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For a Fish, There's no Place Like Home, Say Major Studies, Offering Key Information for Fisheries Management

Pathbreaking fisheries research from two different oceans yielded the same results, published as this week's cover story in *Nature*: chemical tests show that coral reef fish often spend their life cycle close to home, rather than drifting in the open ocean, thus providing important information for global fisheries management.

By studying the chemical composition and physical structure of the otolith -- the tiny crystalline stone in the inner ear of the fish -- scientists from the University of California, Santa Barbara discovered that significant numbers of larval fish return to reefs where they were spawned.

"These are the first numbers we've ever had on this. It's impressive that our results and those from Australia, also published in this issue*, are so similar," said Robert Warner, professor of biology at UC Santa Barbara**, and co-author of the Santa Barbara paper entitled, "Larval Retention and Recruitment in an Island Population of a Coral Reef Fish." Other authors are Stephen Swearer, graduate student, Jennifer Caselle, assistant research biologist and David Lea, associate professor of geological sciences, all of UC Santa Barbara.

"To manage and conserve any marine population, we must know the fate of the young produced by that population, and we must know something about the sources of young recruiting to that population," said Warner.

The study of the otolith holds great promise, according to Warner. "Previous researchers have assumed that after a 50-day planktonic larval duration, larvae would have been swept tens or hundreds of kilometers downstream," he said.

The UC Santa Barbara study, initiated by first author Steve Swearer, came out of his questioning of the prevailing view that individual larval fish settling to reefs were most likely spawned elsewhere.

"This was my approach to challenging that hypothesis," said Swearer, who chose to focus on a well-studied coral reef fish called the bluehead wrasse in three different locations on the reefs of St. Croix in the U.S. Virgin Islands.

"The basic paradigm didn't make sense to me," said Swearer. "If a larva develops out in the open ocean and disperses away from the natal population, it's at great risk of not finding suitable adult habitat at the end of the larval phase. If you leave an isolated environment like an island, what's the likelihood that you will encounter another coral reef habitat?"

Swearer used the fish earstone with its daily growth rings as a "flight recorder" of the environmental conditions experienced throughout the life cycle. "The calcium carbonate crystalline structures can tell you the age of the individual fish, and how fast or slow it grew at a particular time," he said. Over the last decade researchers have begun to use it to reconstruct the chemical and physical environment experienced during development."

The authors used techniques that have been refined by co-author David Lea, a marine geochemist and associate professor of geological sciences at UC Santa Barbara. Lea who measures trace elements by plasma mass spectrometry to study past oceans and climate, said it is very fortuitous that the same techniques work to track marine larvae by analyzing the trace quantities of metals. He explained that geochemists have demonstrated strong contrasts in trace element composition of nearshore versus open ocean waters. "We can use that difference as a chemical fingerprint of which waters the larvae have inhabited," he said.

Although it is difficult technically, Lea's lab can analyze quantities as small as 10 millionths of a gram to determine one part per billion.

The authors want to see their data used in developing strategies for marine conservation and protection of biodiversity. "If we continue to assume that recruitment comes from non-local reproduction, when in reality local adults contribute significantly to local recruitment then we run the risk of over-harvesting, whittling away at the population of parents," said Swearer.

The growing interest in developing marine reserves must be based on the latest scientific knowledge, he said. "If we want to be effective in determining optimal placement of marine reserves, as well as evaluating the capability of reserves to sustain exploited stocks, we need to have some empirical techniques that allow us to evaluate the level of connectivity among populations of marine organisms."

In Nature's "News and Views," Stephen R. Palumbi, from the Department of Organismic and Evolutionary Biology at Harvard University, called the implications of the two studies profound. "Far from being obligate ocean drifters destined for a life far away from their parents, these fish larvae enter the plankton and drift for weeks, but they come home again," he said. "Understanding how often fish larvae are retained on near-by reefs, and whether these results also apply to continuous coastlines with consistent long shore current patterns, will require complementary studies of other species and other oceanic settings. But for the first time, we know the fish come home."

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EDITORS: A graphic and photo are available. *Self-recruitment in a Coral Reef Fish Population," by G.P. Jones, M.J. Milicich, M.J Emslie and C. Lunow of James Cook University, Townsville, Queensland, Australia.

**Professor Warner is currently on sabbatical at the National Center for Environmental Analysis and Synthesis (NCEAS) the international think tank based at the University of California, Santa Barbara.

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