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Recent assembly of European biogeographic species pool

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A recommendation – based on reviews by 3 anonymous referees – of

Calatayud J, Rodríguez MÁ, Molina-Venegas R, Leo M, Hórreo JL and Hortal J. 2018.

Pleistocene climate change and the formation of regional species pools. bioRxiv 149617, ver. 4

Peer-reviewed by Peer Community In Evolutionary Biology. doi: [10.1101/149617](https://doi.org/10.1101/149617)

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Biodiversity is unevenly distributed over time, space and the tree of life [1]. The fact that regions are richer than others as exemplified by the latitudinal diversity gradient has fascinated biologists as early as the first explorers travelled around the world [2]. Provincialism was one of the first general features of land biotic distributions noted by famous nineteenth century biologists like the phytogeographers J.D. Hooker and A. de Candolle, and the zoogeographers P.L. Sclater and A.R. Wallace [3]. When these explorers travelled among different places, they were struck by the differences in their biotas (e.g. [4]). The limited distributions of distinctive endemic forms suggested a history of local origin and constrained dispersal. Much biogeographic research has been devoted to identifying areas where groups of organisms originated and began their initial diversification [3]. Complementary efforts found evidence of both historical barriers that blocked the exchange of organisms between adjacent regions and historical corridors that allowed dispersal between currently isolated regions. The result has been a division of the Earth into a hierarchy of regions reflecting patterns of faunal and floral similarities (e.g. regions, subregions, provinces). Therefore a first ensuing question is: “how regional species pools have been assembled through time and space?”, which can be followed by a second question: “what are the ecological and evolutionary processes leading to differences in species richness among species pools?”.

To address these questions, the study of Calatayud et al. [5] developed and performed an interesting approach relying on phylogenetic data to identify regional and sub-regional pools of European beetles (using the iconic ground

beetle genus *Carabus*). Specifically, they analysed the processes responsible for the assembly of species pools, by comparing the effects of dispersal barriers, niche similarities and phylogenetic history. They found that Europe could be divided in seven modules that group zoogeographically distinct regions with their associated faunas, and identified a transition zone matching the limit of the ice sheets at Last Glacial Maximum (19k years ago). Deviance of species co-occurrences across regions, across sub-regions and within each region was significantly explained, primarily by environmental niche similarity, and secondarily by spatial connectivity, except for northern regions. Interestingly, southern species pools are mostly separated by dispersal barriers, whereas northern species pools are mainly sorted by their environmental niches. Another important finding of Catalayud et al. [5] is that most phylogenetic structuration occurred during the Pleistocene, and they show how extreme recent historical events (Quaternary glaciations) can profoundly modify the composition and structure of geographic species pools, as opposed to studies showing the role of deep-time evolutionary processes.

The study of biogeographic assembly of species pools using phylogenies has never been more exciting and promising than today. Catalayud et al. [5] brings a nice study on the importance of Pleistocene glaciations along with geographical barriers and niche-based processes in structuring the regional faunas of European beetles. The successful development of powerful analytical tools in recent years, in conjunction with the rapid and massive increase in the availability of biological data (including molecular phylogenies, fossils, georeferenced occurrences and ecological traits), will allow us to disentangle complex evolutionary histories. Although we still face important limitations in data availability and methodological shortcomings, the last decade has witnessed an improvement of our understanding of how historical and biotic triggers are intertwined on shaping the Earth's stupendous biological diversity. I hope that the Catalayud et al.'s approach (and analytical framework) will help movement in that direction, and that it will provide interesting perspectives for future investigations of other regions. Applied to a European beetle radiation, they were able to tease apart the relative contributions of biotic (niche-based processes) versus abiotic (geographic barriers and climate change) factors.

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Appendix

Reviews by 3 anonymous referee: <https://doi.org/10.24072/pci.evolbiol.100053>