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Using stable isotopes to estimate habitat-based risk of contaminant exposure in fish

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Abstract

Sediment contamination is a common threat to sustainability in coastal ecosystems. For fish, the risk of exposure to contaminants will vary with respect to life history, including movements between contaminated inshore and less impacted offshore areas, trophic level, and habitat use. Stable isotopes can provide information on all these aspects of fish life history. The objectives of our study were 1) to determine the prevalence of microscopically-verified skin and liver tumors throughout a coastal tributary impacted by legacy contaminants, and 2) to evaluate fish tumor risk in terms of habitat usage as indicated by carbon (C) nitrogen (N) stable isotope analysis. Our case study was conducted in the St. Louis River, the largest U.S. tributary to Lake Superior and the largest “freshwater estuary” in the Great Lakes. The estuary has a mix of historical and current industrial impacts. We studied white sucker (Catostomus commersoni); they have been widely used as an indicator species for contaminant effects monitoring and are abundant and widespread within the St. Louis River. Skin and liver neoplasms both were present in 4.5% of breeding adult white sucker. The stable isotope data revealed that most white sucker were resident in the river and only a few were migrating to Lake Superior. Based on logistic regression, habitat usage was a significant predictor of tumor incidence. Further, a similar habitat use pattern was observed among fish with skin or liver tumors. Fish that obtained more than half their diet from the most polluted portion of the estuary had a risk of tumor incidence about twice as high as fish that fed elsewhere. We conclude that the stable isotope analysis was useful for identifying a sub-group of white sucker with a high risk of tumor incidence.