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Detecting prehistoric landscape features using thermal, multispectral, and historical imagery analysis at Midewin National Tallgrass Prairie, Illinois

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ABSTRACT

Locating the subtle and uneven deposition of human activities across the landscape continues to challenge archaeologists. Existing tools (e.g. excavation, shovel testing, pedestrian survey, and terrestrial geophysics) have proven effective at locating many types of archaeological features but remain time-consuming and difficult to undertake on densely vegetated or topographically complex terrain. As a result of these limitations, key aspects of past communities remain largely outside of archaeological detection and interpretation. This flattening of past lifeways not only affects broader understandings of these communities, but can also negatively impact the preservation of archaeological sites. This paper presents the detection of archaeological features through an analysis of drone-acquired thermal, multispectral, and visible light imagery, alongside historical aerial photography, in the area surrounding Middle Grant Creek (11WI2739), a late prehistoric village located at Midewin National Tallgrass Prairie in Will County, IL. Our investigations discovered a probable housing area and a ritual enclosure, increasing the area of the site from 3.4 ha to 20 ha. The proposed housing and ritual areas of this village also help contextualize finds from the ongoing archaeological excavations at Middle Grant Creek. More broadly, results demonstrate the valuable contributions that these relatively new archaeological survey methods have in shaping our understandings of the archaeological landscape and highlight the importance of integrating them into the archaeological toolkit.

1. Introduction

Archaeologists agree that narrowly defined sites, areas with high concentrations of artifacts, are small components of the complex and textured ways in which people make use of and interact with broader landscapes (e.g. Basso, 1996; Erickson, 2008; Gordillo, 2014; Ingold, 1993; Lelièvre, 2017; Yaeger and Canuto, 2000). However, documenting the varied traces of past human activities, which are often spread over large areas and produce little readily identifiable surface signatures, remains a perennial challenge. These challenges are heightened in locations where materials used for prehistoric construction (e.g. wood) easily degrade and where industry, housing, and agriculture have heavy impacts. Locating the often fragmented archaeological record in these contexts has previously required time intensive and expensive survey techniques, like pedestrian survey and shovel testing, that are poorly suited to documenting broadly dispersed archaeological landscape features.

This paper presents advances in the use of high-resolution, drone-acquired thermal and multispectral imagery in concert with historical aerial photographs to detect previously unrecognized components of the archaeological landscape at a late prehistoric (c. 1600 CE) village in northern Illinois, Middle Grant Creek (11WI2739) (Fig. 1). Our approach uses historical aerial photography; thermal, multispectral, and visible light drone-acquired imagery; as well as experimental image processing techniques to offer a powerful, non-invasive, low-cost method to document different archaeological features across large areas. Employing these methods at Middle Grant Creek, we located a probable habitation area primarily in the historical imagery as well as a ritual earthwork or enclosure through drone-acquired imagery. Our results suggest that the prehistoric occupation spread over at least 20 ha and contextualize the findings of previous survey and excavation of the activity and storage area. These findings also lay the foundation for ongoing research at Middle Grant Creek, suggest that similarly unrecognized features may be preserved at other late prehistoric sites in

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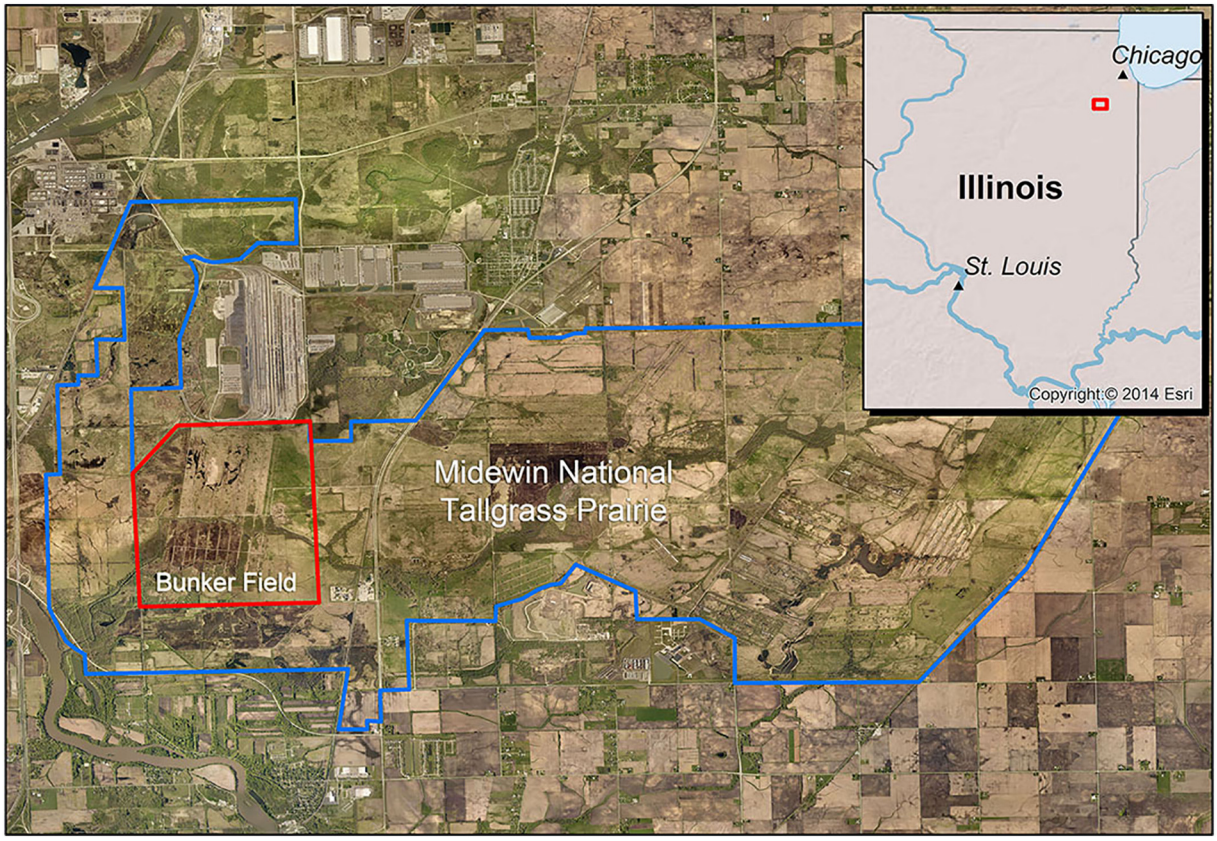

Fig. 1. Location of Midewin National Tallgrass Prairie (map data courtesy ESRI© 2018).

the region, and demonstrate the power of drone-acquired aerial imagery to locate archaeological sites and features across large areas.

2. Study area

Middle Grant Creek (11WI2739) is a late prehistoric, Native American village located in Midewin National Tallgrass Prairie, Illinois, an 8000 ha protected tallgrass prairie managed by the Forest Service, USDA. The site is located within a flat prairie and wetland ecosystem along the intermittent Middle Grant Creek, approximately 5 km from the Kankakee River. Beginning in 1839, Euro-Americans began farming the area after a series of treaty negotiations with the Potawatomi. Farms continued to expand into the 19th century and by 1893, the Alexander farmstead (11WiI738), located within our study area, was founded. In 1940 at the start of WWII, the US Army constructed the 16,000 ha Joliet Arsenal, which manufactured trinitrotoluene (TNT) and packaged it into explosives. The Arsenal was operational until the 1980s and maintained hundreds of buildings, over 166 miles of paved roads, and 110 miles of railways (Walsh and Wingo, 1995) (Fig. 2).

Situated within the now decommissioned TNT storage bunker field (Fig. 3), Middle Grant Creek dates to 16th–17th centuries, the regional archaeological period known as the Huber Phase (Brown and O'Brien, 1990). Huber sites are found throughout northern Illinois and Indiana as well as southern Wisconsin and Michigan, and are noted by their distinctive pottery, a local variant of the Midwestern Oneota tradition. Huber communities were semi-sedentary and moved among specialized camps and agricultural villages. Huber sites contain a mix of locally produced goods and trade items indicative of far-flung trade relationships spanning Canada to Florida (McLeester and Schurr, 2017). The Middle Grant Creek site was first located in 2002 during an archaeological survey of the former arsenal grounds. In 2006, a Phase II shovel testing survey of the site was conducted by the Great Lakes Archaeological Research Center (GLARC), the results of which estimated the extent of the site to be a minimum of 3.4 ha. The survey located Huber Trailed pottery, Upper Mississippian lithics, rolled metal tubes, faunal, and carbonized plant remains within feature contexts (Haas et al., 2012). A new, multi-year archaeological investigation at Middle Grant Creek began in Spring 2016 as part of Kankakee Protohistory Project, an initiative co-directed by McLeester and Schurr that is dedicated to exploring late prehistoric communities and lifeways along the Kankakee River in Illinois and Indiana. Excavations to date have focused on a cluster of subterranean storage pits refilled with refuse that are typical of prehistoric sites in the American Midwest (McLeester, 2018).

While the arsenal construction damaged some archaeological features, Middle Grant Creek has remarkably good preservation for the region, a consequence of deep storage pits, clay rich soils, and the fact that the TNT storage bunkers prevented other forms of development since 1940 (Fig. 3). Based on excavation data, the site appears to have a single prehistoric component and was occupied for about one decade during the warm weather months. Excavations have also identified the only known evidence of marine shell working outside of the Mississippian period in the Midwest and uncovered painted pottery, which is regionally very rare for this time period (McLeester and Schurr, 2017).

3. Methods

In order to explore the archaeological landscape at Middle Grant Creek, we undertook drone-based aerial surveys using visible light, near infrared multispectral, and thermal infrared sensors. Our survey sought to implement advances to these relatively new methods together with an analysis of historical aerial photography in order to map the organization of the prehistoric settlement and to prospect for cultural features over a large area surrounding the known site location.

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