

External Review Committee Report for the UC Santa Cruz Ocean Sciences Department

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Summary

The UC Santa Cruz Ocean Sciences Department (OSD) is a unique academic unit focused on graduate education, research and undergraduate instruction of our oceans in the thematic areas of 1) Ocean Ecology, 2) Ocean Biogeochemistry, 3) Ocean Circulation and Climate, and 4) Paleoceanography. There are presently nine core OSD faculty. Considering its small size, the OSD is world-renowned in nearly all of its core thematic areas and plans are being implemented to maintain and round out faculty excellence in all areas. Graduate students in the OSD graduate program are uniformly satisfied with their experiences and the department's analytical facilities are world class.

That said, many OSD and affiliated unit faculty members noted that the OSD is at a critical juncture in its evolution as it grows and transitions from a small group of core faculty who have historically acted to integrate existing UCSC resources in marine science to a larger and more capable stand-alone ocean sciences department. In this report, our external review committee offers a series of recommendations in all areas of their program that we hope will help the department position itself for its short- and long-term future.

Introduction

On January 16 and 17, 2008, the external review committee (ERC) met with the chair, faculty, staff, graduate students and postdoctoral researchers of the Ocean Sciences Department (OSD), affiliated faculty members, representatives of their affiliated units, department chairs of interacting departments, the Dean of Physical and Biological Sciences, the Vice-Provost for Academic Programs and the Provost of UCSC. The ERC also toured OSD space as well as, some of the spaces it shares with other campus units.

Charge

The ERC was asked to consider a wide range of academic, institutional, educational and other issues given by both the administration and academic senate committees. Given the time allotted to the ERC's visit and our perception

of the present state of the OSD and its future challenges, we focused our review on the following issues:

1. An evaluation of the status and overall quality of the department (i.e., research and education program, national/international stature, space, state of facilities, etc.),
2. The department's plans for faculty growth and an evaluation of long-term department size, and
3. Interactions of the department among campus, regional, national and international programs and an assessment of the department's place among these programs.

Following a discussion of our findings, we provide a set of recommendations that we think will help the department position itself for its short- and long-term future.

The Ocean Sciences Department

The research foci of the OSD are the thematic areas of 1) Ocean Ecology, 2) Ocean Biogeochemistry, 3) Ocean Circulation and Climate and 4) Paleoceanography, which integrates the dynamics of these other areas over paleo time scales. There are presently nine core OSD faculty that provide the strength in these research foci, with most having interests that span more than one theme. Contributions from affiliated faculty members from UCSC and surrounding marine science institutions bolster the academic programs and greatly enhance the diversity of graduate student training that the OSD can offer. Three of these areas are unquestionably excellent with several faculty members with national and international prominences and at least one superstar faculty in each area. The remaining thematic area of expertise (Ocean Circulation and Climate) is not as strong – though it is clearly the youngest of the four and a new hire is underway to build additional strength in this area.

As we will describe, OSD faculty, educational programs and facilities are uniformly excellent. The faculty culture is as collegial and supportive as one can imagine for a top ranked faculty. This atmosphere trickles down through the postdocs and graduate students and the interactions the OSD has with other affiliated units on campus. That said, the OSD faculty members all have a strong entrepreneurial spirit. All core OSD faculty members have funding and their “can do” attitude is clearly visible in their drive to constantly upgrade their excellent analytical facilities. Further, success of the OSD graduate program is predicated on faculty having funding to support graduate students beyond their first year.

Many individuals we interviewed commented that OSD is at a crossroads in its evolution. The most important challenge that OSD will face in the near-term is how to transition from a small group of core faculty that have historically acted as a nucleus for integrating existing campus resources in marine sciences to a larger, stand-alone ocean sciences department.

Educational Program

The educational focus of the OSD is largely on its graduate degree programs (PhD and MS) although it makes significant contributions to UCSC's undergraduate general education curriculum and the marine biology degree concentration of the Ecology, Evolutionary Biology (EEB) department. The OSD through its active research programs also mentors a large cohort of postdoctoral students (who are officially affiliated with the Institute of Marine Sciences [IMS]). It is testimony to the dedication and prowess of the faculty that the OSD meets its faculty workload targets. This is largely due to the success of its large enrollment undergraduate offerings, with at least two lower division general education courses offered every quarter. Since the last external review in 2001-2002, total student enrollments in OSD courses have risen by more than 60%, a strong indication of the popularity of the offerings. This number greatly exceeds the growth in overall campus enrollments over the same period and has occurred with a core faculty that is no larger now than in 2002.

Graduate Program

The OSD offers MS (thesis) and PhD (dissertation) degree programs in Ocean Sciences. Since the PhD program was instituted in 1998, the size of the PhD program has grown to where it now dwarfs the MS program (especially as many MS students are taking a MS/PhD track). Roughly 60% of the graduate students in the program are mentored by core faculty in the OSD while the remainder are advised by affiliated faculty members both from UCSC ("below the line" appointments) and from surrounding marine research institutions (adjunct faculty members). Non-UCSC ladder track affiliated faculty are nominated by the department and their suitability for affiliated appointments is fully vetted according to UCSC academic procedures (and reviewed on CAP intervals). Both the MS and PhD degree programs require successful completion of a suite of Ocean Science core courses (in physical, chemical, geological and biological oceanography), a series of electives, and a two unit course in graduate teaching in the ocean sciences. All students must pass an oral departmental examination before a faculty committee that tests their comprehensive knowledge of the ocean sciences. PhD students, in addition, take an oral qualifying exam in their third year in which they defend the contents of a written research proposal.

In our interviews with the graduate students, we found high levels of satisfaction with the quality of the education and research training they are receiving, the core faculty and core classes, the procedures and feedback from the oral departmental examination on the core courses, and the process of advancement to candidacy. No issues or concerns were brought to us about these aspects of the OSD's graduate program.

In contrast, there was significant discussion regarding non-academic issues having to do with departmental cohesiveness and fellowship. Although the core faculty are uniformly judged to be caring and approachable, it was generally felt that more could be done to foster a spirit of community and cohort building within

the OSD graduate student body. Students noted, for example, that unlike other departments, OSD has no central photo board where current graduate students are listed and pictured. Similarly, there is no listing of graduate students, their contact information, and details of their thesis/dissertation research available on the departmental website. Given that many OSD students work for and in the labs of non-core faculty in other departments and programs, it is understandable how feelings of isolation can set in. It was noted that beginning students often don't get to know more senior students in OSD unless they share mentors and laboratories.

There appears to be no formal department orientation that introduces incoming graduate students to the OSD and that provides them with an initial bonding experience as well as guidance concerning rules and regulations and to whom one goes when different kinds of issues/problems arise. The students who were present at the interview also lamented a lack of opportunities for learning about what other graduate and postdoctoral students were doing in terms of research. The students suggested that OSD could organize an annual retreat or event where posters and talks were used to highlight exciting student research in the department. Our external committee noted, in turn, that students and postdocs should be allowed more involvement in the regular departmental seminar series, particularly as a venue for delivering practice talks prior to student participation in major outside scientific conferences or meetings.

Many of the obvious changes needed to foster a more cohesive social environment should be simple and straightforward to implement, but they likely require additional staffing for OSD and should not be added to the already heavy duties of the faculty. In particular, there seems to be a need for additional staffing for a graduate student staff assistant to assist in the coordination of the graduate program (within the OSD and across affiliated departments), its recruiting program and providing a central person for graduate student comments and concerns.

We note that the quality of the graduate student body is high and that recruitment efforts (e.g., a recruitment open house for top applicants) appear to be working well. As at most institutions, the primary limits on student numbers are the availability of faculty sponsors and of funding to support their research and education. Students we talked to noted concerns during the recruitment process about not receiving multiyear offers in writing, but conceded that there were few cases where funding after the first year was a serious issue. Given that OSD students can have UCSC faculty outside of the OSD core faculty as their primary advisors, we recommend that junior faculty members in other departments or programs who could potentially benefit from below line appointments in OSD be encouraged to seek them. In doing so, they would then have access to OSD graduate applications, which opens to them a pool of talented OSD recruits and increases the potential base of student funding.

At the time of the previous external program review, the PhD program was new enough that the committee felt it premature to attempt a thorough evaluation. Our

examination of information on graduates since 2001 indicates that the potential cited by the former committee has since been realized, with a steady stream of PhD graduates who have moved into and beyond postdoctoral assignments to occupy positions in academic, government, and non-governmental organizations.

Discussions with the OSD faculty indicate that they have been considering the addition of a non-thesis, coursework-only MA program that would be based on existing core and elective classes, and for which students would not have financial support. We have no strong opinions on whether such a program should be implemented or not. On the one hand, such a program could be a source of revenue and additional students to bolster class enrollments. On the other, there are resource issues to consider since such a plan would likely require the offering of core and certain popular elective courses on a yearly basis. We presume that OSD faculty will carefully consider all the variables before deciding to move in this direction.

Finally, we heard from both faculty and students that access to the ocean as a part of routine coursework was a challenge at best, and that opportunities to gain practical field experience, collect specimens or samples, and to learn to deploy modern oceanographic instruments were limited for both graduate and undergraduate courses. This issue is not unique to UCSC, but could perhaps be at least partially addressed through enhanced ties and collaboration with the numerous other marine science entities bordering Monterey Bay, some of which operate research vessels.

Undergraduate Program

The OSD offers neither a stand-alone undergraduate degree program nor a formal minor in Ocean Sciences. Nevertheless, the core faculty offer and teach an impressive range of courses on an annual basis which are sufficient to keep faculty workload numbers at a more than respectable level. These include lower division courses that satisfy UCSC general education and quantitative (Q code) requirements, as well as upper division courses that fulfill required and elective requirements in other undergraduate programs, primarily for Marine Biology and Earth and Planetary Sciences (EPS). An “ocean sciences concentration” is available as an option for students pursuing an EPS degree. In addition, OSD core faculty play an important role as advisors for senior theses of students in other programs, with a total of 16 senior theses having been supervised by members of the core faculty since 2000.

The question of whether OSD should consider development of a stand-alone undergraduate Ocean Sciences major has hung in the air since the previous external committee (2002) urged serious consideration of this option. Interestingly, we found strong support for the development of an undergraduate major among the graduate students we talked to, many of whom indicated that undergraduates in courses they serve as Teaching Assistants express interest in such a program. Among the OSD core faculty, however, there seems to be

minimal enthusiasm for establishing a full undergraduate major at this time, a position with which we concur. At the present faculty size, and even with planned faculty hires that are part of the OSD growth strategy, we feel that faculty resources would be stretched by the combined demands of offering both a full spectrum of undergraduate majors courses and the current diverse array of graduate core courses and electives. This could lead to curricular inflexibility and stagnation because of the need to offer sufficient upper division electives on a regular basis to satisfy BS degree demands for the major. Space limitations that exist at present also argue against the initiation of an undergraduate program because of the need for specialized teaching space including new laboratories and classrooms.

Although not discussed in the OSD self-study document, we heard from several parties that there have been internal UCSC conversations about the merits of developing a rigorous interdepartmental undergraduate major in Environmental Sciences. From our perspective, it probably makes greater sense for OSD faculty to join forces with other interested departments/programs to offer a new Environmental Sciences degree instead of committing to the development of a stand-alone undergraduate Ocean Sciences major. The addition of selected “ocean-based” courses as part of a broad Environmental Science curriculum would provide for increased contact hours and enrollments essential for supporting planned/future growth in the OS department, while at the same time not committing the core faculty to the teaching of both a full undergraduate and graduate curriculum. Undergraduate Environmental Sciences programs are also a growth industry at this point and a rigorous, quantitative, science-centric major is likely to be a stronger draw to today’s students than a pure Ocean Sciences program. In short, there are a variety of reasons why this sounds like a good tactic and we encourage OSD faculty to explore the opportunities and benefits that could come from contributing to the development of a new Environmental Sciences curriculum and major at UCSC.

Resources

Space

There was not a single discussion the ERC had with any party at UCSC where the issues of space and the OSD were not discussed. Space is clearly tight – though it seems to be inordinately driving departmental planning. Research space is also tight; however space is clearly adequate for all present core faculty members. This is due in part to the equipment facilities that the OSD and affiliated research units (IMS, EPS, ETox, etc.) share in the EMS building. Adequate plans are in place for research and faculty office space for the Climate-Circulation position which is at the short list stage and we were reassured by many that space can be found for their planned Biochemical Ocean Scientist position. We would like to emphasize that space should not be used to stall the OSD’s near-term hiring plans. The worst example of space limitations we saw is

graduate student office space where in one example more than 9 graduate students share a single office. The graduate students noted that this particular situation is very disruptive if one student is TA'ing and has undergraduates in the office. Clearly this one example needs to be rectified. That said, the space planners we met at UCSC are all open minded, problem solvers and have a long history in working together and making tight situations work.

We were reassured by core faculty, affiliated unit chairs and directors and the administration that space relief is coming shortly. Small amounts of space are expected (offices) to be released very soon through a consolidation of EEB program space after the recent move of some marine biology faculty to the Long Marine Laboratory (LML). However, the ultimate space solution for the OSD is the planned construction of the Coastal Biology Research building at LML and the transfer of space to the OSD in EMS from the full consolidation of the EEB faculty at LML. The good news is that this solution appears to be only 3-5 years into the future. The ERC strongly endorses these plans and the construction of this new research space at LML. Any future faculty growth for the OSD beyond eleven is critically dependent upon this (or other) new space.

Several OSD faculty members mentioned that the composition of the short-list for the open Ocean Circulation and Climate faculty position (data user vs. data collector) was driven in part by space considerations (i.e., data "users" require less space). The ERC was very concerned that the department's present space limitations were at all a factor in consideration of a 30+ year faculty hire.

Facilities

Ocean Sciences faculty have clearly been very successful in obtaining and managing an outstanding array of high quality analytical instrumentation. Much of this instrumentation is housed in the IMS Marine Analytical Laboratory, a central lab complex within the EMS Building. The facilities are run as open-access, multi-user operations with maintenance and training provided by lab manager Rob Franks, who is directly supported by IMS. Graduate students, postdocs and faculty who have particular analytical needs receive training, assistance in experimental design and data interpretation, and are then allowed to run most of the instrumentation themselves with appropriate supervision. This philosophy extends to OSD analytical facilities outside of direct IMS control, such as the Light Stable Isotope Laboratory managed by Dyke Andreasen, which occupies space jointly provided by OSD, EPS and IMS. The model of having centralized analytical facilities that are jointly sponsored and have such open access is one that few institutions in the ERC's experience have been able to pull off with as much success as found at UCSC. The ERC asked OSD faculty, faculty from participating departments, postdocs, and graduate students if there were any scheduling conflicts or other complaints / concerns they had with their access to the facility. All parties were highly satisfied with the quality of the analytical facilities and their access to them. The success of the analytical facility model and its management across a wide spectrum of users and uses points directly to

the excellent staff support given to the facility by the administration. The IMS clearly deserves much credit for its role in facilitating the growth and management of the analytical capabilities available to OSD and other investigators – few institutions, even those that are much larger, have access to the rather dizzying array of cool toys we were shown.

The Ocean Sciences basic computing needs, including personal computer hardware and software support and basic networking, are supported by UCSC central information technology. The presence of a UCSC IT person in the Earth and Marine Sciences Building seems to be working effectively, and faculty, staff and students were generally content with the level of support. Not all ocean sciences organizations have IT support from central campus, so this service is appreciated and should continue.

Regarding the need for high-end computational resources for the numerical analysis and modeling of ocean circulation and climate, faculty members Moore and Edwards have been successful in attracting external research funds to buy substantial, modern computing clusters. These are housed in a small room in the basement of the EMS building, where they require adequate cooling and ventilation for operation. Evidently, the slightly expanded cooling system, now just adequate for the present needs, was supported by research grants of Moore and Edwards. The department and university should support adequate space and cooling needs for high-end computing in the department. Infrastructure support for high-end computing is no different from that currently provided by the university and IMS for any of the other analytical facilities (see above) and should be provided for the growing Ocean Sciences modeling group. We note that with increased analysis of large, global data sets, other faculty, postdocs and students may be able to benefit from the high-end computing infrastructure if an appropriate arrangement could be brokered.

Interactions

Campus

The on-campus identity of the OSD is an interesting issue. Both core OSD as well as affiliated faculty members noted that the OSD is rather protective of its identity. The word “introverted” was used many times to describe the OSD and its relationship with other campus units. The reasons why are not important. However it is clear that the OSD needs to work outwardly to promote its vision of Ocean Sciences to the rest of the campus. This includes being more involved with affiliated faculty members who currently mentor and support ~40% of the graduate students in OSD. This will involve taking leadership on campus initiatives (such as what occurs now in supporting their analytical facilities). We expect that this will come naturally as the department grows and the junior members assume increasing ownership of the department. This also includes thinking more strategically about how planned future faculty hires couple to other

departments and units on campus (see our comments on a potential coastal oceanographer position below).

A certain degree of confusion arises concerning the Institute for Marine Science (IMS). Although IMS has done a superb job in supporting facilities for ocean research (analytical instrumentation, Long Marine Laboratory), we are concerned with the lack of an academic vision for IMS and the impacts this may have on the OSD. IMS is uniquely positioned to knit university-wide ocean and marine research together to further UCSC's impact in this critical environmental field. This, of course, must be done in coordination with OSD research planning and hiring activities. We understand that we are not reviewing IMS, but we urge IMS to lead a long-range research planning effort, in coordination with OS, EPS, EEB, and other marine related departments and entities, with the goal to elevate UCSC's impact on local and regional marine research.

It should be mentioned that core OSD faculty members play important roles in on-going campus research initiatives such as the Institute for Geophysics and Planetary Physics (IGPP) and the IGPP Center for Dynamics of the Land-Sea Interface (C.DELSI), and contribute significant time spent in service on a variety of Academic Senate, campus and division committees.

National / International

The OSD is nationally and internationally recognized for its scholarship excellence in three of its four thematic research areas. For these three focus areas, one cannot avoid thinking about the role that UCSC plays nationally and internationally. Considering the small size of the core faculty in the department, the *per capita distinction* is inspiring and the impact disproportionate to the faculty numbers. Profs. Zehr, Silver, Bruland and Delaney are all noted superstars in their fields and the more junior faculty members are clearly following their lead. To a large degree, junior faculty members are being mentored to achieve national / international prominence first and foremost (as should be the case).

The one area where the ERC feels national and international prominence is lagging is in the Ocean Circulation and Climate thematic focus area. This thematic area is much younger than the others as Moore and Edwards have been at UCSC for less than 10 years. The on-going search and anticipated new hire will clearly help grow this important thematic area.

Regional

The Monterey Bay and central California coast offer a unique opportunity for the OSD to make a strong contribution to ocean sciences and the local community, while garnering international recognition for that effort. In recent years, an enormous amount of ocean observing activity has occurred in and around Monterey Bay, including NSF-sponsored ocean observatories, ONR-sponsored autonomous underwater vehicle experiments, and NASA-sponsored remote sensing and circulation modeling. The central California coast is also the focus of

attention for recent Marine Life Protection Act (MLPA) activities and the Central and Northern California Ocean Observing System (CenCOOS) continues to grow. While some Ocean Sciences faculty members are participating in these activities, it is our impression that the UCSC Ocean Sciences Department is not thought of as a major player in these regional research efforts. As the OSD is the only PhD granting ocean sciences program in the Monterey Bay region, we believe it should be playing a bigger role in its home region. Hence, the ERC recommends that Ocean Sciences devote energy to developing a better regional presence.

We recognize that certain OS lines of research, including regional circulation modeling, ground-breaking studies of the importance of trace metals to ocean productivity, and ongoing studies of plankton and Harmful Algal Blooms, can be cited as part of the OSD's regional focus. What appears to be missing, however, is strong leadership on local and regional efforts which likely needs to be coordinated between the OSD and IMS. As noted below, one way to help accomplish this goal is to hire a coastal physical oceanographer with experience conducting field research in an interdisciplinary environment.

A second way to make an impact among the many Monterey Bay marine and ocean institutions would be to expand Ocean Sciences' role as the academic partner of the Monterey Bay Aquarium Research Institute (MBARI). MBARI is an acknowledged international leader in ocean observing and technology development, but they do not conduct graduate education. UCSC Ocean Sciences is uniquely positioned to partner with MBARI. There are presently a few students and postdocs who share time between UCSC and MBARI, but this interaction is now limited though ripe for further development. Ocean Sciences would also benefit from an agreement with MBARI to have students gain experience at sea using MBARI vessels, even as far as formally arranging for a short student training cruise each year.

Future plans for the Ocean Sciences Department

We have partitioned our discussion of the OSD's plans for growth into two time scales; one for the near-term where space needs for new hires can be met with existing allocations and one where new OSD space needs to be created.

Near-term plans & requirements

The OSD is currently conducting a search for a physical oceanographer with an emphasis on Ocean Circulation and Climate ("Position 10"). Our understanding is that the preferred hire will not be a sea-going oceanographer, but rather a data analyst and/or numerical modeler. The ERC recognizes that this emphasis will fit well with existing OS faculty expertise (Moore, Edwards) and will potentially push the Ocean Circulation and Climate focus area to a "critical mass" of faculty, students and postdocs. However, the ERC notes two concerns with this plan. First, as mentioned above, we are concerned that the disciplinary emphasis for this particular position was unduly influenced by the availability of space and

facilities within OS, where only a numerical modeler and/or data analyst could be accommodated in the existing spaces. The department does not need to be reminded that faculty hires are often 30+ year commitments. Second, by choosing not to hire a sea-going physical oceanographer, as originally envisioned in previous departmental plans, OSD is missing an important and fundamental opportunity to increase the department's impact on local and regional oceanography, and to foster key interactions across the university outside of the OSD. To be specific, a coastal observational physical oceanographer would be particularly effective at catalyzing increased local research, cooperation and impact. With the departure of Dr. Margaret McManus, an empirically minded, coastal biophysical oceanographer, the department has lost this capability. We also note that an observational coastal physical oceanographer would be a key ingredient to the successful delivery of a coastal policy masters program, as well as helpful with "town-gown" issues since local issues are of high visibility. We strongly urge the OSD to consider the importance of a sea-going, coastal physical oceanographer to its program, its relationship to other campus programs and the region.

The ERC strongly supports OSD plans to hire an ocean biochemist ("Position 11") to complement the work of Zehr, Silver and Kudela. In particular, this position should be filled in time to gain maximum synergy with the very visible and high-quality microbial ecology research program of Jon Zehr (Marine Environmental Genomics, Applications, Modeling, Experimentation, and Remote Sensing - MEGAMAR). Zehr has created world-class facilities with MEGAMAR and university support and the addition of a biochemist, especially in light of potential retirements, would propel the OSD to new heights in ocean ecology. MEGAMAR has given UCSC a leg up on many academic competitors in the marine genomics arena and a hire in this area is long overdue. As mentioned above, the ERC was told that there are no space impediments to filling this position.

Regarding future impending retirements of faculty in ocean ecology and biogeochemistry, the ERC strongly urges that OS be allowed to retain these FTEs in order to maintain their international stature in these disciplines. The OSD and its senior faculty have built unique, world-class ocean ecology and biogeochemistry research facilities that should be taken advantage of by allowing the department to retain these FTEs and hire new faculty who will utilize these labs. Further, these searches should ideally be timed as much as possible so that the new hires can overlap with the faculty they are intended to replace as they potentially assume emeritus, but still active, status. To maintain the OSD's international stature in ocean ecology and biogeochemistry, the OSD and the Dean of the Division of Physical and Biological Sciences should seriously consider whether an open search (any professorial rank) would be best. This will be particularly important for the Ocean Biogeochemistry thematic focus area, which will lose much of its national and international standing with the near-term retirement of Bruland.

Full faculty size

The ERC concludes that the OSD is likely best served with a final faculty size of fourteen (14). This will enable robust programs in all four of the thematic research areas and provide for a diversity of potential graduate academic programs, a wider array of advanced course offerings, and larger cohort of graduate students. This will also allow the OSD to grow with UCSC's projected undergraduate student body growth. The success of this growth plan requires the OSD to continue to meet its faculty workload targets and the realization of new space for the expanded faculty. As mentioned above, the OSD has plans for how to meet both of these requirements.

The ERC recognizes that a full faculty size of fourteen is one more than what is envisioned in the OSD's own long-term plan. However as discussed above, we believe that the addition of a sea-going, coastal physical oceanographer to the growth plan of the department is essential for many reasons. The ERC fully supports the two planned positions in Marine Food Webs and in Marine Sedimentary Geochemistry.

Recommendations

Our task as an external review body was greatly simplified by the fact that the UCSC Ocean Sciences Department has many strengths and few real weaknesses. This is not a program in trouble and, if anything, the challenge ahead for the department will be to maintain its reputation for scholarly excellence in the years to come as faculty growth and renewal occur. Our recommendations that follow should thus not be viewed as criticisms but as well-intentioned suggestions for positive actions that we hope will assist the faculty and administration to make wise decisions and investments. Our recommendations are ranked in rough priority order.

1. The planned long-term growth of the OSD is heavily dependent on the future availability of new space. Though very tight, the OSD appears to have adequate space for the next two faculty positions in the current strategic plan. However, any faculty growth beyond this or the addition of any new large scale programs, such as MEGAMAR, will clearly require new space. *The ERC strongly endorses the planned construction of a new Coastal Biology Building at the Long Marine Laboratory as it will provide released space essential for the long-term growth of the OSD.*
2. The OSD needs to complete its on-going faculty search in Ocean Climate and Circulation and *should then move quickly to begin recruitment for their planned Biochemical / Ocean Ecology position. There are no space impediments for this growth and a variety of good reasons why this search should not be delayed.*

3. Within the next five years, there will be important retirements of core OSD faculty. *The Dean of Physical and Biological Sciences needs to aggressively protect and retain these core faculty positions in OSD* (preferably with the new hires having time to overlap with the retiring faculty), and take advantage of the unique laboratory facilities already in place (which will help reduce startup costs). In the short term, the OSD should begin to plan for what they want these positions to be. Last, it appears to us that the Bruland position should be recruited at open rank (i.e., up to full professor) in order to maintain the national / international stature of this thematic area.
4. *We strongly encourage the OSD and university to add a sea-going, coastal, interdisciplinary physical oceanographer to its planned FTE list.* This position is essential for interactions across thematic research areas within the department, with other units on campus (EEB in particular), and regionally.
5. *The ERC believes that an appropriate full faculty size for the OSD should be fourteen core OSD faculty members.* This will provide balance across the thematic areas as planned and includes the coastal physical oceanographer position that is recommended here. This faculty growth will mirror that expected for UCSC as a campus and in the ocean sciences nationally. This level of growth will require adequate planning to maintain core OSD faculty teaching loads and the addition of new space in the long-term.
6. The OSD faculty is of exceptional quality with national and international prominence in nearly all of the department's thematic areas. However, *the stature and prominence of the OSD both on campus and within the Monterey Bay region needs to be enhanced.* The ERC has provided suggestions of how this may be accomplished.
7. Growth of the undergraduate teaching program is essential for future growth of the OSD core faculty. However, the current faculty does not have much enthusiasm for the development of a stand-alone undergraduate major in Ocean Sciences and the ERC agrees that this should not be pursued. *The ERC does support participation in the planning of an undergraduate major in Environmental Sciences,* which we feel has a greater likelihood of success and would be of more value to the OSD and for UCSC.
8. The graduate students interviewed by the ERC conveyed an extreme sense of satisfaction with the graduate program and their faculty mentors. However, they did note several issues that would give them a broader sense of community. *In this report, we have provided a series of suggestions which would improve the working environment for both graduate and postdoctoral students,* including weekly coffees, Friday TG's, a greater participation in seminars and seminar series planning, a graduate student webpage that lists all of the graduate students with links

- to personal webpages, a photoboard in the lobby of the EMS building, and a pre-fall orientation program that will create a better cohort sense within the graduate student population.
9. Several of the core OSD faculty members – mostly junior ones – remarked that graduate student recruitment remains a problem. *The ERC made a number of suggestions for improving graduate student recruitment* including institutionalizing “below the line appointments” for OSD faculty in relevant departments, making multiyear support letters for incoming students, institutionalizing a graduate student recruitment open house, a better web presence, etc.
 10. The previous two suggestions appear to place yet more work on the core OSD faculty who, although excellent and dedicated, are simply too few to successfully pull this sort of organization off year after year. Frankly, there are too many tasks needed to occur here that are inconsistent with expectations for the roles of UC faculty members. *The ERC notes the need for an additional career staff member to be the point of contact for the graduate student body and to be responsible for institutionalizing socialization and recruitment efforts.* This would help at a partial level for now but department staffing may need to grow further as the faculty and graduate student populations expand in the future.
 11. Students and postdocs all pointed to improvements needed in the OSD website. These improvements are required for better communication within the core unit, for the affiliated faculty members and their students within the OSD graduate program, and for faculty and graduate student recruitment. For example, there is not a unified OSD phone list and students do not know how to build their own websites. *The ERC notes that these website issues are simple to correct and these improvements should be implemented as soon as possible.* One suggestion is to build a website construction section into the TA training course (OS 296).