Undergraduate Program Review: Environmental Systems

Review Committee:
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Overview:

The Environmental Systems (ESYS) program was created about ten years ago; this is the first time it is has been reviewed. It is a unique and successful interdisciplinary cross-campus program. The success of the program is particularly striking given that it is operating on a small budget and is understaffed. In Spring quarter 2008, there were 172 ESYS majors, and in Spring 2012, there were 358 majors; over the past five years, enrollments in ESYS courses have increased by ~85%. While some of this recent growth can be attributed to the impacted Biology major (as the very recent 'un-impaction' of majors in the Division of Biology has likely resulted in a decrease in ESYS majors to 321 at the time of this review[1]), it is still remarkable under any circumstances to have the major grow to be among the top 20 majors grouped by department or program at UCSD, comparable in size to Chemical Engineering, Literature, and History and larger than Physics and Anthropology, in only a decade since its inception.

The program is administered through the Dean's office in the Division of Physical Sciences, and the ESYS major, including all course scheduling and student advising, is administered through the educational offices in Galbraith Hall. The program is directed by Dean Mark Thiemens and Dr. Jane Teranes. Dr. Teranes also serves as the Academic Coordinator (50% position) for the program. The ESYS educational office is staffed by Josh Reeves, Administrative Analyst (35% position), and Sid Eads, Assistant Student Affairs Officer (25% position). Dr. Teranes and staff all hold full time positions and use the other percentage of their time to administer undergraduate education at the Scripps Institution of Oceanography (SIO). The ESYS program has no permanent faculty or LSOEs and is dependent on faculty from various departments, including SIO, Biology, MAE, Economics, and Chemistry, to teach almost all of its courses.

ESYS majors choose one of four tracks: Ecology, Behavior and Evolution (EBE), Environmental Policy, Earth Sciences, and Environmental Chemistry. All four tracks require rigorous lower-division preparation (i.e., prerequisites in math, physics, chemistry and biology) and an upper-division core curriculum (ESYS101, ESYS102, ESYS103, POLI160AA, and ECON131) that applies these fundamentals of science and mathematics to the description and quantification of the interactions of the atmosphere, hydrosphere, lithosphere, and biosphere (including humans). Apart from these required courses, students have a great deal of freedom in choosing their

[1] On May 18, 2013, blink.ucsd.edu showed 234 declared ESYS majors for Fall 2013.

elective courses, and there is great variation even within the four tracks. The capstone of the ESYS curriculum is the integrative Senior Project, which all majors complete in their final year. The Senior Project is 8-units of upper division credit (ESYS190A). The project is designed by the student to focus on an interdisciplinary environmental problem or a research topic. These students can be engaged in internships, research projects, community/educational outreach or a variety of other activities for their senior projects. Students prepare a final report of their project and give a formal presentation of their work in ESYS190B. At the time of this review, 88 ESYS majors were working on their Senior Projects; about half of the students were working in off campus internships, and the other half were working on campus in labs or as part of campus sustainability projects.

In the five years since 2008, a total of 223 UCSD students have graduated with ESYS majors, and a total of 26 UCSD students have graduated with ESYS minors. According to the ESYS program self-study, the majority of these students continue in careers in the environmental field with over half continuing on to graduate or professional school to earn higher degrees. It is also reported that dozens of ESYS alumni now work in the region in a variety of organizations including environmental consulting firms (e.g. Dudak Engineering, Nautilus Environmental), environmental non-profit organizations (e.g. Solana Center for Environmental Innovation, San Diego River Park Foundation) and local and regional government agencies (e.g. Air Quality Control Board, City of Encinitas, Environmental Services).

On April 19, 2013, the review committee met with Dean Mark Thiemens, Dr. Jane Teranes, Josh Reeves, Sid Eads, undergraduate ESYS majors, graduate students who had served as TA's for ESYS courses, and affiliated faculty and lecturers. Miky Ramirez (Senior Analyst, Academic Senate) also took part in the committee meetings.

Strengths of the ESYS Program:

An outstanding aspect of the program based on reports to us by the administrators, faculty and lecturers, staff and students is clearly the Senior Project. The project can serve as an invaluable opportunity for undergraduate research and professional networking and serves the mission of the University well. It is also reported that a number of ESYS students continue with their internships after graduation and approximately 5% go on to be employed at the places where they did their internships.

The individualized nature of advising in the ESYS program and how it is executed by the staff is another of its major strengths. Due to its broad and interdisciplinary nature and the senior internship requirement, ESYS students require much more face time and hands-on advising than students in many other majors. As described above, the major begins with a set course curriculum, but afterwards the four tracks consist mostly of technical electives. Students need advising as to which classes are

most appropriate both for their particular ESYS track and for their career aspirations.

Feedback from the current ESYS majors who came to the review meeting was overwhelmingly positive. The review committee met with five undergraduate students: four seniors and one freshman. Two of the seniors noted that they had initially chosen the ESYS major due to the impaction of the biology major, but they now feel that this was the perfect program for them; one of them described the program as shaping her career goals. Another two of the students chose UCSD over other UC campuses specifically for the ESYS major. All of the students described the major as challenging but rewarding and the specific courses as broad yet rigorous. They also appreciated the freedom to take a wide range of courses. The four seniors that we interviewed felt they were graduating with a valuable cross-disciplinary training and broader perspective and consider themselves well prepared to be successful in their fields. A few of the students felt very strongly that the core courses should be taken during the junior year rather than the sophomore year, as recommended, noting that they would have gotten or believed they did get more out of the core courses taken in their junior year.

Despite its rapid growth, the ESYS program has managed to maintain a nurturing environment for its students; one student said, “Jane, Josh, and Sid are rooting for us to succeed." It is clear that all the staff know all the ESYS students by name. The students also said that the advisory staff are always ready to help and give good advice and are always available outside of office hours. The ethnic diversity of the ESYS majors is comparable to or more favorable than many other science majors at UCSD, further attesting to what appears to be a welcoming and nurturing climate in the ESYS program.

The ESYS symposium and alumni reunion, held once a year, is also worthy of note. During this symposium, which started four years ago, graduating students present their Senior Projects to each other, to students at an earlier stage in the major, and to alumni, one of whom is invited to give a keynote address. Thus, it not only serves to highlight senior projects, but also serves as an opportunity for new majors to get ideas for their Senior Projects and to facilitate interactions and professional networking among new majors, seniors, and alumni.

Weaknesses of the ESYS Program:

The advising model, which is one of the program's major strengths and is crucial to its success, is not sustainable. As described above, there is currently only a 25% FTE allocation for advising over 300 students. This is a factor of 2 to 4 or more above the campus norm. What has likely made this large a factor tenable so far as the ESYS program has grown is both the dedication of the staff and the fact that this single advisor is being shared by SIO majors and ESYS majors; technically he has a 75% FTE allocation for SIO, but he spends the majority of his time advising the ESYS students. With the introduction of SIO's new Marine Biology major, however, a large

new batch of SIO majors may begin to need advising next year (e.g., 200 Marine Biology majors were admitted for Fall quarter 2013, although it is unknown how many have accepted). Thus, even if the "un-impaction" of the Biology Division majors results in a decrease in ESYS majors in the short term, the 25% advising FTE is expected to still be significantly below the campus norm for the number of ESYS majors and significantly below the level that is needed for continuing success of the advising-intensive ESYS major.

Staffing of some of the core ESYS courses is at best difficult and at worst appears to be fraught with tensions and misunderstandings. With the exception of ESYS101, which has been shepherded by Eric Allen, it is difficult for the program to find instructors to teach the core courses ESYS102, ESYS103 consistently, or even at all. Some of the reasons for these difficulties are:

- There are strong disincentives for faculty and lecturers to teach these classes. One problem is that the temp FTE goes to ESYS and not to the department whose faculty teaches the course. Another (likely related) problem is that, while some chairs have been very supportive in advising their instructors to teach within this interdisciplinary environment, some department chairs have advised their faculty that it would not be in their best interest to teach these courses.
- There is a lack of understanding among the instructors about both the financial model and teaching credit for the ESYS core courses. (Indeed, it took much questioning of the administration and Senate representatives on the day of the review for the review committee members to get a single definitive answer as to how the various types of funds and various types of teaching credit on campus for the ESYS courses are allocated!) Of particular note, more than a few instructors say they feel guilty and conflicted that they are shortchanging their department by teaching these courses instead of courses with their departmental designations.
- There are widespread feelings of a lack of ownership of the courses among the instructors interviewed. One issue is that the administration of the ESYS program is through Physical Sciences but historically the core courses have been largely taught by SIO faculty. Another issue is that, for many of the newer instructors, there is no memory of there ever being a dialogue regarding the contents and goals for each of the core ESYS courses nor for the sequence of courses as a whole.

Another weakness is that there is no structure in place to foster communication and collaboration between past and present instructors of the core courses, and, together with the aforementioned difficulty of staffing these courses, this results in inconsistency of curricula and courses which have no chance to benefit from the insight and experience of instructors who have taught them multiple times. ESYS102 seems to have suffered the most; over the past five years, CAPE scores for this course and its instructors have been, on average, much lower than those of all of the other ESYS courses. Former ESYS102 teaching assistants described the course

curriculum as changing significantly from one year to the next and, in some instances, the teaching to be uncoordinated and with too many guest lecturers presenting material incoherent to the students. Some students also mentioned that they were confused as to the material and expectations for the exams in this course.

An emerging problem appears to be the temporary nature of Dr. Teranes' teaching and administrative positions and duties. She has admirably endeavored over the past decade to bring the ESYS program to its current level of visibility and success, and with a remarkably small budget, and yet at the same time she is now reaching her 18-unit limit as lecturer, leading to uncertainties in both the administration of and teaching in the program that are not sustainable in the long run for the more mature program that ESYS has become.

Recommendations:

The ESYS undergraduate program at UCSD appears to be a highly successful and highly visible interdisciplinary cross-campus major that is attractive to students and appears to serve them well in both depth and breadth of intellectual inquiry and undergraduate research experiences. While we are aware that there is debate in some circles as to whether the program should remain a cross-campus program or should retreat to a single department, we come down strongly on the side that it remain the interdisciplinary program that it was originally designed to be and currently is -- with students trained broadly and deeply in the physical and life sciences, social sciences, and mathematics and their application to the environment. A number of the recommendations below, some of which are also included in the ESYS self-study, will help to maintain and strengthen the strong interdisciplinary nature of the program.

- The ESYS program needs additional institutional resources; in the absence of such resources, the quality of this extremely valuable interdisciplinary program will diminish. In particular, resources are needed for (1) additional advising FTE, at a minimum to be more inline with advising of other majors whose numbers are similar to those of ESYS as well as in consideration of the advising-intensive nature of the ESYS program; and (2) to more effectively and predictably deal with the temporary staffing issues surrounding Dr. Teranes' appointments.

- Teaching in the ESYS program must be incentivized. If teaching were incentivized, the ESYS program could minimize the turnover of instructors in the core courses, thus resulting in more consistent curricula and opportunities for repeat instructors of the courses to fine tune and improve them. More specific recommendations towards this end include:
    - The current funding model should be re-examined and perhaps re-negotiated. Currently, for example, no temp FTE funding goes to the home department of the instructor who is teaching the course, and that

creates a disincentive for teaching the courses. If the temp FTE went to the home department of the faculty member that is teaching the ESYS course, this disincentive would go away. If in turn ESYS needs these funds to run their program, then another funding model is needed to meet ESYS needs – e.g., support directly from the VCR or from Undergraduate Education, or another office with both resources and an interest in seeing cross-campus programs succeed.
    - There should be transparent and open communication and frequent clarifications made to affiliated faculty and lecturers about teaching credit and funding models.

- A faculty steering committee or advisory council for the ESYS major should be formed, made up of members from participating departments across campus. The guidance, debates, and discussions provided by and within such a committee could go a long way towards remedying a number of the current weaknesses of the program, which largely result from its now having outgrown its fledgling small-scale status when it started a decade ago, now with more than 300 majors. Such a committee could:
    - Advocate for the major in general, including from the student, staff, and program perspectives.
    - Review curricula and suggest and approve curricular and course changes. It would be highly desirable, for example, to revisit, after the first decade of teaching, the 3 core ESYS courses, 101, 102, and 103, especially in light of the significant increases in the number of researchers at UCSD with specialties in atmospheric sciences and climate. "Environmental Systems" is broad and interdisciplinary and yet a focus at UCSD can and should involve the expertise and input of faculty from all the participating departments. The core courses could be updated to reflect this, perhaps to a higher degree than it does today.
    - Review and identify opportunities for teaching assignments.
    - Strategize regarding approaches for teaching and funding models that incentivize teaching as the program evolves and changes and advocate needed changes to the administration.

- Finally, we note that a large fraction of ESYS graduates responding to the 2009-2010 Post Baccalaureate Survey reported they were unemployed, and this is potentially a cause for concern. While the program self-study, as well as the impression given to the review committee during the in-person meeting, suggests that ESYS graduates are largely successfully employed perhaps in part due to the internship experience and connections off campus associated with the ESYS Senior Project, the survey results show that 14 of the 32 (44%) ESYS graduates who responded to the survey reported that they were unemployed, compared with only 14 of 120 (13%) of all majors grouped together as "Science/Math" who responded to the survey. With only one survey available since ESYS was created, with respondents likely weighted towards the 1-year or

3-year rather than the 5-year alumni given the newness of the ESYS major and taken in the depth of the Great Recession, along with the small number of respondents, it will be important to compare the ESYS and Science/Math responses for the most recent (i.e., upcoming) Post Baccalaureate survey in 2013. We recommend that ESYS staff carefully evaluate the results of the upcoming 2013 survey when they become available and then report back to VC Sawrey either that the issue has gone away on its own or to lay out steps to research this issue more deeply and to develop a plan of action.

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April 16, 2014

PROFESSOR MARK THIEMENS, Dean
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PROFESSOR JANE L. TERANES, Associate Director
Environmental Systems Program

SUBJECT: Undergraduate Program Review for the Environmental Systems Program

Dear Professors Thiemens and Teranes,

The Undergraduate Council has discussed the Environmental Systems' 2013 Undergraduate Program Review. The Council supports the findings and recommendations of the review subcommittee and appreciates the thoughtful and proactive response from the Program. The Council's comments centered on the following:

- **Faculty Leadership**: The Council was pleased by the potential appointment of Dr. Teranes as a Lecturer with Potential Security of Employment (LPSOE) as it agrees that a faculty appointment is necessary to solidify faculty leadership in the program. A permanent administrative head will stabilize the inconsistencies that inevitably arise from an interdisciplinary program.

The Council will conduct its follow-up review of the Program in Spring Quarter 2015. At that time, our goal is to learn about the Program's progress in implementing the recommendations of the program review subcommittee and the Undergraduate Council. The Council extends its thanks to the Program for its engagement in this process and we look forward to the continued discussion.

Sincerely,

James Nieh, Chair
Undergraduate Council

cc: G. Boss
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