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Climate Change Is Putting Larger Fish at Risk

News


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Credit: Hiroko Yoshii / Unsplash.

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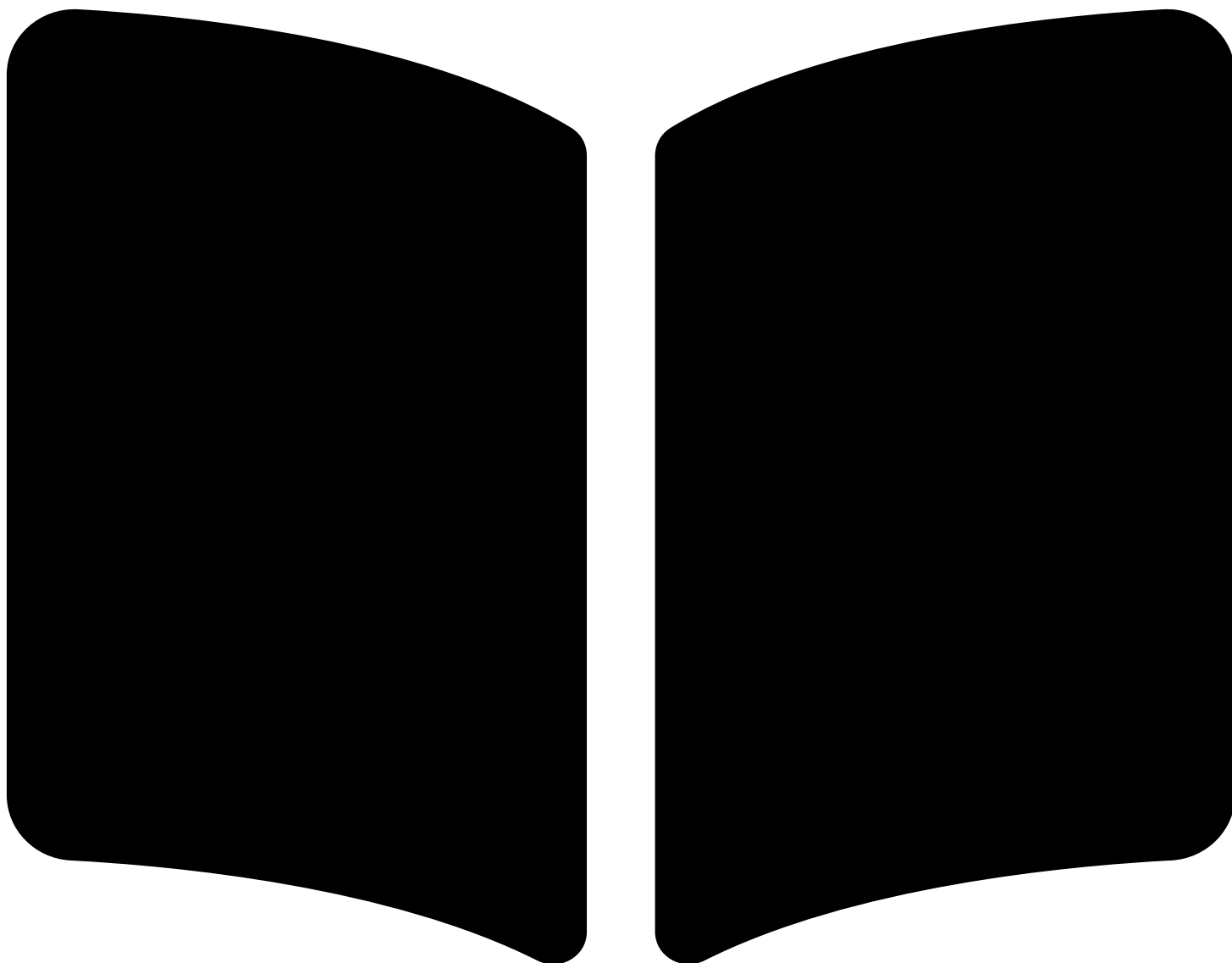


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As the old proverb goes, “there’s always a bigger fish.” But will that hold for much longer?

According to a new paper examining drought-induced fish deaths in the Netherlands, climate change is disproportionately impacting larger and older fish, which are struggling to adapt as our waters become warmer and more deoxygenated. The research was published in the journal [Environmental Biology of Fishes](#).

Studying at-risk groups

Previous scientific research has established that there is an inter-species correlation between a fish’s body size and its sensitivity to hypoxia and thermal stress. However, it is less clear whether this trend holds within a species as well.

To make matters more complex, experimental studies and fisheries management literature can sometimes contradict each other, making it particularly challenging for researchers to draw fixed conclusions about which fish might be most at risk

under certain conditions.

“There is usually a discrepancy between the interpretation by the authors of some laboratory studies versus fieldwork experience when it comes to explaining whether and why larger fish are more vulnerable than smaller fish to warming and deoxygenated waters,” [said Daniel Pauly](#), co-author of the new study and principal investigator of the Sea Around Us initiative.

“Resolving this discrepancy is urgently needed, as rapid climate change increases periods of drought and extreme heat worldwide and we need to understand the tolerance of fishes of different sizes to these events.”

A poorer metabolism is putting large fish at risk

In search of a broader explanation to explain this question, the researchers behind this new study conducted a thorough literature review, searching for collected data on three phenomena: sensitivity to hypoxia and high temperatures; aquatic surface breathing and the size-related scaling of anaerobic metabolism in fish.

This was combined with data that had been collected on three fish kills that occurred in the summers of 2020 and 2022 in Brabant, a region in the south of the Netherlands. The extreme heat during these seasons caused surface water levels to fall to record lows, prompting interventions to save the surviving fish. During the rescue of these fish, the numbers and size of the fish were recorded.

“In 30 of the 35 species assessed in the different studies and field manuals that we reviewed, larger fish were explicitly reported as having less tolerance to oxygen-depleted and warm waters,” [said Johannes Müller](#), lead author of the paper and a lecturer at Leiden University. “In the case of the fish kills in the Netherlands, we confirmed that lack of oxygen and heat stress affected larger fish more drastically than juveniles, particularly pike, perch and tench.”

The researchers determined that the smaller gill size to body mass ratio of larger fish is the most likely reason why they are disproportionately impacted by warming waters.

Under normal conditions, a smaller ratio would only impact a fish’s growth rate. But when temperatures get higher, a fish’s oxygen demand will also increase. At the same time, the amounts of available oxygen in the water will start to decrease, increasing the strain.

Smaller and younger fish, with a larger gill surface-to-body mass ratio and thus a more favorable “aerobic scope” – referring to an animal’s capacity to increase its aerobic metabolic rate above normal maintenance levels – are physiologically better primed to deal with these additional stressors.

“Larger individuals, in the course of fish kills, often resort to sucking better-oxygenated surface waters and relying on metabolic mechanisms that do not require oxygen, which allow them to survive for a little bit longer, but these resources are not endless,” Pauly [explained](#). “The accelerated metabolism caused by heat and its higher oxygen demand eventually kill the larger fish.”

What does this mean in a warming world?

As climate change continues to cause episodes of extreme weather, including drought and extreme heat, it is important that scientists are able to model the effects that this could have on fish populations properly.

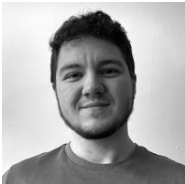
The researchers believe that their findings could help to shed some light on why fish in some regions are not reaching their full potential. For example, large fish in colder environments are already close to their limits in terms of supplying their bodies with sufficient oxygen. These animals will find it even more difficult to deal with higher temperatures and critical levels of oxygen.

“This is why in colder places that have been warming up, some fish are not reaching anymore the maximum sizes that would be possible for their species,” [said](#) co-author [Niels Houben](#), a consultant at the sports fishing association Sportvisserij Zuidwest Nederland.

Reference: Müller J, Houben N, Pauly D. On being the wrong size, or the role of body mass in fish kills and hypoxia exposure. *Environ Biol Fish.* 2023;106(7):1651-1667. doi:[10.1007/s10641-023-01442-w](https://doi.org/10.1007/s10641-023-01442-w)

This article is a rework of a [press release](#) issued by the Sea Around Us initiative. Material has been edited for length and content.

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