RESEARCH EXPERIENCES IN ESTUARINE SCIENCE FOR UNDERGRADUATES AT MOTE MARINE LABORATORY, WITH SPECIAL FOCUS ON NATIVE PACIFIC ISLANDERS

Annual Report for period:  
June 2002 – June 2003

SUBMITTED TO:  
National Science Foundation

SUBMITTED BY:  
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Mote Marine Laboratory Technical Report No. 1385

March 15, 2003
Title:
Research Experiences in Estuarine Science for Undergraduates at Mote Marine Laboratory, with Special Focus on Native Pacific Islanders

Project Participants

Senior Personnel

Name: Gelsleichter, James
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Kirkpatrick, Barbara
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Zeigler-Chong, Sharon
Worked for more than 160 Hours: Yes
Contribution to Project:
Ms. Zeigler-Chong coordinated efforts to recruit Native Pacific Islander students from colleges and universities in U.S.-held Pacific Islands.

Post-doc

Graduate Student

Undergraduate Student

Name: Perry, Erika
Worked for more than 160 Hours: Yes
Contribution to Project:
Ms. Erika Perry assisted Sharon Ziegler-Chong in the recruitment of Native Pacific Islanders for participation in this program.

Technician, Programmer

Other Participant

Name: Walsh, Catherine
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr. Walsh will serve as a research advisor and mentor for one REU student during the summer 2003 program.

Name: Kirkpatrick, Gary
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr. Kirkpatrick will serve as a research advisor and mentor for one REU student during the summer 2003 program.

Name: Heupel, Michelle
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr. Heupel will serve as a research advisor and mentor for one REU student during the summer 2003 program.
Name: Simpfendorfer, Colin
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr. Simpfendorfer will serve as a research advisor and mentor for one REU student during the summer 2003 program.

Name: Estevez, Ernest
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr. Estevez will serve as a research advisor and mentor for one REU student during the summer 2003 program.

Name: Reynolds, John
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr. Reynolds will serve as a research advisor and mentor for one REU student during the summer 2003 program.

Name: Wetzel, Dana
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr. Wetzel will serve as a research advisor and mentor for one REU student during the summer 2003 program.

Research Experience for Undergraduates

Organizational Partners

University of Hawai‘i at Hilo
Two participants in this program, Sharon Ziegler-Chong and Erika Perry, are staff members of the University of Hawai‘i at Hilo/Hawai‘i Sea Grant College Program. NSF project funds supporting the recruitment of Native Pacific Islanders for this program were a sub-contract from Mote Marine Laboratory to this organization.

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:
Not used for REU-specific material.

Findings:
Nothing yet to report (the first session of this program will take place in Summer 2003).

Training and Development:
See attached file.

Outreach Activities:

Journal Publications

Books or Other One-time Publications

Web/Internet Site
URL(s):
http://www.mote.org/~jimg/reu.htm

Description:
This is the main Program Web site, which provides an extensive overview of topics such as student eligibility, application procedures, financial support, research opportunities, and research mentor interests. This Web site also includes a page discussing the representation of Native Pacific Islanders in science careers (http://www.mote.org/~jimg/npis.htm).

Other Specific Products

Contributions within Discipline:
Not used for REU-specific material.

Contributions to Other Disciplines:
No Ethics component included.

Contributions to Human Resource Development:
As discussed in the section entitled 'Activities and Findings: Training and Development', the initial session for this program will be held in summer 2003. Because of this, contributions of the program to human resource development cannot be discussed in past tense. However, based on recruitment outcomes, the program goal of providing research experiences in estuarine science to undergraduates, with special focus on Native Pacific Islanders is likely to be met. Therefore, it is expected that this program will contribute significantly to the training and education of future scientists, particularly members of a minority group severely under-represented in science and rarely targeted by similar programs. Efforts to compile and distribute information regarding the representation of Native Pacific Islanders in science careers (see Products: Internet) via the program web site also will contribute significantly to minority science education.

Contributions to Resources for Research and Education:
Not used for REU-specific material.

Contributions Beyond Science and Engineering:

Special Requirements

Special reporting requirements: None
Change in Objectives or Scope: None
Unobligated funds: less than 20 percent of current funds
Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:
Activities and Findings: Any Outreach Activities
Any Journal
Any Book
Any Product
Contributions: To Any Beyond Science and Engineering
Activities and Findings – Training and Development

GOALS AND OBJECTIVES OF REU SITE

The Research Experiences for Undergraduates (REU) Site Program at Mote Marine Laboratory (MML) was developed to provide mentored experiences in cooperative estuarine research to eight U.S. college and university undergraduates annually, with special focus on Native Pacific Islanders — students having origins in any of the original natives of Hawaii, Guam, Samoa, or other U.S.-affiliated Polynesian, Micronesian, or Melanesian Pacific Islands. The goal of this program is to foster positive learning outcomes in participating students. The special emphasis placed on Native Pacific Islanders has been motivated by a need to increase the representation of this poorly studied minority group in science and engineering. This REU program represents one of very few programs focused predominantly on increasing the participation of Native Pacific Islanders in science and engineering.

CURRENT PROGRESS

Since this is a newly developed program that largely focuses on an extremely small minority group, the PIs requested and were granted approval to delay the initial summer session until June 2003 to allow sufficient time for student recruitment. Because of this, the present report focuses on describing progress made in program development and recruitment.

Program development: Intellectual focus

The intellectual focus of this REU Site program is on estuarine science, basic and applied research on the biological, chemical, and physical features of estuaries. In particular, students will gain research experience through involvement in MML’s newly initiated, multidisciplinary study on Charlotte Harbor, one of Florida’s largest and most ecologically and economically important estuaries. Although Charlotte Harbor is less adversely impacted than most Florida estuaries, it is increasingly threatened by several factors including changes in freshwater flow, nutrient loading, and habitat loss/degradation. The objective of MML’s Charlotte Harbor study is to determine how natural and human-caused changes to freshwater quantity and quality affect the structure, function, and condition of this estuary and its ecosystem components. This objective will be met by addressing five fundamental questions:

- How does freshwater inflow influence the ecology and productivity of Charlotte Harbor, and what will be the long-term consequences of flow alterations?
- How do algal blooms produced by nutrient loading and flow alterations affect the onset, duration, and extent of hypoxia in this estuary?
- What is the role of natural perturbations, particularly hypoxia, in controlling the distribution of plants and animals in Charlotte Harbor?
- What processes mediate trophic links in the estuary’s food web, and how influential are hydrological and chemical factors in regulating secondary production, especially of fishes and other large carnivores?
• What estuarine areas are important to large mobile fauna, including endangered species, and how do natural and anthropogenic stressors affect the quality of these areas and animal health?

During the REU period, participants will gain research experience by addressing one or more of these questions under the mentorship of one of the over 30 Ph.D.-level scientists collaborating on this multi-investigator study. The intellectual focus of the REU program was selected largely to provide participants with experience in collaborative estuarine research. Students will participate in a variety of activities in this program, several of which are geared toward encouraging cooperative learning and reflect the solidarity of the Charlotte Harbor study.

Program development: Summary of planned activities

Students enrolled in the REU program will attend: 1) a standard project orientation and commencement social; 2) individual orientations with the program PI and their research mentor; 3) weekly program meetings; 4) occasional research seminars presented by MML staff and visiting scientists; and 5) a variety of social activities highlighting the culture and environment of southwest Florida. All participants will also: 6) complete individual research projects, written project reports, and oral project presentations; and 7) contribute to a cooperatively developed annual program summary.

Program development: Research mentors, Individual research projects, and project reporting

The core activities of the REU program will be the individual research project, project report, and oral presentation. Participants will be paired with mentors and learn skills in estuarine science through hands-on experience in the planning, execution, and dissemination of research projects related to MML's Charlotte Harbor study. Participants and mentors will cooperatively select the relevant topics, objectives, hypotheses, and methodology of individual projects. Afterwards, students will gain experience in scientific communication by reporting the results of their individual projects in short research papers (5-10 pages) and oral presentations. Oral talks (PowerPoint presentations of 15-min duration) will be presented at a laboratory-wide seminar series and culminating social event. Students also will be encouraged to present their findings at professional conferences and/or as publications in peer-reviewed journals if they are of appropriate quality, a characteristic that will be determined by their research mentor.

The research topics that participants will address in their individual projects are specific to the research center that they are integrated in and the interests of their research mentor. Descriptions of the research interests and selected activities relevant to the Charlotte Harbor study, along with prospective student projects, are presented below for mentors that have agreed to participate in the REU program during Year 1 (participation by additional mentors will be solicited in subsequent years):

James Gelsleichter, Ph.D. — Dr. Gelsleichter is a marine physiologist focusing on the endocrinology and reproduction of sharks, skates, and rays, and the effects of environmental pollutants on their health. As part of the Charlotte Harbor Project, Dr. Gelsleichter is investigating the potential effects of pesticides on reproductive and immune competence of
sharks and rays inhabiting this estuary. Students working with Dr. Gelsleichter will participate in the collection and/or captive maintenance of these animals, and utilize a variety of laboratory procedures (e.g. tissue and cell culture, hormone or chemical treatment, enzyme immunoassays, histology, vital staining, immunocytochemistry) to either determine some aspect of animal health or develop new means for characterizing reproductive or immune function. Examples of projects that a student working with Dr. Gelsleichter may complete include: 1) assessments of different methods for characterizing acrosome reaction in elasmobranch sperm; 2) comparisons of uterine function in stingrays residing in polluted and non-polluted environments; and 3) laboratory investigations on the effects of environmentally relevant pesticides on cell proliferation or apoptosis in elasmobranch testes.

**Gary Kirkpatrick, Ph.D., Senior Scientist** — Dr. Kirkpatrick is a marine biologist focusing on the ecology of phytoplankton, particularly those responsible for harmful algal blooms. He is currently investigating the taxonomic succession and primary productivity of the phytoplankton community of Charlotte Harbor, in order to quantify changes in community structure and abundance that are mediated by seasonal variations in freshwater input and nutrient loading. Students working with Dr. Kirkpatrick would aid in sample collections and utilize methods such as chemotaxonomic analyses of HPLC-derived pigment complements, radioisotope incubations, and/or pulse amplitude-modulated (PAM) fluorometry to complete individual projects related to these research interests. Examples of projects that a student working with Dr. Kirkpatrick may complete include: 1) field- and computer-based studies that relate particulate light absorption to phytoplankton pigment content; 2) assessments of the photosynthetic capacity of Charlotte Harbor phytoplankton using parallel measurements of chemically stimulated fluorescence and PAM fluorometry; and 3) laboratory growth studies on phytoplankton cultures established from isolates collected in Charlotte Harbor.

**Ernest Estevez, Ph.D., Senior Scientist** — Dr. Estevez is a marine scientist focusing on the ecology of rivers and their relation to estuaries, and the distribution patterns of plants and benthic invertebrates. He is the Program Coordinator for MML's Charlotte Harbor study, and is currently conducting field-based research on the ecology of Charlotte Harbor flora and fauna in relation to freshwater input and oxygen levels. Students working with Dr. Estevez would develop skills in small boat operation, the use of field instruments and collection of environmental data (e.g. salinity, dissolved oxygen, temperature), sampling of benthic organisms and/or vegetation, data entry and analysis, and reporting. For individual projects, students will utilize these skills to determine the distribution patterns of specific ecologically and/or economically important species of the Charlotte Harbor ecosystem.

**Cathy Walsh, Ph.D., Staff Scientist, CSR** — Dr. Walsh is an immunologist who conducts basic research related to innate and acquired immune function in marine organisms, and applied research geared towards developing and using predictive indicators of immune distress associated with exposure to environmental and anthropogenic stressors. As part of MML's Charlotte Harbor study, Dr. Walsh is conducting studies to assess the short- and long-term effects of cold stress and other environmental factors on immune function in endangered or threatened species such as the Florida manatee and marine sea turtles. Students working with Dr. Walsh will develop skills in animal cell culture, antibody applications, and protein biochemistry. For their individual project, students may: 1) utilize *in vitro* lymphocyte proliferation assays to
characterize the immune health of selected Charlotte Harbor fauna; or 2) develop and evaluate the use of previously untested indicators of immune function for these species.

**John Reynolds, Ph.D., Staff Scientist** — Dr. Reynolds' research focuses on the ecology of the Florida manatee. He is currently conducting studies on the distribution and habitat use patterns of manatees in the Charlotte Harbor estuary. Students working with Dr. Reynolds would utilize technique such as aerial reconnaissance, telemetry, animal photo-identification, and GIS to develop, execute, and complete individual projects that assess the movements of manatees in selected regions of Charlotte Harbor. Students may also choose to examine changes in manatee distribution patterns associated with environmental (e.g. distribution of seagrasses) and/or anthropogenic (e.g. boat traffic, thermal pollution) factors.

**Dana Wetzel, Ph.D., Staff Scientist** — Dr. Wetzel manages a program in aquatic toxicology, and focuses on the sources, fates, and effects of natural and anthropogenic toxins in marine environments. Dr. Wetzel is currently conducting research on distribution of chlorinated hydrocarbons, organophosphates, petroleum products, and red tide toxins in water, sediment, and wildlife of the Charlotte Harbor ecosystem, and the effects of these stressors on animal development. Students working with Dr. Wetzel would use techniques such as chemical extraction, gas chromatography/mass spectroscopy (GC/MS), and HPLC to address these research topics. Examples of individual projects that students working with Dr. Wetzel may complete include: 1) assessments of pollutant accumulation at different levels of the Charlotte Harbor food web; 2) studies on the levels of oil-related contaminants in Charlotte Harbor due to marine boating operations; and 3) laboratory-based studies on the effects of environmentally relevant chemicals on larval development of marine invertebrates.

**Colin Simpfendorfer, Ph.D., Senior Scientist** — Dr. Simpfendorfer conducts research on the life history, population dynamics, ecology, and conservation of fishes, particularly sharks and rays. He is currently investigating the distribution and abundance of the smalltooth sawfish in Charlotte Harbor, one of the few remaining areas where these critically threatened animals are regularly encountered. He is also planning to investigate the importance of the elaborate canal system of Charlotte Harbor as habitat for elasmobranchs and other fishes. Students working with Dr. Simpfendorfer would use field sampling techniques, tagging surveys, acoustic telemetry, and GIS to address these research topics. Examples of individual projects that students working with Dr. Simpfendorfer may complete include: 1) field studies on species distribution of sharks and rays within canals; 2) comparative research on the relationship between canal water quality and habitat use; and 3) computer-modeling studies on sawfish distribution based on creel surveys and other forms of public reporting.

**Dr. Michelle Heupel, Ph.D., Staff Scientist** — Dr. Heupel is a behavioral ecologist focusing on habitat utilization patterns of sharks in various regions on Florida’s Gulf coast. She is currently investigating the movement of blacktip and bonnethead sharks in the Charlotte Harbor estuary using acoustic telemetry. Students working with Dr. Heupel will participate in extensive field collections and conduct independent research on various aspects of shark ecology.
Program development: Timetable and schedule of student activities

The Summer 2003 session will take place during the ten-week period between June 16 and August 22. A tentative timeline for all student activities is provided below:

<table>
<thead>
<tr>
<th>Student activity</th>
<th>Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientations and commencement social</td>
<td>X</td>
</tr>
<tr>
<td>Weekly discussion meetings</td>
<td>X X X X X X X X X</td>
</tr>
<tr>
<td>Social/cultural activities</td>
<td>X X</td>
</tr>
<tr>
<td>Research seminars</td>
<td>X X X X X X X X</td>
</tr>
<tr>
<td>Select research topic</td>
<td>X X</td>
</tr>
<tr>
<td>Conduct individual project</td>
<td>X X X X X X</td>
</tr>
<tr>
<td>Research report due (students should begin ASAP)</td>
<td>X</td>
</tr>
<tr>
<td>Oral presentations/culminating event (1 day)</td>
<td>X</td>
</tr>
<tr>
<td>Cooperative final project summary (2-3 days)</td>
<td></td>
</tr>
</tbody>
</table>

Student recruitment: General Procedures

Student recruitment for this program began in September 2002. The PIs developed a one-page program announcement that was sent via electronic mail to chairpersons of Marine Science, Biology, and Chemistry departments at over 300 institutions. The schools selected to receive this announcement included all U.S. mainland colleges and universities with Marine Science/Oceanography programs, based on Peterson’s Guide to Colleges and Universities. Program advertisements also were sent to a large number of 4-year institutions in California, Oregon, and Washington; the U.S. mainland states with the largest populations of Native Pacific Islanders based on Census reports. Lastly, the program was advertised on web sites of Mote Marine Laboratory, the National Society of Experiential Education (a professional organization of internship coordinators from a large number of U.S. colleges and universities), the American Elasmobranch Society, the National Association of Marine Laboratories, the American Society of Limnology and Oceanography’s Minorities in Aquatic Sciences Program, and NSF’s REU Program.

Additional recruitment of Native Pacific Islanders for participation in this program was performed by University of Hawaii at Hilo/Hawaii Sea Grant College Program staff members, which currently administer several Pacific Islander-specific internship programs. Program advertisements were sent to a variety of Pacific Island-based community groups and regional contacts, as well as all 2- and 4-year colleges and universities in U.S.-held Pacific Islands.

A program web site (http://www.mote.org/~jimg/reu.htm) was developed to provide general information on the application process, student eligibility, financial support, intellectual focus, research opportunities, and research mentor interests. Students were requested to submit a program application form (downloadable at the program web site), official transcripts, and two letters of recommendation to the PI by the application deadline of March 15, 2003. Students will be notified of the status of their applications by no later than April 30, 2003.
Student recruitment: Outcomes

To date, recruitment of students for this program has been highly successful. Over 120 students from 95 institutions have applied for participation in this program. The current applicant pool includes Native Pacific Islanders (N = 5), Hispanics/Latinos (N = 2), African-Americans (N = 2), and Native Americans (N = 1), in addition to non-minority students. The PIs currently are summarizing data on student GPA, grade level, gender, institution, and major field of study for inclusion in the final program report.

Based on the outcomes of recruitment procedures, correspondence with Department Chairpersons and NSEE members via electronic mail were highly successful methods of program advertisement. In the subsequent year, the PI intends to expand the currently archived mailing list to include 250-300 additional institutions that were not previously targeted. Program information available at NSF’s REU web site also was an important method for recruiting student applicants.

Although the targeted number of Native Pacific Islander (N = 3-4) participants for this program will clearly be met, the PIs intend to conduct more vigorous recruitment of this minority group in subsequent years. In addition to current methods, the PIs will provide program announcements to previously untargeted community colleges in California, Oregon, and Washington.