## Trait data: A shell classification system for North American Mussels

To develop a classification system that captures interspecific variation of several morphological traits we compiled a dataset derived from specimen measurements and calculated median values. We measured shell height (maximum distance dorsal to ventral), length (maximum distance anterior to posterior) and width (maximum distance across valves) to the nearest decimal point (0.1 mm). We recorded dry shell mass by weighing both valves to the nearest decimal point (0.1 g). We used median values and not averages as they are less biased to skewed data (e.g., size outliers). We then calculated height: length, width: length, width: height, and mass: length ratios. Ratios allow us to standardize measurements across sizes and reflect geometric shape differences. To get a quantitative measurement of shell outline we measured the distance between the shell center and equidistant points along the shell edge in ImageJ (Schneider et al. 2012) using representative pictures of each species obtained from MolluscaBase (“MolluscaBase” 2023). We then calculated standard error (STE) of outline distance to center within an individual. This metric allows to assess overall variation in the shell outline and have a quantitative gradient of previously used shape descriptions (e.g., triangular, elliptical, rectangular). For example, a perfect circle would have an STE of 0 while an elliptical shape would have much greater variation.

We used categorical sculpturing variables modified from the Watters (Watters 1994) classification including: unsculptured, winged, ridged, pustuled or plicated (Figure 1) and assigned numbers (1-5) based on the sculpturing gradient. As we specifically focused on what type of structure was present, this variable included only the type of sculpturing and not the position throughout the shell as depicted in the previous classification. We scaled our variables using the *scale* function to eliminate bias caused by differing scales and variances. We selected the variables that were not highly correlated (R2 <0.6) and provided representative and complete information for mussel shape, size and sculpturing to create a hierarchical classification tree with the Ward distances method using the ‘R’ package ‘Vegan’ (Oksanen et al. 2019) and ‘Nbclust’(Charrad et al. 2014)and the function *hclust*. We selected the optimal number of clusters using the Duda-Hart stopping rule, a statistical index that measures the separation between clusters and is calculated by dividing the sum of squared errors within the two resulting clusters by the sum of squared errors within the original data until the model fit does not improve (Clarke et al. 1973). Additionally, we performed a principal component analysis (PCA) to further visualize distances among the classified species and obtain not just categorical classes, but a continuous gradient of morphological traits.