

# Two ways to be endemic. Alps and Apennines are different functional refugia during climatic cycles

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## Abstract

Endemics co-occur because they evolved in situ and persist regionally or because they evolved ex situ and later dispersed to shared habitats, generating evolutionary or ecological endemicity centres, respectively. We investigate whether different endemicity centres can intertwine in the region ranging from Alps to Sicily, by studying their butterfly fauna. We gathered an extensive occurrence dataset for butterflies of the study area (27,123 records, 269 species, in cells of 0.5x0.5 degrees of latitude-longitude). We applied molecular-based delimitation methods (GMYC model) to 26,557 COI sequences of Western Palearctic butterflies. We identified entities based on molecular delimitations and the most recent checklist of European butterflies and objectively attributed occurrences to their most probable entity. We obtained a zoogeographic regionalisation based on the 69 endemics of the area. Using phylogenetic ANOVA we tested if endemics from different centres differ from each other and from non-endemics for key ecological traits and divergence time. Endemicity showed high incidence in the Alps and Southern Italy. The regionalisation separated the Alps from the Italian Peninsula and Sicily. The endemics of different centres showed a high turnover and differed in phenology and distribution traits. Endemics are on average younger than non-endemics and the Peninsula-Sicily endemics also have lower variance in divergence than those from the Alps. The observed variation identifies Alpine endemics as paleoendemics, now occupying an ecological centre, and the Peninsula-Sicily ones as neoendemics, that diverged in the region since the Pleistocene. The results challenge the common view of the Alpine-Apennine area as a single “Italian refugium”.

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