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The Spillover Effect

You can’t have your cake and eat it too, as the saying goes. But what if you could save your slice while enjoying the benefits at the same time? New research suggests this is possible when it comes to marine reserves.

Marine protected areas (MPAs) are among the best conservation tools at our disposal today. However, by their very nature, these reserves take away fishing grounds, which can make them unattractive to commercial fishermen. Scientists and resource managers often promote MPAs as beneficial for the fishery. In theory, they provide a refuge for stocks to rebuild and spill over into nearby waters, leading to improved catch rates.

“And yet, there’s a lot of skepticism about that because there aren’t many instances where anyone’s ever shown that to be true,” said Dan Reed, a research biologist at UC Santa Barbara’s Marine Science Institute.

Most of the work so far has documented the buildup of species populations within reserves and the subsequent spillover. “What hasn’t been documented is how that actually affects the catch,” he continued. Namely, whether any increase in catch from spillover actually compensates for the loss of fishing grounds.

Reed and his colleague Professor Hunter Lenihan, a professor at UCSB’s Bren School of Environmental Science & Management, along with other researchers at UC Santa Barbara and the California Department of Fish and Wildlife, sought to determine to what extent the spillover effect compensated for the fishing grounds incorporated

into marine reserves. To this end, they leveraged catch reports from lobster fishermen as well as scientific surveys. Their results, published in Scientific Reports, affirm the benefits that MPAs confer to fisheries and ecosystems.

“The key question is what is the net effect of the reserves on the fishery?” proposed lead author Lenihan, a fisheries ecologist. “If you take away a certain amount of territory, do you make up for it by this increase in catch through spillover?”

“What we found is that you not only make up for the lost area, but actually enhance the fishery,” replied Reed.

The team compared lobster populations and catch records from waters off the coast of Santa Barbara and Goleta. From 2012 through 2018, divers conducted surveys of the size and abundance of lobsters at five sites studied by the Santa Barbara Coastal Long Term Ecological Research program (SBC LTER), which is part of the National Science Foundation’s LTER network. Three of these reefs have always been open to fishing, while two of them (Isla Vista and Naples reefs) were incorporated into two marine reserves in 2012.

Spiny lobsters support an important fishery in Southern California.

Photo Credit: SBC LTER

The researchers also obtained data for commercial landings and fishing effort — measured in the number of traps pulled — from the California Department of Fish and Wildlife, which manages the state's fisheries. Records from six years before and after the establishment of the two MPAs gave the scientists a sizable window to examine the impact that the reserves had on the lobster catch. The department divides the coast into rectangular fishing blocks, and these became the spatial units the researchers used in the study.

The team observed that the number and overall biomass of lobsters increased in and around the marine reserves once fishing was prohibited. This suggested that lobsters were indeed proliferating inside the reserves and spilling out into surrounding areas, just as predicted by the theory.

They also found that annual lobster landings more than doubled in the fishing block with the two MPAs during the six years after their establishment despite the 35% reduction in fishing area in that block. In contrast, the annual catch in blocks without MPAs remained relatively unchanged over that timespan.

“This study is one of the first to quantify and document that the establishment of marine reserve actually enhanced catch despite reducing the area that fishermen could actually fish,” said Reed.

Records indicate that a roughly 225% increase in catch near marine reserves was accompanied by a 250% increase in fishing activity; however, the researchers note that this isn’t merely a case of laying more traps and catching more lobsters. The increased effort was targeted largely near the borders of the reserves as fishermen “fished the line” to target lobsters that spilled over from the reserves into fishable areas. “Without spillover from a reserve, increasing fishing effort is much less likely to result in increased catch,” said Reed.

“Our data suggest that in the case of lobster the MPAs have the potential to lead to a higher sustainable catch,” he concluded.

Lobster populations build up size and numbers in the refuge of the reserves and begin spilling over into nearby areas.

Photo Credit: MATT KAY

Lenihan and Reed were quick to point out that studies like this are possible largely thanks to projects like the SBC LTER. The sustained funding from the NSF enables scientists to curate rich timeseries datasets they can use to investigate questions that involve relatively long timespans.

The researchers at the SBC LTER have worked with the local fishing communities for years in an effort to understand the effects of reserves. Their collaboration with the California Lobster and Trap Fishermen's Association has been particularly fruitful, Lenihan said. Lobstermen Chris Miller, Sam Shrout and Chris Voss dedicated substantial time to train Bren School doctoral students Matt Kay, in 2006, and Sean Fitzgerald, in 2018, to trap lobsters like professionals, thus assuring collection of excellent fisheries data. In addition, scientists hopped aboard commercial fishing boats to trap lobsters with the fleet.

They've also relied on fishermen for data. After tagging some 17,000 lobsters with researchers' names and phone number, the scientists waited for fishermen to report where the lobsters were caught. This provided insight into the animals' movements that would not have been possible without such a collaboration.

Lobstermen also appear to be benefiting from this relationship. Reserves seem to have increased landings in the northern extent of the fishery much more than in the south. Lenihan and Reed suspect this is because the fishermen in the north have been working with the scientists, giving them access to insights that their southern counterparts don't have.

"We learn from them; they learn from us," Lenihan said.

"Collaboration between researchers and fishermen not only serves their interests, but it can also really benefit the conservation value of the MPAs and the resource agencies charged with managing them," added Reed.

Cooperation between scientists, fishermen and resource managers leads to better information, more transparency and more trust, Lenihan explained. Ultimately, that improves science, management, conservation and fishing.

The study's other coauthors include Associate Professor Adrian Stier and graduate students Jordan Gallagher and Joseph Peters in the Department of Ecology, Evolution, and Marine Biology, as well as Jennifer Hofmeister of the California

Department of Fish and Wildlife.

About UC Santa Barbara

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