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Stable Carbon and Nitrogen Isotope Variability of Bone Collagen to Determine the Number of Isotopically Distinct Specimens

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Abstract

Archaeological and palaeontological excavations frequently produce large quantities of highly fragmentary bone. These bones can help to answer questions regarding past environments and human and animal lifeways via a number of analytical techniques but this potential is limited by the inability to distinguish individual animals and generate sufficiently large samples. Using stable carbon and nitrogen isotope values of bone collagen ($\delta^{13}C$, $\delta^{15}N$), we present a metric to identify the number of isotopically distinct specimens (NIDS) from highly fragmented faunal assemblages. We quantified the amount of intra-individual isotopic variation by generating isotopic data from multiple elements from individual animals representing a wide variety of taxa as well as multiple samples from the same skeletal element. The mean intra-individual variation (inter-bone) was 0.52‰ ($\sigma = 0.45$) (Euclidean distance between two points in isotopic bivariate space), while the mean intra-bone variation was 0.63‰ ($\sigma = 0.06$). Using archaeological data consisting of large numbers of individual taxa from single sites, the mean inter-individual isotopic variation was 1.45‰ ($\sigma = 1.15$). We suggest the use of 1.50‰ in bivariate ($\delta^{13}C$, $\delta^{15}N$) space as a metric to distinguish NIDS. Blind tests of modelled archaeological datasets of different size and isotopic variability resulted in a rate of misclassification (two or more elements from the same individual being classified as coming from different individuals) of $< 5\%$.

Keywords Zooarchaeology · Isotopic variability · Bone turnover · Identifying distinct individuals · NISP

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