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"A comparative outlook of 2D vs 3D Geometric Morphometrics in the Virginia Opossum"

Quantifying morphology is a critical component of a variety of fields including evolutionary biology, medicine, anthropology, conservation biology, among others. A commonly used approach to statistically characterize the shape of anatomical structures is geometric morphometrics (GM). The data gained from using GM provides information on shape variance that can be quantified in both two-dimensions (2D) and three-dimensions (3D). 2DGM is performed using still images of a single plane of a structure (e.g., the ventral aspect of a series of skulls). 3DGM is done using photogrammetry, computed tomography, or with laser surface scanners. The primary difference between 2D and 3DGM is that 2DGM flattens the structure into a single plane, eliminating information in the z-axis. 2DGM is also generally less expensive because it only requires a camera, while 3DGM can be cost-prohibitive. As a result, it is important to know how well 2D data approximate 3D shape.

To access the impact of the z-dimension on shape analyses, we performed 2D and 3DGM analyses on the same set of Virginia opossum (*Didelphis virginiana*) crania. The crania were first photographed in ventral view and then laser surface scans of the skulls were taken. The results from the study indicated high correspondence between the 2D and 3D data gathered. In 2D, the main axis of shape variation was largely driven by size. The driving force of the difference appeared to reside in the basicranial and molar region where these regions were expanded in larger specimens and contracted in smaller specimens. In 3D, this observation was also apparent across the specimens, but the z-dimension provided height information that was especially pronounced in small and large specimens. Evaluating 2D and 3D shape compared to size showed that the 3D shape data were less related to size particularly in smaller and larger specimens. When examining 2D and 3D shape using partial least squares analysis, we found that 2D and 3D landmark configurations were significantly correlated and had a high correlation coefficient. The results of this study support the claim that 3DGM provides more information than 2D but may not be necessary for many studies. Due to this, using a subsample to determine the method of choice could conserve time and cost related to obtaining data for GM studies. In many cases, 2DGM may adequately characterize shape rendering the increased cost of 3DGM unnecessary.