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Archaeobotanical inference of Bronze Age land use and land cover in the eastern Mediterranean

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ABSTRACT

Charcoal and charred seeds at five Bronze Age archaeological sites discern ancient land use in the eastern Mediterranean. Seed frequencies of orchard crops, annual cereals and pulses, and wild or weedy plants are used to characterize plant utilization at different archaeological sites on the island of Cyprus, in the Rift Valley of Jordan, and in the Jabbul Plain and along the upper Euphrates River valley in Syria. Seed to charcoal ratios provide proxies to determine the relative usage of dung versus wood for fuel across the ancient Mediterranean landscape. Greater charcoal and lower charred seed values are interpreted to represent a wooded environment, while higher amounts of charred seeds and minimal wood charcoal suggest a much great use of dung as a fuel source. Interestingly, Politiko-*Troullia* (Cyprus, Cypriot archaeological sites are, by convention, named for the nearest modern village (Politiko), followed by an italicized toponym (*Troullia*) referring to the plot of land that incorporates the site) has the lowest seed to charcoal ratio, suggesting its residents primarily burned wood and that the landscape surrounding *Troullia* remained relatively wooded during the Bronze Age. In contrast, villagers at Tell el-Hayyat (Jordan) utilized a mixture of wood and dung, in contrast to Tell Abu en-Ni'aj (Jordan), and especially Umm el-Marra and Tell es-Sweyhat (Syria), where inhabitants relied solely on dung fuel. Comparative analysis and interpretation of seed and charcoal evidence thus illustrates the variety of fuel use strategies necessitated by the dynamic and diverse Bronze Age landscapes of the Eastern Mediterranean.

1. Introduction

The landscapes of the eastern Mediterranean have been home to the growth, expansion and collapse of many of the world's earliest civilizations (Blondel, 2006). These societies transformed their landscapes, especially over the last 10,000 years following the advent of agriculture, in a lengthy co-evolution of humans and their environment (di Castri, 1981). This study highlights variability in this co-evolution, as seen in a comparison of Bronze Age land use and landscape in Syria, the southern Levant and Cyprus. The development of agrarian economies in the eastern Mediterranean and Near East incorporated population growth, production of agricultural surpluses and specialized technologies (e.g. plaster, metallurgy) that entailed significant environmental impacts (e.g., exploitation of woodland resources, deforestation; Miller, 1998). Intriguingly, these impacts were manifested in trajectories that varied geographically and temporally. This study focuses on detailed botanical evidence for land use and land cover from five archaeological sites that highlight this inherent variability in the evolution of agrarian landscapes in the ancient eastern Mediterranean and Near East.

Perhaps the most pervasive environmental impacts of human society result from mankind's myriad uses of fire. Economic activities of early agrarian communities often are inferred from analyses of carbonized plant remains as they relate to crop production, processing and consumption (e.g., Renfrew, 1973; Hastorf, 1988; Lipschitz, 1989; Pearsall, 1989; Cotton, 1996). Furthermore, such floral data are often augmented by the integration of the faunal data to assess and compare agroecocomies among sites (Smith and Munro, 2009; Smith and Miller, 2009). Independently studied however, floral remains recovered from archaeological sediments may represent burned refuse, crop processing debris or consumed fuel (Schwartz et al., 2000, pp. 445–446). Seeds originating from burned crop processing debris often are identified by the presence of spikelets, rachis fragments and stalks within the charred remains (Hillman, 1984). The burning of stored supplies or fodder, which is more difficult to determine, often produces carbonized seeds in storage rooms or jars (Miller, 1990). In addition, pyrotechnology

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figures prominently in the development of specialized crafts (e.g., pottery production, metallurgy), as well as general cooking and heating needs (Sillar, 2000; Miller, 2004). As Miller (1997a) notes, however, crop processing, burning of stored foods and craft production tend to be seasonal or episodic, whereas fuel use is more constant. Indeed, fuel use constitutes a major, often under-emphasized, source of carbonized plant macrofossils (Miller, 1996). This evidence provides particularly valuable reflections of land cover and land use, indicative of human interactions with surrounding plant communities.

1.1. Crops, fodder and fuel

In general, fuel wood or charcoal constituted readily utilized sources of fuel for cooking, heating and craft industries in early agrarian societies (Nesbitt, 1995). Fire wood provides a particularly expedient fuel source, but without close monitoring may produce highly variable temperatures. Burning of fuel wood in a reducing environment creates charcoal, which can be stored for later use and produces steady, more easily controllable heat (Sillar, 2000, p. 46). When wood becomes scarce, animal dung provides a more labor-intensive supplemental or alternative fuel (Winterhalder et al., 1974; Anderson and Ertug-Yaras, 1998). In addition to its malodorous characteristics, it must be handled and allowed to dry prior to use or storage. Nevertheless, dung may be hand-formed and ignited in standardized chunks, providing a controllable source of relatively even heat. Dung fuel from ruminants like cattle, sheep and goat, the leading domesticates at our sample of sites, produces more energy than dung from equids (Rhode et al., 2007, p. 207, Table 1). A variety of studies world wide document the use of dung fuel for heating, cooking and firing pottery (e.g., Winterhalder et al., 1974; Sillar, 2000; Rhode et al., 2007).

Archaeobotanical remains provide an avenue for inferring the links between early agrarian communities and their larger environments because so many food, fuel and technological needs of agrarian societies require use of both cultivated and wild plants (see discussion in Hastorf, 1988). Archaeobotanically deduced social interactions with the environment can provide particularly acute reflections of agricultural strategies, deforestation and erosion (e.g., Butzer, 1978, 1996; Kirch, 2005). Although plant macrofossils often are interpreted as indicators of crop management strategies and human food consumption, seeds recovered from trash deposits more likely stem from dung that was burned for fuel, and reflect wild or cultivated pasture vegetation or fodder grown for animal consumption (Miller, 1996). Seeds originating from dung often are highly fragmented or still embedded within charred dung remnants (Miller, 1990). However, increased reliance on animal dung for fuel potentially indicates multiple landscape, economic or climatic characteristics including expansion of uncultivated land due to greater importance of animal grazing, over-utilization of trees, or reduction of woodlands due to climate change. Previous studies at Tepe Malyan, Iran (Miller, 1985) and in the Khabur Basin of Upper Mesopotamia (Wilkinson, 2003, pp. 103–104) suggest ancient deforestation by contrasting the modern degraded steppe with woodland vegetation reconstructed for the mid-Holocene. For example, at Malyan evidence of charcoal decreased as charred seeds increased (Miller, 2004), suggesting that excessive wood harvesting during the third millennium B.C. led local residents to adopt animal dung as an alternative fuel source. Building on these previous insights, our study explores varying combinations of charcoal and plant seed remains as they suggest distinct signatures of crop, herd and fuel management at a series of Bronze Age communities across the eastern Mediterranean and Near East.

We recognize the presence of charred seeds may be the result of many social activities (burning of crop debris, unintentional burning of orchard remnants), and may also contain a temporal element to their frequencies (as is the case with seasonal burning crop debris or stored products). We are assuming that charred botanical remains indeed come from animal dung given the abundance of charcoal at the sites, and thus may be a reflection of land use and land cover; with further rationale ascertaining that if charcoal is preserved at the sites, logically charred seeds, had they been utilized as a fire source, would be preserved as well. Because this evidence differs among the sites, it potentially reflects fundamental regional differences in land cover during the rise of early complex societies. The goal of this paper is to illuminate contrasts in ancient agrarian landscapes on the basis of carbonized plant macrofossils and charcoal recovered from a selection of Bronze Age excavations in Syria, Jordan and Cyprus. In particular, we are concerned with explaining the apparent dearth of carbonized seeds found on Cyprus, not as an issue of archaeological preservation, but as part of fundamental insight on the ancient agrarian landscape of this island.

2. Study areas

This research presents an inter-regional comparison of archaeobotanical evidence from which we may infer distinct differences in land use and landscape formation between Bronze Age agrarian communities in the Near East and on Cyprus. The modern climatic regime of these regions is distinctly Mediterranean, with long, hot summers and short, cool, rainy winters (see discussions in Wigley and Farmer, 1982; Roberts and Wright, 1993; Wilkinson, 2003). We utilize data from five Early and Middle Bronze Age settlements in the eastern Mediterranean that provide substantial bodies of detailed excavated evidence of charcoal and carbonized seeds, including Tell Umm el-Marra and Tell es-Sweyhat in Syria, Tell Abu en-Ni'aj and Tell el-Hayyat in Jordan, and Politiko-*Troullia* in Cyprus (Fig. 1). Tell Umm el-Marra (in the Jabbul Plain) and Tell es-Sweyhat (in the upper Euphrates drainage) sit about 50 km apart amid the rolling steppe of inland Syria. The town of Tell es-Sweyhat (35 ha) witnessed the rise and collapse of Early Bronze Age urbanism in Upper Mesopotamia (ca. 3000–2000 B.C.E.; Danti and Zettler, 2002). Habitation at Umm el-Marra (25 ha) began in the Early Bronze Age (Curvers and Schwartz, 1997) and subsequently experienced the urbanization, collapse and reurbanization of the third and second millennia (ca. 3000–1200 B.C.E.; Schwartz et al., 2000; Schwartz, 2007). A legacy of long-term intensive agriculture and pastoralism has left the region resembling a treeless agro-desert with portions of previously-cultivated land left bare (Wilkinson, 2003, p. 18). During the Bronze Age, however, this region consisted primarily of terebinth-almond woodland steppe, along with shrubby vegetation of almond, cherries, and hawthorns (Moore et al., 2000). Uncultivated portions of this steppe would have been ideal for grazing (Miller, 1997a).

Tell Abu en-Ni'aj and Tell el-Hayyat lie well below sea level in the northern Jordan Valley, Jordan. Early Bronze Age towns in the southern Levant flourished in the early third millennium B.C., experienced near-wholesale abandonment at the end of that millennium, and then during the Middle Bronze Age recovered in greater numbers and sizes than before (Ilan, 1995; Falconer and Savage, 2009). Tell Abu en-Ni'aj (measuring 2.5 ha) represents an agricultural village of about 500–600 people inhabited during the abandonment of towns during the final roughly 300 years of the Early Bronze Age (ca. 2300–2000 B.C.). Abu en-Ni'aj would have been part of a deurbanized settlement system of villages and seasonal encampments in the fertile fields and grazing lands along the Jordan Valley (Falconer et al., 2007). Tell el-Hayyat (0.5 ha) was a hamlet of 100–150 farmers during the redevelopment of Middle Bronze Age towns (ca. 2000–1500 B.C.; Falconer and Fall, 2007). In