NEWS RELEASE

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Plants essential to stop nitrogen pollution and global warming

Scientists have found that the way the nitrogen cycle responded to global changes in carbon dioxide in the past could provide an important insight into the way the planet combats global warming in the future.

Nitrogen, an essential nutrient for life, is now being produced in far greater quantities than in the past, mainly as a crop fertilizer, and has become a major pollutant. While greater nitrogen availability has allowed global food production to keep pace with growing human demands, it can also impair water and air quality, reduce plant species diversity and exacerbate global warming. Concerns have been raised about whether the biosphere is able to soak up this extra nitrogen and what that means for the future. However, research has shown that despite an increase in nitrogen production through industrialization, nitrogen availability in many ecosystems has remained steady over the last 500 years.

Nitrogen is a key component of the ecosystem and the largest regulator of plant growth. It determines how much food, fuel and fibre the land can produce. It also determines how much carbon dioxide plants remove from the atmosphere, and it interacts with several components of the climate system. Research carried out by an international team including Elizabeth Jeffers, James Martin Fellow at the Biodiversity Institute, Oxford Martin School, looked at how nitrogen availability changes when atmospheric carbon dioxide increases. To do so they compiled palaeoecological records of nitrogen availability from the end of the last glacial period – when carbon dioxide increased rapidly – to recent times when humans have contributed greater amounts of carbon dioxide to the atmosphere through the burning of fossil fuels. The team collected and analysed data from the sediment records of 86 lakes across six continents representing most biomes (ecosystems). With the data, the team was able to compare past and present nitrogen cycling in various regions.

Roughly 15,000 years ago, the Earth began to warm, melting many glaciers and ice sheets that covered the landscape. Their research revealed that the Earth experienced an 8,000-year long decline in nitrogen availability when plants recolonized the deglaciated landscapes and sequestered increasing amounts of carbon. This decline persisted for 4,000 years after atmospheric CO_2 levels stabilized. How the nitrogen cycle responded to these ancient global changes in carbon dioxide could provide a glimpse into the future, researchers believe.

"There is growing concern that future plant productivity and carbon storage could be limited by nitrogen. When carbon dioxide rose in the past, plants responded by storing increasing amounts of carbon and our results show that this was associated with a long-term, global decline in nitrogen availability," said Jeffers.

Although humans have nearly doubled the amount of nitrogen released to the environment, globally nitrogen levels have remained stable at most sites for the past 500 years as seen in this dataset.

One reason may be that plants are using more nitrogen than they previously have, keeping nitrogen levels consistent with those thousands of years ago, suggested co-author Kendra McLauchlan, Kansas State University.

"Our best idea is that the nitrogen and carbon cycles were linked tightly back then and they are linked tightly today," McLauchlan said. "Humans are now manipulating both nitrogen and carbon at the same time, which means that there is no net effect on the biosphere."

The lack of a globally consistent trend in nitrogen availability over the last few hundred years highlights the need to better understand what controls nitrogen availability within biomes, particularly those which are most vulnerable to change. Results from their study suggest that cold and high altitude environments are more likely to be experiencing declines in nitrogen availability.

"Today people are relying on trees to offset our growing emissions of carbon, yet when trees sequester carbon, nitrogen is also locked away for long periods and this could have knock-on effects on plant productivity. This underscores the need to integrate policies relating to carbon and nitrogen as changes in one will have profound effects on the other," said Jeffers.

According to the European Nitrogen Assessment, existing policies aimed at controlling nitrogen pollution are targeted at specific forms and sources of nitrogen and there is not yet an integrated strategy for managing the complex flows of this nutrient through the environment. Results from this study support efforts to integrate nitrogen management approaches and further suggests that any strategy must also be integrated with efforts to control carbon emissions as these two cycles are intricately linked through changes in plant productivity.

McLauchlan and Jeffers worked with Joseph Craine, research assistant professor in biology

and Joseph Williams, postdoctoral research associate at Kansas State University. The team published their findings, *Changes in global nitrogen cycling during the Holocene epoch* in the current issue of Nature, published 21 March 2013.

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Notes to Editors:

The Biodiversity Institute is a member of the **Oxford Martin School** at the University of Oxford. The School is a unique interdisciplinary community that fosters innovative thinking, deep scholarship and collaborative activity to address the most pressing risks and realise new opportunities of the 21st century. It was founded in 2005 through the vision and generosity of James Martin, and currently comprises over 35 interdisciplinary research programmes on global future challenges. The Oxford Martin School's Director is Ian Goldin, Professor at the University of Oxford. http://www.oxfordmartin.ox.ac.uk.

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For further information contact:

Dr. Elizabeth S. Jeffers
James Martin Research Fellow
Long Term Ecology Laboratory
Biodiversity Institute
+44 (0)1865 281 326
+44 (0)7592 991 294
Elizabeth.jeffers@zoo.ox.ac.uk

Julia Banfield
Communications Officer, Oxford Martin School
University of Oxford
+44 (0) 1865 287429
+44 (0) 7972 284146
Julia.banfield@oxfordmartin.ox.ac.uk