

Marine reserves hit the spotlight in PNAS special issue

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Marine reserves are known to be effective conservation tools when they are placed and designed properly. This week, a special issue of the *Proceedings of the National Academy of Sciences (PNAS)* is dedicated to the latest science on marine reserves, with a focus on where and how reserves can most effectively help to meet both conservation and fisheries goals.

"There is plenty of new evidence to show that if reserves are designed well, they can benefit both fish and fishermen," explains Steven Gaines, newly appointed Dean of the Bren School of Environmental Science & Management at UC Santa Barbara and a guest editor of the PNAS special issue. "An enormous amount of research has already been done on marine reserves, helping to facilitate their use and development around the world, and yet many lingering questions remain. Papers in this special issue help answer many of those questions."

Several scientists with papers in the issue will be discussing their findings today at a press briefing at the Annual Meeting of the American Association for the Advancement of Science (AAAS) in San Diego.

Each paper in the special issue describes a different yet interrelated aspect of reserves and the societies in which they function. One global study, for example, identifies large stretches of coastal ocean where marine reserves can play a major role in reducing cumulative impacts on marine ecosystems. In some cases, fishing is responsible for as much as 90 percent of the overall damage to the ecosystem. These areas include the South China Sea, East China Sea, Bering Sea, Sea of Okhotsk, North Sea, and Norwegian Sea, as well as much of the Coral Triangle. When fishing is the most significant threat to a particular ecosystem, marine reserves can serve as powerful tools for improving the overall condition of the ocean.

"It was surprising to see how much marine reserves could improve overall ocean health in many places around the world, but also humbling how much still needs to be done," says Ben Halpern, an associate research biologist at UCSB and lead author of this study. "Marine reserves and other marine protected areas are an important piece of the puzzle in addressing marine resource management comprehensively, but they are only part of the solution."

Another global study - the first of its kind - examined the social determinants of success in 56 coral reef marine reserves, representing every major reef region in the world. The results suggest a clear link between reserve performance and proximity to a human population center. However, the overall effect of having humans nearby - beneficial or detrimental - varied by region. In the Indian Ocean, for example, reserves near a human population performed better than their more remote counterparts. In the Caribbean, however, reserves near a population center fared relatively poorly.

"Success also has to do with cooperation by the local communities," explains Joshua Cinner, Senior Research Fellow at James Cook University in Australia and a co-author on this study. "In areas where people work together to invest in their resources, we saw less poaching inside marine reserves. This was really about having processes that allow people to be consulted about the reserves and engage in research and management activities. Our study found that, to get high levels of compliance with reserve rules, managers need to foster the conditions that enable participation in reserve activities, rather than just focusing on patrols."

Detailed spatial information on where fish spawn and spend their lives can help in the design of effective reserve networks. To that end, another study looks at what ecologists call "sources" and "sinks." Source areas are very productive spawning

grounds that are well connected to other areas by ocean currents. Larvae hatched there are swept to the sink areas, where they seed populations that might otherwise dwindle to unsustainable levels. The study suggests that, if fishing is prevented in source areas and instead concentrated in sink areas, [fisheries](#) could realize a significant gain in value - greater than 10 percent according to model simulations.

"If you care about both conservation and fisheries, regardless of the relative value you place on each, better information about dispersal will help you achieve both goals," explains Andrew Rassweiler, a biologist at UC Santa Barbara and a co-author on this study. "Because managers have to be selective when placing reserves, information on sources and sinks will help them get the best results with the least disruption to fishing."

"What you'd really like to do is close the source to fishing and only fish in the sink area," adds Christopher Costello, an economist at the Bren School and lead author on this paper. "It turns out you get a much higher economic value and much better conservation when you do that. But if you don't know where the sources and sinks are, you can't do that, so that is where the information comes in."

Finally, another study presents findings from the Channel Islands National Marine Sanctuary, home to a network of marine protected areas first established by the California Department of Fish and Game in 2003. The authors found that, after only five years, fished species were significantly larger and more abundant inside no-take reserves than they were outside.

"We're at the point where we can actually begin to assess network benefits, including increases in the size and number of fish across the entire network," says Jennifer Caselle, a research biologist at the Marine Science Institute at UC Santa Barbara. "Based on what we know so far, it seems the whole really can be more than the sum of its parts when networks are designed with larval and adult movements in mind."

Many scientists point to networks as a key strategy

for getting the most out of reserves. In fact, the special issue and press conference coincide roughly with the implementation of a comprehensive network of [marine reserves](#) in Southern California mandated by the California Marine Life Protection Act (MLPA). The MLPA network (of which Southern California represents the third of five stages) is the first in the United States to be designed from the ground up as a network rather than a patchwork of independent reserves.

The scientists emphasize that the coupling of new marine reserve network science with appropriate public process is the key.

"If the public and stakeholder process and networks are well designed and implemented, it will work, even in an area like California with tens of millions of users," says Gaines. "These networks can benefit both [fish](#) and fishermen. It's not a choice."

Provided by University of California - Santa Barbara

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