

**Using simple body-size metrics to estimate fossil body volume: Empirical validation
using diverse Paleozoic invertebrates**

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ABSTRACT

Body size is one of the most significant organismal characteristics because of its strong association with nearly all important ecological and physiological characteristics. While direct body mass measurement (or estimation from other size metrics) is not feasible with most extinct taxa, body volume is a measurable and general proxy for fossil size. This study explores the reliability of several metrics that can be used to estimate the body volume of Paleozoic invertebrates of various sizes, shapes, taxonomic affinities, and ecological habits. The ATD model, based on the product of lengths of the three major body axes (anteroposterior, transverse, and dorsoventral), is simple and widely applicable. Models specific to particular morphological and taxonomic groups are slightly more accurate than this ATD model, but the advantages are minor. The ATD model is consistent with previous studies demonstrating widespread shape allometry—that is, small taxa tend to have globose geometries while large ones tend to be conical, even within the same taxonomic group. The ATD model successfully predicts the volume of 10 validation samples that were excluded from development of the original model. Because the linear measurements used to estimate volume are easy to obtain from specimens in the field or from published work, estimates of body volume can be incorporated into paleontological analyses, even those spanning multiple phyla.