

Temporal trends in nitrogen isotope ratios of winter flounder collected from Rhode Island coastal systems

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Nitrogen isotope ratios ($\delta^{15}\text{N}$) were measured in muscle tissue of juvenile winter flounder, *Pseudopleuronectes americanus*, collected from several estuarine systems along the coast of Rhode Island, USA, including Narragansett Bay, Narrow River and three coastal lagoons. Fish collections were made over two three-year periods ten years apart (2002-4 and 2012-14). Significant differences in $\delta^{15}\text{N}$ were observed among estuarine systems within each of the collection years. Nitrogen isotope ratios in the winter flounder were significantly positively correlated with human population densities in the watersheds of the estuaries. Within Narragansett Bay some unexpected trends in $\delta^{15}\text{N}$ were observed. During 2002-4 flounder from stations in the lower Bay had depleted $\delta^{15}\text{N}$ values as expected. However, $\delta^{15}\text{N}$ values for fish from the other Bay stations along a strong nutrient gradient were not different from each other except for the northernmost station with the highest nutrient concentrations which had a significantly lower $\delta^{15}\text{N}$ value than anticipated. During the decade between sampling periods several major wastewater treatment facilities in the Narragansett Bay watershed upgraded their treatment systems and significantly reduced nitrogen inputs. After the nutrient reductions, $\delta^{15}\text{N}$ values in the winter flounder at the northernmost station significantly increased and the $\delta^{15}\text{N}$ trend in the Bay now showed decreasing $\delta^{15}\text{N}$ values in fish collected along the Bay nutrient gradient as expected. Our hypothesis is that the depleted $\delta^{15}\text{N}$ values in the food web at the nutrient-rich northern areas of the Bay during 2002-4 were related to concentration-dependent fractionation at the base of the food web. Increased $\delta^{15}\text{N}$ values at that location during 2012-14 may indicate that lower nitrogen concentrations in this area reduced the degree of isotopic fractionation which led to higher isotope ratios in the winter flounder.

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