

Diet analysis using generalized linear models derived from foraging processes using R package mvtweedie

Diet analysis integrates a wide variety of visual, chemical and biological identification of prey. Samples are often treated as compositional data, where each prey is analyzed as a continuous percentage of the total. However, analyzing compositional data results in analytical challenges, e.g., highly parameterized models or prior transformation of data. Here, we present a novel approximation involving a Tweedie generalized linear model (GLM). We first review how this approximation emerges from considering predator foraging as a thinned and marked point process (with marks representing prey species and individual prey size). This derivation can motivate future theoretical and applied developments. We then provide a practical tutorial for the Tweedie GLM using new package `mvtweedie` that extends capabilities of widely used packages in R (`mgcv` and `ggplot2`) by transforming output to calculate prey compositions. We demonstrate this approach and software using two examples. Tufted puffins (*Fratercula cirrhata*) provisioning their chicks on a colony in the northern Gulf of Alaska show decadal prey switching among sand lance and prowfish (1980-2000) and then Pacific herring and capelin (2000-2020), while wolves (*Canis lupus ligoni*) in Southeast Alaska forage on mountain goats and marmots in northern uplands and marine mammals in seaward island coastlines.