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BUILDING A SCIENTIFIC FOUNDATION FOR SOUND ENVIRONMENTAL DECISIONS



ECOSYSTEM SERVICES RESEARCH PROGRAM

RESEARCH FOCUSES ON NITROGEN AND ITS IMPACTS ON ECOSYSTEM SERVICES

Issue:

Reactive nitrogen is a pollutant of national and global significance because its use and impacts are widespread and increasing.

Nitrogen is one of life's essential nutrient elements. It is used to produce our food and crops to make the clothes we wear. The creation of reactive nitrogen by human activities has been approximately five-fold in the United States during the last century. This has resulted in both positive and negative effects. For example, the conversion of atmospheric nitrogen to fertilizers and fuel has greatly improved human nutrition and well-being across the globe.

Yet this explosion in the use of nitrogen has been accompanied by significant impacts on ecosystems and human health. The nitrogen released from combustion by motor vehicles and industry and by the application of fertilizers can run into

streams, rivers, and other water bodies. As a result, nitrogen can impact the quality of water, cause oxygen-depriving conditions such as hypoxia and result in algal blooms that can kill fish and other aquatic life.

Reactive nitrogen release also contributes to air quality problems such as the formation of ozone and particulates, which impair respiratory health for many people. Increasing nitrogen also threatens Earth's climate systems and protective ozone layer.

A new generation of observation and assessment tools are needed to inform decision makers about the trade-offs between the human well-being benefits of increasing reactive nitrogen and impacts on the environment and public health. The research will provide critical information for use by EPA, states, and partners to assessing alternative

approaches for improving air and water quality.

Science Objective:

EPA researchers are studying reactive nitrogen to assess its positive and negative impacts on the environment and public health.

Research is being done on the national and regional levels. The national effort includes contributing to a National Atlas of Ecosystem Services. This atlas (available in 2011) will be the roadmap that identifies many key ecosystem services and drivers in the country impacted by nitrogen.

At the regional level, research is under way to assess the costs and benefits of nitrogen in Tampa Bay, the Willamette Basin in Oregon, the coasts of North and South Carolina, and a 12-state region of the Upper Midwest. In each area, specific problems are being addressed such as the trade-offs between biofuel

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production and other ecosystem services, and impacts of nitrogen loading on different ecosystem types such as wetlands and streams.

Individual studies and efforts are being conducted to:

- Improve estimates of total atmospheric nitrogen deposition in the U.S.
- Determine removal of nitrogen by streams in the Upper Midwest
- Understand the relationship between nitrogen loading and impacts on ecosystem services in the Northeast and Gulf of Mexico
- Develop systematic approaches to quantify nitrogen removal by wetlands and riparian buffers, in coordination with the ESRP wetlands program
- Generate model outputs from the Nutrient Export from Watersheds model (NEWS) and compare these outputs with other nutrient models and tools used by EPA
- Compile the recent literature in *Nitrogen News*, a monthly summary of information related to

cycling, effects and management of nitrogen.

[<http://www.epa.gov/wed/pages/research/nitrogen/index.html>]

Application and Impact:

Nitrogen research is providing new data and tools for EPA and others that can be used to make decisions that will protect air and water quality, two vital services provided by ecosystems.

The research is advancing the ability to protect human health in many ways. Applications include:

- Directly supporting EPA's development of nitrogen oxide standards to protect air quality
- Supporting nutrient criteria development for the nation's lakes, streams, rivers, wetlands, and estuaries
- Guiding decisions on the development of load limits of nitrogen in waterways as part of EPA's regulations for Total Maximum Daily Loads (TMDLs)

- Contributing to development of best management practices for controlling nutrient pollution from non-point sources such as agricultural runoff

The research conducted by EPA is offering tools that will enable states, communities, and others to develop sustainable solutions to the use of ecosystem services. With the aid of science, good stewardship can be practiced to protect the environment and human health.

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