Quaternary Science Reviews 90 (2014) 158–182

Contents lists available at ScienceDirect

Quaternary Science Reviews

journal homepage: www.elsevier.com/locate/quascirev

# Holocene semi-arid oak woodlands in the Irano-Anatolian region of Southwest Asia: natural or anthropogenic?

Eleni Asouti*, Ceren Kabukcu

*Department of Archaeology, Classics and Egyptology, University of Liverpool, Hartley Building, Liverpool L69 3GS, UK*

ARTICLE INFO

*Article history:*
Received 11 October 2013
Received in revised form
1 March 2014
Accepted 3 March 2014
Available online 22 March 2014

*Keywords:*
Oak steppe-forest
Irano-Anatolian vegetation
Human impact
Crop progenitors
Anthracology
Neolithic
Southwest Asia

ABSTRACT

It is commonly accepted that, following the end of the Pleistocene, semi-arid deciduous oak woodlands did not spread in the Irano-Anatolian region of Southwest Asia as quickly as they did in the Levantine Mediterranean littoral, despite the fact that climatic improvement occurred broadly at the same time in both regions. Prehistoric impacts on woodland vegetation (such as woodcutting, burning and clearance for cultivation), the harsh continental climate of inland Southwest Asia and its distance from late Pleistocene arboreal refugia have all been discussed in the literature as likely causes of the delay. In this paper we argue that semi-arid deciduous oak woodlands should not be viewed as part of the "natural" vegetation of the Irano-Anatolian region that has been progressively destroyed by millennia of human activities since the Neolithic. They represent instead one of the earliest anthropogenic vegetation types in Southwest Asia, one that owes its very existence to prehistoric landscape practices other scholars commonly label as "destructive". Drawing on anthracological, pollen and modern vegetation data from central Anatolia we describe how the post-Pleistocene species-rich and structurally diverse temperate semi-arid savanna grasslands were gradually substituted by low-diversity, even-aged *Quercus*-dominated parklands and wood pastures in the course of the early Holocene. Economic strategies that encouraged the establishment and spread of deciduous oaks included sheep herding that impacted on grass and forb vegetation, the controlling of competing arboreal vegetation through woodcutting, and woodland management practices such as coppicing, pollarding and shredding that enhanced *Quercus* vegetative propagation, crown and stem growth. Understanding the origin and evolution of the Irano-Anatolian semi-arid oak woodlands of Southwest Asia is of critical importance for reconstructing the changing ecologies and geographical distributions of the progenitors of domesticated crop species, and the nature and scale of early agricultural impacts on the landscape.



## 1. Introduction

Globally the late Pleistocene–early Holocene transition was characterised by climate and vegetation changes that framed critical shifts in human socioeconomics (Rosen, 2007). In Southwest Asia these shifts materialised as increasingly sedentarising behaviours which, alongside novel and regionally diverse plant and animal resource management strategies, framed the appearance of the earliest integrated agro-pastoral economies in the Old World during the 8th millennium cal BC (Asouti and Fuller, 2012, 2013). Pollen, sedimentological and other palaeoecological archives *accumulated* in the course of the last two decades have furnished a robust record of the associated climate and environmental changes (see summaries in Roberts et al., 2001, 2008, 2011; Rosen, 2007). These records demonstrate that although climate change occurred synchronously across the different parts of Southwest Asia changes in terrestrial environments, in particular vegetation, were asynchronous. In the Irano-Anatolian region several studies have confirmed the existence of a ~3–5 ka gap between the onset of climatic amelioration at the beginning of the Holocene and the establishment of deciduous *Quercus* woodlands in mid-Holocene (for recent reviews see Roberts, 2002; Rosen, 2007; Djamali et al., 2012). By contrast, in the Levantine littoral (identified as part of the Mediterranean region) the available palaeoecological evidence points to the overall synchronicity of climate improvement and post-Pleistocene oak woodland expansion (Wright and Thorpe, 2003; Rosen, 2007).

Understanding the nature and causes of this disjunction between climate and vegetation change in the Irano-Anatolian region

* Corresponding author. Tel.: +44 (0) 151 79 45284.
*E-mail address:* E.Asouti@liverpool.ac.uk (E. Asouti).

http://dx.doi.org/10.1016/j.quascirev.2014.03.001
0277-3791/

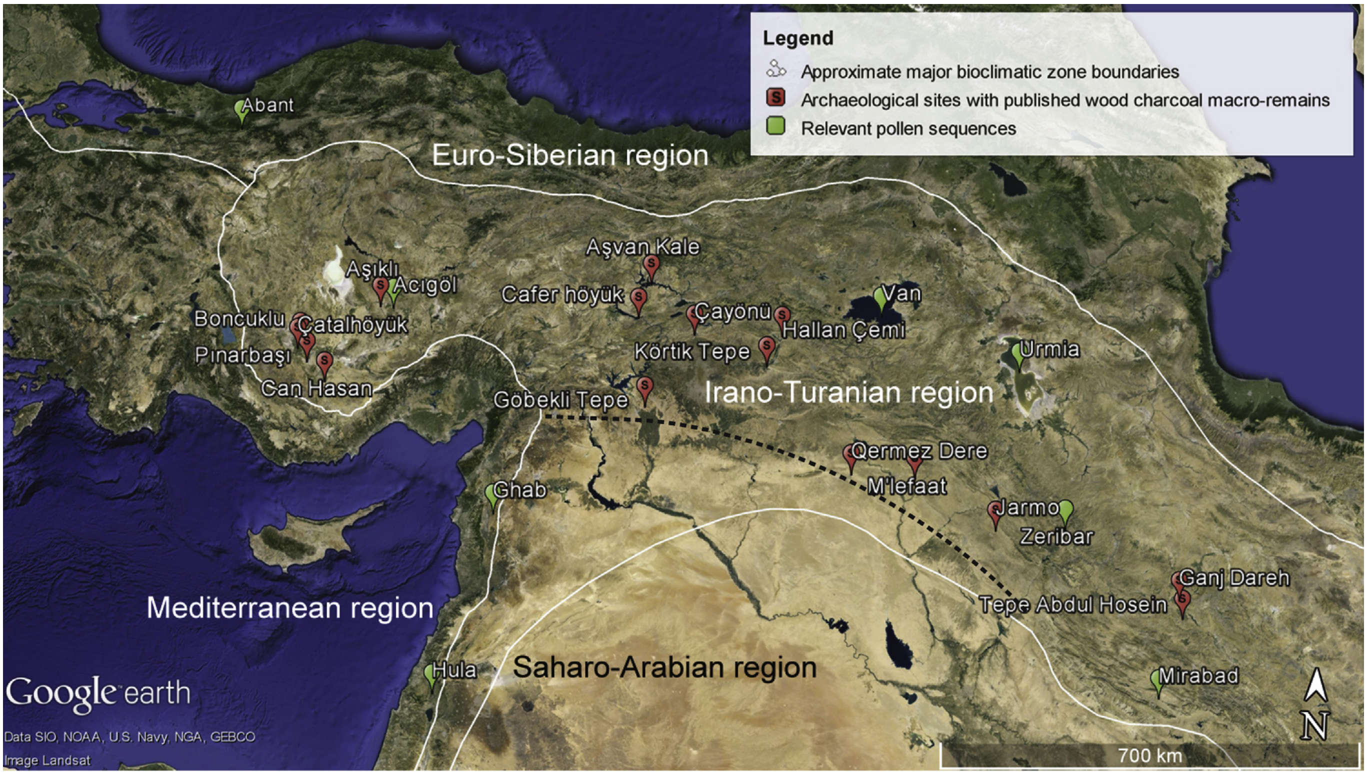


**Fig. 1.** Map of the major bioclimatic regions of Southwest Asia marking the location of the key pollen sequences recording the Pleistocene–Holocene transition, and the location of early Holocene habitation sites with studied wood charcoal macro-remains. The dark dotted line indicates the southern limit of the Irano-Anatolian region (partly overlapping with the Irano-Turanian region of inland SW Asia) (compiled by E Asouti).

of Southwest Asia is important for two reasons. Firstly, this area is home to a significant portion of the so-called primary habitats of the wild progenitors of the founder crop species, namely the semi-arid deciduous *Quercus* woodlands (Zohary's "open park forest belt") growing on the piedmont zone of the northern and eastern Fertile Crescent (i.e., the foothills and low- to mid-elevation slopes of the Taurus, the Anti-Taurus and the Zagros ranges). At present oak steppe-forests are often associated with populations of wild-type einkorn (*Triticum boeoticum*), emmer (*Triticum dicoccoides*), barley (*Hordeum spontaneum*), lentil (*Lens orientalis*), bitter vetch (*Vicia ervilia*), pea (*Pisum humile*) and flax (*Linum bienne*) (Harlan and Zohary, 1966; Zohary, 1969; Zohary et al., 2012, pp.34, 41, 54, 79, 83–84). The ecological history of semi-arid *Quercus* woodlands is thus intimately connected to that of the crop progenitors and the first steps to plant cultivation and domestication. This "special relationship" colours the on-going debate about the polycentric nature of plant cultivation and domestication, in which the present-day geographical distribution and ecological properties of oak steppe-forests are perceived as representative of the ecology of prehistoric oak woodlands. Secondly, continuing from the previous point, modern *Quercus* steppe-forests are also believed to be representative of the "natural" climax vegetation communities that have been progressively destroyed by activities such as woodcutting (for fuel and timber), clearance for cultivation and caprine pastoralism since the Neolithic. Hence they are often portrayed, implicitly or explicitly, as the surviving remnants of the supposed original ecology and geographical distribution of deciduous *Quercus* woodlands in prehistory (e.g., Zohary, 1973; Hillman, 1996, 2000; Willcox, 1999, 2002; Asouti and Hather, 2001; Asouti, 2005; Deckers and Pessin, 2010). For these reasons a re-assessment of the environmental history of the Irano-Anatolian semi-arid *Quercus* woodlands is both timely and necessary in order to understand their changing ecologies and co-evolution with Neolithic plant and animal management strategies, and the nature and scale of early agricultural impacts on the landscape.

## 2. The regional geographic setting

Following previous phytogeographic classifications of Southwest Asia (Boissier, 1867-1884; Eig, 1931; Zohary, 1950, 1971, 1973; Davis et al., 1965; Guest and Al-Rawi, 1966; Çetik, 1985; Takhtajan, 1986) and more recent syntheses (Djamali et al., 2012) we define the Irano-Anatolian region (part of Eig's greater Irano-Turanian province; Eig, 1931; see also Fig. 1) as encompassing the bulk of the central Anatolian plateau (bordered to the west by a notional line running between the cities of Eskişehir and Afyon, to the south by the north-facing slopes of the Taurus mountains, and to the north by the North Anatolian mountains), the highlands of east and southeast Anatolia, the Zagros range and the Elburz mountains. Other than mountain ranges it includes high-altitude intra-montane steppe plateaux and internally drained, karstic basins, coinciding with Boissier's *Sous-région des Plateaux* (Boissier, 1867: vi). Its climate is markedly continental, with hot and arid summers, cold winters and very low atmospheric humidity. Plant growth is thus characterised by a pattern of bi-seasonal dormancy: in the summer it is arrested by extreme aridity and prolonged drought, and in the winter by extreme cold and prolonged snow cover (Guest and Al-Rawi, 1966, p. 59; Çetik, 1985, pp. 54–71; Djamali et al., 2012). Due to the high topographic diversity and the steep altitudinal gradients annual precipitation varies from ~200 to 300 mm at the steppe and plains level to ~1500 mm on high elevation slopes and mountain peaks. Precipitation variance and the heterogeneity of the terrain are the chief causes of the diversity of vegetation habitats which include forests, woodlands, alpine and