Consequences of large temporal variability of zooplankton d15N for modeling fish trophic position and variation

Matthews, Blake, Asit Mazumder

Limnol. Oceanogr., 50(5), 2005, 1404-1414 | DOI: 10.4319/lo.2005.50.5.1404

ABSTRACT: We use a temporal integration model (TIM) to determine how estimates of trophic variation, using δ'⁵N, depend on consumer growth dynamics and temporal isotopic variation (δ'⁵N) of food sources. Consumers are rarely in isotopic equilibrium with their food sources, so instantaneous comparisons between the δ'⁵N of a consumer and its diet provide little information about trophic variation, even if the trophic positions of the diet are known. In this paper, we focus on the trophic link between zooplankton and planktivorous fish. We first review the extent of temporal variability of zooplankton δ'⁵N, then examine the consequences of this variability for understanding the isotopic composition of planktivorous fish communities. We use time series of δ'⁵N for *Daphnia*, calanoid copepods, and particulate organic matter (>200 mm) to generate theoretical diets for a model juvenile sockeye over a typical growing season. We use a TIM to predict the isotopic trajectory of individual juveniles feeding on these diets and explore how variance in growth rate and isotopic enrichment (Δ_{sm}) can affect estimates of trophic position and intrapopulation isotopic variability. In general, we found that using a seasonal average of Daphnia δ'⁵N to estimate the trophic position of planktivorous fish is nearly equivalent to using a TIM. However, temporal variation in the δ'⁵N of food sources, coupled with individual differences in the growth rate of consumers, can contribute to intrapopulation isotopic variation of consumers and lead to correlations between consumer size and δ'⁵N.