Three Gorges dam threatens vast fishery

25 February 2006
From New Scientist Print Edition.
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http://www.newscientist.com/channel/earth/energy-fuels/mg18925404.800.html

CHINA'S Three Gorges dam isn't fully operational yet, but it is already threatening one of the world's biggest fisheries in the East China Sea. A drop in the amount of fresh water and sediment reaching the sea is to blame.

The dam, which is the largest in the world, sits about 2000 kilometres upstream of the mouth of the Yangtze river, which empties into the East China Sea. The dam's mammoth reservoir was partially filled for the first time in June 2003.

Gwo-Ching Gong and colleagues at the National Taiwan Ocean University in Keelung, Taiwan, have been monitoring the ecosystem of the East China Sea since 1998. Within two months of the reservoir's first filling they detected a massive decline in the phytoplankton that forms the base of the food chain.

The team measured the amount of carbon dioxide being absorbed by the photosynthesising phytoplankton before and after the dam's construction. Areas of high CO_2 absorption correspond to high levels of phytoplankton, which eventually translates into a rich fishery as the phytoplankton are eaten and their nutrients move up the food chain. The researchers found that by August 2003 the 114,000-square-kilometre "high-productivity zone" surrounding the mouth of the Yangtze river had shrunk by about 86 per cent, down to 16,000 square kilometres.

This is probably because of a reduction in the amount of fresh water flowing out of the Yangtze, says Gong. Though the Chinese government has promised not to decrease the total annual flow into the sea, the water may not be released at the right time. Phytoplankton need fresh water in the summer flood season to maintain high productivity. Unfortunately, that's when farmers need the most water for irrigation. "They may try to release more fresh water during the fall season to compensate for the whole year," Gong says, "but it cannot stimulate high productivity, so there's no use for it then."

The team also found that sediment loads at the river mouth have decreased by about 55 per cent since before the reservoir was filled. Also, the ratio of silicates to nitrates in the water reaching the sea has dropped from 1.5 in 1998 to 0.4 in 2004. This has caused a shift in the dominant species of phytoplankton from silicaceous diatoms - a hallmark of a healthy ecosystem - to flagellate species, Gong says.

This bodes ill for fisheries. Flagellates can kill fish by depleting oxygen in the water or secreting toxins. One particular flagellate, for example, causes the infamous red tides. Above all, flagellates are a less nutritious base for the food chain than diatoms. "The richest fishing ground in the western Pacific Ocean is around the mouth of the Yangtze," says Gong. Given the observed reduction in phytoplankton, he estimates that annual catches will be reduced by about 1 million tonnes compared with catches before the dam was built.

More than the reduced flow of fresh water, it is the stagnation of water and silicates behind the dam that is responsible for the decline in productivity at the mouth, says John Milliman of the Virginia Institute of Marine Science in Gloucester Point. The reservoir probably retains water long enough for diatoms to grow, depleting silicates and other nutrients in the water, Milliman says. The diatoms settle out behind the dam, so the water that reaches the East China Sea does not have enough silicates to generate the usual productivity.

A similar shift in phytoplankton populations was seen in the Black Sea following the building of a dam on the Danube (New Scientist, 29 March 1997, p 4). But there may be worse to come for the Yangtze. "There are half a dozen more dams on the books, which are going to increase the water storage capacity by more than 100 per cent," Milliman says. "If there's a problem now, it's a problem that will only be enhanced."

>From issue 2540 of New Scientist magazine, 25 February 2006, page 18