Empirical critical loads for nitrogen for ecoregions of the United States: current and future

Pardo, L.H., Geiser, L.H., Fenn, M.E., Lynch, J.,

Background/Questions/Methods

Human activity in the last century has led to an exponential increase in nitrogen (N) emissions and deposition. This N deposition has reached a level that has caused or is likely to cause alterations and damage in many ecosystems across the United States. is the critical loads approach. The critical load, defined as the level of a pollutant below which no detrimental ecological effect occurs, is one approach for quantifying the level of pollution that would be harmful to ecosystems.

The objective of this project was to synthesize current research relating atmospheric N deposition to effects on terrestrial and aquatic ecosystems in the United States and to identify empirical critical loads for atmospheric N deposition where possible. The receptors that we evaluated included aquatic diatoms, mycorrhizal fungi and other soil microbes, lichens, herbaceous plants (forbs, graminoids), shrubs, and trees. The main responses reported fell into two categories: biogeochemical and soil microbial responses and individual, population, and community plant and lichen responses. Biogeochemical and soil microbial responses included increased N mineralization and nitrification, changes in microbial community structure (including shifts in the relative proportion of bacteria:fungi), increased gaseous N losses (ammonia volatilization, nitric and nitrous oxide from nitrification and denitrification), and increased N leaching. Plant and lichen responses included increased tissue N, physiological and nutrient imbalances, increased growth, altered root:shoot ratios, shifts in competitive interactions and community composition, increased susceptibility to secondary stresses, changes in species richness and other measures of biodiversity, increases in invasive species, and altered fire regime.

Results/Conclusions

The range of critical loads for nutrient N reported for U.S. ecoregions, inland surface waters, and wetlands is 1-39 kg N ha^{-1} y^{-1}. This broad range spans the range of N deposition observed over most of the country. The empirical critical loads for N tend to increase in the following sequence for different life forms: diatoms, lichens and bryophytes, mycorrhizal fungi, herbaceous plants and shrubs, trees.

The critical loads approach is an ecosystem assessment tool with great potential to simplify complex scientific information and effectively communicate with the policy community and the public.

The objective of this on-going analysis is to refine existing critical loads for nutrient N based on finer scale resolution of the biotic and abiotic factors that influence the critical load.

US Forest Service
705 Spear St
S. Burlington, VT 05403 USA
ph: 1-802- 951-6771 x1330 fax: 1-802-951-6368; e-mail: lpardo@fs.fed.us