



Capturing People on the Move: Spatial Analysis and Remote Sensing in the Bantu Mobility Project, Basanga, Zambia

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Abstract From its inception in 2014, the interdisciplinary Bantu Mobility Project has sought to refocus research on the Bantu Expansions away from the macro-scale towards a “writ small” approach within a well-defined region with well-understood episodes of language expansion, namely, the middle Kafue and middle Zambezi catchments of southern Zambia. This tighter focus enables the project to capture the human agency shaping movements of people, animals, material goods, and languages, and to consider the productive tension between mobility and rootedness as Bantu-speaking populations became settled in particular regions between the sixth and sixteenth centuries AD. From an archaeological standpoint, careful study of the spatial contexts of recovered artifacts—and of the various human activities that left them behind—captures different forms and scales of mobility that existed alongside the rootedness of mounded settlements occupied over generations. This paper shows how a better understanding of those spatial contexts, and the settlement patterns and land use they encode, is being achieved around

Basanga, Zambia, by combining systematic archaeological survey with data derived from satellite imagery using analytical techniques available through GIS, such as spatial interpolation and linear regression modeling. Ultimately, the project will aim to integrate the insights of that geospatial analysis with other archaeological, linguistic, historical, and environmental datasets to capture the stories of the people whose ideas, practices, and forms of mobility and rootedness constituted the local experience of the Bantu Expansions.

Résumé Depuis sa création en 2014, le Bantu Mobility Project, un projet interdisciplinaire sur l’histoire de la mobilité des bantous, a proposé de remplacer une approche à grande échelle vers une approche à petite échelle dans une région bien définie avec des épisodes d’expansion linguistique bien compris, les bassins versants du Kafue moyen et du Zambezi moyen dans le sud de la Zambie. Cette focalisation permet au projet de capturer l’agence humaine influençant les mouvements des personnes, des animaux, des matériaux et des langues, et de prendre en compte la tension productive entre mobilité et enracinement au fur et à mesure que les populations de langue bantoue se sont installées dans ces régions entre les 6^e et 16^e siècles. D’un point de vue archéologique, une étude du contexte spatial des artefacts récupérés (et des diverses activités humaines qui les ont laissés) capture différentes formes et échelles des mobilités qui existaient parallèlement à l’enracinement des établissements en ruines occupés au fil des générations. Une meilleure compréhension de ces contextes spatiaux, ainsi que des modèles de peuplement et de

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l'utilisation des terres qu'ils codent, est réalisé autour de Basanga (en Zambie), en combinant une prospection archéologique systématique avec des données dérivées de l'imagerie satellitaire à l'aide de techniques analytiques disponibles via SIG, telles que l'interpolation spatiale et modélisation par régression linéaire. Le projet intégrera les connaissances de l'analyse géospatiale avec d'autres données archéologiques, linguistiques, historiques et environnementales pour capturer les histoires des personnes dont les idées, les pratiques et les formes de mobilité et d'enracinement ont constitué l'expérience locale des extensions bantoues.

Keywords Spatial analysis · Remote sensing · Archaeological modeling · Mobility · Zambia · Basanga · Botatwe

Introduction

As the other papers in this special issue show, the techniques and technologies developed over the past few decades that are available for archaeologists undertaking spatial analysis in Africa provide many opportunities: site identification and determining settlement patterns, locating intrasite features, the investigation of past environments, and collaborative research. The work described here from central Zambia, drawn from the initial seasons of the Bantu Mobility Project (in 2014, 2015, and 2018) directed by the authors, seeks to demonstrate the utility of combining traditional archaeological survey methods and GIS-based spatial-analysis tools, such as interpolation and predictive modeling, using freely available satellite data. It draws on established methods in archaeology of GIS spatial analysis (see Allen et al. 1990; Connolly and Lake 2006; Westcott and Brandon 2000; Wheatley and Gillings 2002) and predictive modeling more generally (e.g., Kvamme 1983, 1990, 1992; Kohler and Parker 1986; Reid 2016; Vaughn and Crawford 2009; Warren and Asch 2000) to explore and model the spatial patterning of settlement and land use in the region around Basanga, Zambia. That effort is part of the project's broader aim: to better understand the productive tension of rootedness and mobility as Bantu-speaking communities come to predominate in new places by integrating geospatial data with linguistic, historical, archaeological, and environmental datasets.

This study also participates in exciting trends within African archaeology. While survey and predictive modeling using aerial photography has long been used in Africa (e.g., Denbow 1979; McIntosh and McIntosh 1980, 1986), GIS-based and other digital spatial analyses have provided important insights only over the last decade. These studies range from intrasite distribution of material culture and mineral residues to regional analyses of settlement patterns and connections between sites and geographic landforms (e.g., Harrower and D'Andrea 2014; Pawlowicz 2019; Salvatori et al. 2011; Sampson et al. 2015; Sulas et al. 2017; Wilmsen et al. 2009; Wright et al. 2014). In addition, the use of multispectral satellite imagery (e.g., Biagetti et al. 2017; Klehm et al. 2019; Parcak 2003, 2009; Reid 2016) and new techniques of acquiring spatial data, such as LIDAR (e.g., Sadr 2016), laser scanning, and photogrammetry (Rüther 2002), is providing new capabilities for identifying archaeological sites and mapping their extent. The work documented here draws on some of these methods and new datasets to better understand changing spatial patterns as Bantu speakers occupied central Zambia.

In particular, this paper will describe: (1) the creation of interpolated trend surfaces based on archaeological survey data from the region around Basanga to assist in the identification of settlement and land-use patterns; (2) the correlation of those patterns with data drawn from satellite imagery; and (3) the creation of a predictive model for the mounded sites that were the focus of long-term settlement in the region. The results help guide preliminary interpretations of patterns of mobility and rootedness in central Zambia and show how these methods can be integrated into a broader, multidisciplinary project. When considered alongside data from archaeological excavations and linguistics, they suggest that mobility and rootedness were in productive tension: as Bantu speakers became more settled on the landscape, they developed new forms of mobility that, in aggregate, shaped the nature and pacing of the Bantu Expansions.

The Bantu Mobility Project

The Bantu Mobility Project seeks to shift the focus away from the macroscale approaches that have characterized many earlier studies of the Bantu Expansions, the spread of about 500 closely related languages across much of central, eastern, and southern Africa over the past

4000 years or so, with accompanying demographic (e.g., Marks et al. 2014; Pakendorf et al. 2011) and cultural shifts. Instead, we conceive of our project as a micro-history of the Bantu Expansions that aims to understand one region very well to capture the stories of the humans shaping the local expressions of the processes that, in aggregate, constituted the Bantu Expansions. In this fashion, we draw attention to human agency and culture in explanations of the Bantu Expansions (cf. Klieman 2003) while also following Robertshaw's (2012) call to focus on complicated "how" and "why" questions of the African past. This focus on human agency and culture is often missing from macroscale approaches to linguistic expansions, which overlook local and regional contingencies in favor of universalizing instrumental logics, such as population pressure and climate change (e.g., Bellwood and Renfrew 2002; Bostoen et al. 2015; Heggarty and Beresford-Jones 2010), limiting our perspective on the way those who relocated actually experienced the changes we study in aggregate as the Bantu Expansions.

Foregrounding human actions, perceptions, and intentions in culturally and historically contingent contexts requires a multidisciplinary effort. The Bantu Mobility Project has linked archaeology, historical linguistics, oral history, and environmental science from the beginning of the project, so that each discipline pursues the same questions and shares results in real time, allowing for continuing adjustment in research questions and strategies. As this paper will show, these different disciplines offer distinct datasets and ways of knowing the past and operate at different scales, which can mitigate the limitations of any single approach on its own (de Luna and Fleisher 2019).

Our research region is the middle Kafue and middle Zambezi catchments, focusing on the sixth through sixteenth centuries AD (Fig. 1). This region served as an east-west and north-south crossroads for the diffusion of languages and material culture traditions in the earlier macroscale approaches (e.g., Huffman 1989; Phillipson 1977; Vansina 2004), so understanding its history is especially relevant for making sense of later stages of the Bantu Expansions. The middle Kafue and middle Zambezi catchments have rich datasets for our different disciplines. The region is home to the Botatwe subfamily of Bantu languages, which have seen recent historical linguistics research regarding social organization, long-distance connections, and strategies of food procurement (Bostoen 2007; de Luna 2010, 2012a, 2016;

Ehret 1998; Saidi 2010) that our project extends. The archaeology is focused on a smaller area of the Kafue floodplain around a series of large Iron Age mound sites. The two largest of these mounds, Basanga and Mwanamaimpa, were last explored nearly 50 years ago by Brian Fagan (1978), whose test excavations were never fully published after the records were lost in a fire. The mounds were continuously occupied for centuries (Pawlowicz et al. 2015, 2018) and were important settlements of a "central frontier," which contributed ideas, languages, and products to the wider region throughout the period of study (de Luna 2016). The results from the archaeological study area can be compared with work elsewhere in the region (e.g., Derricourt 1985; Fagan and Phillipson 1967; Huffman 1989; Katenekwa 1978; Vogel 1971).

While our timeframe does not capture the very first Bantu speakers in the region (de Luna 2016; Ehret 1998; Fagan 1963; Grollemund et al. 2015; Phillipson 1974), our focus on Botatwe history does capture the two key processes of the Bantu Expansions: the movement of a Bantu-speaking community into a new area, and the long-term progression by which that speech community became predominant there. In considering these processes, we engage with the concepts of rootedness and mobility as conceptualized recently in the "new mobilities paradigm" (Hannam et al. 2006). Our use of these concepts draws on recent research in African archaeology (Ashley et al. 2016) and further afield (Beaudry and Parno 2015; Leary 2016) that suggests mobility is ubiquitous, even in settled societies, and significant to social organization. Movement and sedentism are no longer seen as opposing states or simple reactions to external forces. With respect to the Bantu Expansions, this requires rethinking earlier narratives of Bantu speakers as moving into an area, becoming settled, and thereby concluding a chapter in the larger story of expansion. Mobility, rather than fitting into a typology of movement (e.g., Tilly 1978), is instead understood as a broad category uniting various kinds and spaces of "historically and geographically specific formations of movements, narratives about mobility, and mobile practices" (Cresswell 2010, p. 17). This reading of mobility is not opposed to sedentism, but is instead often complementary to a powerful sense of and connection to place, which can be termed "rootedness" (Cuzzocrea 2018). After all, life in south-central Africa between the sixth and sixteenth centuries was characterized by both increasing sedentariness, with more permanent homes

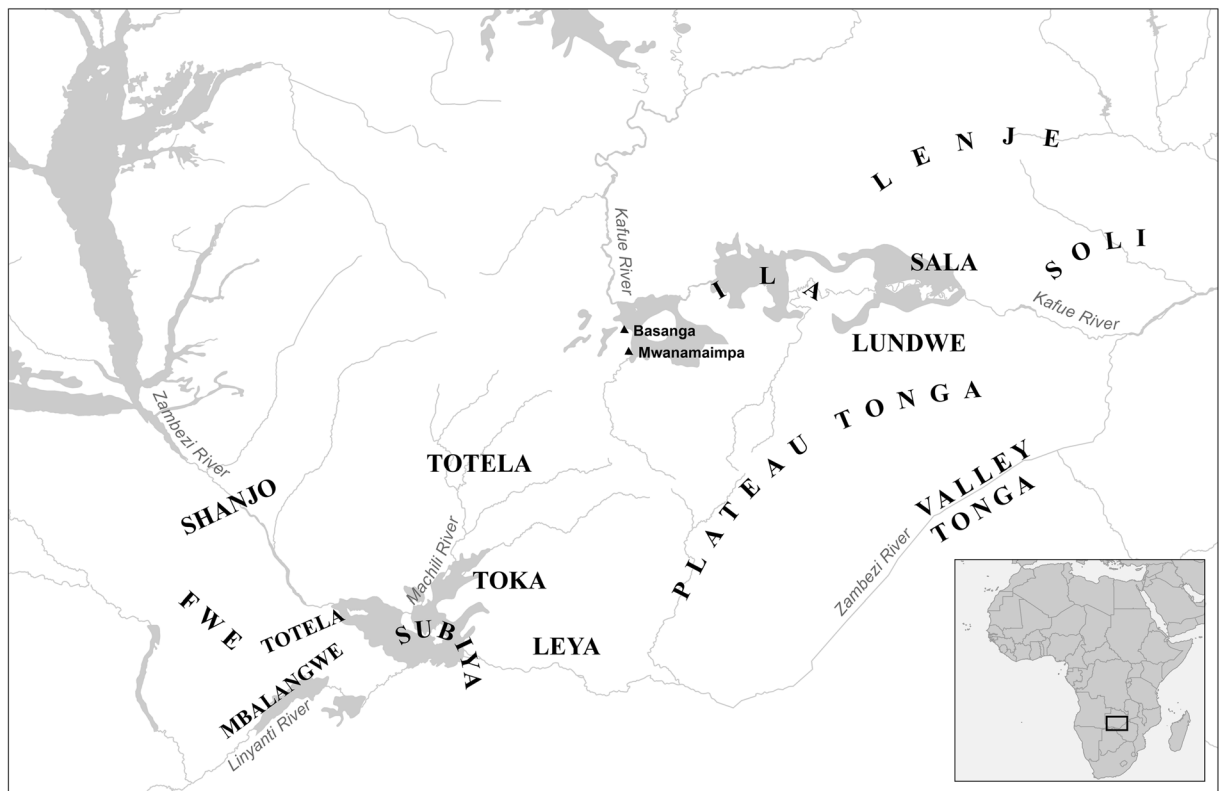


Fig. 1 The study region of the Bantu Mobility Project, showing the locations where extant Botatwe languages are spoken around the middle Kafue and Zambezi catchments. Basanga and Mwanamaimpa are shown near the center of the image

filled with greater quantities of material goods (Fagan and Phillipson 1967; Fagan et al. 1969) and the ongoing mobility of people, objects, and languages, marked in historical linguistics, oral history, and the archaeological evidence of long-distance trade (de Heusch 1982; de Luna 2016; de Maret 1999; Vansina 2004). We consider the interplay of mobility and rootedness to be a historical and archaeological problem and ask how ideas and practices of mobility and rootedness allowed one way of speaking and living in south-central Africa to become predominant.

Befitting the focus on mobility and rootedness, one important component of the Bantu Mobility Project is an archaeological survey of a universe around the Basanga/Mwanamaimpa mound system, so that the range of sites where people lived and worked (and between which they moved) might be better understood. The survey is intended to yield the settlement and land-use patterns of the area's inhabitants over time, as well as serving as a platform for the collection of environmental data illustrating the nature of the human-environment interaction there. In this way, the project aims to capture

patterns of mobility related to, for instance, long-distance trade, hunting, and bushcraft, alongside those of settled agriculture. The work of the survey is enhanced by the ability to analyze the spatial data it produces using ArcGIS software (ESRI). Spatial interpolation of data from shovel-test pits (STPs) enables the identification of sites and loci of specific activities (e.g., ironworking, hunting). Determining the spatial relationships of those locations with one another and with specific geographic features can then be accomplished by incorporating satellite data.

Exploring Mobility: Systematic Archaeological Survey, Interpolation, and Land-Use Patterns

The work described here took place during the three field seasons undertaken in the survey region around Basanga. Because the survey was designed to capture the full range of sites, from settlements to activity areas, where people would have lived and worked, it provides important archaeological insight into the forms and

practices of mobility there. This research is ongoing, and the number of units explored in the systematic survey is not yet enough to offer statistically robust predictions for the rest of the survey universe, so the results presented should be considered preliminary. However, even these preliminary results provide interesting hypotheses for human settlement, activity, and mobility in the region. This section describes the systematic archaeological survey, the creation of interpolated trend surfaces from survey data, and the initial correlation of settlements and land-use patterns with geographic features drawn from satellite imagery. The preliminary spatial patterns give us hints of the forms, ideas, and practices of mobility here, including new mobilities that developed as Bantu speakers became more settled.

Methodology

The survey has pursued two main tracks. The first of these is a systematic archaeological survey of the region around the Iron Age mounds near Basanga and Mwanamaimpa. The second, discussed below, involves the reconnaissance of other mounds. In pursuit of the first track, the project defined a 13 km × 15 km survey universe (195 km²) encompassing the two mounds, split into survey units of 1 km × 1 km. A stratified random sample of this universe was then selected for survey. Given the ecological richness and diversity of the Kafue floodplain (see Smith and Dale 1921; Smith 2001), the survey units were stratified by the different environments encountered in the survey universe: the grassy floodplain, portions of which are annually inundated; low elevation grasslands just above the floodplain; wooded miombo at higher elevations; disturbed higher-elevation woodlands with more evidence of contemporary human activity (usually farming); and transition zones between the woodlands and grasslands. The random sample maintained the proportions of these environments across the entire survey universe (Fig. 2). The determination of those environments was made using existing topographic maps (General & Office 1982), analysis of Landsat imagery, and on-the-ground inspection during the first field season. For the survey units selected as part of the stratified random sample, either the eastern or western half of the unit was surveyed because of logistical constraints, combining pedestrian surface survey with a program of STPs (ca. 30 cm diameter holes dug to subsoil) at 100 m intervals. Subsurface testing was necessary because the

Kafue floodplain and its surroundings are heavily vegetated, with seasonally poor visibility of some sites (see Derricourt 1985, p. 16–18) and others buried at considerable depth. For instance, the wider settlement immediately surrounding mound sites was typically buried at depths between 50 and 125 cm. STPs were selected as the means of subsurface testing most likely to recover artifacts and provide insight into regional settlement patterns (Lightfoot 1986; McManamon 1984). Additional STPs were excavated around positive tests in order to distinguish sites and define their boundaries (Lightfoot 1986), at flexible distances between 25 and 50 m based on the results of nearby STPs. The 100-m STP interval allowed the survey to capture all sites larger than one hectare (Krakker et al. 1983), as well as several smaller sites. All material from the STPs was sieved, using a high quality, woven wire mesh (1/8 in), except for some of the wet, clayey floodplain soils, which had to be hand sorted. Each STP also provided a geographic anchor for the collection of environmental data, such as soil samples for geoarchaeological and charcoal geochemistry analyses. While this methodology is quite well-established within archaeology, the ability to use GIS to analyze the survey data enables insights into the spatial patterning of settlements and the locations of activities that were more difficult to identify previously.

Results from Systematic Archaeological Survey

Thus far, 17 survey units have been surveyed using this methodology, with 1095 STPs excavated (Fig. 3). All of the environments have been tested with multiple units. Almost a quarter of excavated STPs ($n = 249$, 22.7%) yielded artifacts, with a total of 1482 artifacts recovered. The majority of those artifacts were low-fired earthenware ceramics, likely produced locally ($n = 1276$, 86.1%). Significant quantities of lithics ($n = 92$) and slag ($n = 112$, mostly small pieces) were found as well, along with daub and animal bone. The survey has also recovered a single red glass bead, a sharp contrast from the dozens of glass and shell beads recovered in the mound excavations (Pawlowicz et al. 2015, 2018).

Perhaps more importantly, the survey has enabled the project to begin identifying the locations of sites other than the mound settlements, and the material culture and environmental samples obtained will aid in documenting the activities taking place at those locations. Sites were distinguished through multiple adjacent positive STPs or

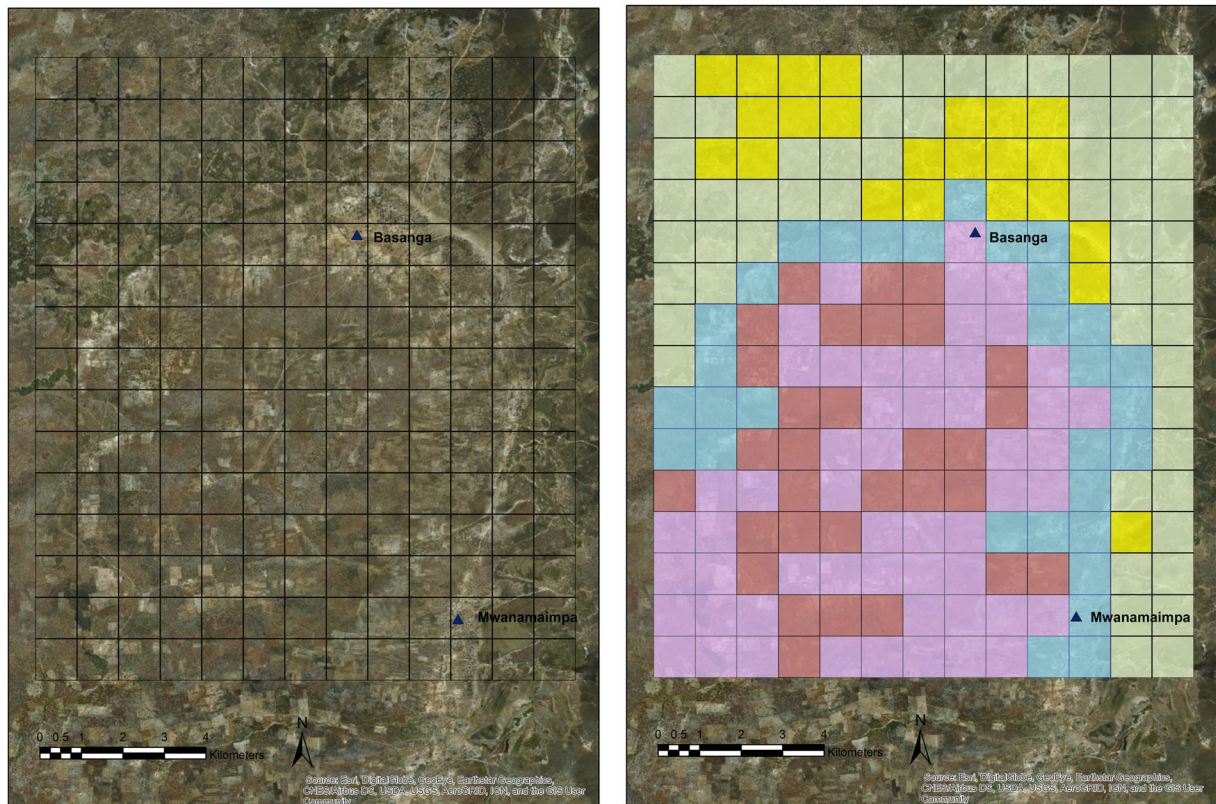


Fig. 2 The survey region around Basanga and Mwanamaimpa shown in satellite photography (L) and displaying the different environmental zones encountered (R). For the environmental

zones, green represents the floodplain, yellow the low-elevation grasslands, blue the transition zone, red the heavily wooded miombo, and purple the disturbed higher-elevation woodlands

surface artifact scatters. Using GIS to create interpolated trend-surface maps from the STP point-data provides a powerful visualization of sites identified in this manner, as well as non-site activity (Fig. 4). However, unless the survey data used for the interpolation demonstrate spatial autocorrelation (testable within ArcGIS using the Spatial Autocorrelation Moran's I tool), the predictions of the trend surface should not be considered statistically robust (Childs 2004). Proceeding in this fashion, with data demonstrating spatial autocorrelation, the survey has recovered 19 sites across the 17 surveyed units (Fig. 5; Table 1). Four units yielded no sites at all, two from the floodplain and two from the higher elevation miombo woodlands. Two of the recovered sites represent settlements associated with and surrounding mound sites, which enables the project to determine the overall spatial scale of mound settlements. In each case, the broader mound settlement covered more than a dozen hectares, and at each location there was suggestion of spatial segregation between those living atop the mound and the larger population living below it.

Two other recovered sites yielded only lithics, and three additional sites presumed to date to the Iron Age based on their ceramics also yielded lithic artifacts. Lithic-only sites have traditionally been considered to belong to the Late Stone Age (e.g., Derricourt 1985; Musonda 1987). However, given the absence of good chronological information thus far in the survey, as well as the persistence of lithic technology on Iron Age sites and in the later phases of occupation of Iron Age mounds in the survey region (Pawlowicz et al. 2015, 2018), the possibility that these sites come from the Iron Age must also be considered. Such an interpretation will be tested through the analysis of environmental samples from those sites and would be broadly consistent with the diverse strategies of food procurement practiced in our study region over the last 1500 years (de Luna 2016).

The remaining 12 sites represent Iron Age sites, for a total of 15 non-mound Iron Age sites. Unfortunately, at this stage of the project it is difficult to reliably determine more specific dates for these sites beyond the very broad range of the Iron Age. While there is overlap

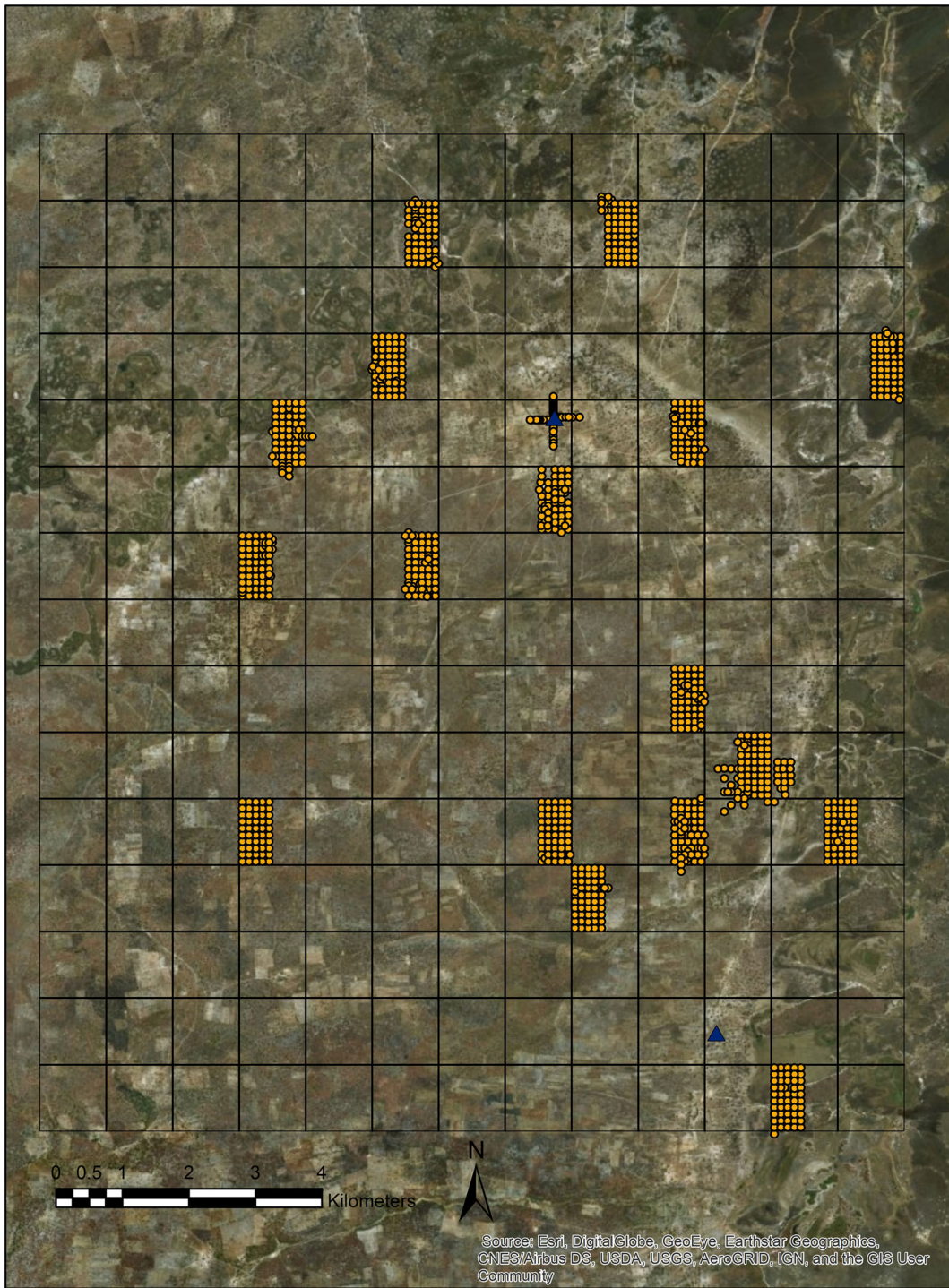


Fig. 3 The survey universe showing the location of all STPs excavated thus far during the systematic survey, with Basanga and Mwanamaimpa shown as triangles

between diagnostic local ceramics at these sites and those found at the mounds, such artifacts are not yet

sufficient to suggest narrower phases. Preliminary study of the ceramics from the mounds suggests that ceramic

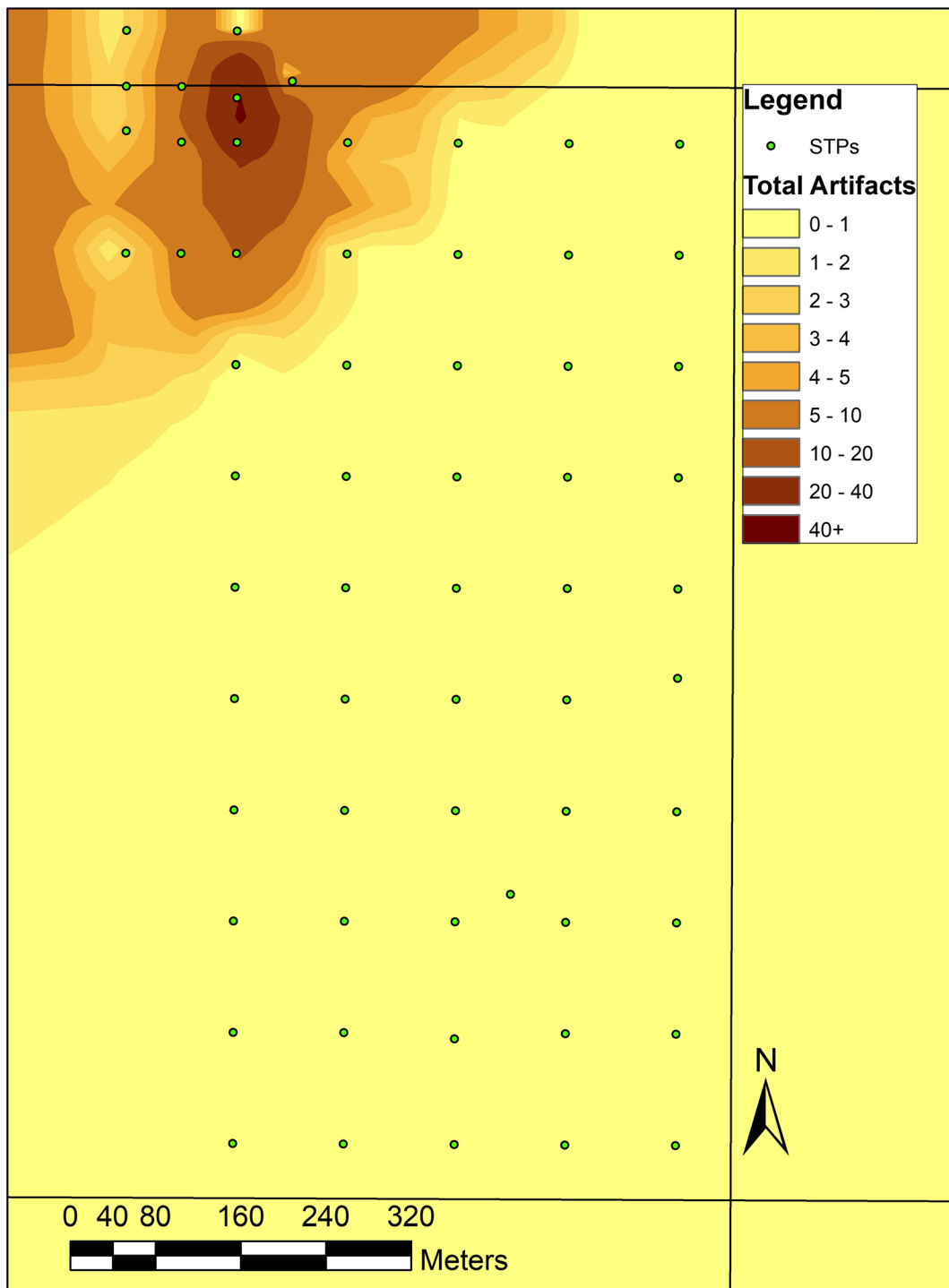


Fig. 4 The interpolated trend surface (via kriging) for total artifacts in Survey Unit 122, a low-elevation grassland unit from the north of the survey universe. Similar surfaces were developed for every other tested unit. Portions of the unit with greater expected

artifact density are in darker shades, and site 122-A, a dispersed homestead or regularly used activity area, is visible at the north-west corner

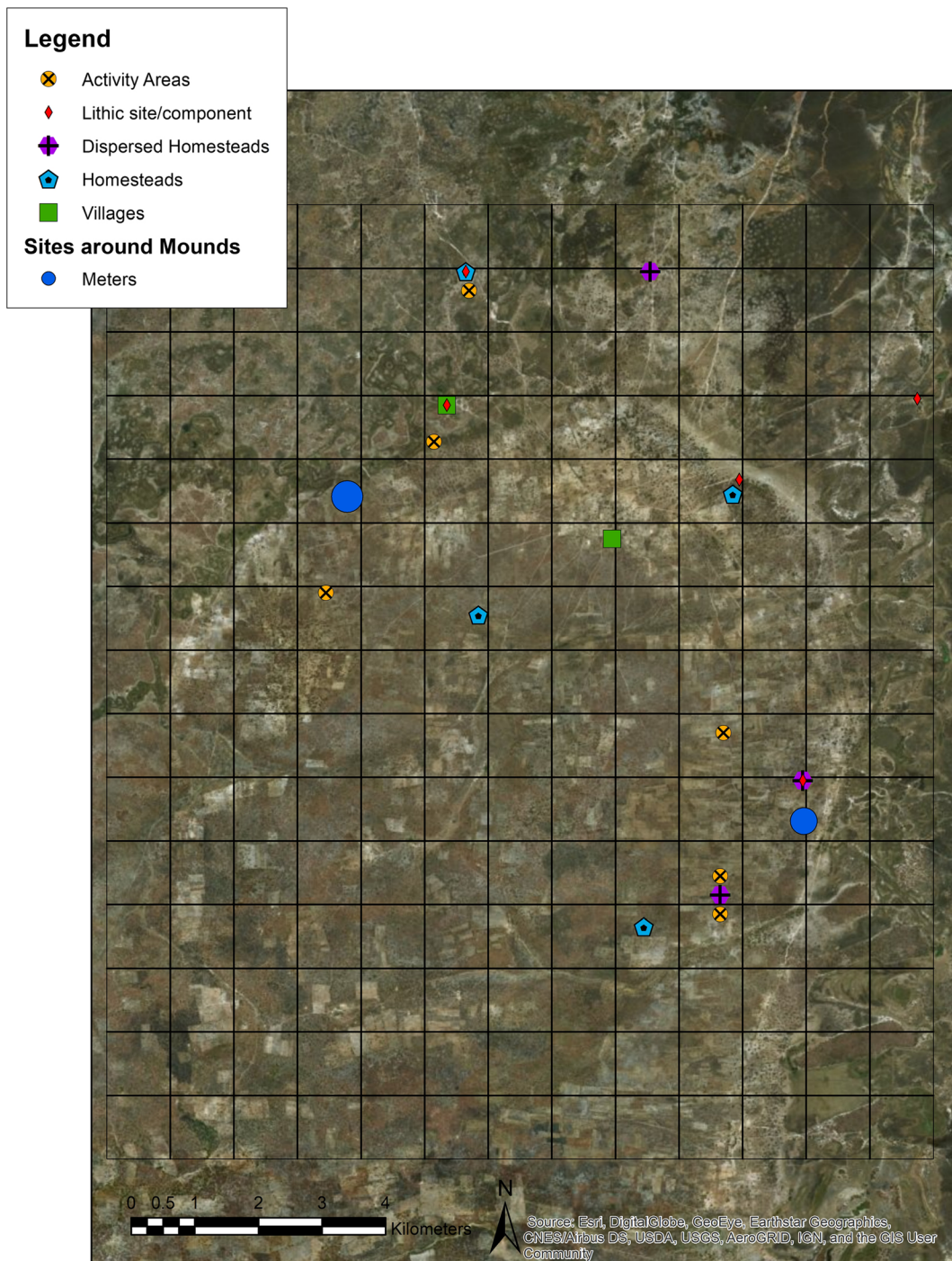


Fig. 5 The sites recovered from the survey. The blue circles ($n = 2$) are (to scale) representations of settlements around mounds; the green squares (2) are non-mounded villages, the light blue pentagons (4) are homestead settlements; the purple hexagons (3) are

large, frequently-used activity areas or dispersed homesteads; red diamonds (5) represent lithic sites or components; and orange circles (6) are small, low density activity areas

forms and decorative motifs were relatively consistent throughout most of the mounds' occupations, dating to

at least the tenth to fourteenth centuries AD and possibly earlier. Like ceramics excavated by Derricourt (1985),

Table 1 Non-mounded sites recovered through systematic survey

Site	Easting	Northing	Size (ha)	Artifacts per STP	Site type
50-A	398,785	8,241,410	19	19.43	Mound – Iunga Lukombo
160-A	405,965	8,236,310	14	7.36	Mound – Makona I
111-A	402,950	8,240,750	2.5	5.67	Settlement – Village
79-A	400,350	8,242,850	2	9.80	Settlement – Village
146-A	404,650	8,235,150	1	3.36	Regular-use area/dispersed homestead
160-B	405,950	8,236,950	1	3.00	Regular-use area/dispersed homestead
122-A	403,550	8,244,950	0.75	3.50	Regular-use area/dispersed homestead
82-A	400,850	8,239,550	0.5	6.25	IA Settlement – Homestead(s)
184-A	407,750	8,242,950	0.5	8.00	Lithic-only site
79-B	400,150	8,242,275	0.5	1.00	Activity area
146-B	404,650	8,235,450	0.5	2.00	Activity area
146-C	404,650	8,234,850	0.5	2.00	Activity area
140-B	404,850	8,241,450	0.375	6.67	IA Settlement – Homestead(s)
132-A	403,450	8,234,650	0.25	10.30	IA Settlement – Homestead
77-B	400,650	8,244,950	0.25	6.67	IA Settlement – Homestead
77-A	400,700	8,244,650	0.25	2.00	Activity area
144-A	404,700	8,237,700	0.25	3.00	Activity area
52-A	398,450	8,239,900	0.125	1.67	Activity area
140-A	404,950	8,241,675	0.0625	1.00	Lithic-only site

there are two dominant decorative motifs, namely, comb-stamped and incised decorations (Pawlowicz et al. 2018). However, as the project progresses with the analysis of more samples from the survey and greater command over the local material culture, our chronological command over settlement patterns should continue to improve. Nonetheless, when considering the known characteristics of the Iron Age sites, namely, their size, material culture, and artifact density, it seems likely that some represent settlements, ranging in size from small villages to single households. Others were likely activity areas of more irregular use (and less dense artifacts), some of which were large and might have been employed seasonally over several years, potentially with field houses, and others which were small and may even have only been used once or twice. Additional study of charcoal and soil samples taken from these sites will test for particular human-environment interactions and should help clarify these distinctions as well as the range of activities taking place across the landscape.

Using GIS to map the survey results alongside environmental data offers a number of intriguing

suggestions for land-use patterns in the region. Again, these suggestions are provisional while the survey is ongoing and the sample of surveyed units remains small, but they provide intriguing hypotheses as the project moves forward. First, the locations of the lithic-only sites, as well as most lithic scatters associated with Iron Age sites, tend to be at lower elevations near the margin of the floodplain (Fig. 6), perhaps identifying an ecological niche for the use of stone tools. Second, during the Iron Age, the focus of settlement was the transition between lower-elevation grasslands and higher-elevation woodlands, as attested by the location of mound sites (see below) and several non-mounded settlements. This pattern is likely the result of efforts to locate permanent settlements in spaces that would have access to subsistence resources in each zone, as has been true in recent periods (Maluma 1985), and the diversification of provisioning technologies and landscapes in the late first and early second millennium AD (de Luna 2016). Still, Iron Age sites, both settlements and activity areas, were found in all five environments. So while settlement concentrated in the transitional zone, settlement and activity areas were not exclusive to that environment.



Fig. 6 Satellite image of site 184-A, a lithic only site. Note that the site, centered on the blue diamond, is located at the edge of a low rise above the floodplain, which stretches around it in an inverted-U

Another hypothesis comes from the relative absence of material culture in the wooded, higher-elevation

survey units. Of the three such units surveyed thus far, two had no sites, and the other had just one single-

household settlement. While there was little evidence for settlement in this zone relative to other environments, there was nonetheless a strong suggestion of human activity and influence over its ecology. Most STPs excavated in each of the three units produced substantial quantities of charcoal throughout the top meter of the STP, sometimes in association with artifacts, which suggests that the area might have been subject to a consistent fire-management regime. The project aims to test this hypothesis through charcoal geochemistry, identifying what material was burned, at what temperature, and when, to distinguish between natural and anthropogenic fires (e.g., Gao et al. 2016). If true, it is worth noting that the same land-management strategy has been used in recent times to prepare these areas to receive cattle herds when they must leave the floodplain, though it could also have been used as a hunting strategy, to clear land for farming, or some combination of the three.

Exploring Rootedness: Reconnaissance of Mound Sites and Predictive Modeling

The other part of the survey work considers the location of the Iron Age mound sites, which, owing to their long, continuous occupations, are the best places in the region to consider rootedness and how rootedness complements mobility. In 2014, the project excavated a trench at Basanga, which demonstrated continuous occupation between at least the tenth and fourteenth centuries, with another 80 cm of deposits below the oldest dated context (Pawlowicz et al. 2015). As we discussed our interests in these mounds with members of the community, they offered to show us others in the region, such that the survey was able to record ten additional mounds beyond Basanga and Mwanamaimpa in the area. These additional mounds are either within our survey universe or within a few kilometers of its edges, as in the case of Syansaka, located in Kafue National Park (Table 2). The presence of all of these mounds was not entirely surprising, as Fagan (1978) and Derricourt (1985) each noted the existence of other mounds in addition to Basanga and Mwanamaimpa. Derricourt even plotted several on a map, but until now data was available for only those two, so our reconnaissance produced a more robust dataset.

Table 2 Mounds recovered through reconnaissance in survey universe

Name	Easting	Northing	Size (ha)	Height (m)
Basanga	402,745	8,241,731	1.30	5
Ilyabanji	396,795	8,239,405	0.41	3
Itifwi	402,350	8,238,760	1.00	3
Iunga Lukombo	398,785	8,241,410	0.3	1.5
Makona II	406,345	8,238,350	0.79	3
Makona I	405,965	8,236,310	0.85	5
Miyoba	396,035	8,238,835	0.47	5
Mulundo	398,020	8,241,000	0.50	4
Mwanamaimpa	405,180	8,232,475	1.71	7
Silibelo	404,100	8,230,340	0.22	0.5
Syansaka	393,175	8,236,995	0.78	7
Syantebe	405,000	8,230,340	0.35	1

The mounds are locations of settlement and habitation that stretched over generations and centuries, capturing the rootedness of people in this region, which would have enabled and structured particular forms of mobility. At the same time, the mounds were not identical. Some were taller than others, some had larger footprints, and some mounds seemed relatively intact, while others had been significantly disturbed through farming and erosion. And so, this fortuitous mound reconnaissance survey, undertaken in collaboration with the local community with support from the local paramount, Chief Musongwa, posed additional spatial questions for the project. First, what was the logic for mound settlements in this region, in terms of where mounds were located? Which mounds thrived and attained larger sizes? Second, did that logic carry over to other regions? Could it be used to find additional mound settlements? These were questions that could be addressed using GIS-based predictive modeling and data available from satellite remote sensing. The modeling effort described here involved: (1) creating a grid around the mounds, which would be the modeled area, (2) extracting and joining information from remote sensing data to the units of that grid, and then (3) bringing the remote sensing and archaeological data together in GIS-based regression analyses, before (4) extending the best-fit model beyond the modeled area.

Creating a Predictive Model for Mound Sites

It is very likely that all of the mounds in the region were documented during the reconnaissance survey, owing to the expertise of our local guides and our traversing the area during the systematic survey. This provided the project with the opportunity to study the characteristics of the places where mounds were located, as well as where mounds were *not* found. Areas without mounds were true negative evidence, rather than locations that had yet to be explored. Knowing both where mounds were and where they were not within the survey region meant that the project could employ GIS not only to display and qualitatively inspect the location of mounds but also to create a predictive model to determine which sorts of locations were most likely to support large mound settlements. Such a model would not only help explain some of the spatial and environmental logic behind mound locations in the survey region, but it could also be tested elsewhere in the middle Kafue and Zambezi catchments to see if similar rootedness-related decision-making existed in the wider study region, or if this pattern was unique to the Kafue floodplain. Such comparisons could start with the areas immediately surrounding the survey region, which were historically the territory of other chieftaincies (Rennie and Mubita 1985, p. 49–51), and eventually move out to the better-known complexes of mounds in the middle of our study region: Kalomo, Isamu Pati, Kalundu, and others located in southern Zambia (Fagan 1963; Fagan and Phillipson 1967; Fagan et al. 1969).

Prior to creating the predictive model, GIS mapping of the mounds was undertaken to help identify how mounds relate spatially to one another and to environmental features, which would suggest variables to include in the model. The initial effort plotted the mounds on a georeferenced 1982 contour map (Fig. 7). Strikingly, all 12 mounds were located along the 1000-m elevation contour that marked the transition from grasslands at the edge of the floodplain to a drier, more wooded environment. This is true even of Itifwi, which was located more centrally than the other mounds amid the woodlands, along an arm of lower elevation and a seasonal watercourse. The contour also marks the transition between distinct geological regimes, from alluvial to more consolidated Kalahari sands overlying the Katanga system (Reeve 1962; Thieme and Johnson 1975). While river channels meander freely in this floodplain area, the hydrology tools available through ArcGIS

were able to show that the mound sites were located within one kilometer of either a perennial or seasonal watercourse (Fig. 8). This finding largely echoed Fagan's (1978, p. 129) recollection of mound locations from his initial survey of the area. Nonetheless, the clear spatial patterning of mound locations supported the development of a predictive model for mound sites, especially as visual inspection of available satellite imagery proved unsuccessful at identifying mounds.

To create the predictive model, the boundaries of the modeled area were extended beyond the survey universe to capture all of the known mounds. This step created a 15-by-16 km region, divided into 240 square-kilometer units. For the purposes of model-building, these squares, rather than the mounds themselves, were the units of analysis. The model was intended to predict the area covered by mounds in any unit (i.e., their footprints), such that the actual mound footprints (or lack thereof) were characteristics of each unit and dependent variables in the analysis used to create the model. The independent variables collected at this stage were elevation, land cover, individual bands of multispectral satellite imagery that correlate with vegetation and geological signatures (see Barsi et al. 2014), and a variety of soil data, including soil type, pH, carbon content, and bedrock depth (Table 3). These variables were drawn from satellite imagery and machine-learning-derived predictive models available for free online, including Sentinel-2, Landsat-8 (see Parcak 2009), and soil models available from [SoilGrids.org](https://www.soilgrids.org) (Hengl et al. 2017; ISRIC 2018). The multispectral Landsat imagery obtained from the USGS was a level-two product processed to capture surface reflectance. ArcGIS hydrology tools were also employed to create a trend surface for distance to perennial fresh water, which served as another independent variable. For each variable, the data from each pixel of satellite imagery was extracted from its raster and joined to the square-kilometer units using GIS tools. While the resolution of these datasets varied, each was smaller than the square-kilometer unit, with the most coarse being the 250 m soil data. Thus, data from several pixels of each raster image were joined to each square-kilometer unit. For continuous/interval data, such as elevation, the average of all measured pixels within a given square was calculated, while for nominal/categorical data, such as soil type, the most common type (i.e., the mode) was used. This process indicates that a model with tighter focus could be created in the future, but square-kilometer units were maintained for comparability with the systematic survey.

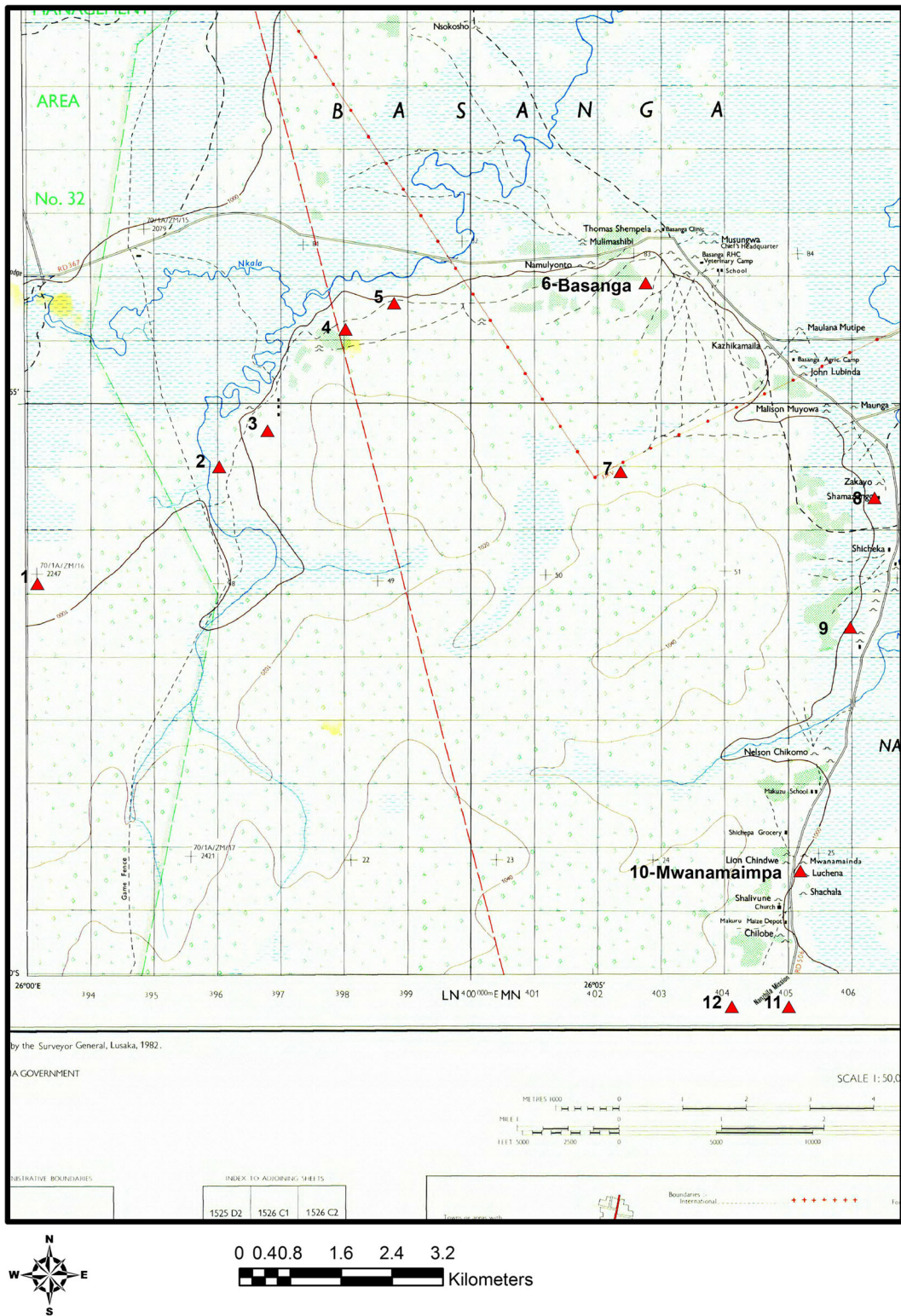


Fig. 7 Iron Age settlement mounds (red triangles) located in the survey region plotted on 1982 contour map. Note how the mound locations follow the 1000 m contour line. Following that arc clockwise from the

southwest the mounds are (1) Syansasa, (2) Miyoba, (3) Ilyabanji, (4) Mulundo, (5) Iunga Lukombo, (6) Basanga, (7) Itifwi, (8) Makona II, (9) Makona I, (10) Mwanamaimpa, (11) Syantebe, and (12) Silibelo

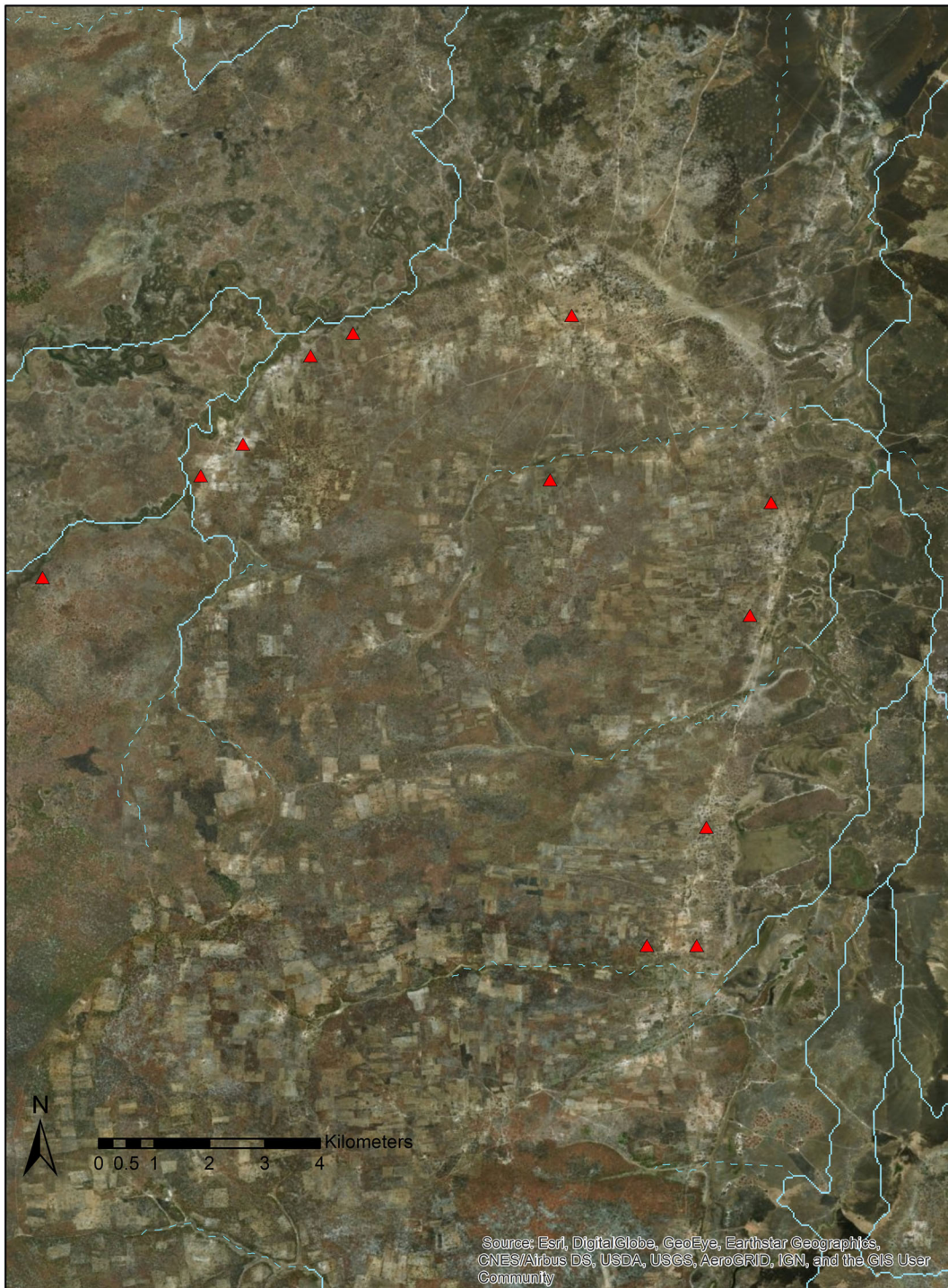


Fig. 8 Iron Age settlement mounds shown with perennial (solid) and seasonal (dashed) watercourses in the survey region. The hydrology displayed was developed using tools in the GIS platform

When the various data classes were joined with the GIS layer of the square-kilometer units, the

characteristics of squares that contained mounds could be compared. No single unit contained more than one

Table 3 Remote sensing datasets investigated during the model-building phase

Raster image	Variable(s)	Spatial resolution	Spectral resolution	Source
Shuttle Radar Topography Mission (SRTM)	Elevation	30 m	N/A	USGS EarthExplorer (https://earthexplorer.usgs.gov/)
Distance to Water	Hydrology	30 m	N/A	Calculated in ArcGIS from SRTM
Landsat 8 OLI/TIRS	Vegetation, biomass, geology and soil boundaries	30 m	Visible, near-infrared, SWIR, thermal	USGS EarthExplorer (https://earthexplorer.usgs.gov/)
SoilGrids automated soil mapping	Soil type, pH, carbon content, depth to bedrock	250 m	N/A	ISRIC SoilGrids (www.soilgrids.org)
Sentinel-2	Land use/land cover	20 m	Visible, near-infrared, SWIR	RCMRD/SERVIR-East Africa (http://geoportal.rcmr.org/people/profile/serviresa)

mound. Clear patterns emerged from the comparison (Table 4). The average elevation of most units with mounds clustered around 1000 m ASL (with a range of 999–1012 m ASL). The mounds were mostly found in areas dominated by sandy soils derived from Kalahari sands, with 10 of the 12 units characterized by arenosols. The units around the other two mounds, Mwanamaimpa and Syantebe, were distinguished by lixisols, denoting the presence of clays likely deposited from the nearby Nanzhila River. All of these soils were estimated to be 3–5 m deep and had similar carbon content, relatively low at 1.5–2.5 per mille. Contemporary land use around the mounds is mostly agricultural, though not around Syansaka due to its location on national park lands. Such land use provides a challenge to present-day preservation, as cultivation is currently

taking place atop several mounds and some, perhaps most notably Itifwi, have been substantially deflated. The existence of these patterns suggested that a robust model could be developed. Because of the existence of outliers in most data classes and because the units showed considerably more variability across the different Landsat spectra, a regression-based approach to modeling was pursued.

The model for mound locations was produced using ordinary least squares linear regression within the ArcGIS platform. This approach requires ordinal- or interval-level variables, so rather than the presence or absence of mounds, the total area of mounds (measured in square meters) in a unit was used as the dependent variable. Using mound area had the added benefit of distinguishing between sets of conditions that were

Table 4 Environmental characteristics of squares with mounds

Mound	Elevation	Distance to Water (m)	C Content (per mille)	pH	Soil type	Land cover
Basanga	1007	1507	0.8–1.1	6.1	H. Arenosol	Cropland (85.4%)
Ilyabanji	999	610	1.1–1.5	6.2	H. Arenosol	Cropland (52.4%)
Itifwi	1015	275	2.4–3.0	6.0	H. Arenosol	Cropland (55.2%)
Iunga Lukombo	999	303	1.9–2.4	6.2	H. Arenosol	Grass-cover (27.3% cropland)
Makona I	1011	964	1.5–1.9	5.8	F. Arenosol	Cropland (62.3%)
Makona II	1001	686	2.4–3.0	6.1	H. Arenosol	Cropland (57.4%)
Miyoba	1007	245	1.5–1.9	6.0	H. Arenosol	Cropland (49.8%)
Mulundo	1011	443	1.5–1.9	6.0	H. Arenosol	Cropland (57.2%)
Mwanamaimpa	1003	749	1.1–1.5	6.0	H. Lixisol	Cropland (49.1%)
Silibelo	1009	364	1.5–1.9	5.9	H. Arenosol	Cropland (50.6%)
Syansaka	1012	352	1.9–2.4	5.8	H. Arenosol	Wood cover (15.6% cropland)
Syantebe	1000	488	1.5–1.9	6.2	H. Lixisol	Shrub cover (25.3% cropland)

more likely to yield larger mounds. The requirement for ordinal-level variables also influenced the choices made regarding independent input variables. Many, such as elevation and pH, were interval/continuous and directly communicated measured values. Others, such as carbon content, were ordinal and communicated a range of values along an ordered continuum. But other variables, such as land-use and soil-type, were nominal/categorical, where the numerical pixel-data communicated a particular type (i.e., haplic arenosol) and there was no clear order between types. Fortunately, the other soil characteristics (i.e., pH, carbon content) provided much of the information that the “soil type” variable would have contributed, as overlaying the rasters showed that different soil types typically corresponded with higher or lower pH, or greater or lesser carbon content. A variable for land use was created by determining the number of pixels in each square-kilometer unit (out of a possible maximum of 2500) that represented the agricultural land-use type often found near mounds.

After testing several combinations of variables, a statistically significant ($p = 0.0108$) model was obtained which incorporated elevation, distance to water, soil pH, soil carbon content, Landsat-8 band 2 (useful for distinguishing between soil and vegetation), and the land-use variable. Over the course of model testing, a number of other variables, including the other Landsat spectra and other classes of soil data, were explored and discarded, frequently because they were redundant with the included variables. The model is not perfect (see Fig. 9 for a map of residuals), as the clustering of residuals shows under-prediction where there were mounds and over-prediction elsewhere along the contour line. There is undoubtedly some overlap between the soil variables, as well as the land-use variable and Landsat band 2. But a perfect model cannot be produced without additional cultural information from the project’s other disciplines. In part this is because the mound settlements were not only about rootedness—that is, their inhabitants were not only concerned with what was to be found at or immediately adjacent to the mounds. Instead, the mounds also served as anchors for the broader networks and new forms of mobility their inhabitants participated in, and these locations would have been responsive to the needs of those mobile people for trade commodities, hunting opportunities, and wider social connections.

Even so, the model as it exists captures some of the factors influencing mound locations. It suggests that the

most popular locations for large mounds were located towards the middle of the elevation continuum, above the floodplain but below the highlands proper, close to water, and on contemporary agricultural land. Whether the latter association comes from the presence of good soils, or simply because people have continued living around mounds, even though they no longer live atop them, is unclear. Perhaps because of the association with contemporary farming or with higher intensity agriculture in the past, the model somewhat counter-intuitively suggests that more acidic and lower carbon-content soils are also more likely to be locations of larger mounds.

Field Testing the Predictive Model

Once created from the data of our survey region, the predictive model was extended to adjacent areas to explore how widely this particular mound system and its logic extended. This would enable the project to address the question of whether the decisions driving rootedness in the survey region also structured rootedness elsewhere in the middle Kafue and Zambezi catchments between the sixth and sixteenth centuries. The process of extending the model to adjacent areas was straightforward, as it relied on the same GIS-based process of extraction and joining of remote sensing data, using mostly the same raster datasets (see Table 3). The result (Fig. 10) provided predictions for the total area of mounds likely to be present in a square-kilometer unit of the regions located around the modeled area. Of course, not every unit with a high value is likely to have a mound, in part because the model does not effectively consider the distance between mounds.

The visual inspection of satellite data was unlikely to succeed, given the coarse spatial resolution of the data, substantial vegetation in the area, and the modest visual signature of even relatively large mounds. Therefore, the testing of the predictive model proceeded in two other ways. First, the project tried to rely on local expertise and collaboration to guide us to mound sites. This is an unsystematic, but often useful, source of knowledge. In practice, however, this proved less fruitful than it had been within our survey universe. Members of the project were able to successfully cooperate with the Shezongo chieftaincy, located south of our region, and with officials from Kafue National Park to conduct reconnaissance of their territories and, in the former case, interview knowledgeable residents. However, while the survey team was shown and was able to

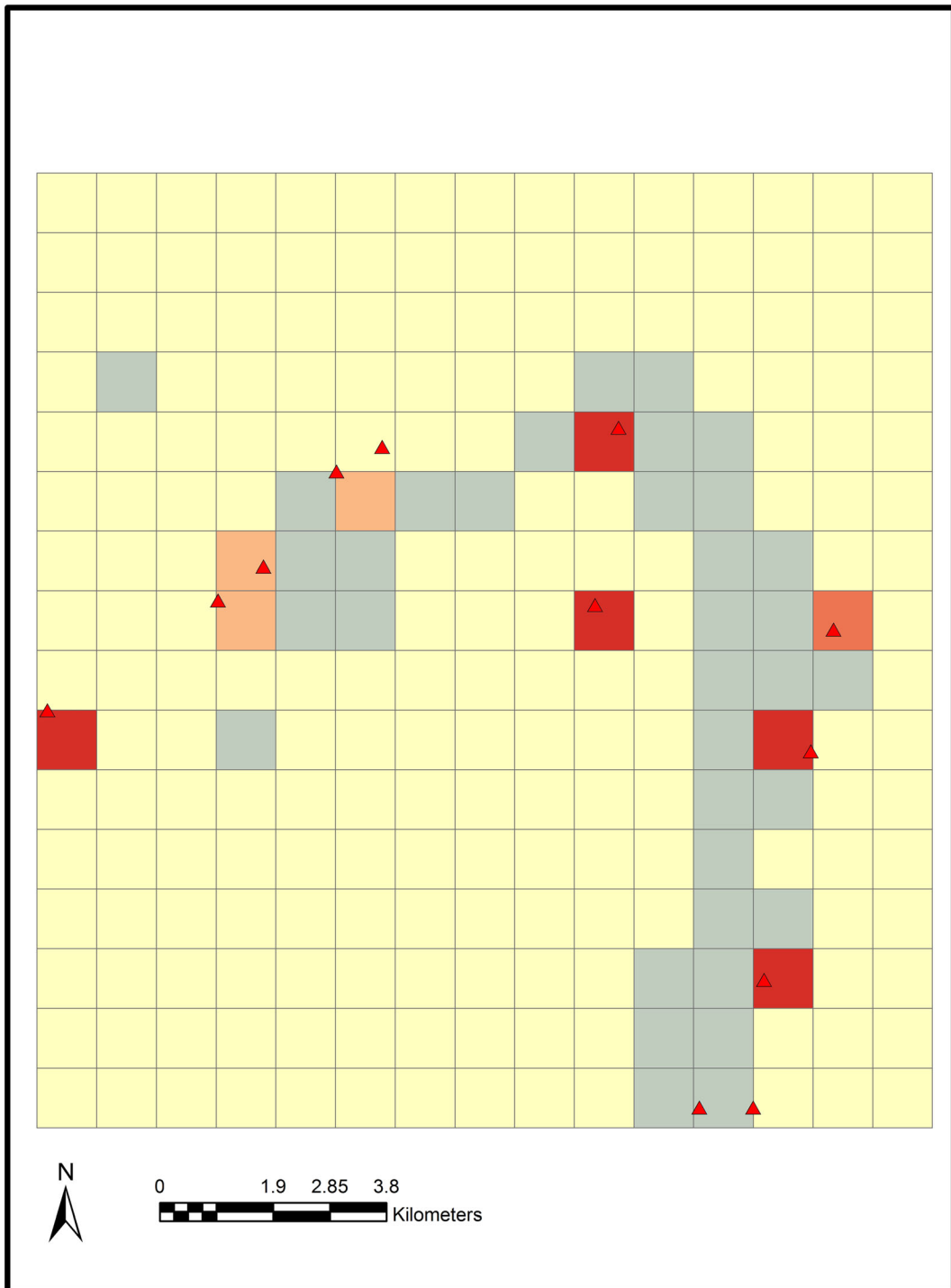


Fig. 9 Residual map for the statistically significant regression model, showing the clustering of residuals near the 1000-m contour line, suggesting continued limitations of the model exist

record coordinates for significant historical sites in each area, the only known mounds in Shezongo were located far to the southwest. For the region of Shezongo

territory immediately south of our study area, local sources communicated that a mound-centered settlement pattern never existed there. Kafue National Park

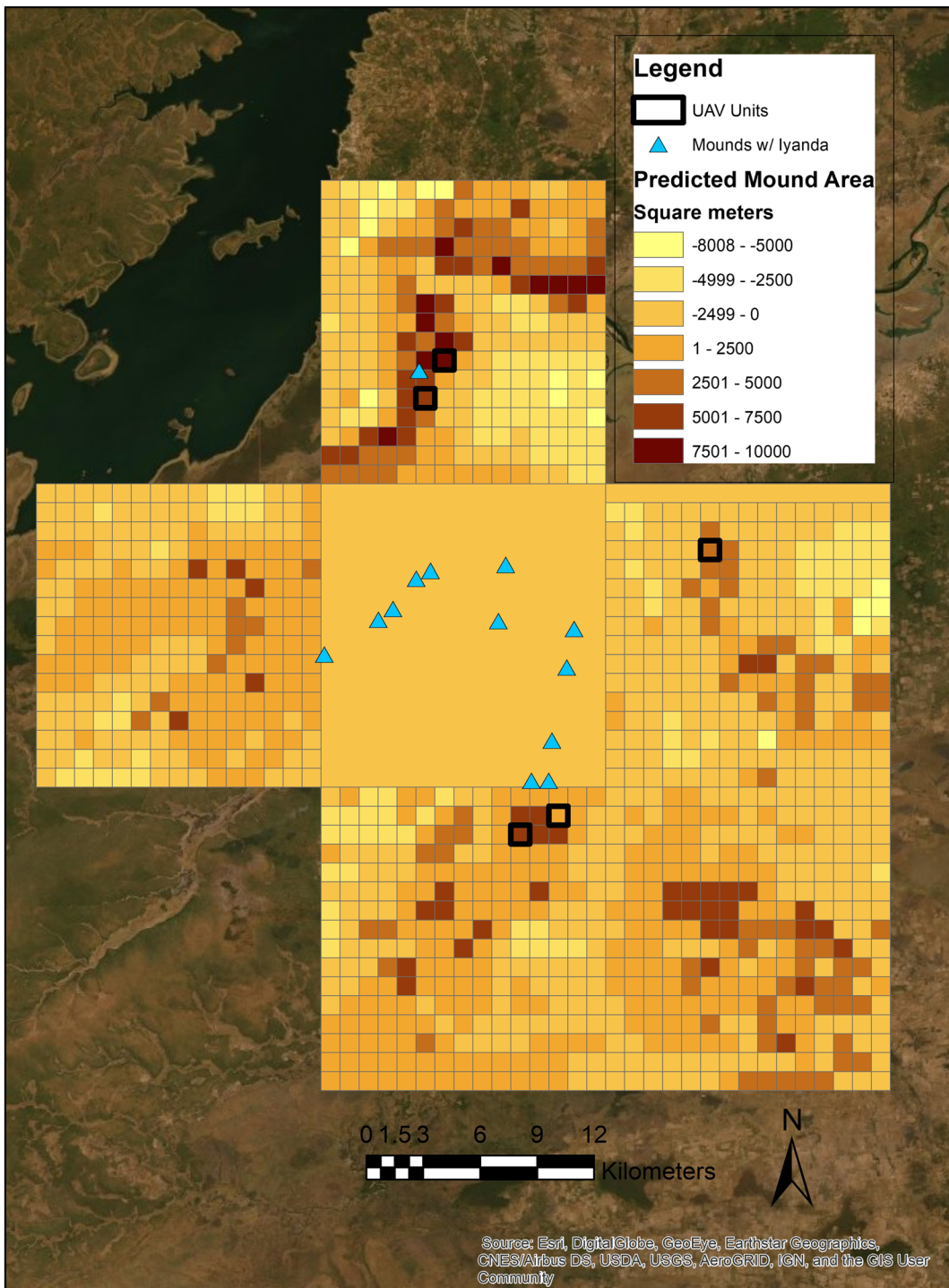


Fig. 10 Mound-area-prediction map for areas adjacent to the survey region developed from the regression model. Darker shades denote predictions of larger mound-footprints in those units, while lighter shades suggest the absence of mounds. Iyanda mound

shown as a blue triangle north of the model region, and is found in a unit with an expected mound footprint of 5000–7500 m². The units explored with the UAV are outlined with thicker borders

presented a different difficulty, because people no longer live in the park and substantial local historical knowledge for the region has been lost. However, the project was able to locate one mound site, Iyanda, at the park's eastern edge north of our study region (Fig. 10). The survey team has not yet developed cooperative relationships to study the areas north and east of our study region, in part because larger portions of those areas are comprised of floodplain rather than modern towns and villages.

Because of these difficulties, the project also undertook a second approach to testing the extended model. The team employed an unmanned aerial vehicle (UAV, commonly known as a drone) to capture high-resolution imagery of square-kilometer units of the extended model. Specifically, a DJI Mavic Pro UAV, featuring a stabilized 4 K/30fps Ultra HD camera, was flown over survey routes programmed using the Drone Deploy application. This provided hundreds of 12-megapixel images of different parts of the unit at a resolution of less than 5 cm/pixel. When subsequently stitched together, the images provided not only two-dimensional surface imagery but also high-resolution maps of elevation and vegetation (so-called “false NDVI” calculated from RGB imagery using the VARI algorithm). This approach is still very much in its initial stages, having been piloted in 2018, but the survey team has collected images for two square-kilometer units located to the north of our survey universe, two to the south, and one to the east. The UAV has also been flown over 9 of the 14 currently known mound sites, which shows that the mounds stand out clearly in the elevation maps, if not always in the aerial imagery and vegetation maps (Fig. 11). While in the field, one difficulty encountered was an inability to harness sufficient computer processing power to create maps and work with the data in real time. Thus, while the UAV survey is able to detect the elevation difference of the mounds themselves and has identified a few locations to ground-truth among the surveyed units, especially to the north, none have yet been visited because the analysis of the UAV data occurred only after returning from the field.

These two approaches to testing the predictive model have so far produced mixed results. The reconnaissance recovered another mound site, Iyanda, from a location deemed likely by the predictive model. However, in general the reconnaissance was less fruitful than in our survey region and, in the case of Shezongo, has suggested that the pattern of mound settlements from our

region possibly did not extend south. While the UAV survey is still only beginning, analysis of its high-resolution data has suggested the possibility of additional mounds in high-probability areas to the north, but has not yet found compelling evidence for mounds elsewhere. These preliminary findings do not necessarily confirm that no mounds existed in northern Shezongo, nor do they give us cause to challenge it. And so, the possibility exists that the mound phenomenon observed at Basanga is relatively spatially limited and does not extend far beyond the survey universe. However, as a more restricted phenomenon, the comparison of the social, economic, and ecological influences on mound settlements here relative to the famous sites further south, such as Kalomo and Isamu Pati, would become even more interesting.

Discussion: Tested Methods and Tracing Mobility and Rootedness

Perhaps the most salient point to emphasize here is how well older and newer tools, methods, and techniques can work together. Much of the survey work undertaken thus far, whether the systematic STP survey or the mound reconnaissance, has parallels in the long history of archaeological survey in Africa (see Bower 1986; Livingstone Smith et al. 2017). These methodologies, combining pedestrian survey with subsurface testing, have proven effective at addressing research questions that demand detailed regional information, much as this project does. Going further, GIS platforms and satellite remote sensing provide powerful tools for the visualization and analysis of the spatial data produced by such surveys. As shown here, interpolation of material culture or environmental data can produce trend surfaces that enable a project to identify archaeological sites and characterize regional mobility. Overlaying such data and satellite imagery, one can consider and quantify the spatial relationships between settlements, activity areas, and a variety of environmental features. Tools for model-building exist, and the data to include as variables in these models are increasingly available. Where they are not available, or at least not at a sufficiently high resolution, it is also increasingly possible to create new datasets using UAVs or geophysical equipment. Yet rather than making systematic survey obsolete, these techniques make it more powerful, enabling survey to address increasingly sophisticated spatial questions

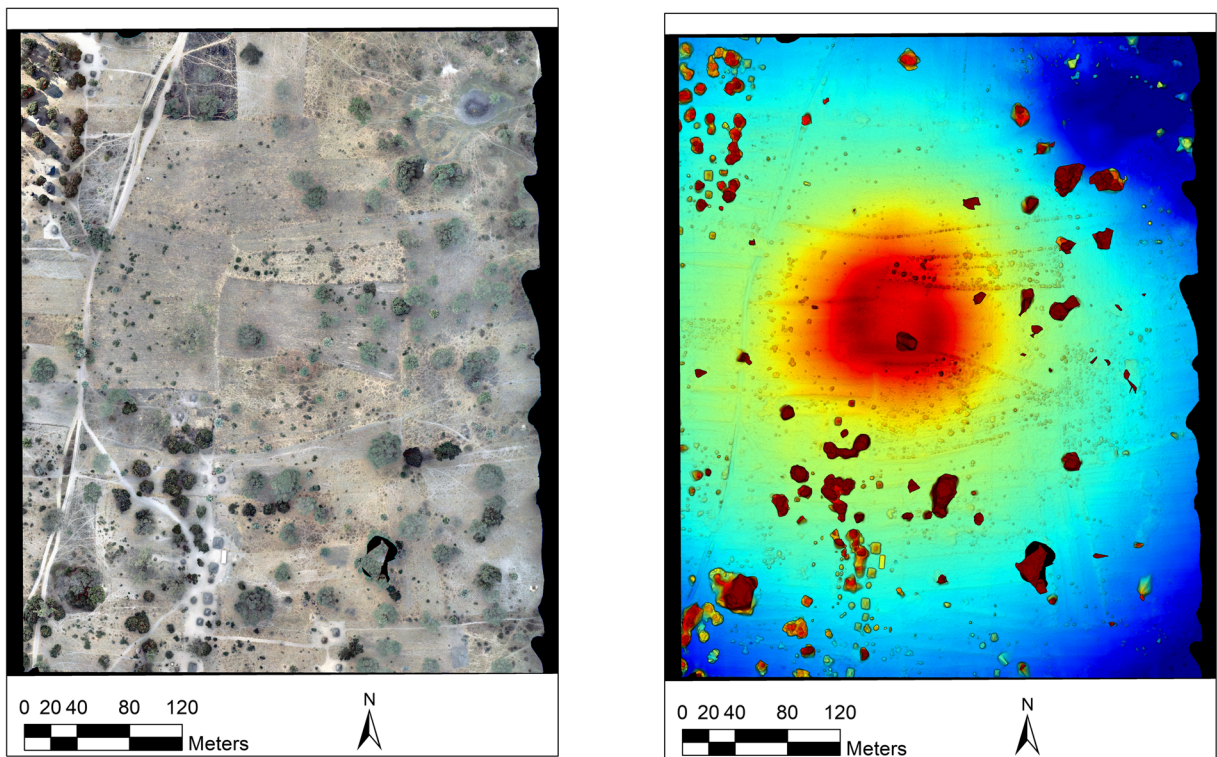


Fig. 11 Maps created from images taken over Mwanamaimpa by UAV. The map on the left is the two-dimensional orthomosaic image of the mound and its surroundings, and the map on the right is the elevation model

more readily and providing new hypotheses to test, much as this project has begun testing the spatial model for conditions guiding the rootedness of settlement mounds in adjacent regions.

At the same time, it is also worth recognizing the limitations of these tools. The analytical techniques available on GIS platforms depend on the value of the data that they are analyzing, and this is perhaps especially true of predictive modeling (Kamermans 2010). While satellite remote sensing offers a vast new trove of information to archaeologists, not every dataset is immediately (or sometimes ever) suitable for certain analyses. Depending on the region, satellite data may not capture the full range of sites (e.g., buried sites, ephemeral sites, sites without substantial architecture) that might be pertinent for research questions where the full range of sites is necessary, as in this case. In such instances, archaeologists would need good data produced through traditional survey, but that raises a separate series of questions regarding methodology, sampling strategies, sample sizes, and surveyed fractions (Plog 1976). For this particular project, the full range of mound settlements needed to be identified through

traditional survey before the predictive model could be created, and some of the datasets developed from satellite imagery, such as soil type and land use, were not immediately suitable for the regression analysis undertaken. Further, STP survey capable of identifying buried sites would need to proceed to capture a much larger sample of sites before predictive modeling could be extended to non-mounded settlements.

Archaeologists should also be aware of the kinds of influences on rootedness and mobility that such spatial modeling is not capturing by itself. While the model for mounds shows environmental influences on spatial decisions, like many efforts at predictive modeling in archaeology, it fails to capture social and cultural influences on those decisions (Kamermans 2010, p. 274; but see Whitley 2005). In general, this has left predictive modeling open to charges of environmental determinism. Yet in this case, we might simply acknowledge that the absence of cultural variables is a source of error in the model, but one which might be mitigated through consideration of the other datasets revealed by excavation, historical linguistics, and oral history, as part of the broader Bantu Mobility Project.

Indeed, full consideration of the tension between mobility and rootedness between the sixth and sixteenth centuries demands attention to additional datasets from the project's various disciplines. For instance, while the mounds, having been occupied continuously for centuries, are clear examples of rootedness and have spatial patterning in their locations, understanding that patterning demands recognition that they are also sites of new forms of mobility that sustained long-term settlement at the mounds.

The regional linguistic record (de Luna 2016) and archaeological data from excavations at two of the mounds, Basanga and Miyoba (Pawlowicz et al. 2015, 2018), shows that people there were involved in long-distance trade and engaged in a variety of food procurement activities, such as collecting, hunting, fishing, and herding, in addition to farming their immediate surroundings. Both Basanga and Miyoba (excavated in 2018) have numerous trade items, including ostrich and other shell beads in the early phases and glass beads and copper bangles after the twelfth century. At Miyoba the project also recovered a glass “garden roller” bead, likely made at K2 in South Africa, an indication of the scale of the trade networks into which this region was connected, as articulated in the “central frontier” hypothesis (de Luna 2016, p. 172–3). The scale of these connections is reflected also in the geographies of loanwords, such as terms for “ostrich,” in the first and early second millennium AD.

Each site also has a sizeable faunal record, which includes not only domesticated animals like cattle but also a wide range of large and small wild animals and abundant fish. Names for some wild species were sites of linguistic innovation in the wider region during this period, as were lexicons for the processes by which they were procured. These developments track the historical record produced by the study of Botatwe languages, where hunting (de Luna 2012a, 2012b) and bushcraft in general (de Luna 2016) became spheres of social and political innovation through which mobile specialists could achieve renown and influence. This politics created different opportunities in different areas of our study region. For example, at the turn of the millennium, the social and political significance of communal hunting was reimagined (and renamed) by Botatwe-speaking residents of the middle Kafue as they extended their speech community to the Batoka Plateau, using communal hunts to forge connections across social and linguistic boundaries (de Luna 2016, p. 160–165).

With respect to the spatial modeling of the location of mounds such as Basanga and Mwanamaimpa, such cultural and demographic factors need to be taken into consideration. Mounds were not only located in the transition zone to access resources from multiple environments, they were likely located in specific parts of the transition zone to access *particular* resources in those environments, whether commodities like salt from the pans near Basanga, hunting grounds for targeted species, or others that were used by the mobile populations of the mounds. If mounds truly do not extend further south, perhaps it is because of the absence of those resources, rather than the model's set of broad environmental conditions. This would be in keeping with other archaeological and linguistic evidence for the uneven nature of settlement, contact, trade, and production on the central frontier (summarized in de Luna 2016, Chapter 5).

The Botatwe emphasis on bushcraft may also help explain the presence of non-mounded Iron Age settlements and activity areas across the different environments of the study universe (for arguments and evidence supporting a direct association between Botatwe languages and these specific archaeological sites, see de Luna 2012b, 2016, de Luna and Fleisher 2019). Similarly, it could help explain non-site evidence for manipulation of the environment even in zones where there was little material culture. Might these spatial patterns reflect the multifaceted approach to food procurement where hunting, collecting, fishing, farming, and herding all played a role?

And so, while such interpretations must be considered provisional at this early stage of the project, perhaps better thought of as hypotheses from preliminary work, they do point to a useful tension between mobility and rootedness that could characterize the region, and which might be influential elsewhere in the Bantu-speaking world. After all, there seems to have been a greater emphasis here on hunting, bushcraft, and trade—all dependent on mobility—after people settled the mound sites where they proceeded to stay for centuries. And these new forms of mobility that developed around the mounds may also have prompted new patterns of more widely dispersed non-mounded settlement and land use. Initial indications from the linguistic record suggest these spatial patterns were linked with new social practices and a reconceptualization of landscape into new kinds of territories specifically juxtaposing mobility and rootedness (de Luna 2013, p. 145–148; 2015; 2016, p. 98–105,

121–30). Botatwe speakers, it seems, were both mobile and settled during our study period.

Conclusion

While the survey around Basanga and the larger Bantu Mobility Project are ongoing, the techniques of spatial analysis documented here have shown significant promise for exploring questions of mobility and the Bantu Expansions more generally. It is clear that traditional methods of archaeological exploration such as systematic survey can and should make use of the datasets and analytical techniques offered by new technologies. The combined approach yields a deeper understanding of land-use and settlement patterns, identifying and modeling the relationship between archaeological sites and geographic features. Such spatial data can be integrated with other datasets, from history and linguistics, to capture social and cultural influences on those patterns. For instance, consideration of linguistic and excavation data from this project has emphasized the importance of hunting, bushcraft, and trade among settled communities at the mounds, perhaps indicating explanations for the broad distribution of non-mounded sites and the possible absence of mounds in Shezongo. Indeed, the multidisciplinary approach enables the project to consider the historically and culturally specific practices of mobility and rootedness that underlie spatial patterning and the human agency shaping the movements of people, animals, material goods, and languages as Bantu-speaking communities came to predominate south-central Africa.

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