Detecting the effect of past biotic interactions and climate changes on phenotypic evolution

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Résumé

Understanding the role of biotic interactions in shaping phenotypic evolution over macroevolutionary timescales remains a key challenge. While many verbal hypotheses exist about the influence of interspecific competition on trait evolution and its interplay with abiotic factors like climate, quantitative assessments are still limited. Fossil data, increasingly recognized as essential for reconstructing deep-time evolutionary dynamics, offer critical insights into these processes. Here, we present a new phylogenetic comparative framework designed to detect the influence of interspecific competition on trait evolution, and its potential interaction with climate. Through a simulation framework, we show that including fossil data is necessary to detect part of those effects, especially for the most complex developed models. We use our approach to evaluate the hypothesis that traits linked to resource use are more likely to be shaped by competition over long timescales, whereas other traits like body size evolution would more closely follow climatic trends. To test this, we applied our approach to two datasets containing both extant and fossil species: North American canids and equines, both of which include traits related to diet and body size. Our results show that resource-use traits were more consistently influenced by inter-specific competition, while body size followed different evolutionary patterns-being shaped by competition in canids but evolving as a random walk in equines. Contrary to expectations, we detected no significant effect of past climate on body size evolution in either clade, nor evidence for an interaction between climate and competition on all studied traits. These findings highlight the importance of interspecific competition as a driver of trait evolution at macroevolutionary scales and challenge the prevailing view that long-term climate change is a primary determinant of phenotypic evolution.

Mots-Clés: Biotic interactions, Abiotic effect, Macroevolution, Trait evolution

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