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Experimental taphonomy and the anatomy and diversity of the earliest fossil vertebrates (Chengjiang Biota, Cambrian, China)

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The oldest fossil vertebrates are from the Lower Cambrian Chengjiang biota of China, which contains four genera of fish-like, primitive vertebrates: *Haikouichthys*, *Myllokunmingia*, *Zhongjianichthys* and *Zhongxiniscus*. These fossils play key roles in calibrating molecular clocks and informing our view of the anatomy of animals close to the origin of vertebrates, potentially including transitional forms between vertebrates and their nearest relatives. Despite the evident importance of these fossils, the degree to which taphonomic processes have affected their anatomical completeness has not been investigated. For example, some or all might have been affected by stemward slippage – the pattern observed in experimental decay of non-biomineralised chordates in which preferential decay of synapomorphies and retention of plesiomorphic characters would cause fossil taxa to erroneously occupy more basal positions than they should. This hypothesis is based on experimental data derived from decay of non-biomineralised chordates under laboratory conditions. We have expanded this analysis to include a broader range of potentially significant environmental variables; we have also compared and combined the results of experiments from several taxa to identify general patterns of chordate decay. Examination of the Chengjiang vertebrates in the light of these results demonstrates that, contrary to some assertions, experimentally derived models of phylogenetic bias are applicable to fossils. Anatomical and phylogenetic interpretations of early vertebrates that do not take taphonomic biases into account risk overestimating diversity and the evolutionary significance of differences between fossil specimens.