THE SEASONALITY OF WETLAND AND RIPARIAN TASKSCAPES AT ÇATALHÖYÜK

Jesse Wolfhagen, Rena Veropoulidou, Gianna Ayala, Dragana Filipović, Ceren Kabukcu, Carla Lancelotti, Marco Madella, Kamilla Pawłowska, Carlos G. Santiago-Marrero, John Wainwright

Abstract:
The Neolithic inhabitants of Çatalhöyük in central Anatolia used local wetland and riparian environments for a variety of different tasks throughout the site's occupation. These tasks tended to vary throughout the year as different resources became available and residents organized their labor to focus on particular tasks. We summarize paleoenvironmental and archaeological data from recent analyses at Çatalhöyük to describe how the use of wetland and riparian environments fluctuated over the course of a typical year at Neolithic Çatalhöyük, as well as how these patterns changed over the course of the site's occupation. Çatalhöyük's later residents reorganized the ways in which they interacted with their surrounding landscape and managed labor demands as livelihoods and experiences became more varied across the community, which impacted the regularity and variety of uses they had for local wetland and riparian environments.

Seasonal variation in the natural world of Neolithic Çatalhöyük shaped the organization of daily life and social world of its residents. Seasonal cycles in climatic patterns, hydrology, growing seasons of wild and domestic plants, and seasonal behaviors of herded, hunted and gathered animals would have affected the overall productivity of the landscape and consequently the rhythms of social life (e.g., Fairbain, et al. 2005, Pels, 2010). These created social conceptions of seasonal patterns and activities that shaped the ways in which people interacted with their local environments and structured the timing and spatial requirements of everyday tasks.

In this paper, we explore seasonal signals of different tasks associated with the use of local wetland and riparian (i.e., riverbank) habitats at Neolithic Çatalhöyük (ca. 7100-5950 cal BCE). Previous research at the site has investigated seasonality and landscape use within the Neolithic community (e.g., Charles, et al. 2014, Fairbairn, et al. 2005); this paper updates these analyses with recent paleoenvironmental and archaeological data focused on the use of wetland and riparian habitats. Neolithic Çatalhöyük's local environments significantly varied in their topography and hydrology, impacting the spatial and temporal availability of wetlands. This paper investigates how people used local riparian habitats and wetlands to allow insights into the exploitation of the fluctuating affordances of the landscape. Potential changes throughout the site's occupation will be also explored to reveal how environmental and social factors influenced the ways in which the Neolithic community managed seasonal tasks and opportunities.

MATERIALS AND METHODS

Seasonality studies are based on the premise that natural resources vary in their availability throughout the year, affecting human activities and decisions regarding tasks. Plants and animals recovered from the site offer seasonally informed signals (e.g., presence of certain plants/animals, dental eruption, chemical composition) that can highlight different seasons of activities (e.g., Halstead, 2005, Figure 1). Furthermore, chemical analysis (e.g. stable isotopes) of certain biological materials, such as tooth enamel and shell carbonate, reflect seasonal variation (e.g., Balasse, 2002, Versteegh et al., 2010). However, cultural practices, such as storage, can disassociate the seasonal signal of a resource's use from the season of death/harvest. Thus, while these data can provide insights about seasonal behaviors of exploitation, only contextual arguments can link on-site activities to specific seasons.

A variety of biotic remains excavated during the 2009-2017 excavation seasons at Neolithic Çatalhöyük offer insights into the wetland and riparian taskscapes of its residents. The materials include plant remains, such as charred seeds, charcoal and phytoliths, domesticated and wild faunal remains, such as animal bones, bird bones and shells, coupled with stable isotope analysis of oxygen (^{16}O, ^{18}O) and carbon (^{13}C, ^{12}C) in teeth enamel of sheep and cattle, and freshwater mussels carbonate (Figure 2). Recent paleoenvironmental reconstructions offer the backbone of this study, while previous seasonality studies are also considered (Wolfhagen et al., in press).

PREVIOUS RESEARCH ON PALAEOENVIRONMENT AND SEASONALITY OF ACTIVITIES

Previous research into the paleoenvironment of Neolithic Çatalhöyük describe an environment dominated by a major spring flood, which would have impacted accessibility to the site and the range of possible activities around the site throughout the year (Roberts and Rosen, 2009). In this setting, Fairbairn et al. (2005) stressed the impact that the high groundwater would have had on procurement, production, and processing tasks, and suggested a community that managed subsistence activities.

This paleoenvironmental scenario has been challenged by more recent on- and off-site data. Doherty (2013), working on the use of clay, suggested that drier hillocks of marl soils would have been available near the site rather than extensive backswamps. Charcoal and charred plant remains suggest that crops and exploited woodlands come from a variety of wetland/riparian and dry environments (Asouti, 2013, Asouti and Kabukcu, 2014, Bogaard et al., 2013). Earlier analysis of strontium isotopes ($^{87}Sr/^{86}Sr$) on seed remains and sheep enamel suggested that people herded animals and cultivated crops on the alluvial plain, rather than being forced to regularly use higher-elevation land to avoid large-scale floods (Bogaard et al., 2014, *contra* Roberts and Rosen, 2009). In this framework, Charles et al. (2014) proposed a wider ecological variability near the site, of which people took full advantage, including herding caprines over a wider variety of environments, selecting crops to suit differences in growing conditions and traveling more (Charles et al., 2014, Pearson et al., 2015).

THE ENVIRONMENTAL SETTING

The most recent tranche of high-resolution reconstruction of the alluvial landscape further supports the view that Çatalhöyük was characterized by many different environmental niches, as the area was occupied by an anastomosing channel system, which is characterized by multiple (relatively) stable channels that are interconnected (Ayala et al., 2017, Ayala et al., in press, Figure 3). The Neolithic Çarşamba River was made up of multiple small channels with intervening higher, drier ground, which at least initially were defined by riparian vegetation that increases bank cohesion. Sediment sequences suggest that this channel belt overlies an earlier, more wetland channel belt which in turn is above an undulating marl surface (Ayala et al., 2017). The complexity of the subsequent sediment depths and permeability would have created hydrological conditions where seasonal ponding of water occurred near areas that remained more consistently dry through the Neolithic and into the Chalcolithic (see Figure 4 for modern riparian vegetation for Central Anatolia).

This paleoenvironmental reconstruction influences ideas about where Çatalhöyük's farmers located their fields and managed the agricultural cycle. Contrary to Sherratt's (1980) suggestion, the vast majority of the cultivated crops at Çatalhöyük appear to have been autumn-sown (Fairbairn, et al., 2005, Charles, et al., 2014, Filipović, 2014). Isotopic analyses of plant remains–particularly $\Delta^{13}C$ and $\delta^{15}N$ analyses–show that most crops were grown in moderately to poorly watered conditions (Stroud, 2016, Wallace, et al., 2015). Additionally, ecological data on the crop weed taxa show that crops were grown in persistent plots that were intensively managed in dryland environments; seeds from wetland species are associated with animal dung rather than crop processing (Bogaard, et al., 2013, Filipović, 2014, Green, et al., 2018). This pattern of land use also varies from earlier settlements in the area, like Boncuklu Höyük, where crops may have been grown in wetland environments (Baird, et al., 2018).

This reconstruction of the paleoclimate is not straightforward; recent research suggests the climate was already relatively dry by the start of the Neolithic occupation and became drier over time. Wainwright and Ayala (2019) suggest that the principal driving force in this drying is most likely to have been an increase of summer temperatures. Before autumn rains started, it is likely that soils were desiccated and the water table had dropped dramatically. The hydrology of the Neolithic channels likely responded to climate fluctuations, both morphologically and in terms of flood regime (Ayala et al., in press). Highland areas may have produced a combination of flashy runoff in autumn and winter, and snowmelt in spring, while the runoff in the remaining undulating or low-lying areas may have been more uniformly spread in the autumn and spring seasons. This flow regime would have led to occasional flooding in autumn, and in most but not all years in spring, even in the relatively drier parts of the Final phase of the East mound settlement.

SEASONAL ACTIVITIES IN RIPARIAN ENVIRONMENTS AND WETLANDS

This updated paleoenvironmental view of the Çarşamba river system gives further insights into the availability of riparian and wetland habitats, forming the context for revisiting the related available seasonal signatures for major subsistence and livelihood activities. Despite the normative character of these summaries, they call attention to sets of tasks that would have likely occurred at the same time of the year (Figure 5).

Reed, Sedge, and Wood Collection

The phytolith record is dominated by stems and leaves of grasses, sedges, and reeds used for the creation of basketry and matting, as fuel, and as inclusions in brickmaking (Ryan, 2013, Figures 6 and 7). The different degrees of silicification of phytoliths suggest that harvesting took place throughout their growing season, but certain collection tasks were focused on particular parts of the year: reeds incorporated into mudbricks were collected in spring/early summer, while other reeds and sedges were collected from August through October (Ryan, 2013, Stevanović, 2013). The two major pulses of reed and sedges collection are further supported by the age distribution of the micro-mollusk *Valvata piscinalis*, which was likely introduced to the site along with the roots of these plants. The majority are juvenile specimens that would have been found at the end of summer to mid-autumn, while a smaller proportion are older in age mollusks that would have been found during the spring (Veropoulidou, in press).

The charcoal data indicate that riparian and wetland woody taxa (e.g., *Celtis, Ulmus,* Ulmacaea, *Fraxinus*) are dominant on site (Kabukcu 2018). Signs of fungal decay in charcoal samples suggest that people focused on using dry deadwood or seasoned wood as fuel sources. Thus, riparian wood collection was less seasonally constrained, but may have been a regular task for residents going into riparian and wetland environments throughout the year, possibly as a secondary task embedded in other activities (Asouti, 2013).

Caprine Herding

A significant portion of the archaeobotanical assemblage represents charred seeds embedded in caprine dung pellets burnt for fuel (Bogaard et al., in press, Filipović, 2014, Figure 8). These seeds can be classified into two broad sources of grazed vegetation: marshy to riverine habitats (*Aeluropus*, small-seeded legumes, *Bolboschoenus glaucus*) that provide seasonal estimates for caprine grazing or fodder collection, and dry/seasonally wet steppe characterized by *Artemisia* and *Juncus* (Bogaard et al., 2013, Filipović, 2014). There were also some analyzed samples containing instances of seeds of the likely arable weeds (*Chenopodium, Polygonum*) associated with dung, perhaps indicating stubble grazing in late summer or foddering with crop (by-)products (Filipović, 2014).

In addition, Henton's (2013) analysis of sheep enamel stable oxygen isotopic values and dental microwear patterns provide direct evidence for sheep grazing in wetter environments and eating wetland plants. Modeled averages of sheep isotopic $\delta^{18}O$ tooth profiles cluster into two groups, likely corresponding to two kinds of habitats that differ in their aridity. The majority of the sheep average $\delta^{18}O$ values fall in the lower $\delta^{18}O$ group, suggesting that these sheep were grazing in well-watered areas rather than the drier steppe. These wetter areas could have been in the riparian zones of the "islands" of the anastomosing river. Similarly, dental microwear evidence suggests that 46% of the sheep grazed on wetland grasses or dirty winter pastures (Henton, 2013). Different lines of evidence suggest that caprines grazed regularly in local wetlands and riparian environments during the spring through autumn (Figure 9). This strategy may have antecedents at earlier sites like Boncuklu Höyük, as shown through individuals with elevated $\delta^{15}N$ and $\delta^{13}C$ values (Middleton, 2018).

Hunting Birds and Mammals

The bird bone assemblage is dominated by ducks and geese that would have been hunted in wetland environments, as well as bones from migratory birds that suggest at least some birding in the winter or spring/autumn migrations (Russell and McGowan, 2005). Similarly, the eggshell assemblage is dominated by ducks (Best, 2015, Sidell and Scudder, 2005). The majority of eggs were unhatched, thus reflecting collection in the spring through early summer (Best, 2015).

According to modelled average enamel and seasonal variation in $\delta^{18}O$ and $\delta^{13}C$ values, most *Bos* appear to have lived mainly in riparian/wetland environments. Hunters may have focused on aurochsen specifically during the rutting season (autumn), when males would have been most predictably located in the landscape. During the Late and Final Çatalhöyük phases, people shifted their focus from aurochsen to domesticated cattle, impacting how people used cattle (Pawłowska, 2020; Russell et al. 2013, Figure 10). The pattern of *Bos* enamel $\delta^{18}O$ and $\delta^{13}C$ values however do not change in these later phases, suggesting that these domesticated cattle lived in similar kinds of seasonal habitats as earlier aurochsen and thus possibly followed natural patterns of seasonal dispersal (Wolfhagen, 2019).

Red deer, fallow deer, and wild boar also likely lived in riparian environments around Çatalhöyük (Pearson, 2013); while these taxa make up only small proportions of the overall faunal assemblage, some potential seasonal patterns of exploitation can be discerned (Pawłowska, in press, Twiss et al., in press). The cervid assemblage is dominated by antler, which could be collected once it had shed in the late winter/spring (Figure 11). Pig remains show an emphasis on infantile/juvenile animals; however, since farrowing can extend across the year, it is difficult to associate these to a specific season (Russell et al., 2013, Twiss et al., in press). Pig remains are rare at Çatalhöyük overall, despite the accessibility of local wetlands. The rarity of pig remains on-site also differs from the earlier community of Boncuklu Höyük, where pigs are a significant component of the faunal assemblage (Baird, et al., 2018). This difference may highlight changes in the context of human-boar interactions as part of larger changes in wetland activities, though may also reflect cultural choices in the appropriateness of boar consumption and/or on-site deposition (Russell, 2012).

Mollusk Collection and Fishing

The archaeological shell record is dominated by freshwater mussels (from the genus *Unio*, Figure 12) that were consumed as food, as well as a large variety of other species, many of which were brought unintentionally on site probably along the roots of riparian plants (Veropoulidou, in press). Stable isotopic analysis of mussel shells indicate that harvesting took place in the winter/early spring or from spring-fed lakes in the earlier phases of occupation, while in the later phases the focus shifted to late spring through autumn (Veropoulidou, in press).

The fish bone assemblage includes mainly species of the Cyprinidae and Cobitoidea families (Hamilton-Dyer, in press, Van Neer et al., 2013) and overwhelmingly dominated by small juvenile fish that must have been fished after the spawning season (late spring/early summer, Figure 13). Mussel gathering and fishing do not necessarily imply immediate consumption, as both mussels and fish could have been dried and stored for later consumption (e.g., Van Neer et al., 2013).

A SEASONAL ROUND IN WETLAND AND RIPARIAN ENVIRONMENTS

Wetland and riparian habitats around Neolithic Çatalhöyük were the setting for many activities throughout the year: they were sources of grazing land and wood fuels, of wild foods, of wild grasses for food and craft, and hunting places for wild mammals and birds. While not an exhaustive list, these activities showcase how people have regularly used these environments within the mosaic of habitats in different seasonal pulses.

Low-level floods regularly recharged the wetland environments in the spring, when people collected wild grasses, mollusks, eggs, antler, and secondarily hunted some migratory birds and possibly farrowed pigs. They also collected reeds for temper in construction materials; perhaps they also cut new wood for storage or collected drying deadwood. It is possible that these spring tasks were embedded in people evaluating the extent of spring floods to determine what areas will be prime areas for grazing and other activities.

Late in the spring or early summer, larger task groups may have fished together using nets and/or traps. During the early summer, most activity in the wetlands appears to have focused on caprine herding. Other tasks, like digging for mollusks, hunting, or collecting wild grasses, may have occasionally occurred while herding, but it appears that caprine herds may have been moved into riparian environments shortly after the lambing season in the late spring, possibly as a way to move herds away from areas where they could hurt growing crops. Harvesting autumn-sown crops would have made significant labor demands during the early-mid summer, so animals may have been moved to riparian environments to avoid land and labor conflicts with the harvest.

As rainfall picked up at the end of summer into the autumn, there was some potential for smaller floods in the Çarşamba channel belt. People may have focused on collecting more wild grasses, sedges, and reeds for food (edible tubers) and as raw material for making mats and basketry over the winter. Aurochs may have been hunted during their rutting season. Woodland management may have been a particular focus in the fall to prepare stores of winter fuels and browse fodder before shifting attention to preparing fields for autumn-sown crops. Winter would have seen relatively infrequent use of local wetland and riparian environments, though freshwater mussels may have been sought out as supplemental foods. People may have collected these while hunting geese and ducks, whose populations would be at their densest during the winter months.

DIACHRONIC TRENDS

While the variety of wet and dry environments continued to be available throughout the site's occupation (Asouti, 2013, Ayala, et al., 2017, Bogaard et al., 2017), the ways in which people encountered, managed, and used wetlands appear to have changed over the millennia. These renegotiations of the use of wetland spaces was a constant process; Çatalhöyük's residents did not use wetland habitats for plant cultivation, unlike in the earlier Boncuklu Höyük occupation in a similar environment (Baird, et al., 2018). These changes may underlie the scarcity of pig remains at Çatalhöyük, as boars would have been less-frequent crop robbers (Baird, et al., 2018); though cultural restrictions regarding the consumption and deposition of boar at Çatalhöyük and other later Central Anatolian Neolithic communities likely played a role, as well (Arbuckle, 2013).

Some of the changes to local hydrological patterns and wetland composition may have been due to human activities, such as the changes to the distribution of clay sources (Doherty, 2013), or the evolution of the Çarşamba river system (Ayala et al., in press), while climatic change at Final Çatalhöyük phase has also been suggested (Pawłowska, in press, Roffet-Salque et al., 2018). Around 6300 cal BC (the change from the Late to the Final phase), there is a reorganization of sheep management, as herds became smaller and slaughter focused on older animals (Pawłowska, in press), while birthing time was shifted into the early spring (Henton, in press). Such an arrangement integrates labor better with agricultural production but requires more effort to collect and store fodder for pregnant animals in the winter (Henton, 2013).

Phytolith signatures suggest that *Phragmites* reeds become more common in the local environments during the later phases of occupation, suggesting disturbed habitats (Ryan, 2013). Taxonomic diversity in the micro-mollusk assemblage decreases considerably during these phases, as also happens with freshwater mussels and fish (Van Neer et al., 2013, Veropoulidou, in press). This decrease could mirror the actual availability of natural populations due to climatic and/or ecological variability (Lewis et al., 2016, Roffet-Salque et al., 2018) or habitat disturbance (Ayala et al., 2017, Doherty, 2017), or could reflect a decreased interest in exploiting these food sources (Van Neer et al. 2013). Alternatively, this pattern could represent a change in the types of wetland materials exploited and used or possible changes in the loci of landscape exploitation and variation in off-site activities, such as farming, herding, fishing, collection of plants and woods (Charles et al., 2014).

Other datasets also suggest that the variety of environments people were exploiting changed over the site's occupation. Dung-derived seed data show that 'steppic' dung signatures become common in the Middle and Late phases, whereas 'riverine' signatures dominated earlier (Bogaard et al., in press, Figure 14). Dietary signatures from stable isotopic samples ($\delta^{13}C$, $\delta^{15}N$) suggest that sheep, goats, and cattle were grazed over more isotopically diverse areas in the later phases, possibly reflecting changes in herd organization and the inclusion of more graze from drier environments (Pearson, 2013, Pearson et al., 2015). Human bone data also suggest increased mobility (Larsen et al., 2019). These data for increased mobility among Çatalhöyük's residents may be in accord with some evidence for increased variability in the seasonal signals found at the site. Migratory bird taxa, predominantly found only in the later levels of the site, possibly suggest that some residents were able to hunt birds during the autumn (Russell, 2018), as also happens with *Unio* mollusk collection (Veropoulidou, in press). These changes to seasonal patterns may be responses to larger renegotiations in the organization and scale of labor, with the possibility of smaller labor groups within the community following diverse subsistence and other strategies (Bogaard et al., 2017, Russell et al., 2013).

SEASONALITY OF TASKSCAPES

The examination of seasonal activities in wetland and riparian environments around Neolithic Çatalhöyük highlights the role that these environments played in terms of labor budget and economic activity. While agricultural production was obviously a central task for community members and key to navigate their calendars around (Fairbairn, et al., 2005), people used the non-agricultural parts of the landscape for a variety of subsistence and craft-related tasks. Some of these tasks, such as fishing or caprine herding, appear to have been seasonally constrained in ways that may affect who could take part in these activities and what other tasks could be going on at the same time. Other tasks, like *Unio* collection or woodland management, may have been pursued and planned intentionally or carried out while fulfilling other needs/activities in these environments. One must consider the makeup of groups that travelled to these environments and the skills necessary to successfully and safely gather these goods.

This admittedly narrow focus on the productive and economic potential of the wetland and riparian environments around Çatalhöyük ignores the social and ritual importance these habitats would have had for community members. The division between strictly utilitarian and socially distinctive products is a false one: bird wings and aurochs were socially important; wild grasses, sedges, and reeds were used to make storage vessels, funerary baskets, and cordage (e.g., Haddow et al., in press, Ryan, 2013). Minor dietary products, such as fish, sedge tubers, mollusks, and birds, may have been fallback foods onto which people relied in the face of subsistence adversities (Bogaard et al., in press, Van Neer et al., 2013).

Over the course of the site's occupation, people visited a variety of riparian and wetland environments, though the ways in which people organized their activities across the larger landscape changed over time. These changes also occurred within the larger context of Central Anatolian occupation, wherein earlier communities like Boncuklu Höyük were more clearly centralized around wetland exploitation (Baird, et al., 2018). Some of these changes may reflect reorganization of labor group sizes. Similarly, inter-household variability in resource management strategies could have led to more variation in seasonal signals for some activities, such as birding or *Unio* collection. Wider variation in seasonal signals for different tasks may reflect increased freedom for households to adapt to opportunities and challenges in areas that they had control over, producing resilient community-wide practices. In the face of larger changes in social organization related to agropastoral production (Hodder and Doherty, 2014), wetlands may have represented areas where people could resist or renegotiate changing social demands.

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Figure 1: Examples of archaeological data that can provide seasonal signals of activity, showing flotation samples drying, faunal remains from a midden being sorted, a sample of archaeological shells, and a scanning-electron-microscope image of charcoal from an Ash (*Fraxinus*) tree. Note that seasonal signals reflect seasonality related to a plant's or animal's life and thus do not directly reflect on-site activities unless other contextual arguments can be made. Photographs by Dragana Filipović, Ceren Kabukcu, Rena Veropoulidou, and Jesse Wolfhagen.

Figure 2: Examples of stable isotopic sampling on an *Unio* shell (18928.S26) and a *Bos* lower molar (13419.S4). Drilled samples from shell carbonate and tooth enamel can be analyzed for $\delta^{13}C$ and $\delta^{18}O$ values that reflect different aspects of past environments and ecologies. Photographs by Rena Veropoulidou and Jesse Wolfhagen.

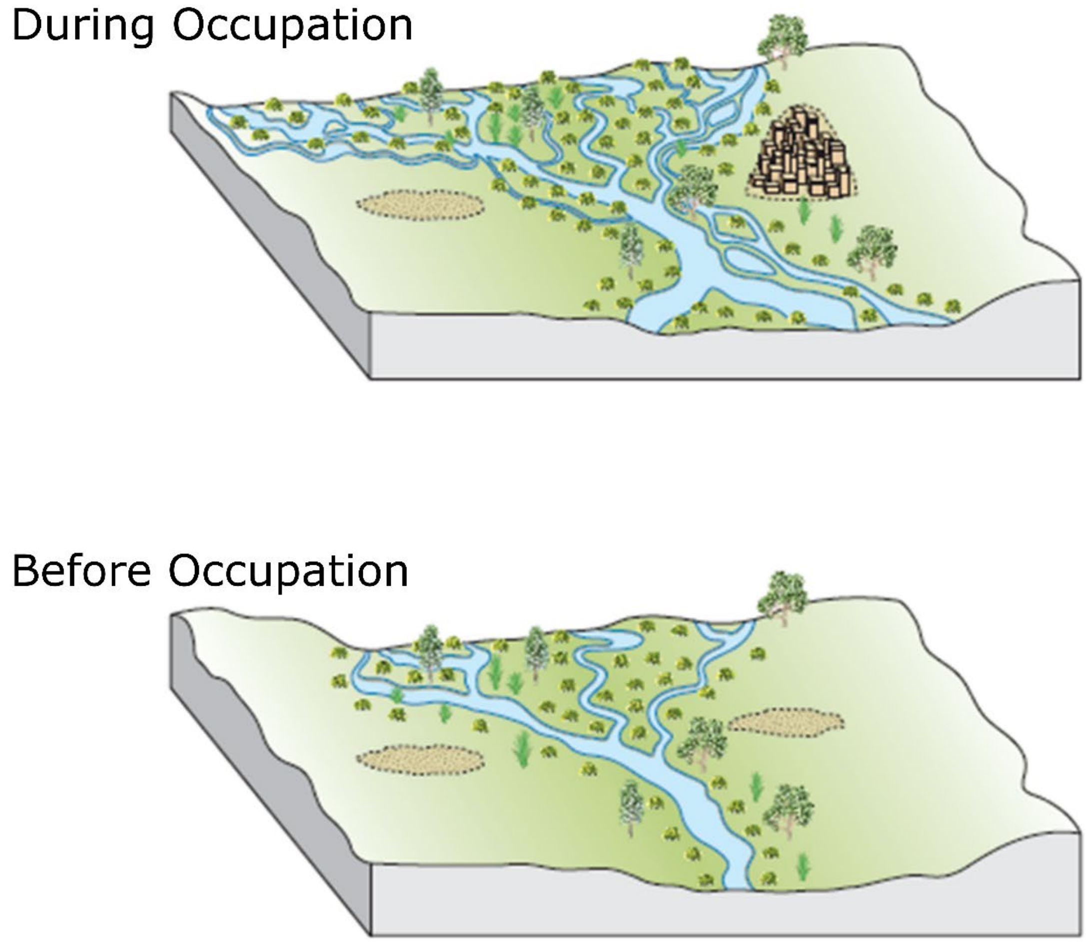

Figure 3: Schematic of landscape development around Neolithic Çatalhöyük before (below) and during (above) the site's occupation based on coring evidence (modified from Ayala, et al., 2017 and Ayala, et al., in press). The schematic shows the humid anabranching system of the Çarşamba River; this multi-channel system became more widespread and convoluted during the site's occupation, creating a mosaic of different habitats around the site including localized wetlands that would have been easily accessible to Çatalhöyük's occupants.

Figure 4: Photographs of modern wetland and riparian vegetation from Central Anatolia. The top image shows reeds growing in wetlands of Nar Gölü (Cappadocia), while the bottom image shows a willow growing near Çatalhöyük along a modern irrigation canal. Photographs by Eleni Asouti and Ceren Kabukcu.

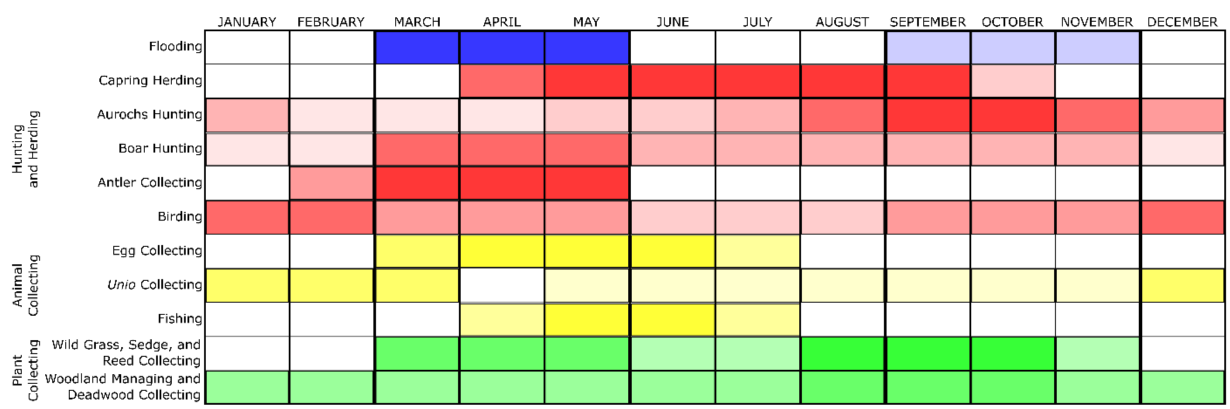

Figure 5: Seasonality chart of different activities that would have taken place in local wetland and riparian habitats around Neolithic Çatalhöyük. Months where an activity is more likely to have occurred based on archaeological and paleoenvironmental data are filled in with a deeper color. These gradations are not specifically quantified, however, and months that are blank do not mean that the activity could not have possibly occurred. Furthermore, deeper color

does not mean that events like flooding would have been at a greater extent but rather were more likely to occur. Activities are grouped into different thematic groups, with the flooding cycle (blue) separated from various animal-related tasks (red), tasks involving the collection of animals (yellow), and the collection of plants (green).

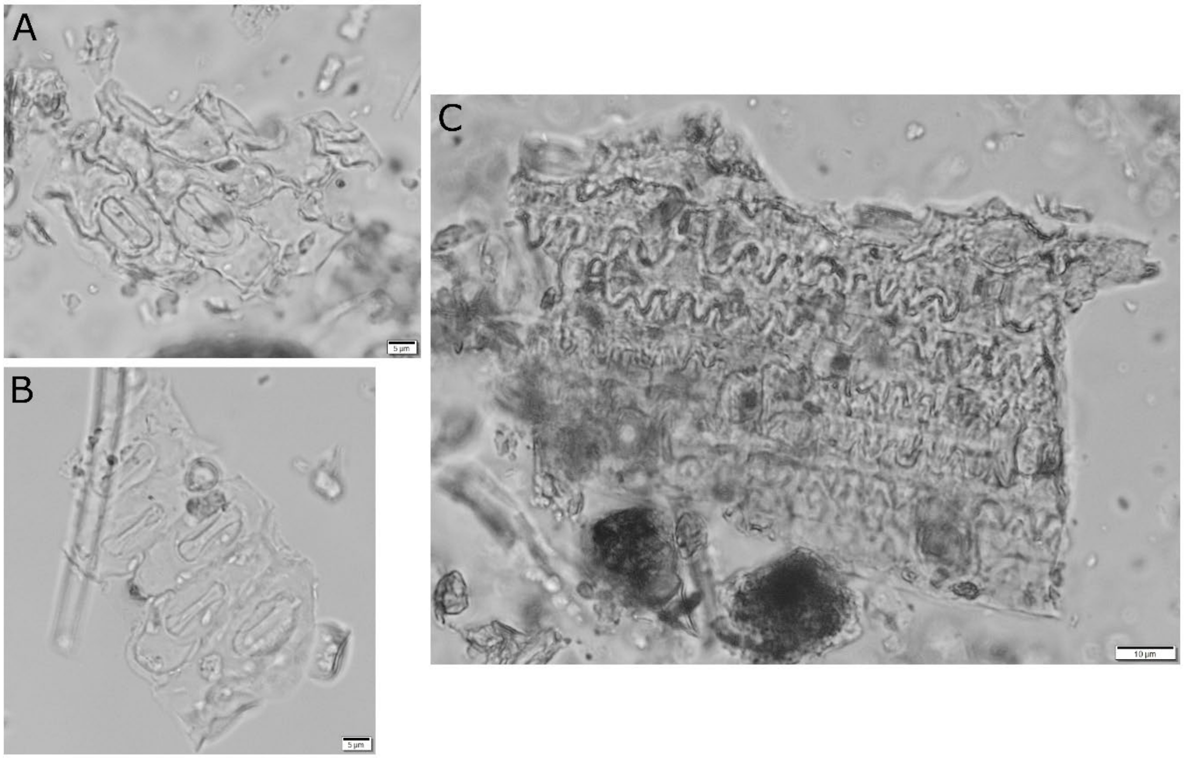

Figure 6: Archaeologically recovered phytoliths from the East Mound's Late Çatalhöyük occupation (South Area, Building 80). Silicified cell structures from reed (*Phragmites* spp.). (A): A completely solidified stomata cells from a mature plant (fully grown). (B): Similar silicified structures at an early formation stage (young leave). (C): Culm cell´s structure. Images at 400 magnification. Photographs by Carlos Santiago-Marrero.

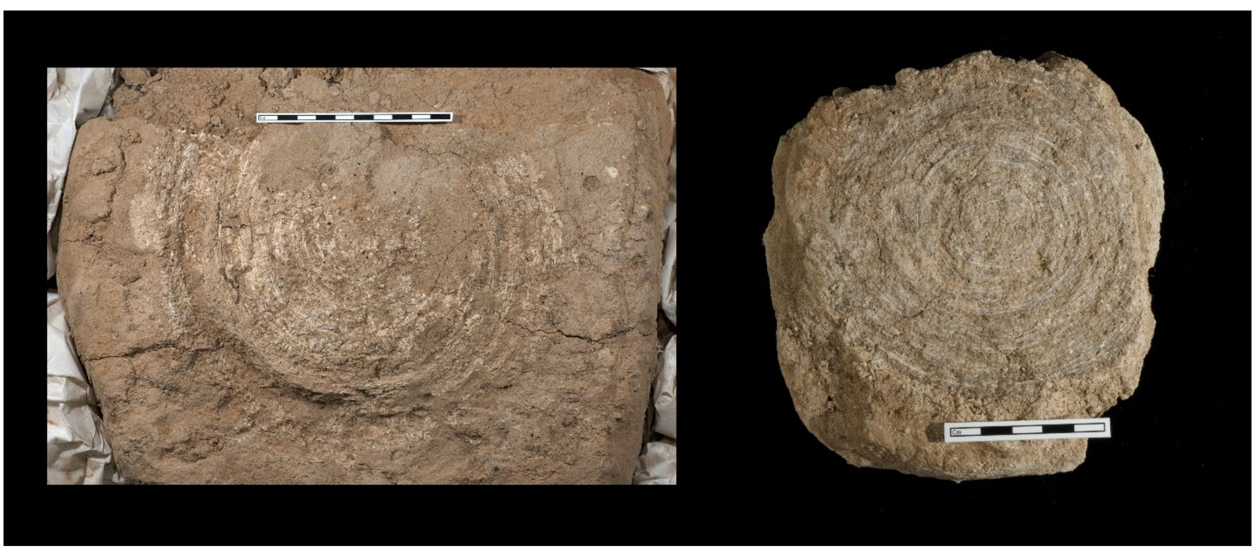

Figure 7: Phytolith impressions of baskets recovered from East Mound's Late Çatalhöyük occupations (Left: South Area, Building 56, U.12806; Right: North Area, Building 55, 12304.X1). Photographs by Jason Quinlan.

Taxon	Fruiting Months							Life Cycle				
	April	May	June	July	August	September	October	Annual	Biennial	Perennial	Plant Stem Height	Typical Habitats
Bolboschoenus glaucus (Lam.) S. G. Smith	X	X	X	X	X					X	100-200 cm	wetlands and riparian
Sporobolus R. Br.		X	X	X	X	X	X			X	up to 40 cm	
Aeluropus Trin.			X	X	X	X	X			X	9-25 cm	
Juncus L.	X	X	X	X	X	X		X		X	5-150 cm	dry or seasonally-wet steppe
Crypsis Aiton		X	X	X	X	X	X	X			2-70 cm	
Artemisia annua L. type				X	X	X		X	X	X	up to 250 cm	
Leguminosae (small, wild)		X	X	X	X	X		X	X	X	up to 250 cm	generally dry

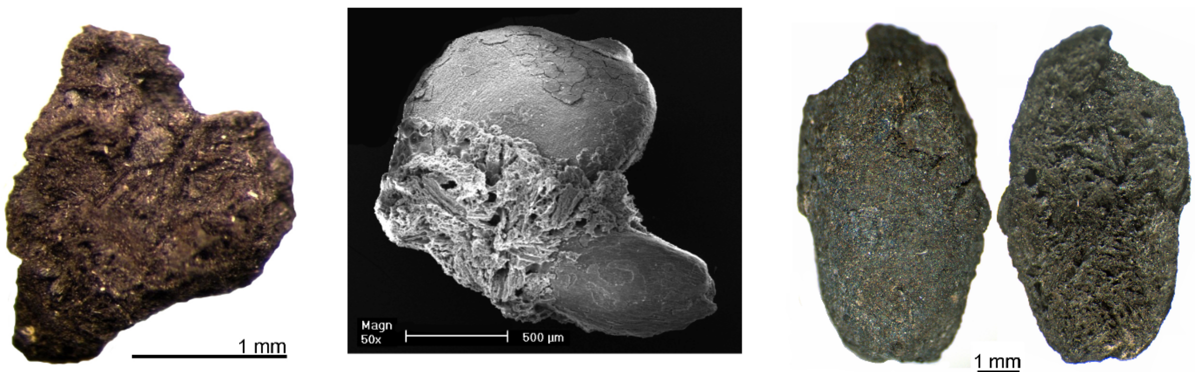

Figure 8: Table of the fruiting months of various wetland-adapted wild plants, showing the months when seeds would have been available for sheep to ingest them. Images show different examples of archaeologically-recovered charred dung fragments with seeds embedded in them. Photograph by Dragana Filipović.


Figure 9: Photograph of modern sheep grazing near the Kars River in Kars, northeastern Turkey. Photograph by Jesse Wolfhagen.

Figure 10: Abandonment pits (Left: F.7832, Right: F.7833) from the East Mound's Early Çatalhöyük occupation (South Area, Building 160) with aurochs bones deliberately placed around the perimeters. Some elements plausibly articulate between the different pits, though more than one animal was included. Photographs by Jason Quinlan.

Figure 11: Modified piece of antler base recovered from the East Mound's Middle Çatalhöyük occupation (South Area, Building 89). While the antler base was used as a tool, the preserved base shows that the antler had shed naturally before it was collected in the past. Photograph by Jason Quinlan.

Figure 12: An assemblage of *Unio* shells from the East Mound's Early Çatalhöyük occupation (Unit 32692). *Unio* bivalves (freshwater mussels) were collected from freshwater ponds, small lakes, and rivers in the vicinity of the site; the mussels were a food source and the shells were a raw material for artifacts. The isotopic composition of freshwater mussel carbonate generally reflects the values of the waters in which they grew, thus these shells are a useful proxy of past climates and ecology, while isotopic analysis of incremental growth lines can provide information about the seasonality of shell collection. Photograph by Rena Veropoulidou.

Figure 13: Pharyngeal tooth plates of *Pseudophoxinus* spp. recovered from the East Mound's Middle Çatalhöyük midden layer (North Area: Space 490). Bones from this genus and *Capoeta* dominate the diagnostic fish bone assemblage at Çatalhöyük. Species in these genera are small-bodied and are likely to have been caught seasonally using hand nets and scoop baskets in shallow waters. Photograph by Sheila Hamilton-Dyer.

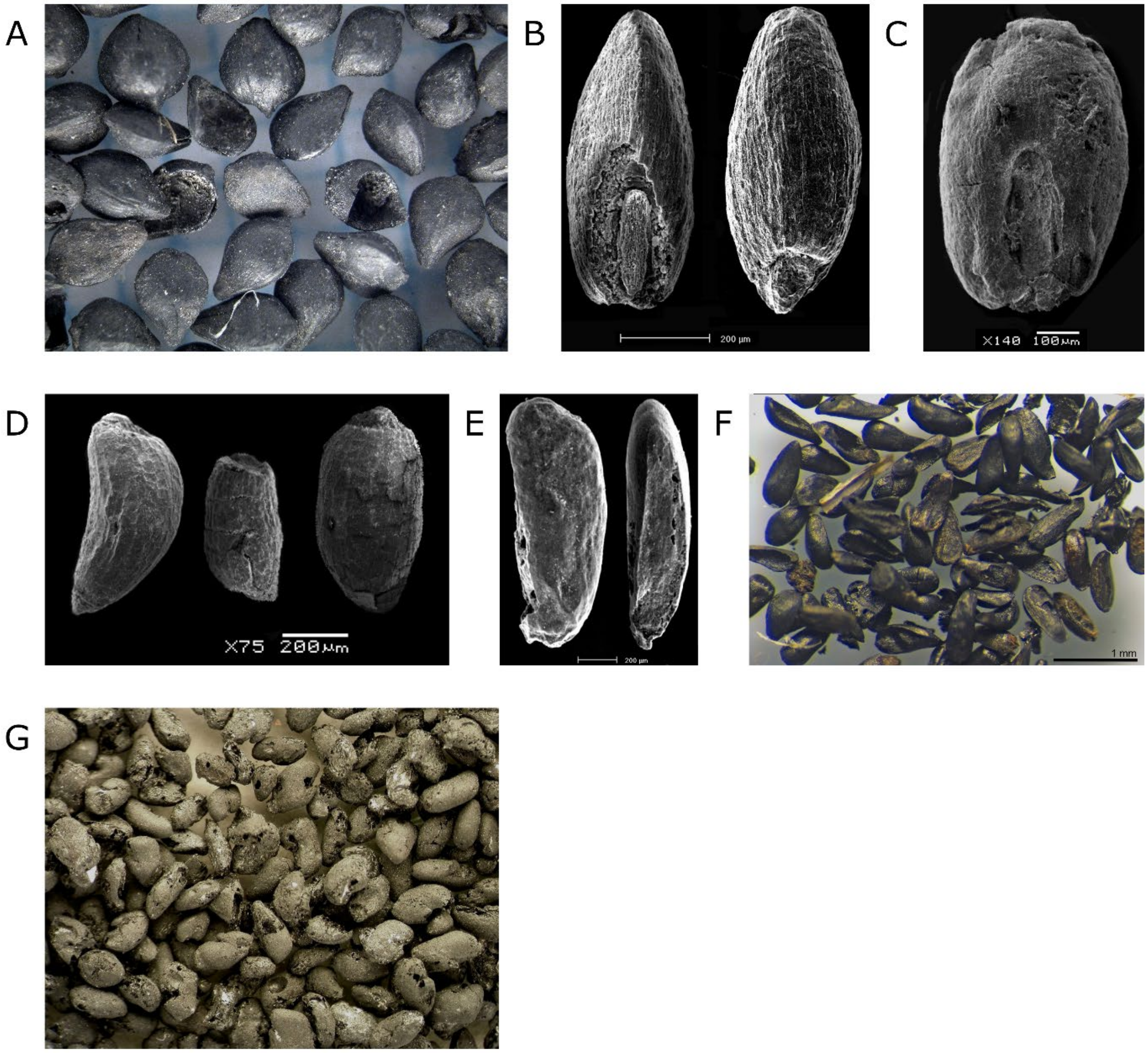

Figure 14: Images of dung-associated seeds from the Çatalhöyük assemblage. The top row includes wetland-related taxa: *Bolboschoenus* (A), *Sporobolus* (B), and *Aeluropus* (C). The middle row includes taxa that grow in dry or seasonally-wet steppes: *Juncus* (D), *Crypsis* (E), and *Artemisia* (F). The bottom row shows various wild *Leguminosae* species (G), which generally grow in dry habitats. Wetland-related taxa are common throughout the site's occupation, while drier ('steppic') taxa are only regularly found starting in the Late Çatalhöyük phase. Photographs by Dragana Filipović.