Time-calibrated phylogenies reveal mediterranean and pre-mediterranean origin of the thermophilous vegetation of the Canary Islands

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Running title: *Origin of thermophilous plants from the Canary Islands*

Summary

· **Background and Aims** The Canary Islands have strong floristic affinities with the Mediterranean Basin. One of the most characteristic and diverse vegetation belt of the archipelago is the thermophilous woodland (between 200 and 900 m). This thermophilous plant community consists of many non-endemic species shared with the Mediterranean Floristic Region together with Canarian endemic species. Consequently, phytogeographic studies have historically proposed the hypothesis of a origin of the Canarian thermophilous species following the establishment of the summer-dry mediterranean climate in the Mediterranean Basin around 2.8 million years ago.

· **Methods** Time-calibrated phylogenies for 39 plant groups including Canarian thermophilous species were primarily analysed to infer colonization times. In particular, we used 26 previously-published phylogenies together with 13 time-calibrated phylogenies (including newly generated plastid and nuclear DNA sequence data) to assess whether the time interval between stem and crown ages of Canarian thermophilous lineages postdates 2.8 Ma. For lineages postdating this time threshold, we additionally conducted ancestral area reconstructions to infer the potential source area for colonization.

· **Key Results** A total of 43 Canarian thermophilous lineages were identified from 39 plant groups. Both mediterranean (16) and pre-mediterranean (9) plant lineages were found. However, we failed to determine the temporal origin for 18 lineages because a stem-crown time interval overlaps with the 2.8 Ma threshold. The spatial origin of thermophilous lineages was also heterogeneous, including ancestral areas from the Mediterranean Basin (nine) and other regions (six).

· **Conclusions** Our findings reveal an unexpectedly heterogeneous origin of the Canarian thermophilous species in terms of colonization times and mainland source areas. A substantial proportion of the lineages arrived in the Canaries before the summer-dry climate was established on the Mediterranean Basin. The complex temporal and geographical origin of Canarian thermophilous species challenges the view of the Canary Islands (and Madeira) as a subregion within the Mediterranean Floristic Region.

Keywords: thermophilous woodland, Canary Islands, Mediterranean Floristic Region, colonization times, stem age, crown age, ancestral area, extinction