Carbon sinks: the fish factor

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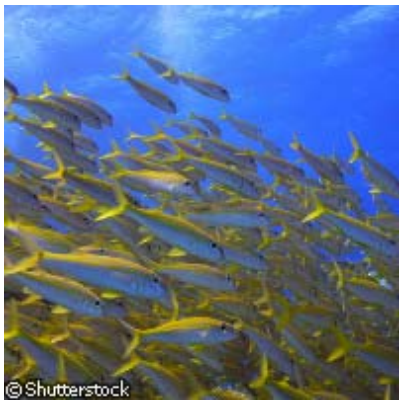

Research by EU-funded scientists has shed light on how the guts of marine bony fish contribute to the marine carbon cycle, which is undergoing rapid change as a result of increasing CO2 in the atmosphere. The findings, which are published in the journal Science, have helped to resolve a long-standing scientific puzzle and open up new avenues for carbon-cycle research.

Calcium carbonate dissolves as it sinks, making seawater alkaline. This has in the past been largely attributed to microscopic marine plankton, whose 'skeletons' tumble to the depths when they die. In fact, many creatures migrate between shallow feeding grounds and the lower depths where they continue to excrete CO2, effectively pumping it out of the atmosphere and into the deep sea.

In the present study, researchers in the UK, US and Canada estimated that between 3% and 15% of this calcium carbonate is actually produced in the intestines of bony fish, and is excreted whether or not the fish has eaten. Their discovery explains to some extent why the carbonate is distributed in the oceans' upper 1,000 metres, rather than lower down where spent plankton bodies are found.

Dr Rod Wilson of the University of Exeter in the UK said: 'Our most conservative estimates suggest 3 to 15% of the oceans' carbonates come from fish, but this range could be up to three times higher. We also know that fish carbonates differ considerably from those produced by plankton. Together, these findings may help answer a long-standing puzzle facing marine chemists, but they also reveal limitations to our current understanding of the marine carbon cycle.'

Bony fish continuously drink seawater; they take in an excessive amount of calcium, which they then precipitate into calcium carbonate pellets called 'gut rocks'. These rocks are then excreted in a process that is separate from digestion and production of faeces. In the current study, these carbonates were found to be more soluble than those produced by plankton, which explains why they dissolve at shallower depths.

The biologists used two completely different scientific approaches to model the size, composition, and abundance of marine fish in the world's oceans. Both approaches relied on satellite technology, using estimates of phytoplankton concentrations and models of organic matter conversion along the food chain that were derived from satellite observation data.

Their data allowed them to estimate the total mass of fish in the ocean: between 812 and 2,050 million tonnes. Further calculations led them to conclude that bony fish produce around 110 million tonnes of calcium carbonate per year. Taken together, their findings show that the impact of fish on the carbon cycle is massive.

'This study really is the first glimpse of the huge impact fish have on our carbon cycle - and why we need them in the ocean,' commented Dr Christensen of the University of British Columbia in Canada. 'We must buck the current trend of clear-cutting of the oceans and foster these unrecognised allies against climate change.'

The researchers predict that increasing sea temperatures and rising CO2 levels will lead to fish producing even more calcium carbonate, as higher temperatures stimulate overall metabolism in fish. However, this is expected to be offset by dwindling numbers of fish.

Dr Wilson concluded: 'We have really only just scratched the surface of knowing the chemistry and fate of fish carbonates. Given current concerns about the acidification of our seas through global CO2 emissions, it is more important than ever that we understand how the pH balance of the sea is normally maintained. Because of the impact of global climate change, fish are likely to have an even bigger influence on the chemistry of our oceans in future. So, it is vitally important that we build on this research to help fully understand these processes and how this will affect some of our most precious marine ecosystems.'

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