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Opening The 'Black Box': Scientists Gain New Tools To Learn About The Near-Shore Environment

(Denver, Colorado) -- A group of scientists is putting together a picture of what until now has been a black box -- the near-shore ocean environment. At the same time, they are developing a picture of where marine animals live in the different parts of their life cycle. The information is invaluable to marine reserve planners, the fishing industry and many others.

"New Tools for Designing Effective Marine Reserves," to be published in a future edition of the journal Frontiers in Ecology, outlines the state of the art of management of marine reserves. The findings will be presented at a press conference of the American Association of the Advancement of Science on Friday, February 15, at noon Mountain Time.

Previously, the open ocean has been studied the most, and yet the area where most fishing occurs and where humans interact with the ocean has been neglected, partly because it is so complicated, according to author Robert R. Warner, professor of ecology, evolution and marine biology at the University of California, Santa Barbara.

In short, the authors look at:

·Remote sensing which provides "real time" data about the ocean.

·The chemical signal of trace metals in growing skeletons which provides a tracking device for where larvae and juveniles drift in the sea.

·Genetic differences among populations that can reveal barriers to dispersal that are otherwise unseen, and are beginning to be used to measure the scale of dispersal inside and outside reserves.

·Layers of ecosystem information placed in a geographic context by GIS (global information systems) computer mapping, which provides an accessible summary of this complex information that can be used by computer search engines to list alternative management solutions.

The authors explain that one expanding technology is remote sensing via satellites that measure characteristics of the ocean including color, temperature, surface elevation and winds, helping to map the physical forces that drive ocean circulation.

Warner provides an example of the complexity. "It is as if one is trying to manage a deer population on land but the does give birth to dandelion puffs and the seeds drift off in the wind," he said. "We haven't known how far they go, or how they get back. We are just beginning to discover where the marine young go, to take this apart. We need to be able to uncover the physical mechanisms, the current flows and the oceanographic features."

"In order to figure out the movement of both fish and invertebrates, we've got to become really good oceanographers," said Steve Gaines, co-author and director of the Marine Science Institute at UC Santa Barbara. He said that marine larvae may drift for awhile on a top current and then drop to a lower current going the opposite direction that brings them back close to where they began.

Warner explained how the inner ear, or balancing mechanism of the fish (the otolith for fish or the statolith for invertebrate marine animals) is like a pearl that begins before birth with tiny rings that reflect the composition of the water for each day of the life of the animal. With further study, scientists will be able to use these markers like internal flight recorders to follow the movements of the marine animal.

Another important tool is genetics, according to Warner. The human genome project has moved genetics forward so that scientists will be able to compare the genes in populations of fish and find out if they are moving from one area to another. For example, Oregon waters may be the birthplace of fish that eventually settle in

California waters. Or certain areas of the ocean may be seeding themselves.

The paper, New Tools for Designing Effective Marine Reserves, in Frontiers in Ecology, was written by S. R. Palumbi, of the Department of Biological Sciences at Stanford University; S. D. Gaines, director of the Marine Science Institute at UC Santa Barbara; H. Leslie of the Department of Zoology, Oregon State University; and R. R. Warner, Department of Ecology, Evolution, and Marine Biology.

The authors are contributing to the work of the highly interdisciplinary group, PISCO, the Partnership for Interdisciplinary Studies of Coastal Oceans, a long-term program of scientific research and training dedicated to advancing the understanding of marine ecosystems along the U. S. West Coast. The principal investigators are from UC Santa Barbara, UC Santa Cruz, Oregon State University, and Stanford University.

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