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Patterns, processes and geological biases in the fossil record of jawless vertebrates at the time of jawed vertebrate origins

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The dominance of the jawed vertebrates over their jawless vertebrates in the Middle Palaeozoic represents a landmark evolutionary event in the history of vertebrates and a potential episode of competitive replacement. The timing and nature of the origin, radiation and extinction of each of the relevant clades of stem- and crown- gnathostomes is not, however, well understood. Here, stratigraphic, phylogenetic and palaeoenvironmental data for the closest relatives of jawed vertebrates (Osteostraci, Galeaspida and Thelodonti) are analysed. The Osteostraci and Galeaspida are restricted to shallow-water environments, and as such, are subject to facies biases resulting from sea-level change. Confidence intervals calculated upon the basis of non-random models of fossil recovery in light of sea-level changes stretch the potential origins of Osteostraci and Galeaspida into the Upper Ordovician, and are thus more compatible with phylogenetic schemes. Diversity changes through time for the Osteostraci, Galeaspida and Thelodonti were found to lie within the expected limits predicted from estimations of fossil record quality indicating that it is geological factors rather than biological that are responsible for apparent patterns. The relative demise and eventual extinction of ostracoderms during the Mid-Late Devonian is suggested to result from their inability to adapt to changing environmental conditions and their limited geo-dispersal ability rather than competition with their more generalist and cosmopolitan jawed relatives.