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Environment and Rock Art in the Jebel Ousselat, Atlas Mountains, Tunisia

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Abstract

The Jebel Ousselat, on the eastern edge of the Atlas Mountains in Tunisia, is a semi-arid, degraded upland landscape; in many ways, it is a marginal environment. Here we present evidence from the early to middle Holocene (ca. 6200–4200 BC), a period of significant climate change in the wider region, moving from the African Humid Period towards an arid environment and the development to the south of the Saharan desert. Employing rock art and lithic evidence from across the landscape, we consider how these strands of archaeological evidence intersect and facilitate the description of human-environment interactions that were wholly different from those we see today. The interpretation of the full range of sites is underpinned by a landscape/environmental framework that considers site location and relationships with topography and hydrology. We also develop a socio-ecological approach that avoids environmental determinism but willingly accepts the role that the environment plays in contributing to the structure of human activity in a complex landscape. The art and archaeology of the Jebel Ousselat reflect complex interactions during a period of environmental, economic and cultural change. We feel that the art is not a mere reflection of food procurement but instead points to the production of complex socio-ecological relationships during a period of transition.

Keywords: rock art, Tunisia, uplands, environmental change, prehistory (Capsian, Neolithic)

Introduction

Research Questions

Today, many southern Mediterranean upland landscapes are degraded. Denuded land-surfaces with sparse vegetation typify many areas where rural populations often struggle to extract a living. Such landscapes represent a specific form of the Anthropocene (Maslin and Lewis 2015; Steffen *et al.* 2011): these are environments that have suffered from human mismanagement. The Anthropocene is defined as a geological epoch that will be identifiable in the future via sedimentary deposits; these are the product of humanity's significant impact on all environmental systems, including geology, ecology and obviously, the climate. The traumatism of the maladapted exploitation strategies of the nineteenth and twentieth centuries, often the product of colonial systems and the imposition of centralised economic and landscape management strategies, has resulted in the emergence of some highly impoverished environments that have moved beyond a significant tipping point (Auclair 2001; Gammar 1991). The upland landscapes of northern-central Tunisia typify this process (Figure 1). Today soil cover is superficial, and population levels are extremely low. Pastoralism and the exploitation of forest products, such as essential-oil production (thyme), are the principal economic activities. Sheep and goat dominate the fauna in the modern *jebel* (mountainous) landscape, and there is little doubt that changes in pasture management have played their part in the creation of the modern degraded landscape (see below).

>>Insert Figure 1 about here<<

This study assesses human-environment relationships during the Capsian and Neolithic (ca. 6200-4000 BC) (see Figure 2 for all dates) in an arid, upland landscape in central Tunisia — the Jebel Ousselat. The evidence from the Jebel Ousselat comprises a series of sites spread across the *jebel*. These include shell-middens (*rammadiya*) with lithics and, most importantly, rock art. The term itself is derived from the Arabic *rmad*, which means 'ash'; these sites are also referred to as *escargotières*. We consider the extent to which the rock art sites and archaeological material allow us to reconstruct the nature of prehistoric lifeways in this landscape. We emphasise the importance of the very different environmental conditions that were present during the middle-Holocene and consider how the archaeological evidence facilitates the elucidation of past lifeways in this area during this period. The rock art, or rather motifs, depict a phase in this

landscape's trajectory when the environment was significantly different and undoubtedly more stable and bountiful. Artistic motifs or depictions are often considered a form of socio-ecological representation (Bradley *et al.* 1994). An important question or theme involves the extent to which the evidence, especially rock art, represents the endeavours of hunter-gatherers and/or pastoralists, or possibly, communities engaged in both sets of practices.

>>Insert Figure 2 about here<<

The structure of the paper is as follows. First, we present the context for this study, then a review of the main landscape and environmental characteristics. This is followed by an explanation of the methodology and the characteristics of the dataset. The central part of the paper presents the evidence, with an emphasis on the rock art. Our analysis develops its main argument using the motifs of the two key rock art sites: R'mada and Aïn Khanfous. The discussion of the archaeological evidence develops inferences that draw on our understanding of the Middle Holocene climate of the region. This underpins our interpretation of human-environment interactions during the Capsian to Early Neolithic in the Jebel Ousselat.

Context of the Study

Located on the Tunisian ridge, an extension of the Saharan Atlas, the Jebel Ousselat is part of the inner fringe of the Mediterranean, immediately to the north of the steppe and the desert (Figure 3). Due to its central geographical position, it has been influenced by cultural and environmental processes emanating from the Atlas Mountains, the Sahara and the Mediterranean, from prehistory to the present. The archaeological study of rock art in Tunisia is less developed compared to other countries in the Maghreb, notably Algeria and Libya, where there are numerous sites and associated studies (Lhote 1984; Hachid 1992, 1998, 2000, 2015, 2016; Jelinek 2000; Le Quellec 1987, 1993, 1998, 2013; Zerboni 2012).

The dearth of Tunisian rock art publications is due more to the lack of surveys and investigation, rather than to a real absence of sites. The development of systematic surveys mainly in central Tunisia (Ben Nasr 2007) has demonstrated that rock art in Tunisia is not as rare as once thought and our research in the Jebel Ousselat provides a noteworthy example of a landscape containing a significant rock art corpus. The Jebel Ousselat is particularly significant, as it contains the richest and most varied rock ensemble known in Tunisia, with paintings and

engravings of different styles from different periods. Moreover, it permits the consideration of stylistic and thematic connections with the corpus from the North African Atlas and Sahara.

>>Insert Figure 3 about here<<

The rock art and lithic data are derived from Ben Nasr's thesis research (Ben Nasr 2007), and the present study is the product of joint field visits by the two authors, with Walsh developing the paleoenvironmental and interpretive elements. While other researchers have used the Jebel Ousselat data (e.g. Yahia-Achèche 2009), none has developed an archaeological and palaeoenvironmental contextual perspective.

Geography and Geology

Formed mainly during the Upper Eocene and Pleistocene, the Tell Atlas (Mountains) stretch from Morocco, where they attain their highest point (Jebel Toubkal, 4165 m), across to the east terminating at the Tunisian coast (Frizon de Lamotte *et al.* 2000). The Jebel Ousselat is located on the southeastern edge of the range in Tunisia. The key feature is a significant anticline comprised of limestone on brown marl. At the foot of the Kef Taourit, there is a flint horizon within limestone layers (Pervinquière 1903: 181). To the east of the *jebel* lies the vast and fertile alluvial plain of Kairouan. This is important as this region provides a significant environmental contrast to the *jebel* in that it is characterised by reasonably well-watered agricultural land. The Jebel Ousselat dominates the plain of Ouesslatia and Marguellil to the west and the Haffouz depression in the south.

The Jebel Ousselat is about 10 km wide and 15 km in length. A slight undulation subdivides it, and its highest area comprises a plateau that is cut by deep ravines with abutting long ridges (Figure 4). Its highest peak reaches 881 m at Kef-el Guitoun, 887m at Taourit and 895 m at Chaib. These altitudes are lower than those of the large *jebels* of the Tunisian Ridge that rise farther to the west (Jebel Serdj: 1357 m, Bargou: 1242 m). The landscape encompasses a labyrinth of ridges and valleys, centred on a plateau dissected in several directions. This highly eroded dome has given way to wadis cut into the bioclastic and nummulitic limestone (limestone that contains numerous, large lenticular fossils) (Rigane *et al.* 1998). The limestone surface of the Jebel Ousselat has eroded in many places and is dominated by gullies and sinuous ridges (Boukadi and Zargouni 1991).

>>Insert Figure 4 about here<<

Modern Environment

Soil cover across the Jebel Ousselat is negligible, although there are areas where soil has been trapped and comprises relatively thick units. However, the wadi-beds are laden with pebbles, transported either during storms or as colluvial sediments derived from scree on the slopes. These features typify this degraded landscape. Today's environment is characterised by a harsh and dry climate, which results in the absence of perennial water; such conditions limit agricultural potential (see Figures 1, 4 above).

The Jebel Ousselat is today under the influence of a semi-arid Mediterranean bioclimate with low and irregular annual precipitation of between 200 and 400 mm that varies according to altitude and exposure. The winters are severe, during which a fierce and cold wind blows and the peaks are sometimes whitened by snow. The summers, on the other hand, are very hot and temperatures can easily reach 40C. When rain does fall, it is not necessarily 'beneficial' as about 12% of rainfall events in the semiarid areas of Tunisia are considered 'exceptional', i.e. extremely high intensity and thereby erosive, exacerbating soil loss once vegetation has been cleared (Jebari *et al.* 2008). The watercourses within the wadis are temporary, and supply is essentially meteoric, limited to the rainy seasons and draining quickly due to evapotranspiration, and percolation through the limestone. The complexity of groundwater infiltration in the upland areas and the percolation of rainwater down into subsurface or phreatic zone means that the relatively high levels of rainfall seen in mountainous areas do not necessarily translate into usable water (Dutcher and Thomas 1968: 52-53); reduced soil cover today exacerbates this problem. Layers of impermeable clays and marls that constitute the required geological conditions required for springs and surface wells are non-existent in the heart of the massif, appearing only in its abutting areas (Bergaoui and Gammar 1990: 201).

The only spring in the Jebel Ousselat is that at Aïn Khanfous, the 'spring of the beetle', which emanates from a cave located below a rock art site perched on a rocky escarpment. The site is perched high up, and access is difficult. Interestingly, Aïn Khanfous possesses the highest number of rock-art motifs on the Jebel Ousselat (described and discussed below), and it is the only rock site directly associated with a water source (Ben Nasr 2017: 23).

Methodology

The archaeological material presented and discussed here (rock art and lithics) is the result of extensive fieldwork. The systematic surveys in Jebel Ousselat between 2000 and 2005 and follow-up visits and surveys carried out in subsequent years (Ben Nasr 2002, 2007, 2015) allowed the verification and enhancement of existing data. More significantly, this fieldwork increased the number of known prehistoric sites in the massif, and this work has allowed us to evaluate their geoarchaeological contexts.

It is very likely that the archaeological material collected comprises only a small proportion of the original record from the area. To a certain extent, the rock shelters protect the motifs, but the nature of the rock surface, namely soft limestone, which is porous and brittle, degrades easily. Water seeps in and causes fading (calcite deposition) and the complete erasure of many motifs. Also, the disintegration of the rock surface can result in the removal of large blocks, and the possible loss of prehistoric paintings and engravings. Also, many rock shelters have seen continuous use by people over the millennia, sometimes as sheepfolds, at other times as habitations. The combination of natural and anthropogenic factors (runoff, vegetation action, agricultural work and terracing) contributed to the disappearance of several sites with lithic industries; hence, there is a problem with the representativeness of the material.

Our approach here is to present a synthesis of the Jebel Ousselat data (rock art iconography, morpho-technological characteristics of lithics) and focus on the most relevant elements for our arguments. Then we evaluate the relative chronology of these data in relation to the regional and inter-regional archaeological contexts. Finally, we discuss and deduce the economic and environmental trajectories that can be envisaged. The palaeoenvironmental evidence employed in the discussion is derived from published sources (Zielhofer and Faust 2003; Kröpelin *et al.* 2008; Dormoy *et al.* 2009). This includes a recent reconstruction of hydroclimatic trends produced as a part of the project, 'Changing the Face of the Mediterranean' (Finné *et al.* 2019). The combination of archaeological and palaeoenvironmental evidence underpins our inferences regarding the ecological context of the archaeological data and the consequent discussion of the relationship between the rock art and economic activities that they must represent.

The Evidence: Rock Art and Lithics

Rock Art

Before Ben Nasr's doctoral research, which commenced in 2000 and investigated the prehistoric settlement of the Jebel Ousselat, our understanding of the prehistory of this mountainous area was minimal. Before 1987, only three rock art sites (Oued Majel, Oued Chaara and Aïn Khanfous) were known. These had been found by amateurs and then verified by the prehistory team of the National Heritage Institute (Tunisia) (Gragueb *et al.* 1991). Ben Nasr's research (2003, 2017) made significant additions to the inventory and included the discovery of ten shelters with paintings and engravings (Ben Nasr 2002, 2007, 2015).

Access to the various sites is mainly through steep and winding mountain trails that follow the two central (seasonal) river valleys and their main tributaries, cluttered with scree slopes due to their low sediment-transport capacity. Most of the sites are close to the streams, springs, and in one case, the Guelta pond. There is very little evidence to suggest that the sites with rock art were also dwellings. However, the Oued Majel cave (a *rammadiya* site, 50 m from a rock art site in the southwestern zone of the *jebel*) is an exception to this rule, as is the R'mada rock shelter (central-western zone), which comprises engravings and *rammadiya* with Epipalaeolithic stone tools (Ben Nasr 2007: 229).

The rock art iconography is varied, usually comprising human and animal representations (wildlife and domestic fauna), non-figurative representations (signs and abstract motifs and weapons (Tables 1 and 2). Several conventionally recognised 'styles' and periods of Saharan rock art are represented in Jebel Ousselat. The relative chronology of the rock art, which considers stylistic and thematic elements, follows that developed by Ben Nasr (2007: 22).

>>Insert Tables 1-2 about here<<

The first group that can be described as 'Early', which includes the engravings of the R'mada and Dar H'ssine shelters (Stylized Stage of the Early Period and Tazina style). This group includes the first set of paintings from Aïn Khanfous (characters armed with bows and arrows and seemingly involved in hunting). Also, this site includes small engravings in Tazina style and paintings qualified as 'Round Heads' (Aïn Khanfous). This group also includes wild and domestic fauna (note the absence of pastoral scenes). These scenes are generally considered to represent hunting traditions.

The ‘Tazina style’ was first identified at the Aïn Tazina site (Ksours Mountains, Saharan Atlas, Algeria) (Lhote 1970). It refers to a group of stylised rock engravings whose principal characteristic is the elongation of animals’ extremities (legs, tails, horns, muzzles). This style is recognised across a wide geographical area; from Ténéré to the Atlantic Ocean to Aïr (Niger, southern Sahara), up to the Atlas Mountains. There are two significant zones — a western area in Morocco, and Rio de Oro in the Saharan Atlas, and an eastern zone close to Messak (Tassili-nAzjer, Djado) (Gauthier *et al.* 2010). The discovery of Tazinian engravings in the Jebel Ousselat has extended the geographical distribution of this style. The Tazinian engravings of Jebel Ousselat are the most northerly examples of the style, which starts ca. 5500 BC (Hachid 2015) and ends ca. 1500 BC (Le Quellec 2013).

The second group (paintings from Oued Chaara and Bourrime) are dominated by images of Bovidae and ovicaprines, but with no wild fauna. Although limited in number, we consider these to form part of ‘pastoral stage/tradition’. The third group includes paintings from the sites from Grabich, El Guilta el-Berda as well as the schematic paintings from Aïn Khanfous. This group is distinguished by the presence of the shield image, a combat weapon characteristic of the recent stages of North African rock art (Caballin and Camelin phases).

The Key Sites: Lithics and Rock Art

Compared to the other sites, which are in a poor state of conservation, the two shelters of Aïn Khanfous and R'mada (Figure 5) are noteworthy due to the richness and variety of the motifs present. The art at these two sites represents the most diverse range of animal motifs. Nine different species are represented at R’mada and six at Aïn Khanfous. All the other sites reveal two or three different species (see Table 1, above).

>>Insert Figure 5 about here<<

Aïn Khanfous (literally the ‘(water)source of the beetle’) is the most important rock art site on the Jebel Ousselat. Located on a rocky escarpment, inside the massif, the site is perched up high, and access is difficult. It possesses a series of cavities that overhang a shallow cave inside which the water source is located (Ben Nasr 2017). With several phases of motif-production, this site was exploited/revisited on numerous occasions over a long period. At Aïn Khanfous, there are two main phases of artistic activity, which may correspond to the key phases of use of the shelter. The first group of the oldest paintings includes the figurative motifs featuring groups of

people in action or isolated individuals, armed mainly with bows in an environment where the emphasis is on hunting. The presence of *Syncerus caffer antiquus* (long-horned buffalo) is one of the most interesting elements here (Figure 6). The second group of motifs, which is more recent, consists of more schematic paintings (absence of wildlife and absence of hunting weapons).

>>Insert Figure 6 about here<<

The presence at Aïn Khanfous of small, finely engraved Tazina style (*sensu stricto*) engravings, now entirely patinated, include a ram and what is probably a bovine with collar and a spherically shaped cap. As the only site directly associated with a spring, Aïn Khanfous' artistic diversity may well be a consequence of its situation in what would have been an ecologically rich habitat within the *jebel*.

The engravings at the R'mada shelter are exceptional due to their style and the themes represented. R'mada is the only site in Central Tunisia with engravings of the 'Stylized Stage of the Early Period' (stylised figurative style) that are also associated with Tazina-style compositions. The main panel presents two rhinoceros and four antelopes (2 *Alcelaphus* and 1 antelope-giraffe and an addax antelope) (Figure 7). The two rhinoceros are not identical; their heads and horns are entirely different. It is highly likely that we have (1) the genus *Diceros* (black rhinoceros), a species that has significant water requirements, and (2) the genus *Ceratotherium simum* (white rhinoceros), which has less demanding niche requirements. This species can be relatively sedentary, remaining in restricted humid zones.

>>Insert Figures 7-8 about here<<

The *Syncerus caffer antiquus* is another important example of wild fauna and is present on the second panel associated with a *suidae*, an African wild dog (*Lycaon pictus*), a domestic dog and two rams adorned with collars (Figure 8). The people (n=12) visible on both panels are armed (ropes, throwing stick, arrows, quiver). One of them, wearing animal skin, is associated with a ram (Ben Nasr 2018).

The nature of the panels at R'mada permits the articulation of two hypotheses: (1) the panels are contemporary, and possibly produced by hunter-pastoralists; (2) there were two distinct phases of 'artistic' activity, the first was Capsian (hunter-gatherers), and the second Neolithic (hunter-pastoralists). The recent research of Malika Hachid (2015, 2016), which assesses a range of material, including rock art and archaeological data from across the Maghreb and the central Sahara, allows us to reconsider the antiquity and development of North African

rock art. Consequently, we feel that a 'short' chronology for the engravings at R'mada (Jebel Ousselat) can no longer be accepted. 'The Stylized Stage of the Early Period' associated with the Tazina style (*sensu stricto*) should be attributed to the 'long' chronology, approximately towards the middle of the sixth millennium BC (Hachid 2015: 25).

Lithics

As it stands, 16 *rammadiya* sites (and traces of *rammadiya* sites) have been recorded in the Jebel Ousselat: two sites are reported in the *Prehistoric Atlas of Tunisia* (Zoughlami *et al.* 1998: 31, 47-48), and 14 other sites were recorded following the surveys undertaken by Ben Nasr (2007: 101-89). These are considered Capsian sites, typical of the eastern Maghreb. They are generally open-air deposits, sometimes under rock-shelters but rarely located inside caves. They often take the form of a blackish deposit comprising mainly burnt stones, lithic material, faunal remains and terrestrial gastropods (Figure 9**).**

>>Insert Figure 9 about here<<

Out of a total of 16 *rammadiya*, only 11 have significant lithic material on the surface. These sites have been subject to surface collection, and none have been excavated. The lithic material collected from the Jebel Ousselat comprises a total of 1,511 pieces of flint, mainly of local origin (Zoughlami *et al.* 1998; Ben Nasr 2007). The observations presented below concern the lithic material that comes from sites identified as Epipaleolithic. In total there are 1,427 pieces of lithic material. The 84 pieces recovered on the site of Oued Majel, identified as a Neolithic site (Zoughlami *et al.* 1998), are not considered here.

We have sites that yielded small quantities of material and lack diagnostic tools, or where the débitage does not allow us to identify a reduction sequence (the consequence of a poor state of conservation). Other series are relatively 'rich' and include a good number of diagnostic elements (for example Ghasren 2, Oued Yadmen, Kroumet el Bil, R'mada) (Table 3). Despite these relatively small quantities, the available lithic material does permit typological and technological observations, which we consider essential for the understanding of the socio-economic trajectories of the Holocene transitions considered in this study.

>>Insert Table 3 about here<<

Cores

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The number of cores is relatively small (n = 170 or 12% of the total of 1,427 lithics). Almost all the cores were discarded after exhaustive reduction. A large proportion (40%) of these elements are globular/polyhedral. From a technological point of view, it is difficult to deduce a specific debitage sequence (Table 3).

On 60% of the cores, the reduction strategy is usually unipolar and occasionally bipolar. The negative scars demonstrate bladelet production. Signs of pressure flaking are seen on the pyramidal and fluted-to-bladelet cores from the following sites: Ghasren 1 (n=3) and Ghasren 2 (n=4) sites, Kroumet el Bil (n=1) and Oued Yedmen (n=2). At Oued Yedmen, pressure-flaking is suggested by the presence of platforms on the completed bladelets or the intact proximal ends. This technique is characterised by fine linear platforms (n = 9) and dihedral and faceted platforms (n = 9). The scarcity of pressure-flaking cores compared to other core-types and associated reduction techniques is often the consequence of core reuse and percussive flaking, a typical characteristic of Capsian technology (Tixier 1984: 62).

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Debitage

The lithic assemblage contains a high number of debitage products (n = 725, i.e. 51% of the total). Flakes are the most common element (n = 481 or 66% of total), followed by blades (n = 196, 27%). Laminar production is limited to 48 pieces (6%). Overall, there are low numbers of blades compared to flakes and bladelets.

As this material is derived from surface collection, it is difficult to state with certainty whether it represents exclusively flake production or secondary products related to lamellar production. Nevertheless, the presence of these cores supports the interpretation that the debitage represents lamellar production. The negative scars visible on the cores and fragments of cores are typical for a bladelet core reduction strategy.

Tools

Blank forms Flakes, blades and bladelets were all used as tool blanks. Flakes constituted more than 60% of these blanks, followed by bladelets (25%) and then blades (12%). Flakes underpinned the manufacture of various types of tools, especially scrapers, burins, notched tools, denticulate elements and tools with marginal retouch. As noted above, because all this material derives from surface collection, we cannot construct a complete *chaînes opératoires*. It is

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therefore difficult to ascertain whether the flakes were the product of a unique tool-making strategy, or if they were the by-products of a lamellar production strategy.

It is evident that the choice of laminar blanks corresponds to the manufacture of relatively elongated tools. For the most part, the blades were selected to manufacture backed-blades, notches and burins. Only one scraper on a small blade was recovered. Backed-bladelets were the primary tool derived from lamellar production sequences.

Flakes are common on all sites except at Kroumet el-Bil, where lamellar blanks are particularly dominant. Flakes are involved in the production of various types of tools, especially scrapers, notches and denticulate tools. This might reflect an increase in tools required for new activities associated with a shift in the economy towards pastoralism. The same technological behaviour has been demonstrated in other contexts attributed to the final phases of the Epipaleolithic on sites located between the dorsal mountains and the coast of central Tunisia not far from Jebel Ousselat (Belhouchet 2013: 198, Belhouchet *et al.* 2017: 16).

Tool types The tools consist of 150 pieces or 10.50% of the total of lithic material. The series shares some similarities, including the presence of shared typological groups of tools, even if some types identified on one site are missing are not always present on other sites (see Table 3, above). A large proportion of the tools are assigned typologically to the Maghreb Epipaleolithic-Capsian tradition — essentially Capsian forms of burins, scrapers, backed blades, and backed bladelets are common (Figure 10).

>>Insert Figure 10 about here<<

Certain types, such as notched scrapers (n = 3) (Oued Yadmen and Kroumet el-Bil) are often present in industries associated with the final phase of the Capsian, shortly before the advent of Neolithic technologies (Tixier 1963: 60). The burins, which constitute a significant proportion of the material (18 %), are a common tool-type in Capsian assemblages, some arguing that these were used for working wood or even ostrich eggs (Rahmani 2004: 73).

Burins on backed blades, dihedral burins, burins on breaks or on truncated elements (Tixier 1963: types N ° 29 to 33) [Oued Yedmen (n = 2), Ghasren 1 (n = 1), Ghasren 2 (n = 2)] and the burin nuclei-form (Ghasren 2, n = 1) are typically Maghreban, and more specifically, Capsian tool-types (Tixier 1963: 68). The truncation burins (Tixier 1963: type N ° 22), which were found on the site of R'mada (n = 1), are also typical of the Capsian tradition.

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The backed-blades (Tixier 1963: type No. 42) (R'mada, n = 2), curved backed-blades (Tixier 1963: type No. 37) (Kroumet el Bil, n = 2), and backed-blade on a convex-concave edge (Tixier 1963: No. 39) (Ghasren 2, n = 1)are also types associated with Capsian industries (Tixier 1963: 91).

Backed bladelets (n = 23) are present on almost all the sites. In this group, there are four burins with abrupt retouch (Tixier 1963:type No. 54) from the sites of Ghasren 2, Kroumit el bil and Oued el Hroug. Capsian industries are unusual, and perhaps unique, due to the presence of numerous bladelets produced from a burin used as a core that are systematically reshaped on backed bladelets (Tixier 1963: 29). Other tool-types, such as notched pieces (n = 39) and truncated tools (n = 6) are also common for this type of Epipalaeolithic facies.

The Spatial Distribution of Sites Across the Jebel

Despite the taphonomic issues mentioned earlier, it is important to note that across the plateau there are many other, similar locations with comparable geological configurations that have been surveyed but have not yielded sites with art. Consequently, the distribution discussed here does seem to represent a choice and preference for location on this part of the *jebel*. The rock art sites are concentrated in the central-western part of the massif, and they are in relatively close to one another (all situated within a 4 km circle), while the *rammadiya* are spread across the entire massif, with many of these concentrated in the western area, close to the concentration of rock art sites (Figure 11). This observation can be explained, in part, by the geological ion of the *jebel*. The rock art sites are concentrated in the most rugged and geologically complex area of the *jebel*, an area that graphical complexity renders movement into and through this zone difficult. These characteristics may well explain e sites. These sites are situated between 500 and 700 m ASL. Most were located within 50 m of what would have been active water sources. While these watercourses are no longer active, Ballais (1992) argued that earlier in the Holocene, they were permanent.

>>Insert Figure 11 about here<<

No funerary monuments are associated with rock art sites or settlement sites. The only burial monuments (dolmens and tumuli) are found around the edge of the *jebel*, mainly centred on the 'Jebil' sector (west of Jebel Ousselat) (Zoughlami et *al.* 1998: 49, 55), although new sites,

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as yet unexcavated, were noted during survey work undertaken between 2001 and 2005 (Ben Nasr 2007).

Regional Archaeological Context: The Capsian to Early Neolithic

At a regional level, the Capsian is divided into two phases, the first — Typical Capsian — from ca. 8000 to 5000 BC, and the second — Upper Capsian — from ca. 5000 to 4500 BC (Aouadi *et al.* 2014) (see Figure 2, above). In some areas, it is possible that the Upper Capsian was contemporary with the Neolithic for about one millennium (Rahmani 2004: 88).

Once pressure-flaking had been adopted as the principal tool-production technique after ca. 6000 BC, this diversification of toolkits was accompanied by movement into a larger geographical area and the exploitation of a wide range of medium to small mammals. Toolkit diversification may well have been related to the exploitation of new environmental types and resources. Neolithic societies continued 'Capsian' strategies, hunting in those landscapes that did not offer ideal conditions for agriculture. Neolithic groups, while gradually increasing the exploitation of domestic animals and their by-products, maintained similar hunting strategies (Aouadi *et al.* 2014). There is little evidence for arable practices on the Early Neolithic sites studied thus far in Tunisia (Mulazzani *et al.* 2016). Regional faunal assemblages reveal a mixture of hunted wild animals and some domesticated species that may well have yielded secondary products (Aouadi *et al.* 2014).

In central Tunisia, the resumption of research in the Kef el-Guaria region, part of the Tunisian Dorsal, less than 30 km from the Jebel Ousselat, allows us to understand better the complexity of economic and cultural changes before Neolithization around the seventh millennium BC. The study of the lithic assemblages, and the faunal and botanical remains associated with the Late Epipalaeolithic hunter-gatherers of the Kef Hamda site (Upper Capsian, dated ca. 6559-6049 BC), reveal a subsistence economy primarily based on the hunting of large mammals. This implies alternating and seasonal exploitation of the different territories situated between plain and mountain (Belhouchet *et al.* 2017: 14).

Zooachaegical data from the Neolithic site of Doukanet el Khoutifa (Mulazzani et *al.* 2016 129) shows that wild fauna dominate the oldest phase here, dated to ca. 5305 ± 50 BC (SacA42298 7412-7166 Cal BP). In the next level, dated to ca. 4296 ± 32 BC (SacA42306 6296-6182 Cal BP), there is evidence for the emergence of a pastoral economy represented by a significant increase in

domestic animals, especially sheep and goats and a few oxen (Aouadi *et al.* 2014). In northwestern Tunisia (the Tell region), research carried out on the Neolithic Mediterranean site of Kef el-Agab, dated ca. 4879 ± 35 BC showed the presence of sheep and goats, but wild fauna were still predominant (Aouadi *et al.* 2014: 9).To the west of our study area, across the Algerian border, on the geographical extension of the Tunisian Dorsal, the Neolithic Capsian site of Capéletti cave (Monts des Aurès) testifies to a semi-sedentary settlement. Here, people practised mountain-based pastoralism during the period from 5906 to 2465 Cal BC; the occupation levels indicate a gradual increase in the number of domestic animals, a gradual shift from 'random breeding' towards full domestication (Roubet 2012: 5490).

Discussion: Human-environment Interactions in a Semi-arid Landscape

Rock Art, Lithic Evidence and Economic Trajectories

As mentioned above, the archaeozoological data from the Tunisian Dorsal sites (Kef Hamda and Doukanet el-Khoutifa in El-Guéria) and the wider Atlas mountain area (Capéletti cave), provide us with useful contextual evidence for the Jebel Ousselat. More specifically, it supports the notion of the evolution of economic strategies, moving from hunting alongside the exploitation of some domestic animals to a system of mountain pastoralism where sheep/goat were the key animals in a subsistence economy.

At a regional level, we argue that the Atlas rock art reflects this process: during the early phase of rock art production (ca. sixth millennium BC), with the first stage of the acquisition of domestic species, the iconography represents a universe of hunting and non-domesticated animals, but with the presence of a few domesticates. This signals a transition towards a new world or engagement with the landscape. Following on from this phase, we have the rock art of the 'Atlas Pastoral Period' (ca. fifth millennium BC) with the representation of flocks of sheep, goats and some oxen (Hachid 2015: 25).

At Jebel Ousselat, the early phase is significant, with representations of people, animals and objects that are undoubtedly associated with hunting. The absence of composition styles common in other parts of North Africa, however, should be noted. In particular, the relative dearth of motifs or scenes associated with pastoralism is different from what is seen in Saharan iconography (Holl 2004). While there are two rams and one bovine at the Dar H'ssine site (Figure 12), this is quite unlike the Saharan scenes which show numerous domesticated animals.

Although representations of domesticated species only represent a small proportion of the range of animals represented on the *jebel*, this insignificant number might represent a significant moment or idea, the initial stages of movement towards pastoralism. In the Jebel Ousselat, as with the 'Old Period' motifs seen in the Saharan Atlas, the ram is often found with wild animals. By making the same observation in the Atlas Mountains, Hachid (1992) always supported the idea that the presence of domesticates and wild species implied the production of art by people engaged in 'incipient domestication', i.e. the first attempts at domestication that was followed by structured controlled breeding later in time.

>>Insert Figure12 about here<<

Moving on to the lithics, we accept that the material in our study area represents a partial sample of the technology employed in the exploitation of the environment and its resources. We should still consider, however, the possible function of specific tools. A significant proportion of lithic tools are on backed-edge bladelets (25%), all produced by pressure flaking. Pyramidal and fluted cores also represent evidence of pressure debitage. The lamellar products were exploited in the production of backed edge bladelets, a hunting tool present on almost all the sites. In the Maghreb, between eastern Algeria and western Tunisia, the adoption of pressure flaking is attributed to the transition to the Upper Capsian and associated with the environmental changes that took place during the arid episode of ca. 6200 BC (Rahmani 2004; Jackes and Lubell 2008). For many of the sites on the Jebel Ousselat, the lithic assemblages are characteristic of the final phase of the Capsian, shortly before the Neolithic. This is a lithic industry where the Epipaleolithic substratum remains present and Neolithic tendencies are not yet apparent. This observation corresponds with our interpretation of the rock art and our assessment of prehistoric activities in the Jebel Ousselat between the Upper Capsian and Early Neolithic.

Rock Art, Lithics and Environmental Knowledge in the Jebel Ousselat

Interpretation of the archaeological evidence from the Jebel Ousselat must be underpinned by reflection on the nature of the climate and environment in the region during the middle Holocene. Although situated north of the limits of the 'Green Sahara', the climate changes that took place in south-central Tunisia were associated with processes centred on the Sahara. The radically different Saharan ecologies dating to this period are inferred from evidence for significantly higher lake levels, including those in central North Africa, palynology, isotopes and

leaf-wax analyses. Although the Saharan humid phase lasted from 11,000 to 5000 years ago, some evidence suggests a 'pause' about 8000 years ago, when an arid phase set in for about one millennium (Tierney *et al.* 2017). The present arid phase is in part signalled by significant dust-mobilisation that started about 4300 years ago (Kröpelin *et al.* 2008).

The African Humid Period between ca. 9000 and 3000 BC would have underpinned the development of a richer ecology. A recent synthesis by Finée et al. (2019) for southern Iberia and North Africa suggests relative humidity from 6000 to ca. 3800 BC. Wet-dry oscillations are identified for southeast Tunisia during the period from 6000 to 1000 BC (Jaouadi et al. 2016). The period between 6000 and 3500 BC has been identified as a phase of enhanced fluvial activity, with analyses of marine cores off North Africa suggesting fluvial discharge from Libya and Tunisia/Algeria (Wu et al. 2017). This is followed by a 'Mid-Holocene climatic collapse' (Zielhofer and Faust 2003: 859), when fluvial activity, more specifically sedimentation, increased due to aridification (Benito et al. 2015; Zielhofer et al. 2004) (see Figure 2, above). Of particular interest is an arid phase between 3700 and 2600 BC (Jaouadi et al. 2016).

The presence of plentiful water on the Jebel Ousselat would have facilitated a wide range of activities during the Capsian and Neolithic periods. Regional evidence demonstrates the existence of a climate that permitted the development of abundant vegetation and concomitant populations of wild fauna. The semi-arid regions of North Africa were in part subject to the same climatic processes as the Sahara to the south. Also, the fauna represented across the sites in the Jebel Ousselat reflect the variety seen across the Saharan region during the African Humid Period (de Menocal 2014: 100).

The exploitation of any landscape involves economic and ideological phenomenon that seamlessly intersect with one another. The movement into new landscapes, where ecological variety and economic reliability may well have fluctuated, unsurprisingly witnessed ideological investment, i.e. the production of rock art or motifs across important sites or nodes in the landscape. The images relating to the early phase of the rock art of Jebel Ousselat, along with the lithics found across the study area, imply hunting traditions. Weapons are among the most frequently represented objects in direct association with the painted or engraved characters. The bow is the most common weapon. Curved weapons, sticks and ropes are also present.

Despite the absence of faunal remains that could corroborate our inferences, we feel that the depictions in the rock art represent the animals that likely roamed this landscape. The wild

fauna represented by the motifs in the Jebel Ousselat is diverse: two very characteristic elements of North African wildlife are represented, namely the rhinoceros and the *Syncerus caffer antiquus* (long-horned buffalo). They are witnesses to a bioclimatic phase now in the distant past. The rhinoceros is a good indicator of the environment; it is an open steppe animal with a preference for wooded steppe and abundant water to which it tends to remain close. The Jebel Ousselat would have been a humid biotope with perennial water supporting diversified fauna, including rhinoceroses, buffaloes and antelopes. The combination of antelopes and rhinoceros makes it possible to evoke vegetation in which the antelope exploited tender shoots and the rhinoceros the thorny bushes.

Finally, *Syncerus caffer antiquus* were suited to open, herbaceous steppe-type environments. The span of the horns and the sheer body size are problematic for this species in dense-forested environments. Moreover, this animal requires swamp-areas for cooling (Gautier and Muzollini 1991). If these animals were grazing in the area, this implies a forested or certainly, richer maquis-type environment, very different to the actual degraded landscape with olive trees struggling for survival. The massif would have offered a diverse range of ecological niches: valleys, steep slopes, plateau and plains. The *jebel* also had relatively easy access to the lower altitudes, which facilitated the coexistence of plain and mountain species. This landscape and environmental context provided people with a wide range of potential prey. It is possible that the concentration of sites within the central zone of the *jebel* has significance, possibly as the most remote, inaccessible areas where specific forms of environmental or hunting knowledge were at a premium.

Moving into the Neolithic, with the development of pastoralism, the Jebel Ousselat offered the advantage of combining plains and plateau, desirable topographic characteristics for pastoralism in semi-arid zones. We can assume that during the dry season, Neolithic pastoralists and their flocks remained on the edge of valleys where residual water and vegetation were sufficient until the rainy season. Once they returned, they moved their livestock to the surrounding plains at the edges of lakes and ponds. After a few months, they could bring their flocks back into the massif. Favourable climatic conditions for a human settlement and exploitation of varied resources offered by the mountain environment thus appear as the two main reasons for this settlement.

Conclusions: Towards a Socio-cultural Ecology of a Once Diverse Ecosystem

The rock art of Jebel Ousselat was not produced in a single period; the different styles, techniques and the range of fauna represented, and iconographic diversity, express the complexity of the massif's settlement over different periods. We feel that the primary phase of artistic, hunting and then incipient pastoralism dates to about the middle of the sixth millennium BC as part of a hybrid transition economy hunters/pastoralists in a different environmental context.

The Jebel Ousselat has undoubtedly benefited in the past from much more favourable climatic conditions, as suggested by the palaeoclimatic and archaeological evidence. Although there is a possibility that the species represented in the art were not present on the *jebel*, and represent animals seen by the artists on their travels, this seems highly unlikely, as the environmental evidence suggests that the ecological habitats required by the species depicted would have been present during the early to mid-Holocene. The large wildlife (*Syncerus caffer antiquus*, rhinoceros and hartebeest antelope) would have flourished in a wetter climate.

We propose the Late Capsian to Neolithic humid period as the climatic episode most compatible with this wildlife. This relatively long-lasting climatic phase underpinned a more diverse ecosystem, which had socio-cultural implications. The conditions were ripe for increased wadi flow and the maintenance of quite extensive water bodies, thus supporting populations of large mammals in the area, and eventually, the development of pastoralism. Large mammals have since disappeared under the combined impact of climate change and human activity.

The absence of faunal remains does mean that we are reliant on the art/motifs across our study area. Although the environmental evidence, the lithics and the rock art do combine to provide us with an interesting and convincing image of an important stage in this landscape's trajectory, the depictions reflect cultural choices of the prehistoric populations and thus indicate only a part of the animal population that existed alongside human occupation.

The study of the Jebel Ousselat landscape, and the assessment of the distribution of archaeological sites, lithics and artwork, all situated within a review of environmental changes during the early to mid-Holocene, allow us to consider a form of socio-ecological process and human culture that is so very different to that which exists today. We posit a phase of human activity or a point on the trajectory in this landscape's development that stands in complete contrast to today's impoverished and marginal environment. This type of research is not only of

interest to us as archaeologists but can also serve as a reminder to Mediterranean societies how landscapes are mutable and dynamic and were not always the problematic and marginalised zones that are so typical of semi-arid zones of the Anthropocene.

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References

Aouadi, N., Y. Dridi and W. Ben Dhia

2014 Holocene environment and subsistence patterns from Capsian and Neolithic sites in Tunisia. *Quaternary International* 320: 3–14.

Auclair, L.

2001 Population et désertification en Tunisie au cours du XXe siècle. In L. Auclair, P. Gubry, M. Picouet et F. Sandron (eds.)*, Régulations démographiques et environnement.* Paris: Institut de Recherche pour le Développement/Centre Population et Développement/Laboratoire Population-Environnement. 237: 45

Ballais J. L.

1992 Le climat au Maghreb oriental: apports de la géomorphologie et de la géochimie. In: *Les Nouvelles de l'Archéologie - Le climat à la fin de l'Age du Fer et dans l'Antiquité (500 BC-500 AD).* 50: 27-31.

Ben Nasr, J.

2002 Quatre abris peints découverts au Jebel Ousselat (Tunisie Centrale). *Préhistoire Anthropologie Méditerranéennes* 10-11: 156–66.

2007 Recherches sur le peuplement préhistorique du Jebel Ousselat (Tunisie Centrale). Thèse de doctorat, Université d'Aix-Marseille I, Aix-en-Provence.

2015 Les peintures rupestres du Jébil (Jebel Ousselat - Tunisie Centrale). In J. Ben Nasr and N. Boukhchim (eds.), *Montagne et plaine dans le bassin Méditerranéen,* 277–84. Tunis: Faculté des Lettres et des Sciences Humaines de Kairouan.

2017 Aïn Khanfous (Jebel Ousselat - central Tunisia): a rock art site symbolically elected. *Expression* 17: 23–31.

2018 À propos d'une association de l'Homme et du bélier orné sur une gravure de l'abri de R'mada (Jebel Ousselat, Tunisie centrale). In D. Huyge and F. Van Noten (eds.), *What Ever Happened to the people? Humans and anthropomorphs in the rock art of northern Africa*, 55-61. Royale de Sciences d'Outre-Mer).

Belhouchet, L, S., Mulazzani and Z., Jeddi

2013 Les techno-complexes lithiques de SHM-1. In S.,Mulazzani (ed.), *Le Capsien de Hergla (Tunisie). Culture, environnement et économie, Reports in African Archaeology,* 156-220. Afriag.

Belhouchet, L, L. Salanova, J. Dunne, R. Evershed, N. Aouadi, J. Morales, A. Zazzo, J. Zoughlami and S. Mulazzani.

2017 Derniers chasseurs-cueilleurs et premiers paysans dans la dorsale Tunisienne. In A. Mrabet (eds.), *Vie et genres de vie au Maghreb: Antiquité et Moyen Age,* 11-22. Lettres et des Sciences Humaines de Sousse.

Benito G., M.G. Macklin, C. Zielhofer, AF. Jones and M.J. Machado

2015 Holocene flooding and climate change in the Mediterranean. *CATENA* 130 (Supplement C): 13–33.

Bergaoui, S., and A. Gammar

Commented [VDP3]: Reference formatting needs to be checked carefully throughout. Especially
-remove space before colon
-contracted page nos
-distinction book and serial titles
-placement page nos in edited vols
-use of upper case (not in article titles; not in French book titles (French serial titles is probably preferable capitalized)

1990 Typologie des citernes et barrages du secteur de Dar el Bey à Jebel Ouesslet (Dorsale Tunisienne). *Cahiers de Tunisie (Les)* 41-42: 199–223.

Boukadi, N., and F. Zargouni

1991 Sur l'interférence des directions structurales dans l'Atlas de Tunisie: L'exemple du nœud tectonique des Jebels Mrhila-Labeîd. *Comptes Rendus de l'Académie des Sciences. Série 2, Mécanique, Physique, Chimie, Sciences de l'univers, Sciences de La Terre* 312 (5): 529–34.

Bradley, R., F. Criado Boado and R. Fábregas Valcarce

1994 Rock art research as landscape archaeology: a pilot study in Galicia, north-west Spain. *World Archaeology* 25: 374–90.

DeMenocal, P.B.

2014 Marine sediment records of African climate change: progress and puzzles. *Treatise on Geochemistry* (Second Edition) 14: 99–108.

Dormoy, I., O. Peyron, N. Combourieu Nebout, S. Goring, U. Kotthoff, M. Magny and J. Pross

2009 Terrestrial climate variability and seasonality changes in the Mediterranean region between 15,000 and 4000 years BP deduced from marine pollen records. *Climate of the Past* 5 615-32.

Dutcher, L. C., and H. E. Thomas

1968 Regional geology and ground-water hydrology of the Sahil Susah area, Tunisia. United States Government Printing Office, Washington.

Finné, M., J. Woodbridge, I., Labuhn and N. Roberts

2019 Holocene hydro-climatic variability in the Mediterranean: A synthetic multi-proxy reconstruction. *The Holocene*. 14: 847-63.

Frizon de Lamotte, D., B. Saint Bezar, R. Bracène and Eric Mercier

2000 The two main steps of the Atlas building and geodynamics of the Western Mediterranean. *Tectonics* 19 (4): 740–61.

Gammar, A.

1991 L'évolution des dépressions fermées. Présentation de cas en Tunisie : El Gouréa, El Majen et El Goléa. *Géographie et Développement* 11: 30–46.

Gauthier, Y., B. Veneur, N. Desaphy and P. Seuriel

2010 Nouvelles gravures en style de Tazina: figurations du Nord de l'Immidir, Algérie. *Almogaren* 41: 149–92.

Gautier, A., and A. Muzzolini

1991 The live and times of the giant buffalo Alias Bubalus/Homoioceras/Pelorovis Antiques in North Africa. *Archaeozoologia* 4 (1): 39–92.

Gragueb A., M., Harbi-Riahi, A., M'timet, and J., Zoughlami

1991 Nouvelles découvertes de représentations rupestres en Tunisie : Jebel Ousselat (Tunisie Centrale). *Bulletin des travaux de l'Institut National d'Archéologie et d'Art de Tunis* 4: 41-64

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Hachid, M.
1992 *Les Pierres écrites de l'Atlas saharien : El-Hadjra, El-Mektouba*. Alger, ENAG.
1998 *Le Tassili des Ajjer. Aux sources de l'Afrique, 50 siècles avant les pyramides.* Edif, Paris-Méditerranée. Paris
2000 *Les Premiers Berbères : entre Méditerranée, Tassili et Nil*. Aix-en-Provence / Alger: Edisud / Ina-Yas.
2015 La domestication des ovins, caprins et boeufs domestiques au Maghreb et un âge pour l'art rupestre de l'Afrique du Nord: 8000 ans Cal. BP. *INORA* 73: 18-31.
2016 Chronostratigraphie, bandes pariétales de couleur sombre et claire des parois au Tassili-n-Ajjer et un possible 'calage' chronologique des peintures rupestres. In N. Honoré and M. Guterriez (eds.)*, L'Art rupestre d'Afrique. Actualité de la recherche, Actes du Colloque International,* 65-10. Paris: Centre Panthéon et Musée du Quai Branly.
Holl, A F C.
2004 *Saharan rock art: Archaeology of tassilian pastoralist iconography.* AltaMira Press, Walnut Creek, Lanham.
Jackes, M. and D. Lubell
2008 Early and middle Holocene environments and Capsian cultural change: Evidence from the Télidjène Basin, Eastern Algeria. *African Archaeological Review* 25 (1–2): 41–55.
Jaouadi, S., V. Lebreton, V. Bout-Roumazeilles, G. Siani, R. Lakhdar, R. Boussoffara, L. Dezileau, N. Kallel, B. Mannai-Tayech and N. Combourieu-Nebout
2016 Environmental changes, climate and anthropogenic impact in southern-eastern Tunisia during the last 8 kyr. *Climate of the Past* 12:1-39.
Jebari, S., R. Berndtsson, A. Bahri and M. Boufaroua
2008 Exceptional rainfall characteristics related to erosion risk in semiarid Tunisia. *Management* 1: 25–33.
Jelinek, J.
2004 *Sahara. Histoire de l'art rupestre libyen*. Grenoble: Jérôme Million (Collection l'Homme des origines).
Kröpelin, S., D. Verschuren, A. M. Lézine, H. Eggermont, C. Cocquyt, P. Francus, J. P. Cazet, M. Fagot, B. Rumes, JM. Russell, F. Darius, DJ. Conley, M. Schuster, H. Von Suchodoletz and DR. Engstrom
2008 Climate-driven ecosystem succession in the Sahara: The past 6000 years. *Science* 9: 765-78.
Kuper, R. and S. Kröpelin
2006 Climate-controlled holocene occupation in the Sahara: motor of Africa's evolution. *Science* 313 (5788): 803–7.
Le Quellec, J. L.
1987 *L'Art rupestre du Fezzan septentrional (Libye : Widyan Zreda et Tarut (Wadi esh-Shati)*, (*Cambridge Monographs in African Archaeology*, 22 / *British Archaeological Reports - International Series*, 365). Oxford: B.A.R.

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1993 *Symbolisme et art rupestre au Sahara*. Paris l'Harmattan.
1998 *Art rupestre et préhistoire du Sahara: Le Messak*. Paris:Payot et Rivages.
2013 Périodisation et chronologie des images rupestres du Sahara Central. *Préhistoires Méditerranéennes* 4: 1-46
Lhote, H.
1970 *Les gravures rupestres du Sud-Oranais.* Paris: Arts et métiers graphiques (Mémoires du Centre de recherches anthropologiques, préhistoriques et ethnographiques 16).
1984 *Les Gravures rupestres de l'Atlas saharien. Monts des Ouled Naïl et région de Djelfa*. Alger: Office du Parc National du Tassili.
Liu, Z., Y. Wang, R. Gallimore, M. Notaro and I. Colin Prentice
2006 On the cause of abrupt vegetation collapse in north Africa during the Holocene: climate variability vs. vegetation feedback. *Geophysical Research Letters* 33 (22).
Lok, T., O. Overdijk, JM. Tinbergen and T. Piersma
2011 The paradox of spoonbill migration: Most birds travel to where survival rates are lowest. *Animal Behaviour* 82 (4): 837–44.
Maslin, M. A. and S. L Lewis
2015 Anthropocene: Earth system, geological, philosophical and political paradigm shifts. *The Anthropocene Review* 2 (2): 108-16.
Mercuri, A.M., L. Sadori and P. Uzquiano Ollero
2011 Mediterranean and north-african cultural adaptations to mid-holocene environmental and climatic changes. *The Holocene* 21 (1): 189–206.
Mulazzani, S., L. Belhouchet, L. Salanova, N. Aouadi, Y. Dridi, W. Eddargach, J. Morales, O.Tombret, A. Zazzo, and J. Zoughlami.
2016 The Emergence of the Neolithic in North Africa: A new model for the Eastern Maghreb. *Quaternary International* 410: 123-143
Ouda, B., K. Zouari, H. Ben Ouezdou, N. Chkir and Ch. Causse
1998 Nouvelles données paléoenvironnementales pour le Quaternaire récent en Tunisie centrale (bassin de Maknassy). *Comptes Rendus de l'Académie des Sciences - Series IIA - Earth and Planetary Science* 326 (12): 855-61.
Pervinquière, L.
1903. *Etude géologique de la Tunisie Centrale*. Paris.
Rahmani, N.
2004 Technological and cultural change among the last hunter-gatherers of the Maghreb: The Capsian (10.000–6000 B.P.). *Journal of World Prehistory* 18 (1): 57–105.
Renssen, H., V. Brovkin, T. Fichefet and H. Goosse.
2006 Simulation of the Holocene climate evolution in northern Africa: The termination of the african humid period. *Quaternary International* 150 (1): 95–102.
Rigane A., F. Kamoun, B. Peybemes, R. Martini, L. Zanietti, J. M. Vila, and A. Trigui.
1998 Associations de foraminifères benthiques dans les séquences de dépôt du Trias moyen supérieur de l'Atlas tunisien central et méridional**.** *Geobios* 31: 703-14.

Roubet C.
2012 Néolithisation atlasique pastorale et pré-agricole en Algérie: comportements de subsistance. *Encyclopédie Berbère* 34: 5489-96.
Steffen, W., J. Grinevald, P. Crutzen and J. McNeill
2011 The Anthropocene: Conceptual and historical perspectives. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 369 (1938): 842–67.
Tierney, J.E., F.S. R. Pausata and P. B. DeMenocal
2017 Rainfall regimes of the green Sahara. *Science Advances* 3 (1): e1601503.
Tixier J.
1963 *Typologie de l'Epipaléolithique du Maghreb*. Mémoires du Centre de recherches anthropologiques, préhistoriques et ethnographiques 2. Paris, Arts et Métiers graphiques.
1984 *Préhistoire de la pierre taillée 2: Economie du débitage laminaire: technologie et expérimentation*. Paris: Cercle de Recherches et d'Etude préhistorique.
Yahya-Acheche S.
2009 *L'art rupestre en Tunisie: inventaire et analyse: ses relations avec les foyers artistiques de l'Algérie et la Libye voisines,* Thèse de doctorat. Paris 1
Wu, J., Z. Liu, J. W. Stuut, Y. Zhao, A. Schirone and G. J. de Lange
2017 North-African paleodrainage discharges to the central Mediterranean during the last 18,000 years: A multiproxy characterization. *Quaternary Science Reviews* 163: 95-113.
Zerai, K.
2009 Chronostratigraphy of Holocene alluvial archives in the Wadi Sbeïtla basin (central Tunisia). *Géomorphologie: relief, processus, environnement* 15(4): 271-86.
Zerboni, A.
2012 Rock art in the Central Sahara (SW Libya): a geoarchaeological and palaeoenvironmental perspective. In D., Huyge, F., Van Noten, and D., Swinne (eds.), *The Signs of Which Times Chronological and palaeoenvironmental issues in the rock art of northern Africa*, 175-95. Brussels:Royal Academy for Overseas Sciences.
Zilhofer C and D. Faust
2003 Palaeoenvironment and morphodynamics in the mid-Medjerda floodplain (northern Tunisia) between 12 000 and 2000 BP: geoarchaeological and geomorphological findings. In A.J. Howard, M.G. Macklin and D.G. Passmore (eds), *Alluvial Archaeology in Europe*, 203–16. Lisse: Swets & Zeitlinger,.
Zielhofer C, D. Faust, RB. Escudero, FD. Del Olmo, A. Kadereit, and KM. Moldenhauer
2004 Centennial-scale late-Pleistocene to mid-Holocene synthetic profile of the Medjerda Valley, northern Tunisia. *The Holocene* 14(6): 851–61
Zoughlami J.
2009 *Le Néolithique de la dorsale tunisienne. Kef el Guéria et sa région,* Centre de Publications Universitaires. Tunis Institut National du Patrimoine /Institut de Recherche pour le Développement.
Zoughlami, J., R. Chenorkian and M. Harbi-Riahi

Deleted: *E*

1998 *Atlas Préhistorique de la Tunisie 11. Kairouan*. Rome École Française de Rome.

Figure Captions

Figure 1 Photo – the degraded landscape on the Jebel Ousselat today (photo K. Walsh)

Figure 2 Chronology and climate phases across the study area. Indicated are the key archaeological periods, broad trends in climate changes (and associated publications) for different areas, with a focus on Tunisia. The top (climate) curve is extracted from Finné et al. (2019). This is a meta-analysis of regional isotope data from North Africa, note the overall wet to arid trend from the mid-Holocene onwards. ([1]Jaoudi, *et al.* 2016, [2]Dormoy, *et al.* 2009, [3]Zerai 2009, [4]Ouda, *et al.* 1998, [5]Zielhofer, *et al.* 2004, [6]Benito, *et al.* 2015, [7]Mercuri, *et al.* 2011, [8]Wu, *et al.* 2017)

Figure 3 Map of the region and study area.

Figure 4 Example of ravines and ridges that characterise the Jebel Ousselat (photo K. Walsh)

Figure 5 The shelter of R'mada. *Rammadiya* in connection with a shelter with engravings of wildlife and domestic animals in the background the shelter and in the foreground the ashen archaeological deposit of the *rammadiya* (Photo J. Ben Nasr).

Figure 6 The shelter of Aïn Khanfous: 'scene of the archers' (Photo: J. Ben Nasr).

Figure 7 The shelter of R'mada; scale-drawing of panel 1: wild fauna (rhinoceros and antelopes) and armed characters. 1, 2, 3 and 8: antelopes, 4: zoomorphic, 5 and 7: rhinoceros, 6: canine, 9, 10 and 12: armed characters, 11: anthropomorphic, 13: oval signs (Drawing by J. Ben Nasr)

Figure 8 The shelter of R'mada; scale-drawing of panel 2: domestic species (rams and canine) and wildlife (*Syncerus caffer antiquus* and wild boar) and armed characters (Drawing by J. Ben Nasr)

Figure 9 The rammadiya of Kroumet el Bil (southeast of Jebel Ousselat) The grey/blackish archaeological deposit is visible from afar. The rammadiya is located in front of a small shelter hidden by the vegetation (Photo J. Ben Nasr).

Figure 10 Diagnostic lithics from the Jebel Ousselat **1 and 3**: Simple endscraper on flake (Tixier N ° 1); **4**: Notched endscraper on small blade (Tixier N ° 7); **2 and 5:** double scrapers on flakes with two opposite fronts (Tixier No. 11); **6**: Endscraper end retouched blade (Tixier N°. 9); **7**: Abruptly retouched burin spall (Tixier N°. 54); **8**: Backed bladelet (Tixier N ° 56); **9**: Piercer (Tixier N°. 16); **10**: Blade with continuous retouching; **11**: Strangulated blade; **12,13 and 14**: burins; **15**: fluted pyramidal core; **16, 17, 18 and 19**: Bladelet cores. (Drawing by Marwa Marnaoui)

Figure 11 Map of sites across the Jebel Ousselat.

Figure 12 Dar H'ssine shelter: 1 bovine and 2 sheep (painted engravings) (Photo J. Ben Nasr).

Table Captions

Table 1 Range of different species represented across the rock art sites

Table 2 Numbers of human figures, weapons and other motifs on the rock art panels

Table 3 Key sites with quantification of lithics by typology