

**Marine, Estuarine,
Environmental Sciences
(MEES)
Graduate Program**

Self Study

**Undertaken under the auspices of the
College of Chemical and Life Sciences,
University of Maryland
College Park**

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**Submitted by the
Marine, Estuarine, Environmental Sciences graduate program**

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First draft reviewed & revised by members of the MEES program committee.

Second draft submitted to the general MEES faculty for comments.

**Final draft approved for submittal to the external review committee
by the program committee.**

Executive Summary

This document will present a summary review of the state of the Marine, Estuarine, Environmental Sciences (MEES) graduate program. Below is an outline representing the information and data that is included in the self-study.

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1. Overview of the program

The Marine-Estuarine-Environmental Science (MEES) Graduate Program is an ambitious academic endeavor within the University System of Maryland (USM). A brief history of the program is included in Appendix I-A. Because it draws faculty from not only USM's degree-granting but also from USM research institutions as well as from government and non-government agencies and other non-academic units, the MEES program affords students an unparalleled opportunity to combine the expertise of the best environmental scientists in the region to guide their program of study. MEES offers masters and doctoral degrees in six areas of specialization (AOS) including Oceanography, Fisheries Science, Ecology, Environmental Molecular Biology, Environmental Chemistry, and Environmental Sciences. These specialties include such disciplines as restoration ecology, aquaculture, fisheries management, marine biotechnology, toxicology, remote sensing, and landscape ecology, among others. The title of the program emphasizes its strengths in marine and estuarine sciences, although the program spans environmental science as a whole, irrespective of habitat. The interests of students in the program are diverse, but generally center on some aspect of the interaction between biological, physical and/or chemical systems in the environment. Research activities range from studies of molecular mechanisms to fisheries ecology, chemical pollutants, or economics of environmental impact. Since its faculty members come from so many sources, and the program is administered at individual institutions, MEES provides unique and valuable graduate education across the broad range of the environmental sciences.

The MEES Program was established in 1978 as an interdisciplinary, inter-institutional, and system-wide graduate program (Appendix I-A). Today it is one of the largest environmental graduate programs in the System with approximately 200 faculty members drawn from several of USM's 11 universities and two research institutions including departments of the Baltimore Campus (UMB), Baltimore County Campus (UMBC), the College Park Campus (UMCP), the Eastern Shore Campus (UMES), one of the biotechnology centers of the University of Maryland Biotechnology Institute (UMBI), or at any of the three laboratories of the University of Maryland Center for Environmental Science (UMCES). See page 9 for an outline of institutional structure.

All of the more than 180 MEES students are enrolled in research-based degrees with most conducting research in their advisor's laboratory in the department or unit to which the advisor belongs. Courses within the program are available to any graduate student registered at any campus in the System through intercampus enrollment. Additionally, the programs strives disseminate courses to the extent that MEES is the single largest user of the interactive video network (IVN) in the USM. Most courses taught by UMCES and COMB faculty are offered over IVN, but only a few originate from main campuses such as UMCP.

Expertise and interest of faculty and within the MEES Program have led to six formally defined Areas of Specialization (AOSs) from which a student may choose. The AOSs are: Ecology, Environmental Chemistry, Environmental Molecular Biology and

Biotechnology, Environmental Science, Fisheries Science, and Oceanography. Course offerings over the last 5 years are tabulated in Appendices I - G thru J.

The two non-degree granting research institutions within USM play a central role in the program. Together the faculty from the three UMCES institutions (Appalachian Lab, the Horn Point Lab, and the Chesapeake Biological Lab), and the UMBI Center of Marine Biotechnology (COMB) advise about half the students in the MEES program. Importantly, well over 90% of all graduate students training at those institutions are MEES students. Thus, UMCES and COMB faculty members have a special stake in the MEES program, and how it is administered, since it is the main program through which those faculties can recruit and advise graduate students. Given the critical nature of the MEES program to those institutions, it is not surprising that UMCES and COMB faculty have been among the most involved as MEES course instructors and members of the Program Committee which governs the MEES program.

MEES has developed a unique and valuable set of inter-institutional policies and agreements that help the program work (Appendix I – L). For instance, all admissions are coordinated through a single central administrative office. All MEES students, regardless of institution of matriculation, must comply with the same program requirements including prerequisites and limits on time to advancement to candidacy. In addition, a valuable arrangement with the research laboratories sends tuition income from courses taught by their faculty to their laboratories where those funds are reinvested in supporting graduate education.

Despite the development of these productive policies and agreements over the last thirty years, the MEES program faces significant administrative challenges as a system-wide program:

- 1) the structure of the program does not allow an efficient coordination of faculty and curriculum since the program relies on *participating* faculty across several institutions over whom the MEES program has little authority or influence.
- 2) as with many interdisciplinary, non-departmental programs, the pools of participating faculty usually have stronger commitments to their home departments. This may be important in affecting the integration of faculty and curricula across departments, colleges and institutions.
- 3) the recent uncoordinated development of other environmental science graduate programs within the USM (several graduate programs in environmental science have been established by USM institutions during the last 14 months) may dilute both the pool of students from which MEES has traditionally drawn and the faculty who participate in the MEES program.
- 4) the research institutions (UMCES and UMBI-COMB) which by virtue of their large faculty participation strongly influence the program, do not have an administrator in charge of graduate education who has the authority to undertake planning, make decisions regarding teaching loads or schedule courses. This administrative gap has caused difficulty in organizing and improving the MEES curriculum.

- 5) it has been difficult to coordinate the dedication of resources, both human and financial, in an effective way because the inter-institutional structure of programs like MEES has not been formalized by the USM or by inter-institutional agreements that would codify responsibilities and commitments of each participating institution.
- 6) although the USM invested in MEES in 1989 by providing both UMCP and UMES \$125,000 each to support the program, since that time no additional funds have been allocated to the program by the USM nor have funds been allocated to the other participating institutions to support MEES.

Much supporting documentation for this report can be found in the Appendices. Appendix I will be especially informative as it includes all relevant information pertaining to the program but the Curricula Vitae of MEES faculty. Appendix I contains the following information:

- A. Brief history of the program
- B. Description of Facilities at MEES Campuses and Laboratories
- C. MEES Faculty
 - a. Tabulation of faculty status, campus of residence, department affiliation, AOS membership, Institution of degree, & research interests
 - b. Tabulation of patents, publications, grants, MEES students supervised, non-MEES students supervised, committee service, MEES courses taught, non-MEES courses taught
- D. Current students
 - a. Degree sought, entry date, advisor, location, AOS, GPA, gender, ethnicity
- E. Alumni
 - a. Advisor, degree awarded, entry date, graduation date, title of research, current position
- F. Featured Alumni
- G. Courses taught by laboratory or campus
- H. Courses offered 2005-2008
- J. Course listings and requirements by AOS
- K. Progress Report Forms
- L. Academic Policies
- M. UMCES Graduate Education Self Study 2003
- N. Learning Outcome Assessments
- O. Institutional Perspectives
- P. 1989 MEES Self Study

A self study was previously conducted in 1989 and the report may be informative to the external review committee (Appendix I – P). Additional and ancillary information can be found at the MEES website: www.mees.umd.edu.

2. Institutional Structure

Participating institutions

Faculty from many different places within the USM participate in the MEES program including in alphabetical order:

University of Maryland, Baltimore - Baltimore

- Dental School
 - Biomedical Sciences
- School of Medicine
 - Epidemiology and Preventive Medicine
 - Medical and Research Technology
 - Oncology

University of Maryland Baltimore County - Catonsville

- College of Arts, Humanities and Social Sciences
 - Geography and Environmental Systems
- College of Engineering and Information Technology
 - Civil and Environmental Engineering
- College of Natural and Mathematical Sciences
 - Biological Sciences
 - Chemistry and Biochemistry
 - Physics

University of Maryland Biotechnology Institute

- Center of Marine Biotechnology – Baltimore

University of Maryland Center for Environmental Science

- Appalachian Laboratory - Frostburg
- Chesapeake Biological Laboratory - Solomons
- Horn Point Laboratory - Cambridge

University of Maryland, College Park – College Park

- A. James Clark School of Engineering
 - Civil and Environmental Engineering
- College of Agriculture and Natural Resources
 - Agricultural and Resource Economics
 - Animal and Avian Sciences
 - Environmental Science and Technology
 - Plant Science and Landscape Architecture

- College of Architecture, Planning and Preservation
 - Urban Studies and Planning
- College of Behavioral and Social Sciences
 - Anthropology
 - Geography
 - Government and Politics
- College of Chemical and Life Sciences
 - Biology
 - Cell Biology and Molecular Genetics
 - Chemistry and Biochemistry
 - Entomology
- College of Computer, Mathematical and Physical Sciences
 - Atmospheric and Oceanic Science
 - Geology
- School of Public Policy

University of Maryland Eastern Shore – Princess Anne

- School of Agriculture and Natural Sciences
 - Agriculture
 - Food Science and Technology
 - Natural Sciences
- School of Business and Technology
 - Business, Management and Accounting
 - Engineering and Aviation Sciences

These institutions and their affiliated facilities offer MEES graduate students access to a multitude of environments and laboratories with state-of-the-art equipment. Appendix I-B contains information about the facilities at each laboratory and campus.

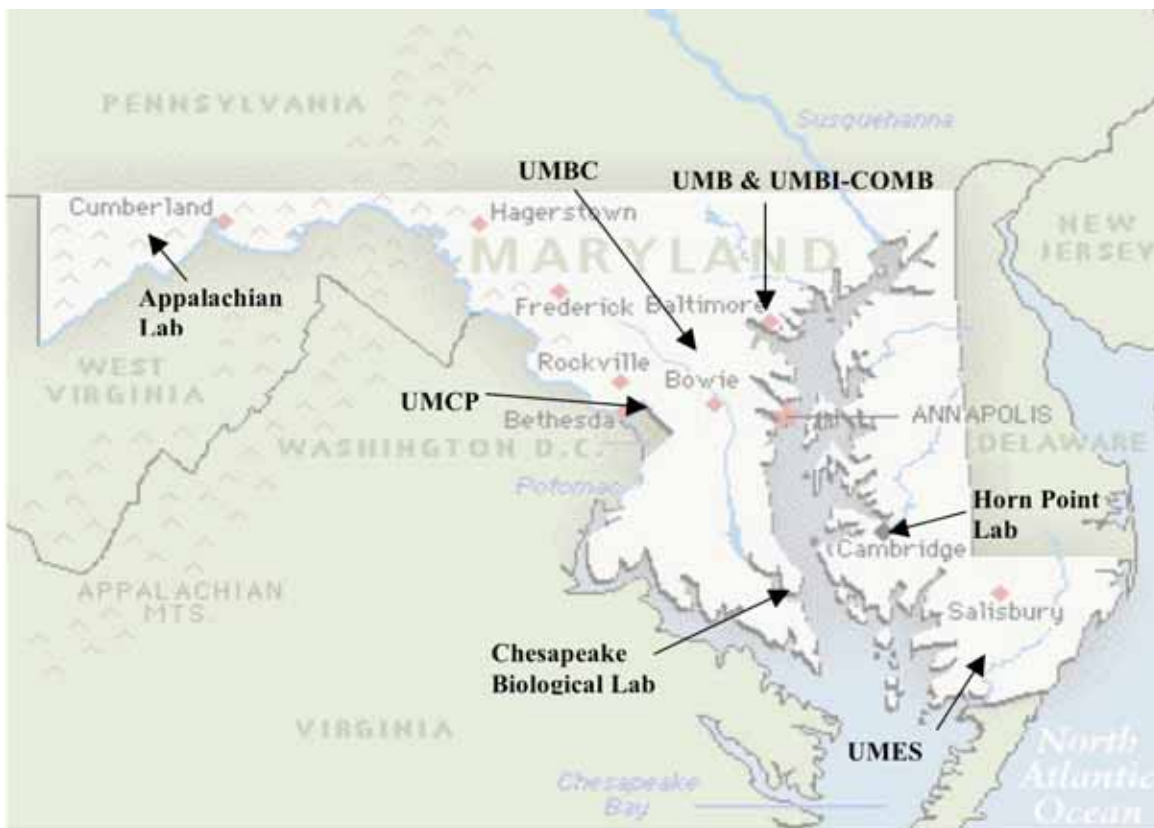


Figure 1. Map of Maryland showing locations of MEES institutions.

Associated Institutions

Special members of the MEES faculty have been appointed from numerous institutions and agencies in the area including:

- Smithsonian Institute
- US Geological Survey
- National Oceanic and Atmospheric Administration
- National Aeronautics and Space Administration
- US Department of Agriculture
- US Fish and Wildlife Service
- US Environmental Protection Agency
- Maryland Department of Natural Resources
- The Institute for Genomic Research

These special members cannot serve as major advisors but do sit on thesis and dissertation committees and are often extremely valuable contributors to the students program of study, sometimes serving as co-major advisor.

3. Governance

The system-wide nature of the MEES Program, or any other inter-institutional program, requires a strong central office to oversee and coordinate the application process, student tracking and paperwork, course offerings and scheduling and alumni tracking over the eight campuses. With a student population that comes from different departments, colleges, and even institutions, it is important the program has strong central policies that assure equitable treatment of each student within the program. Otherwise, students will recognize disparities between campuses and/or laboratories, become disgruntled and distracted by the unfairness. For example, graduate students at College Park typically receive higher stipends than those working with UMCES faculty regardless of where they live. Moreover, graduate education will be inconsistent and uneven, producing students of varying caliber and training. Although it may be difficult to mandate complete evenness in terms of financial support such as stipends levels, it should certainly be straightforward to assure academic equity wherein all students can be expected to be treated in a similar way.

Although MEES is a system-wide environmental science graduate program of the University System of Maryland, it is administered through the University of Maryland, College Park, in the College of Chemical and Life Sciences (CLFS). Dr. Norma Allewell serves as Dean of the College and is the immediate supervisor of the Director of the MEES program. CLFS carries a specific budget dedicated to the MEES program (see below). The President of the University of Maryland Center for Environmental Sciences (UMCES), Dr. Donald Boesch, plays an important and formal advisory role to the Dean of Chemical and Life Sciences with regard to the governance of MEES.

The MEES program is directed by a single faculty member who is paid to dedicate 50% time to the program. The current director is Dr. Kennedy T. Paynter, Associate Professor at the Chesapeake Biological Laboratory, UMCES, and Director, College of Chemical and Life Sciences, UMCP. The director is assisted by a full time assistant director, Debbie Morrin-Nordlund, who oversees the day-to-day operations of the program. Typically, several part-time clerical staff persons assist the assistant director. These may be part-time staff or graduate students provided an assistantship for their services.

The director is responsible for final admissions decisions as well as all recommendations made to the graduate school regarding student advancement, changes, or termination. He is also responsible for all budgetary issues and the assignment of teaching assistantships and other financial rewards/stipends to students. The director also chairs the Program Committee (see below) and typically proposes changes in policy or other programmatic matters. It should be noted that the director has no formal authority over any MEES faculty member except in the power to terminate a faculty member's association with the program. Therefore, unlike a department chair, dean, or lab director, the MEES director has little power to influence, control, or otherwise administer MEES faculty. The MEES program, then, is run based on the goodwill and dedication of a relatively small group of faculty, and not by formal or contractual obligation to the

MEES program or the College of Chemical and Life Sciences. That said, the altruism and dedication of most of its faculty members is a strong driving force in MEES.

The primary governing and policy setting body of MEES is the Program Committee, comprised of the Chair and Chair-elect of each AOS and an institutional representative from any institution not represented as an AOS chair or chair-elect. This group decides programmatic guidelines and requirements including time limits, comprehensive examination structure, admissions requirements, faculty membership, and other major aspects of the program. Chair-elects are nominated each year by popular vote of the faculty of each AOS. Many faculty members are members of several AOSs.

Typically, each degree-granting campus has had its own MEES coordinator. Both UMES and UMBC have had active institutional coordinators in the past. However, the UMBC coordinator recently retired and has not been replaced. The MEES director serves as UMCP coordinator. The research labs (UMCES and UMBI-COMB), whose faculty members combined comprise about 50% of active MEES faculty, have graduate education committees which oversee the distribution of tuition return funds, but do not have designated central graduate education administrators with the authority to direct teaching loads and assign teaching commitments. Although this problem is common among many, if not most, graduate programs, its affects are magnified when whole institutions lack a coordinator or centralized authority for a given graduate education program.

Applications and student management

The number of applications has remained relatively stable over the last five years at approximately 200 per year. Recently a trend of increased female applicants and students has occurred – reflecting a national trend in graduate education. MEES is now approximately 55% female. The threat of global warming and the recent interest in ‘being green’ suggests that applications to environmental programs in the next 10 years will increase significantly. MEES has a rigorous admissions review, typically accepting 25 to 30% of those who apply (Figs. 2 & 3). Admission and enrollment rates have been similar for the College, Biology department and MEES over the last 5 years. Mean GPA of undergraduate applicants has risen from near 3.0 ten years ago to over 3.3. Mean undergraduate GPA of accepted students has been about 3.5 for the last 5 years.

Applications are received through the UMB, UMBC, UMCP and UMES graduate school application processes. Once an application is complete (application, statement essay, transcripts, GRE general scores and three letters of recommendation) it is evaluated by an admissions committee (min. three members) specific to the Area of Specialization for acceptability to the program based on standard criteria (GPA, GRE scores, course background, essay, letters of recommendation, goals). If a student is found acceptable, and has an advisor secured, an acceptance request is sent to the graduate school for admission. If the applicant does not have an advisor, they are notified that they have been found acceptable, but need to secure an advisor in order to be admitted.

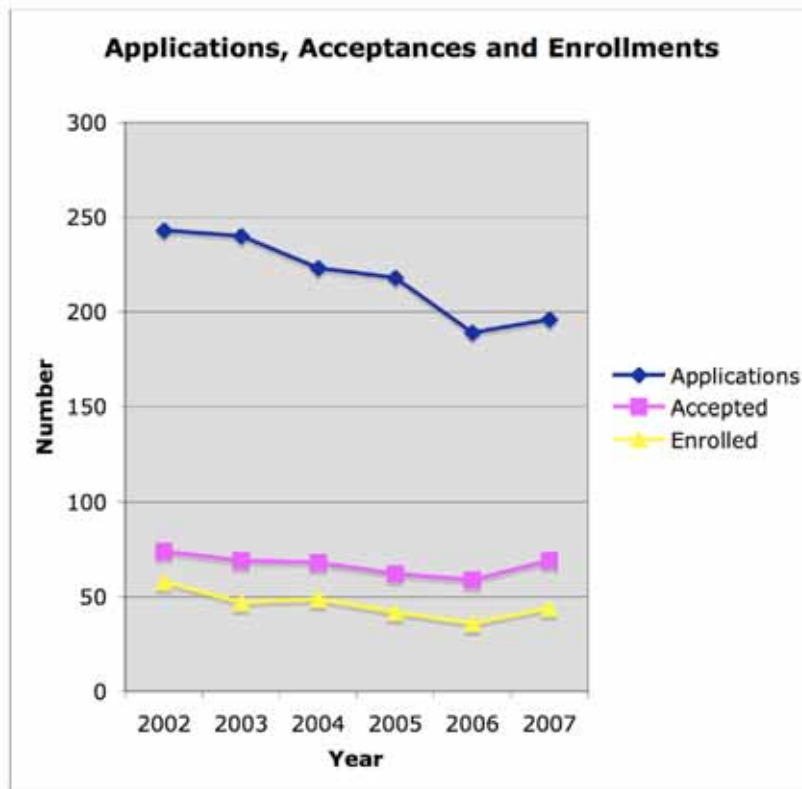


Figure 2. Applications, acceptances and enrollments in the MEES program 2002-2007.

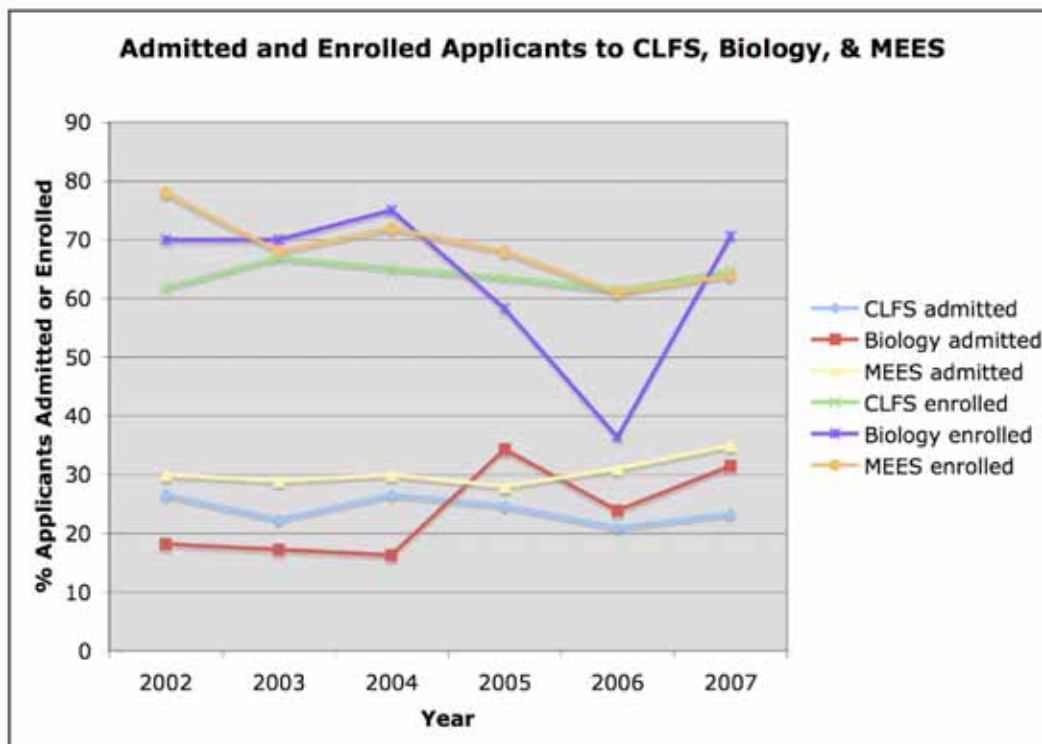


Figure 3. Admitted and enrolled applicants in the College of Life Sciences (CLFS), Biology and MEES 2002-2007.

Although it is up to the prospective student to locate an advisor, the MEES office staff provides substantial guidance to those students. In addition, the MEES office notifies relevant faculty members of highly qualified applicants to accelerate the admissions process for well-qualified students. Note that the admission process has been centralized and that the graduate schools of all participating institutions have agreed to abide by the decisions administered through the central MEES office. This ensures equity among admissions decisions across institutions.

MEES has a “progress” framework set up for both M.S. and Ph.D. students to follow throughout their graduate careers (see Appendix I-K). All students are required to form a committee, have an initial meeting prior to the end of the 2nd semester, and submit an initial research plan within the first year. Annual progress reports are required after the first year and must include an unofficial transcript and report on research progress and be signed by their committee members. MEES office staff review each progress report and bring issues or problems to the director’s attention.

Doctoral students are required to complete written and oral comprehensive exams and a formal proposal defense in order to be advanced to candidacy. Written comprehensive exam guidelines exist for each area of specialization. Doctoral students are expected to advance to candidacy within 6 semesters of matriculation. Again, these policies apply across institutions.

Learning Outcome Assessments

Assessment of educational productivity or learning outcomes has become a standard in the academic community in the last few years. In the past, the results of graduate training are often not assessed in a formal way. Learning Outcome Assessments (LOAs) have been established for both masters and doctoral students within the MEES program. LOA assessment criteria and outcomes for 2007 are presented in Appendix I – N. Please note that the outcomes for both MS and PhD students were very high in 2007.

Budget

Operating costs of graduate education including graduate student support, stipends and assistantships, housing, office space, etc are all borne separately by the various institutions that participate in MEES. Many graduate students are supported by their advisors’ research grants from the time of their entry into the program. Faculty may be hesitant to take on new graduate students unless they have secure grant funding in place for several years. In times of tight federal funding, it can therefore be difficult to find advisors willing to take on new students and this can limit the admission of students into the MEES Program. In contrast to some other graduate programs [e.g. the Graduate Program in Life Sciences (GPILS) at the University of Maryland Baltimore], the MEES Program does not have the programmatic funding to offer assistantships to incoming students for the first year or two, during which most of the student’s time is devoted to coursework. It is a testament to the commitment of MEES faculty to graduate education

that they continue to accept graduate students whenever financially possible. Stipend levels range from \$12,000 to over \$18,000 for 9 months, depending on the institution and graduate pay level, include additional support for health benefits and a waiver of tuition for up to 10 credits/semester. In general, these stipend levels are not highly competitive on a national basis. However, the additional benefit costs raise the actual value of these stipend levels by \$2,000 to \$3,000. Summer salaries are generally around \$2,500.

The annual budget for the MEES program central office has been \$200,000 to \$250,000 for the last 10 years. In 2007, the College of Chemical and Life Sciences dedicated \$233,208 to MEES and the average over the last 6 years has averaged approximately \$308,000. These funds support the director's salary for 50% of his time commitment to his post, the assistant director's salary, an office assistant, part time staff, teaching assistantships, operating costs, travel, supplies, and equipment (including two IVN classrooms). Although the program is allocated 4 or 5 teaching assistantships to award each semester by the Biological Sciences Program in the College of Chemical and Life Sciences, there are no dedicated fellowship funds or other student support within the central office budget. Competitive grants, fellowships, stipends and other support are available through all campuses and laboratories on a limited basis. However, most administrators at the degree granting institutions insist that college or departmental funds be used by students in those colleges or department, thus making MEES students at the research institutions ineligible for those kinds of support. Most students in the MEES program are research assistants supported by research grants and/or teaching assistantships.

MEES has two modest foundation accounts, about \$10,000 in each, which are used to make small travel awards and other forms of modest student support.

Inter-institutional administration

Policies without walls

Part of what makes MEES effective as an inter-institutional program has been the past support of USM officials. In 1998, then Vice Chancellor Charles Middleton agreed with the MEES program recommendation that all students in the MEES program should be held to the same standards and policies, regardless of the institutional affiliation. This was an important decision because at the time, it was not clear whether individual graduate school policies or program policies took precedence. Vice Chancellor Middleton determined that any policies deemed more academically rigorous should take precedence over less rigorous requirements. For instance, when the MEES program committee decided that the time limit for a student earning a doctoral degree was 7 years, then that became the time limit for MEES students even though the UMCP graduate school had a 9-year limit. This allowed the MEES program to establish more uniform academic structure for students across all institutions.

Tuition return funds

In order to stimulate faculty from research institutions like UMCES and UMBI-COMB to teach, a tuition return agreement was established between UMCP, which receives tuition, and UMCES and UMBI-COMB. It states that 85% of the tuition paid by students taking a MEES class taught by UMCES or UMBI-COMB faculty members would be returned to the institution to be used exclusively to support graduate education. This has been an important source of funds for UMCES students and will be for UMBI-COMB students as well (tuition return at UMBI-COMB just started in Fall 2007). In 2006/2007 academic year over \$250,000 was paid by UMCP to UMCES as tuition return. The funds are used to provide assistantships, travel, and other support for graduate student activities at both institutions.

Admissions

As stated earlier, admission procedures have been centralized in the MEES office. All applications, whether they are received by the graduate schools of UMCP, UMES, UMB, or UMBC are routed through and administered by the central MEES office. Complete applications are reviewed by MEES faculty and final recommendations for admission are made by the MEES director and forwarded to the appropriate graduate school.

Institutional coordinators/administrators

Although a centralized, universal administration is important to large, inter-institutional programs like MEES, a decentralized tier of administration is also needed. Coordinators and/or administrators at each campus/lab with some degree of academic authority are important especially with regard to administrative service of faculty and students at that campus and the coordination of such broader activities such as curriculum development. Original program structure calls for them, but the MEES program has been relatively unsuccessful at maintaining coordinators at some participating institutions. The most successful has been UMES where a separate budget line for MEES was established for support of the MEES program at UMES in 1989. An institutional representative from UMES has been actively involved in MEES since the late 1980s, played the role of MEES campus coordinator at UMES and represented UMES on the program committee. Funds dedicated by the USM as budget line items in support of MEES administration at each campus and institution would be extremely helpful.

Colloquium

An annual colloquium is held each fall for MEES students and faculty. It is hosted on a rotating basis among the institutions that participate in MEES. Each 3rd and 5th year student is asked to present a poster on his or her research. This serves two purposes: 1) it provides a critical mass of presenters (about 50) for the afternoon poster session and 2) provides an opportunity for a 'progress check' of sorts on the 3rd and 5th year students. Typically, 80 to 100 students attend. Fifty to sixty faculty members typically attend.

Activity fee waiver

Many MEES students who are registered at College Park live in Frostburg, Baltimore, Cambridge, or Solomons, Maryland, at locations at least an hour away from the College Park campus. In 1999, the current director negotiated with the bursar at the University of Maryland, College Park, to waive the activity fees of non-UMCP-resident MEES students. These fees, which are \$317/semester (for 1 to 8 credits) or \$538 (9 or more credits) in 2008, are charged to students to support various campus activities including the gyms, shuttle buses, etc. Since non-resident MEES students do not use these services, the bursar agreed that they could be waived. Since that time, each semester the MEES program submits a list of students who are registered at UMCP but non-resident and their activity fees are waived. Since its inception, this agreement has saved MEES students more than \$4.2 million.

Institutional Perspectives

During the faculty-wide review of this document, institutional leaders were invited to submit a brief perspective relating the importance of the MEES program to their institution, any specific assets they felt they brought to the program and any concerns or issues they felt were pertinent to their institution regarding the review. They have been included in Appendix I – O.

4. Curricular structure

A. Areas of Specialization (AOSs)

MEES is a competitive graduate program with high admission standards and requiring independent and original research from both Masters and Doctoral students. Each AOS has its own focus, educational goals and curricular structure. Although six areas of specialization exist, they have some common prerequisites for admission into the program. These prerequisites include:

- 2 semesters of physics
- 2 semesters of biology
- 2 semesters of calculus
- 2 to 4 semesters chemistry, organic chemistry and/or biochemistry (depending on the AOS)

Courses taught by MEES faculty sorted by laboratory or campus are tabulated in Appendix I – G. All courses offered by MEES faculty in the last five years can be found in Appendix I – H. Some of them may not be currently offered but have been included for the review. Course listings and requirements by AOS are listed in Appendix I – J.

Ecology

The MEES Program provides access to a broad curriculum of interdisciplinary graduate training and research in ecology. Within this Area of Specialization, approximately 60 scientists throughout the campuses are involved in teaching and research. Facilities are available on the campuses and in their environs to allow students a wide range of ecological research experience.

Ecology is a broad discipline encompassing terrestrial, freshwater, estuarine and marine environments. Specific areas of study include behavioral, community, evolutionary, marine, benthic, limnological, systematic, and physiological ecology. Variations and/or combinations of one or more of these subdisciplines are common (e.g., marine benthic community ecology as one area of study or the evolution of terrestrial communities as another). Students successfully completing this AOS go on to academic appointments in a variety of departments (e.g., Environmental Sciences, Ecology, Biology, Zoology, Botany, etc.), or work for environmental consulting companies, as well as federal or state government agencies.

Due to the nature of the MEES Program, heavy emphasis is placed on the student's unique research interests and goals in this AOS. As such, core course requirements are kept to a minimum. The student's course load is determined by each student and his or her advisory committee on the basis of the individual's research topic and previous academic experience. The University System of Maryland has a wide and diverse set of course offerings in ecology and related areas, making it possible for students in almost any area of ecology to create a beneficial program of study.

Ecology AOS Core Courses and Other Requirements (M.S. and Ph.D.):

1. Population Biology, including mathematical modeling (600 level, 3-4 credits)
2. Ecosystem Ecology and/or Community Ecology (600 level, 3-4 credits)
3. One course from one of the other MEES AOSs (from an approved list)
4. One course in Statistics/Biostatistics (600 level for the Ph.D., 400 level for the M.S.)
5. One graduate level seminar for each year in residence (on average) up to cap
6. One course or seminar in Management, Policy, Ethics or Philosophy of Science (400 or 600 level, 1-4 credits)
7. One specialized field or laboratory based Ecology course is recommended
8. Courses in experimental design and analysis and scientific writing are recommended.

Environmental Chemistry

The objective of the Environmental Chemistry AOS is to train scientists to apply basic chemical principles to the study of the environmental behaviors of natural and anthropogenic chemicals. Environmental chemistry includes interdisciplinary studies that integrate across geochemistry, analytical chemistry, transport processes, and toxicology to determine the cycling and impact of chemicals in the natural environment. With over 25 faculty and excellent research facilities equipped with state-of-the-art analytical instrumentation across campuses, opportunities are available for wide-ranging chemical studies.

Students graduating from MEES through this AOS generally find professional positions in federal, state, and local government agencies (such as EPA, FDA, NIH), private chemical and manufacturing industries, academic institutions, and consulting firms.

The University System of Maryland campuses have a wide and diverse set of course offerings in environmental chemistry, geochemistry and related areas, making it possible for students in almost any area of chemistry to create a beneficial program of study within this AOS.

Environmental Chemistry Core Courses and Other Requirements (M.S. and Ph.D.):

1. One fundamental and one advanced course in Environmental Chemistry or Geochemistry (one 400-600 level, one 600-700 level, 3-4 credits)
2. One course in Physical Transport Processes (600 level 3-4 credits)
3. One course in Aquatic Toxicology/Ecology (600 level 3-4 credits)
4. One 400 or 600 level course from one of the other MEES AOSs (from an approved list)
5. One course or seminar in Environmental Management, Policy, Ethics, or Philosophy of Science (a 3-4 credit course can satisfy item 4) (400 or 600 level)

6. A course in Statistics/Applied Mathematics (600 level for the Ph.D., 400 level for the M.S.)
7. One graduate level seminar for each year in residence (on average) up to cap
8. One or more courses in Physical Chemistry are strongly encouraged (2-4 credits each)
9. Courses in experimental design and analysis and scientific writing are recommended.

Environmental Molecular Biology/Biotechnology

Molecular approaches pervade every biological discipline, and MEES campuses have over 35 faculty members who emphasize molecular mechanisms of ecological interactions and dynamics. Expertise includes molecular microbial ecology and physiology; bioremediation; molecular endocrinology of fish growth, development and reproduction; environmental stressors contributing to fish physiological dysfunction and oncogenesis; mechanisms and stressors of nitrogen fixation; molecular models of marine surface colonization; molecular cues of organism-organism interaction; and invertebrate immunity. The Environmental Molecular Biology and Biotechnology Area of Specialization encourages interaction between campuses and is synergistic with other AOSs.

Graduates of the Environmental Molecular Biology/Biotechnology AOS will most often be found employed in academic and research institutions (governmental and private), as well as consulting and other private sectors.

Campuses and departments throughout the University System of Maryland offer courses (lecture and laboratory) and facilities for the student of molecular biology, genetics, pathogens, immunology, biotechnology and other related areas within the realm of this AOS.

Environmental Molecular Biology Core Courses and Other Requirements (M.S. and Ph.D.):

1. One course in Molecular Biology/Genetics (600 level, 3-4 credits)
2. One course in Cell Biology/Physiology (600 level, 3-4 credits)
3. One course in Ecology (400 or 600 level, 3-4 credits)
4. One course in Advanced Chemistry /Biochemistry (400 or 600 level, 3-4 credits)
5. One elective 400 or 600 level course
6. One course or seminar in Environmental Management, Policy, Ethics, or Philosophy of Science (a 2-4-credit course can satisfy item 5) (400 or 600 level)
7. One course in Statistics/Biostatistics (600 level for the Ph.D., 400 level for the M.S.)
8. One graduate level seminar for each year in residence (on average)
9. Courses in experimental design and analysis and in scientific writing are also

recommended

Note: For the M.S. degree, only three of the first four requirements must be fulfilled (5-8 are required for all students).

Environmental Sciences

This Area of Specialization provides broad but comprehensive training in the environmental sciences. It is clear that some students do not want to specialize in a scientific discipline to the extent the other AOSs require, but would like to gain experience and take courses in a variety of scientific, economic, and social disciplines related to the environment. Faculty from all other MEES AOSs are potentially involved in teaching and advising Environmental Science graduate students.

Graduates from the interdisciplinary Environmental Sciences AOS often find positions in various governmental sectors (federal, state, local), academic institutions, consulting, international and non-profit organizations.

Students are able to take advantage of courses in the sciences (biological, chemical, physical), social sciences (geography, public policy, economics, anthropology) and management offered throughout the USM in numerous departments and program.

Environmental Sciences Core Courses and Other Requirements (M.S. and Ph.D.):

1. One approved course from three of the four distribution areas (biology, chemistry, physical science, management) for M.S. students; and from each of the four distribution areas for Ph.D. students. One of these courses can be at the 400 level, the others will be at the 600 level or above
2. One course in Statistics/Biostatistics (600 level for the Ph.D., 400 level for the M.S.)
3. One graduate level seminar for each year in residence (on average) up to cap
4. One or more courses in computer science or computer applications are strongly recommended
5. Courses in experimental design and analysis and scientific writing are recommended.

Fisheries Science

Fisheries Science is a multidisciplinary field, drawing expertise from the biological, physical, and social sciences. Approximately 20 fisheries scientists study fish and invertebrate populations and communities of aquatic resources, their responses to exploitation, to changes in environmental conditions, and/or their management from the sub-cellular to ecosystem level. Much of the research is quantitative in nature and can be either basic or applied in nature.

Most career opportunities in fisheries science are in the government and academic sectors, although in recent years private businesses, research firms and aquaculture businesses offer increasingly diverse career choices.

The multidisciplinary nature of fisheries science requires broad training in areas that may include ecology, oceanography, aquaculture, economics, mathematics, seafood technology, pathology and diseases, and management science – courses that can be found through a number of campuses within the USM. Students select a curriculum with assistance from their advisor and committee that best achieves their academic and professional goals.

Fisheries Science Core Courses and Other Requirements (M.S. and Ph.D.):

Core components will be offered and at least three different core area courses must be completed by all students in the Fisheries Science AOS. The requirements may be waived if equivalent course work has been obtained elsewhere, and if the student and his or her Research Advisory committee successfully petition the AOS Committee.

1. Fisheries Science and Management
2. Fisheries Ecology
3. Aquaculture
4. Quantitative Fisheries Science
5. Graduate Level Course in Oceanography (physical, chemical or biological) or Limnology
6. One 400 or 600 level course from one of the other MEES AOSs (from an approved list)
7. One course or seminar in Environmental Management, Policy, Ethics or Philosophy of Science (item 1 may satisfy this requirement; any such 3-4-credit course can satisfy item 6)
8. One course in Statistics/Biostatistics (600 level for the Ph.D., 400 level for the M.S.)
9. One graduate level seminar for each year in residence (on average).
10. Courses in experimental design and analysis and scientific writing are strongly recommended.

Oceanography

Expertise of the 30 faculty members in oceanography within the University System of Maryland lies in the sub-fields of biological and physical oceanography and cross-disciplinary studies of marine biogeochemistry, chemical and geological oceanography. The expertise in biological oceanography includes water column nutrient cycling and trophic dynamics (comprising the entire pelagic food web and fishes), benthic ecology, and theoretical ecosystem analysis.

Students graduating from the Oceanography AOS can expect to find jobs in universities, oceanographic laboratories, government agencies (federal, state and local), and

consulting firms.

Students in this AOS have access to oceanographic courses and facilities throughout the USM. Fundamental courses in the sub-fields of oceanography are required to provide interdisciplinary breadth, but the degree coursework determined by the student's committee emphasizes the student's independent research area and goals.

Biological Oceanography Core Courses and Other Requirements (M.S. and Ph.D.):

1. One 3-credit course in Physical Oceanography (MEES 661 or equivalent)
2. One 3-credit course in Biological Oceanography (MEES 621 or equivalent)
3. One 3-credit course in Chemical Oceanography (CHEM 723), Environmental Geochemistry (MEES 626) or equivalent
4. Two 3-credit courses in Oceanography or related fields (400 or 600 level) including: a recommended additional interdisciplinary course, although item 1 above can satisfy the MEES requirement for interdisciplinary depth
5. One course in Statistics/Biostatistics (600 level for Ph.D. and 400 level for M.S.)
6. One course or seminar in Management, Scientific Philosophy or Ethics
7. One graduate level seminar for each year in residence (on average) up to cap
8. Courses in experimental design and analysis and scientific writing are recommended.

Physical Oceanography Core Courses and Other Requirements (M.S. and Ph.D.):

1. One 3-credit course in Physical Oceanography (MEES 661 or equivalent)
2. One 3-credit course in Biological Oceanography (MEES 621 or equivalent)
3. One 3-credit course in Chemical Oceanography (CHEM 723 or equivalent)
4. Two 3-credit courses in Oceanography or related fields (400 or 600 level) including: a) one course in rotating fluid dynamics, and b) one course in non-rotating fluid dynamics
5. One course in Statistics/Biostatistics (600 level for Ph.D. and 400 level for M.S.)
6. One course or seminar in Management, Scientific Philosophy or Ethics
7. One graduate level seminar for each year in residence (on average) up to cap
8. Courses in experimental design and analysis and scientific writing are recommended.

B. Course offerings

Students within the MEES program can take a variety of courses as part of their program of study. However, the current structure of the MEES program has resulted in the *ad-hoc* development of a pool of courses within each AOS with little to no 'vertical' structure in course organization. This translates to the existence of only a few advanced, upper level courses. Oceanography, Fisheries Science, and Environmental Chemistry have the most organized curricula, offering specific course steps or sequences for

required courses. However, these are limited to a few courses. In addition, many courses are offered a few times, then discontinued. Because the faculty of MEES is distributed among many institutions, it has been difficult to organize the curriculum to a great degree (see Program Strengths and Weaknesses).

Courses taught, arranged by laboratory or campus, are presented in the Appendix I-G. Courses offered in the last 5 years are presented in I-H. Lists of course requirements and available courses for each AOS are listed in Appendix I-J.

C. Proposed curricular changes

Prior to the undertaking of the self study and external review of the program, the MEES program committee conducted a series of meetings to discuss curricular changes and establish greater curricular structure. A new structure was developed and shared with MEES faculty. At this time, however, no formal proposal has been made to the governing bodies of MEES institutions for approval. Decisions regarding the formal proposal and implementation were postponed pending the completion of the external program review. As a part of the proposed curriculum revision, the course work within the first two years of a students program was rationalized and realigned to become highly organized. First, a general 'MEES' course would be taught each fall, which all incoming students would be required to take. This would be an overarching environmental course that would touch on the many disciplines associated with environmental sciences, address many broad, important topics such as global warming, and serve as a 'launching pad' of sorts for the incoming cohort of students. Introductory courses would also be established in three disciplines: geosciences, ecosciences and cellular/molecular sciences. Depending on their intended program of study, students would choose two semesters of one of the disciplines in their first year. Quantitative courses would also be established and offered on a regular basis and include general quantitative methods, experimental design, and statistics.

Therefore, within this new curricular structure and students first year would be composed of the following:

First semester

MEES 601- Overarching environmental sciences course

Discipline 601 – intro course for chosen discipline (geo-, eco-, or cell-)

Quantitative 601 – basic quantitative methods

Second semester

Discipline 602 – the second semester of the discipline specific curriculum

Quantitative 602 – Statistics

Elective

The establishment of such foundation courses allows and facilitates the development of more advanced courses and creation of a more ‘vertical’ curriculum. As students move through the foundation courses, they will then choose from a variety of specializations in addition to the current areas of specialization. Again, development of this new curricular structure has been put on hold until the internal and external reviews are completed.

5. Faculty

MEES faculty members are associated with one or more of the six Areas of Specialization. Many are ecologists and environmental scientists with specialized expertise in a broad variety of subjects from ecological modeling to wildlife management, molecular pharmacology, and marine geochemistry. Faculty members and certain biographical information are tabulated in Appendix I-C. CVs for MEES faculty for the last five years have been placed in Appendix II. The breadth of expertise in the faculty available for supporting and advising graduate students is one of the greatest strengths of the MEES program.

MEES depends on the participation of faculty members of the various member institutions. The faculty members of degree granting institutions have primary appointments in departments of those institutions and participate in MEES on a voluntary basis. Those faculty members who belong to research institutions are also largely volunteers within the program since teaching is not their primary responsibility and may not be part of their employment contract at all. However, as mentioned earlier, MEES is usually the best venue through which research faculty can train graduate students. The voluntary status of all MEES faculty is a significant administrative impediment to the program. Organization of the curriculum, assignment of teaching loads, uniformity of comprehensive examinations, and other organizational aspects of any graduate program are difficult, sometimes impossible, to undertake and enforce. That said, it is worth noting that there has been a proliferation of graduate programs on many campuses so faculty are pulled in many directions and this problem of faculty commitment (of time, etc) to graduate program administration is becoming a problem for all programs.

Table 1. Distribution of MEES faculty, students, course offering and graduates among institutions and laboratories for the last 5 years. (other courses are currently being tabulated).

Lab/Campus	Current # of Faculty	Current # of Affiliate Faculty	Fall 2007 # of Students	M.S.	Ph.D.	MEES* Courses taught 2003-2007	M.S. Degrees 2003-2007	Ph.D. Degrees 2003-2007
UMCP*	48	10	39	18	21	40	21	23
UMES*	25	5	36	19	17	15	20	8
UMBC*	16	2	14	4	10	1	6	3
UMB*	8	0	0	0	0	0	0	2
UMCES - AL	13	0	8	2	6	35	8	6
UMCES - CBL	18	1	28	10	18	54	28	17
UMCES - HPL	30	2	36	21	15	48	17	16
UMBI-COMB	17	3	18	1	17	15	6	20
Total	175	23	179	75	104	193	106	95

*Many non-MEES courses are taught by MEES faculty through campus departments at the degree-granting institutions and thus are not formally MEES courses but may be used in the program of study of a MEES student.

Faculty expertise tends to be focused by location. For instance, UMBI-COMB faculty expertise is nearly all in environmental molecular biology while the Horn Point Lab houses many oceanographers and ecologists. The Chesapeake Biological Laboratory has environmental chemists, system ecologists and fisheries experts in its faculty. Each institution/lab tends to be self-centered in its graduate education and graduate student support. Each determines individual levels of stipend or assistantship support; each determines office space, and copier and printer support.

In the last 5 years, MEES has awarded 106 masters degrees and 95 doctorates (Table 1, see Appendix I - E). Abstracts of theses and dissertations awarded over the last five years are included in Appendix III. All degrees are awarded through a degree-granting institution. The vast majority of students at the research institutions (UMCES and UMBI) are awarded degrees through UMCP. That said, the breakdown among research campuses is interesting. The Chesapeake Biological Laboratory (CBL) has produced the most graduates over the last 5 years (45) and taught the most courses (54). This is particularly impressive in light of having only 19 faculty members. UMB has been inactive for several years since changes occurred in the Pathobiology laboratory, where MEES students usually conducted their research. However, 2 PhDs were awarded through UMB during 2003-2007. Note that the research labs (AL, CBL, HPL & UMBI-COMB) contribute just under half of the faculty population and about half of the student population, but teach over 75% of MEES courses. UMCES faculty members are the single dominant group of faculty of any participating institution, advising nearly half of all MEES students.

6. Students

In general, applicants to the MEES program are highly competitive and do very well while in graduate school. The current MEES student population is listed in Appendix I-D. Mean time to finish for MEES graduates 2003-2007 was 3.3 years for MS and 6.5 years for PhD. Mean GPA for those students was 3.59 for MS and 3.65 for PhD. The majority of MEES doctoral students are Caucasian (58%) but foreign students, mostly from Asia, make up 30% of the student body. African Americans represent 2% of MEES doctoral students and Hispanic Americans 2%. Asian Americans made up 5%.

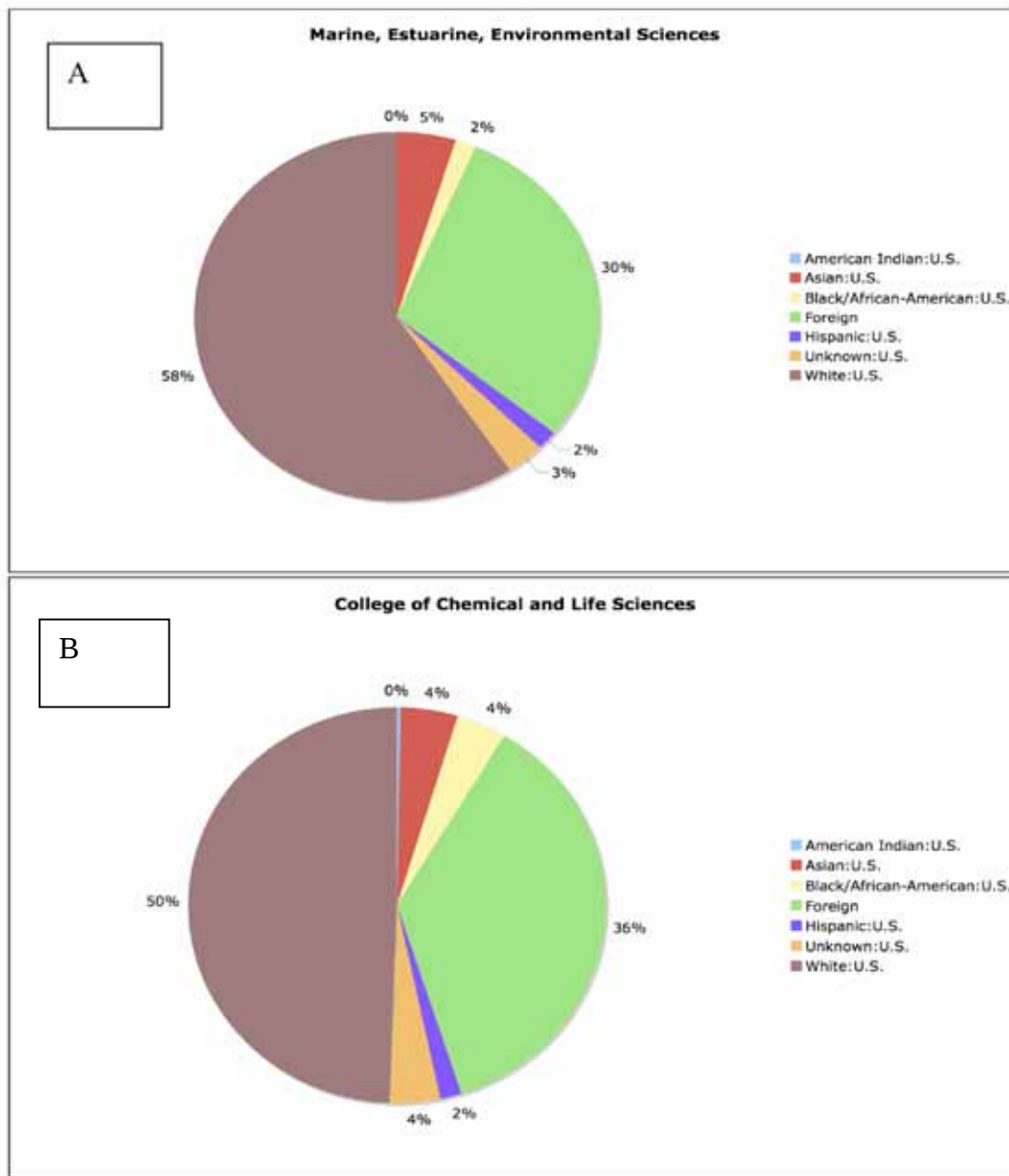
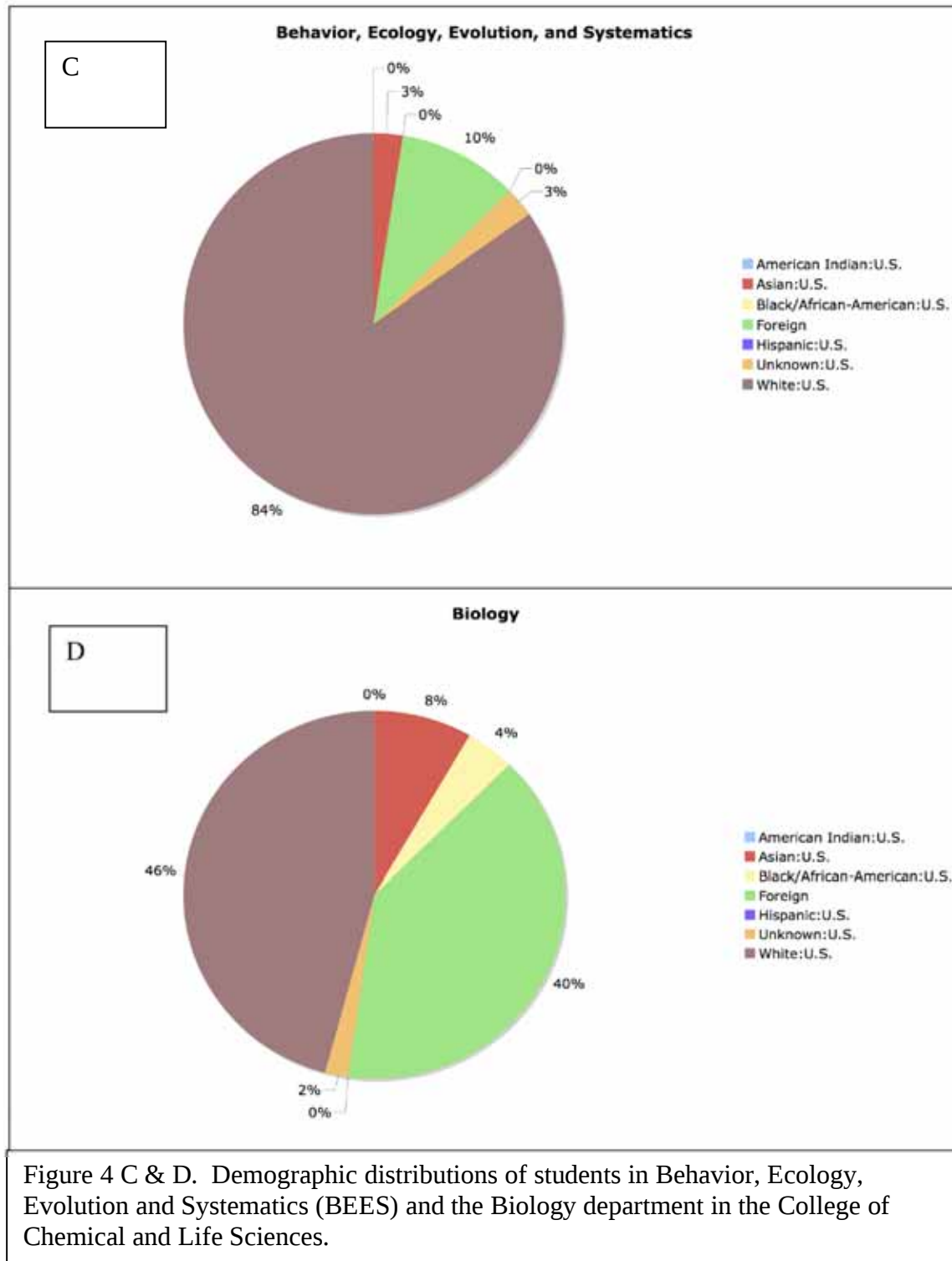


Figure 4 A & B. Demographic distribution of students in MEES and the College of Chemical and Life Sciences.

(see Fig. 4 A-D). Distributions within the MEES program (A) are similar to the overall College of Chemical and Life Sciences (B; CLFS) and the Biology department (D) showing a primary population of white Americans followed by a preponderance of foreign students from 30 to 40%. However, the Behavior, Ecology, Evolution and Systematics (C; BEES) program is very different, dominated by white Americans (84%).



Graduate Record Examination (GRE) scores of incoming doctoral students are reported in Table 2. Mean scores of incoming MEES students have improved over the last 5 years and were higher than Biology and overall CLFS student scores in 2005-2006.

Table 2. GRE scores among the doctoral students enrolling in the MEES program and comparative scores from students in the Biology Department and in the overall graduate student population of the College of Chemical and Life Sciences (CLFS).

	2003-2004	2004-2005	2005-2006
Mean Score, Verbal GRE	530	520	590
Mean Score, Quantitative GRE	645	660	720
2005-2006	MEES	Biology	CLFS
Mean Score, Verbal GRE	590	572	541
Mean Score, Quantitative GRE	720	700	682

Table 3. Student distribution among campuses and AOSs.

	Ecology	Env Chem	Env Mol Biol	Env Sci	Fisheries	Oceanography	Campus Total
UMCP	17	2	1	15	3	1	39
UMB	0	0	0	0	0	0	0
UMBC	2	0	1	10	0	1	14
UMES	6	11	6	7	6	0	36
UMCES AL	3	0	0	5	0	0	8
UMCES CBL	3	6	2	3	11	3	28
UMCES HPL	9	3	0	11	2	11	36
UMBI- COMB	0	0	17	0	1	0	18
Total MEES	40	22	27	51	23	16	179

The distribution of students within the MEES program among labs and campuses and Areas of Specialization is presented in Table 3. Current students are also listed in the Appendix I-D along with some relevant biographical and academic information. As the data in Table 3 show, students at UMCES and UMBI-COMB comprise about half of all students in the MEES program. Note that student populations at certain campuses are members almost entirely of a single AOS. The majority of students (17 out of 18) at UMBI-COMB, for instance, belong to the Environmental Molecular Biology AOS. In contrast, some campuses have a diverse student AOS distribution such as UMCES-CBL, which has at least 2 students from each AOS. Conversely, some AOS populations are focused on certain campuses. For instance, 11 of 16 oceanographers are in residence at UMCES-HPL. On the other hand, students in the Environmental Science AOS are spread across 5 of the 6 AOSs.

7. Alumni

Recently, we have developed an extensive alumni database (see Appendix I-E) and discovered that most of our former students are doing very well in the real world. Figure 5 shows the career placement of 2003-2007 PhD graduates. Figure 6 shows the placement of Master degree recipients.

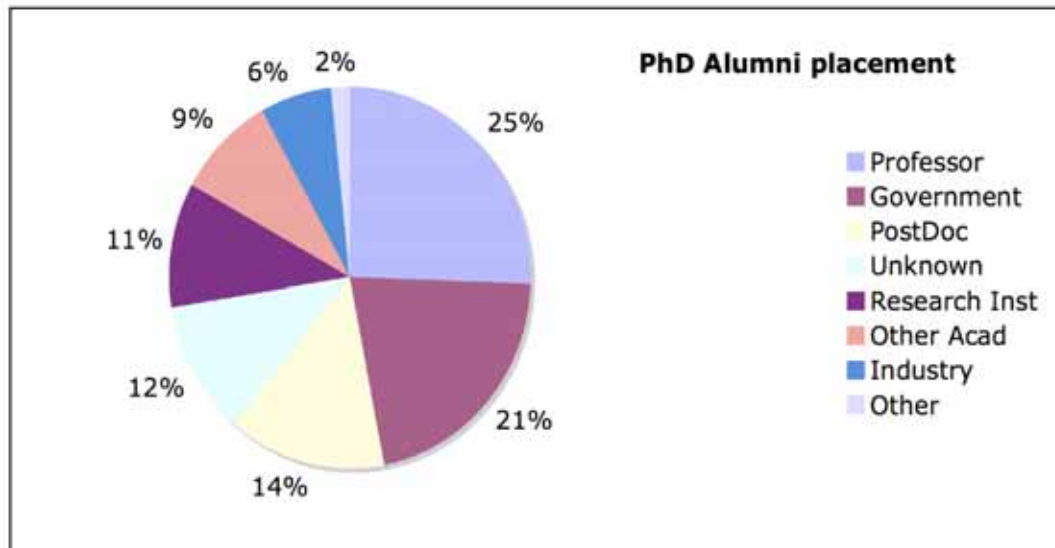


Figure 5. Placement of alumni PhD degree graduates 2003-2007.

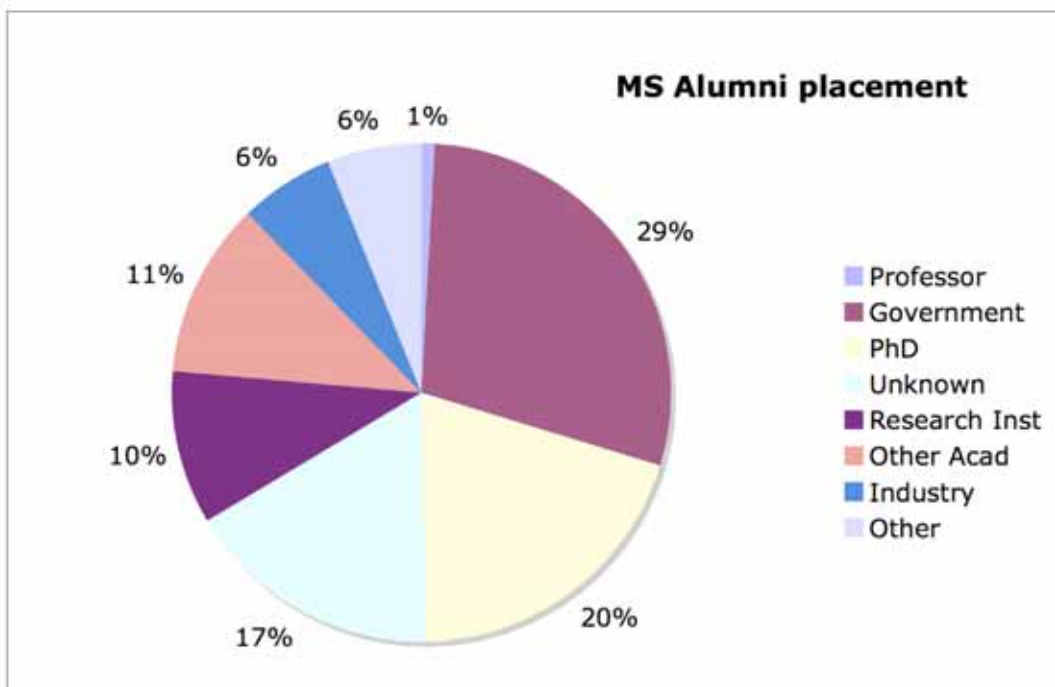


Figure 6. Placement of alumni MS degree graduates 2003-2007.

Most (60%) PhD recipients have moved into academic or government jobs. Of masters recipients, 29% got government jobs and 20% have moved on to earn their PhD. MEES has spawned some auspicious alumni, among them Richard Arnold, who will be aboard the next space shuttle mission scheduled for November 2008. Appendix I-F features short biographical sketches and pictures of a subset of our alumni.

8. Program Strengths and Weaknesses

The main strength of the MEES program is the broad faculty expertise in environmental sciences that is available to all students and an integration and framework for collaboration across campuses. From this pool of highly talented faculty members, students can select any individuals to comprise their thesis or dissertation committee. For instance, a student whose advisor is at the Chesapeake Biological Laboratory can select faculty from University of Maryland College Park, the University of Maryland Baltimore County or UMBI's Center of Marine Biotechnology in Baltimore. In addition, special members of the faculty – temporary faculty appointments from non-academic institutions – can be created as well. MEES has special faculty members from NASA, the Smithsonian Institution, USDA, EPA, USFWS, and many other governmental and non-governmental organizations. Thus, rather than a parochial committee composition of five faculty members, three of which are required to be from within a department, MEES encourages faculty involvement from broad backgrounds and bypasses institutional barriers.

This broad faculty participation goes hand-in-hand with the interdisciplinary nature of the program, curriculum, faculty and students. MEES seeks to expose students to a spectrum of environmental issues and disciplines while requiring focused and original research from each student. MEES students learn the discipline required to undertake thesis and/or dissertation research, but also understand the context of their work in a larger world of the environment. Finally, the combination of the diverse laboratory facilities especially found at UMCES labs, two of which are on the shores of Chesapeake Bay and one in the mountains of western Maryland, and UMBI-COMB, provide unique and important opportunities for graduate education.

The success of the MEES program is no better represented than by its alumni. Appendix I-E lists alumni and shows what they have done and/or are doing now. Many have become leaders in their field and many are involved in state or federal agencies, making important decisions regarding the environment. Appendix I-F is dedicated to a subset of “featured alumni” who have gone on to pursue exciting and productive careers.

The major weakness of the program is the lack of standardized support across the eight USM sites – financially, administratively, and pedagogically. This includes support of students, curriculum availability and program support processes (staff and financial). That said, each campus/laboratory contributes substantially to the MEES program at its own location in a variety of ways. The major problem is the lack of effective de-centralized authority and the inability of the MEES program to influence or otherwise control/incentivize participating faculty or administrators. For instance, once a certain curriculum has been established (i.e. a three course sequence in environmental chemistry), the MEES program has no formal authority to ensure those three courses will be taught. Many participating faculty at teaching institutions have substantial departmental teaching loads outside of the MEES program. Getting release time to teach in MEES requires understanding by departmental chairs at these institutions. Some of these faculty members do not have any teaching requirement as part of their employment contracts, having instead requirements in areas such as economic development. Many teach on a volunteer basis

because of their willingness to take on additional workloads and responsibilities and because of their commitment to graduate education. The result is a great disparity in the teaching loads and involvement among MEES faculty members with a handful of faculty members carrying the majority of the graduate education load. This is evident in the makeup of the MEES program committee, which has been made up of a small minority of faculty members for nearly a decade.

Finally, the number of environmental science programs and departments has grown within the USM in an uncoordinated and unstructured way over the last decade. This growth and fragmentation threatens many aspects of quality environmental graduate education. It also threatens the exchange across campuses of intellectual diversity associated with graduate education. The environmental graduate programs, which are in many cases redundant and overlapping, confuse potential students and create an unhealthy competition among colleges, departments and faculty. For instance, as departments such as Environmental Science and Technology in the College of Agriculture at UMCP are established, their faculty may be more predisposed to advise graduate students through the department rather than a program like MEES. On the other hand, a well coordinated environmental science graduate education effort, be it a multi-institutional school or college, could offer the most relevant faculty to students and bring structure to the development of various bodies of expertise within the many departments, labs and centers involved. The MEES program could serve as a model for such a multi-campus program.

Issues and Needs

A formal framework for inter-institutional entities such as the MEES program should be established within the University System of Maryland (USM). MEES has developed and matured to the point of being as good as it can be without such a framework. Coordination, integration among campuses, and reduced fragmentation will promote intellectual diversity and cohesive programs of study in environmental sciences within the University System of Maryland. The lack of clear lines of authority and the specific commitment of faculty to the program reduces the program's ability to undertake the development of curricular structure and the subsequent development of such things as training grants and fellowship programs. A governance structure is needed within which faculty get credit for their efforts in teaching and curriculum development despite their primary appointments in other departments, colleges or institutions. Accompanying this administrative structure must be some form of financial support design such that participation in the MEES program does not penalize contributing institutions. Funding is needed at each participating campus for administrative oversight and clerical needs, as well as student support in the form of teaching and research assistantships. Opportunities for funding, teaching and other graduate activities should be available to MEES students at the same level as other graduate students in "home" based programs (e.g. MEES students mentored by a faculty member in Entomology should have the access to the same opportunities as an Entomology graduate student). Issues as simple as lack of office space and lack of departmental mailboxes can make MEES students feel as "second class graduate students" at some campuses. If MEES had a substantial funding base from which to provide

competitive stipends and some fellowships, it would improve recruitment and retention not only the top students but also keep faculty more engaged and committed to the program.

Centralized and standard policies that apply across campuses and institutions are essential to ensure discipline and fairness in the graduate education that the MEES program provides. To reach this goal, each institution and all of the faculty participating should formally agree to participation in the MEES program, and to embrace and abide by the policies and goals of the program. This might come in the form of a memorandum of understanding or other formal agreement. A well-defined academic structure that clearly identifies lines of authority, policies, goals, objectives, rights and responsibilities within and among institutions is important for MEES to continue to be successful.

9. Summary

The MEES program has improved and grown over the last ten years and has arrived at a crossroads in pursuit of its academic goals. In order to improve interdisciplinary, multi-institutional graduate education in environmental sciences, however, major system-wide administrative changes should be considered to create a stronger academic structure, a more fully involved faculty, and provide incentives and rewards for participation. The curriculum, or sets of curricula, should be restructured and a central program governing body should have the authority to coordinate faculty members to undertake and accomplish such restructuring. That said, decentralized, coordinators/administrators, who might at least in part make up that governing body, could help organize and coordinate the MEES effort at each campus or lab, bringing the assets, needs, concerns, and goals of each campus or lab to the effort. Budget lines specifically dedicated to support MEES administration and students *at each institution* would allow such structure at each campus. These funds, along with formal agreement defining the administrative structure of the program, the rights of the participating students and faculty, and the commitment of the institution, would solve many problems. Scott Bass, Dean of the Graduate School at UMBC, summed it up nicely in one of his comments on a draft of the self study document: "...arrangements to make MEES financially viable with sufficient assets to involve and reward both departmental leadership and individual faculty in decision-making and instruction, [would create] greater buy-in to the Program and the recognition for certain universal operational procedures across sites."

The MEES program:

1. Strengths

- a. Scientific excellence of faculty teaching and mentoring in the program
- b. Large inter-institutional faculty shared across many disciplines
- c. Strong academic policies governing student admission and progress
- d. Widely recognized inter-institutional agreements and cooperation
- e. Cordial and productive working relationships with and among the provosts, deans, and laboratory directors of participating institutions
- f. Facilities and equipment available at a variety of institutions and laboratories across the state including mountain and shoreline access
- g. Broad training opportunities in both field and laboratory settings
- h. Excellent students with an annually strong applicant pool
- i. Strong performance of students after graduation
- j. 30% international students
- k. Annual system-wide student colloquium
- l. Well developed interactive video network utilization and web-based course support

2. Weaknesses

- a. Lack of specific budget lines at each campus and laboratory to support administrative and clerical needs as well as graduate assistantships

- b. Dependence on ‘volunteer’ faculty resulting in poor coordination of faculty effort and curriculum
- c. Lack of recognition of MEES faculty and students as *bona fide* members of the academic community at some campuses and/or within some colleges
- d. TA and RA stipends across most institutions are too low to be competitive nationally
- e. Inequities in graduate student treatment including office space, computer/IT/library resources, comprehensive examinations, and stipends between programs and campuses lower student morale and satisfaction
- f. Too few faculty actively involved
- g. Differences, sometimes institutional, exist in expectations of educational outcomes and faculty commitments
- h. Inability to incentivize, encourage and coordinate the production and submission of training grants
- i. Lack of inter-institutional information technology (IT) coordination – electronic submission of grades, for instance, and IVN classroom support
- j. Uncoordinated development of environmental science departments and programs that may be redundant and/or competing with the MEES program.

3. Recommendations

Restructure MEES organization both within and across participating USM institutions

- a. Create formal commitments of faculty and administrators to a system-wide environmental graduate education program
- b. Create/expand budgetary commitments to support faculty, students, and administrators participating in this system-wide program
- c. Create administrative structure that facilitates inter-institutional administration, collaboration and cooperation.