

## Use of Elliptical Fourier Analysis to Determine Morphospace Occupation in Modern Edentulous Mussels to Help Identify “Natural” Limits of Fossil Groups

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The probability that poorly preserved or “catch-all” fossil taxonomic groups represent real clades can be tested by examining the morphospace occupation of modern models occupying the same habitat/niche and possessing similar morphology.

Elliptical Fourier Analysis (EFA) was performed on outlines of left and right valves of 1) nine edentulous modern freshwater mussel genera and 2) representative specimens from the Das Goods (Locality L6516) molluscan fossil assemblage. Synthetic shapes were used to quantify error introduced into the EFA results due to manual digitization of valve outlines; manual rather than automatic digitization was necessary due to preservational issues and the need to keep methods constant.

EFA produced 22 scores per specimen. Two statistical methods were employed to describe the size of the 22-dimensional morphospace occupied by 1) selected modern freshwater mussel genera (Superfamily Unionoidea) and 2) representative specimens from the Das Goods molluscan fossil assemblage. Morphological variation (MV) was calculated as the sum of the variances (or the trace of the variance-covariance matrix) in a particular group (genus). Within-group dispersion (WD) was calculated as the mean pairwise Euclidean distance between all specimens in a group.

The MV of modern genera varied from 0.0009 (95% confidence interval 0.0008 to 0.0011) to 0.0061 (95% CI 0.0038 to 0.0095), mean 0.0035. WD varied from 0.0427 (95% CI 0.0421 to 0.0434) to 0.1057 (95% CI 0.1045 to 0.1068), mean 0.0790. MV and WD of modern genera ranked from most to least morphospace occupied: *Anodontites*, *Anodonta*, *Pyganodon*, *Gonidea*, *Strophitus*, *Anodontoides*, *Utterbackia*, *Simpsonaias*, and *Pilsbryoconcha*. MV of L6516 specimens (N=27) was 0.0041 (95% CI 0.0026 to 0.0059); WD 0.0890 (95% CI 0.0871 to 0.0910), suggesting this assemblage falls within natural generic variation.

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