

New Scripps-based Research Program to Analyze Ecosystems of the California Current

August 24, 2004

\$5 million granted for program to understand processes important for California's ocean ecosystems, climate and resource management

Building upon a half century of research, scientists at Scripps Institution of Oceanography at the University of California, San Diego, and their colleagues have embarked on an unprecedented effort to uncover the mechanisms underlying changes in the ecosystems off California's coast.

A grant of nearly \$5 million from the National Science Foundation (NSF) will establish the Scripps Institution-based California Current Ecosystem (CCE) site, a program that will peer into the California Current as never before. CCE, one of two newly established sites, is part of NSF's Long-Term Ecological Research (LTER) program, a network that focuses on ecological research over long time periods in different terrestrial and marine ecosystems.

CCE will benefit from more than 50 years of research conducted by the California Cooperative Oceanic Fisheries Investigations (CalCOFI)-a unique partnership of Scripps Institution, the California Department of Fish and Game and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service-which was launched to examine the dynamics of the important California Current, the eastern portion of the large, clockwise circulation of the north Pacific Ocean that travels just off California's shores. CalCOFI, originally founded to understand the plummeting harvests of the Pacific sardine, is one of the world's longest-running multidisciplinary field programs concentrating on one of the most productive coastal ecosystems in the world's oceans.

"We are fortunate to be standing on the shoulders of the scientific giants who built the CalCOFI program over more than five decades, enabling us to see further into the workings of pelagic ecosystems here in the California Current than is possible anywhere else in the ocean," said Mark Ohman, a professor of biological oceanography at Scripps Institution and lead principal investigator of CCE.

Ohman said the scientific findings established through CalCOFI have uncovered multiple, interacting processes that influence the California Current system, including an ocean warming trend, El Niño events, and the Pacific Decadal Oscillation. More than 26 scientists involved in the CCE site will work to understand how these climatic influences modify marine ecosystems.

Understanding the mechanism of change in coastal ecosystems is important to the management of living and non-living resources in the coastal zone, the researchers believe. They hope to develop an understanding of how these phenomena affect changes in food webs, predator-prey relationships, the movement of organisms into and out of the region and the transfer of groups of organisms along the California coast.

"The California Current is a highly productive upwelling ecosystem that sustains a variety of fish, invertebrate, marine mammal and kelp populations of importance to the people of California. It also helps to modify the climate of much of the western United States," said Ohman. "This new LTER site will enable us to understand how

climate change affects the California Current ecosystem and to build this understanding into mathematical models that will, eventually, help us forecast the effects of climate change on living marine resources."

The NSF has now established 26 LTER sites. The two newest, including a site investigating coral reef processes, will receive approximately \$820,000 each per year for the next six years, for a total of nearly \$5 million each. The CCE site also will capitalize on Scripps's ship fleet, including 80 days of experiments at sea on the research vessel *Revelle* and 24 days on the *R/V New Horizon*, in addition to the quarterly CalCOFI cruises.

"The California Current system sustains active fisheries for a variety of finfish and shellfish, modulates weather patterns and the hydrologic cycle of much of the western United States, and plays a vital role in the economy of myriad coastal communities," said Phil Taylor, director of NSF's biological oceanography program.

Ohman said it is difficult to distinguish the differences between human and naturally produced changes in the marine environment because of the widely variable forces interacting there.

"With this new LTER site we have a rare opportunity to tease out the causes of the natural sources of variability," said Ohman. "This will prove invaluable in managing the living marine resources of importance to California."

The other new LTER program, the Moorea Coral Reef site, will be located at the University of California's field laboratory on the island of Moorea in French Polynesia. Research there will help scientists better understand coral reef processes that drive the functions of this ecosystem; the nature of coral reef animal and plant community structure and diversity; and the factors that determine the abundance and dynamics of related populations.

Participants in CCE include scientists from Scripps Institution of Oceanography (Scripps), Pacific Fisheries Environmental Laboratory (PFEL), Georgia Institute of Technology (Georgia Tech), Duke University's Point Reyes Bird Observatory (PRBO), the Birch Aquarium at Scripps (BAS), the California Center for Ocean Sciences Education Excellence (CA COSEE) and Southwest Fisheries Science Center (SWFSC) of the U.S. National Marine Fisheries Service.

The participants are, including their area of CCE study: **Mark Ohman**: lead principal investigator, Scripps, mesozooplankton ecology **Lihini Aluwihare**: co-principal investigator, Scripps, dissolved organic matter **Karen Baker**: co-principal investigator, Scripps, information management **Katherine Barbeau**: co-principal investigator, Scripps, iron geochemistry **David Checkley**: co-principal investigator, Scripps, mesozooplankton, ichthyoplankton **Peter Franks**: co-principal investigator, Scripps, biophysical modeling **Ralf Goericke**: co-principal investigator, Scripps, phytoplankton ecology **Michael Landry**: co-principal investigator, Scripps, food-web structure and function **Art Miller**: co-principal investigator, Scripps, physical oceanography, modeling **Greg Mitchell**: co-principal investigator, Scripps, remote sensing, bio-optics **George Sugihara**: co-principal investigator, Scripps, nonlinear modeling **Farooq Azam**: associate, Scripps, bacteria/microbial food webs **Steven Bograd**: associate, PFEL, physical oceanography **Ron Burton**: associate, Scripps, molecular probes for protists **Dan Cayan**: associate, Scripps, atmospheric physics **Teresa Chereskin**: associate, Scripps, ADCP currents **Emanuel DiLorenzo**: associate, Georgia Tech, biophysical modeling **Sharon Franks**: associate, CA COSEE, education and outreach planning **David Hyrenbach**: associate, Duke/PRBO, seabird ecology **Cheryl Peach**: associate, BAS and CA COSEE, education and outreach planning **Brian Palenik**: associate, Scripps, microbial diversity **Dan Rudnick**: associate Scripps, mesoscale ocean physics **Christian Reiss**: associate, SWFSC, planktivorous fishes **Ken Smith**: associate, Scripps, deep-sea benthic ecology **Bill Sydeman**: associate, PRBO, seabird ecology, marine mammals **Elizabeth Venrick**, associate, Scripps, phytoplankton floristics

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Scripps Institution of Oceanography, at the University of California, San Diego, is one of the oldest, largest, and most important centers for global science research and graduate training in the world. The National Research Council has ranked Scripps first in faculty quality among oceanography programs nationwide. Now in its second century of discovery, the scientific scope of the institution has grown to include biological, physical, chemical, geological, geophysical, and atmospheric studies of the earth as a system. Hundreds of research programs covering a wide range of scientific areas are under way today in 65 countries. The institution has a staff of about 1,300, and annual expenditures of approximately \$140 million from federal, state, and private sources. Scripps operates one of the largest U.S. academic fleets with four oceanographic research ships and one research platform for worldwide exploration.

NSF is an independent federal agency that supports fundamental research and education across all fields of science and engineering, with an annual budget of nearly \$5.58 billion. NSF funds reach all 50 states through grants to nearly 2,000 universities and institutions. Each year, NSF receives about 40,000 competitive requests for funding, and makes about 11,000 new funding awards. NSF also awards over \$200 million in professional and service contracts yearly.

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