GEOARCHAEOLOGICAL RESEARCH OF HOLOCENE OCCUPATIONS IN WĀDĪ AL-ḤASA: A PRELIMINARY REPORT ON THE 1999 SEASON

by

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Introduction

A first season of geoarchaeological and remote sensing research focusing on Holocene cultural ecology in Wādī al-Ḥasa was conducted between 15 April and 15 May, 1999. The goals of this research were two-fold: (1) to begin a general assessment of the relationships among Holocene archaeological sites and fluvial terraces in the lower Wādī al-Ḥasa and its primary tributary drainages, and (2) to record ground control points (GCP's) for the classification and analysis of LandSat remote sensing imagery. Preliminary indications show that this research will provide some interesting and unexpected results, as well as considerable information for structuring a second stage of research planned for next year.

The ecological research described here is based on the premise of human impact on the environment in the Near East. Although clearly variable throughout the region, anthropogenic degradation is generally thought to have become a major factor shaping the landscape of the Levant sometime during the early to mid-Holocene. Its timing and nature remain a subject of debate in Levantine archaeology (Baruch 1986; Goldberg and Bar-Yosef 1990; Gophna 1986; Liphschitz 1989; Rollefson, *et al.* 1992; van Zeist and Bottema 1982). Anthropogenic environmental degradation is also thought to have played an important role in the development of local cultural traditions among populations forced to cope with its effects. The effects of environmental change might have been felt most strongly in mesic to arid ecotones because these areas are already marginal to plant and animal husbandry, and small scale environmental changes might have been sufficient to render them non-productive for certain activities (Gophna 1995; Tchernov and Horwitz 1990).

With these premises in mind, research focused on paleoenvironmental reconstruction and human/landscape relations during the Holocene in Wādī al-Ḥasa. Wādī al-Ḥasa is an ideal location for seeking clues to the timing of environmental impacts and the human response to them. Relatively little Holocene environmental research has been done in this area but one of the best archaeological survey databases in Jordan has been developed through the efforts of two large systematic survey projects conducted by MacDonald (1988) and Clark (Clark *et al.* 1992; 1994). These data in conjunction with information provided by geomorphological studies of Vita-Finzi and Copeland (Copeland and Vita-Finzi 1978; Vita-Finzi 1966), and Schuldenrein and Clark (Schuldenrein 1988: 1998; Schuldenrein and Clark 1994) offer a good point of departure for developing a chronology of fluvial terrace formation. It is my goal to evaluate such a chronology with respect to known chronologies of climatic and archaeological change in order to identify episodes of erosion and aggradation that were likely linked to cultural factors.

The second goal of this research is to elucidate human responses and/or adaptations to environmental (esp. anthropogenic) degradation. By analyzing the spatial correlates of human behavior over the span of Holocene agro-pastoralism, I hope to develop a better understanding of the kinds of land management decisions people made during periods of environmental change. I have already documented several interesting patterns and trends in settlement among past

populations (Hill n.d.). Briefly, there appears to have been a high degree of settlement relocation from one time period to the next and a tendency for long term successful settlement to be located in areas distant from water but geomorphically stable. I interpret these findings in terms of differential vulnerability to degradation in the high relief, semi-arid Wādī al-Ḥasa drainage. These conclusions were based on analysis of archaeological settlement locations in relation to topography and sources of permanent water. I hope to supplement these geographic data with maps of sediment and soil types, water retention variables, and vegetation resulting from LandSat imagery classification.

Methodology

The first stage of research entailed the relocation of numerous Holocene period sites recorded by the MacDonald (1988) and Clark surveys (Clark *et al.* 1992; 1994), and the evaluation of their geomorphological contexts. A number of sites that appeared to be associated with wadi channels and bottom-lands were selected, based on published descriptions. Using a Global Positioning System (GPS) and site descriptions, 25 sites ranging in age from Pre-Pottery Neolithic to Byzantine were relocated. Upon relocating a site, its location with respect to identifiable terrace remnants was documented, and an attempt to ascertain the terrace sequence present in the vicinity was conducted.

The second stage of research entailed recording the description and location of GCPs for LandSat image classification. Using printouts of the LandSat images and general surveillance of the area, 60 locations of variable surface characteristics were selected. At each location the position using GPS, and surface characteristics including land form, sediment and soil type, vegetation coverage and type, and current land-use were recorded. The locations were then uploaded as points into ArcView GIS software where tables of surface characteristics will be associated with them. The use of these data for an initial classification of the LandSat images will be performed in the spatial analysis laboratory at the Archaeological Research Institute at Arizona State University. This classification will then be ground-truthed and refined in a second season of field work planned for the year 2000.

Conclusions

At this stage of research conclusions are, of course, preliminary. Much of the data remains to be analyzed and a second season of field work is necessary to substantiate hypotheses developed thus far. Nevertheless, a few observations are worth mentioning because they are somewhat unexpected and would have significant implications for the archaeology of human adaptation in this region.

The first goal of this project was to begin developing an understanding of the chronology of fluvial terrace development in Wādī al-Ḥasa and the relationships among terraces and archaeological sites. It was in this domain that the most interesting impressions have emerged.

Previous research in this area has focused on the terrace chronology in the upper al-Ḥasa drainage. Based on the stratigraphic positions of archaeological materials and radiocarbon dates, Vita-Finzi and Copeland (Vita-Finzi 1966; Copeland and Vita-Finzi 1978) developed a chronology of cut and fill episodes spanning the Middle Paleolithic to late Holocene. More recently, Schuldenrein and Clark (Schuldenrein 1998; Schuldenrein and Clark 1994) presented a modified interpretation of the sequence, based on their analyses of some of the sediments as lake deposits (lacustrine marls) rather than fluvial terraces. Moreover, Schuldenrein and Clark offer a refined and slightly modified chronology based on additional archaeological evidence and new radiocarbon dates. As noted above however, these studies have focused primarily on the upper portion of the

drainage, which now appears to have been a lake basin during much of its history rather than a fluvial system continuous with the lower drainage. It remains unclear exactly how and where the upper lake-basin system and the lower fluvial system were integrated, and they probably do not share an identical history of incision and aggradation. My analyses have little to contribute to an understanding of the history of the lake basin, which was a Pleistocene phenomenon, and instead are focused on Holocene developments in the fluvial system.

One of the most obvious features in the al-Ḥasa drainage is a high terrace, herein designated the Ṭabaqa Terrace. This terrace is clearly visible throughout the length of the trunk drainage as a fine, light brown, silty deposit anywhere from 35m to 60m above the current channel. In most cases, this terrace currently exists only as small remnants clinging to the fairly steep bedrock wadi sides. But, in places where it has been protected, either in ancient oxbow deposits or at relatively wide confluences of tributary drainages, it is fairly well preserved and has even become a locus for contemporary cultivation (e.g., at the confluence of Wādī al-Ḥasa and Wādī al-Aḥmar, and Wādī al-Ḥasa and Wādī Khasra) .

This terrace first became a feature of interest to the present research when its uppermost 2 m were determined to be post-Natufian in age based on stratigraphy at the site of Ṭabaqa (WHS 895), which is buried by it near the confluence of Wādī al-Ḥasa and Wādī al-Aḥmar (Olszewski and Hill 1997; 1998). Determining how long after the 12000 BP Natufian occupation the Ṭabaqa Terrace continued to aggrade would thus appear to be a baseline from which to begin establishing a Holocene geochronology. It has previously been suggested that the floodplain associated with this terrace was deeply incised down to bedrock or marl surfaces by 9000-8000 BP (Schuldenrein 1998; Schuldenrein and Clark 1994).

I began by relocating as many Neolithic, Chalcolithic and Early Bronze Age sites as I could from the MacDonald and Clark surveys in hopes of finding further stratigraphic evidence with which to bracket the end of the Ṭabaqa Terrace aggradation and its subsequent incision. Based on the published data, I was able to relocate several Pre-pottery Neolithic sites and all of the Pottery Neolithic and Chalcolithic/Early Bronze Age sites associated with the wadi channels. I evaluated a total of 15 Neolithic and Chalcolithic/Early Bronze Age sites and their positions with respect to fluvial terraces and was unable to verify any *in situ* components buried by fluvial deposits associated with the Ṭabaqa Terrace. A striking pattern did emerge, however, in regard to site locations. One hundred percent of the *in situ* Neolithic and Chalcolithic/Early Bronze Age components I evaluated were located on or very near the surface of the Ṭabaqa Terrace. No verifiable *in situ* remains from these periods were located below the level of the Ṭabaqa Terrace surface.

While surface indications such as these lack the positive implications of well-studied and dated stratified sections, the implications are nevertheless quite significant. More precise figures remain to be calculated, but for the purposes of the present discussion I estimate that the extant surface of the Ṭabaqa Terrace represents somewhat less than 10% of the present land surface in close proximity to the wadi channels. It is therefore extremely unlikely that all Neolithic and Chalcolithic/Early Bronze Age sites were randomly located on that surface.

Archaeological site location is of course never random but predicated on such concerns as access to resources (e.g. water, agricultural land) and defense. Given what is currently known and what can reasonably be supposed about settlement in the Neolithic and Chalcolithic/Early Bronze Age periods, it appears even more unlikely that they would have chosen to settle on high terrace

remnants. Indications from elsewhere in the Levant are that people chose settlement locations close to water sources and floodplain farmland (Banning 1995; Bar-Yosef 1995; Levy 1983) or, in some cases, on high saddles close to open pasture for grazing (Hanbury-Tenison 1986). The settlement locations in Wādī al-Ḥasa satisfy neither of these criteria, nor any imaginable defensive criteria. They are located in part way up steep, often unstable slopes without easy access to agropastoral resources either on the floodplain below or the plateau above. Moreover, they are typically overlooked by hilltops and steep slopes, rendering them indefensible. These settlement locations are, in short, difficult to explain in the current landscape. It appears more likely that the Ṭabaqa Terrace surface represents the approximate level of the floodplain as late as the Chalcolithic period and perhaps the Chalcolithic - Early Bronze Age transition.

It is not until the Early Bronze Age I period that archaeological materials begin to appear on lower surfaces. The incision of the Ṭabaqa Terrace may be associated with the spike in precipitation noted by Frumkin (1997) and Neev and Emery (1995) in the Chalcolithic/EB-I transition, but such conclusions await further analysis. In any case, such a late date (approximately 6500-5500 BP) for the abandonment of the Ṭabaqa Terrace by channel incision is bolstered by, and helps to explain, a number of other archaeological phenomena in this region.

There is a notable lack of settlement recorded in the lower Wādī al-Ḥasa during the Pottery Neolithic and Chalcolithic periods when nearby areas were experiencing rapid settlement growth. If the Ṭabaqa Terrace surface were a reasonably stable floodplain into the Chalcolithic, its current remnants must represent a small fraction of its former extent. As above, precise calculations await, but if it represents a small sample of the ancient floodplain, then the number of sites recorded there indicate a great deal more Neolithic and Chalcolithic settlement in this area than had previously been supposed. Furthermore, there appears to have been an increase in both the number of EB-I settlements and an increase in their distance from the major channels when compared to earlier periods (Hill n.d.). If there was a rapid incision of the Ṭabaqa Terrace floodplain and this land was being lost to agriculture, such a move may represent abandonment of the floodplain by EB-I populations. The present discussion is obviously preliminary and somewhat speculative, but the converging lines of evidence are noteworthy and merit further research.

There are at least four terraces at lower elevations than the Ṭabaqa Terrace that date from the middle to the late Holocene. Of these, only the current floodplain is readily identifiable throughout the Wādī al-Ḥasa drainage system (Copeland and Vita Finzi's Fill III [1978]). Two intermediate terraces are represented only by occasionally identifiable remnants and their dates and extents are unclear at present. Likewise, a low terrace is found intermittently within the main channel and banked against the greater floodplain deposits (Copeland and Vita Finzi's Fill IV [1978]). While the location of archaeological materials on the intermediate terraces can help us to bracket the timing of their formation such conclusions await further analyses.

A final comment is in order with regard to the current floodplain and the lowest terrace. Copeland and Vita-Finzi (1978) dated the formation of Fill III to the period from 8000-4000 BP based on buried archaeological materials and a single radiocarbon date. They also proposed that this terrace was incised at some point between 4000-2000 BP based on the position of a Nabataean/Roman retaining wall in the current channel and supporting Fill III sediments against lateral erosion in the vicinity of a large Nabataean/ Roman settlement (WHS 725, Umm Hraga) (MacDonald 1988).

Schuldenrein and Clark subsequently revised the date of Fill III based on an additional radiocarbon date of 1000 BP near its surface. They proposed that it was still aggrading by 1000 BP and that downcutting did not begin until 400-500 years ago (Schuldenrein 1998; Schuldenrein and Clark 1994). The discovery of a small Byzantine component at WHS 725 since the time of Vita-Finzi and Copeland's study (MacDonald 1988) may indicate a somewhat later date for the construction of the retaining wall, perhaps into the seventh century AD. Nonetheless, the retaining wall clearly predates Schuldenrein and Clark's radiocarbon date and most likely supports Copeland and Vita-Finzi's date of incision at 4000-2000 BP. This date is supported by evidence from a Roman bridge (WHS 535) downstream, dating to the early 2nd century AD (MacDonald 1988), whose base is also built in the current channel, below the level of the floodplain. This bridge has alluvial sediments from Fill IV banked directly against it and subsequently incised, again supporting Copeland and Vita Finzi's original interpretation of Fill IV deposition and incision during the Roman to Medieval periods (Copeland and Vita Finzi 1978).

In conclusion, the geomorphological evidence thus far, suggests that during the period from approximately 6500 BP to 2000 BP the Wādī al-Ḥasa landscape was transformed from one with a broad floodplain 35 to 60 m above its present level, to its current, deeply incised state with a relatively narrow floodplain and channel often at the level of bedrock. The deposition and incision of Fill IV represent a relatively minor fluctuation dating to the late Holocene. This interpretation stands in contrast to earlier views in which the major transformations were thought to date to the early Holocene with a more recent period of degradation dating to the late historic period.

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