What features are reliable for species designations?

Methods

All 203 Naraoia specimens in the U.S.N.M. Collection were examined (Zhang et al. 2007). A decay series (Fig. 1) was constructed from the available range of preservation in the collection. The taphonomic index semi-quantitatively assesses the preservational state of each individual. This series approximates a decay scale, which was compared to other notable characteristics such as body size, orientation to bedding plane, and preservation of genal spines, diverticula, caeca, gut, and appendages.

Results and Discussions

Apatite is a principal mineral in Burgess Shale fossils, which requires sufficient phosphate to inhibit the production of calcite or aragonite. Decomposition will typically produce enough phosphorous to stimulate precipitation of apatite (Briggs 2003). The lack of correlation between body size and decay (Fig. 3 left) suggests that Naraoiids were not large enough to greatly influence the production of apatite. As such characters associated with body size, legs, gut, presence (or) of diverticula and caeca are less influenced by decay.

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Further Results and Conclusions

Specimens show a trend with high preservation concentrated near the upper margins, validating the decay series and revealing a decay-influenced region. Characters within the decay-influenced region are taphonomically biased, supporting our previous results (Fig. 3-4). We originally hypothesized that molts and highly decayed individuals would be indistinguishable. However, our NMDS ordination isolates molts from other decay-influenced characters. Molts are also negatively correlated with the presence of legs, supporting their validity.

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Specimens from U.S.N.M. 57687, 57688, 83945D, 235842, 235843, 235845, 235847, 235853, 235862, 241035, 241037 were examined. The decay series shows the range of preservation within the Naraoiidae, with high variation in anterior shield shape influenced by the orientation of the specimen in reference to the bedding plane (Fig. 4 left). Oblique specimens were typically poorly preserved (Fig. 4 right), possibly due to higher exposure to scavenging, diffusion of mineral producing ions, or hidden and distorted structures (Briggs 2003). Consequently, overall shape is highly influenced by decay and orientation in substrate, and should not be used in species designation.