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California Current Ecosystem Program Ready to Dig Deeply into Mechanisms at Work in the Sea

Innovative program granted more than $5 million

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A groundbreaking research program designed to uncover the mechanisms underlying changes in the ecosystems off California's coast has received renewed funding to advance its vital work.

The National Science Foundation (NSF) will provide $5.62 million over six years to the Scripps Institution of Oceanography at UC San Diego-based California Current Ecosystem (CCE) program, part of NSF's Long-Term Ecological Research (LTER) program.

Now entering "phase two," Mark Ohman, lead principal investigator of CCE-LTER and a professor of biological oceanography in Scripps Oceanography's Integrative Oceanography Division, said CCE-LTER is now armed with a "dream team" of scientists, including ecologists, molecular biologists, marine chemists, physical oceanographers and ocean modelers. He said CCE-LTER has been bolstered by the addition of new collaborators to help the program dig deeper into phenomena at the interface of biology and the physical sciences.

Launched in 2004, CCE-LTER employs an interdisciplinary approach to discover fine details of the California Current, the eastern portion of the clockwise flow of the North Pacific Ocean that circulates just off California's shores. The program has been building upon scientific foundations laid by the California Cooperative Oceanic Fisheries Investigations (CalCOFI), a monitoring program launched in 1949 with Scripps Oceanography, the California Department of Fish and Game and NOAA's National Marine Fisheries Service.

The quality of the science being generated from the CCE-LTER program is of the highest order and its insights are important for the state of California," said Tony Haymet, director of Scripps Institution of Oceanography. "The program also is proving to be a vital training ground for our students and their future leadership in science."

Among the many accomplishments of the initial phase, CCE-LTER scientists have: • Uncovered a new climate mode, the "North Pacific Gyre Oscillation," which explains many of the biological and physical changes in the North Pacific Ocean. • Discovered marked differences in the food web structures between two areas of rising seawater, or "upwelling," in the California Current system. • Detected several long-term ecosystem changes, including a decline in gelatinous grazers called tunicates, a decline in oxygen levels and an increase in the stratification of ocean water off California, as well as more details about the El Niño phenomenon. • Introduced new technologies to study the California Current, including a robotic glider known as *Spray*, a free-fall moving vessel profiling instrument and high-tech moorings outfitted with a variety of biological and chemical sensors.

"We're now poised to tunnel in on the mechanisms that underlie responses to climate variations, including how the changes in the physical environment mechanistically affect the biology and chemistry of the system," said Ohman.

"We're also ready to take the next step toward building this understanding into ecosystem forecast models. This is an excellent opportunity to move from the understanding we have developed toward mechanically-based interpretations and models."

Said David Garrison, director of NSF's Biological Oceanography Program, Division of Ocean Sciences: "Coastal upwelling systems are likely to be markedly affected by changing climate. CCE-LTER research is giving us a mechanistic understanding of how climate and environmental changes will effect food webs and fisheries production in these important and dynamic coastal ocean systems."

At present, more than 125 scientific journal articles, book chapters and conference proceedings have resulted from CCE-LTER. Forty-four graduate students, 13 postdoctoral researchers and 21 technical staff have participated in the program's research cruises, experiments and modeling efforts. Twelve Ph.D. and two master's theses have resulted. And, bringing science directly to the classroom, five graduate courses and three undergraduate courses have already incorporated results from CCE-LTER science.

"This is a highly talented, energetic and creative group of people who are pushing the science forward," said Ohman, who added that the "dream team" of participants includes very capable graduate students, postdoctoral researchers and technicians. "We are poised to become a real world center of coastal upwelling ecosystem research."

In addition to higher learning, CCE-LTER's outreach efforts also have touched hundreds younger students by teaming scientists with educational organizations. More than 1,200 children have been involved in at-sea data collection through the Ocean Institute in Dana Point, Calif.

CCE-LTER's Beth Simmons co-wrote *Sea Secrets: Tiny Clues to a Big Mystery*, an engaging book for young readers that promotes scientific discovery through curiosity

see: http://explorations.ucsd.edu/Around_the_Pier/2008/Nov/Simmons/

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