

Abstract

1. Stable isotope mixing models are increasingly used to quantify contributions of resources to consumers. While potentially powerful tools, these mixing models have the potential to be misused, abused, and misinterpreted. Here we draw on our collective experiences to address the question: what are the major challenges to the effective application of such mixing models?
2. Mixing models have increased rapidly in sophistication. Models using a Bayesian framework to estimate probability distributions of source contributions, have been published with user-friendly interfaces, and can now incorporate important complexities such as variability in isotope signatures, diet-tissue discrimination factors, hierarchical variance structure, covariates, and concentration dependence. While these advances hopefully have provided novel insights, they still need to be properly implemented.
3. For the effective application of mixing models, we offer the following suggestions. First, mixing models can only be as good as the study and the data. Studies should have a clear question, be informed by knowledge of the study system, and have a strong sampling design to effectively characterize isotope variability of consumers and resources on proper spatial and temporal scales. Second, studies should use a mixing model that is an appropriate tool for the question and recognize the assumptions and limitations of the tool. Decisions such as the grouping of sources or the incorporation of concentration dependence can influence results. Third, studies should be careful about the interpretation of model outputs. Mixing models generally estimate proportions of assimilated resources with substantial uncertainty distributions. Last, a heavy dose of common sense, such as graphing the data before analyzing, can go a long way to getting the most out of these tools.
4. We hope that these suggestions for the effective implementation of stable isotope mixing models will aid the continued development and application of this field.