organic matter to a tropical estuarine food web. ASLO, Nice, France.

*Bambico, T., Turner J.P. & McDermid, K. 2009. Foraging Ecology of the Hawaiian Green Sea Turtle (*Chelonia mydas*) at Punalu'u, Hawai'i. Annual Meeting, Portland, Oregon.

*Barnett, C., Bertelmann, P. & *Morishige, K. 2009. Ko kua uka, ko kua kai: Hā'ukeuke a me hala. Hawai'i Conservation Conference, Honolulu, Hawai'i.

*Collins, T. 2009. Limu of Hawai'i: presence and absence between Big Island and Pihemanu. Hawai'i Conservation Conference, Honolulu, Hawai'i.

deMaintenon, M. 2009. Body size within species groups; do snail taxa have a specific size? Society of Integrative and Comparative Biology 2009 Annual Meeting, 3–7 January 2009, Boston, Massachusetts.

*Goo, N. 2009. The natives are restless. Hawai'i Conservation Conference, Honolulu, Hawai'i.

*Gregg, T.M., Farah, E., †Burns, J. & Takabayashi, M. 2009. Coral skeletal growth anomalies in Wai'opae tide pools, Hawai'i Island. American Society of Limnology and Oceanography, Paris, France.

*Gregg, T.M. & †Mead, L. 2009. Hinahele: Coral reef zonations along an age gradient, Hawai'i to Pihemanu. Hawai'i Conservation Conference, Honolulu, Hawai'i.

*Manuel, M.K. & Tom, S.K. 2009. Nā 'opihi o Hawai'i nei. Hawai'i Conservation Conference, Honolulu, Hawai'i.

Molloy, S.L., *Seiber, K.L. †Mead, L. & Wiegner, T. 2009. Sources of pollution in Hilo Bay, Hawai'i, under baseline and storm conditions. USEPA National Beach Conference, Huntington Beach, California.

*Olson, N.D., Falcon, L, Takabayashi, M. & Lesser, M.P. 2009. NifH diversity for nitrogen-fixing bacteria associated with Caribbean and Hawaiian corals. International workshop on responses of coral holobionts under the impact of climate change, Taipei, Taiwan.

Takabayashi, M. 2009. How can a non-Hawaiian build a culture-based curriculum at University of Hawaii? Quality of Education for Minorities Network Workshop on Culture and Curriculum. Albuquerque, New Mexico.

Takabayashi, M. & *Wilhelm, A. 2009. Symposium: Integration of Native Hawaiian and Western Sciences to Understand the Environment of Hawai'i: Lessons from the Kū'ula Class at UH Hilo. Hawai'i Conservation Conference, Honolulu, Hawai'i

Takabayashi, M., Turner, J.P. & Wiegner, T.N. 2009. Coral diseases in Hawai`i: Correlation with water quality and effects on corallivore trophic dynamics. NSF CRESTTHBCU-RISE Jam, Washington, D.C.

Turner J.P. 2009. Development of the Hawaii Cetacean Rehabilitation Facility and Island Response Teams. 4th Annual Pacific Islands Region. Marine Mammal Response Network Meeting, Maui, Hawai`i.

Turner J.P. 2009 Feeding ecology of *Eleotris sandwicensis* and *Xenoconger fryeri* found in Hawaiian anchialine ponds; a possible paradox. American Society of Ichthyologists and Herpetologists Annual Meeting, Portland, Oregon.

Turner J.P. 2009. Island Reports: Monk Seals and cetacean strandings on Hawaii Island (East). 4th Annual Pacific Islands Region. Marine Mammal Response Network Meeting, Maui, Hawai`i.

Wiegner, T.N. 2009. Storm effects on water quality and productivity of a tropical Hawaiian estuary. UHH TCBES Seminar, Hilo, Hawai`i.

Wiegner, T.N. & Adolf, J. 2009. Past, present, and future water quality research in Hilo Bay. Mokūpapapa Center, Hilo, Hawai`i for the Hilo Bay Watershed Advisory Group.

Wiegner, T.N. & †Mead, L.H. 2009. Effects of storms effects on water quality of a Hawaiian estuary. Hawai`i Ecosystem Meeting, Hilo, Hawai`i.

Wiegner, T.N. & †Mead L.H. 2009. Storm effects on water quality and productivity of a tropical Hawaiian estuary. Coastal and Estuarine Research Federation, Portland, Oregon.

2008

†Adams, L.M. & Takabayashi, M. 2008. Asymbiotic coral larvae preferentially acquire free-living *Symbiodinium* from the sediment rather than from the water column. 11th International Coral Reef Symposium, Fort Lauderdale, Florida.

Adolf, J.E. 2008. Phytoplankton ecology of Hilo Bay. TCBES Graduate Program, October 29, 2008, UHH, Hilo, Hawai`i.

*Atwood, T., Wiegner, T.N. MacKenzie, R.A. & Turner J.P. 2008. Effects of an invasive N-fixing tree (*Falcataria moluccana*) on a Hawaiian stream food web. IsoEcol 2008: 6th International Conference on Application of Stable Isotope Techniques to Ecological Studies. Honolulu, Hawai`i.

*Atwood, T., Wiegner, T.N., MacKenzie, R.A. & Turner J.P. 2008. Effects of an invasive N-fixing tree (*Falcataria moluccana*) on a Hawaiian stream food web. North American Benthological Society 56th Annual Meeting, Salt Lake City, Utah.

*Bambico, T. & *Soares, T. 2009. Connecting the land to the sea: He'e and 'Ulu. Hawai'i Conservation Conference, Honolulu, Hawai'i.

deMaintenon, M.J. 2008. Systematics of *Anachis* and related taxa (Neogastropoda: Columbellidae) in the American tropics. Annual Meeting of the American Malacological Society, 29 June–3 July 2008, Carbondale, Illinois.

deMaintenon, M.J. 2008. Systematics and evolution of *Anachis* and related taxa (Neogastropoda: Columbellidae) in the American tropics. Society of Integrative and Comparative Biology 2008 Annual Meeting, 2–6 January 2008, San Antonio, Texas.

Inglis, K. Takabayashi, M., Ramos, C.M. & Makekau-Whittaker, K. 2008. The Uluākea Process: Applying a Hawai`i-based perspective to university education. Kamehameha Schools Research Conference on Native Hawaiian Well-Being. Oahu, Hawai`i.

†Jessop, H., Lessios, H.A., deMaintenon, M.J. & Takabayashi, M. 2008. Sibling sea urchins of the genus *Echinothrix* in Hawai'i. Society of Integrative and Comparative Biology 2008 Annual Meeting, 2–6 January 2008, San Antonio, Texas.

†Jessop, H., Lessios, H.A., deMaintenon, M.J. & Takabayashi, M. 2008. Sibling sea urchins of the genus *Echinothrix* in Hawai'i: unification of morphological characters and genetic clades. Fifth North American Echinoderm Conference, 20–25 July 2008, Melbourne, Florida.

†Jessop, H., Takabayashi, M., *Barnett, C., *Olson, N. & deMaintenon, M. 2008. Sea urchin herbivory in Hawaiian shallow water ecosystems: *Echinothrix* as allies with *Tripneustes*. 11th International Coral Reef Symposium, 7–11 July 2008, Fort Lauderdale, Florida.

†Jessop, H., Takabayashi, M., deMaintenon, M.J., *Barnett, C. & *Olson, N. 2008. Sea urchin herbivory in Hawaiian shallow water ecosystems: *Echinothrix* as allies with *Tripneustes.* Society of Integrative and Comparative Biology 2008 Annual Meeting, 2–6 January 2008, San Antonio, Texas.

*Olson, N.D., Ainsworth, T.D., Gates, R.D. & Takabayashi, M. 2008. Ecology of nitrogen fixing bacteria associated with the coral *Montipora capitata*. 108th Annual Meeting of American Society of Microbiology, Boston, MA.

*Olson, N.D., Ainsworth, T. & Takabayashi, M. 2008. The coral host as a habitat divided. Abstracts of 11th International Coral Reef Symposium, Fort Lauderdale, Florida.

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Appendix F

Appendix C: Quantitative Data
University of Hawai'i at Hilo
B.A. and B.S. in Marine Science

	Yr 1 2009-10	Yr 2 2010-11	Yr 3 2011-12	Yr 4 2012-13	Yr 5 2013-14	Yr 6 2014-15
1. Student Count Information (by Fall Semesters)						
a. Number of Majors [1]	19	170	200	188	219	218
b. Number of Minors [2]	12	11	6	12	11	10
c. Number of Graduate Students	N/A	N/A	N/A	N/A	N/A	N/A
2. Annual Course Information (by Fall Semesters)						
a. Student Semester Hours (SSH) Generated	1,662	1,716	1,703	1,730	1,775	1,613
b. Full Time Equivalent (FTE) [3]	111	114	114	115	118	108
c. Percent of FTE of own Majors	64.3%	61.7%	62.0%	55.4%	62.9%	66.1%
d. Percent of FTE of Majors within College	26.4%	27.7%	28.8%	33.5%	24.1%	25.7%
e. Percent of FTE All Others	9.3%	10.6%	9.2%	11.2%	13.0%	8.2%
f. Percent of FTE of Writing Intensive (WI) Courses	5.8%	4.2%	4.9%	4.3%	4.9%	4.5%
g. Percent of FTE General Education (GE) Courses [4]	65.3%	68.2%	64.5%	71.8%	72.4%	67.5%
3. Course Delivery (by Fall Semesters)						
a. Average class size - Brick and Mortar [5 6]	20	21	23	21	20	19
b. Average class size - Distance Learning [5 7]	24	16	40	24	21	29
c. Number of FTE Tenure/Tenure-Track Faculty [8 10]	3.08	3.58	3.50	2.83	4.08	4.42
d. Number of FTE Adjunct Faculty [9 10]	3.08	2.92	2.08	3.25	2.67	2.25
e. Number of FTE Other Faculty [10 17]	0.25	0.25	0.00	0.00	0.17	0.00
f. % SH Taught by Tenure/Tenure-Track Faculty	48.1%	53.1%	62.7%	45.3%	59.0%	66.3%
g. % SH Taught by Adjunct Faculty	48.1%	43.2%	37.3%	52.0%	38.6%	33.8%
h. % SH Taught by Other Faculty	3.9%	3.7%	0.0%	2.7%	2.4%	0.0%
i. FTE student-faculty ratio [11]	17	17	20	18	17	16
4. Graduation and Placement (by Fiscal Year)						
a. Number of graduates/degrees earned [12]	31	29	25	33	25	Data Not Available
b. Percent of Majors Graduating [13]	163.2%	17.1%	12.5%	17.6%	11.4%	
c. Number of Native Hawaiian graduates	6	4	3	6	6	
d. Number of Certificates awarded: Marine Option Program	0	6	4	12	8	
5. Cost of Delivery (by Fiscal Year)						
a. Budgetary Allocations [14]	$876,400	$790,356	$664,570	$818,603	$950,297	Data Not Available
b. Cost per SSH [15]	$266.14	$252.35	$200.17	$246.20	$276.01	

Notes:

1/ Number of Majors = Number of 1st Declared Majors of the selected program. These figures do not count 2nd, 3rd, or 4th declared major.
2/ Number of Minors = Number of 1st Declared Minors of the selected program. These figures do not count 2nd, 3rd, or 4th declared minor.
3/ Undergraduate FTE Calculation = SSH/15. Graduate FTE Calculation = SSH/12.
4/ GE Course Listing from C.Travis "approved gen ed and courses approved to meet integrative requirements nov 2013"
5/ Excludes classes numbered -99 (individual instruction)
6/ Average Class Size Calculation = Number of Registrations/Number of Classes
7/ Average Class Size Calculation = Number of Registrations/Number of Classes
8/ HR Datamart defines Tenure/Tenure-Track Faculty as Instructor Grades: I3's, I4's, I5's and/or otherwise specified.
9/ Adjunct Faculty defined as Instructor Grades: I2's, LecA, LecB, and LecC and/or otherwise specified.
10/ Faculty FTE Calculation = SH Taught/12
11/ FTE Student-Faculty Ratio Calculation = Full Time Equivalent (FTE) / Total FTE Tenure/Tenure-Track Faculty & Adjunct Faculty
12/ Number of graduates/degrees earned *includes* dual degrees
13/ Percent of Majors Graduating Calculation = Number of graduates or degrees earned/Number of Majors
14/ Budgetary Allocation provided by E.Kho on 2014-10-30. Budget Allocations is not available by Program Level for the College of Arts and Sciences. Presented here is an *approximation* of the salaries paid for the Fiscal Year. This total includes faculty members with paid leave. This total does not include fringe benefits paid
15/ Cost per SSH Calculation = Budgetary Allocation/SSH Generated

Sources: C. Travis "approved gen ed and courses approved to meet integrative requirements nov 2013; HR Datamart: "Faculty-Lecturer Listing 2005-2013"; IRO_BASE (Census); IRO_DEGREE (EOS); IRO_REGS (Census); IRO_SOCAD (Census); IRO_SOCALL (Census)

Appendix G – Quantitative Reasoning Assessment Instrument (Spr 2015)

Please indicate your class standing by placing a check in the appropriate box.

☐ Freshman

☐ Sophomore

☐ Junior

☐ Senior

On the accompanying page are two graphs that depict respectively the historic price of silver per ounce and the historic price of gold per gram from the year 2000 to 2014. The tick marks and labels at the bottom of each graph depict the first day of each year.

Circle each statement below that is a reasonable conclusion that can be made based on these two graphs. You can either clearly circle the appropriate statement numbers, or the entire statement.

1. The amount of gold that could be purchased with $1000 at the beginning of 2008 is approximately the same as the amount of gold that could be purchased with $1000 at the beginning of 2009.

2. Gary bought $1000 in gold at the beginning of year 2002 and Sylvia bought $1000 in silver at the same time. They both sold their investments at the beginning of year 2007. Sylvia received more money than Gary at the time of the sale.

3. Thomas bought $1000 worth of gold at the beginning of 2002 and sold it at the beginning of 2008. Patricia bought $1000 worth of gold at the beginning of 2010 and sold it at the beginning of 2012. Patricia received more money at the time of her sale than Thomas received at the time of his sale.

Historic price of Silver per ounce in the US

Historic price of Gold per gram in the US

This assessment is intended to assess the Visual Representation aspect of quantitative reasoning (i.e. column three in the institutional QR rubric). The following table equates raw scores to the QR rubric.

Raw Score	QR Rubric
3	Advanced
2	Competent
1	Emerging
0	Beginning