NEWS OCEANOGRAPHY

# How do you protect fish that swim beyond your safety net?

Despite their limited size, marine reserves boost populations of far-ranging tuna

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A juvenile yellowfin tuna caught on a hook near Hawaii WATERFRAME/ALAMY



Tuna are Olympic-caliber fish. They can swim hundreds to thousands of kilometers, some even cross the Pacific Ocean and back. That would seem to make it difficult—if not impossible—to establish a marine reserve large enough to protect them. But a new study shows two kinds of tuna have become much more abundant in a large marine reserve near Hawaii, suggesting they and other long-distance swimmers can be sheltered from overfishing.

The new study "shows that we can protect fish and we can eat more of them too," says Darcy Bradley, a conservation scientist at the University of California, Santa Barbara, who was not involved. "That hasn't been shown in this way before—this is the first demonstration at a large scale."

Marine protected areas safeguard coral reefs and other sensitive habitat or species. Governments establish them after consulting with conservationists, marine industries, and local people. When funding is available, boats patrol smaller areas and planes or satellites can keep an eye on large reserves. In addition to conserving biodiversity, marine parks can also be used as nurseries for commercial stocks of fish. The idea is that when fishing is prohibited, the population inside will grow faster and "spill over" into waters beyond the borders of the reserve.



A vivid demonstration of this spillover benefit is when fishing vessels line up at the edge of a marine reserve to catch these fish, notes fisheries biologist Daniel Pauly of the University of British Columbia, Vancouver. But the protection isn't always popular with industry, because it takes time for the population to increase—and meanwhile, there are fewer places to fish.

For scientists, a lingering question is how big marine reserves must be in order to protect species that swim long distances, such as tuna. If the fish spend too much time outside the boundaries, they're likely to be caught—perhaps before they reproduce inside the reserve. So, the population would not get an extra boost.

Whether reserves protect such highly mobile species "is just really, really hard to detect with a high degree of confidence," says John Lynham, who studies marine ecology and fisheries economics at the University of Hawaii, Manoa. One reason the question is so difficult to answer is that it is rare to find data from fishing vessels near marine reserves that are detailed enough to know precisely where and how they were fishing and what they caught.



Lynham and his colleagues found such catch records from fishing vessels around the Papahānaumokuākea Marine National Monument, which was created to protect biodiversity west of Hawaii in 2006. A decade later the monument, where fishing is prohibited, was greatly expanded to encompass 1.5 million square kilometers. This change helped the researchers compare the rate at which fish were being caught before and after the protections were put into place.

The researchers found yellowfin and bigeye tuna have increased around the reserve. Vessels now catch 54% more yellowfin than before the reserve was expanded, given the same amount of fishing effort, the team reports today in *Science*. For bigeye, the increase was 12%.

It makes sense that the population boost was smaller for bigeye, Lynham says, because they travel farther from the Hawaiian Islands. That means a bigeye tuna is more likely to be caught outside the reserve compared with yellowfin, which travel less and have been shown to spawn inside the reserve.

Another finding helps makes the case. For both tuna species, boats fishing closer to the reserve had an easier time catching the fish than did those fishing farther away.

Leah Gerber, a conservation scientist at Arizona State University, Tempe, praises the statistical rigor of the paper, calling it "unusually compelling." Bradley says the approach should be applied to evaluate other large marine protected areas.

Lynham and others say the finding strengthens the case for establishing more no-fishing zones, especially on the high seas, where migratory species such as turtles and sharks would benefit from protection. Such reserves might also mean island nations would not have to forgo lucrative tuna fishing when they establish reserves, if catch rates increase outside.

Daniel Ovando, a fisheries scientist at the University of Washington, Seattle, notes the study doesn't prove the Hawaiian tuna fishery is better off than before the reserve was created. That would require a fuller analysis, accounting for the fact that the boats can no longer fish inside the reserve. Nor is it clear how much the Hawaiian reserve benefits the broader populations of

tuna. Marine protected areas “are really good at protecting stuff inside their borders,” he says. “The much more complicated question is: What are the net costs and benefits outside?”

To Pauly, the answer is already clear. “Creating no-take marine reserves is actually something that we have to do, because otherwise we will lose the biodiversity of the world.”

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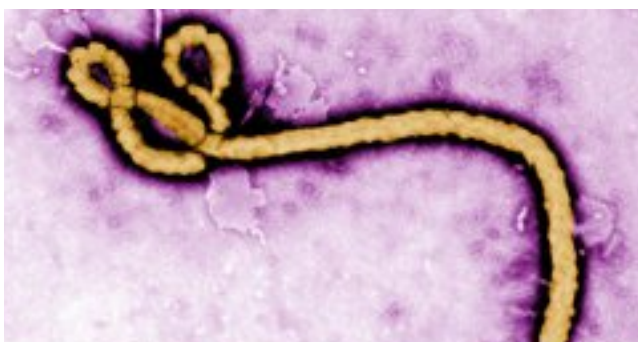

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