REPORT OF THE OCEAN SCIENCE EDUCATORS RETREAT 2005

By

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OSER 2005 was co-hosted by the Consortium for Oceanographic Research and Education and Woods Hole Oceanographic Institution

Steering Committee: Dr. John Farrington (MIT/WHOI Joint Program), Dr. Arthur Nowell (U. Washington), Dr. Peter Betzer (University of South Florida), Dr. Gary Griggs (U. California @ Santa Cruz, and Dr. Nancy Targett (University of Delaware). CORE staff: CORE Education Director Dr. Susan Cook, CORE President Richard West, NOSB Director Susan Haynes and Education Coordinator Henry Hope.

EXECUTIVE SUMMARY

Since 1994, the Ocean Science Educators Retreats (OSER) have been convened every two to three years by the Consortium for Oceanographic Research and Education (CORE), now operating as part of the Consortium for Ocean Leadership. OSER is an expansion of the Joint Oceanographic Institutions Dean's Retreats which have been held biennially beginning in 1980 to assess demographics and various aspects of graduate education in the ocean sciences. The 2005 OSER meeting was hosted by Woods Hole Oceanographic Institution on October 26-28, 2005. This report of the meeting contains an overview assessment of graduate education as reflected in demographic data for the academic years 2002-2003 and 2003-2004. The data were collected by CORE via a survey sent to all member institutions with graduate education programs. Thirty programs responded from twenty-six universities, colleges, and institutions. Data analyzed by Steering Committee Member Russ McDuff formed the basis for the workshop's lead plenary talk and subsequent discussion. Subsequent comparison of this survey data with the geosciences and ocean sciences sectors of annual Science and Engineering Indicators reports from NSF by John Farrington demonstrate that the CORE survey dataset is reasonably robust and provides a useful survey of ocean sciences graduate education and postdoctoral efforts.

Breakout groups at the retreat addressed effective strategies for recruiting students, financial support for graduate students, and career services and career retention. Additional plenary sessions included a synopsis report on a recent workshop "Mentoring Physical Oceanography Women to Increase Retention" (MPOWIR), the potential role of CORE in funding opportunities for strengthening marine graduate education, and future challenges related to the education sections of the U/S Commission on Ocean Policy Report of 2004. Invited Panels addressed the issues of: (i) Strategies for Enhancing Diversity in the Ocean Sciences, and (ii) Graduate Student K-12 (GK-12) Fellowship Experience and experiences from similar programs.

At the Retreat, there was consensus that CORE survey data contain important and useful information for ocean sciences as a whole and for individual programs. In addition, the workshop's overview of survey data, coupled with focused plenary, breakout and panel discussions, led to a series of important recommendations described in the next section.

SUMMARY OF RECOMMENDATIONS

1) CORE (now the Consortium for Ocean Leadership) and its members should continue the OSER workshops every two to three years. A more concerted effort should be made to have representatives from each graduate program attend the next OSER workshop and to have all members complete the survey.

2) Federal Agency Programs Managers, representatives of business and industry and government agencies employing Masters and Ph.D. degree recipients in ocean sciences, engineering, fisheries and marine policy should be invited and encouraged to attend.

3) There should be a more concerted effort to track employment of MS and Ph.D. recipients to provide those entering graduate studies with indications of career options and to guide programs in providing training and exposure to appropriate career skill sets.

4) While there has been demonstrable progress with gender equity in terms of enrollment and earning of degrees by women, there is a need for continued attention to employment and career climate issues for women.

5) Participation of underrepresented groups in ocean sciences graduate education and careers needs continued and sustained attention. The ongoing programs now in progress bode well for the future. Two specific additional actions are appropriate: (i) emphasis on explaining the relevance to society and rewards of a ocean science and engineering and ocean studies career to young people (K-12 and undergraduate) and their families; and (ii) greater attention to cultural competency for the 'Gatekeepers' – those individuals who are engaged in recruiting, educating, advising, and mentoring members of underrepresented groups.

6) Expanded survey questions for postdoctoral appointees are needed in order to provide useful demographic information about the transition of women and members of underrepresented groups from graduate studies to postdoctoral appointments and then to subsequent careers.

7) Exit surveys and interviews conducted by member institutions for students leaving individual programs before graduation or at graduation will provide important information that should prove useful to improve all aspects of a program's efforts including academic requirements, curriculum, mentoring and advising. It might be useful to have a standardized set of exit survey questions that would allow for collection of anonymous information across the set of programs.

8) Reverse the trend of increasing time-to-degree that seems to be occurring in some, if not all, programs. While a detailed understanding of aspects of time-to-degree will result from improved survey instruments that record leaves of absence and part time enrollment, it is clear that some students are taking far too long to complete MS and Ph.D. requirements.

9) Continued attention to expanding efforts to provide a broad range of career skill sets for all graduate students by various mechanisms, including Teaching Assistantships, seminars, and workshops, is highly recommended.

10) NSF graduate teaching fellowship (GK-12) programs and similar activities are highly recommended as a mechanism for broadening the career skill sets of graduate students.

11) Diversification of graduate student support beyond such a heavy reliance on graduate research assistantships should be a priority for graduate education leadership and federal agency officials.

12) The Consortium for Ocean Leadership should encourage the sharing of graduate curricula, career skill set activities, mentoring and advising practices among and between Ocean Leadership members to promote the formulation and sharing of best practices.

13) In concert with the previous recommendation, there should be significant efforts to refresh, broaden, and/or deepen the curriculum as appropriate for the various programs and groups of programs.

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I. BACKGROUND AND INTRODUCTION

Starting in 1980, the education "Deans" and/or other educational administrators from the Joint Oceanographic Institution (JOI) schools have met approximately biennially to assess the status of graduate education in the ocean sciences (with ocean engineering added later). The initial focus was on issues such as demographics of students and faculty, curriculum, numbers and quality of applicants, sources of graduate student support, and time-to-degree. The late Mr. A. L. "Jake" Peirson (Associate Dean of WHOI) originally suggested the idea to the late Dean Charles D. Hollister of WHOI and Professor Arthur R. M. Nowell, then Director of the School of Oceanography at the University of Washington. In the beginning, the schools funded participant travel and in the mid 1980s JOI and ONR provided funding (Nowell and Hollister, 1988). Sustained leadership for the effort through the 1980s by Nowell and Hollister, with constant background prodding and work by A. L. "Jake" Peirson III, led to the assessments we have today.

The results of the early surveys conducted in conjunction with these retreats and the issues discussed at the retreats have been summarized in publications by Nowell and Hollister (1988), Nowell, Hollister and Baggeroer (1988), and Nowell and Hollister (1990). We will reference these publications later in this report when we discuss selected aspects of the most recent surveys and review the longer term demographic data sets of the JOI schools.

In the early 1990s, the Deans' retreat was expanded beyond the JOI schools by inviting several more colleges and universities with larger departments or schools of ocean sciences offering graduate degrees. After the Consortium for Oceanographic Research and Education (CORE) was established in 1994, participation expanded to include deans and program directors from additional graduate programs. CORE sponsored workshops were held every two to three years at a CORE member institution and were referred to as Ocean Science Educators Retreat (OSER) workshops. Nine to ten months prior to each workshop, CORE staff distributed Graduate Program Surveys, Faculty Workforce Surveys and Funding and Facilities Surveys to the CORE membership. Until 2003, Professor. Arthur R. M. Nowell continued to play a leadership role in data analysis and community discussion of trends and patterns. As keynote speaker for OSER 2005, Professor Russell E. McDuff of the University of Washington presented a review of survey data from academic years 2003 and 2004 as well as an analysis of trends and patterns over time. In 2007, CORE and JOI merged to become the Consortium for Ocean Leadership. Ocean Leadership plans to continue OSER workshops at appropriate intervals.

It is regrettable that there have been no published reports between the 1988 references cited for the Dean's retreats and the present report, although copies of presentations analyzing the data have been distributed in draft form to Deans' retreats and CORE OSER workshops and posted on the CORE website. At Oceans 2006, a poster describing OSER05 was presented (Cook et al., 2006). Throughout this period, CORE has provided copies of the data (with institutional identifiers removed to protect confidentiality) to members who wish direct access to this information.

II. OSER 2005 SURVEY DATA AND INTERPRETATION

The Steering Committee for the Ocean Science Educators Retreat 2005 (listed on the title page of this report) commented on and approved the survey questionnaire for the years 2003 to 2004

taking into account the need for continuity with previously collected demographic data as well as the addition of new or revised questions to meet emerging needs. The survey instrument for 2005 (attached as Appendix I) follows the template used by CORE in an earlier demographic survey specific to the requests of the Ocean Commission (USCOP, 2004) and is a compromise between the brief surveys typical of the JOI years and an excessively long instrument.

This report is a compilation and synthesis of the presentations and discussions at OSER05 as reflected in our notes from the meeting. The topics in the report follow the sequence laid out in the Retreat Agenda (attached as Appendix II) developed by the Steering Committee to highlight key elements of the data and address specific issues deemed of high importance for graduate education in ocean sciences and ocean engineering. Appendix III contains a list of names, affiliations and contact information for those participating in the meeting.

A REVIEW OF GRADUATE PROGRAM CHARACTERISTICS: SELECTED INTERPRETATIONS OF THE 2003 AND 2004 SURVEY DATA AND COMPARISONS TO EARLIER DEMOGRAPHIC DATA

Power Point Presentation – Russ McDuff
Discussion Leader – John Farrington
Scribes – Susan Cook and John Farrington

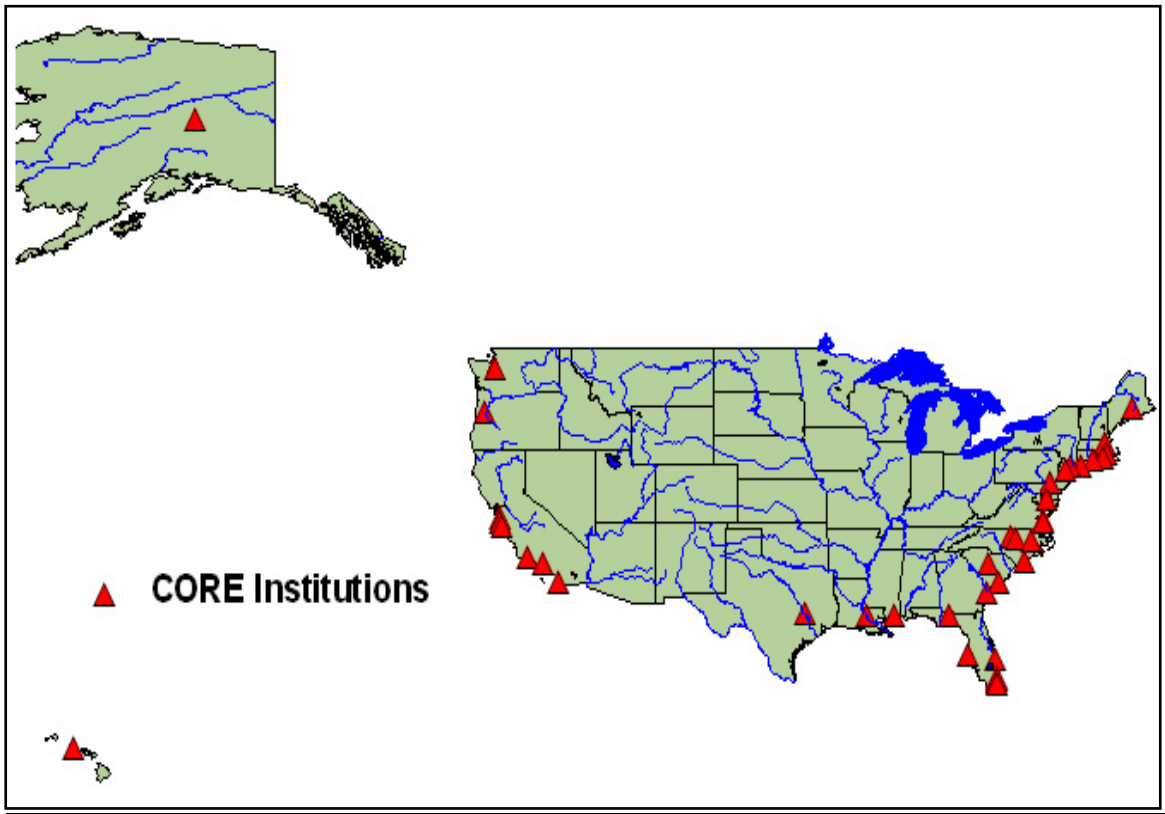
Caveat: A complete national assessment of graduate education in ocean sciences is a challenge not yet met. The obstacle, difficult to overcome, is the fact that graduate education encompassing course work and research on ocean topics is often part of programs with a focus broader or different than an "ocean sciences" or "oceanography" designation. Such programs might be part of a Zoology department or a Geology department and more recently are often part of Geosciences or Environmental Sciences departments or interdisciplinary graduate programs. Even the data of the Survey of Doctorate Degrees conducted for the National Science Foundation (NSF, 2008) that assesses fields in which Ph.D.s are earned must be interpreted with caution because of this 'taxonomic' diversity. Over time, OSER analyses have focused primarily on data from JOI member institutions because this smaller dataset represents the majority of graduate programs in oceanography and has yielded a higher rate of return with less of the variability inherent in data from the full complement of diverse CORE programs.

The entire data set from the CORE OSER meetings is available from staff at the Consortium for Ocean Leadership. Although raw data from some of the JOI Deans' retreats may not be available, two sets of longitudinal data are available for review and interpretation: data for the JOI Institutions collected since the JOI Dean's Retreats initiated in 1978, and CORE data starting with the 1996 OSER Retreat for the larger number of CORE member institutions. Both datasets contain gaps caused by lack of reporting by one or more member institutions for one or two survey periods as well as periods of growth when new CORE members add their data to the dataset. We have learned over the years that often the gaps in data are the result of changes in personnel at the reporting institutions or lack of time available to provide the requested information due to personnel or budgetary matters. In spite of these imperfections, it is feasible to use the data as a framework to provide guidance for graduate education in ocean sciences and engineering and point to issues that need to be addressed. This report focuses on selected aspects of the data. We have not attempted a comprehensive review or examined individual elements in

great detail since the dataset is available for members to access if more in-depth information is needed for study by individuals, programs, or agencies.

Status of Programs 2003-2004.

Some Basic Characteristics of the Responding Programs. Thirty programs responded from twenty-six universities, colleges and institutions (Figure 1). This number is lower than the 48 institutions that responded to the U.S. Commission on Ocean Policy survey of graduate



College of Charleston	Nova Southeastern University	University of Connecticut
College of William and Mary/VIMS	Old Dominion University	University of Delaware
East Carolina University	Rutgers, The State University of New Jersey	University of Maine
Florida Atlantic University	Skidaway Institute of Oceanography	University of Maryland
Florida State University	Stony Brook University	University of Massachusetts Dartmouth
Louisiana State University	The University of Southern Mississippi	University of North Carolina Chapel Hill
Massachusetts Institute of Technology/WHOI	University of Alaska, Fairbanks	University of North Carolina Wilmington
Moss Landing Marine Laboratories	University of California Santa Barbara	University of South Carolina
Naval Postgraduate School	University of California Santa Cruz	University of South Florida
North Carolina State University		University of Southern California

Figure 1. Map and List of CORE Institutions that responded to the OSER05 Survey

programs in ocean sciences, fisheries and aquatic sciences, coastal and estuarine studies, and ocean engineering and marine policy (USCOP, 2004), but larger than the 23 institutions surveyed by Knudsen et al (1950). This early study focused on two well established programs, one recently established effort and about twenty other ocean science education efforts at other universities and colleges in the United States. The numbers of graduate programs in oceanography have approximately doubled in the 50 years between 1950 (Knudsen et al, 1950) and the present (USCOP 2004).

In the OSER05 Survey of 2003 and 2004 demographics, four of the programs awarded the MS degree as the highest level of degree, four other programs required the MS en route to the doctorate degree. Sixteen programs have the option of an MS en route to the Ph.D. and nineteen programs have MS degrees programs separate from the Ph.D. programs.

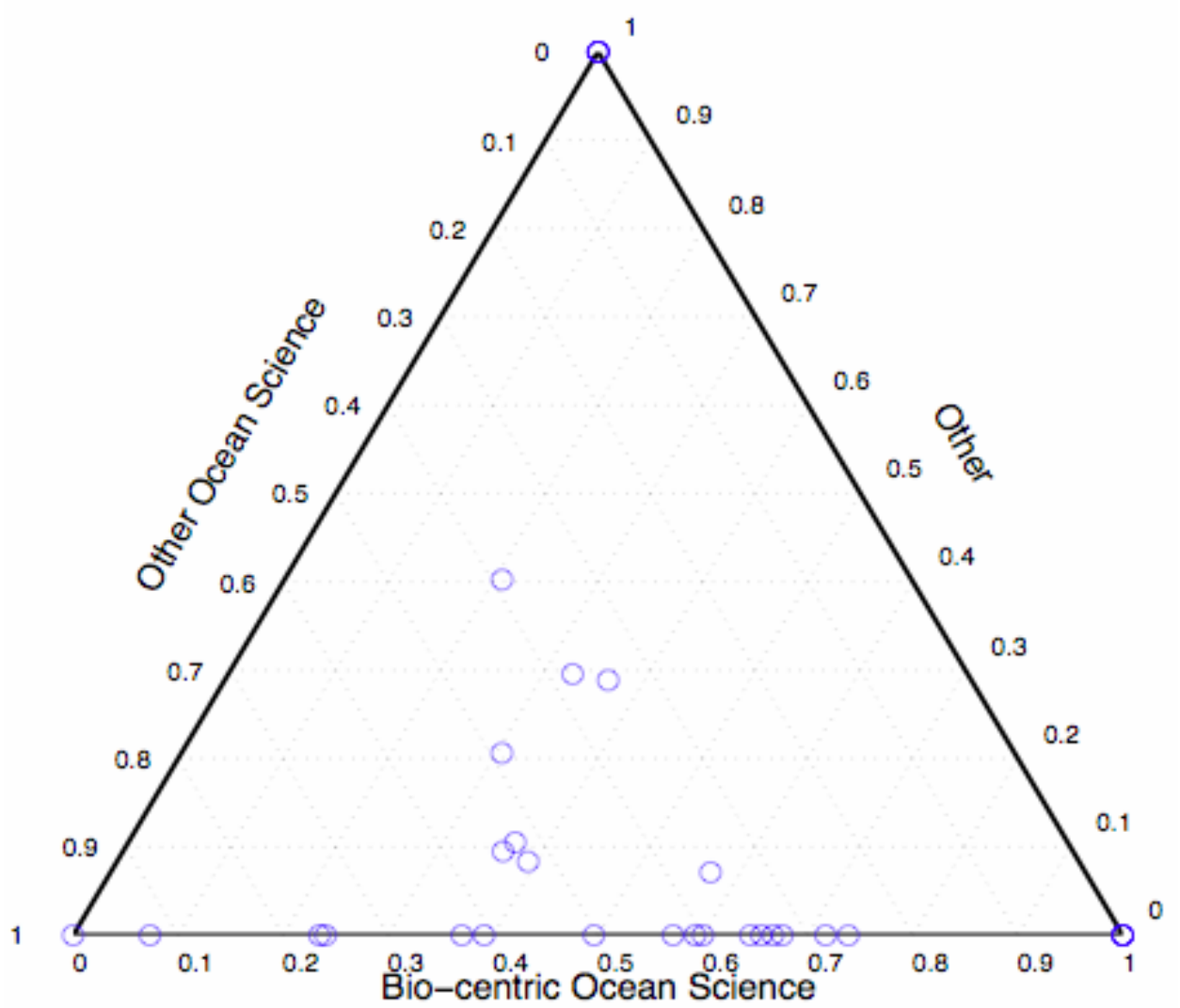


Figure 2. Program Emphasis. Other Ocean Sciences = Chemical Oceanography, Physical Oceanography and Marine Geology and Geophysics. Bio-centric Ocean Science = Biological Oceanography, Fisheries and Aquatic Sciences, and Coastal and Estuarine Sciences, Other= Marine Affairs and Ocean Engineering.

Graduate work in the ocean sciences can be viewed as an array of sub-disciplines with varying numbers of students enrolled in each sub-discipline, i.e. biological oceanography, chemical oceanography, marine geology and geophysics, physical oceanography, fisheries and aquatic sciences, coastal and estuarine sciences, marine affairs, and ocean engineering. Figure 2 presents this sub-disciplinary focus data in a ternary diagram with the axes being bio-centric ocean science (biological oceanography , fisheries and aquaculture and coastal and estuarine sciences), other ocean science, and then "other" (Marine Affairs and Ocean Engineering). A significant number of the responding programs have a bio-centric focus. Programs represented by circles in the middle of the diagram are several of the larger, longer established programs of ocean sciences and ocean engineering such as Scripps Institution of Oceanography, University of Washington, Graduate School of Oceanography at the University of Rhode Island, Oregon State University, University of Miami, and the MIT/WHOI Joint Program.

An assessment of the enrollment of the various programs (Figure 3) reveals that program sizes range from about 8 students up to slightly more than 200 students. There is a wide range of program size and diversity of emphasis (Figures 2 and 3). We believe that this diversity is healthy

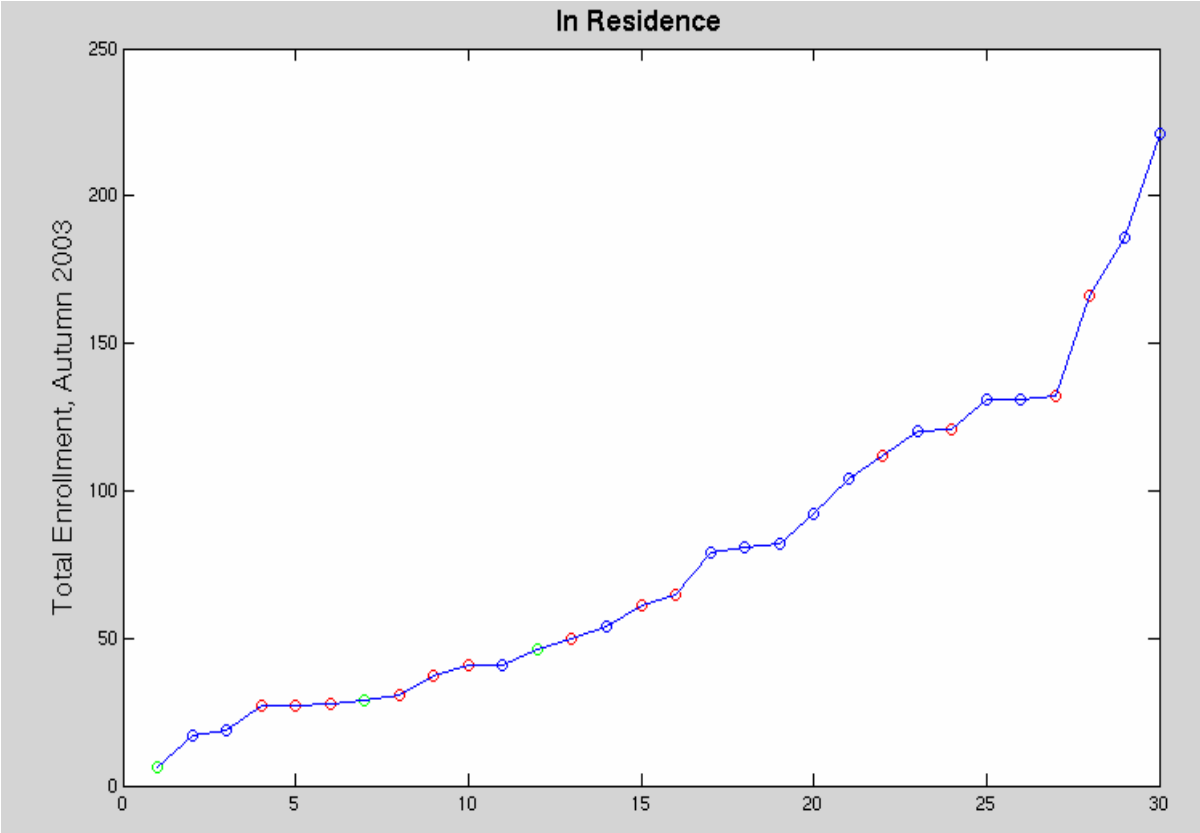


Figure 3. Program Size and Emphasis. The X-Axis is individual programs 1 to 30 ordered by size and the Y-axis is enrollment for Fall 2003**.** The blue circles representing Ocean Sciences includes Chemical Oceanography, Physical Oceanography and Marine Geology and Geophysics. The red circle, mainly Bio-centric Ocean Science, includes Biological Oceanography, Fisheries and Aquatic Sciences, and Coastal and Estuarine Sciences. The green circle includes Marine Affairs and Ocean Engineering.

because it provides a range of options for students seeking a graduate education in ocean related science and engineering and policy/management studies. We also believe that this means that some of the challenges in carrying out graduate education efforts will vary from program to program because of various factors, for example breadth and depth of curriculum, the effect of critical numbers of graduate students who can mentor and teach each other (e.g. see Farrington, 2001), and flexibility in sources of funding.

Our Student Population for the Fall of 2003. A demographic snapshot of the students in residence for the programs responding to the survey as of the Fall of 2003 is as follows: 2337 students, 50.5% are men, 79% are US citizens, 90% are white (Caucasian, Non-Hispanic), 87% are supported by some form of stipend and three-fourths of the stipends are from US federal funding of some type. Some of the more detailed demographic characteristics of the graduate student population enrolled as of Fall 2003 are summarized in Tables 1 to 3 in the separate tabular pdf accompanying this report. A breakdown of enrollment in terms of various sub-disciplines (Table 1) shows that marine biology/biological oceanography has the largest number of students – equal to the next three discipline enrollments combined. The other sub-disciplines that have traditionally been a component of ocean sciences graduate study – marine chemistry/chemical oceanography, marine geology and geophysics, and physical oceanography - all have about the same enrollment followed closely by the category of fisheries and aquatic sciences.

The gender balance (Table 2) of most of the sub-disciplines appears to be what would be expected given the gender balance of the undergraduate student population in the United States. Physical Oceanography and the category "Other" are exceptions where enrollment of women still lags behind that of men. Ocean Engineering has far fewer women than men enrolled, a pattern that is typical of engineering fields in general. The long struggle to attain gender equity in ocean sciences is chronicled in depth in a special issue of ***Oceanography*** magazine (Oceanography, 2003). We will discuss some aspects of the issue of gender equity and the increasing role of women in ocean sciences in more detail later in this report. It suffices for now to state that gender equity in overall numbers does not, in and of itself, mean that there are not major gender related issues that need to be addressed in the various sub-disciplines of ocean sciences or in ocean studies in general.

Table 3 compares the racial and ethnic diversity data for the 2003 survey to the survey data collected for the U.S. Ocean Commission. The two sets of data (two years apart) present a consistent picture of about 11% non-white students enrolled. Racial/Ethnic diversity among the graduate students enrolled in ocean sciences clearly does not reflect the diversity of students enrolled in undergraduate studies in the United States nor in the population of the nation's young people (NSF, 2007).

In a recent study, Nelson, Brammer and Rhoades (2007) have examined the demographics of degree recipients from the top 100 departments of science and engineering disciplines at research universities. Earth Sciences as an overarching discipline has a relatively low representation of under represented minorities (URMs) completing degrees in comparison to other disciplines (Table 4). Any comparison of ocean sciences with earth sciences in general (Table 3 compared to Table 4) must be viewed with caution because Nelson et al surveyed only the top 100 research universities and degree recipients in contrast to OSER's data on students from a wider range of institutional types.

During the 1990s and into the 2000s, various workshops have addressed the issue of under-representation of minority groups in ocean sciences and made recommendations about how to meet the challenge of increasing diversity in ocean sciences (e.g. Jearld and Peloquin, 2005). Several programs have been put in place by several agencies and individual institutions, colleges and universities (NSF, 2008). There is also anecdotal information, discussed later in this report, indicating that various programs and efforts are beginning to have a positive impact and will result in increased enrollment and success of underrepresented minorities in graduate studies and in ocean sciences in general.

Graduate Student Support. In the ocean sciences, sources of financial support for graduate students fall into several categories. The most common form of support is a research assistantship followed by equal numbers supported by teaching assistantships and fellowships. The distribution among categories of support is similar to the report of Nowell and Hollister (1988) for JOI Schools for the Fall of 1987. There are 284 students reported as without support in the present survey. We do not know if these are part time students who have a professional position or students writing their thesis for whom the time limit of support has expired.

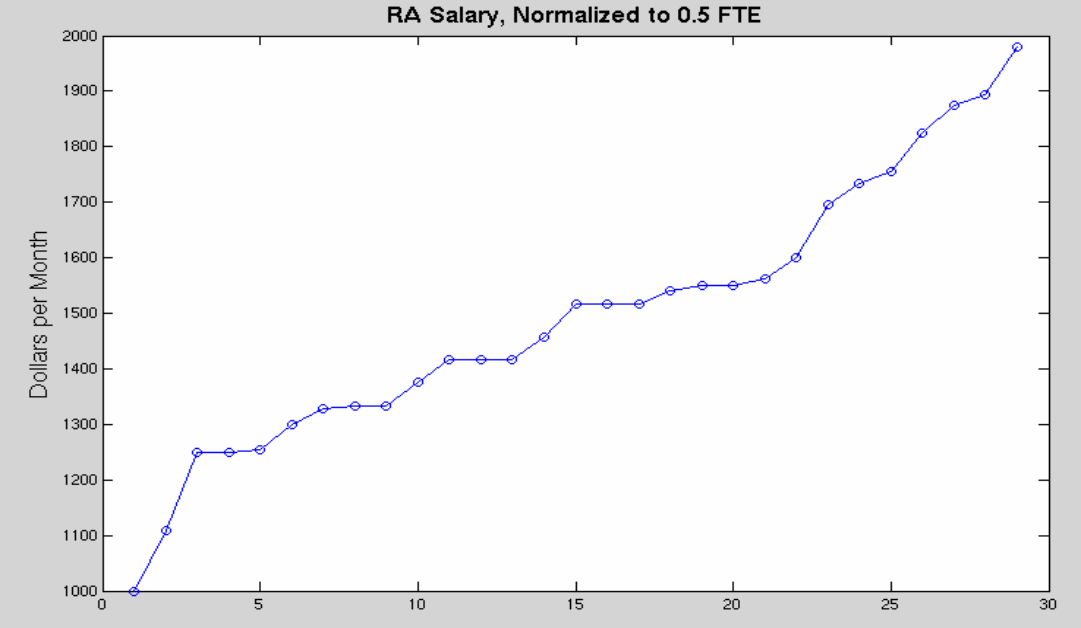


Figure 4. Range of Research Assistantship Salaries. Values are in $ per month along the Y Axis and individual survey respondents 1 to 30 on the X- axis.

Figure 4 plots the monthly salary reported for Research Assistantships adjusted for an equivalent of 0.5 FTE. There is a difference of about a factor of two between the high and low salaries. Certainly some of the spread in salaries reflects the cost of living differential for various areas of the United States. The survey information indicates that approximately three fourths of the research assistantships are supported by government grants or contracts.

The mean salary for teaching assistantships and research assistantships is reported in Table 5, along with the mean of Full Time Equivalents (FTE) for each of the positions. An FTE is taken to

be 40 hours per week of expected work. In accord with most science and engineering graduate assistantships, those in ocean sciences are close to an FTE of 0.5 or twenty hours of week of expected work in exchange for the assistantship. Not all fellowships or assistantships are equal in amount, even when adjusted for amount of work hours expected for assistantships.

As reported in Table 5.4 Appendix 4 of *An Ocean Blueprint for the 21st Century* (USCOP, 2004), reproduced here as Table 6, ocean sciences are similar to astronomy and atmospheric sciences and differ from life sciences and physical sciences in the proportion of graduate student financial support provided by various types of funding. Ocean sciences, astronomy, and atmospheric sciences are more dependent on research assistantships for graduate student support (Table 6), perhaps because there are fewer undergraduate course sections for teaching assistants to teach in these disciplines.

According to the USCOP (2004), "The type of support a student receives in graduate school influences the development of research, teaching, and management skill sets and can limit or expand a student's awareness of different career paths and sectors open to them." Anecdotal evidence suggests that some graduate programs in ocean sciences can, and do, provide for a full range of skill set development irrespective of source of student support. Our sense of the discussion at the OSER 2005 meeting is that sharing of "best practices" could spread this experience to all graduate programs and is a consensus recommendation of the meeting.

Discussions at OSER 2005 provided anecdotal evidence that undergraduate course offerings in Introduction to Ocean Sciences, or Climate and the Oceans, and similar courses, are becoming more prevalent at colleges and universities and that these courses are being taught by faculty engaged in graduate education and research in ocean sciences. This activity should increase opportunities for ocean science graduate students to be involved as teaching assistants. It is important in future surveys to assess if a trend in increasing numbers of teaching assistantships is changing the profile of graduate student support in ocean sciences. Such a trend would be a welcome diversification of ocean sciences graduate student support.

A more troubling aspect of the reliance on research assistantships for the majority of graduate student support in ocean sciences is the disruptive effect on a graduate student's education and thesis research that ensues when an advisor's grant or contract funding is temporarily reduced or continuing grant proposals are not funded. As federal grant and contract funding has become more difficult to obtain, some advisors are more reluctant to become responsible for graduate student support. In some graduate programs, a sense of shared responsibility for graduate student support, at least in the first two years of study, has provided a "safety net" of shared or joint funding. Other programs have departmental college, university or institution funding that bridges the gaps in graduate student support. However, these other sources of funds are finite and as grant funding becomes more difficult to obtain, longer term planning for graduate student support and the use of "safety net funds" needs greater attention at the time of admissions to graduate programs in ocean sciences.

Application-Admit-Enrollment. Figures 5 to 10 (see pages 17-19) are selected plots of numeric data for applications, admission offers, and enrollment for 2003 and 2004. In these plots, the log of the number in each category is plotted on the y-axis with applications on the left, admissions offers in the middle, and enrollment numbers on the right along the x-axis. The log scale was used to allow categories with small numbers to be compared to categories with large numbers. In

all cases, it is important to keep in mind that there is overlap in application numbers (students applying to more than one program) and in admission data (more than one program offering admission to the same students). Given current laws and regulations preventing exchanges of data on specific names of student applicants, it is not possible to sort through the overlaps.

The only indication we have of how much overlap there might be comes from the Nowell and Hollister (1988) report, where the authors report on the total number of applicants to the 4 main sub-disciplines and compare this to the total number of applications received for each group (Table 7). If the authors have accurately assessed the total number of individual applicants, the difference between the number of applications and the number of applicants can be viewed as an indicator of the number of iterative applications and thus a measure of overlap. Table 7 also presents similar data comparing the total number of admissions offers with the number of individuals receiving offers.

Currently, applicants have more information available to them from websites and email, and greater numbers of students are participating in undergraduate research experiences compared to the 1980s. It may be that students are more selective in terms of how many apply to multiple schools. However, anecdotal information available from casual discussion with students offered admission suggests several of the top students are visiting more than one program after receiving admission offers and we can conclude from this that there is still overlap in applications and admissions offers.

Furthermore, the conversion of admissions offers into enrollment is not simply a question of competition among the CORE schools/programs. Discussion among OSER 2005 participants, and some survey information by several schools of why offers were not accepted, indicates that several students offered admission are not choosing to enroll in ocean sciences programs. Instead they enroll in graduate programs in related areas of emphasis at other universities and colleges e.g. climate studies, aquatic chemistry, hydrology, environmental sciences, environmental engineering, or environmental policy.

All sub-disciplines have similar application/offer/enrollment plots with the exception of Marine Affairs (Figure 9) which has a greater number of admissions offers relative to applications compared to other sub-disciplines and then a significant drop off in enrollment relative to admissions offers. We have no way of knowing if this is due to significant overlaps in applications and admissions offers or if this is due to acceptance of admissions offers outside of Marine Affairs.

The data in Figures 5 to 10 (and in the broader dataset) indicate no significant systematic bias in evaluating applications for admissions in terms of gender or ethnic/racial status. Likewise, acceptance of admission offers does not indicate any gender or ethnic/racial influence in accepting offers of admission. There may be fewer admissions offers relative to applications for non-U.S. Citizens in some fields (Figure 10). Once offers are made, though, there is not a significant difference in terms of enrollment (Figure 10). Although it is not apparent from this plot (Figure10), there is anecdotal information from among the OSER 05 participants that there are greater difficulties and longer delays in students receiving visas to enter the United States as a result of tighter US Homeland Security measures.

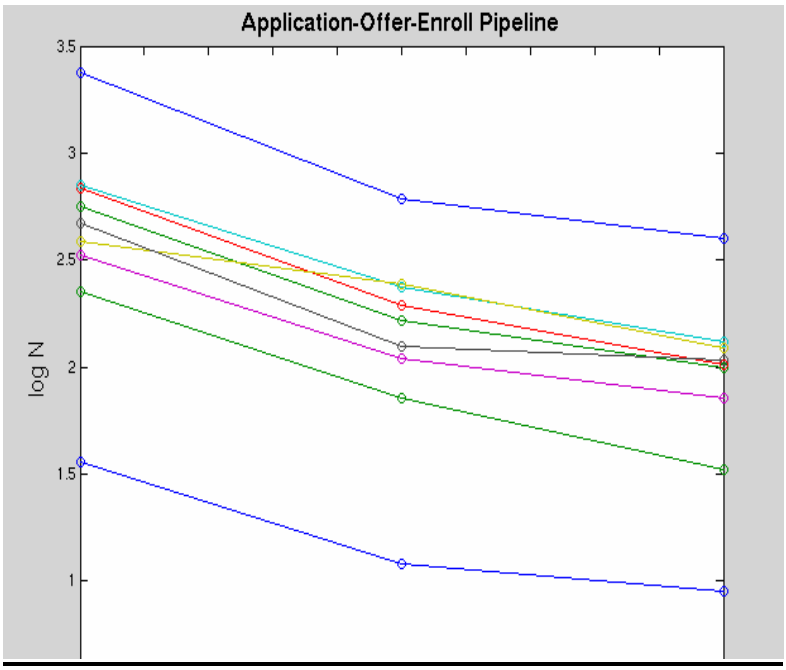


Figure 5. Plot of Applications, Admissions and Enrollment Demographic Data Combining Student Numbers (N) for 2003 and 2004. The Y-Axis is Log N to allow for trends within various sized Sub-Disciplines, to be Plotted in the Same Graph. BO = top blue; MGG = turquoise; PO = red; CO= green Marine Affairs = Yellow; Fisheries= grey; ocean engineering = pink ; other = green; estuarine and coastal science = blue.

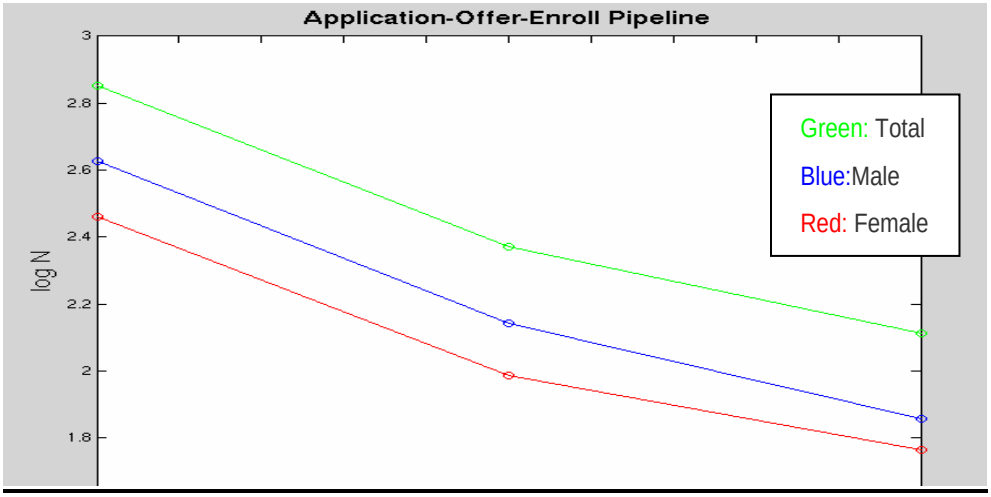


Figure 6. Plot of Physical Oceanography Applications, Admissions and Enrollment Demographic Data Combining Student Numbers (N) for 2003 and 2004. The y-Axis is Log N. Application numbers plotted on the left side of the x-axis, admission offers in the middle, and enrollment numbers on the right.

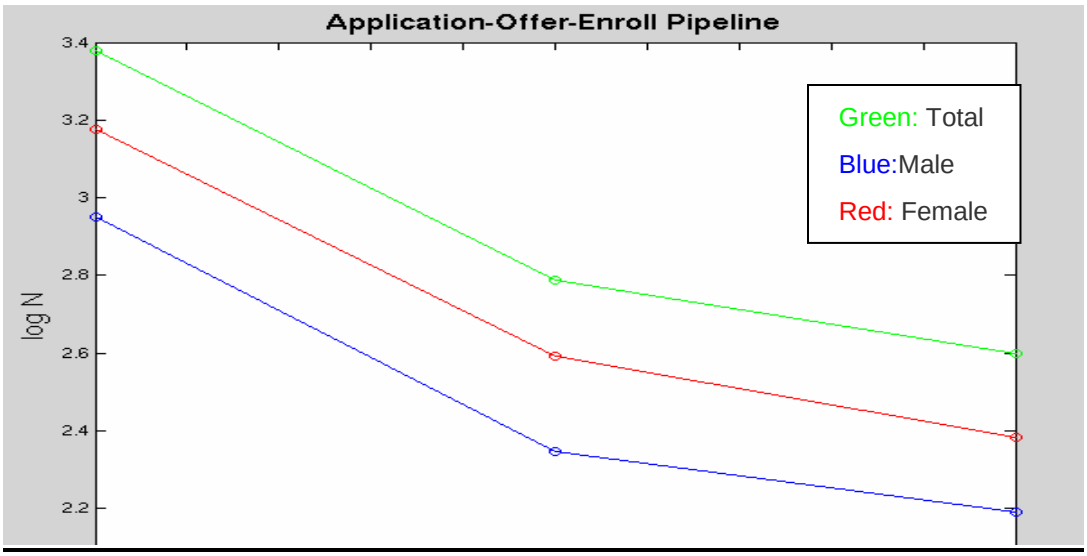


Figure 7. Biological Oceanography/Marine Biology Applications, Admissions and Enrollment Demographic Data Combining Student Numbers (N) for 2003 and 2004. The y-Axis is Log N. Applications numbers are on the left, admissions offers are in the middle, and enrollment numbers are on the right.

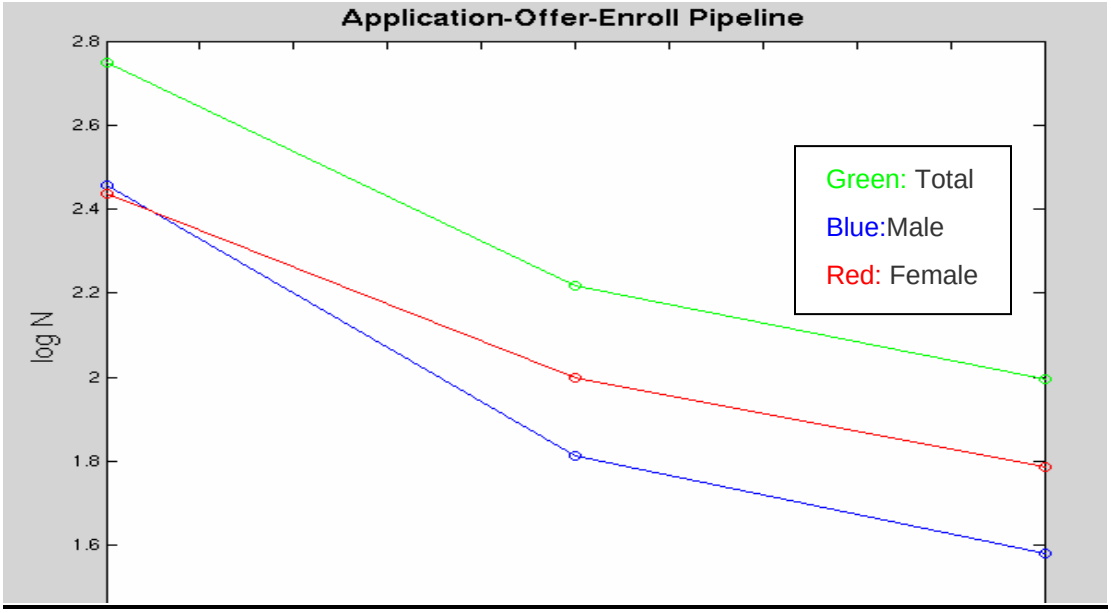


Figure 8. Chemical Oceanography/Marine Chemistry Applications, Admissions and Enrollment Demographic Data Combining Student Numbers (N) for 2003 and 2004. The y-Axis is Log N. Applications numbers are on the left, admissions offers are in the middle, and enrollment numbers are on the right.

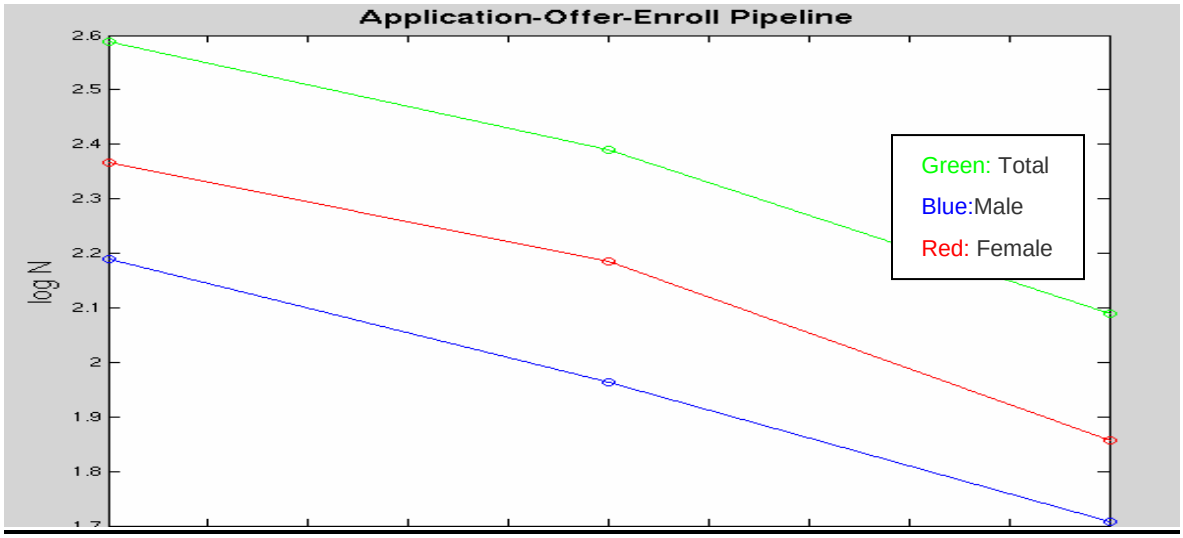


Figure 9. Marine Affairs Applications, Admissions and Enrollment Demographic Data Combining Student Numbers (N) for 2003 and 2004. The y-Axis is Log N. Applications numbers are on the left, admissions offers are in the middle, and enrollment numbers are on the right.

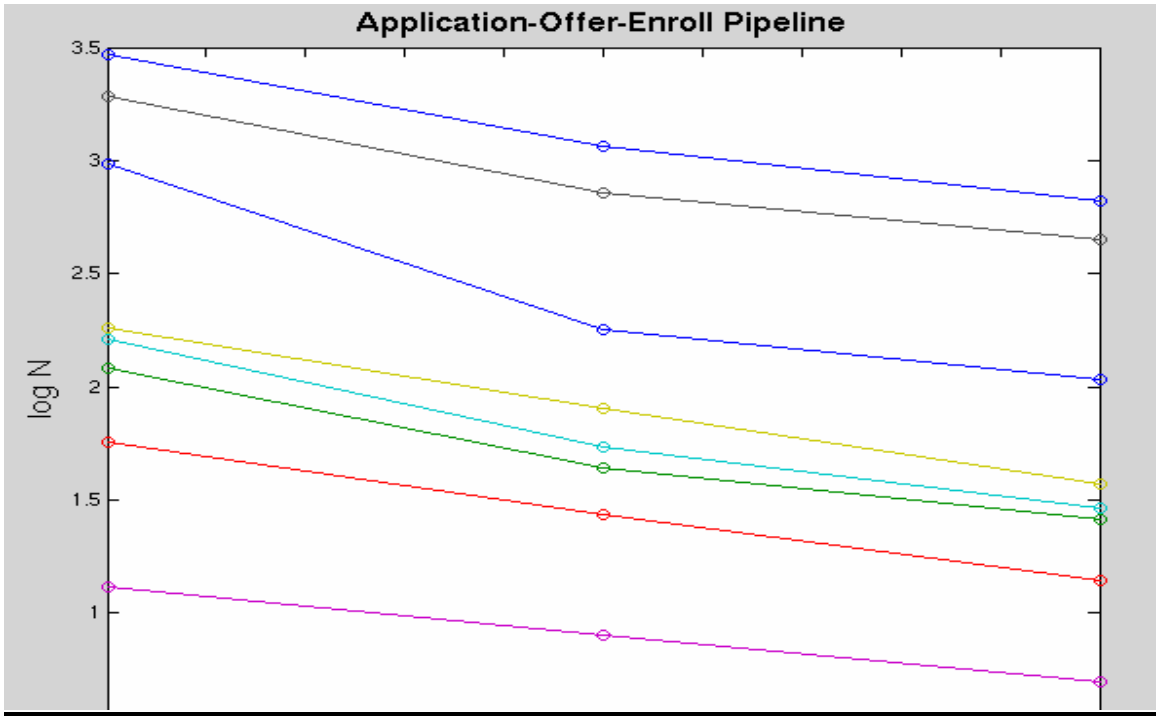


Figure. 10. Ethnicity/ Citizenship Applications, Admissions and Enrollment Demographic Data Combining Student Numbers (N) for 2003 and 2004. The y-Axis is Log N. Application numbers for non-citizens are on the left, admissions offers are in the middle, and enrollment numbers are on the right. See figure 5 for sub-discipline color codes. ‘ Other’ data not plotted.

Outcomes: Degrees (2002- 2003, 2003-2004 Academic Years, Time to Degrees (2003-2004), Careers. The numbers of MS degrees and Ph.D.s earned in various sub-disciplines according to gender are detailed in Tables 8 and 9. Unless noted in the following, the gender distribution of degrees indicates about the same number of degrees earned by men and women.

The number of women earning MS degrees in Marine Biology/Biological Oceanography is twice that of men in both 2003 and 2004. The number of men earning MS degrees in Physical Oceanography is twice that of women for 2003, but the reverse is true in 2004. Combining 2003 and 2004 data, almost three times as many men earned degrees in ocean engineering as did women. For the combined 2003 and 2004 data, about twice as many men earned Ph.D.s (30) in physical oceanography as did women (18). The pattern is similar for fisheries and aquatic sciences – 19 PhDs for men and 11 Ph.D.s for women. Although only a small number of Ph.D. degrees were earned in ocean engineering for 2003 and 2004 (9 degrees total), twice as many men (6) as women (3) earned the degree.

For Marine Affairs, 2003 had a predominance of men and 2004 a predominance of women earning the MS degree. Combining both years, 55 women and 42 men earned MS in Marine Affairs degrees. During the same years, 3 women and 8 men earned the Ph.D. in Marine Affairs.

There is a wide range of times for completing MS and Ph D degrees (Table 10). There is a sense that time to degree is growing longer for both degrees. However, we cannot tell from the survey data if those reporting long times to degree for MS and PhD students are reporting enrolled time or total time, including part time students and those with leaves of absence. If some MS students do enroll continuously for four years or greater, then this is too long a time period and raises questions about the appropriateness of the curriculum, thesis research requirements, and/or the quality of advising /mentoring. Similar concerns apply for PhDs taking more than eight years.

Anecdotal information suggests some instances of slow-down for either a wait for a spouse or significant other to complete graduate studies or waiting for the ideal postdoctoral or other career position to become available. In situations where funding is tight and laboratory space is limited, such delays may adversely affect enrollments by other deserving and qualified students. To avoid such situations, several programs have guidelines and limits for years of financial support – with appropriate consideration for exceptional situations such as the loss of access to a laboratory and equipment because of fire or long-term illness of the student or immediate family members or of the faculty advisor.

The initial career and employment pathways for graduates earning MS and PhD degrees are listed in Table 11. Degree recipients clearly pursue a wide range of options, including continuing study for the Ph.D. for M.S. degree recipients.

One flaw in the questionnaire is that there is no separate category for postdoctoral positions for Ph.D. recipients. Because of this, it is impossible to tell how many individuals employed at universities and colleges were in postdoctoral positions and how many were employed as faculty (Table 11). A second problem is the lack of information about immediate post-degree employment for a surprisingly large number of M.S. and Ph.D. recipients. Programs should undertake measures to rectify this situation if at all possible because information on career options and likely outcomes is important to applicants thinking of entering various sub-disciplines.

Anecdotal information suggests that career mobility is becoming more common for doctoral degree recipients. Many of the Ph.D. graduates first go to a postdoctoral position of some type and then from there to an academic or government agency research position. Later they may shift between the academic position and government agency or go to the private sector.

Only recently, has there been a systematic attempt to obtain career data for M.S. degree recipients, e.g. Table 12. A comparison of the post-graduation employment for the cohorts of graduates for 2001 obtained by CORE for the USCOP (2004) and the OSER 2005 survey of graduates for 2002-2003 and 2003-2004 (Table 12), indicates that there is reasonable agreement between the surveys and that a diversity of career options are pursued by both M.S. and Ph. D. degree recipients.

Earlier survey data for JOI Institutions reported by Nowell and Hollister (1988) provide a five year composite of employment for graduates of seven JOI schools (Table 13). Although the data for various schools in Table 13 are in percentages and can not be directly compared to the data in Tables 11 and 12, Table 13 clearly provides additional support for the view that a diversity of careers are now being pursued by Ph.D. graduates. It is also interesting that the schools surveyed by Nowell and Hollister appear to differ in terms of the career pathways of alumni. Graduates of schools A, B and C appear to be concentrated in faculty or other academic positions while alumni of D, E, F and G are more dispersed across employment sectors.

An hypothesis consistent with the available data and also anecdotal information is as follows: Expansion of graduate programs in ocean sciences in the 1950s and 1960s led to many of the Ph.D. graduates, often after a postdoctoral year, expanding ocean sciences related faculty at the JOI Schools in the 1960s and 1970s (Farrington, 2001). Subsequently, many of the next several cohorts of graduate students provided a base for expanding faculty of small marine biology coastal laboratories into departments or programs of ocean and marine sciences in the 1980s and 1990s. Now, many of these programs are represented among the CORE member institutions (Figure 1). The Ph.D. graduates of these newer graduate programs, plus those from the longer established graduate programs, are going on to diverse careers (Table 12) although the largest employment/career category is still 4 year college or university. In regard to the latter, the survey data do not distinguish by Carnegie Institution classification of 4 year colleges or university. Historical anecdotal information suggests that many of the graduates going to academic careers in the cohort reported by Nowell and Hollister (Table 13) went to research university schools or departments. The OSER 2005 workshop participants believe that there is a wider distribution of recent graduates across the spectrum of 4 year colleges and universities – some with no graduate programs, some with M.S. programs only, some recently emerged research universities with both M.S and Ph.D. programs, and the longer standing research universities.

Temporal Trends.

To illustrate the type of data available and the limitations to interpreting these data, we will now focus on temporal trends in several aspects of the dataset. Temporal trends for applications to the JOI schools for 1978 through 2003 are plotted in Figure 11. The large minimum for the years 1985 to 1999 and large maximum for the years 1993 through 1998 in the applications reflect the general trend for applications to graduate education in science and engineering for all fields in the U.S. It is important to note that some of the minor fluctuations in the plot could be due to the fact

that in some years there were only 8 schools reporting (e.g. 1999 and 2000) and other years nine to ten schools reporting. To confuse matters even more, sometimes it is not the same eight or nine schools reporting. However, from the data for those schools for the years in which they did report, we can extrapolate that their lack of reporting is not responsible for the entire dip to the minimum in 1999 and 2000.

A similar minimum also occurred between 1996 and 2004 in the more recent larger CORE-OSER dataset. From 1996 to 2004 applications decreased and then returned to the 1996 number in 2004. During that time, eight programs experienced increased applications, including three with a doubling of applications. Nine programs had decreases in applications and some of these experienced decreases of about a factor of two.

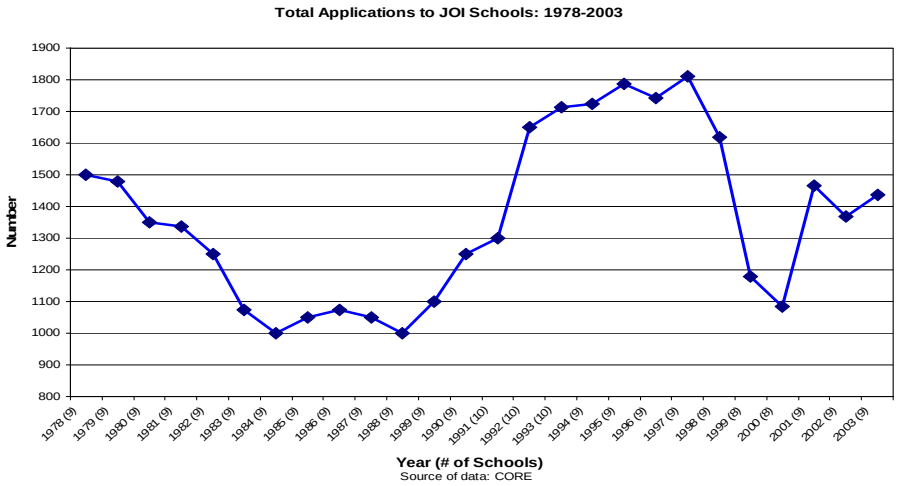
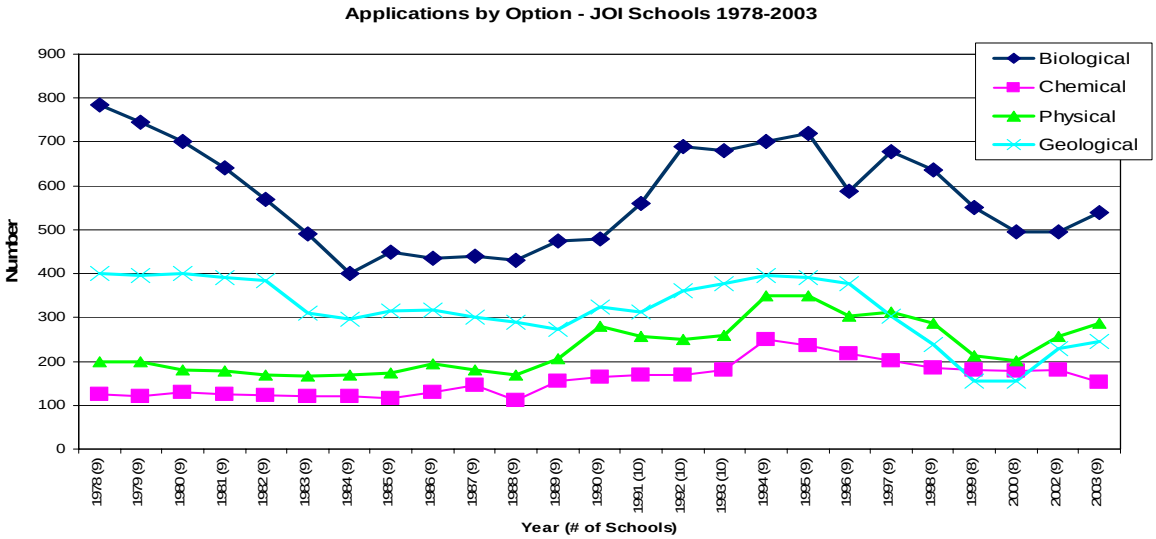


Figure 11. Total Applications to JOI Schools 1978-2005.

For the most part, the temporal pattern in applications for various sub-disciplines at the JOI schools (Figure 12) follows that seen in the overall dataset. Thus there is an application minimum in the mid to late 1980s with a maximum in the early 1990s and a more recent smaller decline around 1999-2000 for the most popular sub discipline of biological oceanography/marine biology, a pattern that is also present when the larger CORE dataset for this sub discipline is examined. The other sub-disciplines appear to track minima and maxima in a similar way, although the numbers are smaller and the fluctuations are less dramatic.

One anomaly in the sub disciplinary comparisons (the movement of geological oceanography from the second rank in applications to lowest rank in the time interval from 1997 to 2000) is consistent with lower enrollments in geology at the undergraduate level. However, this fluctuation in geological oceanography applications may have also been skewed by the fact that only eight schools reported data for the years 1999 and 2000. One of those schools usually had a reasonable number of geological oceanography applications and this gap in the data may be responsible for the shift in relative ranking of applications by option.



Source of data: CORE. CORE did not collect data on Fall 2001 applications by option.

Figure 12. Applications to JOI Schools by Sub-discipline Option 1978-2003.

How sensitive should administrators be to temporal cycles in the supply of applicants for graduate studies in the sciences overall or in a specific field? What strategies (if any) should be used to respond to lower than anticipated or desired numbers? The challenges implicit in these questions are well illustrated by the concerns and outcomes of the Deans' retreats of the JOI Institutions in the early to mid 1980s. At the 1985 Deans' retreat, there was a consensus that something had to be done to increase applications for graduate studies in ocean sciences in several of the disciplines. The concern was not so much about Biological Oceanography since the quality and number of applicants was still high relative to admissions offers. However, the application numbers relative to available admission slots for the physical sciences, especially physical oceanography and chemical oceanography, were borderline (Farrington and Peirson,1996). A strategy was put in place to have summer workshops for faculty who taught and advised undergraduates from potential feeder schools. These workshops were about a week in duration and introduced the faculty to the latest in research in the various sub disciplines of oceanography and the opportunities for graduate studies in the ocean sciences. The Office of Naval Research and the Pew Memorial Trust provided funding for the workshops. The first workshops were held in the summers of 1997 and 1989**.**

The last workshop held in the summer of 1992 focused on increasing applications as well as on faculty teaching and advising students from underrepresented groups. However, as Figures 11 and 12 show, the 'supply' situation was already changing with an upswing in applications beginning in 1989-1991. By 1996, as noted by Farrington and Peirson (1996), there were discussions at various professional society meetings about the possibility of an "oversupply" of people with doctorate degrees in oceanography. This parallels the situation for sciences overall. In less than a decade from the late 1980s to the early to mid 1990s, the United States moved from a crisis in supply of people earning a doctorate degree in sciences to a crisis of Ph.D. recipients being stuck in low paying postdoctoral positions for years or not having a job at all.

The paper by Farrington and Peirson (1996) documents the challenge of devising an effective strategy to respond to a demographic trend in graduate education, especially for the Ph.D. The

time constant to yield results – from identification of the problem, to devising a strategy to address the problem, and then implementing the strategy to have it play out to a cohort of Ph.D.s graduating - is about seven years minimum if the strategy is implemented within a year.

Outcomes: Gender patterns over time.

Available data for all schools in the survey indicate that there is no systematic bias against admitting women into ocean studies once applications have been received (Figure 13). Although there are gaps in the data, the number of women enrolled has been growing steadily since 1992,

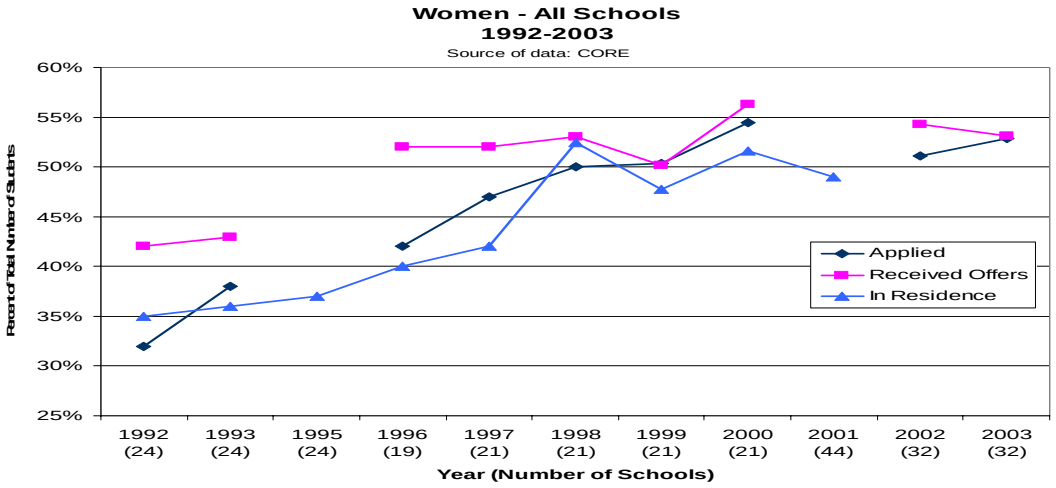


Figure 13 . CORE-OSER Survey: Applications, Admission, and Enrollment Data for Women.

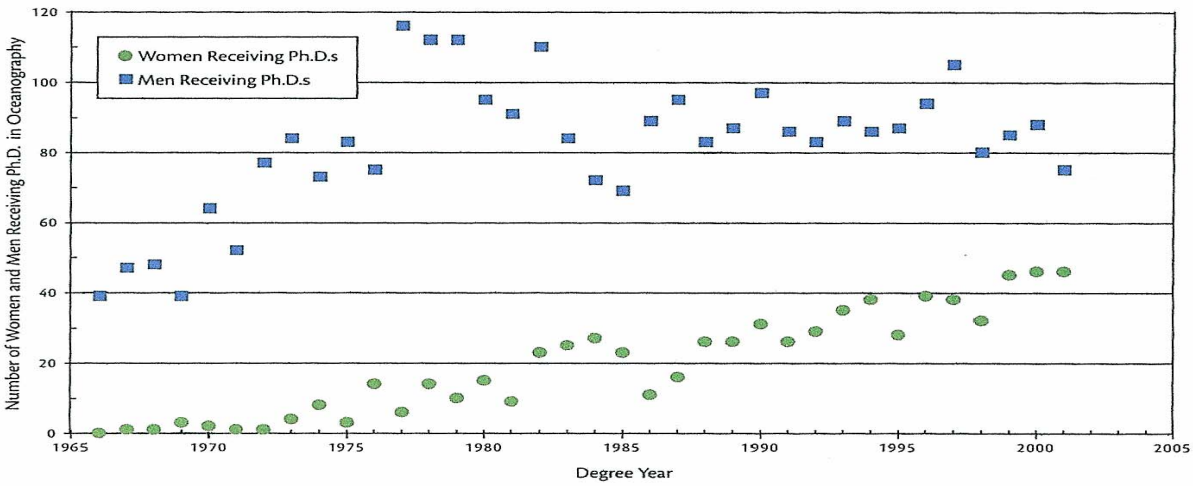


Figure 5. Number of women and men receiving Ph.D.s in oceanography between 1966 and 2001. Source: NSF (2004).

Figure 14. Ph.D.s in Oceanography Earned by Men and Women 1966-2001. NSF data as plotted by O'Connell and Holmes (2005).

continuing the trends noted by Nowell and Hollister (1988) for the 1980s. O'Connell and Homes (2005)'s plot of Ph.D.s earned by men and women from 1966 to 2001 provides further support for a steady, sustained increase for women starting in the mid 1970s (Figure 14).

Comparison of OSER Survey and NSF Survey Data.

Given the difficulty of obtaining meaningful demographic data by means of surveys, as noted earlier in this report, questions can always be raised about the incomplete nature of surveys and to what degree can we be confident in the efficacy of survey results. One means of validating the OSER Survey Data is a comparison of OSER Survey Data collected by CORE and the corresponding data for the same years collected, archived and made available by the National Science Foundations Division of Science Resource Statistics (SRS) http://www.nsf.gov/statistics/. At the time of OSER Workshops the latter set of data was not available for the years surveyed by OSER, but is available now for those years and through 2005 (NSF, 2008; http://www.nsf.gov/statistics/.)

The total enrollment of students in ocean sciences in 2003 according to the NSF survey is 2,695 students. The responses to the OSER 2005 survey for fall of 2003 is an enrollment of 2,070 - totals from Table 3 minus the enrollment for Marine Affairs and for Ocean Engineering since these categories would not be included under ocean sciences in the NSF Survey. It is not surprising that the NSF Survey includes slightly more respondents than the OSER dataset because the NSF surveys more college and university programs, especially some of the smaller programs or emerging programs that either were not part of the CORE membership or did not respond to the CORE OSER survey if they were CORE members. The fact that the totals are relatively similar suggests that the OSER survey is accessing programs providing a large majority of the graduate education in ocean sciences and that lessons learned from the survey are important for ocean science graduate education in the United States overall.

A comparison of Ph.D.s earned for 2003 and 2004 by men and women in the field of ocean sciences (Table 14), provides further evidence that OSER data are relatively robust. Although there are more Ph.D.s recorded in the NSF survey than in the OSER Survey (expected because not all ocean science/marine science programs were surveyed by CORE or responded to the CORE survey), the relative numbers of men and women earning degrees in the two surveys are slightly different in 2003 and identical for 2004. .This provides a sense of confidence that the OSER surveys provide a reasonable assessment of the ratio of men to women earning Ph.D.s in Ocean Sciences.

Discussion of survey results and Recommendations for Future OSER Surveys.

Overall, the OSER survey data is useful for providing an assessment of United States graduate education in ocean related subjects. There is overlap with NSF survey data, but the OSER data is more detailed and specific to the ocean sciences. The OSER survey data are made available to the CORE survey participants without identifying specific programs. While preserving anonymity of programs and privacy of their records, this allows individual programs to evaluate their strengths and weaknesses in comparison to other graduate programs in ocean sciences, engineering, and related studies.

The full utility of the OSER Survey Data Set is hampered by the gaps in responses by some programs and the unevenness of these gaps – one or two schools or programs one year are missing and other schools or programs in other years. For example, full records are available 1996-2004 for only 17 programs. Concerted effort is needed in the future to get a more complete data set, and if at all possible, to fill in gaps in the past data.

Rear Admiral Richard West (USN Retired), President of CORE, noted that it was important that the community recognize that adequate funding was needed to prepare and carry out the survey, to interpret the data and to maintain the long-term data set. The OSER 2005 participants agreed with this observation.

There was also explicit recognition that completing the OSER Survey required significant effort on the part of individual program administrations. Sometimes this is complicated by the fact that at some universities and colleges, information required for OSER surveys is obtained and stored centrally and is not always easily reconstructed from the central data base. In addition, some categories of OSER survey information are not collected by these centralized data bases.

Suggestions for improvement of the OSER Survey:

(i) Add information for undergraduate majors of applicants and those enrolled.
(ii) How many students come into Ph.D. studies already having earned a M.S? In what discipline? If ocean sciences/engineering/ocean studies, was it in the same or a different program?
(iii) Rephrase question on time to degree to account for leaves of absence, part time registration, and combined M.S. and Ph.D. degrees earned in the same program by a specific individual with times noted for each degree.
(iv) Why are leaves of absence granted – without getting into personal circumstances?
(v) Try and ascertain where students who do not accept our offers actually enroll – is it outside the field? This is difficult data to obtain and depends on the willingness of individuals to volunteer information about their choices.. All programs are encouraged to include a form which poses such question as part of the mailing packet accompanying offers of admission.
(vi) Retention data. How many students who enrolled in a given year class leave and for what general reasons, e.g. academic record, loss of interest, advisor leaves for another program?
(vii) We need a more comprehensive survey and data set for graduates planning on postdoctoral positions, applications for postdoctoral positions, offers and acceptances.

At the workshop, there was a sense that while it would be advantageous to collect additional data (such as that suggested above), longer surveys are a burden for the individual program administrations.

During the discussion there was agreement that it would be enlightening to compare aspects of the OSER survey with data from other fields of science and engineering. More use of the NSF survey data set and surveys conducted by other professional societies such as the American

Chemical Society, the American Institute for Geology, and the American Institute for Physics would be helpful.

III. "MENTORING PHYSICAL OCEANOGRAPHY WOMEN TO INCREASE RETENTION"(MPOWIR) PRESENTATION.

Drs. Amy Bower and Robert Beardsley of WHOI presented a summary of a workshop "Mentoring Physical Oceanography Women to Increase Retention" (MPOWIR) that was held October 9-12, 2005 at The Arleigh Center, Warrenton, Virginia and funded by the Office of Naval Research and the National Science Foundation. Their presentation and the discussion focused on the fact that the number of women enrolled in graduate studies in physical oceanography and completing Ph.D. degrees and as a percentage of students and those completing degrees has increased over the past several decades. Yet, the number of women in Principal Investigator Status or faculty status remains rather low. The women who are graduating with Ph. D. degrees seem to be leaving the academic sector and this represents a serious challenge for physical oceanography. Similar concerns have been noted for other fields of study. A summary of the MPOWIR information presented at the OSER 05 workshop is attached as Appendix IV.

A multitude of individual institutional, university or college actions are needed to address the concerns raised by MPOWIR. There also was a clear sense that the MPOWIR project activities are very important not only to Physical Oceanography but also to the ocean sciences in general.

IV. DISCUSSION GROUPS: (1) EFFECTIVE STRATEGIES FOR RECRUITING STUDENTS, (2)FINANCIAL SUPPORT FOR GRADUATE STUDENTS, (3) CAREER SERVICES AND CAREER RETENTION.

These smaller 'break-out' groups were designed to provide a forum where recent concerns and responses as well as best practices could be discussed among the OSER participants. The three groups met for about ninety minutes and then reported back to the group as a whole. Note takers for these discussions were S. Cook, S. Haynes and H. Hope.

Group 1: Effective Strategies for Recruiting Students.

The following issues were discussed:

- **(i) Print materials and mailings.**
- **(ii) Web sites.**
- **(iii) Booths at Professional meetings and Career Fairs.**
- **(iv) Word of mouth among and between faculty and students.**
- **(v) Research Experience for Undergraduates and similar programs as a recruiting mechanism.**
- **(vi) Visits to undergraduate "feeder" schools.**
- **(vii) Post Admission offers "open house" and individual candidate visits.**

i. Print materials and mailings. Mailings of print material and brochures to hand out with information about programs with reference to web sites that can be accessed are still helpful - even in the electronic age.

ii. Web sites and recruiting videos. Web sites have become more important and are now essential in communicating with a diverse cross section of potential applicants and their undergraduate faculty mentors and advisors. In addition, many programs have electronic application forms. Exchanges of emails answering questions of potential applicants between a graduate student office and the student and potential advisor-student email exchanges have increased and are viewed as having a very positive impact on recruitment. A few programs have prepared CDs with video and recruiting information to send to schools with potential undergraduate applications and for use in recruiting activities of various types.

iii. Booths at Professional Society Meetings and Career Conferences. A career and recruitment booth at major meetings such as ASLO, AGU, TOS were not considered to be cost effective by some. However, it was noted that more undergraduates attend such meetings now because of the growing focus on undergraduate research experiences and funding for student travel to such meetings. If this is combined with information on postdoctoral and Ph.D. level opportunities for the graduate students attending such meetings (recognizing at some MS students are looking for Ph.D. opportunities at other universities, then a booth may become more cost effective and useful. Interestingly, the panel on diversity on day 2 of OSER05 noted that booths at career gatherings aimed at underrepresented groups and at Minority Serving Colleges and Universities are an important way to reach out to such students re: graduate education opportunities and careers in ocean related studies.

The group agreed that while individual colleges and university departments of ocean related studies might not be able to afford a booth or other institutional presence at such conferences, this is something that CORE might consider doing on behalf of the membership. As summarized by one participant, it all comes down to the most effective use of limited financial and human resources.

iv. Word of mouth among and between faculty and students. Word of mouth (from faculty who have had undergraduate students attend graduate programs and from alumni and alumnae of OSER graduate programs who are now in positions in colleges and universities) remains an important means of referrals for graduate studies. It is important to supply colleagues and alumni with the latest brochures and web site URLs for the graduate programs. There was agreement that it is important to keep program information up to date and check to be certain that weblinks to agencies and organizations providing guidance on graduate opportunities (e.g. ONR, TOS, CORE among others) are still active and appropriate.

v. Research Experience for Undergraduates (REU) and similar programs as a recruiting mechanism. At the start of this discussion, OSER 05 participants commented on the lack of data on the impact of REU and similar programs on student enrollment in graduate school in the sciences and exhorted NSF to fund such studies. A year later, SRI International submitted a report to NSF on the results of such a comprehensive study (Russell, 2006) with a short article on this work published in the Education Forum section of Science (Russell et al., 2007).

The Executive Summary of the report confirms that 'undergraduate research experiences were found to be important in both in raising student expectations for pursuing higher degrees and in graduate school decisions.

Although this report clearly documents a positive effect for REU and similar programs overall, a study specific to the ocean sciences has not been done. At OSER 2005 there was a clear sense that the expansion of REU programs in colleges and departments of ocean related studies has had a positive impact on bringing undergraduate students to apply for graduate studies in ocean related studies. Because sharing of application, admission and enrollment information between colleges and universities is not normal practice, it is difficult to track REU students who have applied to programs not affiliated with where they had their REU experience. It would be useful for CORE member institutions and departments to survey their students in residence to see how many actually had an REU experience in ocean related sciences and studies (or other field of science or engineering) prior to applying for graduate school in ocean related studies. It was noted that as more of the applications for graduate school are by electronic means, it should be possible to have a section of the application that referred to that issue specifically. However, others noted that larger universities and colleges have standardized electronic forms that do not allow easy capture of such information.

vi. Visits to undergraduate "feeder" schools. Several programs have funded faculty travel to present seminars at other schools with the expectation that faculty will also give recruiting talks to undergraduate students. Some faculty have embraced the opportunity and other faculty have noted that the turn out for such talks is often insufficient (e.g. as low as one or two) to justify the effort. Some programs pay for part or all of the travel for enrolled students to give a recruiting talk when they visit home or their undergraduate school. Some of these programs supply a prepackaged Power Point or CD presentation for these visits. There is little in the way of objective, or even anecdotal, evidence of the yields/effectiveness of these recruiting efforts.

vii. Post Admission offers "open house" and individual candidate visits. Once offers of admission have been made to prospective graduate students, several programs invite students from the U.S or nearby countries (e.g. Canada and Mexico) to visit to assist them in deciding where to accept admission since students often have more than one admission offer for graduate study. Smaller programs report that they have a difficult time securing such funds from their administration. Some programs invite only the top tier of those to whom they have offered admission. A few of the larger programs have been using the strategy of having cluster visits of all admitted students or sub-disciplinary subsets for an "open house". One benefit of such visits is that it gives the students a sense of the cohort they might find upon enrollment. The focus on one period of time makes it easier to schedule faculty participation. Some of the larger programs have worked hard to avoid overlapping open houses in order to provide students with an opportunity to make the most informed choice.

Generally, individual visits and 'cluster type' open houses have been viewed as a success by both prospective enrollees and by the programs. When the costs per student are weighed against the total support of stipend, tuition, research supplies and the like, the investment per student is a reasonable and wise investment to maximize the correct match of student with advisor and program. From the student perspective, an investment of a few days per open house or visit- even for three or four programs – is a worthwhile investment compared to making an incorrect decision from a distance.

There was about an even distribution among the OSER05 workshop participants with respect to favoring either individual student visits or cluster type visits. However, there was unanimous consensus that individual visit or cluster-open house type visits should involve significant time for interaction between prospective students and students already enrolled in a program. Prospective students want this type of interaction for the obvious reason that enrolled students have a student's perspective on the strengths and weaknesses of a program and of individual advisors.

Group 2: Financial Support for Graduate Students.

The major topics for discussion were:

(i) Diversifying funding sources for graduate students.
(ii) Relationship between source of funding and broad exposure to career enrichment opportunities.
(iii) Limits on years financial support.

These two issues were strongly interrelated and thus the report out from the group for these issues was combined. Participants identified various types of support and commented on possible benefits and drawbacks for each. Most commonly, graduate students in the ocean sciences are supported by Graduate Research Assistantships (GRA) tied to grants and contracts from federal agencies (see Tables 5 and 6) with a lesser percentage of students supported by fellowships, teaching assistantships and traineeships respectively.

A positive aspect of GRA support is that establishing a tie between a specific advisor and a graduate student can be helpful because a faculty member has a vested interest in looking after the well-being of the graduate student. On the other hand, a possible disadvantage of early GRA support is that students can become locked into a particular research focus early in their graduate studies. If the program has no fall back or safety net financial support for the student, the student may have to pursue a thesis project in this area of research even if their class-work and general research literature reading lead them in the direction of wanting to do thesis research on another topic or with another advisor.

A cautionary note was raised early on in the discussion that relying almost exclusively on GRAs was not a healthy situation in a time of tight federal research funding. One specific issue was whether or not first and second year students should be supported by GRAs. Participants pointed out two compelling reasons for this practice. The first is a legal one in the sense that the grant or contract actually requires this work. Second, getting into actual research – even if it is not strictly related to the eventual thesis research – is important training for the graduate student if the GRA work is correctly formulated. Others noted that in the past, for some programs, advisors supporting a first year student on a GRA would basically tell the student not to worry about "working" and instead concentrate on their class studies. This type of approach has become less frequent as funding has become more difficult to secure.

The group also noted that, in theory, and sometimes in practice, the vast majority of GRAs require only twenty hours per week of work, thereby allowing a student to pursue their thesis research outside that twenty hour per week time frame – especially after class work has been

finished. However, it is generally accepted by faculty and students that having a student's GRA support tied to their thesis research, for post- qualifying exams students especially, is the more desirable situation.

The group also talked about the disadvantages and advantages of fellowship support. Some participants expressed concern that students supported on fellowships in their first year or two might "fall between the cracks" in that they might have no requirement other than course work and thus miss out on the training associated with a first year GRA. In several programs, this potential problem is handled by requiring involvement with research as an essential part of the first year or two of graduate studies for students on fellowship support, prior to their actually beginning their thesis research. In addition to ensuring training in research activities and techniques, the assignment of a fellowship recipient to an advisor or a series of research advisors, encourages closer relationships with a faculty member who keeps an eye on the student's progress. Fellowship support also allows for greater flexibility for student involvement in career enrichment activities such as rotation among various research laboratories prior to choosing a thesis topic, volunteering in outreach activities, and other opportunities. With a fellowship, such activities do not take time away from a grant's research activities as might be the situation for a GRA.

Teaching Assistantship (TAs) opportunities are somewhat limited in ocean studies as noted in Table 6 and to a lesser extent in Table 5. There was general agreement that there should be a concerted effort to provide a Teaching Assistantship opportunity for each graduate student for at least one semester. A few programs have a requirement that students must be a TA for at least one semester while most do not. The TA experience is particularly important for students who go on to seek positions in the academic sector where experience with teaching – especially undergraduate teaching experience, is an important qualification. Ocean sciences graduates can be at a disadvantage when applying for positions such as an Assistant Professorship in an environmental sciences department compared to competition with candidates who received a doctorate in chemistry or physics and acquired a year or more of TA experience.

The GK-12 Fellowship Program of NSF was identified by the group as a very important relatively new source of funding for graduate students which provides the students with critical exposure to the opportunities to connect with K-12 education. This program is discussed in more detail in the summary of the GK-12 Panel presentations later in this report.

Traineeships are another form of graduate student support that is more prevalent in biological sciences than in ocean sciences because of NIH Traineeship Program grants. However, recently the Integrated Graduate Education Traineeship (IGERT) program at NSF has provided grants to several ocean sciences programs. The advantage of such support for first and second year graduate students is that it allows rotations between various research laboratories to gain training in a variety of research skills, and fosters activities that provide students with career enrichment opportunities such as interactions with industry and businesses. Further aspects of career enrichment and career skill sets are discussed later in this report in the report from Career Services discussion group.

Limits on years of financial support. The "Time-to-Degree" data (Table 10) indicate that some students are taking a much longer than anticipated time to complete their degree requirements. As discussed earlier, these data may be skewed towards longer times by inclusion of part-time

students and students who had leaves of absences. However, there was a general agreement among OSER participants that it was not unusual for students to take six years and sometimes seven years to complete Ph.D. studies. Data for M.S. degrees was less clear-cut but there is evidence that it was not unusual for M.S. degrees to take four years. Many programs have policies that require seeking and obtaining permission from the Departmental Chair or Dean, or some faculty oversight group for financial support, (stipend plus tuition) beyond the fifth year, and have strict rules about ending such financial support after the sixth year unless there are unusual circumstances.

A few faculty and graduate students oppose such programmatic rules and believe that the situation should be decided on a case by case basis. If the advisor has financial support and the student is agreeable, then there should not be any limits. Often both the advisor and student in these cases are striving for the "perfect" thesis and the availability of the optimal postdoctoral position. In the present funding situation with tuition waivers and cost sharing on grants and contracts for GRA tuition, financial support for the graduate student is rarely provided only by the advisors grant or contract funds. Thus, funds that might be assigned to a new student are often tied up if a continuing student is supported in the sixth, seventh or more years. There are also a small number of situations where an advisor might want an experienced student to stay on because they have higher research productivity than a new student. The OSER participants were also aware of a few situations where significant others among students or married students appeared to be "slowing down" and waiting for their partner to finish thesis research. All of these situations are difficult to document.

The consensus was a recommendation that it is desirable and fair to set some identifiable limits on years of financial support and to clearly communicate these limits to both students and faculty when students enroll in a program. Five to six years of support was considered to be sufficient under normal circumstances for completion of a Ph.D. and three years maximum for a M.S. with thesis. There should be a provision for unusual circumstances in such policies that require a decision for further support by an appropriate authority other than the advisor or thesis committee, e.g. Department Chair or Dean.

Group 3: Career Services and Career Retention

This discussion group focused on the following major issues:
(i) Career tracking.
(ii) Career information for enrolled students and applicants,
(iii) Providing Career skill sets.
(iv) Retaining graduates in the field with particular attention to women and underrepresented groups.

i. Career Tracking. There was general agreement that it is difficult and time consuming to obtain longitudinal data about educational and career trajectories from individual graduate students. Although some larger programs have periodically collected data about the career pathways of graduates, none of the discussion group participants were aware of any comprehensive studies of career pathways for ocean science graduate programs as a whole. For degree recipients in the 2003-2004 OSER study, data for the period following graduation is lacking for about 25% of the total pool (see Table 11). While the voluntary nature of such information means that some gaps are inevitable (e.g. when departing students fail to share career

plans with program administrators), a more concerted effort should be undertaken to obtain this information within and across CORE member programs.

A majority of the Ph.D. graduates first go to a postdoctoral position of some type and from there to an academic or government agency research position. Later they may shift between the academic position and government agency or go to the private sector. Anecdotal evidence suggests that career mobility is becoming more common for doctoral degree recipients. Only recently, has there been a systematic attempt to obtain career data for M.S. degree recipients, e.g. Tables 11 and 12. A comparison of the post-graduation employment for the cohorts of graduates for academic year 2000-2001 obtained by CORE for the Commission on Ocean Policy (2004) and the OSER 2006 survey of graduates for 2002-2003 and 2003-2004 (Table 12), reveals reasonable agreement between the surveys and indicates that a diversity of career options are pursued by both M.S. and Ph.D. degree recipients in terms of employment sector as previously discussed.

ii. Career information for enrolled students and applicants. A common complaint of Ph.D. students, is that some advisors and thesis committee members have the expectation that the students will become semi-clones of their advisor, i.e. become academics with a focus on research and some teaching. This attitude on the part of faculty seems to be changing and progress is being made with respect to various program leaders and administrators plus faculty providing information about career options. In this respect, it was noted that the initial practice in a few programs of designating these efforts as providing information on "Alternate Career Options" had a negative and chilling effect because it implies that there is the preferred career of being an academic and if you do not succeed at that or wish to follow that route, then somehow this is a second rate effort.

Several CORE programs have gone well beyond the word of mouth approach to career opportunities for graduates of ocean studies. One example – the MIT/WHOI Joint Program – brings alumni back to WHOI for panel discussions of careers with alumni/ae and former WHOI postdoctoral appointees from a diverse set of careers such as industry (large and small companies), government research laboratories, four year college professors, and professor at research universities. This is supplemented with non-MIT/WHOI Joint Program alumni/ae from other career paths such as science writing. This program has been ongoing on an annual or semi-annual basis since the early 1990s.

Programs at national and international meetings of professional societies such as the American Geophysical Union, The American Society or Limnology and Oceanography, and The Oceanography Society have talks on careers and also provide career enhancement and guidance workshops.

The importance of taking advantage of the willingness of alumni/ae of programs to discuss various careers with current students cannot be overstated. Contact can be initiated by alumni/ae visits to campus or by email and telephone conversations, although the campus visit with in-person contact with students seems to be preferred by students.

iii. Providing Career Skill Sets. There was an initial discussion about what was meant by the term "Career Skill Sets" and what these may encompass for ocean sciences/engineering/studies graduates. Generally, Career Skill Sets are those attributes gained by students during the course of their studies and research that allow them to be successful at careers they pursue after

graduation. Commonly accepted skill sets are an ability to formulate and carry out independent research and to write the result and interpretations in a manner that will be publishable in peer review scientific literature. An ability to prepare a course syllabus and teach specific subject matter is another skill set. Such academic credentials, plus an ability to prepare and present a poster or short oral talk for a professional meeting, an ability to present a longer professional scientific seminar, and the ability to write a grant proposal have been long considered as skill sets for which graduate students should become familiar and proficient by the time they graduate.

Skill sets less discussed in the past, but considered to be important for current students are: (i) a familiarity and practice with outreach presentations and activity effectively conveying state of knowledge science to lay person audiences and K-12 teachers and students, (ii)interacting with the print and electronic media, (iii) discussing science with elected and appointed government officials, (iv) being conversant with issues such as the philosophy of science and the interactions of science with religion (e.g. scientific method pertaining to the theory of evolution compared to creationism and intelligent design), (v) an ability to lead a research group and manage grants and contracts. The latter is often assumed to be learned by the "osmosis approach" of observing advisors, but most students complain that they have no idea of how the grant/contract process really works or appreciation of their advisor's strategy and approach to "people" skills. For ocean sciences and ocean engineering, securing research vessel time, preparing for cruises, serving as a chief scientist, and handling related issues are all skills specific to our field of endeavor.

The above mentioned skill sets can be formally addressed in "career enhancement", or "career skill set" seminar courses and workshops. Some programs have periodic visits of the print and electronic media to campus for briefings on the latest science. Ideally, these media professionals enjoy opportunities to meet with students (and postdocs) as well as faculty researchers, and are able to discuss their perspectives on interactions with scientists and how scientists can better partner with the media to inform the public. Faculty advisors should be encouraged to provide guidance to students and have discussions about their leadership and management philosophies, either in small group meetings or in one-to-one mentoring.

iv. Retaining graduates in the field with particular attention to women and underrepresented groups. The issue of retaining graduate students in graduate studies and after graduation in the field of oceanography, ocean engineering and marine affairs/policy provoked a lively discussion. The difficulty of obtaining information about why students leave programs, other than for academic reasons, was recognized. Even in the situation where there is an academic performance issue of low grades, this is often intertwined with other reasons for unhappiness with the choice of the field of graduate study. Exit interviews initiated at the University of Hawaii are providing important feedback about how students perceive challenges in their graduate studies. The University of Hawaii has found that such one-on-one interactions with those graduating (or leaving for other reasons) have been helpful in guiding faculty advising and mentoring.

Several OSER Workshop participants spoke to the issue that faculty advisors' unhappiness with the tight funding situation was having a chilling effect on graduate students. Coupled with the news reports in professional society magazines about federal budget challenges, faculty pessimism may make it more difficult for students to perceive a satisfying and fulfilling life and career after graduation. While not denying the difficulties of funding, there needs to be a sustained effort by advisors, mentors and program administrators to highlight the positive and fulfilling aspects of various careers, including academic research careers.

Retaining underrepresented groups in graduate studies is basically one of being sensitive in an appropriate way to the pressures to which members of underrepresented groups are subjected. Sensitivity training to foster various types of cultural competency for faculty, staff, and other graduate students is one way to ease the burden. Another major issue is that of more effective recruiting for application, admissions and enrollment to increase the numbers within various programs. These issues will be discussed further in connection with the panel on diversity.

The subject of "Women in Oceanography" and gender equity related issues has been explored in detail in the special issue of ***Oceanography*** (2005) which had just been published six months before the OSER 2005 workshop. The ratio of men and women enrolling in graduate studies and earning MS and Ph.D.s in oceanography (ocean sciences) has steadily improved over the years since the late 1960s and early 1970s as Figure 14 from Figure 5 of O'Connell and Holmes (2005) indicates. The ratio approaches one to one in the field overall (Tables 8, 9, and 14), with a lag for physical oceanography and an even greater differential for ocean engineering, in line with the situation for all engineering fields.

In spite of such overall improvement, several gender equity and "climate for women" issues remain to be addressed (Delaney, 2005; O'Connell and Holmes; 2005; OSER 2005 MPOWIR presentation), especially after women have earned their degrees and begin their postgraduate careers.

A major concern within the academic sector is the loss of women in ocean sciences as they move from successful completion of the doctorate to becoming faculty with successful careers, e.g. see previous MPOWIR section of this report. While many reports use the term "leak in the pipeline", we explicitly recognize that the term can be taken by some to mean a rather confined pathway to follow from K-12 through undergraduate and graduate study to life-long careers. Increasingly, there should be recognition that a diversity of pathways will bring people to fulfilling careers. For example, in the 1960s and 1970s, if a person took time off between undergraduate and graduate studies to pursue other interests, they were labeled as "not being serious about science" and therefore unlikely to be accepted to graduate school. In the present climate, it is much more common –and accepted more readily – for those completing undergraduate degrees to pursue other interests for a year or more, prior to applying to graduate school.

Irrespective of the terms used, it is clear that the transition from earning a Ph.D. to postdoctoral positions is a career transition leading to a net loss of women compared to men. This is not a phenomena limited to ocean sciences and is found across all of earth sciences and indeed all of the sciences (as postdoctoral percentages drop from close to parity to 34.8% women in all sciences and 34.2% for ocean science postdoctoral positions; Table 15; see separate tabular pdf). A logical question to ask is 'is there any systematic bias against women when evaluating candidates for postdoctoral positions?'. To our knowledge, comparisons similar to those done for OSER graduate admissions have not been done for postdoctoral positions nationwide and or even for CORE OSER programs.

Another question that can be asked is 'How well do the plans of recent male and female degree recipients align with the gender ratios of successful postdoctoral position holders. In on-line data from the NSF survey cited above (http://www.nsf.gov/statisticsx/wmpd/postdoc.htm), 57% of the women doctorate degree recipients in 2005 for Earth, Atmospheric, and Ocean Sciences combined planned to go to postdoctoral study. For men, in the same subset of disciplines, 46.7%

planned to go to postdoctoral study. This percentage is strikingly different from the 29.7% of the postdoctoral fellows in the subset who are female.

There are at least three possible explanations for these observations: (i) the approximately 50% of the women doctorate recipients planning for postdoctoral studies is a very recent phenomenon, (ii) fewer of the women who apply for postdoctoral positions are appointed in comparison to men who apply, (iii) the actual appointments for postdoctoral positions are influenced by international applicants who are not applying in the same ratio as men and women graduates of U.S. programs.

In the NSF report (Table 15), there does not appear to be an easily accessible subset of data for the ocean sciences that can be used to narrow the possible explanations. However, evidence from the postdoctoral program at Woods Hole Oceanographic Institution (Farrington, personal communication) suggests that explanation (ii) is not correct since women are appointed in the same ratio to men as the ratio of women to men in the applicant pool. Also at WHOI, the applications by women as a percentage of total applications is about 35% for 2004-2005 and has been growing steadily since 1990. This provides some support for explanation (i). The inclusion of a large number of international applications in the WHOI applicant pool, between 56% and 74% during 1990-2008, is accompanied by variability in the ration of international men to international women compared to the ration of women to men for U.S. applicants. During the past six years, there are a few years when there are more men in the international group in proportion to women than for the U.S. applicants. On this basis, explanation (iii) may be valid on a nationwide basis. The preceding discussion supports the need for further attention to continuing survey data for women and men planning for postdoctoral studies, applications, and appointments.

There was a clear unanimous consensus of the OSER 2005 workshop that continuing attention to gender equity issues such as those discussed within the MPOWIR workshops and in the "Women in Oceanography" volume (Oceanography (2005) are of critical importance to recruit and retain women in the academic sector in ocean sciences.

V. ROLE OF CORE (now Ocean Leadership) IN OCEAN SCIENCES GRADUATE EDUCATION INITIATIVES.

Professor Nancy Targett, Interim Dean of the College of Marine Studies (now Dean), University of Delaware, made a presentation and led a discussion that in several ways was a follow up to the MPOWIR presentation. She asked the question, "Should CORE play a greater and more visible role in ocean sciences graduate education initiatives?" She reviewed the background of various CORE activities and then discussed opportunities with various NSF funded programs for CORE to take a coordinating and leadership role. In particular she noted the upcoming opportunity at NSF to submit a proposal to the NSF Division of Graduate Education; and the Division of Research, Evaluation and Communications - both within the and Directorate for Education and Human Resources – for addressing trends in STEM graduate education in the ROLE (Research on Learning and Education) Program. She reviewed the topics and guidelines for ROLE proposals. A lively discussion followed in which the pros and cons of individual university/college activities and proposals, some across several science and engineering disciplines, were compared and contrasted with potential CORE led or coordinated activities.

Professor Targett agreed to bring the topic to the attention of the CORE Executive Committee for policy guidance.

VI. STRATEGIES FOR ENHANCING DIVERSITY IN THE OCEAN SCIENCES: INVITED PANEL

Panel Membership: ***Dr. Ambrose Jearld, NOAA; Dr. Brandon Jones, US EPA; Dr. Letise Houser, U. Delaware, Ms. Camille Daniels (Univ. of South Florida), Ms. Regina Campbell Malone (MIT/WHOI Joint Program).***

(The following section of our report is not based on transcripts nor on written presentations. It is based on notes taken during the oral presentations by one of the co-authors of this report – Susan Cook, and supplemented by notes taken by another co-author –John Farrington. We have attempted to portray accurately the essential important aspects of the panel members' presentations).

Each of the panel members gave a short synopsis of his/her background and discussed issues of importance to members of underrepresented groups. This report here does not capture all of the valuable information exchange but focuses on a few key points made by the panel members and in the discussion between the panel and audience.

Dr. Ambrose Jearld has been active for years in focusing attention on the issue of lack of greater participation of underrepresented groups in marine sciences. He was the principal organizer of several workshops over the past ten years that brought together representatives of several CORE member organizations with faculty and staff of Historically Minority Serving Colleges and Universities, NOAA and other federal agencies, and faculty and staff from underrepresented groups at majority serving colleges and universities. These "Expanding Opportunities Workshops" began in 1995 at Hampton University. The key recommendations from early workshops paraphrased here were:

1) Need for communication between minority serving and majority serving institutions and individuals at these institutions; especially continue the one to one interactions.
2) Collaboration is the key.
3) Need to increase visibility of ocean science careers in minority communities.
4) Supporting, retaining, and following- up are all key activities in recruiting and retaining minority students.
5) Continuity and sustainability of efforts is key; majority serving institutions need to keep working at recruiting and retaining more minority students, postdocs, faculty and staff.

The Expanding Opportunity Workshops continued until 2003 (Jearld and Peloquin, 2005) when a transition occurred within NOAA in organization and leadership. The recommendations from the workshops after 1995, were similar to the synopsis noted above. Progress has been slow and recommendation 5 above still applies. Dr. Jearld offered his opinion that "Gatekeeper" issues are one of the keys to success; who opens doors and where do these doors open for minority students, postdocs, and faculty to enter. We need to engage people with the authority to act to improve the participation of minorities in ocean sciences, ocean engineering and ocean studies in general. Sometimes this means that convincing a Dean, Department Chair or Program Director is

necessary but not sufficient. In an academic environment, the opinion of faculty has a large influence with admissions and appointments. Thus, faculty share the "Gatekeeper" role with Deans and Department Chairs and Program Directors.

Dr. Brandon Jones manages the Science to Achieve Results (STAR) Graduate Fellowship Program at EPA. He began in marine sciences at the University of Delaware where he earned a M.S. and then taught high school for several years. He returned to the University of Delaware to earn a Ph.D. in Biological Oceanography.. Dr. Jones noted the need for "cultural competency" on the part of all involved in efforts to recruit and retain minorities in ocean sciences. This means gaining an understanding the cultures of the minority students. Different approaches are needed to get the attention of different cultures, institutions, individuals. Science is a very personal undertaking. Young people in minority groups are taught by their family and adults in their cultures that they must take advantage of their education and "give back" to their cultural communities. We have not done a good job of explaining how participation in an ocean science, engineering, or ocean studies career is important to these communities. Dr. Jones also noted that the term "pipeline" is a poor descriptor to use when discussing the need to recruit and retain minority students. The term implies a rigid structure that you have to plug into without much flexibility. He concluded his remarks by noting that, in contrast to recruiting majority students (see above discussion on Effective Strategies for Recruiting Students), careers fairs are a very good idea for recruiting minority students and are an important aspect of recruiting at Historically Minority Serving Institutions. Personal contact is the key – letters, websites and other relatively impersonal strategies do not work very well.

Dr. Letise Houser also graduated from the University of Delaware. She was a Knauss Fellow (at the time of the OSER05 workshop). She grew up in Chicago in an urban environment. A major question for her as she was growing up –What are you going to do with your life? Her mother was a teacher and encouraged her to take advantage of what was available in Chicago. She took the bus to be involved in programs at the Shedd Aquarium. She completed her undergraduate studies at Brown University. She has been involved in mentoring students. Her experience leads to the following recommendations:

1) Role models are important to convey a sense of belief in work of your career and the passion that it is personally rewarding and has global benefits.
2) Work to help fit the student into ocean related activities. Use the approach of asking about the student's interest and then match these with opportunities in ocean sciences. Take advantage of the fact that ocean sciences are multidisciplinary.
3) A multilevel approach is the key – work with science educators, public seminars, as well as higher education community.
4) Provide programs that help transition students from undergraduate studies to graduate school.
5) Sustained financial support is important.

Ms. Camille Daniels (Univ. of South Florida) is a graduate student in the program at the University of South Florida. She grew up in East Baton Rouge, Louisiana At a time when whites had moved to the suburbs and desegregation of the schools was not working. Several of her teachers, while well meaning, were not certified as teachers. The schools had a challenge in preparing students for undergraduate studies. For example, Algebra I was not offered. She

graduated from Louisiana State University with a major in Zoology. She had no science mentor and no research experience during undergraduate study – she did not know about available programs for REU experience. She worked summers and after graduation worked for an insurance company. Then one person on the faculty at LSU (a marine microbiologist), called her and told her about the USF program. She applied , the faculty member at LSU made a telephone call and she was admitted at USF for MS study but without support at first. Another student at USF introduced Camille to Professor Ashanti Pyrtle and Camille was accepted into the MS PHD's program (Minorities Striving and Pursuing Higher Education Degrees of Success in Earth System Science) web site at http://www.msphds.org.

This program has been wonderful for Camille and other minority students involved. It is a novel cross-disciplinary program with links to sources of funding and various types of help and support. There is training and guidance for career skill sets such as STEM professional development, team work, proposal writing, proposal panel reviews (reviewing proposals written by other students), financial management, communicating science to the public, and preparing and presenting professional talks and posters.

Her experience is that a critical number of students – a cohort – is the key to success in the program. Students already in programs are the best recruiters.

Ms. Regina Campbell Malone is a graduate student studying for a Ph.D. in biological oceanography in the MIT/WHOI Joint Program. She had an early exposure to aquatic sciences with Lake Erie, but not to the ocean. She was exposed to marine biology in high school. She had accelerated courses in her education, but that also isolated her. She is one of two African-Americans in the Joint Program. Regina is in residence in Woods Hole the other African-American is seventy-five miles away in Cambridge in residence at MIT. They meet, but infrequently. Regina has reached out to women in the ocean sciences in Woods Hole, but this was not the same as having other African-Americans with whom to interact. She almost left the Joint Program, but she emailed Professor Pyrtle, who referred her to Dr. Ambrose Jearld at NMFS in Woods Hole. This mentoring was a great help. Through the Academic Programs Office staff in WHOI, Dean John Farrington became aware of her interest in doing something positive with respect to minorities in ocean sciences in the Woods Hole scientific community. He sought her advice and she came involved with an effort that has result in a reinvigoration of commitment through a signed Memorandum of Understanding of all the scientific organizations in Woods Hole to focus collective resources and efforts to increase diversity in marine sciences. Regina is a student member of the Diversity Advisory Committee convened by the MOU activities.

Ms. Campbell-Malone noted the importance of critical numbers of students, in agreement with Camille's comments above. She made the following additional key points:

1) The need to get the right people involved.
2) There needs to be better accountability for progress.
3) Reconnecting separate efforts is important because money is being wasted. Businesses would not tolerate such a wasteful situation.
4) We need to get the message across to very young students that "Ocean sciences is a place for you".

General Discussion of Panel Presentations and Topics.

Professor Gary Griggs noted that the presentations and the messages they conveyed were powerful and compelling. In retrospect, it was unfortunate that the panel presentations had not been video taped for use in wider communication to the ocean sciences, ocean engineering and ocean studies communities. There was general agreement with Professor Grigg's comment.

The point was made that minority students have been successful in graduate education in ocean sciences, but they are not being appointed to postdoctoral positions or hired in faculty positions. Some participants commented that with the small numbers thus far, it was difficult to document success. Others noted that while there had been increases in graduation of minority students in the biological oceanography/marine biology sub-disciplines, far fewer minority students have enrolled and graduated in other sub-disciplines of ocean sciences and ocean engineering. A similar pattern can be seen in comparisons of minorities in biological sciences and physical sciences in general.

There was further discussion of the situation of most of the current minority graduate students being in the biological sciences. Unless care was exercised, this could lead to misunderstandings if we use demographics in comparing open positions in the aggregate of ocean sciences for M.S. or Ph.D. level graduates with the aggregate of available minority graduates, if the majority of the open positions are not focused on having an education and skills in biological oceanography/marine biology. This led to a brief discussion of the need for broadening the curriculum and more recognition of interdisciplinary skills. There was general agreement that even if this happened, it did not reduce the need to recruit and retain more minority students to the geological, physical and chemical sub-disciplines within ocean sciences and to ocean engineering. There was less experience with Marine Affairs/ Marine Policy among the assembled group and thus no discussion for that discipline.

The growing tendency for students to not respond to questions asking them to voluntarily identify themselves with respect to race/ethnicity on survey forms was noted. Students of mixed racial and ethnic backgrounds have been especially vocal about inappropriate labels or categorization of students. Other students wish to be certain that they are achieving on their merits and not because of special attention due to race or ethnicity. While this was understandable in the context of a very globally connected new generation, it makes it difficult to use demographic data to document progress and to identify what works and what does not work in recruiting and retention.

There was general agreement that the issues raised and recommendations contained in the panel members presentations, as noted above, provided excellent guidance for future efforts within CORE and the ocean science, ocean engineering, and marine affairs communities to increase minority participation at all stages of education and careers.

VII. GK-12 AND SIMILAR PROGRAMS

Panel Membership: Ms. Teresa Greely (U. South Florida), Ms. Shay Saleem (U. South Florida). Ms. Desiree Plata (MIT/WHOI Joint Program), Ms. Liz Tyner (U. South Florida), Dr. Robert Chen (U.Mass-Boston), Ms. Julie Callahan (U.Mass.-Boston). Discussion Lead, Dr. Peter Betzer, Dean, U. South Florida).

Ms. Teresa Greely presented an introduction to the GK-12 program funded by NSF at the University of South Florida http://www.marine.usf.edu/outreach/GK12/index.php. This was followed by a presentation on her participation as a graduate student in the USF GK-12 program by Ms. Shay Saleem. Power Points from both these presentations are included in Appendix V. Excerpts from these excellent presentations are included here to encourage readers to go to this Appendix for additional information.

Ms. Teresa Greely noted that the USF program in 2005 had 28 graduate students who are GK-12 fellows. 36% of these students were minorities, 18 were in Ph.D. studies and 10 were in M.S. studies. Fifteen focused on biological oceanography, five on chemical oceanography, seven on geological oceanography, and one on physical oceanography. The program involved 31 science teachers from 15 schools – 8 elementary schools, 4 middle schools, and 3 high schools.

Ms. Shay Saleem spoke about her involvement in the activities with a grade 6 Earth Science class and a Grade 7 Life Science class which gave her valuable experience in communicating science. It was important to her that her work related ocean concepts to the students and their immediate surroundings and combined ocean science with the current curriculum. Participation with both classes involved field work. She remained on target with progress in her graduate degree and was thankful for the ongoing support of her GK-12 efforts by her advisor.

Ms. Desiree Plata presented a program of after-school enrichment for minorities in a grade 3 setting in Cambridge, MA that was offered for one semester by Desiree and a fellow MIT/WHOI Joint Program student, Mr. Ari Shapiro. Both Desiree and Ari did this voluntarily as part of their personal interests since both were supported by federal graduate fellowships that did not require a K-12 involvement. A printout of Desiree's presentation (edited for inclusion with this report by John Farrington) is included in Appendix V. It is interesting that Desiree's and Ari's involvement has stimulated interest in similar or related efforts among the MIT/WHOI Joint Program graduate students. Desiree and Ari brought their class to visit WHOI with support from the WHOI Academic Programs Office. While in the area, the class visited a beach. For all these students from the Cambridge, MA area – not more than ten miles from a beach in the Greater Boston area– this was the first time they had visited a beach!

Ms. Liz Tyner took the OSER workshop participants through a GK-12 exercise for small groups used in the University of South Florida Program.

Dr. Robert Chen, University of Massachusetts-Boston presented an introduction to the Watershed-Integrated Sciences Partnership (www.wisp.umb.edu), an 8-year NSF GK-12 program that will place 59 graduate students in local middle and elementary schools impacting over 3000 students. Impacts on graduate students included an improved ability to present scientific research to a non-science audience, an increased awareness and interest in K-12 outreach, and an increased

ability to teach science at all levels. Highlights of the WISP program include an 1100 tile watershed mural on display at the New England Aquarium, a real-time environmental sensor system that looks like a swan in a local pond, and a sustainable graduate course for teachers involving field work, local resources, and several university faculty members. Professor Chen's Power Point presentation is included in Appendix V.

Ms. Julie Callahan discussed her experiences as a WISP Fellow and the impacts of such a program on her doctoral training. She not only enjoyed leading "Watershed Wednesdays", but had more interaction with local schools, increased her ability to present complex science concepts to the general public, and learned how to better organize her time. Upon graduating, she taught middle school for 2 years before accepting a congressional environmental policy fellowship in Washington DC.

Summary of GK-12 and Similar Experiences Panel

These presentations were received with enthusiasm by all present. There was general consensus that the GK-12 and similar efforts, exemplified by the programs presentations, were a very effective addition to the portfolio of graduate education career skill opportunities. Involving graduate students at the interface between ocean research and K-12 education had several positive aspects, including training the next generation of people who would be in various careers (including academic professorships), and what is needed in terms of process and opportunities to make a difference in K-12 education. On a more personal level, current professors became actively engaged in the program because of the involvement of their graduate students. And, teachers and students were brought more directly into contact with ongoing research. The importance of ocean or marine education specialists (non-professors) as coordinators and interface people in these efforts was also identified as key to many of the successes.

VIII. FUTURE CHALLENGES: THE REPORT OF U.S. COMMISSION ON OCEAN POLICY (2004) RECOMMENDATIONS WITH RELEVANCE TO GRADUATE EDUCATION. Gary Griggs, Moderator.

US Commission on Ocean Policy. Recommendation 8-7: Establishing effective relationships between the research and education communities to expand professional development for teachers and teacher educators.

US Commission on Ocean Policy. Recommendation 8-10: Promoting the development of the nation's ocean-related workforce.

Participants decided to discuss these issues in plenary rather break into smaller discussion groups.

Pertaining to both recommendations.

Professor Gary Griggs presented a brief biographical sketch of his background and experience with graduate education and with teaching an undergraduate oceanography course for 37 years at the University of California, Santa Cruz as illustrative of his long standing interest in the ocean education issues addressed by the USCOP (USCOP, 2004). His experience, having taught about

8,000 students in the undergraduate course, is that it is not too late at the undergraduate level to interest students in ocean sciences.

Several workshop participants, e.g. Professor Fred Dobbs and Professor Glenn Lopez , noted that the CORE members can contribute to ocean sciences education in general and specifically, to the recommendations 7 and 10 above, in many ways and are in fact doing so. The lack of a single federal agency with the mandate to be a lead agency in ocean science education was noted as a problem by some workshop participants. Others were concerned about having too rigid centralized mandates and noted that, in the past CORE requests for members to participate in activities such as the National Ocean Science Bowl have provided only partial funding – not the full amount needed to carry out such efforts. Summarizing this part of the discussion, workshop participants recognized the need for coordination on regional and national scales, with allowance for sufficient flexibility for innovation at the local level.

The various NOAA-Sea Grant programs were an example of a structure that has worked and continues to work effectively at the interface between scientific research, outreach and K-12 education, especially with teachers. The more recent NSF COSEE efforts have been having success at the local individual program levels and coordination at the national level is ramping up. The sharing of "best practices" by way of a national coordination effort is highly recommended. This is already ongoing within the COSEE programs.

There was a sense of the workshop that most efforts were focused on in-service teachers and that there was a need for innovation and implementation of partnerships and programs to familiarize pre-service teachers with ocean science research and ocean science education efforts. Perhaps there could be an effort to involve ocean sciences in Masters Degree programs for science teachers.

Graduate Education

There have been several innovations in oceanography graduate curricula at various CORE organizations, but these types of efforts are only slowly gaining momentum and acceptance. For example, VIMS- College of William and Mary has inaugurated a program of multi-disciplinary interaction between marine science/policy/law/and business. However, it has been a challenge to convince some of the faculty of the value of such offerings. John Farrington noted that this was similar to a multidisciplinary seminar on Estuaries in which he was enrolled as a graduate student at GSO-URI in the 1970-1971 academic year (Farrington, 2001). Along these lines, it was noted that URI was beginning new interdisciplinary joint programs that allowed for earning an MS in Marine Policy and Ph.D. in Oceanography. Other innovative MS programs focused more on the training of professionals for the upcoming ocean observing systems were in the planning stages for Rutgers and Texas A & M universities.

A discussion of the issue of broadening the formal curriculum and adding seminars or workshop programs to provide career skill sets, as noted in a preceding section of this report, led to a much broader discussion about curricula. The need to become more "interdisciplinary" is oft quoted by students, some faculty, and potential employers when referring to requirements for particular sub-discipline graduate degrees. Some senior faculty resist changes to a time-tested curriculum in which they have invested considerable effort and which appears to be a success based on the career performance of past graduates. However, there has not been, and is not, a "one curriculum

model fits all" approach to graduate education in ocean sciences. The statement by the ASLO Report (ASLO, 1960):"*Opinions differ pretty much in accordance with the particular route by which each oceanographer has entered the field. It is healthy that varied programs are open to the prospective student*"" - is still applicable in large measure today.

The question about what the assembled group and CORE could do to facilitate refreshing the curriculum led to a recommendation as step one: CORE should facilitate a collection and sharing of the graduate curriculum, degree requirements, general examination requirements and focus, and options for the various CORE member colleges and universities.

Professor Wilf Gardner has noted that the major task of education, including graduate education, is to provide a means for people to learn how to continue life-long learning. Or, as Arthur R. M. Nowell has noted with respect to his review of ocean sciences education at the undergraduate and graduate level, "..inculcate a personal love of learning that will last a lifetime…" (Nowell, 2000).

Follow On Actions and Improvements for the Next OSER Workshop.

A workshop report needs to be presented at the Ocean Sciences 2006 meeting. [Follow-up note: A poster was presented at that meeting briefly summarizing OSER05 authored by Cook, Farrington, McDuff (2006)]. A report of the workshop and some of the data interpretations placed within a larger context is needed. [This report fills the gap].

There was disappointment that there were not more graduate programs of CORE members represented at the present workshop. All folks are busy, but the contents of the workshop seemed to be important. Video taping of the panel discussions would have been a worthwhile effort. This is recommended for the next OSER. There were no agency program managers present. They should be invited and encouraged to attend. One program manager had planned to attend, but had to cancel at the last minute.

Improving participation is a high priority, including getting all programs to fill in the survey information. Perhaps connecting the next OSER with a CORE Board Meeting, as happened with OSER03, would improve attendance and also get more attention for the education issues from the CORE Board.

The preceding recommendations now apply to the Consortium for Ocean Leadership.

HURRICANE KATRINA AFTERMATH UPDATE

Dr. Susan Cook provided a brief update about the needs and activities ongoing as coordinated by CORE to fulfill the needs of colleagues and graduate programs in the Gulf of Mexico coastal area impacted by Hurricane Katrina.

IX. REFERENCES

ASLO (1960). Education and Recruitment of Oceanographers in the United States. A report by The Committee on Education and Recruitment, The American Society of Limnology and Oceanography, August, 30, 1960. Limnology and Oceanography Supplement to Volume VI.

CMSER (1968). Education and Training, Chapter 7. Pages I42-I44, Volume 1. Panel Reports of the CMSER, *Our Nation and the Sea.* Report of the Commission on Marine Science, Engineering and Resources. U. S. Government Printing Office, Washington, DC 20402.

Cook, S.B., J.W. Farrington, R.E. McDuff (2006). The CORE OSER Dataset: A Community Resource for Assessing Patterns in Ocean Sciences Graduate Education Poster. OS451-01, Ocean Sciences Meeting, 2006, Honolulu, HI.

Farrington, J. W. (2001). Sverdrup, Johnson, and Fleming's *The Oceans* revisited: What of the Future of Graduate Education in Ocean Sciences? Oceanography 14: 34-39.

Farrington, J. W. and A. L. Peirson, III. (1996). Undergraduate college faculty workshops in oceanography, 1987-1992. Oceanography 9: 135-139.

Jearld, A. Jr and D. Peloquin (compilers) (2005). Expanding Opportunities in Oceanic and Atmospheric Sciences III; proceedings of the third national conference to strengthen the links among HBMSCUs, NOAA, business, and graduate studies in marine and atmospheric sciences. *U.S. Dep. Commerce, Northeast Fisheries Science Center. Ref. Doc. 05-11; 142 p.* Available from National Marine Fisheries Service, 199 Water Street, Woods Hole, MA 02543-1016.

Knudsen, V. O., A. C. Redfield, R. Revelle, and R. R. Shrock. (1950). Education and Training for Oceanographers. Science 111 (2895): 700-703.

Lill, G.G., A. E. Maxwell, and F. D. Jennings (1959). *The Next Ten Years in Oceanography (A Survey of Growth Potential at Existing Institutions*). Internal Memo of the Office of Naval Research, U.S. Navy.

NAS (1929). *Oceanography: Its Scope, Problems and Economic Importance.* Houghton Mifflin Company, Boston, MA.

NAS-NRC (1960*). Oceanography 1960-1970*. A report by the Committee on Oceanography, National Academy of Sciences, National Research Council, Washington, DC, USA.

NAS-NRC (1971). *Ocean Science manpower Data and their Interpretation*. Report of the Panel on Ocean Science Manpower Data., Committee on Oceanography, National Academy of Sciences – National Research Council, Washington, DC. 19 pages plus 2 pages of appendices.

Nelson, D. J. with C.N. Brammer and H. Rhoades (2007). *A National Analysis of Minorities in Science and Engineering Faculties at Research Universities.* http://cheminfo.chem.ou.edu/faculty/djn/diversity/Faculty_FY07Report.pdf.

Nowell, A. R M., C.D. Hollister, A. B. Baggeroer (1985). Contemplating Tomorrow's Oceanographers. Sea Technology, October 1985.

Nowell, A. R. M., C. D. Hollister, A. B. Baggeroer (1988). Graduate Students in Oceanography: Recruitment, Success, and Career Prospects. EOS 69 (36**),** 834-835, 840-843.

Nowell, A.R.M, and C. D. Hollister (1990). Undergraduate and graduate education ioceanography. Oceanus 33: 31-38.

Nowell, A. R. M. (2000). Education in Oceanography: History, Purpose, and Prognosis. In 50 years of Ocean Discovery, National Science Foundation 1950-2000. National Research Council, National Academies Press, Washington, DC 20005. pages 195-200.

NSF (2008). US National Science Foundation web site. Division of Science Resource Statistics. http://www.nsf.gov/statistics/wmpd/postdoc.htm.

O'Connell. S. and M A. Holmes (2005). Women of the Academy and the Sea. Oceanography 18(1): 12-24.

Oceanography (2005). Women in Oceanography. Special Issue of Oceanography 18(1) March, 2005.

Russell, S. H., M. P. Hancock and J. McCullough (2006). Evaluation of NSF Supp9rt for Undergraduate Research Opportunities: Draft Synthesis Report Executive Summary. Available online (www.sri.com/policy/csted/reports/university/index.html#urosynthesis).

Russell, S. H., M. P. Hancock and J. McCullough (2007). Benefits of Undergraduate Research Experiences. Science 316: 548-549.

USCOP (2004). An Ocean Blueprint for the 21st Century. Final Report of the U.S. Commission on Ocean Policy, Washington, DC 2004. ISBN #0-9759462-0-x. Also available on line at <http://www.oceancommission.com>. Chapter 8 - Promoting Life Long Ocean Education, and Appendix 4 - U.S. Ocean-Related Academic Infrastructure.

APPENDIX I. 2004 SURVEY GRADUATE AND FACULTY QUESTIONAIRES for OSER05

Graduate Program Survey of Ocean Sciences Departments and Institutions

Sponsored by the Consortium for Oceanographic Research and Education

1. Contact information

Name of institution:

Name of department:

Form completed by *(your name)***:**

Your title:

Your email address:

2. Does your department offer graduate degrees (Master's or Ph.D.)?

☐ Yes

☐ No *(if no graduate degrees offered, please stop here and return this form so that we may remove you from our mailing list of graduate programs.)*

3. Please check all that apply about your department's graduate program

☐ Master's is the highest degree offered

☐ Master's is <u>required</u> en route to a PhD

☐ Master's is <u>optional</u> en route to a PhD

☐ We have a separate Master's program parallel to our PhD program

4. Please indicate the number of graduate applications for admission in Fall 2003 in each of the following areas. Specify the total number, the number of men, and the number of women:

	Number of Applications Fall 2003		Number of Male Applicants		Number of Female Applicants
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Affairs (incl. Marine Policy & Maritime/Admiralty Law)		=		+	
Fishery Sciences & Aquaculture		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

4a. How many of your total applications for admission in Fall 2003 *(response entered for total in box above, Question 4)* were from:

U.S. Citizens[1]: ☐ **Foreign Citizens:** ☐

White	Asian-American	African-American
Hispanic	Native American	Other

[1] Include resident aliens in US total but report racial breakdown for US citizens only.

5. Please indicate the number of offers for admission in Fall 2003 in each of the following areas. Specify the total number, the number of men, and the number of women:

	Total Number of Offers Fall 2003		Number of Offers to men		Number of Offers to women
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Affairs (incl. Marine Policy & Maritime/Admiralty Law)		=		+	
Fishery Sciences & Aquaculture		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

5a. How many of your total number of offers for admission in Fall 2003 *(response entered for total in box above, Question 5)* were made to:

U.S. Citizens[2]: ☐ **Foreign Citizens:** ☐

White	Asian-American	African-American
Hispanic	Native American	Other

[2] Include resident aliens in US total but report racial breakdown for US citizens only.

6. Please indicate the number of <u>first-year</u> graduate student enrollments (or offers accepted) for <u>Fall 2003</u> in each of the following areas. Specify the total number, the number of men, and the number of women:

	Number of 1st year enrollments Fall 2003		Number of 1st year enrollments who were men		Number of 1st year enrollments who were women
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Policy (incl. Marine Affairs & Maritime/Admiralty Law)		=		+	
Fishery Sciences		=		+	
Aquaculture (incl. Mariculture)		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

6a. How many of your total Fall 2003 first-year enrollments *(response entered for total in box above, Question 6)* were:

U.S. Citizens[3]: ☐ **Foreign Citizens:** ☐

White	Asian-American	African-American
Hispanic	Native American	Other

[3] Include resident aliens in US total but report racial breakdown for US citizens only.

7. Please indicate the number of graduate students currently in residence in each of the following areas as of last Fall 2003. Specify the total number, the number of men, and the number of women:

	Total number of grad students in residence		Number of grad students who are men		Number of grad students who are women
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Policy (incl. Marine Affairs & Maritime/Admiralty Law)		=		+	
Fishery Sciences		=		+	
Aquaculture (incl. Mariculture)		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

7a. How many of your total graduate students in residence (Fall 2003) *(response entered for total in box above, Question 7)* are:

U.S. Citizens[4]: ☐ **Foreign Citizens:** ☐

White	Asian-American	African-American
Hispanic	Native American	Other

[4] Include resident aliens in US total but report racial breakdown for US citizens

8. Please indicate the number of your total graduate students in residence (Fall 2003) who were <u>primarily</u> supported in each of the following ways.
(Note: Every student should be counted one time. If a student is supported multiple ways, please count him/her only one time by his/her primary source of support)

Source of Support	Total number of graduate students receiving support
Teaching Assistantship	
Research Assistantship	
Fellowship	
Traineeship	
Other sources of support	
Not receiving support	

8a. What is the most common full-time equivalent (FTE) for graduate students with Teaching Assistantships?

*Note: 1.0 FTE = 2080 hours per year (40 hours/week * 52 weeks/year)*
*0.5 FTE = 1040 hours per year (20 hours/week * 52 weeks/year)*

FTE for Teaching Assistantships

8b. What is the average annual salary for the most common FTE of Teaching Assistants referenced in item 8a?

$ per year for Teaching Assistants

8c. What is the most common full-time equivalent (FTE) for graduate students with Research Assistantships?

FTE for Research Assistantships

8d. What is the average annual salary for the most common FTE of Research Assistants referenced in item 8c?

$ per year for Research Assistants

7. Please check all that apply about your department's graduate program

- ☐ Master's is the highest degree offered
- ☐ Master's is <u>required</u> en route to a PhD
- ☐ Master's is <u>optional</u> en route to a PhD
- ☐ We have a separate Master's program parallel to our PhD program

9. How many total Master's degrees were granted in each of the following areas between July 1, 2002 and June 30, 2003? Specify the total number, the number of men, and the number of women graduates.

	Total number of Master's awarded July 02-June 03		**Number of Master's awarded to men**		**Number of Master's awarded to women**
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Policy (incl. Marine Affairs & Maritime/Admiralty Law)		=		+	
Fishery Sciences		=		+	
Aquaculture (incl. Mariculture)		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

9a. How many of your total Master's recipients (July 1, 2002 to June 30, 2003) *(response entered for total in box above, Question 9)* were:

U.S. Citizens[5]: ☐ **Foreign Citizens:** ☐

White	Asian-American	African-American
Hispanic	Native American	Other

[5] Include resident aliens in US total but report racial breakdown for US citizens

10. Of those Master's recipients who left your department in between July 1, 2002 and June 30, 2003, how many did the following?

	Number of Master's recipients
Enrolled in another university (regardless of field of study)	
Foreign students who left the USA	
Employed in Four-year college or university	
Employed in University-Affiliated Research Center	
Employed in Federal Agency	
Employed in State Agency	
Employed in Non-Profit	
Employed in Private For-Profit Sector	
Other	
Don't know	

Note: If your department does not grant Ph.D.s, please stop here and return the questionnaire. Thank you.

11. How many total Ph.D.s were granted in each of the following areas between July 1, 2002 and June 30, 2003? Specify the total number, the number of men, and the number of women graduates.

	Total number of Ph.D.s awarded July 02 - June 03		**Number of Ph.D.s awarded to men**		**Number of Ph.D.s awarded to women**
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Policy (incl. Marine Affairs & Maritime/Admiralty Law)		=		+	
Fishery Sciences		=		+	
Aquaculture (incl. Mariculture)		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

Use this number to respond to next item.

11a. How many of your total Ph.D. recipients (July 1, 2002 to June 30, 2003) *(response entered for total in box on previous page, Question 11)* were:

U.S. Citizens[6]: ☐ **Foreign Citizens:** ☐

White	Asian-American	African-American
Hispanic	Native American	Other

12. Of those Ph.D. recipients who left your department in between July 1, 2002 and June 30, 2003, how many did the following?

	Number of Ph.D. recipients
Foreign students who left the USA	
Employed in Four-year college or university	
Employed in University-Affiliated Research Center	
Employed in Federal Agency	
Employed in State Agency	
Employed in Non-Profit	
Employed in Private For-Profit Sector	
Other	
Don't know	

[6] Include resident aliens in US total but report racial breakdown for US citizens

13. Please indicate the number of graduate applications for admission in Fall 2004 in each of the following areas. Specify the total number, the number of men, and the number of women:

	Number of Applications Fall 2004		Number of Male Applicants		Number of Female Applicants
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Affairs (incl. Marine Policy & Maritime/Admiralty Law)		=		+	
Fishery Sciences & Aquaculture		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

13a. How many of your total applications for admission in Fall 2004 *(response entered for total in box above, Question 13)* were from:

U.S. Citizens[7]: ____ **Foreign Citizens:** ____

White	Asian-American	African-American
Hispanic	Native American	Other

[7] Include resident aliens in US total but report racial breakdown for US citizens

14. Please indicate the number of offers for admission in Fall 2004 in each of the following areas. Specify the total number, the number of men, and the number of women:

	Total Number of Offers Fall 2004		Number of Offers to men		Number of Offers to women
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Affairs (incl. Marine Policy & Maritime/Admiralty Law)		=		+	
Fishery Sciences & Aquaculture		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

14a. How many of your total number of offers for admission in Fall 2004 *(response entered for total in box above, Question 14)* were made to:

U.S. Citizens[8]: ☐ **Foreign Citizens:** ☐

White	Asian-American	African-American
Hispanic	Native American	Other

[8] Include resident aliens in US total but report racial breakdown for US citizens

15. Please indicate the number of <u>first-year</u> graduate student enrollments (or offers accepted) for <u>Fall 2004</u> in each of the following areas. Specify the total number, the number of men, and the number of women:

	Number of 1st year enrollments Fall 2004		Number of 1st year male enrollments Fall 2004		Number of 1st year female enrollments Fall 2004
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Policy (incl. Marine Affairs & Maritime/Admiralty Law)		=		+	
Fishery Sciences		=		+	
Aquaculture (incl. Mariculture)		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

15a. How many of your total Fall 2004 first-year enrollments *(response entered for total in box above, Question 15)* were:

U.S. Citizens[9]: ☐ **Foreign Citizens:** ☐

White Asian-American African-American
Hispanic Native American Other

[9] Include resident aliens in US total but report racial breakdown for US citizens

16. How many total Master's degrees were granted in each of the following areas between July 1, 2003 and June 30, 2004? Specify the total number, the number of men, and the number of women graduates.

	Total number of Master's awarded July 03-June04		**Number of Master's awarded to men**		**Number of Master's awarded to women**
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Policy (incl. Marine Affairs & Maritime/Admiralty Law)		=		+	
Fishery Sciences		=		+	
Aquaculture (incl. Mariculture)		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

16a. How many of your total Master's recipients (July 1, 2003 to June 30, 2004) *(response entered for total in box above, Question 16)* were:

U.S. Citizens[10]: ☐ **Foreign Citizens:** ☐

White	Asian-American	African-American
Hispanic	Native American	Other

[10] Include resident aliens in US total but report racial breakdown for US citizens

17. Of those Master's recipients who left your department in between July 1, 2003 and June 30, 2004, how many did the following?

	Number of Master's recipients
Enrolled in another university (regardless of field of study)	
Foreign students who left the USA	
Employed in Four-year college or university	
Employed in University-Affiliated Research Center	
Employed in Federal Agency	
Employed in State Agency	
Employed in Non-Profit	
Employed in Private For-Profit Sector	
Other	
Don't know	

18. Please indicate the estimated time to degree for your Masters students who graduated between July 1, 2000 and June 30 2003.

Duration		Number of Masters Degree Recipients
< 1	Year	
1 to 1.9	Years	
2 to 2.9	Years	
3.0 to 3.9	Years	
4.0 to 4.9	Years	
5.0 to 5.9	Years	
≥ 6	Years	

19. How many total Ph.D.s were granted in each of the following areas between July 1, 2003 and June 30, 2004? Specify the total number, the number of men, and the number of women graduates.

	Total number of Ph.D.s awarded July 03 - June 04		**Number of Ph.D.s awarded to men**		**Number of Ph.D.s awarded to women**
Marine Biology and/or Biological Oceanography		=		+	
Marine Chemistry and/or Chemical Oceanography		=		+	
Marine Geology & Geophysics		=		+	
Physical Oceanography		=		+	
Ocean Engineering (incl. Applied Ocean Physics)		=		+	
Marine Policy (incl. Marine Affairs & Maritime/Admiralty Law)		=		+	
Fishery Sciences		=		+	
Aquaculture (incl. Mariculture)		=		+	
Coastal & Estuarine Studies		=		+	
Other Ocean Science *(please specify)*		=		+	
TOTAL NUMBER (Sum of Column)					

19a. How many of your total Ph.D. recipients (July 1, 2003 to June 30, 2004) *(response entered for total in box on previous page, Question 19)* were:

U.S. Citizens[11]: ☐ **Foreign Citizens:** ☐

White	Asian-American	African-American
Hispanic	Native American	Other

[11] Include resident aliens in US total but report racial breakdown for US citizens

20. Please indicate the estimated time to degree for your PhD students who graduated between July 1, 2003 and June 30 2004.

Duration		Number of PhD Recipients
< 5	Years	
5 to 5.9	Years	
6 to 6.9	Years	
7 to 7.9	Years	
8 to 8.9	Years	
9 to 9.9	Years	
≥ 10	Years	

21. Of those Ph.D. recipients who left your department in between July 1, 2003 and June 30, 2004, how many did the following?

	Number of Ph.D. recipients
Foreign students who left the USA	
Employed in Four-year college or university	
Employed in University-Affiliated Research Center	
Employed in Federal Agency	
Employed in State Agency	
Employed in Non-Profit	
Employed in Private For-Profit Sector	
Other	
Don't know	

Thank you for your participation!

Please save a copy of this survey for your records and email it back to scook@coreocean.org or print and fax it to (202) 986-5072.
Contact Sue Cook at CORE with any questions at (202) 332-0063, ext. 1223.

APPENDIX II. AGENDA

CORE Ocean Science Educators Retreat
October 26-27, 2005
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

Wednesday, October 26, 2005

8:00 – 8:30 AM Continental Breakfast Clark 5 Foyer

8:30 – 11:15 AM Clark 507. Welcome, Dick West, President of CORE
Plenary Session:

A Review of Graduate Program Characteristics Dr. Russ McDuff, Director, School of Oceanography, University of Washington Dr. John Farrington, Vice President for Academic Programs and Dean, Woods Hole Oceanographic Institution

Ample time will be provided for Q and A and discussion of trends

11:15 – 12:00 AM Clark 507 . Late Breaking News: Results from the workshop "Mentoring Physical Oceanography Women to Increase Retention", Dr. Amy Bower and Dr. Robert Beardsley, Woods Hole Oceanographic Institution

12:00 AM – 1:30 PM Lunch Clark 5 Foyer

1:30 – 3:00 PM Clark 507. Introduction to discussion topics in plenary session to Discussion Groups:

Effective Strategies for Recruiting Students
Financial Support of Graduate Students
Career Services and Career Retention

Breakout Rooms: Clark 201, 271, 428, 509

2:30-3;00 PM Clark 507. Reports from Discussion groups.
3:00-3:30 PM Break

3:30 – 5:00 PM Clark 507. Funding Opportunities for strengthening marine graduate education. Should CORE and its member institutions seek funding from NSF DGE/ROLE?
Dr. Nancy Targett.

6:00 – 7:00 PM Clark 5 Foyer, Clark 509 Reception and Posters (Graduate students accomplishments in education & outreach)

7.00 – 9.00 PM Clark 507 and Foyer Dinner, Keynote Speaker Dr. Isaac

Colbert, Dean for Graduate Students. Massachusetts Institute of Technology

Thursday, October 27, 2005

8:00 – 8:30 AM Continental Breakfast Clark 5 Foyer

8:30 – 10:00 AM Clark 507. Strategies for Enhancing Diversity in the Ocean Sciences: Invited panel, Dr. Susan Cook, lead organizer.

10:00 – 10:30 AM Break

10:30 AM – 12:00 PM Clark 507 Ocean Science Concepts and Research in K-12 Environments Enhancing the Experience of Learning and Doing Science: Invited Panel, Dr. Peter Betzer, lead organizer.

12:00 AM – 1:30 PM Lunch Clark 5 Foyer

1:30 – 3:30 PM Clark 507. Future Challenges. Gary Griggs, Moderator.
Plenary and Break-outs on the U.S. Commission on Ocean Policy's Recommendations with Relevance to Graduate Education.

> Recommendation 8-10: Promoting the development of the nation's ocean-related workforce.
>
> Recommendation 8-7: Establishing effective relationships between the research and education communities to expand professional development for teachers and teacher educators.

Break-out rooms: Clark 507, 509, 428, 201

3:30 Clark 507. Report out from afternoon discussion groups

4:00 Clark 507. Open Discussion: Community Response to Katrina and the Needs of Colleagues in the Gulf Region

4:30 Workshop Adjourns

APPENDIX III

CORE Ocean Science Educators Retreat
October 26-27, 2005
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

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APPENDIX IV.

MPOWIR: Mentoring Physical Oceanography Women to Increase Retention
Workshop Sponsored by the National Science Foundation and the Office of Naval Research
The Airlie Center, Warrenton, Virginia, October 9-12, 2005

Summary

Efforts over the past several decades toward increasing the number of women entering science and engineering fields have largely been successful, with undergraduate and graduate school enrollments averaging between 30 and 50% women (1). Ph.D. attainments show similar progress. However, the percentage of women occupying tenure track positions has not risen commensurably. Across the board, women in science and engineering fill on average only 15-25% of academic positions (1). Since the number of women in graduate school has been sufficiently large for at least a decade, it is difficult to ascribe the lower percentage of women in faculty positions to a small pool of potential candidates. As reported in the Chronicle of Higher Educational earlier this year, the disparity between the number of women trained in a field and the number of women occupying positions in that field is instead attributed by some to subtle biases that keep women out of research or academic positions; others argue that women are simply staying away of their own accord from these positions. The focus of the community effort initiated within the physical oceanographic community is on the latter attribution; namely that women are opting out of the "pipeline' in the early years of their scientific careers. Thus, while recruitment efforts should be lauded, we need to also turn out attention to retention if we are to capitalize on the investment the funding agencies and universities have made on the education of women students and, importantly, if we are to create a scientific workforce whose diversity matches that of the student population and, in a broader sense, that of the U.S. population as a whole.

Ocean sciences provide no exception to these trends. For example, the number of women receiving their Ph.D. in physical oceanography has approached 40% at most major oceanographic institutions; however the number of women with PI status remains fairly low. In the past years, only 12 percent of all proposals submitted to the physical oceanography program at NSF have had women as the lead PI. There are many factors that contribute to the lack of retention of women scientists: competition between family building and career building, competition between career goals of spouse/partner, lack of female role models, lack of adequate mentoring, etc. While some of these problems are best met with institutional changes, the latter problem in particular is one the phys9cal oceanographic community can address. Toward this end, an NSF and ONR-funded workshop was conducted at the Airlie Center in Warrenton, Virginia from October 9-12,

2005. Twenty-nine physical oceanographers, men as well as women, assembled for the purpose of designing a mentoring program for junior women in the field of physical oceanography in order to help remove barriers, real or perceived, in their career development. The overall goal of this community effort is to develop a program within physical oceanography essentially as a pilot project that, if successful, could be expanded to include women in all areas of ocean sciences, or geosciences at a later date. Additionally, we believe that our efforts toward retaining women in the field will also be transferable to the retention of minorities, a goal we heartily endorse.

The initial focus at the workshop was on identifying the obstacles that junior women face in their career development and deciding upon which of these obstacles could be met by a community effort rather than by institutional efforts. Toward this end, workshop participants learned of institutional efforts facilitated by NSF's ADVANCE program and of local mentoring programs, such as that recently implemented at Woods Hole Oceanographic Institution. Results from a survey available on the MPOWIR website (www.mpowir.org) prior to the workshop, from 87 respondents (primarily physical oceanographers) also provided key background information for the design of the community mentoring effort. In addition we read of mentoring efforts in other disciplines; however we recognize that we cannot simply adopt a program that has been developed in another discipline. A career in oceanography is unique in that it often requires sea time, there are few, if any industry jobs, the number of geographical locations were oceanography jobs are available is limited, there are a relatively large proportional of research positions versus academic positions, and the field is relatively small (relative to computing sciences, mathematics, physics, etc.).

From workshop discussions, background readings, presentations and from survey results, it was concluded that the transitions from Ph.D. to post-doc and then from post-doc to entry level position were the most vulnerable times for a junior woman in the field. Identified obstacles include exclusion from large programs; lack of collaboration and collaborators; lack of senior women role models and lack of advice on career development and on balancing family and work. Importantly, the survey results showed that only 30% of the respondents formed an important mentoring relationship during their postdoctoral years. As recently reported, appropriate guidance from one or more senior individuals, acting as mentors with multiple roles, can be critical to success in a scientific career. Alternatively, failure to be engaged in a productive advisor/advisee relationship has been identified as a significant contributing factor to the lack of progress in a scientific career (2). Given the identified obstacles and the known importance of mentoring, MPOWIR workshop participants decided to deign a community mentoring program that would provide continuity from the Ph.D. attainment through the early years of a young woman's career. Importantly, the workshop participants decided to focus on the collective community responsibility for mentoring rather than on mentoring that matched a single junior scientists with a single senior scientist. The goal instead is t create a network of mentors that can fulfill the various needs of a junior scientist. Because our goal is to make mentoring accessible to junior women in a wide variety of

positions and at different types of workplaces (e.g., research institutions, governmental labs, universities, etc) the implementation of our program is multi-pronged. From our deliberations, three main elements for a community mentoring program emerged:

1. **Internet-based Mentoring Program:** We envision this program to be composed of four components: 1) a moderated, anonymous community f9rum that will address issues related to the success of junior women in physical oceanography, but accessible to the entire community, b) a searchable database for mentors to be used as a resource for junior women, c) a list server with important information given to interested scientists about mentoring and funding activities, and d) a resource library on mentoring issues, data and statistics, and links to funding opportunities.

2. **The Palullo* Conference:** The centerpiece of the MPOWIR proposed program, this conference is intended to provide an opportunity for junior women to talk to senior scientists about their current and planned work. The goal is for senior scientists, both men and women, to provide feedback, give advice and make connections for these young women. We envision that this conference would be held annually, that it would have the format of a Gordon conference and that it would be open to all junior women in the field. The conference would also include round table discussions on career development issues.

3. **AGU Social on Mentoring:** It is planned that these socials will take place at all Ocean Sciences meetings, and at the AGU Fall meeting in alternate years. The goal of the socials is to facilitate connections between juniors scientists and more senior scientists in the field. Talks and/or panel discussions on career and mentoring issues are also planned.

In order to implement these initiatives and to measure their success the workshop participants decided to:

1. Establish an ongoing committee that would take responsibility for the implementation of the proposed program elements.
2. Establish mechanisms to identify mentees and attract mentors.
3. Create a statistical database in order to quantify success.

The physical oceanographic community cannot change the structure or family life nor can it make major organizational changes to the structure of scientific careers, however it can begin to make a difference in the mentoring of women junior scientists. If successful the MPOWIR community run program will aid capitalization on the investment the funding agencies and university have made on the education of women, and it will help create a scientific workforce whose diversity matches that of the student population and, in a broader sense, that of the U.S. population as a whole. Additionally, it is believed that by

creating a scientific community that facilitates the retention of women, we are creating a community that will be ore attractive to junior men as well as to minorities.

References

1. *The Nelson Diversity Survey. Nelson, D. J.: Norman, OK, 2002; http://cheminfo.chem.ou.edu/faculty/djn/diversity/top50.html.*

2. *Women Scientists in Industry, Catalyst, 1999. New York, www.catalystwomen.org.*

* June Palullo was the first woman to receive a Ph.D. in physical oceanography from Scripps (in the 1950s) and is believed to be the first to receive such a degree in the U.S.

MPOWIR Steering Committee: Amy Bower (WHOI), Victoria Coles (U. of Maryland), Rana Fine (U. of Miami), Susan Lozier (Duke), Julie McClean (Scripps), Paola Rizzoli (MIT) Lynne Talley (Scripps) and Luanne Thompson (U. of Washington).

APPENDIX V. POWER POINT PRINT OUTS OF GK-12 AND SIMILAR PROGRAMS PANEL PRESENTATIONS.

Due to the large size of these documents, the individual Power Points have been placed in a separate folder.