REASSESSING MIDDLE AND INNER EAR MORPHOMETRICS AS PREDICTORS OF AUDITORY CAPABILITIES IN REPTILES

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ABSTRACT

Hearing, which facilitates the localization of sound and perception of acoustic communication, is directly measurable in living reptiles, but must be indirectly inferred in extinct taxa from morphological proxies. Current proxies utilize only measurements of the inner ear and did not use phylogenetic statistical approaches. Here, we use phylogenetic least squares regressions incorporating morphometrics of the middle and inner ears of extant reptiles (endosseous cochlear duct length, oval window area, round window area, ratio of oval and round window areas) to predict hearing acuity (best hearing range, sensitivity, minimum, and maximum hearing frequency). We use measures of hearing acuity obtained from audiograms and X-ray Computed Tomography data from a sample of 56 reptile taxa to develop a model for all reptiles, and a subset of this dataset to develop Aves-specific (n=25) and Lepidosauria-specific (n=27) models. The best-fitting models, assessed through AICc, were used in predicting the hearing acuity of a sample of extinct reptiles. We find differing clade-wise relationships among ear measures and hearing, with models including middle ear values performing best in all models suggesting different scaling relationships between tetrapod clades. We find that middle ear morphometrics can successfully predict hearing range, best frequency, and minimum and maximum frequencies. In using these models to predict hearing in three extinct taxa, we recover significant differences between the hearing estimates of this study and those of previous proxies, with both *Tyrannosaurus rex* and *Archaeopteryx lithographica* having lower predicted best hearing and maximum frequencies. The proxies developed through this study will allow for more accurate estimates of hearing and a better understanding of hearing shifts in deep time.

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