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Understanding resource choice at the transition from foraging to farming: An application of palaeodistribution modelling to the Neolithic of the Konya Plain, south-central Anatolia, Turkey

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ABSTRACT

The role of the environment in shaping agricultural origins is still not fully understood, despite a century of debate on this topic. Comparison of the expected prevalence of a resource in the landscape with actual archaeological presence of the same resource can provide a metric for assessing resource choice in prehistory. However, the palaeoenvironmental data that would allow resource choice to be evaluated in this way are rarely available. Species Distribution Modelling (SDM) techniques allow independent palaeoenvironmental datasets to be computed, which when compared to actual species' presence at sites as attested by archaeological datasets, can provide data on resource choice. Following recent calls for SDM to be applied more widely in archaeological contexts, we outline a simple method for predicting the presence of plant species in prehistory using modern analogues and palaeoclimatic datasets. These modelled distributions provide an independent dataset for comparison with archaeological data, thus providing a window into human resource choice in prehistory. We outline the method with specific reference to the transition from foraging to farming in the Neolithic of Central Anatolia, but the method could be applied to any period or region. We have used exclusively open source data and provided all code in our online supplementary materials, so that our method can be utilized by researchers interested in human resource choice in any region of the world and any period.

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1. Introduction

Palaeoenvironmental reconstruction, as practiced within archaeological contexts, typically assumes that palaeoecological assemblages are representative of the landscape and climate in which they were deposited. This is the case whether it is the climate or the local vegetation that is being reconstructed. A common approach to quantifying past climate variables from pollen cores is to identify modern analogue counterparts for identified fossil taxa, taking the overlapping range of these species' modern tolerances as the likely past climate range at the site of interest (Guiot, 1990). This method has been widely applied to a variety of Pleistocene and Holocene pollen assemblages, both for regional climate reconstruction (e.g., Chedaddi et al., 1998) and at the continental scale (e.g., Davis et al., 2003). Similarly, where the object of palaeoenvironmental reconstruction is the vegetation history of a particular landscape, the pollen or macro-charcoal assemblages are assumed to be representative of the palaeolandscape subject to an evaluation of their taphonomic histories (e.g., Bottema and Woldring, 1984; Chabal et al., 1999).

Such approaches to palaeoenvironmental reconstruction have several shortcomings, with most palaeoenvironmental datasets being subject to biases. In the case of pollen assemblages, both differential dispersal and preservation can skew the datasets (Campbell, 1999). Anthracological and faunal assemblages suffer from similar biases in addition to being further skewed by human

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resource choice, as humans practice selective foraging in the surrounding habitat; available floral and faunal species will not be uniformly selected, and thus will not form a true representation of the available resources (Asouti and Austin, 2005; Picornell et al., 2011).

While these biases can be problematic for palaeoenvironmental reconstructions, they are potentially useful for archaeological interpretation; any discrepancy between these assemblages and the actual expected distribution of resources in the landscape will provide a window into human resource choice in prehistory. To compare the distribution of flora and fauna in a prehistoric landscape with their presence in archaeological assemblages, an independent record of their presence is required; a record that does not originate directly from the archaeological data. Such an independent record can be obtained using Species Distribution Modelling (SDM) (for an overview see Elith and Leathwick, 2009) an approach that is theoretically opposed to traditional palaeoenvironmental reconstruction methods. While palaeoenvironmental modelling through the 'Mutual Climatic Range' method (Pross et al., 2000) uses the climatic range of modern analogue species to infer the climate of a given site in the past, SDM typically utilizes independent palaeoclimatic models or data to hind cast the presence of a species in prehistory, based on the same observed climatic range of modern analogue species (Franklin, 1995; Svenning et al., 2011). Furthermore, there is no *a priori* reason to believe that there are true modern analogues for prehistoric environments. SDM avoids this problem by treating each species separately and reconstructing prehistoric guilds from the bottom up (Svenning et al., 2011).

Following recent calls for SDM to be more widely applied in archaeology and palaeoanthropology (Franklin et al., 2015), we present a comprehensive example of the method as applied to the Neolithic of the Konya plain, in central Anatolia, Turkey, a study region and period of great archaeological and palaeoecological interest for understanding the origin of agriculture in Southwest Asia and its subsequent spread into Europe (cf. Roberts et al., 2001; Asouti, 2006). In addition to providing a pertinent example of SDM as applied to an archaeological context, we also illustrate how SDM can provide the independent palaeoenvironmental reconstruction that is required if we are to obtain meaningful insights into the nature of human resource choice in prehistory.

2. The regional geographical and archaeological setting

The Konya basin is an endoreic, high-altitude (~1000 m a.s.l.) intramontane steppe plateau. The climate today is continental semi-arid, and the landscape has been heavily irrigated for farmland. In the recent past the plain was noted for its extensive marshlands, lakes, and seasonal water bodies (de Meester, 1970) which have largely disappeared within the past thirty years (Asouti and Kabukcu, 2014). A large palaeolake covered much of the plateau in the late Pleistocene, which dried up around 17,000 BP leaving large areas of marl across its former range (Roberts et al., 1999).

As an early locus of Neolithic communities outside the Fertile Crescent, the Konya Plain represents a key archaeological landscape for understanding the spread of early food production and Neolithic lifeways into central and western Anatolia and southeast Europe. The transition from foraging, through to cultivator-forager and farming economies (~15,000–9000 cal BP) can be traced through the local prehistoric archaeological sequence (Baird, 2012; Baird et al., 2012b, 2013; see also Fig. 1). The rock-shelter and open-air sites of Pınarbaşı, at the foothills of the volcanic massif of Karadağ, on the shores of the Hotamış depression were the focus of prehistoric occupation from the end of the Pleistocene through to

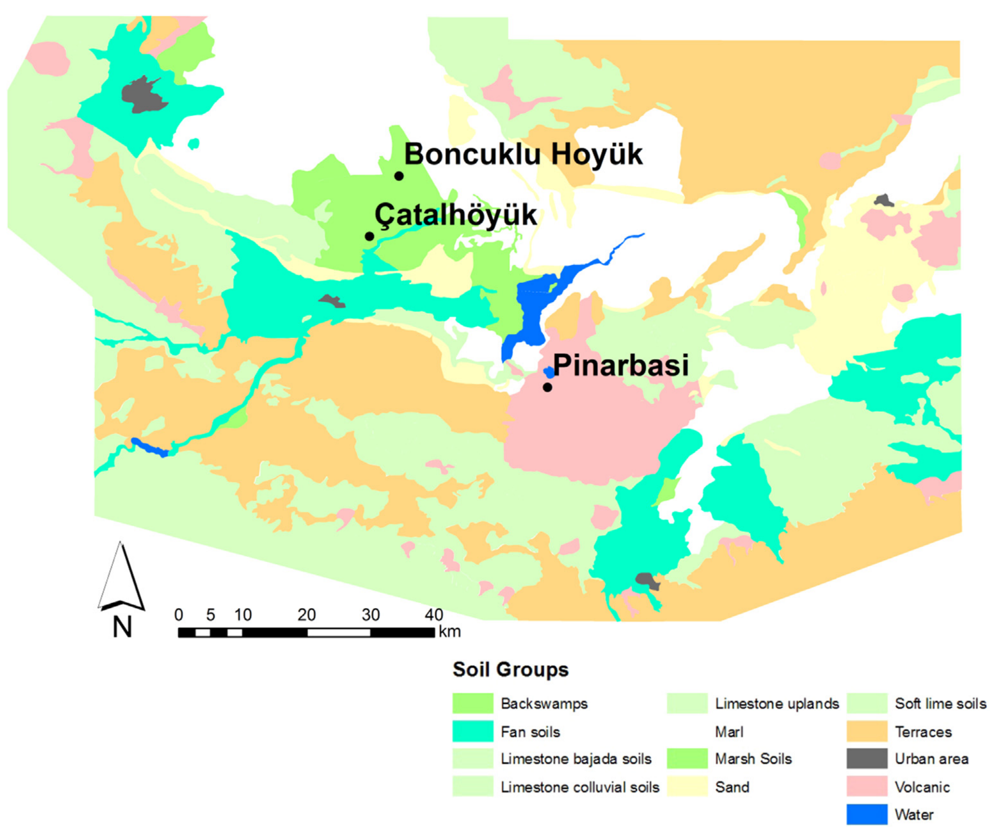

Fig. 1. Map of the major modern landscape units of the Konya basin (modified after de Meester, 1970). The locations of key archaeological sites mentioned in the text are shown.

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