Journal of Archaeological Science: Reports 13 (2017) 211–221

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

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

Ancient shapes, modern measures: A quantitative method to describe bedrock ground stone shape

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ARTICLE INFO

Article history:
Received 17 January 2017
Received in revised form 19 March 2017
Accepted 21 March 2017
Available online 2 April 2017

Keywords:
Bedrock ground stone
Morphometric analysis
Milling space
Bedrock mortars
Chacuaco Canyon

ABSTRACT

Bedrock ground stone features, found throughout the world, are particularly concentrated in the canyons of the Southern Plains of North America. Morphological analysis offers powerful tools for developing descriptions of bedrock ground stone (BGS) which can be used to discuss how prehistoric landscapes were inhabited. Metric representations of morphological variation can be used to test hypotheses about the nature of BGS features, which are often difficult to investigate and analyze. This paper presents a morphological approach to describe and analyze BGS surfaces in a side canyon of southeastern Colorado which can be applied by researchers to datasets in other regions. Results indicate that while variation exists, the BGS design (as determined by shape and size) are similar across the side canyon supporting the hypothesis that the canyon was occupied by a group of closely related people through time; although not all sites were used in the same manner.

1. Introduction

Chronology and function are needed to place bedrock ground stone (BGS) features within archaeological contexts, but are often inaccessible points especially in the early descriptive stages of data recovery. The more we learn about BSG features for a particular region, the more questions emerge. Were they used by highly mobile hunter-gatherers as part of a seasonal foraging strategy or by nascent horticulturalists? Do BGS sites represent tenured landscapes where the same group returned annually to the same locality? Perhaps just as interesting as questions about subsistence behaviors and settlement patterns, are those about social behaviors. Do BGS features represent small groups of people or larger co-operatives working together on related tasks (e.g., grinding food resources or making temper for pottery)? How are the BGS features related to cultural knowledge reproduction? At the moment there is not enough information on the Southern Plains of the United States to provide unequivocal answers to these questions; however, as more data are collected and analyzed we will develop a solid foundation to address these problems.

In this paper I will address a single question using data collected from a small side canyon in southeastern Colorado (Fig. 1.1): What patterns exist in the shape and size of BGS surfaces across sites a bounded landscape? Lynch (2017) collected metric data from BGS surfaces at 11 sites connected by landscape proximity. Trails and paths enable movement between the BGS sites without much difficulty. Abundant water sources are found in a permanent spring located at the head of the side canyon and in the Chacuaco Creek (Lynch, 2017: Fig. 2). Rain catchments, located in the sandstone hoodoos near all of the sites, also provide a temporary water supply (Lynch, 2017: Fig. 2). Lynch et al. (2017) proposed that the larger BGS features could have been used by groups of individuals working together. Lynch (2017) illustrated that the use-wear depths observed in the side canyon could have taken about 200–1000 year create. The presence of rock art and possible small habitation or storage facilities at some sites but not all (Loendorf, 2008; Lynch, 2017), suggests that the small side canyon was used in a variety of ways by related groups of people. Similar patterns in size and shape of BGS surfaces would support the idea of related peoples using the side canyon through time for similar purposes. If the same people (e.g., related, especially at the family level) were performing similar tasks then shape patterns should be similar. If similarly sized individuals (same age or biological sex), were working on sites, then size patterns should emerge.

The exploration of the variability in BGS surface morphology, size, and density provides a baseline for understanding how BGS features fit into the broader archaeological material culture while also offering a means to compare larger data sets. Using morphological analysis, we can begin to understand how the prehistoric landscape was organized and to test hypotheses about the nature of BGS features. The development of methodologies to collect data on and interpret BGS features on the Southern Plains is growing (Castaneda, 2014, 2015; Kemp, 2014; Lynch, 2014; Lynch et al., 2008, 2012, 2013, 2015). This paper presents a method to describe and analyze the patterns of BGS surfaces using standard axial data collected in the field. The study assesses the use of mathematical shape indicators combined with geometric descriptors to define morphological variation across a particular

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http://dx.doi.org/10.1016/j.jasrep.2017.03.055
2352-409X/

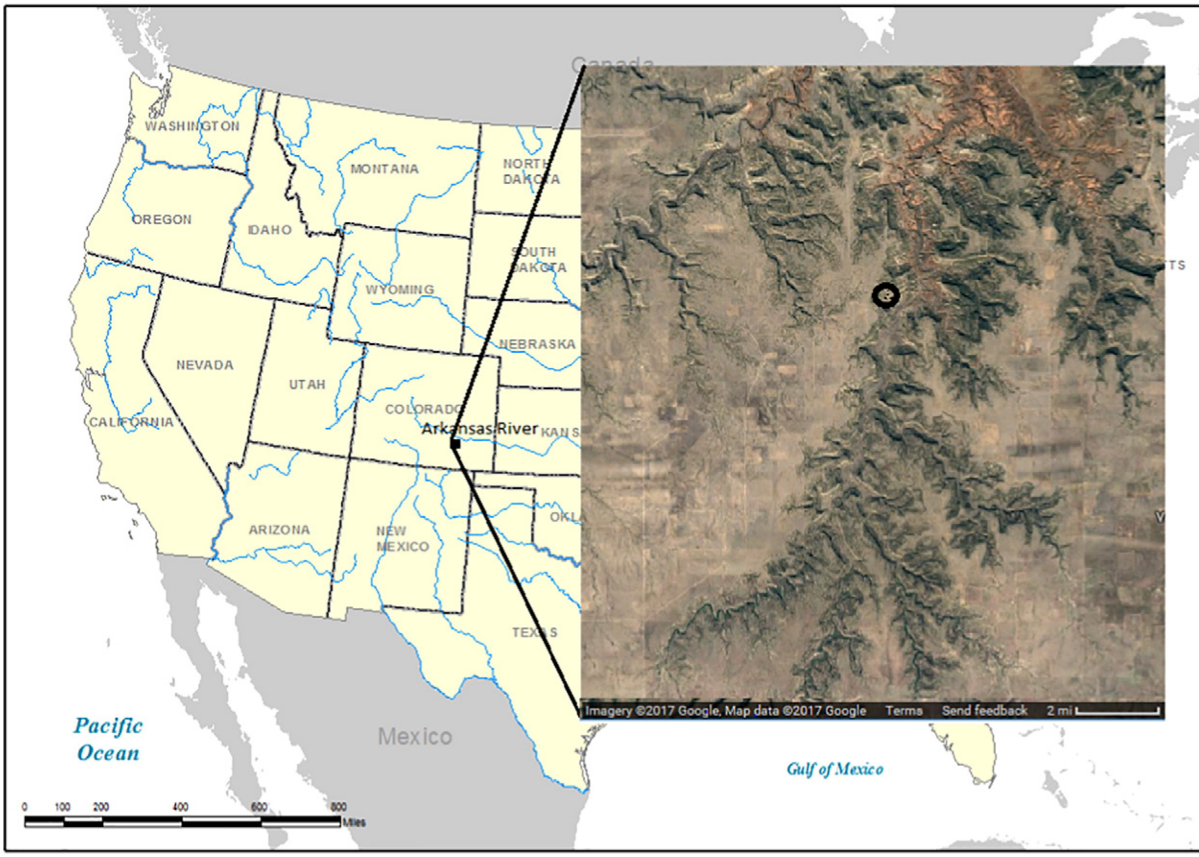

Fig. 1.1. Portion of the Chaquaqua Plateau, Southern Plains, Colorado. Project area is in black circle on inset.

landscape. These methods improve our ability to understand the nature of prehistoric peoples' use of the landscape and foster a scientific discussion on the nature of bedrock ground stone.

2. Bedrock ground stone surface morphology

Exploring the variation in BGS surface morphology commences with carefully controlled metric descriptions of meaningful shape characteristics that can be analyzed and interpreted. Adams (2002), McCarthy et al. (1985), True (1993), and Woodbury (1954) provide the standard methods for collecting the minimum variables useful in describing ground stone surfaces: length, width, and depth. Bedrock ground stone surfaces often have a definable rim that clearly marks the edge of the work surface (Lynch, 2017; Lynch et al., 2017), but significant inter-observer error may exist between field observations (Lynch et al., 2012). For instance, observers will sometime unintentionally ignore the definable "rim", recording instead the edge of the polished surface area, thus leading to many possible interpretations of the length or width of the ground stone surface. Portable ground stone can be curated, so such interpretation can be corrected; however, BGS features are not curated, so such recording bias is difficult to check. Depth measurements, particularly, have a high amount of observer error (Lynch et al., 2012). For this study only length and width are used to construct planar, or flat, shape types, in part because of this bias. Many BGS researchers have begun to use or explore close-range photogrammetry, laser scanning, and other three-dimensional recording methods to develop accurate cross sections of grinding and pounding basins (Castaneda, 2014, 2015; Filin et al., 2014, 2015; Lynch et al., 2008; Lynch et al., 2015; Lynch et al., 2017; Nadel and Lengyel, 2009; Nadel and Rosenberg, 2010; Rosenberg and Nadel, 2011). However, mathematical shape analysis, employed here, makes use of data already archived, thus providing the opportunity to compare data sets across the world.

This study uses descriptive terms such as ellipse, rectangle, groove, amorphous, or circle to identify the gross, perceived morphology of the ground stone surface area. Axial measurements of shape (length, width, and depth) are used to develop a consistent mathematical shape description. This metric shape should be useful for morphological comparisons between features, sites, and across the landscape. In addition, length and width measurements can be used to calculate the size of individual milling surfaces which illuminates differences between the relative sizes of the BGS surfaces.

2.1. Determinants of shape

In order to improve how we record, describe, and analyze ground stone surfaces, it is necessary to understand the variables that influence and determine the shape of a given surface. Raw material type, location of the surface, position of the grinder, intentional design, material being ground, and cultural factors comprise the most influential factors in ground stone shape (Adams, 1993, 2002; Buonasera, 2015; David, 1998; Dubreuil, 2001, 2004; McCarthy et al., 1985; Roux, 1985; Wright, 1993).

2.1.1. Raw material

The material of ground stone tools affects the ability and time investment of users to create the desired shape of milling surface and hand stone. The hardness of the raw material plays a role in the wear and shape of the milling surface (Dubreuil, 2004; Wright, 1993). Bedrock ground stone are often found on granite, limestone and sandstone rock outcrops. Those in southeastern Colorado are mostly found on the local sandstone formations, a softer material that requires less initial shaping to create and maintain an efficient use surface.