Observations of settlement dynamics in Qatar.

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Abstract

The impact of past environments is often considered central to our understanding of formation and change in past societies. This is particularly apposite in marginal landscapes like the Middle East, where small environmental changes can have dramatic impacts on flora and fauna. Changing conditions may provide compelling answers to crucial questions, such as where, when, why, and how people lived. However, a heavy emphasis on environmental factors can also detract from a multiplicity of other factors. In recent years the palaeoenvironment has become a central research theme within Qatar and the wider Arabian Peninsula. Between 2008 and 2015 the Qatar Museums supported the University of Birmingham to develop a bespoke Historic Environment Record for Qatar, known as the Qatar Cultural Historic Information Management System (QCHIMS). This was populated with more than 7,000 archaeological sites and 25,000 references and photographs. The initial analysis of this data provides an important contextual framework for further palaeoenvironment research. This paper briefly examines the dynamics of prehistoric and early Islamic societies within this contextual framework.

Introduction

The peninsula of Qatar comprises largely of Tertiary limestone, shale and dolomite of the Upper Dammam Formation, which formed in shallow marine conditions in the latter half of the Eocene. One of the largest structural features of the Arabian Plate is an anticlinal arch aligned north-south along the centre of the country (Fig. 1), from which wadi systems can be traced to the coast. In places these are interspersed with dissolution hollows or collapsed karst where surface sediment has accumulated. Known locally as *riyadh* (singular *rawdah*), these sediment basins have an important impact on the pattern of interior drainage, forming catchment areas for surface water runoff. This allows for aquifers to be recharged through seepage, rather than allowing surface water to be discharged along wadis into the sea. Riyadh account for c.335km2 of the surface area of Qatar (Sadiq & Nasir 2002) totalling approximately 2,093 individual areas, and are the result of karst systems that formed during phreatic conditions in the Middle Pleistocene (around 560,000 to 325,000 years ago). The dissolution of carbonate-evaporite deposits by circulating groundwater now takes the form of caves, sinkholes and sediment hollows (riyadh). It has been calculated that there are more than 9,700 caves (*duhul*)/karst-related features most of which are located in northern Qatar (Cuttler *et al.* 2013a). Moisture supplied by these sinkholes and sediment hollows that are vital to agriculture and vegetation in Qatar.

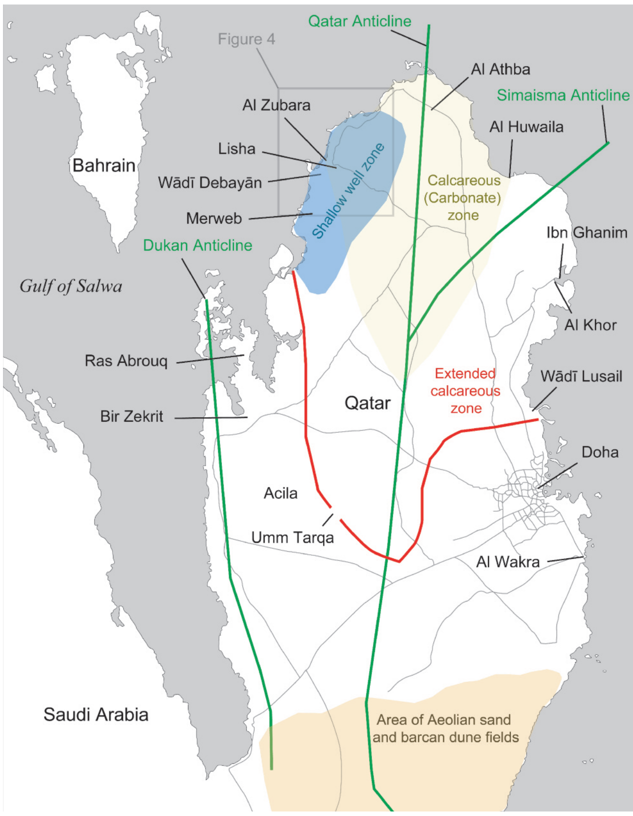

Figure 1: *Geological anticlines, hydrology and locations mentioned in the text.*

Neolithic communities and Holocene environmental change

For much of Prehistory (and in subsequent periods) human survival has focused on the identification, control and exploitation of natural resources. Qatar is no exception, with many early Neolithic sites located close to the coast, a wadi, or an oasis, where water, vegetation and fauna were to be found.

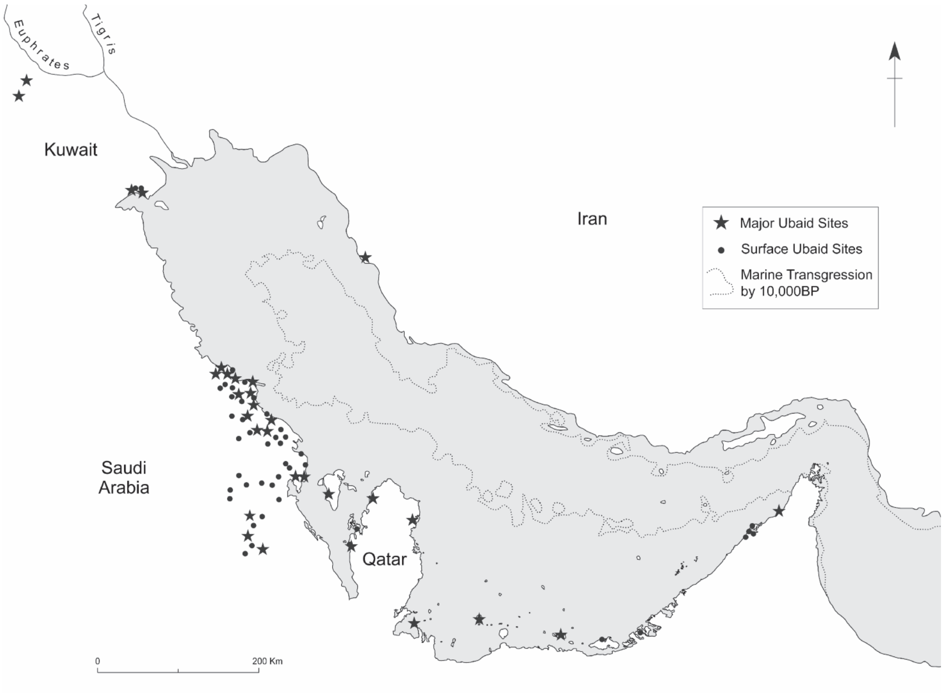

Figure 2: *Distribution of Ubaid sites along the western and southern Gulf.*

The discovery of Neolithic sites along the Saudi Arabian Gulf littoral in the late 1960's (Burkholder 1972) was soon followed by the discovery of similar sites around the coast of Bahrain, Qatar and the Trucial States (Fig. 2). The further discovery that these communities were involved in a long-distance trade between the ?Ubaid communities of southern Mesopotamia was entirely unexpected, and this has since remained a cultural connection that has been difficult to explain. Joan Oates (1978) proposed that the littoral Gulf communities were the result of a southwards expansion from southern Mesopotamia soon after 7.5ka BP, adding that the main reasons for this expansion were likely to be *'economic or climatic factors'*, although conceded that the mechanics of this remained 'as yet, an unanswered question'.

The discovery of the first ? Ubaid communities in the 1960s and 1970s coincided with new environmental research, which indicated a significant increase in rainfall across Arabia between approximately 10kya and 6kya. This increase was thought to be due to changes in weather patterns which weakened the shimal (northerly) winds, allowing the summer monsoon to move northwards (Fig. 3). Over the past fourty years there has been a convincing corpus of environmental data from the southern extent of the peninsula. Much of this indicates a substantial shift in weather patterns resulting in increased precipitation, savannah landscapes and semi-permanent lakes. However, a relative paucity of environmental proxies from Qatar and central Saudi Arabia led researchers to consider that the climatic optimum may rarely have influenced areas to the north of 24 degrees latitude (Fleitmann *et al.* 2004). While proxy data from the Yemen, Oman and the Emirates has been fairly conclusive, proxy data in central Arabia and Qatar has been remarkably conspicuous by its absence. Environmental proxies from southern Arabia record a significant variation in the range, duration and intensity of the Indian Summer Monsoon (ISM) at different latitudes. These indicate that the onset of pluvial conditions was a time-transgressive event that occurred progressively later the more northerly the location. Proxy evidence suggests the ISM affected southern Arabia around 10 kya, but probably took a further ~500 to 1500 years to advance as far as the northern Emirates.

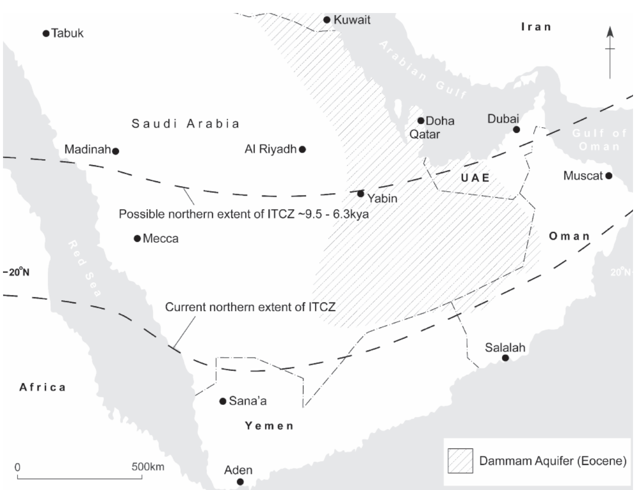

Figure 3: *The projected advance of the ISM across the Arabian Peninsula during the early Holocene.*

Some researchers have suggested that the sedimentological, floral and faunal characteristics of lacustrine like deposits in Arabia indicate shallow, wetland environments rather than lakes, and the extent of palaeoenvironmental change may have been significantly less (Enzel *et al.* 2015). In contrast to lakes, areas of marshland are sustained by much smaller increases in rainfall, and the corresponding palaeo-hydroclimatic changes needed to explain them are minimal. However, this claim is questionable and remains the subject of much debate (Engel *et al.* 2016). Wetlands may be considered superior to lakes in providing resources to humans and animals, however in Qatar; there has been little palaeoenvironmental evidence for either. These ongoing debates demonstrate the importance of further palaeoenvironmental research in Qatar to confirm any Holocene environmental changes, but present research suggests that during the Holocene Qatar did not experience the increase in rainfall manifest within the southern Arabian Peninsula (Cutler 2013). This would lead us also to conclude that there was little change in the environment between the Bronze and Iron ages of the 3rd to 1st millennium. However, cultural and technological progress during the first millennium BC, especially in water management, may have allowed people to exploit inland dry areas for agriculture and pastoral care, which could have been a catalyst for the founding of more permanent settlement in Qatar during the early Islamic period.

The extent of Aeolian sand (dunes) across Qatar during the Late Pleistocene is also unknown, but is likely to have been more extensive than at present. In Qatar barchan dunes are mostly limited to the southeast of the country (Fig. 1), and form the northern-most extent of the Rub' al-Khãli. Prior to 13kya lower sea levels and the prevailing northwest 'Shimal' wind would have facilitated the transport of oolitic sands across the exposed floor of the Arabian Gulf and into northern Qatar. As sea levels rose the Arabian Gulf trapped Aeolian sediment, preventing sand reaching northwest Qatar, which exposed wadis and *rawdah* (Cuttler *et al.* 2011, Cutler 2013, Glennie & Singhvi 2002).

The rise in sea levels between 14kya and 7kya flooded an area in the Gulf of approximately 250,000 km2. However as late as 8.2kya extensive areas of the Gulf between Qatar, Bahrain and the Emirates remained free from marine influence, with research suggesting present sea levels were reached between ~7 and 6 kya (Lambeck 1996). Positive sea-level tendencies continued, with a highstand of between + 1 to 3m between ~5800 and 4600 BP (Vita-Finzi 1978), marking the full extent of the Flandrian Transgression. Lambeck and Vita-Finzi both produced a set of synchronous dates from *Al Khor, Wãdî Lusail and Bir Zekrit,* (Fig. 1) with negative sea-level trends commencing c. 4280±160BP and 4690±80BP (Lambeck 1996; Vita-Finzi 1978). Taylor and Illing (1969) produced dates from *Ras Abrouq* and *Bir Zekrit* which suggested the trangressive phase and highstand were slightly later. At *Ibn Ghanim*, north of the current town of *Al Khor*, evidence suggests maximum height was reached *c.7* kya with negative trends established by *c.5* kya (Inizan 1988).

Most early to mid-Holocene sites are found along wadis, the coast, or on the edge of rawdah where water, vegetation and fauna were more abundant. Pioneering work by Peter Glob (Glob 1957), Holger Kapel (Kapel 1967) and Beatrice de Cardi (de Cardi 1978) indicated a preference for coastal settlement during the prehistoric and later Islamic periods. The effects of fluctuating sea levels were pivotal to the research of these early expeditions and laid the foundation for later missions in the 1980s, which focused their exploration on the coastal zone (Inizan 1988). This body of work sought largely to establish landforms associated with former coastlines and the scope of human exploitation during prehistory. More recently surveys by the Qatar National Historic Environmental Record (QNHER) project undertaken by the University of Birmingham, suggest archaeological sites are not simply found around the coast but are fairly evenly distributed across the northern extent of the Qatar Peninsula.

Demographics of the dead

A paucity of sites in Arabia and Qatar during the 3rd to 1st millennium BC may reflect a population decline, a change of lifestyle from sedentary to nomadic or climatic deterioration. There is very little evidence for late pre-Islamic settlement, however, the 1st millennia BC sees a sharp rise in the construction of burial cairns, particularly in northern Qatar. Extensive survey around *Wãdî Debayãn* in the northwest of Qatar (Figs. 1 and 4) has revealed substantial differences in the regional density and distribution of monuments. Currently 1,449 sites are recorded within or around the hinterland of the wadi, of which 690 have been tentatively ascribed to the prehistoric and would appear to relate to pre-Islamic burial cairns. Most of the cairns within the wider region surrounding *Wãdî Debayãn* remain undated (470 individual sites), currently burial cairns, cairns and clusters thereof, form 48% of the total number of sites within the 13km radius of the mouth of the wadi.

This density of burial cairns suggests either the construction and use of such monuments spans a much greater period than previously thought or, based upon the relative dates obtained from excavated examples, is related to a sharp increase in activity and populations levels during the immediate post iron-age (ca. 350 BC) and decline during the Sasanian period (ca. 224 AD) (Cuttler *et al.* 2013b). Population increase can be linked to a number of factors; gradual changes are usually the results of long-term processes within the cultural group or wider environment and may be linked to such factors as resource acquisition & exploitation, trade and internal political and cultural social structures. Rapid or sudden fluctuations of populations, however, are usually the results of external factors altering the base conditions upon which such cultural groups are based; war, economic competition and disease may adversely affect a population, however, examples from around the world and within the Gulf have consistently proven the importance of ecological and environmental factors in the development of human populations.

Previous excavations of burial cairns in Qatar have discovered pottery; iron sword fragments and articulated camel bone. Dating from such finds has generally indicated dates between c.350BC - 310AD. Similarly cairns at Lisha, north-east of *Wãdî Debayãn* produced human bone (vertebrae and femur) a sardonyx bead and the lower part of the blade of a sword (Schreiber *et al.* 2009). Datable finds in association with burial cairns are often few and it is more commonplace to find such cairns devoid of any artefacts either due to tomb robbing in antiquity or poor preservation. Additionally, bone survival and preservation is extremely poor, often resulting in insufficient data for potential radiocarbon dating. However, the excavation and absolute dating of significant numbers of these burial cairns by the QNHER project and the Qatar Museums over the past six years has begun to provide us with a clearer understanding of population dynamics and funerary practices in prehistory. It is now evident that many tombs previously assumed to date to the late pre-Islamic period may in fact date to earlier periods such as the Neolithic and Bronze Age. Radiocarbon dating and OSL dating suggests funerary practices established in the Neolithic period changed very little over the millennia. While it has now been proven that these burial monuments relate to a longer time span, the relative number of tombs dated to the late pre-Islamic period remains high.

Transitions from nomadic to sedentary lifestyles

Surveys over the past six years have identified significant numbers of Islamic sites including Bedouin temporary settlements, mosques, abandoned villages and small homesteads. The earliest Islamic site discovered to date was a small homestead, located approximately 4km to the south of *Al Wakra* (Fig. 1). Excavations in 2011 revealed the presence of a structure built with large, flat stone slabs, with adjoining three rooms and internal divisions. The dates returned by the radiocarbon samples from the domestic structure cluster around the late 7th to mid-8th century. The pottery assemblage indicates extensive trade with western Iran and the wider Gulf period during Umayyad and early Abbasid rule. Although comparative sites within Qatar are entirely absent, the building techniques are paralleled by other early pre-Islamic and Nestorian sites in the wider gulf region.

During the Abbasid period the number of settlements in Qatar increases and may indicate a temporary change from nomadic to sedentary lifestyles. These settlements, such as those at *Merwab* and *Al Athba* appear to be small villages (Guerin & Al Naimi 2009) or ribbon settlements often on an east-west alignment. This alignment appears to be reflected in the layout of later Bedouin temporary settlements. In addition, almost all of these settlements are located within the interior and away from coastal areas, as opposed to later Islamic settlement which is almost exclusively coastal.

By the 10th century AD most of these settlements would appear to have been abandoned in favour of a Bedouin lifestyle. This is demonstrated by a rise in the number of temporary Bedouin settlements, which by the 15th and 16th centuries become augmented by the rise of Islamic towns around the northern coast of Qatar. In northern Qatar two Islamic towns are of particular importance to both trade and the pearling industry, *Al Zubara* on the northwest coast of Qatar and *Al Huwaila* on the northeast.

Geomorphology, ecology & environment

Minor changes in a marginal environment such as the Arabian Peninsula can have significant effects on settlement patterns. Fluctuations in climate, aquifers and sea level affect the availability of essential resources and affect the duration over which an area may provide sufficient resources for a population. When resources locally are insufficient to provide for a given population, it is clear that there is pressure on a population to become more mobile and draw resources from a much wider area. Whether a population is nomadic or sedentary will further alter the range of resources required and thus which areas are suitable for continued exploitation.

While Qatar is not a large country there are distinct ecosystems across different regions. The southeast is dominated by large dune systems, while the central and northern areas predominantly form parts of an interconnected system of drainage basins and wadis, within which are isolated environmental refugia of *rawdah*. In the north the *rawdah* are all the more important for small scale agriculture and grazing given the accessibility of fresh groundwater. At several points around the coast are resource-rich coastal mangrove forests and protected bays, which are generally found at the end of extensive wadi channels. The presence and development of such environments is directly linked to not only the nature of factors such as climate patterns, sea level and underlying geology, but to the geomorphology of the land. This means that in the north of Qatar the presence of a karst landscape and freshwater aquifers enable groups to obtain resources, even when rainfall is low.

Sites distribution

Palaeolithic and Neolithic

Between 1960 and 1964 a Danish mission carried out extensive field survey resulting in the discovery of 122 Stone Age sites, which yielded a total of over 30,000 artefacts. The flint specialist for the mission, Holger Kapel, subsequently used 68 of these sites and 11,028 artefacts to produce a tentative regional Palaeolithic chronology (Kapel, 1967), where he identified four primary groups. Kapels 'A group' contained the 'oldest artefacts', which he considered to be of Palaeolithic in origin, while he confessed difficulty in deciding where the 'B-group' fitted within his chronology. However, due to a series of misunderstandings by subsequent researchers, and a failure by later researchers to sufficiently challenge their conclusions, Kapels A and B-group classifications were dismissed as being of Holocene date. The following 30 years of research was correspondingly handicapped by a generally accepted, but misguided view, that there was no Palaeolithic in Qatar. A recent review of Kapels assemblage confirms some that the 'B-group' from Umm Taqa (Site XXXIV, Fig. 1) is characteristic of a middle-upper Palaeolithic industry, although the rest of the 'B group' would appear to be of early Holocene date with some researchers suggesting a link between the Qatar B groups and Levantine PPNB due to the discovery of points obtained from bidirectional core (naviform) from Acila (Crassard *et al.* 2013). The *Acila* example is the only example of its kind in the entire Arabian Gulf region, and these cultural styles seem to have disappeared in Qatar as quickly as they appeared. This may suggest a short-term incursion of groups with no long-term impact on local traditions (Charpentier & Crassard 2013; Drechsler, 2009).

Analysis of 'A-group sites reveals the presence of large chopping tools and crude 'Abbevillian' cores, both indicative of an early stage within the lower Palaeolithic (Scott-Jackson *et al.* 2014, 2015). Recent field survey also identified thirty five Palaeolithic surface-scatters/sites, including five early lower Palaeolithic knapping sites (Scott-Jackson 2016). With the exception of the site at Umm Taqa, all the newly discovered Palaeolithic sites are to be found on ridges and plateaus overlooking endorheic basins in southern Qatar. This would seem to conflict with the hydrogeological data, which clearly shows the most accessible, fresh ground water is to be found in northern Qatar. While this might suggest ground water was more accessible in southern Qatar in the Palaeolithic and in the north of Qatar during the Holocene, there are other possibilities that should be considered that may account for this difference.

Firstly, it seems likely that the palaeohydrological regime during the Holocene was similar to today, with ground water in the north being more accessible. Secondly, it seems likely that the topography in the south may have been similarly harsh during the Neolithic, comprising of large barcan dunes and barren interdunal plains (Fig. 1). This may explain the paucity of Neolithic sites in the south. However as sea levels rose and the Gulf became a sediment trap for predominantly northwest to southeast trending Aeolian deposits (Cuttler *et al.* 2013) the natural ground surface and rawdha in the northwest of Qatar would have been exposed, making the north more habitable. A third consideration is that given that Palaeolithic sites are found predominantly around endorheic basins in southern Qatar it seems likely that the environment was significantly different during periods of the lower Palaeolithic and the endorheic basins may have formed lakes attractive to groups of Palaeolithic hunters. However, given the extensive time spans, it is likely that Palaeolithic flint scatters were also prevalent in the north by the early Holocene. But as Aeolian sands were prevented from being deposited in northern Qatar by sea level rises in the Gulf, existing sand in northern Qatar was blown to the southwest, probably exposing Palaeolithic flint scatters. If this is the case, they could easily have been found and reworked by later Holocene groups. However, the absence of Holocene occupation in the south and the extent of sand coverage may have meant that scatters of Palaeolithic flint remained largely untouched throughout the Holocene. However, more research is required in order to reach firm conclusion about the Palaeolithic occupation in Qatar (Muhesen & Al-Naimi, 2016).

The Islamic period

When the location nature and date of the 1450 sites recorded in the hinterland of *Wãdî Debayãn* are displayed against proximal factors such as geology, hydrology and topology, patterns emerge that link these sites to their wider environment and landscape. Permanent Islamic settlements are always situated within the immediate vicinity of silty alluvium deposits and relatively rich agricultural land associated with the presence of *rawdha*. This is unsurprising given that a sedentary population would require such land for agriculture or grazing. Prehistoric sites, while occurring at multiple elevations are always situated in the liminal areas between topographical changes, slopes, hill crests and outcrops commanding extensive views of the surrounding landscape. Furthermore when examining the geological and environmental attributes of such areas we find recurring patterns in the site typology. Middens are surrounded by flint and artefact scatters situated near to natural flint beds. Likewise recent paleoenvironmental work has shown sheltered bays and developing lagoonal areas, such as Wãdi Debayãn, would have encouraged the development of extensive mangrove forests rich in floral and faunal resource during periods of sea level stability and regression.

Clearly the positioning, extent and nature of these sites is inextricably linked to the nature of the wider landscape around them, and the unfolding prehistoric cultural landscape of Qatar is not one of isolated archaeological sites, but of a dynamic population subject to, and exploiting the wider landscape around them, a process which is most visible in later Bedouin cultures. Extensive coastal surveys undertaken by the University of Birmingham as part of the QNHER project aimed to refine existing topological and environmental data for the coastal regions of Qatar. Based upon the projected + 1 to 3m sea level rise, teams conducted extensive pedestrian based surveys of coastal areas within the north-western region of Qatar. As well as noting the location, nature and extent of possible prehistoric sites, teams also noted geomorphological features such as marine sediment deposits, relict coastal features and flint beds all factors known to be linked to the presence and development of prehistoric populations.

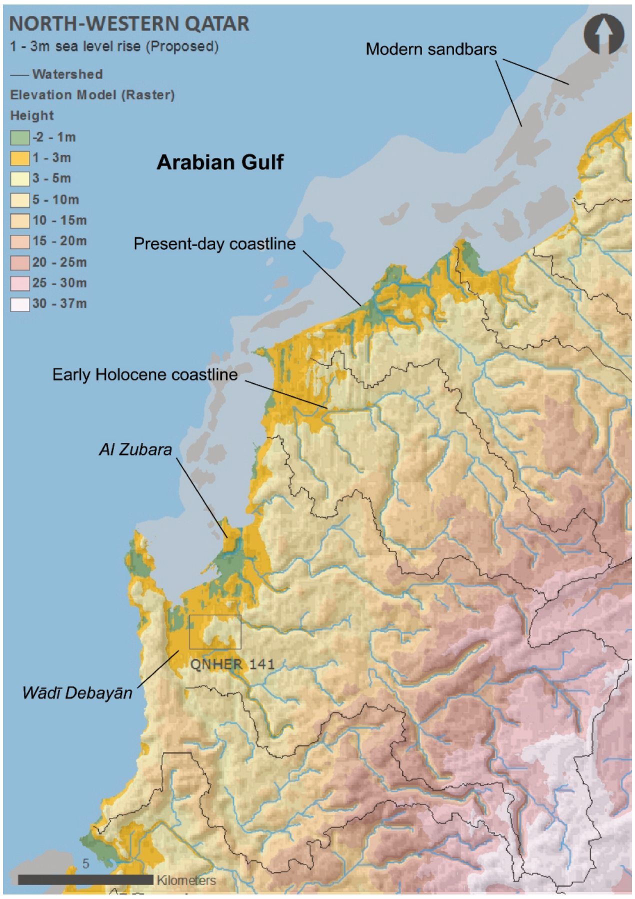

Figure 4: *Elevation model of the northwest coast of Qatar showing water catchment areas (watershed) and the predicted effect of the mid Holocene 1 - 3 metre sea level rise.*

From this data the initial projections of the coastline (Fig. 4), which was initially based on a variety of aerial photography, satellite imagery, geological and topographic data could be refined using survey and ground truthing. Using this data and data from excavations within Wãdi Debayãn, provisional 'landscape characterization' models were produced of the prehistoric costal environment. Sites were considered within their environmental, topological and chronological context. Such models can also be used to model past population's behaviour and form part of the parameters or landscape signatures by which further sites may be located.

Discussion and further research potential

Technological advances within a range of disciplines associated with archaeological research over recent decades have enabled a much wider range of detailed information to be produced regarding past environments. In particular the development of satellite imagery and the incorporation of Geographic Information Systems (GIS) have enabled field archaeologists to rapidly acquire, analyse and project a wide spectrum of complex data (Conolly & Lake 2006). Similarly the use of a range of coarse and fine resolution surveying techniques such as GPS mapping and UAV technology, allows for detailed analysis of the spatial distribution of feature classes or monuments. Sites can be projected against the underlying topographical, geological, and hydrogeological landscape, coupled with a chronological framework provided by a variety of absolute and relative dates produced through excavation results from key sites. This provides a robust tool for analysing the development of the historic landscape within the framework of environmental and geomorphological influences. Using this dataset, we can query the relationship between the construction of specific monument types and underlying factors such as resource accessibility, transportation networks, and line-of-sight analysis. Furthermore, we can use this to develop a meaningful typology of feature classes and the potential relationship between monuments from different chronological periods in terms of influence and cultural connections.

Over the past three decades "landscape" has become an umbrella term to describe many different strands of archaeology. From the processualist study of settlement patterns to the phenomenologist's experience of the natural world, from human impact on past environments to the environment's impact on human thought, action, and interaction, the term has been used (David & Thomas 2010). This ambiguity to some extent branches in part from the very idea of 'landscape' in current society and from the technological and theoretical basis from which the field developed. Landscape Archaeology as with any discipline has both advantages and disadvantages over other archaeological methods. The power of GIS, as with other computer programs, can be deceptive: visually impressive but ultimately meaningless results can appear unassailable because of the sophisticated technologies used to produce them (Eiteljorg 2000). A concept similar to that raised by Thomas (1993) concerning an erroneous belief that can potentially arise in GIS-led landscape surveys: that 'data assembled are data understood'. The apparently 'totalising knowledge' that emerges from the assembly of structures, fields, hydrology, soils, elevation and extant archaeological evidence into a GIS does not directly lead to an understanding of the all-important social landscape (Conolly & Lake 2006).

Landscape is, therefore, not a static background against which human dramas are played out, but an underlying catalyst. How prehistoric societies adapted and transformed reflects not only cultural adaption and communication, but climate, geomorphology and topography and how landscape has an intrinsic influence on the nature of the society which develops within it.

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