

Using delta15N of Chironomidae as an index of nitrogen sources and processing within watersheds as part of EPA's National Aquatic Resource Surveys

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Nitrogen (N) removal in watersheds is an important regulating ecosystem service that can help reduce N pollution in the nation's waterways. However, processes that remove N such as denitrification are generally determined at point locations. Measures that integrate N processing within watersheds and over time would be particularly useful for assessing the degree of this vital service. Because most N removal processes isotopically enrich the N remaining, delta15N from basal food-chain organisms in aquatic ecosystems can provide information on watershed N processing. As part of EPA's National Aquatic Resource Surveys (NARS), we measured □ 15N of Chironomidae in lakes, rivers and streams because these larval aquatic insects were found in abundance in almost every lake and stream in the U.S. Using information on nitrogen loading to the watershed, and total N concentrations within the water, we assessed when elevated chironomid delta15N would indicate N removal rather than possible enriched sources of N. Chironomid delta15N values ranged from -4 to +20 ‰, and were higher in rivers and streams than in lakes (median = 7.6 ‰ vs. 4.8 ‰, respectively), indicating that N was processed to a greater degree in lotic chironomids than in lentic ones. For both, delta15N increased with watershed-level agricultural land cover and N loading, and decreased as precipitation increased. In rivers and streams with high synthetic N loading, we found lower N concentrations in streams with higher chironomid delta15N values, suggesting greater N removal. At low levels of synthetic N loading, the pattern reversed, and streams with enriched chironomid delta15N had higher N concentrations, suggesting enriched sources such as manure or sewage. Our results indicate that chironomid delta15N values can provide valuable information about watershed-level N inputs and processing for national water quality monitoring efforts.