

NITROGEN ISOTOPIC VALUES AS A PROXY FOR LAND USE PATTERNS IN THE CONNECTICUT RIVER WATERSHED: T.A. Douglas¹, C.P. Chamberlain¹ and R.R. Harrington¹, Department of Earth Sciences, Dartmouth College, Hanover, N.H. 03755 USA.

Introduction: Recently, nitrogen isotopic studies have been employed to quantify the extent of non-point source nitrogen contamination in natural waters [1,2]. Major nitrate sources include atmospheric deposition, nitrification of soils and snow, fertilizers and animal waste. Variations in ^{15}N have been successful in defining these sources in waters [3]. We present here results from an ongoing study of the effect of land use on the chemistry of the Connecticut River Watershed, USA. Nitrate concentrations and nitrogen isotopic ratios suggest nitrate in the watershed is directly related to land use practices.

Study Site: The Connecticut River watershed encompasses 15,750mi², stretching 383 miles from its source at the U.S.-Canada border south to Long Island Sound. 4.5 million people live within the river's drainage, with most concentrated in the lower third of the watershed. The Connecticut River begins in remote lakes surrounded by pristine hardwood forests. In southern New Hampshire and Vermont, the river travels through agricultural communities which rely on intensive use of fertilizers to produce corn and hay during the short growing season. The Connecticut River is ideally suited for a nitrogen isotope investigation because of these longitudinal differences.

Sampling and Land use Quantification: The entire Connecticut River watershed was sampled at 41 sites in August and December, 1998 and April, 1999. These three time periods constitute the major seasonal changes in the study area- summer to fall, fall to winter and winter to summer. The Connecticut River was sampled above and below eleven major tributaries which were selected for their representation of geology, land use, drainage population and areal extent. Tributaries were sampled in an attempt to quantify small scale changes in land use within the Connecticut River watershed. Maps from 1991 to 1993 LANDSAT thematic mapper images at 1:24,000 scale were checked with GIS land use cover data. Mapping classified the sample sites into four distinct land use patterns which are, from north to south: forest, mixed forest and agriculture, intense agriculture and dense population.

Results and Discussion: Nitrate-N was measured at each site using a LaMotte colorimeter [4]. $\text{NO}_3\text{-N}$ concentrations in the eleven tributaries are related to their land use classification (Figure 1). The highest nitrate concentrations are in waters from tributaries draining heavily populated watersheds. ^{15}N values of waters were measured using methods adapted from [5]. Results ^{15}N isotopic values from the White River in Vermont (Figure 2) suggest a linear correlation with the percent of agriculture. ^{15}N values increase from 2‰ in the forested catchments to 7‰ in catchments

draining lands categorized as 14% agriculture. Results from the nitrogen isotopic analyses indicate this study should be extended to tributaries in the Connecticut River which drain densely populated areas to further quantify the relationship between land use and non-point sources of nitrate.

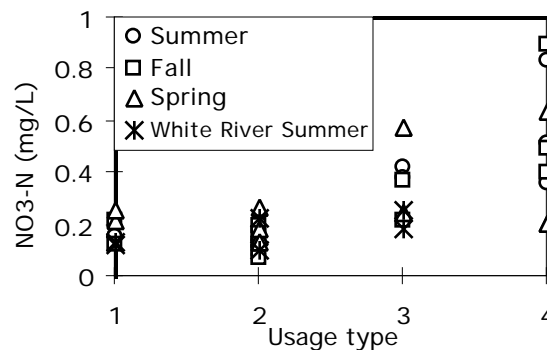


Figure 1: Nitrate-N concentrations (mg/L) vs. land use type for eleven catchments along the Connecticut River and six samples from the White River. 1= forest, 2= forest and agriculture, 3= agriculture, 4= dense population. White River samples from [2].

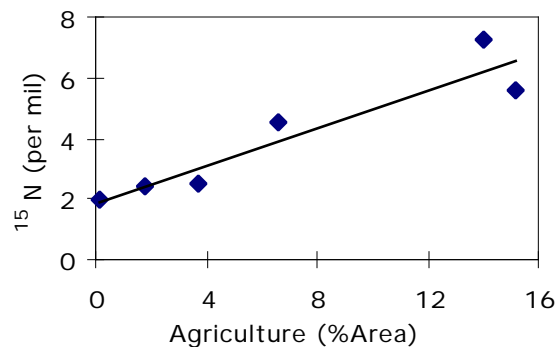


Figure 2: Average ^{15}N values of nitrate in stream water from the White River, Vermont. From [2].

References: [1] Ostrom N.E. et al. (1998) *Chem. Geol.*, 146, 219—227. [2] Harrington R.R. et al. (1998) *Chem. Geol.*, 147, 281—294. [3] Exner M.E. and Spalding R.F. (1994) *Appl. Geochem.*, 9, 73—81. [4] American Public Health Association (1989) *Standard Methods for the Examination of Water and Wastewater*, 17th ed. [5] Kendall C. et al. (1995) *International Association of Hydrological Sciences Publication 228*, p. 339—347.