# Evaluation of changes in landscape loading of total nitrogen to U.S. waters using monitoring results from the National Aquatic Resource Surveys

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## Abstract

Spatially-representative monitoring and nitrogen input inventory allow for the assessment of large-scale management effects on stream total nitrogen (TN) concentrations in the conterminous US. We examined temporal and spatial variations in TN concentrations of streams at over 3000 spatially-balanced sample sites collected by the USEPA between 2000 and 2014. The national stream TN did not change significantly over time. Spatially, streams in the Central Plains had significantly greater TN than Western and Appalachian streams ($p<0.005$). Survey data will be combined with inventory and landscape data to model the response of streams to changes in landscape loading across the US.

Keywords: nitrogen, landscape characteristics, stream survey, N inventory

## 1. Introduction

Previous studies have found a positive correlation between net watershed total N (TN) inputs and stream TN concentrations. However, studies indicate that there can be time lags between the onset of reductions in N inputs and improvements in water quality, further complicating observed relationships between TN inputs and stream concentrations.

Extensive US national stream survey data in conjunction with watershed TN inventory and datasets of landscape characteristics (e.g., soil characteristics, wetland area, agricultural practices, etc.) provide a unique opportunity to address uncertainty about how current management and policy is altering water quality. Our goal is to evaluate how multiple factors interact to control stream TN concentrations, and to help determine whether changes in watershed N inputs lead to associated changes in water quality in the US.

## 2. Methods

Changes in US stream concentrations and watershed inputs are examined at different spatial scales over a period between 2000 and 2014. We relate stream TN concentration ([TN]) data from the USEPA's National Rivers and Streams Assessment (NRSA, 2000-2014) with TN loading data from published HUC8-level and further downscaled N inventories for the contiguous US.

Using linear models and random forests, we will examine the relative importance of other landscape factors

controlling the delivery of nitrogen to streams, including soil erodibility, local weather conditions, riparian and wetland area, tile drainage, and more.

## 3. Preliminary results

Between NRSA survey 1 (2000-2004) and survey 2 (2008-2009), there were proportionally more sites showing decreasing [TN] trends than increasing trends for the contiguous US (48% vs. 45%), and there were more sites with increasing [TN] (49%) than decreasing TN (42%) between survey 2 and the later survey 3 (2013-2014). However, the national stream [TN] did not change significantly between 2000 and 2014, consistent with the lack of a national trend in N inputs. Streams in the Central Plains had significantly greater [TN] than streams in the West and Appalachians, reflecting the pattern in N inputs for those areas. We also found a disconnect between changes in stream TN concentrations and changes in landscape TN inputs at the HUC-8 level. TN loading or inventory data at finer watershed scales are needed for better prediction.

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