Journal of Archaeological Science 37 (2010) 3010–3021

Contents lists available at ScienceDirect

Journal of Archaeological Science

journal homepage: http://www.elsevier.com/locate/jas

Experimental examination of animal trampling effects on artifact movement in dry and water saturated substrates: a test case from South India

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ARTICLE INFO

Article history:
Received 4 May 2010
Received in revised form
21 June 2010
Accepted 22 June 2010

Keywords:
Trampling
Experimental archaeology
Formation theory
India
Hoof-prints
Water buffalo
Goats
Artifact movement

ABSTRACT

This paper presents the motivation, procedures, and results of an experiment that examines short episodes of animal trampling in dry and water saturated substrates in South India. While horizontal artifact displacement was similar to that modeled by other trampling experiments, vertical artifact displacement in water saturated substrates was greater than any reported experiment to date. The toolstone used in this experiment, a silicious limestone, exhibited minimal damage after trampling. Artifact inclination patterning appeared to be a potentially diagnostic middle-range marker of trampling in water saturated substrates. Given the abundant number of Paleolithic sites that are located on flat, open surfaces near water-bodies, or experience monsoonal climatic regimes, we propose that future excavations should measure artifact inclination on a regular basis.

1. Introduction

During archaeological survey work in the Jurreru River Valley, Kurnool District, South India (Fig. 1), team members noticed hardened hoof-prints peppering the valley floor, left over from the previous monsoon season (Fig. 2a). Fresh hoof-prints were also observed along the banks of local streams, where villagers lead livestock daily to fresh water sources (Fig. 2b). The abundance of these marks suggested that stone artifact scatters in seasonally or perennially saturated parts of the valley floor could have been rearranged and possibly damaged by animal hooves in the past. The vertical concavities of some of the hoof-prints we observed were deep enough that they might readily have displaced near-surface buried artifacts. In saturated substrates like these, but where archaeological horizons were embedded, trampling might lead to any number of rearrangements including, but not limited to: (1) the separation of a single archaeological horizon into two; (2) the combination of two archaeological horizons into one; (3) the creation of false buried sites composed entirely of derived artifacts that originated on the surface.

Although the need to study the role of animal trampling in this particular depositional environment was clear enough, it soon occurred to us that it could be of much wider relevance. Actualistic study of trampling in the Jurreru Valley could therefore contribute to a greater understanding of artifact displacement in sites from other regions with highly seasonal rainfall regimes and widely spaced waterpoints that attracted game animals on a daily basis.

It is now generally accepted that post-depositional processes may alter or erase spatial patterns in the archaeological record and may even create artificial ones. It follows that the behavioral interpretation of spatial patterns can only be made *after* the processes that shaped the artifact/ecofact patterning are understood (e.g. Binford, 1983; Schiffer, 1983). Formation Theory (FT) (Shott, 1998) is a form of inference that allows archaeologists to untangle these processes by comparing them, via analogy, to a known reference. FT not only strives to predict the material

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doi:10.1016/j.jas.2010.06.024

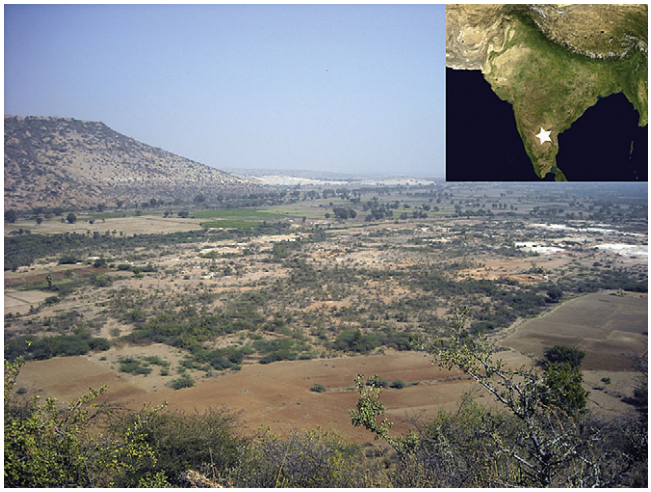

Fig. 1. The Jurreru Valley and its location within the Indian subcontinent.

consequence of human behavior, but seeks to explain how those material consequences become altered between discard and discovery. When the data used to test components of FT (taken from the ethnographic, historic, geologic, and taphonomic records) run out, we resort to controlled replication experiments and actualistic studies.

Artifact trampling experiments fall across the latter two categories of FT testing, and strive to test whether humans and animals can significantly influence the formation of the archaeological record to better understand depositional conditions (e.g. Gifford-Gonzalez et al., 1985; Lopinot and Ray, 2007). Trampling experiments examine three key factors: horizontal displacement of artifacts, their vertical displacement, and artifact damage. Since many variables are implicated in such post-depositional changes (substrate type, trampling agent, artifact material/morphology, time, and trampling intensity) these variables are routinely recorded (e.g. Table 1). The shared goal of all such experiments is to determine the extent to which each variable contributes to the vertical/horizontal displacement of, and damage to, a specific material record.

Here, we present an artifact trampling experiment relevant to much of the Old World, involving mammalian herds trampling upon knapped stone flakes in dry and saturated sediments. The purpose of the experiment is to model, in a controlled setting, trampling as it might occur in regions that experience seasonal rainfall, or sediments on the banks of expanding and contracting water-bodies (i.e. lakes, rivers, streams). As part of this process, we attempt to identify markers that will assist in recognizing whether stone artifacts have been trampled in saturated or dry sediment.

The design of this experiment expands on other published case studies by examining several variables not previously, or rarely, considered or quantified. Firstly, the effects of a saturated versus dry substrate are examined. Secondly, we move the focus away from human trampling to that of two animals of widely differing weights: the water buffalo (*Bubalus bubalis*) and the goat (*Capra aegagrus hircus*). Although likely agents in the alteration of pastoralist settlements, these also serve as preliminary analogs for large and small game animals – suspected agents of post-depositional alteration in many pre-farming contexts (Fiorillo, 1989; Lopinot and Ray, 2007). Our study also differs from most others in that we focus strictly on short trampling episodes rather than the long, accumulative, impact of so many human-agent experiments. We join Behrensmeyer et al. (1986) and Dominguez-Rodrigo et al. (2009) in further exploring the effects of short episodes of animal trampling in open contexts rather than the effects of human foot-traffic in constrained surroundings such as caves or domestic dwellings (e.g. Villa and Courtin, 1983). Furthermore we introduce a silicious limestone as a novel experimental toolstone with different properties and potentials for damage than the flints and obsidians so popular among previous experiments. Finally, we introduce a methodological refinement by recording artifact inclination before and after the experiment. In a saturated substrate we expected that artifact inclination, a trait that potentially preserves archaeologically (Andrews, 2006; Fiorillo, 1989; Pappu and Akhilesh, 2006), would change with trampling, as predicted by Hill and Walker (1972) and Olsen and Shipman (1988: 537).

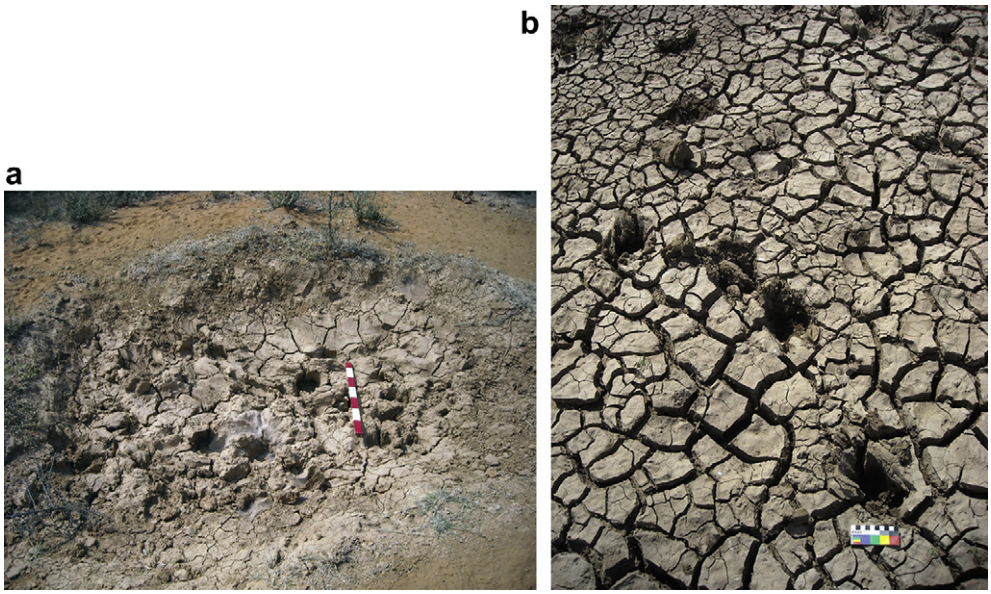

Fig. 2. An example of water buffalo hoof-prints in the Jurreru Valley left over from the previous monsoon season (a) and an example of recently created water buffalo hoof-prints left on the bank of the Jurreru River (b).