6 Department of Oceanography

6.1 Overview

**Brief History**

The Department of Oceanography was established in 1964 in the College of Arts and Sciences, although the Graduate Field of Study in Oceanography had already been established in 1962. Most of the faculty had joint appointments with a research institute, most notably the Hawaii Institute of Geophysics (later renamed the Hawaii Institute of Geophysics and Planetology) and the Hawaii Institute of Marine Biology. After the establishment of the School of Ocean and Earth Science and Technology (SOEST) in 1988, the Department became part of SOEST and most of the Department's faculty were assigned to positions solely within the Department.

The Department of Oceanography conducts research and educational activities covering marine, coastal, estuarine, and global environmental science. As such, the Department plays an essential part in fulfilling the SOEST mission to provide “an integrated, comprehensive, and sustained system of Earth observation, research, and education”.

Currently the Department has 71 graduate faculty, 39 of whom have regular full or associate status. The collective research expertise and programs of these faculty provide a broad diversity of knowledge and research opportunities for students. As well as the graduate program, the Department also administers the Global Environmental Science (GES) program, which offers a Bachelor of Science degree. GES was established in 1998. Since its inception it has grown to become the largest undergraduate program of SOEST. It currently has 63 majors.

Scientists within the Department study the processes that shape and control the modern, past, and future ocean, with an emphasis on interdisciplinary investigations. Research in the Department covers almost all areas of Oceanography. The department emphasizes basic research, but many research projects are relevant to applied problems and societal concerns such as the monitoring of local waters, the fate of “greenhouse” gases, climate prediction, ecological impacts of ozone depletion and coastal urbanization, mechanisms of pollutant
transport and cycling, and fisheries recruitment. The interdisciplinary nature of these and other problems fosters strong collaborative interactions among biologists, geochemists and physicists in the Department and School, across the university, and at other institutions.

1. What is the mission of the department? How do the mission and objectives align with the School/College, UH Mānoa, and UH System strategic plans?

The Department does not have a formal mission statement. In an internal document dated 2006, the vision of the Department is stated to be:

*Maintain and enhance the position of Hawaii as the home of world-class research and education in oceanography and as the premier platform for oceanographic operations.*

The mission is stated to be:

*UH Oceanography conducts innovative research and education programs that enhance our understanding of the ocean and address 21st century challenges and opportunities for Hawaii and the blue planet.*

As stated above, these are very much in line with the mission of SOEST. They also align with the mission of UH Mānoa:

“As a land, sea, and space grant university, the University of Hawai`i at Mānoa is dedicated not only to academic and research excellence but also to serving with aloha the local, national and international communities around us … Central to this mission is faculty dedication to a fertile, engaged, and ethical learning environment characterized by a free exchange of ideas, shared intellectual resources, cutting edge scholarship, and high academic expectations. With its unique geographic location bridging East and West, Mānoa serves as a portal to an exceptional educational experience while striving to improve quality of life in the region through collaborative partnerships that support innovations in education, health care, social development, culture and arts, earth, space, and ocean sciences, sustainable agriculture and land management, and technological advancement. (The University of Hawai`i Mānoa at 2011-2015 Strategic Plan)

2. What is the vision for the next five years? Discuss how planned or pending academic program actions fit within the vision.

Our vision for our academic programs over the next five years is to continue to provide excellence in teaching embedded in a strong and active research environment. This will be accomplished by continual updating of courses and course material. Under
consideration at the moment is a restructuring of our graduate core courses that will present a more synergistic approach while maintaining the rigor of the fundamental science. Continued excellence will also be achieved by new faculty hires that enhance and extend the Department’s research activities. The new hires, particularly those under the Coastal Sustainability Initiative, will enhance links between other enterprises at UHM and the local community (e.g., human health and ocean engineering) and expose students to a broader set of scientific questions and research.

Oceanography faculty will contribute to the new Marine Biology graduate program initiated in Fall 2012. This cross-campus degree program is administered jointly by SOEST and the College of Natural Sciences, and replaces the Marine Biology Specialization option of the Oceanography degree program. Consideration will also be put to new degree programs that build on the strengths of SOEST and have societal relevance. One such possibility is a graduate degree program in climate science.

3. In what ways does the department foster a climate of respect for diversity of backgrounds, ideas, and perspectives among the faculty, staff and students? How are academic program decisions made? Is communication regarding campus and college priorities adequate?

Respect for individuals and for a diversity of ideas and perspectives are encouraged both in the classroom and in informal interactions between students and faculty. Small class sizes promote in-class discussions. The students of both the graduate program and GES are ca. 65% female, which is relatively high for a physical science department.

Diversity of ideas also comes from the make-up of the faculty. At the time of the review in 2001 there was only one female tenured/tenure-track faculty. By August 2012 there will be 5. One of the in-coming faculty is also part native Hawaiian.

Academic program decisions are made by formal votes or consensus based on thorough discussion of recommendations by standing and ad hoc committees. Students are part of the decision-making. Student representatives sit on a number of Department committees, including Curriculum, Teaching Evaluation and Graduate recruitment, as well as search committees for new faculty.

4. What is the national/international reputation and/or ranking of the department? What are your areas of program distinction? Please include any program rankings, and the source of ranking (e.g.,
National Research Council). Is the department satisfied with the level of the ranking?

Establishing the ranking of our degree programs is difficult. There is no equivalent of our GES program. The US News ranking of graduate courses does not have a category for “environmental science” degrees. The National Research Council only quotes the range of rankings, a metric which is dominated by the tails of the distribution. The mode of the distribution of the NRC “survey-based quality ranking” for the Department of Oceanography at UHM puts it as 20\textsuperscript{th} out of 50 for “Oceanography, Atmospheric Sciences and Meteorology” programs. In a 2007 report published in the Chronicle of Higher Education, UHM Oceanography was fourth in a ranking of graduate programs in Marine Biology and Biological Oceanography, and sixth in Physical Oceanography.

5. Please identify peer programs at other U.S. institutions. How does the general quality of your programs compare with those of other institutions? What data support these comparisons?

The figure on the preceding page and the table below compare various statistics of Oceanography PhD programs at Florida State University (FSU), Oregon State University (OSU) and the University of Washington (source NRC).

<table>
<thead>
<tr>
<th></th>
<th># Faculty</th>
<th># Students</th>
<th>GRE(Q)</th>
<th>Time to degree</th>
<th>% faculty with grants</th>
<th>Research ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>UHM</td>
<td>36</td>
<td>74</td>
<td>720</td>
<td>6.5</td>
<td>100</td>
<td>5-34</td>
</tr>
<tr>
<td>FSU</td>
<td>20</td>
<td>47</td>
<td>692</td>
<td>5.0</td>
<td>94</td>
<td>11-43</td>
</tr>
<tr>
<td>OSU</td>
<td>88</td>
<td>51</td>
<td>683</td>
<td>5.5</td>
<td>100</td>
<td>5-34</td>
</tr>
<tr>
<td>UW</td>
<td>77</td>
<td>68</td>
<td>735</td>
<td>7.0</td>
<td>90</td>
<td>8-38</td>
</tr>
</tbody>
</table>

6.2 Research and Faculty

1. Outline research productivity

The Oceanography faculty are highly productive. Over the period FY 2008 to 2012, Oceanography faculty members garnered more than $60M in extramural funding in the form of over 300 new grants. In the 5 years 2007-2011 they published 190 first-authored papers in peer reviewed journals. In addition they were co-author on 420 papers (includes some duplicates). The average publication rate of faculty per year in peer-reviewed journals is 4.
average number of citations in the 5-year period is around 1200.

2. Describe efforts to generate research including grants, fellowships, awards, contracts

The Oceanography funding profile since 2001 is shown in the above figure. Extramural funding is approximately two thirds of the total income of the Department.

Up until 2010 there was a steady increase in extramural income. The peak in 2010 is in large part because of the renewal of the Hawaii Ocean Time-series (HOT) program ($6M). In 2012 the income was reduced to the level of the early 2000’s. The precise reason is unclear. It is noted, however, with the recruitment of highly research active new faculty in 2013 and 2014 the expectation is research income will rise again.

3. What is average research workload? What is average instructional and advising/mentoring workload of faculty?

SOEST faculty are expected to spend approximately 40% of their time on teaching duties, 40% on research and 20% on service. Most Oceanography instructional faculty are expected to teach the equivalent of a minimum of 1 course every year. For recent appointments this has increased to 1.5 courses per year. The average teaching load over the last 4 years is 1.3 courses per year. All faculty advise/mentor graduate students. The time devoted to mentorship spent depends on the number of students, but it is noted that students are encouraged, and do, seek additional advice from faculty who are not necessarily on their committee. Approximately three-quarters of faculty mentor UG students.

4. To what extent are scholarship/research/creative activity linked to improvement of teaching and learning?

Research is very much integrated with the teaching program. Many of the UG and graduate courses focus on recent trends in the field. A good example is OCN 310 (Global Environmental Change) which engages students in current issues through discussion groups. A major component of the GES curriculum is a year-long senior research project that includes a written thesis and a public oral symposium presentation. As another example numerous undergraduate and graduate students utilize HOT program cruises to gain sea-going research experience and fulfill degree requirements for field work, and at UH alone 15 students have based their Ph.D. and M.S. thesis research on HOT program science. In addition, with support from the National Science Foundation and private foundation funding, the Center for Microbial Oceanography: Research and Education (C-MORE) leads a graduate-level training course called “Genomes to Biomes”. This course has helped make UH the “place to go” for training in
Microbial Oceanography. The 6 week summer course hosts 16 international students at UH and emphasizes experiential learning, immersing the students in laboratory and field work, notably including a 10 day research cruise aboard the R/V Kilo Moana.

5. How effectively can department/institute balance expectations of research with teaching/mentoring?

On the whole Oceanography faculty are able to strike the right balance between teaching and research to be successful at both.

6. To what extent are adjunct faculty used in teaching? How are they engaged in assessment?

The Department has no Adjunct faculty. Guest speakers are invited to give presentations to a number of classes. A limited number of non-instructional faculty contribute to teaching to provide additional expertise and to help cover times when faculty are on research cruises or sabbatical.

7. Discuss recruitment and retention efforts. How connected to changing needs?

Since the program review in 2001, Oceanography has made 15 new tenure track faculty appointments. A similar number have been lost through retirement, resignation or move to another SOEST unit. One of the new appointments (Johnson) has subsequently moved to Duke University. Another who transferred in from another SOEST unit failed to get tenure.

Many of the new appointments reflect the evolving development and trends of the Department and were part of Department, SOEST and University initiatives. McManus and Zeebe were appointed to support the blossoming GES program. Richards, Schneider and Timmermann are part of the IPRC and whose positions (at present) are part funded by JAMSTEC, Japan. Carter and Powell are part of an initiative to set up a regional ocean observing system. Lastly, the appointment of Church was made possible in part through Karl becoming the director of C-MORE.

Forthcoming tenure track faculty appointments: January 2013, Anna Neuheimer (ecosystem modeler); August 2013, Rosie Alegado and Craig Nelson as part of the cluster hire for the UHM Coastal Sustainability initiative. We have an open search for a Plankton Ecologist.

In addition Ed DeLong (at present Morton and Clair Goulder Professor at MIT and member of the National Academy of Sciences) will join the Department in August 2014. DeLong’s appointment is part of an initiative of the UH President to hire fifty new World-class faculty who are leaders in their field. It is testament to the regard given to the Department both nationally and internationally that we are able to attract the first of these.

Discussion is needed as to how to respond to the most recent retirements of Huebert, Clarke and Lukas in terms of the impact on the functioning of the Department, the need to replace these faculty programmatically, and the opportunities available if/when new positions are created.

8. List faculty awards and recognitions last 5 years
Awards include:

- B. Glazer  Hanse-Wissenschaftskolleg Fellowship, 2012-2013
- D. Karl  Elected summer research fellow, Harris Manchester College, Oxford University, 2009
  Co-recipient/co-author Cozzarelli Prize for best PNAS paper of 2009 for physical sciences or Mathematics
  Honorary Doctor of Science degree, University of Chicago, 2008
- R. Lukas  Appointed to a 2nd three-year term on the NAS Climate Research Committee – appointments (normally limited to a single term)
  Appointed to the State of Hawaii Climate Change Task Force, 2009
- B. Powell  ONR Young Investigator Award, 2009
- A. Timmermann  Rosenstiel Award for Rosenstiel School for Marine and Atmospheric Science, Miami, 2007

9. Attach brief cv for each faculty
Two-page cvs of each faculty are included in Appendix 6.1.

6.3  Academic Programs

6.3.1  Curricula

1. What actions were taken in response to previous program review recommendations? What has transpired in the unit since submission of your one-year progress report following the previous program review?

The previous program review was conducted in 2001, 3 years after the GES program was launched. Consistent with the recommendations of that review, the GES program was made a permanent program. The Department received additional funding and 2 new faculty positions from the University, and established the position of Chair of Undergraduate Studies. Also consistent with the previous review recommendations, excellence in teaching is now acknowledged by an award. Recommendations to the Chair are made by the Teaching and Evaluation Committee. The Department has recently also introduced a (monetary) award for the best TA.

The review also recommended establishing a separate Chair of Graduate Studies. No move has been made in this direction. Traditionally the Department Chair has taken on this responsibility. The present Chair sees merit in separating the responsibilities and there will be discussion before the end of the present Chair’s term, July 2013.
2. How are disciplines changing, and what research/data support these changes?

The fields of Oceanography, Environmental Science and Environmental Change are evolving rapidly through, among other things, new measurement developments, international monitoring programs and increased computational capabilities. As examples: the ARGO program currently has an array of 3,600 free-drifting profiling floats that measure temperature and salinity of the upper 2000m of the global ocean, continuing satellite measurements allow the assessment of changes of the surface properties of the ocean on the decadal timescale, high resolution models of the physics, biology and geochemistry can be run on the regional to global scale, and developments in molecular techniques have created an explosion in the probing and understanding of the ocean at the microbial scale. Improvements in technologies to observe the ocean, specifically through autonomous and remote sensing platforms and sensors, have revolutionized oceanography over the past decade. The Department has been proactive about leading research programs to capitalize on these changes. For example, scientists in the Department are collaborating with others in SOEST in the implementation of the ALOHA Cabled Observatory program. This seabed cabled observatory provides power and bandwidth to the remote, open ocean field site of the HOT program. The resulting high frequency data are requiring development of new tools for handling and analyzing large data sets.

3. To what extent are scholarship, research and creative activity linked to the curricula?

The GES curriculum is strongly tied to the research being conducted in SOEST. In OCN 100 (Seminar in Global Environmental Science), SOEST faculty give presentations on current research and opportunities for involvement. All students conduct a year-long senior thesis research project (OCN 499), and OCN 490 (Oral Communication of Research Results) helps students develop skills for presentation of thesis research.

4. In what ways have courses and programs been modified to reflect new knowledge and/or changes in the needs of society?

Substantial efforts are made each year to incorporate new reports, results, and data sets in program curricula, especially in OCN 310 and 310L (Global Environmental Change and Laboratory), OCN 320 (Aquatic Pollution), OCN 363 (Interpretation of Earth System Computer Databases), and OCN 401 (Biogeochemical Systems).

As well as the continual updating of graduate courses, new courses have been introduced that reflect both changes in the field of Oceanography and skills and interests of incoming faculty.
These include: OCN 680 Dynamics of Marine Ecosystems, OCN 681 Introduction to Bio-physical Ocean Modeling. The “Topics” courses allow the introduction of courses on recent developments in various formats. These include: Marine Viral Ecology, Paleo-Climate Dynamics and most recently Molecular Methods in Microbial Oceanography and Professional Development Training.

5. In what ways have resources been shifted to respond to these changes?

There have been no major shifts in resource allocation associated with curriculum development. UG and graduate teaching labs, and computer facilities are updated as resources allow.

Assessment

6. What are the learning outcomes for each certificate, undergraduate and graduate program? How has the department ensured that its degree and certificate programs remain rigorous and aligned with educational objectives?

GES Student Learning Outcomes: Students completing the Global Environmental Science degree program will be able to

1. Define the basic principles and concepts of chemistry, physics, biology, calculus, geology, geophysics, meteorology, and oceanography.
2. Apply their understanding of the fundamentals of science and mathematics to description and quantification of the interactions of the atmosphere, hydrosphere, lithosphere, and biosphere, including humans.
3. Employ the scientific approach to problem solving and hypothesis formation and testing.
4. Conduct scientific research and evaluate and synthesize their results.
5. Demonstrate information literacy by collection and evaluation of scientific literature.
6. Express themselves clearly and concisely in written form.
7. Demonstrate skilled delivery of well-organized informal and formal oral presentations.
Graduate program Student Learning Outcomes:

Upon completion of the **Masters** program in Oceanography, students will be able to:

<table>
<thead>
<tr>
<th>Student Learning Outcome</th>
<th>Evaluation Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Define, explain and summarize the basic principles of Oceanography, including the basic tenets of the sub-disciplines, and to explain complex phenomena in their own subdiscipline</td>
<td>• Performance in core courses and in courses specific to each student’s subdiscipline</td>
</tr>
<tr>
<td>• Evaluate the hypotheses, methods, results and conclusions of published scientific literature and apply conclusions to their own work</td>
<td>• Synthesis of a written thesis prospectus which utilizes the peer reviewed literature to place their work into the context of the field</td>
</tr>
<tr>
<td>• Present and defend their scientific findings in front of public audiences</td>
<td>• Performance and response to audience questions during public presentations (e.g., second-year talks, conference venues, etc.) and the thesis defense</td>
</tr>
<tr>
<td>• Write a scientific thesis which contributes to the field</td>
<td>• The quality of critical data analysis, interpretation, and presentation in the student’s written thesis</td>
</tr>
</tbody>
</table>

Upon completion of the **Doctoral** program in Oceanography, students will be able to:

<table>
<thead>
<tr>
<th>Student Learning Outcome</th>
<th>Evaluation Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Perform all of the above</td>
<td>• As above</td>
</tr>
<tr>
<td>• Comprehensively synthesize, evaluate, and interpret the fundamental knowledge in their subdiscipline and how it relates to the other subdisciplines</td>
<td>• Performance on the Ph.D. Qualifying Exam and the Comprehensive Exam</td>
</tr>
<tr>
<td>• Independently construct scientific hypotheses and design and carry out research to evaluate them</td>
<td>• Synthesis of a written dissertation proposal which delineates the student’s hypotheses and a research plan to critically test and evaluate them; ability to explain and discuss the proposal to the student’s committee in the context of the subdiscipline during the Comprehensive exam</td>
</tr>
<tr>
<td>• Critically analyze and synthesize the results of their research to derive conclusions which advance the field and are of a quality suitable for publication in the peer-reviewed literature</td>
<td>• Examination of the student’s written dissertation by their committee</td>
</tr>
</tbody>
</table>
7. What indicators and sources of evidence do you use to assess whether students develop core learning abilities and competencies before they graduate? (Please summarize assessment findings.) How have these findings led to modifications in your curricula?

Assessment tools are being used to evaluate student achievement of learning objectives in several aspects of the GES program:

1. A test is given at the beginning of OCN 310 every year to evaluate students’ backgrounds in basic mathematics and chemistry (SLO #1 and 2). Several homework assignments and a handout were developed to address deficiencies.

2. A rubric for writing assignments has been employed in OCN 401 and has greatly improved development of student writing skills (SLO #6).

3. Senior research theses are read and evaluated by at least two faculty members and feedback is provided to the students (SLO #2, 3, 4, 5, and 6).

4. A faculty panel evaluates oral presentations of senior research projects (SLO # 7).

The only major change in curriculum has been the development of a separate section of OCN 310 (Global Environmental Change) for GES majors only, taught every fall semester. The students are required to have completed the full year of introductory chemistry and a semester of either oceanography or geology before enrolling in the class. The smaller class size and better preparation of the students has allowed us to teach OCN 310 at a more rigorous level and thus provides better preparation of the students for advanced coursework in OCN 310L and OCN 401.

Evaluation criteria for graduate courses are given in the Table above.

8. How would you assess the role general education plays in preparing your undergraduate students for the major(s)? In what areas are students well prepared? Where do you see deficiencies?

The GES program depends strongly on other colleges in providing quality instruction in chemistry, physics, biology, and mathematics. Overall, our students are well prepared in the sciences to tackle the interdisciplinary studies of GES. Instruction in mathematics, however, has been a consistent problem. Our majors struggle to gain a basic understanding of calculus and to successfully complete the required courses. This is the most common reason students give for leaving the GES program, and is the most common factor behind delayed graduation.
9. To what extent does the faculty regularly engage in discussing effective approaches to assessing teaching and learning within the department?

The UHM Instructional Resources Program offers regular workshops on a wide range of topics covering teaching methodology, new technologies, and assessment. Several of our faculty attend these sessions on the order of once per semester. Faculty have shared the writing rubric, and its use is being implemented in several additional GES classes. The GES Chair participates in a science education assessment research group consisting of faculty from University of British Columbia and other campuses of the UH system. She spent a week in spring 2010 at the Carl Wieman Science Initiative at UBC working with several members of this group on development of course level assessment tools for use in global change curricula.

**Graduation Rates**

10. What factors prohibit students in your major(s) from graduating in 4 years? What data support these assumptions?

There are two primary factors that adversely affect students’ time to graduation from GES: the need to repeat math classes, and the need for extra time to finish their senior thesis. Of our currently enrolled majors, 37% have had to repeat a math class because they received a grade below the required minimum of C. Calculus I is the most common stumbling block. To address this issue, the SOEST Dean’s office has funded a TA to serve as an undergraduate tutor for math and basic science. We also regularly recommend that students take Calculus I and II at a nearby community college (Kapiolani Community College) where instruction is better than at Manoa. About 5 years ago, we also started a policy of deferring admittance to the GES major until students had satisfactorily passed a pre-calculus class. This measure emphasizes to new students the importance of mathematics in the GES curriculum. While it presumably would assure that incoming students are “calculus-ready”, we have found that many new students still do not do well enough on the math placement exam to place into Calculus I. Of our current student population, 30% had to take a pre-calculus course, and 50% of those had to repeat the class. Completion of the senior thesis requires an extra summer session or semester for a few students. Exact numbers are not available because students often anticipate this need and decide to add additional courses so as to complete a minor in another field. A best guess is that 10-15% of our students have experienced delayed graduation because of their thesis work.

11. How does the department ensure that its programs can be completed within a timely manner? What is the rotation for required courses in your majors?
Required courses for the GES major are offered at least once a year, and course availability has not been an issue for students. In a small number of cases, we have had to waive a prerequisite to allow students to take courses simultaneously rather than in sequence. This happens most often with transfer students who enter as juniors.

12. Assess the overall health of your academic programs.

The overall health of the GES program is excellent. The curriculum is demanding, and students appreciate the rigor. Matching students with research mentors is challenging at times, but students truly value the experience and skills they gain through the process of completing a thesis.

Likewise the health of our graduate programs is excellent (with the exception of the recent enrollment – see Section 6.4, question 2). This is judged by the enrollment and number of degrees earned (see Section IV.2) and the employability of our students. Of the 59 students who have graduated with an M.S. or Ph.D. in Oceanography since 2008, the Department has records of the present employment of 32. These people are obviously in various phases of their career. The numbers of people employed in various categories, or still studying, are given in the figure above. The vast majority have remained in the field.

6.4 Students

1. What is the department’s overall satisfaction with the quality of your current students?

The academic rigor of the GES program selects for well-prepared and motivated students, and we are very satisfied with overall student quality. Thirteen GES graduates have been accepted into the Department’s graduate program, indicating a department-wide recognition of the high quality of our best students.

Likewise the selection process for graduate students brings well-motivated and capable students into the program. The average GPA and GRE(Q) of incoming students is 3.6 and 720, respectively. On the whole these students are very able to cope well with the rigors of coursework and research. The transition from UG studies to a research-oriented graduate program is not easy, but the majority of our students manage with ease. The majority of graduate students are employed on research grants gained from competitive funding sources. Thus, the PIs select only high quality students and place those students in a well thought out research project in which they have the chance to excel. The high quality of both the presentations given by students at national and international meetings, and publications in leading journals, gives credit to both the Department and UHM.
2. To what extent is the department satisfied with enrollment trends and the number of degrees earned?

Since 2005, enrollment in GES has ranged between 32-81 students, and has averaged 55 students. Enrollment rose during the economic downturn, but appears to have leveled off at about average numbers. We have an average of 9 graduates per year. Several of our required courses are limited in size by computer availability or by the writing intensive general education designation. Enrollments above about 80 students would require us to double those course offerings, and would also pose significant challenges in providing quality thesis opportunities.

<table>
<thead>
<tr>
<th>SEMESTER / YEAR</th>
<th># APPS</th>
<th># OFFERS</th>
<th># ACCEPTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>FALL 2009</td>
<td>96</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>SPRING 2010</td>
<td>21</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>FALL 2010</td>
<td>105</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>SPRING 2011</td>
<td>10</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>FALL 2011</td>
<td>87</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>SPRING 2012</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>FALL 2012</td>
<td>78</td>
<td>12</td>
<td>4</td>
</tr>
</tbody>
</table>

We are therefore satisfied with current enrollments.

Enrollment numbers in the graduate program depend on a number of factors; the number and quality of applicants, the availability of funds, and the fit between available research projects and the interests of the students.

The table above gives the number of applications, number of offers of admission made, and number of offers accepted (and subsequently admitted) to our graduate program. There has been a recent decrease in the number of applications, but more alarming is the low acceptance rate in Fall 2011 and, particularly, Fall 2012. The reasons for this are unclear but will be the subject of further discussion in the department.

The number of students who leave the graduate program without a degree is approximately 15% of those who enter (averaged over AY2000-2006). The table below shows the number for students entering in a particular academic year. The table also shows the number of students who enter the program as a PhD student but leave with a Masters. It is interesting to note that all students who originally started in the MS program, completed an MS, and then went on to do a PhD have all completed their PhD.

The average time to degree is 2.7 years for an MS and 6.5 years for a PhD.
### Yearly Data Table

<table>
<thead>
<tr>
<th>Year</th>
<th># Entered Program</th>
<th># of students who leave without a degree</th>
<th># of students who come in to do a PhD but leave with a MS</th>
<th># still in the system</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-01</td>
<td>11</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2001-02</td>
<td>14</td>
<td>1</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>2002-03</td>
<td>12</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2003-04</td>
<td>14</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2004-05</td>
<td>11</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2005-06</td>
<td>19</td>
<td>4</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>2006-07</td>
<td>17</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

3. **Describe briefly how the department markets its programs and recruits students. What percentage of applicants are accepted, and enrolled in your graduate programs?**

Our major efforts at UG student recruitment are through direct contact of faculty with potential majors, primarily in our introductory oceanography course, OCN 201, and through colleagues at the UH System community colleges. We have a close working relationship with STEM faculty at Kapiolani Community College, as well as several other campuses. The UH Manoa Admissions Department frequently refers students to us, and we receive many email inquiries based on our website. Since 2005, on average we have accepted 79% of applications, and 52% of accepted students have enrolled. These numbers do not include transfer of students from other majors at UH Manoa. C-MORE has a program that actively promotes the recruitment of Native Hawaiians.

The Department has a graduate recruitment committee. Recruitment activities include distribution of a flyer to US physics and engineering departments, information on our website, the use of online services (e.g., the web sites of scientific societies), and contacts in other institutions. Following a period of low acceptance rates from the better applicants, it was decided to invite a number of the top applicants as a cohort for a 2-day visit to see the Department and University, talk to faculty and current students, and to interact as a group. This proved to be very successful in 2009 and 2010, leading to a much improved acceptance rate. The low acceptance rates of 2011 and 2012 have already been noted.

4. **What financial support is provided?**

Beyond scholarship support available to all UH students, we have 3 small scholarships available to GES students.

The majority of graduate students are employed as graduate research assistants, with funds coming from grants to individual faculty. The average number of GRAs per year in AY2008-2011...
was 55 (73% of the total). Teachings Assistantships also form an important source of funding (~15%). The remainder (12%) are funded on national or international scholarships.

SOEST, using funds from a benefactor, has set up the Denise B. Evans Research Fellowships in Oceanography, which are used to fund graduate students. Shimi Rii in Oceanography was one of two students in SOEST to receive the first awards.

5. In what ways does the department cultivate a research-oriented culture of inquiry at the undergraduate and graduate levels?

The GES requirement of a senior thesis involves every student in a research project for at least 2 semesters. Many of our students become involved in research before undertaking their thesis project through volunteer and paid positions with faculty researchers.

Graduate students are encouraged to develop a research-oriented sense of inquiry through not only their thesis or dissertation research but also through, among other things, discussions with mentors, group discussions in class, presentation to peers, writing manuscripts to be submitted to leading journals, and attendance and presentations at national and international meetings. A number of students are also involved in the writing of proposals that fund the latter part of their research.

Advising and Mentoring

6. To what extent are instructional faculty engaged in the advising and mentoring of undergraduate students?

Roughly three-fourths of our faculty have been involved in research mentoring of GES students. Academic advising is provided by a core group of 10 faculty members.

7. Has the department connected the major to co-curricular programs and services, such as development of field settings, service learning, or other similar opportunities for practical engagement? Which co-curricular activities within the college and across campus enhance learning opportunities and development for your students?

UG students are introduced to opportunities for involvement in research projects, the HOT program, and the Honors Program in the OCN 100 seminar class, taken upon entry to the major, and through interaction with their academic advisors. Internships, REU programs, and other opportunities are regularly brought to their attention through email. Many GES majors are regularly involved in activities of the SOEST Undergraduate Club, and a few each year participate in activities of the Marine Option Program run through the College of Natural Sciences.
8. How effectively have advising and mentoring helped students to take advantage of and benefit from available educational opportunities and resources within the department and across campus?

Undergraduate students are required to meet with their academic advisor at least once every semester. In addition to course selection, students and advisors discuss educational opportunities, thesis options, and plans for post-graduation. Although some students report minimal input from their advisors, most make good use of this resource.

Governance

9. How does the department define the role of students in departmental decision-making, and how is that role exercised?

The Department has 5 standing committees – GES steering, Curriculum, Teaching Evaluation, Awards and Graduate Student Recruitment. There is a student representative on each of these committees. A student representative is invited to faculty meetings. An Oceanography graduate student is also on the Marine Science Space committee. Student representatives are elected by the department’s graduate student organization, Na Kama Kai (www.soest.hawaii.edu/oceanography/nakamakai), with whom they consult and to whom they report.

10. What are the grievance procedures for students, and how are these communicated to them? How does the department ensure that grievances and complaints are addressed promptly, appropriately and equitably?

In the case of grievances, students seek council from the Undergraduate Chair or Department Chair. The SOEST Student Services personnel are also available, as well those at the UHM Office of Student Affairs. Most grievances are handled by the Department Chair or UG Chair through discussions with involved persons, although in one recent case, students were referred to UH Judicial Affairs. The Undergraduate Chair meets with incoming students and makes a point of telling him or her that she is always available to them. She also teaches the OCN 100 seminar class to incoming students and spends one class session mid-semester in open discussion with students about their experiences in the major and at UH in general.

11. Please provide any student recognitions over last five years. Awards include:

- Christina Comfort: "Best Graduate Poster" at the 2012 UH Tester Symposium
- Kristen Fogaren: 2010-2011 HIMB-NOAA Fellowship
- Brenner Wai: 2012-2013 NHSEMP Kaiāulu STEM
Scholars award

- Carolyn Anela Choy: 2009 J. Watumull Merit Scholarship
- Rebecca Briggs: 2011 J. Watumull Merit Scholarship
- Mingxi Yang: 2010 J. Watumull Merit Scholarship
- Thomas Decloedt: 2008 J. Watumull Merit Scholarship
- Julia Fieldler: 2010 Best Poster Award, UHM Undergraduate Research Symposium
- Amanda Timmerman: 2008 NOAA E. F. Hollings Scholarship; 2010 NSF Graduate Fellowship
- John R. Casey: 2010 NSF Graduate Fellowship
- Christian Clark: 2011 Our World Underwater Scholar Award

6.5 Staff Support and Facilities

1. Assess the continuing adequacy of physical and staff resources. Identify space and equipment managed by the department that support research and instruction.

Most of the Department is housed in the Marine Science Building (MSB). IPRC ocean faculty have offices in POST while C-MORE faculty associates recently moved to C-MORE Hale. Although space is always an issue for an active, developing and expanding department, pressures on space have been ameliorated by two main developments since the last review. First, office space was created by building out over a former lanai area on the second floor of MSB. This space has been used primary for the Oceanography office plus one faculty office. (Two further internal offices are being built on the second floor at the time of writing.) Second, the move of faculty to C-MORE Hale and their respective laboratories freed up considerable space on the 6th floor of MSB.

The Department manages one medium sized and 3 smaller classrooms, maintaining both the furniture and audio-visual equipment in these rooms. The Department also manages a teaching laboratory used almost exclusively for OCN 201L; a computer room used for teaching; and a room with computers, scanners and a printer. Commons areas are provided for graduate and GES students, with the latter housing a number of computers for student use.
Major research facilities and equipment include:

**The SOEST Flow Cytometry Facility** (www.soest.hawaii.edu/sfcf), which operates on a recharge basis, has several instruments, including a multi-laser sorting research-grade flow cytometer and a clinical-grade ocean-going cytometer. Both instruments are in current use by multiple users (at UH, including within SOEST, and from outside of Hawaii) for biological research, mainly in the oceanographic and plant sciences areas. These instruments are aging (~10 years since purchase) and no longer supported by their parent company for repairs; however both are functional at this time.

**The SOEST Laboratory for Analytical Biogeochemistry** (www.soest.hawaii.edu/S-LAB), which measures dissolved inorganic and organic nutrients (P, N, Si); dissolved organic and inorganic carbon; dissolved oxygen; salinity; solid-phase carbon, nitrogen, sulfur and phosphorus; and chlorophyll a in natural waters, sediments, soils, and vegetation. S-LAB provides analyses at a per-sample rate, as well as access to several instruments for user-based sample analysis.

Up until 2010 the department housed the X-ray Diffraction Analytical Facility. The instrument is no longer operational. A proposal will be submitted for its replacement (led by HNEI researcher N. Gaillard).

2. In what ways does the department support and continue to develop non-academic staff (APT and civil service personnel) in a manner that encourages their effectiveness and actively furthers the mission of the department?

Non-academic staff are actively encouraged to attend training sessions offered by the University on campus. Recent examples include sessions on the new KFS financial system, the analysis of surveys, student hire training, stress management, sexual harassment prevention, secure information destruction, and communications at work.

3. Is the ratio of APT and civil service staff in relation to faculty sufficient for the department to achieve its mission and goals?

On the whole, administrative support is adequate to meet the needs of the Department Office. Following the retirement of two long serving APTs in 2010, modifications were made to the administrative structure to provide good support across the various functions of the Department Office, and to improve research support at the divisional level. However, the three administrative staff members in the division offices have very high workloads, with no backup for periods they are absent for vacation or sick leave. The ever increasing workload of research administration, and the fact that two of these staff members are at retirement age, raises questions as to the long-term viability of the present situation.

At present we have an Office Manager, Student support specialist and 3 APTs supporting each of the research divisions. (The Student Specialist position and one of the division support are supported by G-funds, the rest are supported by S-funds). We have two civil service personnel, one of whom has been on sick leave for a number of years, the other, although very willing to be
helpful, has limited computer skills. To cover the shortfall in support the Department recently recruited an additional APT using S-funds. The Department also employs two part time student helpers.

Computer maintenance of Department machines is an area that has no formal support. At present faculty and office staff maintains them, with some assistance by the SOEST Research Computing Facility.

4. Please provide a list of staff awards and recognitions, 2005-2010

None

6.6 Extension and Outreach Activities

1. Please describe any relationships with organizations/individuals in the community

Faculty engage in a large number of outreach activities. Examples include: UH Sea Grant Hanauma Bay Education Program; West Hawaii Reef Talk in Waimea; Judge, Hawaii Academy of Science, Science Fair for the Pacific Science and Sustainability Symposium; Invited dinner speaker, UH Women’s Campus Club’s Centennial Celebration; Distinguished lecturer, NSF-GEO; Invited lunch speaker, Engineers and Architects of Hawaii; Speaker and panelist, Hawaii Executive Conference, Island Wisdom, Global Solutions; Talk to Kailua rotary club; Interviews for radio and newspapers; Public lectures in Honolulu; Waianae Neighborhood Meeting for Ordnance Removal; Host for Kanegawa Prefecture Marine Science High School (Japan) visits to UHM; Summer Science Program for students at Kamehameha Schools; Presentation to students at Iolani School, Honolulu; Judge for “Project Citizen” project on marine pollution, Mililani High School; Presentation to preschool and kindergarten classrooms at the Mid-Pacific Institute; Talk and tour of ship for students of the College of Micronesia, Pohnpei; ; hosting of COSEE community college faculty from Pacific Islands.

Faculty also contribute to the biennial SOEST Open House for schools and members of the public.
6.7 Concluding Statement

1. What is your overall assessment of the department? What are the strengths, weaknesses, opportunities and threats? Are you poised to meet these challenges in the future?

**SWOT analysis:**

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A diverse faculty who are leaders in their field</td>
<td>• Innovations in instrumentation, ongoing international programs, increases in computing power</td>
</tr>
<tr>
<td>• Strong research funding base</td>
<td>• Recognition of the importance of the ocean in climate on the global and regional scale</td>
</tr>
<tr>
<td>• National and international leadership</td>
<td>• New directions made possible through collaborations with colleagues in SOEST and the rest of UHM</td>
</tr>
<tr>
<td>• Geographic location</td>
<td></td>
</tr>
<tr>
<td>• 50 years of excellence in research, teaching, and service</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weaknesses</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Lack of coverage of some areas of research</td>
<td>• Decline in funding</td>
</tr>
<tr>
<td>• Limited technical support for instrument development</td>
<td>• Decline in student numbers</td>
</tr>
<tr>
<td>• Math preparedness of incoming GES students</td>
<td>• Loss of faculty</td>
</tr>
<tr>
<td>• Geographic location</td>
<td>• Non-replacement of failing facilities</td>
</tr>
<tr>
<td>• Limited facilities for laboratory classes</td>
<td></td>
</tr>
</tbody>
</table>

The Department of Oceanography at UH is an international leader in oceanographic research and education. Our leadership in the ocean sciences derives in part from Hawaii’s proximity to the open ocean waters of the North Pacific Ocean, one of Earth’s largest habitats, and to tropical nearshore marine environments. UH has also been proactive about maintaining facilities and research vessels necessary for access to the sea; UH is a charter member and vessel operator in the University-National Oceanographic Laboratory System (UNOLS), enabling opportunities for shipboard research and educational programs. As a result, students at UH are provided with unprecedented opportunities for hands-on experience and training in
ocean sciences. In addition, the Department of Oceanography has attracted and retained high quality faculty, staff, and students. Oceanography faculty and students publish in leading international journals (including Science, Nature, Nature Geosciences, PNAS). Faculty have attracted a total of more than $75M in research funds since 2007. A number have been elected Fellows of prestigious societies (e.g. the American Geophysical Union, the American Meteorology Society and the US National Academy of Sciences). The national and international regard of the faculty is reflected in the number who are members of national and international committees of major programs (e.g., 3 faculty are lead authors of the IPCC 5th assessment report).

Innovations in instrumentation, accessibility of large global datasets and huge increases in computational capabilities are set to revolutionize ocean sciences. This is coupled with an increasing awareness of the importance of the ocean in climate variability and change on the global and regional scale, and issues such as human health. The Department is well poised to take advantage of these opportunities, covering critical themes such as climate dynamics research and education, physical-biological interactions, paleoceanography and global biogeochemistry, land-ocean dynamics, coupled human-ocean interactions, and sensor development.

There has been a turnover of approximately a third of the faculty since the last review in 2001. This is healthy in that it brings in new blood, strengthens the Department in areas of emerging importance (such as climate, microbial oceanography and regional studies), and allows these areas to be included in the UG and graduate curricula. The majority of new hires have been part of SOEST or University initiatives. This is not a bad thing but it does mean the Department needs to examine our ability to provide excellence in both research and, particularly, UG and graduate education in areas such as more traditional biological oceanography and geochemistry. One particular case in point is the retirement of professors Huebert and Clarke, who are leaders in the field of marine atmospheric chemistry. This comes at a time when research in this area is needed because of the impact on the global climate. The Department and SOEST need to strive to maintain and extend their capabilities through appropriate replacement of departing faculty.

The Department is able to maintain a range of instruments and laboratory equipment for teaching and research. Most of this equipment is part of the labs of individual PIs. Maintenance of existing equipment, and the procurement of new equipment, is subject to the vagaries of the funding agencies. The Department strives to provide and maintain a number of teaching labs, but our ability to do so is dependent on income generated through S and R funds. Thus, the quality of these facilities is vulnerable to a reduction in this income.

2. What is your assessment of how the department fits within the School/College? What is your assessment of interdisciplinary collaboration and communication across the departments?
The Department fits well within SOEST. There are numerous collaborations of research with all units within SOEST. A number of Oceanography faculty are embedded in other units of SOEST (IPRC: McCreary, Richards, Schneider, Timmermann; C-MORE: Karl, Church, Steward). This not only strengthens collaborations and links between Oceanography and other units (such as Meteorology through the IPRC, and HIMB through C-MORE) but also provides UG and graduate students a broader perspective and wider opportunities. The response to new opportunities listed above is envisioned to be a SOEST-wide effort.

There are many educational links with the rest of SOEST. HIMB, GG and HIGP faculty teach OCN courses, and OCN faculty teach GG courses. Many OCN faculty participate in student committees outside of the department, and many graduate students in HIMB are enrolled in the Oceanography program. The development of the new Marine Biology graduate program was a joint effort between faculty from HIMB, Oceanography and Natural Sciences, with faculty from all 3 being involved in the running of the program.

3. Please identify individuals or groups that you recommend the visiting team meet during the campus visit.
   • Chair of Oceanography and Graduate Chair – Kelvin Richards
   • Chair of Undergraduate Studies – Jane Schoonmaker
   • Division Heads and members – Frank Sansone, Jeff Drazen, Margaret McManus
   • Directors of Sea Level Center (Mark Merrifield), JIMAR (Mark Merrifield), C-MORE (Dave Karl) and IPRC (Kevin Hamilton)
   • Graduate students
   • GES students

4. Please identify facilities that the team should tour during the visit.
   • Teaching labs: MSB 203, 626 and 633
   • The HOT team
   • C-MORE Hale
   • Flow Cytometer – POST 104
   • SOEST Laboratory for Analytical Biogeochemistry – MSB 406
   • Individual labs of PIs as requested