

Introduction.

My objective is to test whether fossil evidence of transitional bats (order Chiroptera) in North America can be predicted by integrating paleontological and stratigraphic data. Modern bats are an incredibly diverse taxon, but discerning evolutionary relationships between bats and other extant mammals is difficult and potentially unreliable without fossil evidence (Sears et al. 2005, Gunnell and Simmons 2005). An important step in advancing the study of prehistoric life is increasing the reliability and precision with which scientists can locate fossils evidence; in the past, this process has been largely guesswork (Oheim 2007). I hypothesize that the presence of transitional fossil forms representing primitive bat lineages can be found through this multidisciplinary approach.

Justification.

Despite decades of research, the origin of Chiroptera remains unclear (Thewissen and Babcock 1992, Simmons et al. 2008). Morphological and genetic analyses support the conclusion that bats are monophyletic (Gunnell and Simmons 2005, Simmons et al. 2008), but their evolutionary relationship with other mammals is, as of yet, undetermined. The primary reason for this is simple: intermediate forms between bats and more primitive mammalian ancestors have not been found in the fossil record (Gunnell and Simmons 2005, Simmons et al. 2008). The first bats to appear as fossils already have the complex and derived traits associated with flight and, in many cases, echolocation as well (Gingerich 1987, Simmons et al. 2008, Hand et al. 2015), although echolocation apparently developed after flight (Simmons et al. 2008). In order to determine how these derived traits evolved, paleontologists must attempt to fill in gaps in the depauperate bat fossil record (Eiting 2009). However, extensive efforts to predict where such fossils may be found has not been carried out. More sophisticated predictive modelling of sites where fossils are likely to be found should have huge payoffs in the study of Chiroptera and other extinct taxa. This study offers significant benefits even if no fossils are ever found, because a refined approach to fossil hunting using stratigraphic paleobiology and geography is necessary to answer numerous other unsolved questions in the study of extinct life. In particular, this study furthers exploration into uncommon terrestrial vertebrates, an underrepresented fauna in the current fossil record.

Research Plan.

I will use the distribution of known bat fossil occurrences in the Paleontology Database to determine where temporal gaps in the Chiroptera fossil record are present. For example, because superficially modern-looking bats are found in late Paleocene and Eocene deposits, transitional forms might be found in early Paleocene or late Cretaceous strata. Stratigraphically relevant data from the Paleontology Database, as well as the MacroStrat Database, will be used to determine where deposits of the appropriate age are exposed, and where the depositional environment

would be suitable for bat preservation. After that, I will use GIS data of those sites to produce a suitability matrix determining where within promising deposits fossils are likely to be found, based on metrics such as terrain accessibility, vegetation coverage, and elevation. Fieldwork will be conducted in the summer of 2017. Teams of undergraduate volunteers and I will travel to each site for which transitional fossils are predicted by the above analyses and establish search images and prospect for fossils, if possible. Special emphasis will be placed on deposits and geographic areas that have already produced fossil bats.

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