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Acid oceans may harm fish young

Ocean acidification – caused by climate change – looks likely to damage crucial fish stocks. Two studies just published in *Nature Climate Change* reveal that high carbon dioxide concentrations can cause death and organ damage in very young fish.

Credit: A. Bijukumar

The work challenges the belief that fish, unlike organisms with shells or exoskeletons made of calcium carbonate, will be safe as marine CO_2 levels rise.

Oceans act like carbon sponges, drawing CO_2 from the atmosphere into the water. As the CO_2 mixes with the water, it forms carbonic acid, making the water more acidic. The drop in pH removes calcite and aragonite – carbonate minerals essential for skeleton and shell formation – from the marine environment.

This can mean that corals, algae, shellfish and molluscs have difficulty forming skeletons and shells or that their shells become pitted and dissolve.

At present, atmospheric CO_2 levels exceed 380 parts per million and are expected to climb throughout the century to approximately 800 ppm if emissions are not kept in check. And the oceans are expected to continue to sop up the gas, dropping ocean pH by 0.4 units to about 7.7 by 2100.

However, many scientists have suggested that acidification wouldn't be problematic for marine fish because they don’t have exoskeletons and because as adults they possess mechanisms that allow them to tolerate high concentrations of CO_2.

But a handful of studies have shown that increased CO_2 levels can wreck the sense of smell of orange clown fish larvae and increase the size of the otolith – a bony organ akin to the human inner ear – in white sea bass larvae.

Christopher Gobler, a US marine biologist, decided to test the effects of rising CO_2 levels on the growth and survival of *Menidia beryllina*, a common schooling fish found in estuaries along the North American coast. He and his colleagues placed the fish embryos into CO_2 concentrations comparable to current levels in the seas (about 400 ppm) those expected by mid-century (about 600 ppm) and at levels projected for the end of the century (about 1000 ppm).

'Right away, we saw results,' says Gobler. 'Survival rates were cut in half or worse with high concentrations of CO_2.' When CO_2 concentrations reached 1000 ppm, one-week survival rates dropped by 74 per cent.

The other study, led by Andrea Frommel, a German fisheries biologist, looked at the effects of acidification on the larvae of Atlantic cod (*Gadus morhua*). The team reared the fish larvae under three conditions: present day (about 380 ppm), year 2200 (about 1800 ppm) and an extreme coastal upwelling scenario (about 4200 ppm), where winds bring large amount of CO_2-rich deep water to the surface. As CO_2 levels increased, the cod larvae fared less well, developing severe damage to their liver, pancreas, kidney, eye and gut about a month after hatching.

'We've always said fish are such good acid–base regulators that they won't be affected by increasing ocean acidification. But what we found was that the larvae, which haven't developed these mechanisms yet, are more vulnerable to CO_2 than we thought,' says Frommel. The organ damage was serious enough that it could have lowered the cod's chance of survival, she said.

'These two studies are part of a growing trend that realises that the broader effects of ocean acidification are much more than just calcification,' says Donald Potts, a coral-reef biologist at the University of California.

Source: Hannah Hoag/*Nature*

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