

Science for Environment Policy

Fishing ban enforcement is key factor in restocking fish in marine protected areas

Marine protected areas (MPAs) in which fishing is prohibited contain substantially more fish, including commercially valuable species, than either partially protected or unenforced MPAs, according to a recent survey of rocky reef fish in the Mediterranean Sea. This suggests that MPAs need to be highly protected to offer the best chance of recovery for fish stocks, say the researchers.

Overfishing is one of the biggest threats to [marine ecosystems](#) in the Mediterranean Sea. They are further endangered by the spread of invasive species, and the northward migration of warm-water fish species as the sea temperature rises under [climate change](#).

Previous studies examining single MPAs have found that restricting human activities, particularly fishing, has been effective in replenishing depleted fish stocks. However, this is the first study to explore on a regional scale how MPAs can help fish populations recover from overfishing. The researchers also investigated whether MPAs can slow the spread of invasive species and northward expansion of warmer-water fish species.

To gather the data, researchers surveyed fish communities in rocky reef habitats along the coast from Spain to Turkey in the northern Mediterranean Sea. Scientists identified, counted and estimated the size of the fish they saw while diving 125 m² sections of 13 MPAs and 17 unprotected areas in May-June 2007 and 2008.

The researchers classified the study areas into three types: (i) well-enforced MPAs with no fishing permitted (no-take); (ii) MPAs where some fishing was allowed (intermediate protection); (iii) non-enforced MPAs and open-access areas (unprotected). They also classed the fish as apex predators at the top of the food web; carnivores (fish that feed on other fish and marine animals); planktivores (plankton feeders); herbivores (algae feeders) and detritivores (dead organic matter feeders) lower down the food web.

The researchers found that the level of protection greatly affected the fish communities. No-take MPAs showed the greatest recovery of fish communities, with recovery in intermediate-protection MPAs closer to that of unprotected areas. Furthermore, the numbers and total mass of apex predators, carnivores and detritivores were greater in no-take MPAs, compared with the other areas.

The estimated total weight of the fish per square metre of seabed and the numbers of different species were also significantly greater in the no-take MPAs compared with the other areas. In no-take zones, the average weight was approximately 84 g/m², compared with around 30 g/m² in areas with intermediate protection and 10 g/m² in non-enforced MPAs and unprotected areas. Importantly, highly protected MPAs contained much greater densities of commercially valuable fish.

The results showed that the numbers of invasive species or southern Mediterranean fish that thrive in warmer waters were similar in both MPAs and unprotected areas. Although this means that it is likely that MPAs do not protect against these threats, it also shows that the extra biodiversity found in MPAs was not driven by invasive or warm-water fish.

These results reinforce other studies of single MPAs, which have shown that highly protected areas offer the best chance for fish stocks and entire ecosystems to recover in the Mediterranean Sea.



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<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0091841>

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