Tracking human impact on island ecosystems by detecting "ghost taxa" with ancient DNA

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Abstract

Islands ecosystems have been transformed since the early stages of human settlement. Loss of natural vegetation, and in particular forest cover, is one of the main consequences of human colonization. However, it is difficult to assess the rate of such deforestation processes, especially on islands that have a long history of human occupation. Understanding the transformative processes that island ecosystems have experienced is essential for their effective management and preservation today. The analysis of palaeoecological records and fossil indicators provides the long-term perspective needed to study these processes, while delivering different ecosystem baselines to be used by managers as references for restoration and conservation actions. Within Macaronesia, the Canary Islands were the earliest islands to be colonized by humans (at least 2000 years ago) and the only islands to undergo a double colonization (aborigines and Europeans). However, the precise timing and extent of human impacts on Canarian ecosystems are poorly known, and consequently restoration and conservation management targets usually fail to incorporate pre-human ecosystems. In addition, palaeoenvironmental reconstructions can be limited due to poor conditions for fossil preservation at certain sites, i.e. "*silent sites*", and under-representation of several key taxa in the fossil record, i.e. "*ghost taxa*". Althought there is evidence for human induced changes in forest composition, under-representation of certain key taxa such as Lauraceae

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(the dominant trees in the Canarian evergreen laurel forest) prevent us from determining the true forest composition or confirming the former distribution of forest types at local or regional scale. Combining the analysis of palaeoenvironmental DNA (PalEnDNA), i.e. ancient DNA from disseminated genetic material, and traditional palaeoecological proxies, we aim to improve the detection of such "*ghost taxa*", but also increase the taxonomic resolution to obtain better reconstructions of past Canarian forests. For the first time we isolate PalEnDNA from Canary Island sedimentary deposits at forest sites. Detection of Lauraceae PalEnDNA within the sedimentary sequences indicates when these trees have been components of the forest and show how PalEnDNA can be an effective tool in the identification of "*ghost taxa*" from palaeoecological records on similar island environments.

Keywords: ancient DNA, Canary Islands, laurel forest, palaeoecology, past vegetation