

Using GIS To determine the effects of two common taphonomic biases on vertebrate fossil assemblages

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ABSTRACT

Paleoecological statistics calculated for fossil assemblages are often influenced by biases that may act at more than one scale. These biases are difficult to detect without an overarching method that can accommodate the spatial attributes of fossil specimens. Geographic Information Systems (GIS) can be used to manage, analyze, synthesize, and archive large amounts of paleontological data within a geospatial framework. This study uses GIS to test the impact of variation in sampling area and rate of sediment accumulation on two commonly employed paleoecological statistics—species richness and relative body size. Mammals of the Willwood Formation (early Eocene) from the central part of the Bighorn Basin, Wyoming, USA, serve as a test case. Fossil localities outlined on U.S. Geological Survey topographic maps were digitized and GIS was used to estimate their two-dimensional areas. This metric was compared directly with species richness to test sampling area bias and also was used to calculate the density of species per unit area, which could be compared among various samples. Tests were constructed to examine variation at the locality scale and across the basin. Results of the analysis of the sampling area bias showed that species richness increased significantly with increasing sampling area and that rarefaction, the commonly used method of standardizing richness, did not remove the sampling area-richness relationship when the magnitude of area variation was $> \sim 1 \text{ km}^2$. Results of the analysis of compositional variation related to changes in rate of sediment accumulation showed that locality-scale changes did not have a significant influence on assemblage composition.