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Spatial point pattern identification of an apparent Ice-Age house structure

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ABSTRACT

Archaeological excavations of a late Ice-Age (Pleistocene) site on the western slope of the Rocky Mountains in Colorado uncovered large rocks that were suspected to be the remains of a house structure. Classical statistical analyses supported this possible conclusion but could not characterize the possible shape of the structure. Analyses using Ripley's *K*-function and an adaptation called the *L*-function confirmed the strong likelihood that the location pattern was not homogeneous across the site. Both nearby regularity and more distant clustering were identified. Circular and elliptical fits to the rock locations were compared using *L*-function simulation envelopes. The simulation envelopes provided strong evidence that the large rocks formed a circular pattern, suggesting that they formed the foundation of a prehistoric house structure.

1. Introduction

Spatial point processes (e.g., Cliff and Ord, 1981; Ripley, 1981; Diggle, 1983; Cressie, 1993; Schabenberger and Gotway, 2004) are widely used to characterize spatial locations of interest. Often the interest is in identifying locations that contain dense clusters of vegetation, insect or animal habitats, or mineral deposits. The focus in this article is on identifying nonrandom patterns of rocks

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that could mark the foundation of a prehistoric dwelling at a Late Pleistocene (Ice Age) archaeological site.

Point pattern spatial analysis is of particular value in archaeology, not just in discerning the significance of a spatial pattern and its potential archaeological significance (Miller, 2011) but, as is the case of the Mountaineer archaeological site – the focus of this article – of identifying whether a pattern is cultural in origin or merely a result of natural phenomena. Point pattern statistics in archaeology have been previously applied in a variety of archaeological settings and at multiple spatial scales (Bevan and Conolly, 2006), from the distribution of sites across a region (e.g., Kvamme, 1990; Premo, 2004; Ciminale et al., 2009) to the patterning of objects within individual sites (e.g., MacDonald and Small, 2009; Hill et al., 2011; Miller, 2011; de Smet et al., 2012). Statistical analyses have involved a variety of methods, including the recent application of Ripley's K-function and its transformation to the L-function (e.g., Crema et al., 2010; Miller, 2011), techniques applied to the Mountaineer site rock patterns in this article.

The Mountaineer site is situated atop an isolated, flat mesa located at an elevation of 2625 m above sea level (∼8600 ft) in the Upper Gunnison Basin of Colorado on the western slope of the Rocky Mountains, 50 km from the Continental Divide. The perimeter of the mesa provides a sweeping, virtually unobstructed view of almost 12 km^2 of the surrounding basin. Late Pleistocene hunter–gatherers took notice of this topographic vantage. Archaeological survey of the surface of the mesa top revealed a number of spatially discrete surface artifact clusters, each approximately ∼4–6 m in diameter yielding specimens diagnostic of the Folsom archaeological culture, which is radiocarbon dated to approximately 12,200–12,500 calibrated 14 C years before present (Stiger, 2006; Meltzer, 2009).

Initial excavation of one of those clusters, designated Block A, revealed a concentration of stone artifacts (including diagnostic Folsom projectile points, as well as knives, scrapers and other tools), charcoal, bone and burned mud (clay) daub, all found within and immediately surrounding what appeared to be a roughly circular arrangement of large rocks (>35 cm in maximum dimension) (Stiger, 2006). This discovery was interpreted as the remains of a Folsom-age dwelling, with the large rocks supposed to have formed the foundation and lower walls of the structure, and which presumably anchored wooden poles that served as its upper walls. The inference that the upper walls were made of wood was based on several daub fragments that preserved the rounded form and bark imprint of aspen poles (Stiger, 2006, Fig. 8).

If that interpretation is correct, Mountaineer would be one of the very rare sites from this remote time period to have produced traces of a structure (Irwin-Williams et al., 1973; Frison, 1982; Surovell and Waguespack, 2007; Robinson et al., 2009; Waguespack and Surovell, 2014). The dearth of habitation evidence is due to the fact that the peoples who occupied North America during this time (as well as before and for several millennia afterward) were highly mobile hunter–gatherers who only briefly occupied a place on the landscape, and hence rarely invested the labor required to construct substantial and more lasting dwellings. They were unlike later sedentary groups who occupied the same location for long periods (months, years, and decades) and created a built environment of, for example, adobe or stone (e.g., the well-known prehistoric pueblos of the American southwest).

Yet, however transient Folsom and other early groups were, they assuredly prepared and made use of shelters of some form. The rare archaeological glimpses of their shelters indicate they must have been highly ephemeral structures: little remains of them, save for hints such as post molds (Irwin-Williams et al., 1973; Knudson, 2009), areas of hardened earth interpreted as prepared floors (Frison and Bradley, 1980), bison ribs found driven into the ground below the original surface in a manner to suggest use as tent pegs (Hill, 2008; Frison, 1982, :39-40), or in the spatial distribution and concentration of hearths and artifacts (Surovell and Waguespack, 2007; Hill et al., 2011; Waguespack and Surovell, 2014). In this respect, the possible structure at Mountaineer, with its apparent rock foundation and walls, is especially unusual, if not otherwise unique.

Although the interpretation of the apparent structure at the Mountaineer site as a dwelling is compelling, it is primarily based on a visual examination of the apparently circular arrangement of large rocks, the approximately overlapping area of darkened (presumably anthropogenic) sediment, and relative to them the spatial density and distribution of artifacts, hearths, and other materials (Stiger, 2006). Complicating this interpretation is the fact that the large blocks forming the presumed