

The Spillover Effect: What Do the Reserves in St. Lucia and Cape Canaveral Tell Us?

One of the most difficult scientific and political questions in MPA planning is that of whether no-take marine reserves can serve to increase fish catches in surrounding fished areas. This effect -- achieved when larval or adult fish exit a reserve -- often becomes a central issue both for reserve planners and for stakeholders affected by pending closures, particularly fishermen. When future "spillover" of fish out of a reserve is assumed, support for a reserve can be high among fishermen. But with few real-life demonstrations of the spillover effect existing in the scientific literature, how sure can planners and stakeholders be that it will happen?

The authors of a paper published in *Science* magazine on November 30 say that two sites they have studied show the spillover effect is real, and that reserves can play a key role in supporting fisheries. Lead author Callum Roberts of the University of York (UK) hopes the findings "will help remove a major logjam in the debate." (Co-authors on the paper included Fiona Gell and Julie Hawkins, both of the University of York; Jim Bohnsack of the US National Marine Fisheries Service; and Renata Goodridge of the University of the West Indies [Barbados].)

The reserves

The two reserves are the Soufriere Marine Management Area (SMMA) -- on the Caribbean island nation of St. Lucia -- and the Merritt Island National Wildlife Refuge (MINWR) at Cape Canaveral, Florida.

The SMMA, a zoned MPA that includes a network of five no-take areas, was designated in 1995 to rehabilitate the local reef fishery. The no-take areas constitute 35% of the previous local fishing grounds; in total, the SMMA encompasses 11 km of coastline. From 1995 to 1998, according to the *Science* paper, fish biomass in the no-take zones tripled while biomass in the adjacent fished areas doubled. (Roberts told MPA News that recent, unpublished data show even greater increases, with a quadrupling of biomass in the no-take zones and a tripling of biomass in the fished areas.) While total fishing effort remained stable, the mean total catch per trip by fishermen rose by at least 46%. The paper's authors know of no evidence for similar fishery or stock improvements in nearby islands.

The MINWR encompasses two areas of estuarine habitat that have been closed to public access and all fishing since 1962, for security of an adjacent rocket launch site. The two areas total 40 km². In recent years, the adjacent fished areas have become a hotspot for catches of record-sized game fish, particularly red drum, black drum, and spotted seatrout. World- and state-record catches of these three species have been concentrated in the authors' study area, which extends roughly 100 km north and 100 km south of the no-take zones -- an area equivalent to 13% of the state's coastline. Since 1985, for example, most Florida-record red and black drum have come from this study area, despite the fact that similar, suitable estuarine habitat for these fish exists throughout the state.

What can we learn from this?

Both of the cases described in the *Science* paper involve relatively small-scale reserves and fisheries. "I think we make a strong case that reserves will work at these scales in coastal waters," said Roberts in an interview.

He suggests, however, that reserves may work just as well across a wide spectrum of scales, geographical locations, and fisheries. "Industrial fisheries in continental-shelf and high-seas waters are in deep trouble," he said. "Many scientists believe that marine reserves could throw such fisheries a lifeline. Our study does not make that case alone. But it does establish that the theory is sound as to how reserves will benefit fisheries." He says the next step is to perform large-scale demonstrations of reserve benefits to industrial fisheries.

Roberts says that comparisons of marine reserves to more conventional fishery management tools (e.g., gear restrictions) should be broader than simply measuring against the metric of catches of target species. In other words, he says, reserves offer benefits, besides spillover, that other management tools do not. "The key additional benefit is that reserves protect habitats from damage caused by fishing gear such as trawls," he said. "Aside from the important conservation values of such habitat protection, theory also predicts that better quality habitats will reduce the risks associated with present fishery management, including serious stock declines from management failures."

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Box: The spillover effect, in brief

Roberts et al. in their *Science* article describe the basis for the spillover effect as such:

"Because reserves contain more and larger fish, protected populations can potentially produce many times more offspring than can exploited populations. In some cases, studies have estimated order-of-magnitude differences in egg production. Increased egg output is predicted to supply adjacent fisheries through export of offspring on ocean currents. In addition, as protected stocks build up, reserves are predicted to supply local fisheries through density-dependent spillover of juveniles and adults into fishing grounds."

Excerpted from Roberts, C.M., Bohnsack, J.A., Gell, F., Hawkins, J.P., & Goodridge, R. Effects of marine reserves on adjacent fisheries. *Science*, 294, 1920-1923 (2001).

Box: Recovery of Soufriere Marine Management Area after Hurricane Lenny

The Soufriere Marine Management Area (SMMA), featured in the *Science* magazine article by Roberts et al., was hit hard by Hurricane Lenny in late 1999, destroying as much as 80% of the coral cover in some areas of the park. When MPA News profiled the SMMA immediately afterward, Manager Kai Wulf was concerned about early damage assessments, which showed a severe loss of marine life. "I don't know where the fish have gone," he said. ([MPA News 1:4](#))

Two years later, as indicated by data from the *Science* article, most of the fish have come back. "The SMMA has survived, both physically and as an institution," said Wulf. Although some areas of the park still show little revival in terms of coral cover, other spots are in the midst of a rapid recovery. Wulf is now considering adjusting the boundaries of no-take zones within the SMMA to account for this: one of the few places, for example, where healthy stocks of one coral can be found is in a heavily fished multipurpose zone. "I am afraid that the dropping of fish traps could destroy these few remaining colonies," said Wulf.

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