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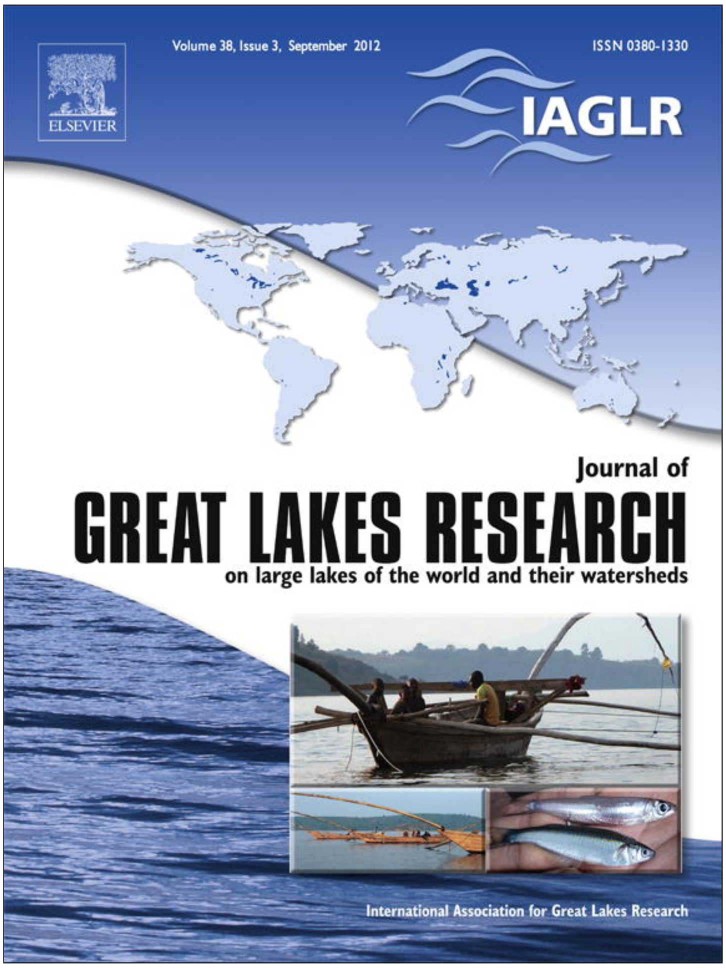

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Commentary

Interpreting stable isotope patterns with depth: A comment on Riley et al. (2011)

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In their recent article, Riley et al. (2011) discuss isotopic differences between adult female lake whitefish collected from lakes Michigan, Huron and Superior and how those differences relate to potential differences in habitat use. In their discussion, the authors interpret their isotopic evidence as indicating a greater reliance on near shore resources for lake whitefish collected in Lake Huron compared to those collected from Lake Michigan. While this analysis forms only one component of their paper, their interpretation of this component is incorrect and difficult to support without consideration of appropriate isotopic baselines.

A number of published studies have demonstrated clearly that benthic prey available to lake whitefish have carbon isotopic signatures that become depleted (i.e., more negative) with depth of collection (Vander Zanden and Rasmussen, 1999; Sierszen et al., 2006). Similar observations for benthic invertebrates collected from South Bay, Lake Huron were used as a baseline to help interpret enrichment in lake whitefish carbon stable isotope signatures over time as evidence of a greater reliance of lake whitefish on nearshore resources following the establishment of dreissenids (Rennie et al., 2009). Thus, lake whitefish feeding in deeper habitats should display more depleted carbon signatures. Though Riley et al. (2011) observe in their results that "Isotopic carbon signatures (δ^{13}C) were significantly more ^{13}C depleted in lake whitefish from Lake Huron than from Lake Michigan" (page 734), they contradict this observation by concluding in their discussion that "…lake whitefish in Lake Huron tend to feed in more near shore environments than those in Lake Michigan as indicated by the more enriched δ^{13}C signatures of fish from Lake Huron" (page 735).

To be sure which is the correct conclusion, I digitized the stable isotope data presented by Riley et al. (2011) in their Fig. 1 (while the caption of the figure indicates that these are stable isotope signatures of lake whitefish eggs, the isotopic signatures are actually for adult female lake whitefish; S. Riley, personal communication). The mean (±1 standard error) carbon isotopic signature for Lake Huron lake whitefish was −22.2‰ (±0.3‰), compared to −19.5‰ (±0.4‰) for Lake Michigan lake whitefish. Based on these data, Lake Huron lake whitefish δ^{13}C are depleted by nearly 3‰ compared to those from Lake Michigan. This is the pattern correctly noted by the authors in their results. It is therefore the contradictory observation in their discussion that Lake Huron lake whitefish are more enriched in δ^{13}C that is incorrect, as are the conclusions drawn from this incorrect statement (e.g., that they show evidence of a greater reliance on near shore feeding in Lake Huron fish compared to those in Lake Michigan).

Even without the contradictory statements in their discussion, conclusions by Riley et al. (2011) regarding differences in resource use between Lake Huron and Lake Michigan based on lake whitefish δ^{13}C are unsupported. Baseline isotopic carbon signatures can vary greatly among lakes, even within taxa (Foster and Sprules, 2010). To interpret isotopic differences between lakes as indicative of differences in resource use, Riley et al. (2011) make an unstated (and untested) assumption that lake whitefish from both lakes have similar isotopic baselines (i.e., the isotopic signatures of their prey are identical over depth in both lakes). Riley et al. (2011) do present data that show the range of values for dreissenids encountered in Lake Huron and Lake Michigan (both references to unpublished data) were similar. It might be argued that this similarity in ranges provides evidence for similar isotopic baselines between the lakes. However, Riley et al. (2011) provide isotopic evidence that indicate the whitefish in their study are, in fact, not feeding on dreissenids, thus making them an impractical organism for use as a dietary baseline for whitefish. In addition, differences (or lack thereof) are not statistically evaluated on ranges, but rather means, medians and standard errors. No statistical evaluation of differences between Lake Huron and Lake Michigan dreissenid isotope values were presented by Riley et al. (2011). Lastly, the depths of collection of dreissenids for the reported isotopic ranges are not given, so the influence of depth of collection on dreissenid isotopic signatures (e.g., Rennie et al., 2009) cannot be evaluated. Differences in depths of collection between lakes could also influence reported dreissenid isotopic values. While isotopic values of benthic prey will vary with depth, the slope and intercept

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of those relationships may differ between lakes. Evaluating differences between isotopic baselines when comparing or combining data across lakes (as in Riley et al., 2011) is necessary to avoid potentially spurious conclusions.

Finally, Riley et al. (2011) cite papers demonstrating a near shore shift in the distribution of lake whitefish in support of their interpretation of isotopic results. But, the authors do not present any data regarding changes in isotopic signatures of lake whitefish over time. How changes in lake whitefish distributions with time in lakes Huron and Ontario inform the isotopic differences between lakes Huron and Michigan presented in their paper is unclear.

While Riley et al. (2011) present compelling evidence that low thiamine concentrations in lake whitefish eggs are unrelated to the consumption of dreissenids, a common diet item of Great Lakes lake whitefish that has been shown to be high in thiaminase (Tillitt et al., 2009), their conclusions regarding differences in habitat use between lake whitefish in lakes Huron and Michigan are not supported by their isotopic data.

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