# New research highlights influence of intraspecific variability on biodiversity studies

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Reconstruction of the study object, Erbenoceras from the Early Emsian (Early Devonian) of Morocco. Credit: Christian Klug

(Phys.org)—A study of around 100 newly collected specimens of early ammonoids (marine invertebrates with distinctive coiled shells) suggests that the number of species they belong to might have been over-estimated due to the large variability in size and shape within each species.

Recognizing this intraspecific variability is important for biodiversity studies as failing to do so might artificially inflate the number of species known from a certain time or place.

Like dogs and various other organisms, ammonoids – a group of

externally shelled cephalopods related to *Nautilus*, squids and octopods – show extremely large ranges in intraspecific variability in size and shape.

They have often been used to study changes in biodiversity, biogeography and extinction events in Earth history due to their high taxonomic and ecological diversity, wide geographic distribution, high evolutionary rates and preservable shell, as well as their successful evolutionary history on the Earth for over 300 million years. They survived multiple mass extinction events, only to go extinct together with the dinosaurs at the end of the Cretaceous.

Dr Kenneth De Baets of the University of Bristol, with Dr Christian Klug (University of Zürich) and Dr Claude Monnet (University of Lille), studied the intraspecific variability through ontogeny (development of an organism) in early ammonoids, which has rarely been attempted before. Ammonoids are ideal for this type of study as they hold a record of growth from embryo to adult in their accretionary shell.

Dr De Baets said: "It took more than three years to collect and prepare around 100 Devonian ammonoid specimens from the same geological layer in the same region of Morocco."

Dr Kenneth De Baets holding a full-grown manticoceratid (Manticoceras) from the Late Devonian of Morocco, one of the largest known ammonoids from this time. Credit: Christian Klug

The earliest ammonoids (Anetoceratinae) are known from the Early Devonian and are still loosely coiled with whorls not, or only partially, in contact. A fairly high number of genera (eight) and species (twenty-four) of Anetoceratinae have been defined, which might be due to considerable intraspecific variability in conch geometry and rib spacing.

Dr De Baets's study, published in *Paleobiology*, could quantitatively demonstrate a large intraspecific variability in ribbing and shell shape in these early ammonoids. Only two species could be separated rather than the four previously recognized in Morocco and the range of multiple, previously defined, global species fell within the range of a single species. Hence, the number of currently valid species of ammonoids is probably much too high in the Devonian and in general. Despite this large intraspecific variability, different species could still be separated using their entire ontogeny.

This is important because underestimating or ignoring intraspecific variability can lead to 'taxonomic oversplitting' where specimens that are actually of the same species are identified as belonging to different species. This significantly biases taxonomy and diversity counts. For example, the effect of the Frasnian-Famennian extinction, one of the Big Five mass extinctions in Earth history, on ammonoids might have been significantly overestimated as it is based on the diversity of manticoceratids like Manticoceras, an extinct genus of ammonoid, which was artificially inflated by oversplitting.

Dr De Baets, now a Swiss National Science Foundation (SNF) postdoctoral fellow at the University of Bristol, said: "Our study does not only demonstrate the need to integrate intraspecific variability to avoid artificial fluctuations of diversity in ammonoids, but also more generally in all other fossil groups."

**More information:** De Baets, K. et al., Intraspecific variability through ontogeny in early ammonoids. *Paleobiology*. www.bioone.org/doi/abs/10.1666/0094-8373-39.1.75

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