



Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

A pastoral landscape for millennia: Investigating pastoral mobility in northeastern Jordan using quantitative spatial analyses

Julia Meister ^{a, b, *}, Daniel Knitter ^c, Jan Krause ^{a, b}, Bernd Müller-Neuhof ^{b, d},
Brigitta Schütt ^{a, b}

^a Freie Universität Berlin, Department of Earth Sciences, Physical Geography, Malteserstraße 74-100, 12249 Berlin, Germany

^b TOPOI Excellence Cluster, Hittorfstraße 18, 14195 Berlin, Germany

^c Christian-Albrechts-Universität zu Kiel, Department of Geography, Ludwig-Meyn-Str 14, 24098 Kiel, Germany

^d German Archaeological Institute, Orient Department, Podbielskiallee 69-71, 14195 Berlin, Germany

ARTICLE INFO

Article history:

Received 27 October 2016

Received in revised form

26 May 2017

Accepted 16 August 2017

Available online xxx

Keywords:

Mobile pastoralism

Pastoral campsites

Clustered enclosures

Point pattern analyses

Traditional herding practices

Migration pattern

ABSTRACT

Northeastern Jordan is one of the few remaining regions in the Middle East where pastoral nomadism is still practiced. In this desert region, pastoral mobility is an adapted land use able to cope with low rainfall rates, great seasonal and annual rainfall variations and thus heterogeneous vegetation and water availability. During winter, herders and their livestock move into the desert; in summer they move to the desert margins to places with perennial water supply. First traces of mobile pastoralism date back to the beginning of the Late Neolithic.

Within the basaltic region of northeastern Jordan, there is a dense distribution of archaeological remains; some of them can be linked to pastoral groups due to the herders' ancient practice of building agglomerations of sub-circular enclosures ('clustered enclosures') made of basalt boulders for corralling their flocks and domestic activities. These features provide an excellent opportunity to investigate a landscape that shows traces of pastoral activity since eight to nine Millennia.

In this study, 9118 clustered enclosures in the northeastern Jordanian basalt desert have been systematically recorded using satellite imagery. In order to investigate potential migration or communication routes, grazing lands and social interactions of former pastoralists, we examine their first- and second-order characteristics using distance and density based approaches of point pattern analyses by integrating geomorphometric and geomorphological site properties. The results of this spatial analysis are combined with available archaeological data and a review on traditional herding practices in northeastern Jordan. Overall, the results demonstrate that the observed spatial distribution of clustered enclosures is influenced locally by natural characteristics but regionally by cultural practices.

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1. Introduction

Northeastern Jordan is climatically classified as desert (BWh after Köppen-Geiger classification; Kottek et al., 2006). With annual average rainfall rates of 50–150 mm, the hot and arid climate of the area leads to water scarcity (Dottridge and Abu Jaber, 1999) and generally poor biomass production. It is one of the few remaining regions in the Middle East where nomadism is still practiced (Tansey, 1999), being the predominant land use (Roe, 2000). Due to

strong annual climatic variations with pronounced seasonality, pastoral mobility is essential in order to respond to spatio-temporal changes in vegetation and water availability (Betts, 1998) and represents an adapted form of land use. It seems likely that mobile pastoralism was introduced to the area during the 2nd half of the 7th millennium BCE (Rollefson et al., 2014). Today, the pastoral system is mainly based on sheep and goat herding (Betts et al., 2013; Roe, 2000) and the herders and their livestock move within the desert area during the winter, while they traditionally spend the summers at places with perennial water supply (Roe, 2000).

The landscape of northeastern Jordan is divided into a basalt desert (*harra* in Arabic) and a limestone desert (*hamad* in Arabic; Fig. 1). Within these regions there is a dense distribution of archaeological remains which greatly vary in their form and

* Corresponding author. Freie Universität Berlin, Department of Earth Sciences, Physical Geography, Malteserstraße 74-100, 12249 Berlin, Germany.
E-mail address: j.meister@fu-berlin.de (J. Meister).

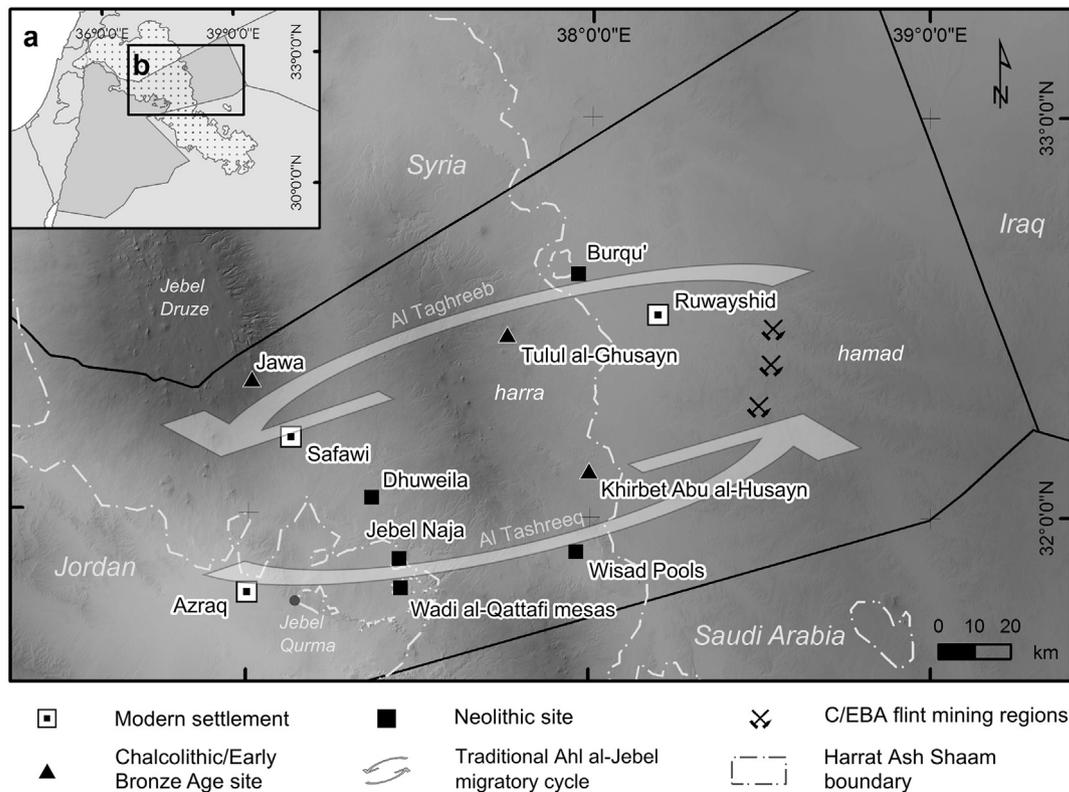


Fig. 1. a: Location of the 'Harrat Ash Shaam' basaltic region within Jordan and neighboring countries. b: Location of northeastern Jordan, modern settlements, selected prehistoric archaeological sites (after Betts, 1998; Müller-Neuhof, 2014a; Rollefson et al., 2014) and traditional annual migration routes of the Ahl al-Jebel tribe (after Roe, 2000) in the *harrat hamad*.

function. Particularly common architectural structures within the *harrat* are simple stone circles (or enclosures) which are scattered throughout the region in a large variety of sizes and shapes (Betts, 1982a, p. 23). Made of stockpiled basaltic stones, they usually occur in clusters of sub-circular structures (Betts et al., 2013, p. 175). In the archaeological record, these sites are commonly linked to previous pastoral activities since the larger structures appear to be animal enclosures (also known as corrals or pens; Betts, 1982a, p. 23) used by herders for corralling their flocks of sheep and goat during the night to prevent straying. Sheltering the animals from wind is especially important in winter and early spring (Betts et al., 2013, p. 175). Evidence for this interpretation is given by modern Bedouins who apply the same technique, often re-using earlier structures (Betts, 1982a, p. 25). In the past these corrals were most likely also used to protect the herds against wild animals (Betts et al., 2013, p. 175). Comparable structures smaller in sizes are commonly attached to the larger ones and are usually interpreted as being simple windbreaks or huts used by the shepherds (Betts, 1982a, p. 23; Rollefson, 2013, p. 215). The abundant occurrence of artefacts in and around such enclosures in the Jebel Qurma region as well as the occasional occurrence of fireplaces suggests that they were also used for habitation and the related domestic activities of mobile pastoralist groups, rather than being simply corrals (Akkermans et al., 2014).

An additional and important characteristic of the enclosures that indicates their use by herders is their location, which is often linked to periodic water sources, e.g. along wadis or the shorelines of mudpans (Akkermans et al., 2014; Müller-Neuhof, 2014a).

A distinctive and elaborate version of roughly circular structures of various forms made of basalt stones are termed "jellyfish" (Betts, 1982a, b), "wheel houses" (Kempe and Al-Malabeh, 2013, 2010) or

"wheels" (Kennedy, 2011; Rollefson et al., 2016). While many of these sites consist of a roughly circular structure, with numerous enclosures in the center, surrounded by small 'huts', others are segmented by radiating walls. Moreover, cairns occur frequently within the wheels or in their direct vicinity (cf. Akkermans et al., 2014; Betts, 1982a, b; Kennedy, 2011; Rollefson et al., 2016). Although the use of the wheels is still unknown, one hypothesis given by Betts (1982b, p. 185) is that the interior divisions may have functioned as animal pens, whereas the 'huts' provided protection and shelter for herders and their family (see also Rollefson et al., 2016, p. 949 for other explanations). Surface findings and OSL dates of such sites in the *harrat* indicate that these wheel-structures originate from the Late Neolithic to Chalcolithic/Early Bronze Age (Akkermans and Huigens, in press; Athanassas et al., 2015).

The basic form of sub-circular stone enclosures has been in use in the Jordanian desert from the earliest prehistoric times (Betts, 1982a, p. 23). However, an exact age determination is often difficult since these structures were commonly rebuilt and reused in later periods (Betts, 1982a). This was also confirmed most recently by the findings of two archaeological transect surveys conducted within the *harrat*, documenting that the majority of the clustered enclosures investigated were already occupied by pastoral groups during the Late Neolithic or the Chalcolithic/Early Bronze Age and were commonly reoccupied in historical periods and modern times (Müller-Neuhof, 2014a; Müller-Neuhof et al., 2013). Since the basic architecture of the enclosures has not changed since prehistoric times and the structures are in some cases in use today it is difficult to categorize them (Betts, 1982a, p. 23). Because of their typical design and location in the northeastern Jordan desert the enclosures are also well visible on aerial photographs and satellite imagery (Fig. 2). Their often exceptionally good preservation might be

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