Nitrogen deposition, catchment productivity, and climate as determinants of lake stoichiometry

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Limnol. Oceanogr., 54(6_part_2), 2009, 2520-2528 | DOI: 10.4319/lo.2009.54.6_part_2.2520

ABSTRACT: Nearly 1000 Norwegian lakes in catchments with low human activity were surveyed. By covering a wide range of nitrogen (N) deposition (0.1-2 g m^{-2} yr^{-1}) along a latitudinal and climatic gradient, we clearly demonstrate how nitrogen (N) deposition, climate, and a few key catchment properties, notably the terrestrial vegetation density and the fraction of bogs, together serve as major predictors of concentrations and ratios of carbon, nitrogen (N), phosphorus (P), and silicate (Si) in downstream lakes. Inorganic N in lakes was positively correlated with N deposition, while organic N was closely associated with allochthonous dissolved organic carbon. The ratio of NO3 to total N as well as NO_3 to total P and NO_3 to SiO_2 were highly variable, and most of this variability was explained by N deposition; terrestrial vegetation density, as inferred from the Normalized Difference Vegetation Index; temperature; runoff; and the fraction of bogs in the catchment. Climate-induced changes in element concentrations and elemental ratios could profoundly affect the lake metabolism and community composition. By linking these data with downscaled climate change predictions we may also predict future shifts in element export and element ratios in various lakes with reasonable accuracy.

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