

RESPONSE OF GLACIAL STAGE TREE POPULATIONS IN GREECE TO ORBITAL AND SUBORBITAL CLIMATE VARIABILITY*P. Chronis TZEDAKIS*

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Quaternary palaeoclimate research has provided information across the entire spectrum of temporal scales from orbital to interannual changes, using archives ranging from ice cores to corals. However, the bulk of the information available is concentrated on variations occurring on orbital and, more recently, suborbital/millennial frequencies, mainly because of limitations on the resolution of the most prevalent types of records. As a result of intensified research activities over the last decade, there has been a substantial increase in our understanding of the character of climate variability, with new palaeoclimate records (mainly marine and ice cores), extending over multiple glacial-interglacial cycles and yet able to resolve millennial- (or even finer) scale events. Such sequences provide the environmental backdrop against which the response of vegetation, as deduced mainly from the fossil pollen record, can be assessed. However, establishing the nature and extent of vegetation changes relative to the external forcing is hindered by the scarcity of suitable terrestrial sequences, extending beyond the Holocene. Intermittent deposition and erosional activity in continental sedimentary environments, means that the terrestrial record is in its vast majority extremely fragmented. Long, continuous, pollen-bearing sedimentary lake sequences are found only in exceptional circumstances and a handful of these occur in Greece. There are now enough long pollen sequences studied in Greece to provide an insight into the vegetation response both on long glacial-interglacial timescales, but also on millennial frequencies. In addition, they also afford a first glimpse into the spatial differentiation of the response. Given the prominent position of the Balkans as a refugial area, particular attention is paid here to the nature of temperate tree populations during glacial periods.

First, an attempt is made to examine the long-term persistence and spatial distribution of residual tree populations in Greece. It has long been suggested that refugial populations would be primarily concentrated in areas proximal to moisture sources (e.g. Ionian Sea) and of high topographic variability. The palaeoecological record provides support for this idea with northwest Greece showing consistently higher levels of representation of temperate tree pollen through multiple glacial intervals than areas to the east or south. Second, the impact of millennial-scale oscillations on glacial stage tree populations is considered. What emerges is that changes in the coupled air-ocean system of the North Atlantic had a downstream impact on the size of tree populations in areas as far east as Greece, most critically through changes in moisture availability. However, while all pollen sequences provide evidence of the impact of such changes on glacial tree populations, they also show a distinct geographical differentiation of the response in terms of the amplitude of changes. In some areas, high-amplitude increases in tree populations followed by collapses are recorded. Of interest are interstadial population increases of certain taxa in locations which are not considered prime refugial areas, suggesting recolonization from beyond the immediate catchment. In other areas, tree populations persist at intermediate levels, with climate oscillations having a relatively subdued impact. These results underline the importance of local conditions in modulating the response of vegetation. They also raise questions on the degree of range expansion and contraction during such climatic oscillations and, by extension, the extent of gene flow between refugial populations. Ultimately, they provide an opportunity to formulate more concrete hypotheses that may be tested by genetic data.

Key words: climate variability, orbital forcing, trees, refugia, lake sediments