Researchers assess effects of a world awash in nitrogen

December 15 2011

Humans are having an effect on Earth's ecosystems but it's not just the depletion of resources and the warming of the planet we are causing. Now you can add an over-abundance of nitrogen as another "footprint" humans are leaving behind. The only question is how large of an impact will be felt.

In a Perspectives piece in the current issue of *Science* (Dec. 16, 2011), Arizona State University researcher James Elser outlines some recent findings on the increasing abundance of available nitrogen on Earth. In "A World Awash in Nitrogen," Elser, a limnologist, comments on a new study showing that disruption to Earth's nitrogen balance began at the dawn of the industrial era and was further amplified by the development of the Haber-Bosch process to produce nitrogen rich fertilizers.

Until that time nitrogen, an essential building block to life on Earth and a major but inert component of its atmosphere, had cycled at low but balanced levels over millennia. That balance ended around 1895.

"Humans have more than doubled the rate of nitrogen inputs into global ecosystems, relative to pre-industrial periods, and have changed the amounts of circulating phosphorus (like nitrogen, a key limiting ingredient for crops and other plants) by about 400 percent due to mining to produce fertilizers," Elser said.

The result has been immediate and widespread, he added.

Commenting on a major new finding in Science by G.W. Holtgrieve and colleagues, Elser said that signs of the "new N" appeared in all regions of the Northern Hemisphere in a remarkably coherent manner beginning around 1895, in concert with when fossil fuel combustion and large scale biomass burning accelerated across the globe. Another significant increase came around 1970 coincident with massive increases in industrial nitrogen fixation for fertilizer production, just as the "Green Revolution" got started.

The effects of the high nitrogen inputs "were immediate, and no place in the Northern Hemisphere – not even the highest reaches of the Arctic – was safe," Elser stated.

One effect from the increased nitrogen inputs can be seen in our inland water features like lakes, reservoirs and rivers.

"Nitrogen deposition to lakes leads to phytoplankton (at the base of food chain) with low content of the important nutrient phosphorus," Elser said. "This is kind of like 'junk food,' for animals that eat the phytoplankton. Such effects are likely to ripple upward in the food chain."

"Overall, changes in nutrient regimes (due to human acceleration of the nitrogen and phosphorus cycles) cause various problems, but especially reduction in water quality, in water supplies and deterioration of coastal marine fisheries ('dead zones')," Elser added. "In the U.S., conservative estimates indicate that nutrient over-enrichment of inland waters results in about $2.7 billion of annual economic costs annually, due to negative impacts on recreational water usage, waterfront real estate values, the cost of recovery of threatened and endangered species and drinking water provisions."

On a grander timeline the effects could be more telling of humans

themselves, Elser said.

"Whether such signals are an ephemeral blip in the stratigraphic record or a sustained shift lasting millennia may, in due time, be seen as an indicator of humanity's success, or failure, in achieving planetary sustainability," he added.

Provided by Arizona State University