Long-term human environment interactions in the Neolithic of the central Zagros, 10,000-6000 BC

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Long-Term Human-Environment Interactions in the Neolithic of the Central Zagros of Iran and Iraq, 10,000-6000 BC

Roger Matthews, Wendy Matthews, Kamal Rasheed Raheem, Yaghoub Mohammadifar, Kamal Raouf Aziz, Abbass Motarjem, Robin Bendrey, Amy Richardson, Sarah Elliott, Jade Whitlam, Ingrid Iversen, Mike Charles, Amy Bogaard, David Mudd and Sam Walsh

Note: All dates in this article are given as calibrated BC.

Reconstructing Neolithic EcoSystems in the Central Zagros of Iran and Iraq

The Neolithic transition from mobile hunting and foraging to sedentary farming and animal husbandry is beyond question one of the most significant episodes in the course of human history. Archaeologists have been definitive in assigning epochal importance to this transition, describing it as "the most fateful change in the human career" (Harris 1996: ix), "one of the most significant developments in the existence of the genus *Homo*" (Bogucki 1999: 839) and "the most crucial revolution of humankind after 2.5 million years of cultural evolution" (Bar-Yosef 2001: 117), to quote a few of the more expressive summaries. The long-term significance of the Neolithic transition lies in the fact that the agricultural surpluses accumulated by settled farming communities enabled and encouraged the development of increasingly diverse social structures, in time underpinning complex socio-political entities including the cities and empires that characterize the ancient and modern history of Southwest Asia and much of the world beyond.

As an integral component of these developments in socio-political structures we can delineate a major increase and intensification of the capacity of human communities to affect their environs and environments through management of desired resources, animal, vegetal and mineral. This aspect of the Neolithic transition underlies its characterization by Hillman and Davies (1999: 70) as "the single most dramatic (and ultimately the most catastrophic) set of changes that human society has experienced since the mastery of fire". It is increasingly clear that if we wish to understand the origins of human impact on Earth's ecosystems, a major contemporary concern, then the Neolithic transition from hunting to farming is a critical episode on which to focus our attention. In this article we examine Neolithic human-environment interactions through new evidence generated by an ongoing programme of research into Early Neolithic societies of the Central Zagros region of western Iran and eastern Iraq. The aim of the Central Zagros Archaeological Project (CZAP) is to apply inter-disciplinary analyses to investigation of multiple aspects of the Neolithic transition in a key region of the Fertile Crescent which has until recently been under-represented in academic discussion, largely due to practical and political difficulties in conducting fieldwork in the region (Hole 1996; Barker 2006).

Current research into the Early Neolithic of Southwest Asia is revealing increasing evidence for spatial and temporal variation in ecosystems and human ecological strategies across Southwest Asia during the transition from mobile hunting-gathering to more sedentary farming and animal herding (Willcox 2005; Zeder 2009). Scholars have largely abandoned an ambition to 'explain' the Neolithic transition through articulation of a single overarching theory of change, such as Childe's 'oasis hypothesis', Braidwood's 'hilly flanks' theory or Cohen's population pressure thesis. The emphasis today is more on the delineation of distinctive trajectories of change and continuity as components of detailed, inter-disciplinary programmes of regional analysis. Meaningful reconstruction of human-environment interactions and the inter-relations between humans, climate, plants, animals and materials in the Early Neolithic thus calls for the integration of rigorous contextual approaches involving input from multiple specialists (Asouti and Fuller 2013). Critical components of such a programme include analysis of palaeoclimate and palaeoenvironment, resource management strategies, settlement practices and patterns, technological choices and the social contexts of food production and consumption, as well as the role of social relations and ritual practices of this episode of change.

The Central Zagros Archaeological Project: research context

The Central Zagros region of western Iran and eastern Iraq was a major focus of earlier investigations into the origins of settled farming life. Robert Braidwood's multi-disciplinary approach to the scientific problem of why human communities made the transition from hunting to farming was inspired by his 'hilly flanks' theory. Braidwood held that the earliest farming communities should be looked for in areas of the Fertile Crescent that were likely to have hosted the wild progenitors of the species of plants and animals that were to become domesticated in the Neolithic, such as cereals, pulses, goat and sheep. He identified this zone as the hilly flanks of mountain ranges such as the Zagros and Taurus, and his 1947-55 excavations at Jarmo and Karim Shahir in Iraqi Kurdistan, and later at Asiab and Sarab in western Iran, were specifically designed to test this theory, employing a then innovative combination of the latest natural-scientific and anthropological techniques and approaches (Braidwood and Howe 1960; Braidwood *et al.* 1983). At the same time, rescue excavations in the 1950s at the site of Shimshara on the Rania Plain in Iraqi Kurdistan uncovered levels that appeared to date to the pre-ceramic Neolithic (Mortensen 1970).

Further to the north in the Zagros range, Ralph Solecki's excavations of so-called Proto-Neolithic human burials in level B1 at Shanidar Cave (Solecki *et al.* 2004), and of a circular dry-stone structure and associated materials at Zawi Chemi Shanidar (Solecki 1981), gave some indication of increasing social, ritual and material engagement by human communities of the Zagros during the Pleistocene-Holocene transition. On the Iranian side of the Zagros, excavations at the important Early Neolithic sites of Tepe Guran (Mortensen 2014), Abdul Hosein (Pullar 1990) and Ganj Dareh (Smith 1976) all shed light on settlement patterns, architecture, burial practices and networks of material interaction amongst the communities of the region around 8000 BC. To the south, within the Zagros zone, excavations at Ali Kosh and Chagha Sefid on the Deh Luran Plain investigated levels of eighth and seventh millennia BC date (Hole *et al.* 1969; Hole 1977; 1987a), in a phase which Frank Hole characterised as the Initial Village Period. Amongst its many scientific achievements this project was notable for employing the first flotation machine in Southwest Asia (Helbaek 1969), generating new forms of evidence for ancient diet and environment, and material for radiocarbon dating, which were critical in approaching the Neolithic transition. In southwest Iran, work directed by Delougaz and Kantor investigated Neolithic levels at Chogha Mish and Chogha Bonut (Delougaz *et al.* 1996; Alizadeh 2003). In 1979 work on the prehistory of Iran came to a halt.

During the hiatus in fieldwork in Iran, scholars conducted research into Iranian Neolithic materials excavated in the 1950s-70s. Significant advances were made in understanding of areas such as chronology (Voigt and Dyson 1992; Hole 1987b), zooarchaeology (Hesse 1984; Hole 1996; Zeder 1999; 2006; Zeder and Hesse 2000), archaeobotany (Miller 2003; Charles 2008), lithics (Kozlowski 1999), figurines (Voigt 2000; Daems 2004; 2008), burial practices (Solecki *et al.* 2004; Croucher 2012) and other elements of Neolithic material culture and society, often situating the Iranian evidence within broader geographical contexts (Kozlowski and Aurenche 2005). Work also progressed on analysis of the major lake core records of the region, above all the Zeribar core, and their implications for palaeoclimate studies (Wasylikowa and Witkowski 2008).

The study of the Neolithic of Iran has been revitalised since 2001 (Matthews and Fazeli Nashli 2013). Some of these investigations comprise rescue archaeology in advance of dam construction, such as the Seimarreh river project in the Central Zagros where the Early Neolithic site of East Chia Sabz has been excavated by Iranian archaeologists (Darabi *et al.* 2011; 2013; Riehl *et al.* 2012). In the Sivand dam project of the southern Zagros, Japanese and Iranian archaeologists have explored caves and rock shelter sites spanning the transition from Late Upper Palaeolithic to Neolithic (Tsuneki and Zeidi 2008; Tsuneki 2013). In addition, excavations at Chogha Golan are shedding light on the earliest phases of the Neolithic of the western Central Zagros (Zeidi *et al.* 2012; Conard *et al.* 2013). In the Fars region, excavations at Tol-e Bashi (Pollock *et al.* 2010) and in the Mamasani region (Potts and Roustaei 2006; Weeks *et al.* 2006; Weeks 2013) have begun to elucidate the Neolithic of southwest Iran.

The Central Zagros Archaeological Project thus builds upon an impressive platform of prior and ongoing research into the complex problem of the transition to village farming in the eastern Fertile Crescent. CZAP is a joint UK, Iraqi and Iranian project active since 2007, co-directed by Roger Matthews and Wendy Matthews of the University of Reading, Yaghoub Mohammadifar of Bu Ali Sina University, Hamedan, and Kamal Rasheed Raheem, Director of Sulaimaniyah Antiquities Directorate. The project is supported from 2011 to 2015 by a major grant from the UK Arts and Humanities Research Council.

CZAP RESEARCH QUESTIONS

Developing from the issues discussed above, CZAP examines a series of connected research questions to investigate the Early Neolithic of the region.

Environment

The environmental context for the Neolithic transition in Southwest Asia was shaped by the major climatic shift that characterises the Pleistocene-Holocene interface, resulting in an increase in temperature and precipitation that mark the end of the last Pleniglacial or Ice Age. Within this broad context, our key question is what was the role of climate change and local ecosystems in transitions from hunter-forager to sedentary farmer? Early Holocene climate and environment change in the Central Zagros can be approached through study of lake core records of the region, prime amongst which is the Zeribar core (Wasylikowa and Witkowski 2008) alongside cores from lakes Mirabad and Urmia in northwestern Iran, as well as through ongoing speleothem analysis. A new programme of British Academy supported research jointly conducted by the Universities of Tehran and Reading will investigate issues of climate change and human interaction during the Neolithic and beyond.

Chronology

Clearly an informed understanding of relative and absolute chronology is critical to investigation of issues such as the earliest domestication of species of plants and animals, and the routes and means by which farming practices and domesticated species spread from core areas outwards. It has been suggested that there was a 1500-year gap in occupation at *ca*. 10,000-8500 cal BC, at least in the high Zagros (Hole 1996), but might this apparent hiatus rather be a factor of the restricted distribution of previous fieldwork? New excavations, including those of CZAP, are re-examining the chronology and direction of spread of Neolithic practices such as sedentarisation, intensified animal husbandry and crop cultivation.

Changing human, plant and animal inter-relationships

A key characteristic of the Neolithic transition is a fundamental shift in the nature of relations between humans, plants and animals from more mobile hunting-gathering to more sedentary herding and farming. There is increasing evidence of multiple centres of innovation in human plant and animal inter-relations (Willcox 2005). What was the role of communities in the Central Zagros in these transformations, where there were natural stands of wild barley and herds of wild goat, for example? How can we characterize human, plant and animal inter-relationships in the Zagros and how did they change through the Neolithic (Zeder 2009)?

Sedentism

The settling down of human communities in permanent or semi-permanent sites is a distinctive feature of the Neolithic transition (Bar-Yosef 2001), but as yet we have little understanding of precisely how Neolithic communities acted out the change from seasonally mobile to permanently resident. In order to address this complex question we are conducting detailed, inter-disciplinary studies of all aspects of early architecture and settlement, including evidence of seasonality such as plants, birds, snails and other micro-fauna and flora.

Ritual, feasting, material engagement, contact and exchange

An emphasis on cultic and social aspects of the Neolithic transition in Southwest Asia broadly has frequently been a focus of investigations over the past 20 years (Cauvin 1994; Hodder 1990). There has, however, been some question concerning cult and ideology in the earliest Neolithic of the eastern Fertile Crescent, suggesting that they were less significant in the lives of communities (Bernbeck 2004). Could evidence for cultic significance have been overlooked in the available evidence? Might this suggestion be revised with more excavation in the region? A key CZAP question therefore is what were the roles of ritual, feasting and material engagement and networks in socio-cultural and ecological transformations in the Neolithic of the Central Zagros?

METHODS

Within CZAP we are applying a wide range of inter-disciplinary approaches to study multiple data sets on societies and ecosystems, including palaeoclimatology, zooarchaeology, archaeobotany, micromorphology, material culture analysis, and pXRF analyses of a range of materials.

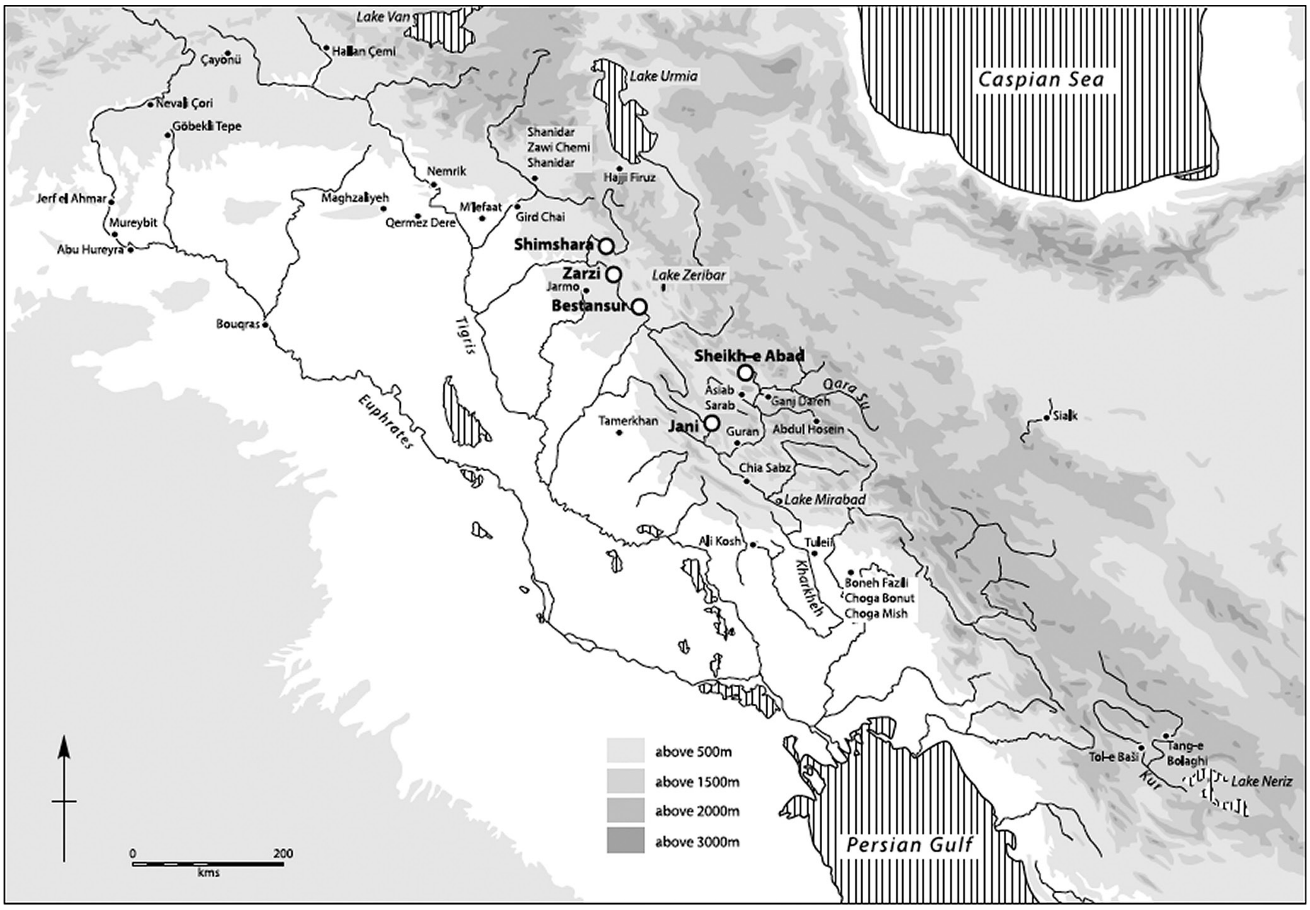

Fig. 1. Map to show location of excavated Neolithic sites.

Four key pre-pottery Neolithic sites have been excavated in order to study ecosystems and communities on an ecological transect through the Zagros mountain range, from Sheikh-e Abad and Jani in the highlands to Bestansur and Shimshara in the piedmont or hilly flanks (Fig. 1). Excavation employs trenches for diachronic investigation and open-area trenches to examine buildings, external areas, middens and streets/corridors. Excavated deposits are quantified, sieved, floated, sampled, and processed for recovery of lithics, ground-stone, clay tokens, figurines, faunal and botanical remains (macro and micro), phytoliths, molluscs, and architectural materials. By these means we are investigating a unique transect of Early Neolithic sites across the Zagros chain to investigate highland-lowland variation in options and strategies during these transformations, from Sheikh-e Abad at 1430 m above sea level in the high Zagros to Bestansur at 550 m in the Zagros foothills to the west. We have also conducted survey in the Zarzi region to investigate whether there are any Early Holocene Neolithic sites in this known area of Palaeolithic occupation in cave sites. Here we identified an open-air Epi-palaeolithic site on the opposite side of the river to Zarzi, but no Neolithic sites.

The highland Zagros

The newly excavated sites are filling a previously suspected gap in occupation in the high Zagros from the end of the Younger Dryas cold period at *ca*. 9800 BC to a peak in the foundation of sites from 8500-8000 BC. According to pollen from Lake Zeribar, the earliest sites such as Sheikh-e Abad were founded at the very outset of an increase in grasses, as well as a dramatic increase in the incidence of fire, arguably associated with human activity (Wasylikowa and Witkowski 2008). The surge in the foundation of new sites in the later ninth millennium BC corresponds with a peak in grasslands and evidence of vegetation disturbance attested by ribwort plantain (*Plantago lanceolata*).

In the highland Zagros northeast of Kermanshah the Early Neolithic site of Sheikh-e Abad was founded on a plain by a spring at an ecotone boundary at the base of 3000m-high mountains (Fig. 2). Three horizons were investigated at the base, middle and top of the 10m-high mound, in Trenches 1-3, which span 2200 years from *ca*. 9800-7600 BC (Matthews *et al.* 2013). The earliest occupation, in Trench 1, is represented by a series of constructed

Fig. 2. View of Sheikh-e Abad mound, Kermanshah province, Iran.

surfaces and accumulations of ash with burnt bone and omnivore coprolites, dating to the tenth millennium BC. In Trench 2, 6m above the base of the mound, dated to *ca*. 7960 BC, there was a series of multiple finely stratified surfaces and in situ burning, rich in ash from nut shells, burnt animal dung, and a figurine. These were overlain by well-constructed architecture and middens.

At the top of the mound, in Trench 3 at *ca*. 7590 BC, a complex of small-roomed buildings and a probable cultic building with five wild goat and sheep skulls were excavated (Fig. 3). Finds include a bird wing-bone, clay tokens and worked bone tools. Micromorphological analysis has identified animal dung both inside Building 1 in a small pen, as well as outside the buildings, attesting close proximity and management of animals. In addition, goat is the most common species recorded in the zooarchaeological assemblage in both Trenches 2 and 3 (Bendrey *et al*. 2013). The well-preserved teeth of Neolithic human burials suggest the diet of six excavated individuals was not heavily reliant on cereals, and more closely representative of hunter-gatherer diet (Cole 2013).

Archaeobotanical analyses of the charred plant remains suggest that there were both wetland and dryland habitats close to Sheikh-e Abad (Whitlam *et al*. 2013). In the earliest levels, there are many large-seeded grasses, perhaps deliberately collected, while large-seeded legumes and cereal types are notably absent. The greatest diversity of plants is attested at *ca*. 8000 BC, in Trench 2. Here there is evidence of some domesticated barley and wheat and storage of large-seeded legumes, but also collection of almond and pistachio nuts. The presence of house-mouse droppings suggests these resources contributed to support of year-round communities at the site. By 7590 BC in Trench 3, the diversity of charred plant remains is reduced. The predominant charred plant species are from small-seeded grasses, such as *Poa*, that were probably consumed by animals and burnt as dung fuel.

Micromorphological analysis is widening our knowledge of the range of plant resources utilised by past communities and the ecosystems that they represent (Matthews *et al*. 2013). It enables study not only of burnt but also non-burnt plant remains, and fragile leaves and stems

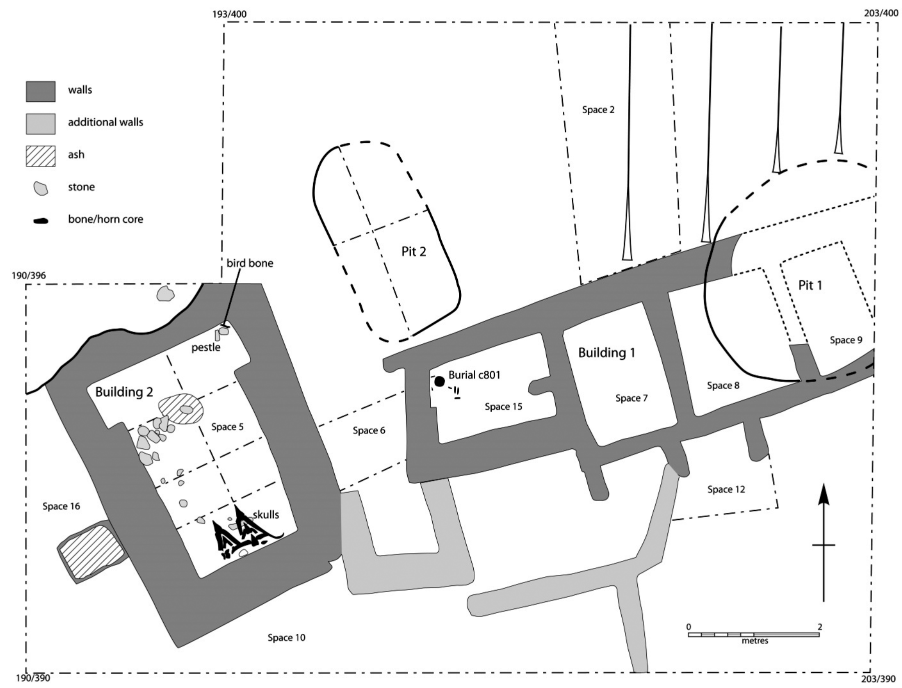

Fig. 3. Plan of Trench 3 architecture, Sheikh-e Abad.

that may be disarticulated during water-flotation. It also enables study of depositional context, which is crucial to interpretation of the taphonomy and significance of plant remains. By quantifying the plant remains as a percentage by area in archaeological sediments, it is evident that charred plant remains often represent <50% of the plants preserved in archaeological deposits. Plants are also preserved as impressions, phytoliths, ash and in dung. As one example, abundant traces of nuts have been identified, preserved not as charred remains, but as fragile ash. This suggests that nuts were an important resource during the early stages of crop domestication and animal management at *ca*. 8000 BC. Also abundant were grasses, reeds and animal dung and omnivore coprolites. In addition, micromorphology combined with archaeobotany has enabled identification of widespread traces of dryland grasses and reeds attesting both wetland and dry land ecosystems, as well as animal dung and omnivore coprolites.

Combined phytolith, GC/MS and micromorphological analyses have enabled identification of compacted layers of non-burnt dung in a small pen in Trench 3 at Sheikh-e Abad, dated to *ca*. 7960 BC, as well as periodic, perhaps seasonal, variation in animal diet or management and ecosystem abundance, represented by alternating layers rich in tree/shrub phytoliths and grass, reed and sedge phytoliths (Shillito and Elliott 2013).

At Jani, to the southwest of Sheikh-e Abad in the lower highland Zagros (Fig. 4), a marked increase in the size and intensity of settlement, represented by multiple surfaces and ash, corresponds with the first evidence for use of animal dung as fuel, at *ca*. 8000 BC. This coincidence suggests that the proximity and management of ruminant herds was a key factor in the transition to greater sedentism. The integrated analysis of dung and zooarchaeological evidence from Sheikh-e Abad and Jani suggests that animal management and goat domestication, in particular, spread outwards from the highlands of the Zagros. This interpretation is based on the evidence for the use of dung fuel at *ca*. 8000 BC at both Sheikh-e Abad and Jani, for the penning of animals at Sheikh-e Abad by *ca*. 7600 BC, and for intensified management of goats at the nearby site of Ganj Dareh by *ca*. 7900 BC (Zeder 2006). These developments in intensified goat management are followed by an initial movement of managed animals out of the highland region, as attested at lowland Zagros sites such as Bestansur by *ca*. 7600 and Ali Kosh by *ca*. 7500 (Hole *et al.* 1969). It is not until the later Neolithic at Jarmo, at *ca*. 7000 BC, that goat becomes the dominant food animal in site assemblages in the Central Zagros piedmont zone (Stampfli 1983).

Fig. 4. View of Jani mound, Kermanshah province, Iran.

The lowland Zagros

The lower piedmont site of Bestansur in Iraqi Kurdistan, at 550m above sea level, lies close to a large perennial spring, with river, hills, mountains and the arable land of the Shahrizor Plain within easy reach (Fig. 5). At Bestansur we have excavated 13 trenches to investigate an extensive Neolithic settlement, dating to *ca*. 7700-7100 BC and covering *ca*. 2.5 hectares in extent. We have uncovered open areas used as shell middens and for butchery, craft production and cooking, as well as groups of rectilinear buildings constructed of mud-brick and pisé. The buildings share the same NW-SE orientation, suggesting a degree of community-wide planning and collaboration. One of these, Building 5 in Trench 10, was a large, well constructed building with more than 28 human burials, most placed below the floors of the largest room (Fig. 6).

At Bestansur, the abundance of female goats retained into adulthood suggests herd management, as at Ganj Dareh. This interpretation is further supported by evidence for the presence of animals on or close to the site, represented by a shed tooth from a young goat, and by widespread use of dung fuel. Sheep by contrast, appear to have been only hunted, as they are predominantly represented by wild adult males. In addition, domesticated cereals and pulses, although attested, are present in low numbers. In thin-section, however, phytoliths from grasses and reed leaves and stems are abundant, used as fuel, matting and fodder/grazing, as they are present in dung, suggesting abundant wetlands and grasslands in the vicinity of the site.

That butchery and discard practices clearly have a major impact on the archaeological representation of species is attested by the variation in species across the site, and highlights the need for excavation of different areas of any site. Sheep, pig, cattle, and red deer bones are more abundant away from the centre of the mound in open areas, where they were butchered and discarded. Fish, by contrast, are much more abundant closer to the centre of the settlement, where they were likely brought in and prepared whole, along with small mammals which may have been commensal with humans.

The location of the site on a boundary between multiple ecozones enabled the community at Bestansur to use a wide range of resources during the early stages of animal and plant domestication. They made use of a broad spectrum of resources including large quantities of molluscs (*Helix salomonica*), water birds, crab and fish, in addition to larger mammals. Access to these ecosystems may have required at least periodic residence away from the site, or engagement in networks with other communities, as suggested by the high number of secondary burials, at least 75 individuals and many of them juveniles, in an elaborate building in Trench 10, Building 5, with a carved stone in the entrance and traces of red pigment on the floors and walls.

At the site of Shimshara, 500 m above sea level, the Neolithic settlement was located close to the current and probable ancient course of the Lesser Zab river, and was also on ecosystem boundaries between riverine, plain and hill zones (Fig. 7). Our excavations at Shimshara show that the inhabitants exploited predominantly pigs, but also a range of other mammalian taxa, wild fowl and fish. Nuts, cereals and pulses were also used. There is thus considerable local variation in resources across the Zagros region, particularly in the principal exploited animals. Goat are more abundant in the highlands, sheep at Bestansur and pig at Shimshara. If we examine animal bone evidence from a wider range of sites and their local ecosystems, it is clear that Early Neolithic communities in the Zagros and beyond were developing ecological strategies that made the

Fig. 5. View of Bestansur mound, Sulaimaniyah province, Iraq.

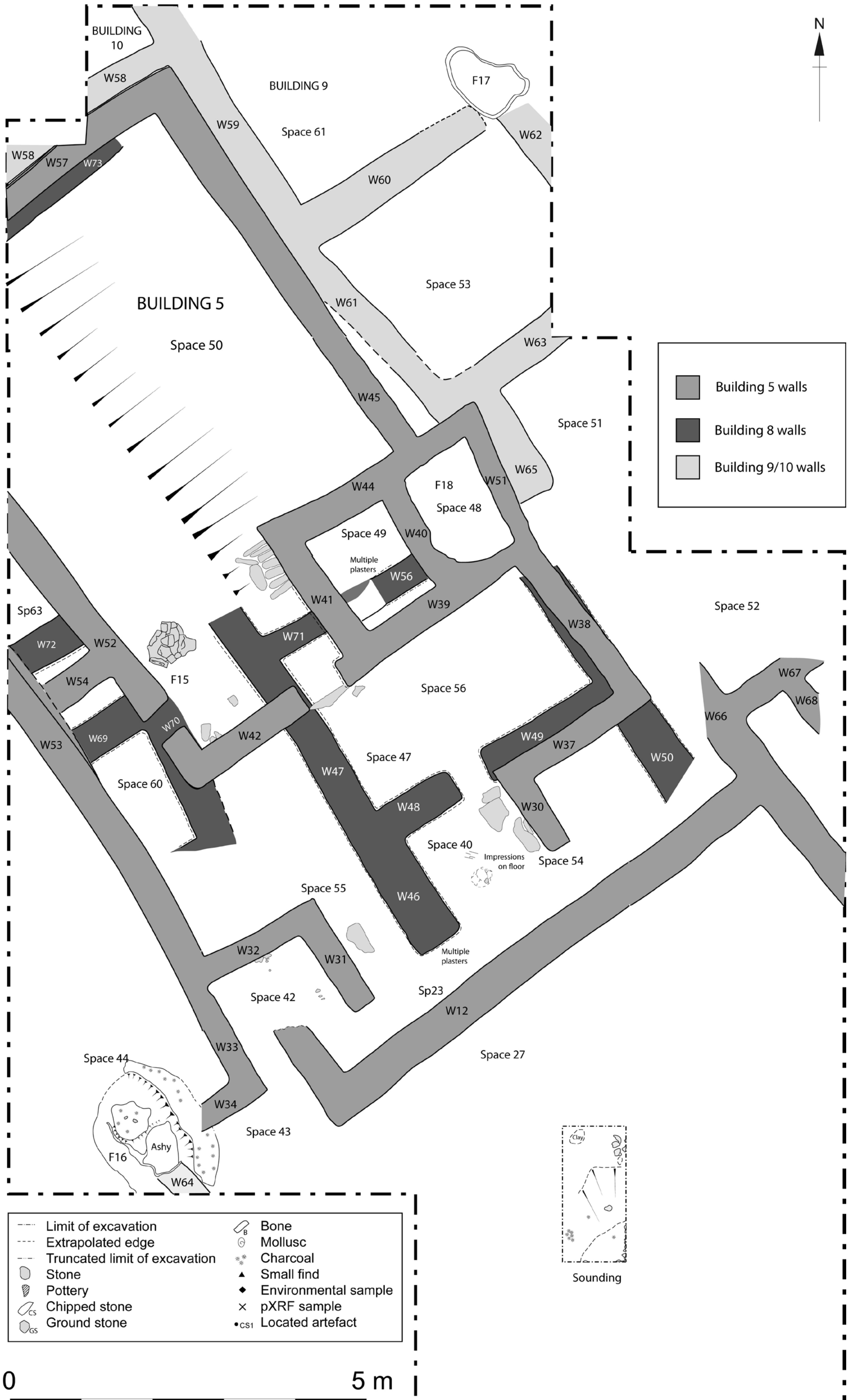

Fig. 6. Plan of Trench 10 architecture, Bestansur.

Fig. 7. View of Shimshara mound, Sulaimaniyah province, Iraq.

optimum use of locally and regionally abundant resources. If we consider wider regional patterns, it is evident that goat were most abundant in their natural habitat in the uplands, sheep are well represented in the piedmont at sites such as Shimshara and Bestansur, and gazelle in the lowland steppe at Nemrik and Qermez Dere to the west of the Zagros zone (Lasota-Moskalewska 1994; Dobney *et al.* 1999).

When we map the altitude of Zagros sites and other on-site ecological data in order to study ecosystems, it is evident that the wetlands were more extensive in the Early Holocene than today, that dry grasslands were also abundant, as attested by the Lake Zeribar core, and that there was less wood in the steppe/plains areas. We are also recovering independent palaeoclimate and environment data in order to investigate the interactions between human communities and changes in environmental factors such as temperature and precipitation.

Alongside the bioarchaeological analyses, we are studying Early Neolithic material networks and issues of access to other local and wider ecosystems and resources, including mechanisms of contact and exchange of ideas and practices. At Bestansur, portable x-ray fluorescence analysis of multiple materials has confirmed use of local resources such as clay, limestone, gypsum alabaster and chert, as well as access to more exotic materials such as dentalium shell, carnelian, serpentine and obsidian from Lake Van sources. There are distinctive patterns in access to the more exotic materials. The Early Neolithic sites of the high Zagros, such as Sheikh-e Abad, for example, lack any evidence for use of obsidian, making exclusive use of locally available cherts for their chipped stone tools, while the lowland Zagros sites, slightly later in date, make use of significant quantities of imported obsidian alongside local cherts. At Bestansur, ground stone tools are generally manufactured from locally available stone sources, although some appear to have been imported as finished artefacts from sources 30-40 km distant from sites.

The sources of these materials and shared artefact types, such as the classic obsidian tools known as Çayönü tools and distinctive ground and polished marble bracelets (Kozlowski and Aurenche 2005), emphasize the importance of Bestansur in its access to resources from multiple ecosystems and its location at a crossroads of material networks and social contacts reaching at least from the Iranian plateau to the east to the Lake Van region to the northwest. Sustainable local ecosystems and widespread networks, therefore, provided a context that enabled greater sedentarisation and social and ritual elaboration, such as that attested by the elaborate painted buildings with multiple layers of plaster at the base of Trench 10 at Bestansur which we plan to excavate in the future.

Conclusions: addressing the research questions

In conclusion, we summarise some key issues here in response to the research questions articulated above, while noting that at present a total of some 40 international collaborators are conducting analysis and interpretation of all aspects of the material past of the CZAP sites prior to final publication of the 2012-2017 field seasons at Bestansur and Shimshara, following the full publication of the earlier work at Sheikh-e Abad and Jani (Matthews *et al.* 2013).

Environment

Plant and animal remains from the four excavated sites indicate that human communities made rich use of diverse local environments and that many sites were on ecotone boundaries, with access to plains, hills, wetlands and mountains and all their natural resources. A major component of the next phase of research will include integrated study of climate proxy records, including lake cores and speleothems, in order more fully to examine the Neolithic transition of the Central Zagros region within its palaeoclimatic and palaeoenvironmental contexts.

Chronology

While further radiocarbon dates are keenly needed, those obtained so far, in particular from Sheikh-e Abad, strongly indicate that the high Zagros of western Iran did not undergo a significant hiatus in human presence during the period 10,000-7500 BC. Filling this gap suggests that the climatic conditions at altitudes of *ca.* 1400 m were not so adverse as to discourage human, and other, activity during the latest stages of the Younger Dryas cold spell and the immediately following centuries. Dates from the lower Zagros, both to the west and the east of the high Zagros, presently indicate that Neolithic developments in the foothills and lower slopes succeeded those in the high zone. There is always the possibility, however, that earlier sites remain to be discovered in the lower Zagros regions, as suggested by the early dates for Chogha Golan (Conard *et al.* 2013), and we know that sites such as M'lefaat, Nemrik and Qermez Dere on the Upper Mesopotamian plains to the northwest were settled well before 9000 BC (Matthews 2000: 35-39).

Changing human, plant and animal inter-relationships

The emerging picture from all four excavated CZAP sites supports current models of the Neolithic transition which lay stress on locally contingent strategies for human communities in their engagement with the natural and material worlds around them. Intensified plant cultivation and animal management are attested by *ca.* 8000 BC, while animal penning is indicated by stratified dung deposits within built spaces by at least *ca.* 7600 BC. Throughout the Early Neolithic, human communities of the Central Zagros, however, also continued to pursue hunting and gathering activities in conjunction with the newly emerging strategies of animal husbandry and plant cultivation.

Sedentism

The process of change from seasonal mobility to permanent settlement appears to have been complex and non-linear. It is likely that significant elements of Early Neolithic societies retained a strong degree of seasonal mobility, in particular for exploitation of more distant natural resources such as hunted animals of the upland zones. There is increasing evidence from sites such as Sheikh-e Abad and Jani, as well as from previously excavated sites such as Guran and Ganj Dareh, to suggest long-term episodes of seasonal human presence at these Early Neolithic sites prior to the construction of significant architecture in the form of mud-brick and pisé buildings. Even when we do have substantial buildings we are not yet sure that they were occupied year-round rather than seasonally. Further work on micro-fauna, birds, plants and other seasonal indicators remains to be carried out. What is clear is that the development of intensified sedentism, attested by significant rectilinear architecture, appears to coincide with a step-change both in the cultivation of plants and in the management of herded and penned animals from *ca.* 8000 BC.

Ritual, feasting, material engagement, contact and exchange

The small building, Building 2, with carefully arranged wild goat and sheep skulls on its floor in Trench 3 at Sheikh-e Abad gives further indication of the significance of cult and ritual display of wild animals in the Early Neolithic of the Central Zagros. At Bestansur in the lowland zone, the burial of at least 75 individuals under the floors of a large room in Building 5, most of them in highly disarticulated state and some of them with burial goods in the form of beads of shell, clay and occasionally semi-precious stones, suggests that Building 5 had a significance beyond a role as a domestic dwelling, perhaps analogous to the 'history houses' identified on the basis of multiple sub-floor human burials at Çatalhöyük in central Anatolia (Hodder 2006).

Early Neolithic communities of the Central Zagros were intimately engaged in wide-ranging networks of material and social interaction, at least from *ca.* 8000 BC, involving access to cherished materials such as obsidian, carnelian and sea-shells. These exotic materials are likely to have accrued social status through their association with remote places and to have been used to augment the status of those who were engaged and endowed with these. Such trans-regional movements and networks must have underpinned the material manifestations of connectivity attested in such widely distributed special objects as obsidian Çayönü tools and polished marble bracelets, which are found at multiple sites across the northern and eastern Fertile Crescent (Kozlowski and Aurenche 2005).

In conclusion, the new results from CZAP investigations at four key Early Neolithic sites in the Central Zagros of western Iran and eastern Iraq provide increasing evidence of the diversity as well as connectedness of human communities during the transition to increasing sedentism and management of resources while transforming from hunter-forager to farmer-herder. Availability of local resources was clearly a significant factor in enabling ecological and social strategies and interactions with changing climatic and environmental conditions in the Early Holocene. The evidence of networks and engagement in trans-regional interactions at Bestansur in particular, however, clearly highlight ways in which specific materials, knowledge and innovations were shared and exchanged across large areas of Neolithic Southwest Asia.

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