Marine reserves will need stepping stones to help fishes disperse between them

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A massive field effort on the Belizean Barrier Reef has revealed for the first time that the offspring of at least one coral reef fish, a neon goby, do not disperse far from their parents. The results indicate that if marine protected areas aim to conserve such fishes, and biodiversity more broadly, then they must be spaced closely enough to allow larvae to disperse successfully between them.

A growing body of scientific research has demonstrated that marine protected areas, particularly no-take marine reserves that exclude extractive activities like fishing, can increase biodiversity and sustain fisheries within the reserves, often with spillover benefits in surrounding areas. But despite the decline of coral reefs and fisheries worldwide, only 3.5 percent of the ocean is protected and only 1.6 percent of it is fully protected. Moreover, for reserves to conserve marine biodiversity most effectively, they must be embedded in networks that are connected such that marine life from one reserve can repopulate other reserves.

"Before our study, we didn't have a deep, quantitative understanding of how far fish larvae do and do not disperse from their parents," says study co-author Peter Buston of Boston University. "If we're going to design effective networks of marine reserves, we need to know how far baby fish can and cannot travel. Our study suggests that for fishes like the neon gobies, protected areas may need to be close together."

Last week, the Pacific Island nation of Palau was the most recent nation to announce the designation of a large-scale marine reserve in its waters.

Other nations announcing large marine reserves in the past year include New Zealand and Chile. In the U.S., in September 2014, President Obama expanded the impressive Pacific Remote Islands National Marine Monument to more than 490,000 square miles.

Such large reserves can provide habitat for a wide variety of species. But most marine reserves remain much smaller, and lead author Cassidy D'Aloia, now at the University of Toronto, notes that marine life still needs to travel among reserves. "If reserves are connected, then if a catastrophe occurs in one reserve, then that population can potentially be rescued by larvae from another reserve."

For their study, D'Aloia and her co-authors collected thousands of tissue samples from neon goby parents and offspring along a 41 km (about 25 miles) length of the Belizean Barrier Reef to determine how far those offspring traveled. They found that larvae typically dispersed no more than 1.7 kilometers (about one mile) from their parents and in no cases dispersed more than 16.4 km (about 10 miles). Although the study looked at only one species, gobies are the most diverse family of ocean fishes.

"Our research shows that some larval fish are not traveling very long distances, and that pattern is likely stable over long-periods of time. This result suggests that large marine reserves will need stepping stone reserves to help some fishes disperse between them," says Buston.

The study will be published in the Early Edition of *Proceedings of the National Academy of Sciences* in the week of October 26th. The study helps address one of the central challenges identified by authors Jane Lubchenco and Kirsten Grorud-Colvert in a recent Policy Forum for the journal *Science*: Namely, how to design networks of marine reserves that protect biodiversity within reserves—while allowing fishing outside of those protected areas—by ensuring ecological connections between

reserves.

More information: Patterns, causes, and consequences of marine larval dispersal , www.pnas.org/cgi/doi/10.1073/pnas.1513754112

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