

News

Overfishing hits all creatures great and small

Size doesn't matter when species collapse, study finds.

Gwyneth Dickey Zakaib

A small body size does not improve the odds when fish species are faced with population collapse. NOAA

On land, the pattern is a sadly familiar one: when an ecosystem is threatened, it is the large predators that usually suffer the greatest decline and therefore are most in need of protection. Logic would seem to dictate that the same pattern should apply at sea, but new research has demonstrated the opposite. It's the small fry at the low end of the marine food chain that may be more prone to population collapse.

In the past six decades, smaller species that are commercially fished have had up to twice as many stock collapses as fishes higher up the food chain, according to a study published on 2 May in the Proceedings of the National Academy of Sciences¹.

"There's been a lot of attention on top [ocean] predators, with good reason, because a lot of them are in trouble," says Malin Pinsky, an ecology graduate student at Stanford University's Hopkins Marine Station in Pacific Grove, California, and co-author on the paper. "But it turns out that there actually have been a lot of collapses at the other end of the food chain as well. We weren't expecting to see that."

Large fish species are sensitive to industrial-scale fishing, so managers tend to impose stricter fishing regulations for them. Highly productive smaller fish are thought to be hardier, so they are taken at a higher rate. Although individual stocks of small fish species have collapsed — the Pacific sardine in the 1940s, for example — fishermen and fisheries managers have, in the past, considered those to be isolated cases, Pinsky and his colleagues write.

"It really wasn't until our study that we realized that all these individual collapses among small fishes actually add up to a lot," says Pinsky. "All kinds of species, including the small ones that we used to think were incredibly resilient, are also vulnerable to overfishing."

Pinsky and his colleagues searched for evidence of stock collapses in a database tracking the abundance of commercially fished species in developed countries back to about 1950. They also included data on landings (numbers of fish brought back to port) from around the globe.

To their surprise, the researchers found that twice the percentage of small-sized fish stocks had collapsed compared with larger ones. Likewise, species low on the food chain

had almost double the percentage of collapses compared with those at the top. The species that were fished the hardest were most prone to collapse.

"It's really overfishing that predicts whether or not a population will collapse," says Pinsky.

A sea change

The pattern is probably different from on land because the principal human impacts that cause population decline are different, he says. On land, habitat loss takes away much-needed space for large, terrestrial animals. But in the ocean, fishing is a main force of population decline, and fishing pressure is adjusted for each species. "We fish more productive species harder and less productive species less hard," says Pinsky. "When you add all that together, all species end up having about the same probability of collapsing."

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Ecologist Ray Hilborn from the University of Washington in Seattle, who helped assemble one of the databases analysed in the study, emphasizes the paper's point that climate shifts also play a big role in population fluctuation in small fish. Palaeoecological data show that small fish populations fluctuated with climate long before they were overfished, he says, and fishing probably exacerbates the problem.

Hilborn adds that the main database used for this particular study looks only at large industrial fisheries in developed countries. Unmanaged species and those of developing countries could show a different pattern. "It may be that in coral reef ecosystems the picture is different," he says.

In fact, the picture could be more similar to that on land for those unmanaged species and in developing countries, where larger species decline more than small ones, says Daniel Pauly, a fisheries biologist at the University of British Columbia Fisheries Centre in Vancouver.

Stock assessments show that managers already recognize risks for many small species, but the big question is how and where to prioritize additional assessment efforts, says Simon Jennings, principal research and advisory scientist at the Centre for Environment, Fisheries and Aquaculture Science in Lowestoft, UK. Limited resources for effective

management of larger species shouldn't necessarily be diverted to small species, because large species are still known to be more sensitive to fishing.

"It's just a reminder of the huge fishing power that's out there," says Jennings.

"Regardless of the lower sensitivity of these small species, we have the fishing power to collapse them. The conclusions are a reminder to society that all types of fisheries in all oceans continue to need effective management."

• References

1. Pinsky, M. L. , Jensen, O. P. , Ricard, D. & Palumbi, S. R. Proc. Natl Acad. Sci. USA [doi:10.1073/pnas.1015313108](https://doi.org/10.1073/pnas.1015313108) (2011).