

Published online 22 September 2011 | Nature | doi:10.1038/news.2011.552

News

# Nitrogen pollution disrupts Pacific Ocean

**Surging nitrates in Asian waters could dramatically affect marine wildlife.**

Susan Moran

Nitrate levels in the waters off China, Japan and the Korean Peninsula are soaring, according to a 30-year study published in *Science* today<sup>1</sup>. Researchers attribute the nitrate spike to rises in nitrogen pollution, and warn that it could severely affect marine ecology, leading to algal blooms and 'dead zones' with low oxygen levels.

Researchers from South Korea and the United States have analysed measurements, taken from the 1980s to the 2000s, of the amount of nitrogen and phosphorous at various depths in the seas bordering China's east coast — namely the Yellow Sea, the East China Sea and the Sea of Japan. They compared the nitrogen levels in the oceans to the amount of nitrogen deposited in the atmosphere, using measurements taken at four air-monitoring sites.

Over that time span, rapid population growth and industrial activity in the region, particularly in China, have caused increases in nitrogen pollution, including nitrogen oxides from fossil-fuel burning and ammonia compounds from agriculture. This nitrogen reaches the sea from the air, and to some degree from rivers.

The researchers found that as nitrogen pollution has increased, oceans in the region have become more enriched with nitrogen relative to phosphorus. They warn that this shift in nutrients could favour marine organisms that thrive in conditions of high nitrogen and low phosphorus.

## Surprise shift

Kitack Lee of Pohang University of Science and Technology in South Korea, one of the authors of the study, says he was surprised to see that nitrogen levels were affected even in such large, deep bodies of water.



Rising nitrate levels provide perfect conditions for algal blooms.

*Imaginechina/Corbis*

**“It's embarrassing how little data we have on oceans worldwide.”**

He does not single out any particular country as the primary source of the nitrogen pollution, but notes that the study areas are located downstream of China and thus the "contributions of anthropogenic nitrogen from China are inevitably large".

The study builds on previous research showing the growing impact of nitrogen pollution on the open ocean<sup>2</sup>, and on isolated lakes, streams and estuaries, including Chesapeake and Tokyo bays and bodies of water in Norway and Sweden.

"The paper takes a large data set to prove the point that has been shown in other regions, but not here," says Hans Paerl, an oceanographer at the University of North Carolina in Chapel Hill, who has researched atmospheric nitrogen deposition and over-enriched coastal waters for decades. He cautions that increasing nitrate abundance in the ocean could spur a rise in the growth of algae, including toxic blooms that are harmful to marine life.

In their study, Lee and his colleagues found that nitrate levels rose most in the Yellow Sea east of China (and southwest of South Korea), where the Changjiang River reaches the sea.

In one of the blocks of water studied in that area, nitrate concentrations have surged from 2 micromoles per litre to 8 micromoles per litre over the past 25 years. The current concentration in that area "is 30 times higher than [in] the Gulf of Mexico," says Ken Johnson, an oceanographer at the Monterey Bay Aquarium Research Institute in Moss Landing, California. "If you saw 8 micromoles in the Gulf, the dead zones there would ultimately be a lot bigger."

Johnson is leading a group of scientists trying to launch a global network of sensors that would continuously measure the impact of climate on nutrient fluxes, including nitrogen, as well as monitoring ocean acidification and oxygen stocks. "It's embarrassing how little data we have on oceans worldwide," he says.

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James Galloway, an environmental scientist at the University of Virginia, Charlottesville, who co-authored an August 2011 report on nitrogen in the environment for the US Environmental Protection Agency, says that the Pacific study demonstrates the need for greater controls on combustion systems and on nitrogen discharges to waterways from agricultural runoff, sewage and other sources. "Ultimately, the challenge is how to prevent the environmental consequences without diminishing the ability to produce food and energy, for Asia and elsewhere," he says.

## References

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1. Kim, T.-W., Lee, K., Najjar, R. G., Jeong, H.-D. & Jeong, H.-J. *Science* advance online publication <http://dx.doi.org/10.1126/science.1206583> (2011).
2. Duce, R. A. *et al. Science* **320**, 893-897 (2008). | [Article](#) | [ISI](#) | [ChemPort](#) |

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I'm wondering if this higher nitrogen content is linked to the appearance of large jellyfish blooms all over these same areas during roughly the same period of time? If so it would seem these higher levels are already responsible for the huge losses incurred by the fishing industry because of these infestations over the last decade or so. #26931

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Posted by: **Sean Marshall** | 2011-09-22 04:05:15 PM

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The explosion of jellyfish is most likely caused by the lack of fish or over-fishing as the predators for juvenile jellyfish would be absent. Filter-feeding fishes are very efficient at removing plankton and young jellyfish are essentially plankton which are only a little bigger than unicellular algae. #27066

Many jellyfish are predators and not filter-feeders (I can't think of any which eat unicellular algae) . The nitrogen levels will promote algae to grow more densely and jellyfish don't use unicellular algae such as clams & oysters, some fish like herring and sardines, and other filter-feeding organisms although the juvenile jellyfish may have better survivorship due to the conditions reported here. Jellyfish commonly feed with stinging cells, nematocysts, and this is no method for utilizing algae.

Some jellyfish have algae living in their bodies which is essentially the same as many corals that have symbiotic algae, so the nitrogen may give them an edge but nitrogen from the metabolic by-product of the jellyfish is probably enough.

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Posted by: **Charles Hollahan** | 2011-09-24 05:48:51 PM

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Disruption of this geochemical cycle will play out in the ways we understand, and many that we **#27133** don't. You can't shift planetary processes without having feedback effects in our global ecological systems. So many complex interactions that are so poorly understood. More bad news.....ugh.

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Posted by: **I.C. Cheap** | 2011-09-26 08:35:49 AM

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**Nature** ISSN 0028-0836 EISSN 1476-4687

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