

Changing availability of water resources in Wadi Faynan: implications for understanding human activity during the Holocene

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A key task facing the archaeological component of WLC is to study the effects of climate change on hydrological regimes and patterns of human settlement, society and technology. This is a broad, coarsely defined task, with a large temporal and spatial remit and, as such, it may be approached in several ways. The approach described here is focused on a small spatial region, the Wadi Faynan, but has broad chronological scope; examining the relationship between patterns of human adaptation and fluctuating water resources throughout the Holocene period.

The Wadi Faynan (30°37'N, 35°37'E) is located near the modern village of Quarayqira (~200m asl) and is fed primarily by the Wadis Ghuwayr and Dana, which emanate from the Jordanian plateau to the East, around the modern towns of Shaubak (~1200m asl) and Dana (~1600m asl) respectively. Until recently (when bore holes were drilled to provide water for modern villages) there were three main sources of water in Wadi Faynan- local rainwater and associated runoff, seasonal floodwater and water from springs located in the Wadi Ghuwayr.

At present the area receives limited rainfall (the nearby station at Ghor Safi receives 74.6mm per annum), the spring water provides a small, perennial base flow and the wadi floods several times most winters. Seasonal wadi floods may be extreme events, stemming from storms occurring in the wetter hills near Shaubak (modern mean annual rainfall 307.3mm). The three water sources differ in several ways, which act to effect their utility to human populations. Local rainfall, and associated runoff, is patchy and unpredictable and often falls in insufficient quantity to allow rain water farming. The flood water has the twin benefits of reliability (it happens every winter) and volume, but it is difficult, even with modern technologies, to manage and store such large quantities of water. The spring flow (figure 1) is reliable, perennial but scant and often does not flow as far as the main wadi, there are also suggestions that this water may not be well suited for irrigation owing to salinity (Barker et al 2000). By working closely with the hydrologists (see Andrew Wade's report) we aim to understand how different scales of human societies used these three sources to meet their water supply needs through technological and social adaptation in the context of a changing climate.

The Wadi Faynan is well suited to such a study. Firstly, this is a semi arid area today, where small changes in the amount and timing of rainfall are likely to have a significant impact on the possibilities open to human inhabitants of the region. Secondly, there has been intense archaeological research in the region over the last 20 years and we now have a fairly secure understanding of the main phases of human occupation in the area (e.g. Barker et al 2000, Finlayson & Mithen in press). In addition, considerable research effort has been invested in understanding the environmental context for past human activity (e.g. Hunt et al 2004).

Archaeological evidence indicates that the Wadi Faynan region was inhabited during remote Lower and Middle Palaeolithic times (1 mya-45 kya) and was probably an important area as early colonising hominin groups dispersed from Africa. There then followed a long hiatus in settlement between ~45,000 BP and ~11,600 BP, when the Faynan area appears to have been abandoned. From Neolithic times (~11,600 BP) onwards the wadi was more intensely, if somewhat intermittently, occupied with settlement reaching it's zenith during the Roman/Byzantine period when the large town of Khirbet Faynan was occupied and reservoirs, aqueducts and channels were constructed to manage water resources.

A particularly dominant feature of the present day landscape of Wadi Faynan is the WF4 field system- a series of walls, terraces, dams and channels, parts of which have been used to harness water for the growing of crops throughout much of the last 6000 years. At it's maximum extent the field system covered 2.5km² and contained approximately 900 individual fields.

Figure 1: Base flow in Wadi Ghuwayr.



This system has been the subject of intense archaeological survey (summarised in Barker 2000) and the remains appear to be a palimpsest of Early Bronze Age, Iron Age, Nabatean and Roman/Byzantine activity.

The WF4 system is of particular interest as research has suggested that at various points in time the system was irrigated with water from all three available sources (Barker et al 2000). Moreover, there also appear to be times, such as the Middle Bronze Age, when the system was abandoned entirely. Our aim is to use GCM and paleoenvironmental data, coupled with hydrological modelling, to assess how the WF4 system may have been irrigated and to what extent the evolution of the WF4 system was driven by natural processes of climatic change. We also intend to consider how human activity in the wadi may have altered the hydrological regimes, for example, through deforestation of the hillside slopes as suggested by Barker (2000).

In order to achieve these aims the WLC project undertook a short season of field work in the Wadi Faynan during spring 2006. This season, undertaken in collaboration with Dr Paul Newson (University of Durham), the Department of Antiquities and the CBRL, had two key aims:

- 1) To improve our understanding of past and present hydrological regimes.
- 2) To identify the types of crops grown in the WF4 system and the source(s), quality and quantity of water used for irrigation.

During the field season we undertook work to gather data on paleofloods and present day base flow in the wadi. We also took a series of water samples from the springs in the Wadi Ghuwayr for trace element and isotopic analysis by Dr Stuart Black. We hope these analyses will allow us to understand the changes in base flow over time and also that by understanding the elemental composition of the spring water we will be able to identify sediments irrigated from this source.

We focussed attention on the WF4 field system and excavated 10 small trenches into the fields and channels of the system in order to collect samples of sediment (Figure 2). These samples will be analysed in order to recover calcium carbonate precipitates

which may allow us to identify any fields which were irrigated using spring water. In addition, we collected samples for phytolith analysis by Dr Emma Jenkins, with the intention that we may be able to identify which crops were being grown within the field system and also how much water was used to irrigate these crops.

To summarise, the WLC project is aiming to provide an understanding of the long term interaction between climate change, hydrological regimes and human activity in Wadi Faynan. Fieldwork has provided data which will facilitate such an understanding, by allowing us to model changes in water availability over time and identify uses of specific water sources. Future work will concentrate on providing more detailed paleoenvironmental reconstructions and relating these to GCM outputs. Once these tasks are complete, we will run hydrological models to consider changes in potential population levels through time providing a fresh context for the interpretation of technological and social responses by human societies in this semi arid area.

Figure 2: Dr Andrew Bradley collecting sediment samples from a trench excavated in the WF4 field system.



References

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