

New Approaches, New Programs

An Interview with Susan Alexander, California State University Monterey Bay, Seaside, CA

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The need for an interdisciplinary, Earth systems approach was clear. As a marine ecology Doctoral student at Stanford University, Susan Alexander was developing mathematical models to explain and predict the population dynamics of invertebrates in the rocky intertidal zone. To do that, she needed to link the dynamics of the sessile adults on the rocky shore with the movement of the free-ranging larvae in the near-shore ocean. Ocean currents, influenced by atmospheric processes, could carry the larvae far offshore and then bring them back onshore again. Adults faced competition and predation from other species. The interconnectedness between the land, ocean, and atmosphere was exciting and dynamic and a necessary framework for understanding marine policy

issues such as the design and location of marine reserves. For Alexander, understanding this need for an interdisciplinary approach became the motivation for a career in earth systems science education.

“Earth system science has provided me with a scientific research framework and an educational agenda”, reflects Alexander. “It has inspired me to study environmental issues and problems from multiple angles, and to teach about earth systems from different perspectives”. In her research, Alexander has used this approach to study issues ranging from trace-gas emissions in Brazilian forests and grasslands to the predator-prey dynamics of wolves, elk, and bison in Yellowstone National Park. In her undergraduate teaching, she has developed case-study courses that are innovative in content and activities, and designed to facilitate an interdisciplinary, inquiry-driven, outcomes-based approach to education. One of these courses, “California Transect” takes students on a two-week journey across California, exploring the interactions of the hydrology, ecology, geology, economic, and policy issues of the Sierra Nevada, with particular emphasis on human impacts on California watersheds.



“Earth system science education has guided my career from the days of being a new graduate student up through my current position as a Professor at California State University Monterey Bay”. It is rare that an interdisciplinary group of educators has the opportunity to design a science curriculum without the constraints of pre-existing

academic departments. In 1994, California State University Monterey Bay (CSUMB) acquired 1,387 acres from the U.S. Department of the Army and began construction of a new campus. CSUMB was developed as a four-year undergraduate university distinctive in its mission to serve the diverse people of California. Inspired by the Earth System Science Education program initiated by NASA and the Universities Space Research Association, CSUMB embarked upon the development of an interdisciplinary Earth systems curriculum that placed a strong emphasis on experience-based learning, integration of science, policy, and technology, outreach to minority students, and partnerships with the local community.



What has experience in Earth system science education meant to your institution?

CSUMB offers an undergraduate, B.S degree program called Earth Systems Science & Policy (ESSP) and a graduate, M.S. degree program in Coastal and Watershed Science & Policy (CWSP). These programs offer innovative, interdisciplinary degrees linking natural science, physical science, technology, economics, and policy. The programs emphasize the critical thinking and technical skills necessary to develop workable solutions to complex environmental problems. ESSP and CWSP provide students with active learning and applied research in marine, coastal, and watershed systems. CSUMB was initially selected to be part of the ESSE II Program in 1996. At that time, joining a community of educators committed to Earth system science education was instrumental in our decision to continue with this unique degree major. Over an almost 10 year period, the enthusiasm and support of colleagues around the nation has been inspiring, especially through the personal interactions that took place at ESSE Annual Meetings. These meetings offered demonstrations of software packages and toolkits, sharing of syllabi, and opportunities to develop reciprocal relationships with institutions offering similar programs. It has been the relationships formed and participation within a growing national movement to embrace Earth system science education that have meant the most to our university. In a more student-focused context, Earth system science education at our university has embodied these goals: 1) To enable students to apply an earth systems perspective to evaluate and solve environmental problems using scientific, technical, and analytical skills; 2) To prepare students for leadership roles in which they contribute to effective policy solutions based on an understanding of the interactions between humans and their biological and physical surroundings; 3) To prepare students to pursue ethical and rewarding career pathways.

What aspect of Earth system science education has been most useful to students at your institution?

Many undergraduate alumni have said that the senior capstone (thesis) project was the single most influential part of their undergraduate training. Before receiving a bachelor's of science degree in ESSP, every student must complete an in-depth independent capstone project that demonstrates an ability to apply a systems approach to environmental problem solving. The capstone project provides students with a powerful



learning opportunity for exploring a particular area of study of interest to them. Students are strongly encouraged to design projects that build on their strengths, tap into their passion, and prepare them for employment once they graduate. The capstone process spans the final two years of the ESSP program, and is typically a rewarding process for faculty and students alike, when, as students gain expertise in their area of interest, the student-advisor relationship transforms into a relationship between

colleagues. Full details of the capstone process are at: <http://essp.csUMB.edu/capstone/>. Other skills and courses that are mentioned by students as being instrumental in their training as earth system scientists include: training in GIS / GPS / Remote Sensing / modeling; field courses that teach experiment design, field techniques, and statistics (e.g. ecology, ecosystems, geomorphology, sea floor mapping, environmental hydrology); courses on environmental ethics and justice; courses that teach the concept of “systems science” in a case study framework (e.g. marine fisheries, ecosystem services, California’s water law, global change).

How can your institution contribute to the future development of the ESSE community?

CSUMB will continue to participate in and fully support the ESSE community. We plan to fully disseminate the results of our current work on “systemic systems”. Information and details about our undergraduate Earth Systems Science & Policy major and our Master of Science in Coastal and Watershed Science & Policy are readily available to other institutions. We welcome opportunities for collaboration.

I would like to thank the ESSE PIs and staff, who over the years have worked so hard to keep Earth system science education growing and advancing at colleges and universities across the nation. The significant efforts of Don Johnson and Martin Ruzek have made the ESSE program both possible and successful over the past 15 years. I hope that the field of Earth system science education continues to advance and build upon the community structure built through the ESSEI, ESSEII, & ESSE21 programs.