of these groups lived in proximity and probably engaged in other routine interactions, which also helped reinforce social relationships. While ritual practices at outlying temples were important to local community formation, people also gathered in the site center for similar performances. These rituals provided occasions for participants to share common experiences and negotiate their differences, thus helping to integrate Ceibal's inhabitants into a larger society. The results of this study ultimately highlight the dynamic and complex relationships between core and periphery and show the importance of considering how interactions at intermediate levels of society affect city growth and sociopolitical organization.

Acknowledgments

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5

From Urban Core to Vacant Terrain

Defining the Heterotopia of Maya Monumental Landscapes at the Crossroads of the Middle Belize River Valley

ELEANOR HARRISON-BUCK, MARK D. WILLIS, CHESTER P. WALKER, SATORU MURATA, AND MARIEKA BROUWER BURG

> There are the scientific theories or the philosophical interpretations which explain why order exists in general, what universal law it obeys, what principle can account for it, and why this particular order has been established and not some other. But between these two regions, so distant from one another, lies a domain which, even though its role is mainly an intermediary one, is nonetheless fundamental: it is more confused, more obscure, and probably less easy to analyze.
>
> Michel Foucault, *The Order of Things*

In his preface to *The Order of Things* Michel Foucault (2005 [1970]) calls this less-understood domain a heterotopia, which stands in stark contrast to an ordered and well-understood social space, such as an urban core in an ancient Maya monumental landscape. Foucault's examples of a heterotopia encompass more aberrant spaces, like prisons and cemeteries, but the concept can usefully be applied in Maya settlement studies when discussing the relationships between the core and the fringes of the peri-urban landscape. Peri-urban refers to where the city meets the countryside. The latter is usually characterized as "rural" in a settlement classification system; it is where farming occurs and where smaller, isolated homesteads are found. Vacant terrain is sometimes conflated with rural, but the former is a less-defined classification as it lies between what can be definitively characterized as built or natural landscape. On the surface, these spaces appear different and even incompatible, but they can, in fact, have mutually contingent relationships with the more ordered urban spaces. Vacant terrain both separates and connects the other more well-classified and ordered spaces and in this way shares elements of a heterotopia; it is both an entry and an exit, an opening and a closing off, a marking of transition in spatiotemporal intensities and discontinuities (Hurren 2018:34).

In this chapter we explore these "heterotopian" aspects of a monumental landscape, examining the fringes or outskirts of Saturday Creek, an ancient Maya urban center in the middle Belize River Valley. We examine some of the activities that the "vacant terrain" may have supported in the fringes of the peri-urban landscape, including wetland and orchard agriculture, and how these agrarian activities related with the neighboring urban core center of Saturday Creek and the nearby secondary centers of Hats Kaab and Chikin Chi'Ha (Figure 5.1). Our study relies on a combination of geospatial technologies, including publicly available satellite imagery and our surveys of the landscape using unmanned aerial vehicles (UAVs) as well as traditional pedestrian survey and total data station (TDS) mapping. We also rely on data we have gleaned from both our archaeological investigations and the ethnohistoric accounts from Spanish chroniclers of the sixteenth and seventeenth centuries. The Spanish recorded details about their journeys to the Maya communities in the middle Belize River Valley and their experience in the surrounding landscape. They describe this location as a crossroads, an entry point for those traveling south on an overland route, which traversed along a sandy pine ridge and through wetland swamps to finally reach the Belize River for travel up or down (west or east) on this riverine "highway."

Our study presented here contributes to a long history of applying innovative methods to settlement studies in the Belize River Valley, which continues to reshape our understanding of the Maya monumental landscape. We first provide a brief overview of this history of settlement pattern studies in the Belize River Valley and how geospatial technologies have revolutionized survey and mapping of ancient Maya monumental landscapes. In our case, archaeological findings are augmented by innovative, mixed geospatial methods, which combine UAV-derived photogrammetry with traditional field survey and mapping techniques. We present the results of our mapping efforts and compare these results to show the efficiency and effectiveness of mapping with drones in the tropics, particularly in areas under cultivation and in salvage circumstances. We discuss the settlement density and how the peri-urban settlement in this area was shaped around vacant terrain that, we argue, may have been used as an overland transportation corridor, as wetland agricultural fields, and as managed riparian

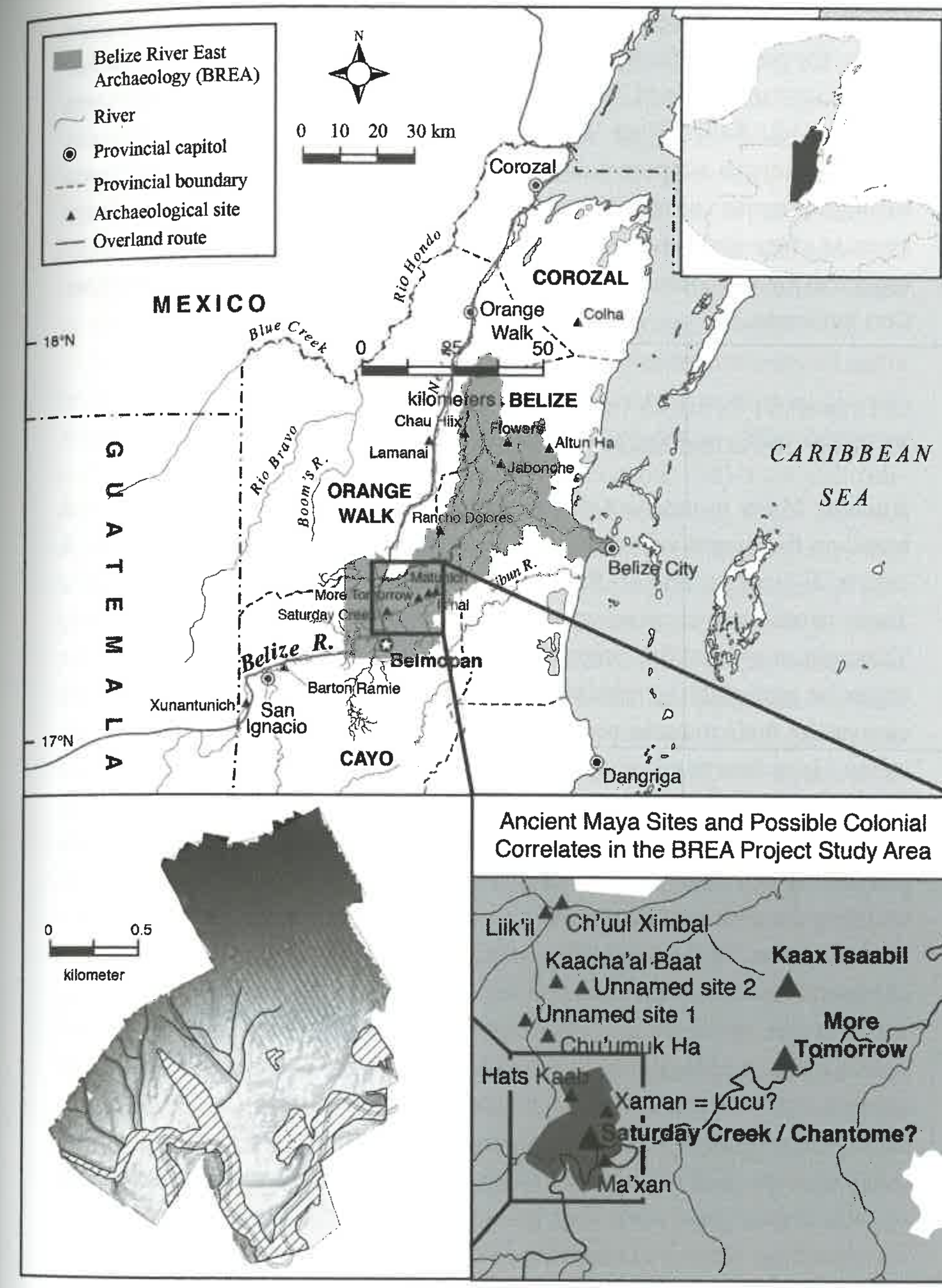

Figure 5.1. Map of the Belize River East Archaeology study area showing location of the 7 km^2 drone survey area (Area 1) and other sites in the middle Belize River Valley noted in the text (map prepared by M. Brouwer Burg).

forests with orchard agriculture. We examine the settlement density in relation to the potential for agricultural production in the region surveyed. Together our findings lend further support to the notion that the inhabitants of the middle Belize River Valley intensively managed their vacant terrain and were able to support a dense population aggregation from Preclassic through Spanish colonial times. They congregated at this location perhaps because of the environmental conditions and because it marked an important crossroads between east–west and north–south trade and communication networks.

Settlement Studies in the Middle Belize River Valley: Revolutionizing Mapping Technologies

Ancient Maya monumental landscapes have traditionally been defined based on the magnitude of the architectural complexes (e.g., pyramids, ball courts, E-Groups, and so forth) with little regard for the vacant terrain. These urban core centers represent the largest of the ancient Maya sites. Throughout most of the twentieth century, archaeologists focused their energies on mapping the architecture of these monumental urban cores and excavating their massive public works at site centers, like Tikal, in the so-called Maya heartland of northern Petén, Guatemala (Coe 1990; Harrison 1999; Jones 1996; Jones and Satterthwaite 1982; Tozzer 1911). Beginning in the early 1950s, Gordon Willey worked in Belize and became known for his pioneering work on "settlement pattern" studies in Maya archaeology, examining the areas not just in but also outside the urban core of monumental site centers. Willey (2004:16) called attention to the "total archaeological site layouts, not only temples, palaces, and public buildings, but residences, their natures, numbers, and distributions" at secondary centers, like Barton Ramie in the middle Belize River Valley (Willey 1965). Importantly, Willey applied innovative methods in his settlement studies of the 1950s, combining field surveys with aerial photography that enabled him to produce detailed maps of all of the archaeological features of the valley—a new kind of monumental landscape that included not just the site core but also its surrounding network of hinterland settlement.

More recent advances in geospatial technologies are now allowing archaeologists to study even greater monumental landscapes than ever imagined in the 1950s. Using a range of innovative geospatial technologies, we can map even larger and more complex spatial distributions of cultural remains across the landscape with a higher degree of accuracy and refinement

than was previously possible, reconstructing broad networks of interaction across space and through time. One such example of a geospatial technology that has revolutionized Maya settlement archaeology in the last decade is a remote sensing technology known as lidar (light detection and ranging). Lidar uses lasers to penetrate the forest cover and relies on specific filtering algorithms to provide detailed topographic maps of the landscape, capable of recording even the very subtlest of features (e.g., Canuto et al. 2018; Chase et al. 2012; Chase, Chase, Awe . . . and Brown 2014; A.S.Z. Chase et al. 2017; Garrison et al. 2019; Prufer et al. 2015; among others).

Lidar has traditionally been mounted on small planes, but more recently technicians have been using UAVs, otherwise known as drones, to perform lidar mapping. In open areas cleared of vegetation, lidar becomes unnecessary, but in these circumstances autonomous UAVs are still useful in the practice of archaeological survey and mapping when they are equipped with digital cameras. This relatively inexpensive geospatial tool is far more powerful than traditional aerial photography because it employs photogrammetric measurements to geo-reference the imagery and transform it into a digital elevation model (DEM). Photogrammetry offers a fast and effective method for mapping large aerial landscapes and reveals archaeological surface and subsurface features with potentially as much accuracy as lidar and in some cases even higher resolution (Casana et al. 2014; Gutiérrez and Searcy 2016; Harrison-Buck, Willis, and Walker 2016; Mozas-Calvache et al. 2012; Ortiz et al. 2013; Poirier et al. 2013; Wernke et al. 2014; Willis 2016; Willis and Murata 2018).

The Geospatial Survey of Saturday Creek and Its Hinterlands

The study presented here of the settlement in peri-urban, rural, and "vacant" landscapes surrounding the urban core of Saturday Creek attest to the power of photogrammetric mapping with drones, which has allowed the Belize River East Archaeology (BREA) project to map an expansive monumental landscape in a quick and efficient manner. In less than two days, Mark Willis and Chester Walker flew a drone across an area of Saturday Creek measuring roughly 7 km^2. Like many Maya sites, Saturday Creek supported dense peri-urban settlement and a sprawling rural community in the surrounding terrain. In many cases, archaeologists can only speculate on the population density as these smaller hamlets often are covered in thick jungle. Traditionally, these circumstances have made it difficult to map every mound without years of investment in the systematic ground-truthing of the surrounding landscape by a designated survey and mapping team. Increasingly, sites in the jungle canopy have been at risk of being cleared, making settlement visible but vulnerable to destruction. This is the case for Saturday Creek.

While the Saturday Creek site core is in bush, the majority of the site's peri-urban and rural settlement is in open fields that were mechanically cleared of jungle vegetation between 10 and 25 years ago. Over the years farmers have systematically removed most of the large stones—the remnants of once-intact ancient Maya architecture—to avoid damage to their plows. In some cases, the farmers have decided that plowing around (rather than over) the larger mounds is easier, but in most cases the small- and medium-size mounds and a few of the larger structures have been victims of bulldozing and repeated seasonal plowing. The Hats Kaab E-Group is one of the monumental complexes that was bulldozed and has been repeatedly plowed over the years (Brouwer Burg et al. 2016; Runggaldier et al. 2013).

Beginning in 2014, following our drone survey, another 7,500 acres of adjacent land was cleared for a vast sugarcane plantation just north of Hats Kaab, which extends all the way to the south side of Labouring Creek. Parts of this newly cleared area, referred to as Area 2 (Plate 5.1), were the focus of intensive pedestrian survey and reconnaissance, both before and after clearing (Buck et al. 2013; Gantos 2015; Gantos and Buck 2018). In all of these cleared areas, mounds have been victims of extensive bulldozing and repeated plowing and are at high risk of further destruction. The repeated plowing and removal of stone shaves off more and more of the mounds in this area each year.

For this reason, one of BREA's primary aims has been to document the settlement before further damage to the mounds occurs (Brouwer Burg et al. 2016; Harrison-Buck, Willis, and Walker 2016). To do so, we have used a combination of survey techniques to map and record the structures in Areas 1 and 2. For Area 1, we used drones and a TDS for mapping as well as pedestrian survey to mark the locations of mounds using a hand-held Trimble GPS with submeter accuracy. Because Area 2 was cleared after our drone survey work took place in January 2014, we used strictly pedestrian survey of this area, creating sketch maps of mounds and recording their locations with the Trimble GPS. Because the area was newly cleared, it offered maximum visibility, and 100% of the mounds visible to the naked eye on the surface were recorded with the GPS (Gantos 2015; Gantos and Buck 2018). However, in the future we plan to fly Area 2 as it is clear that the

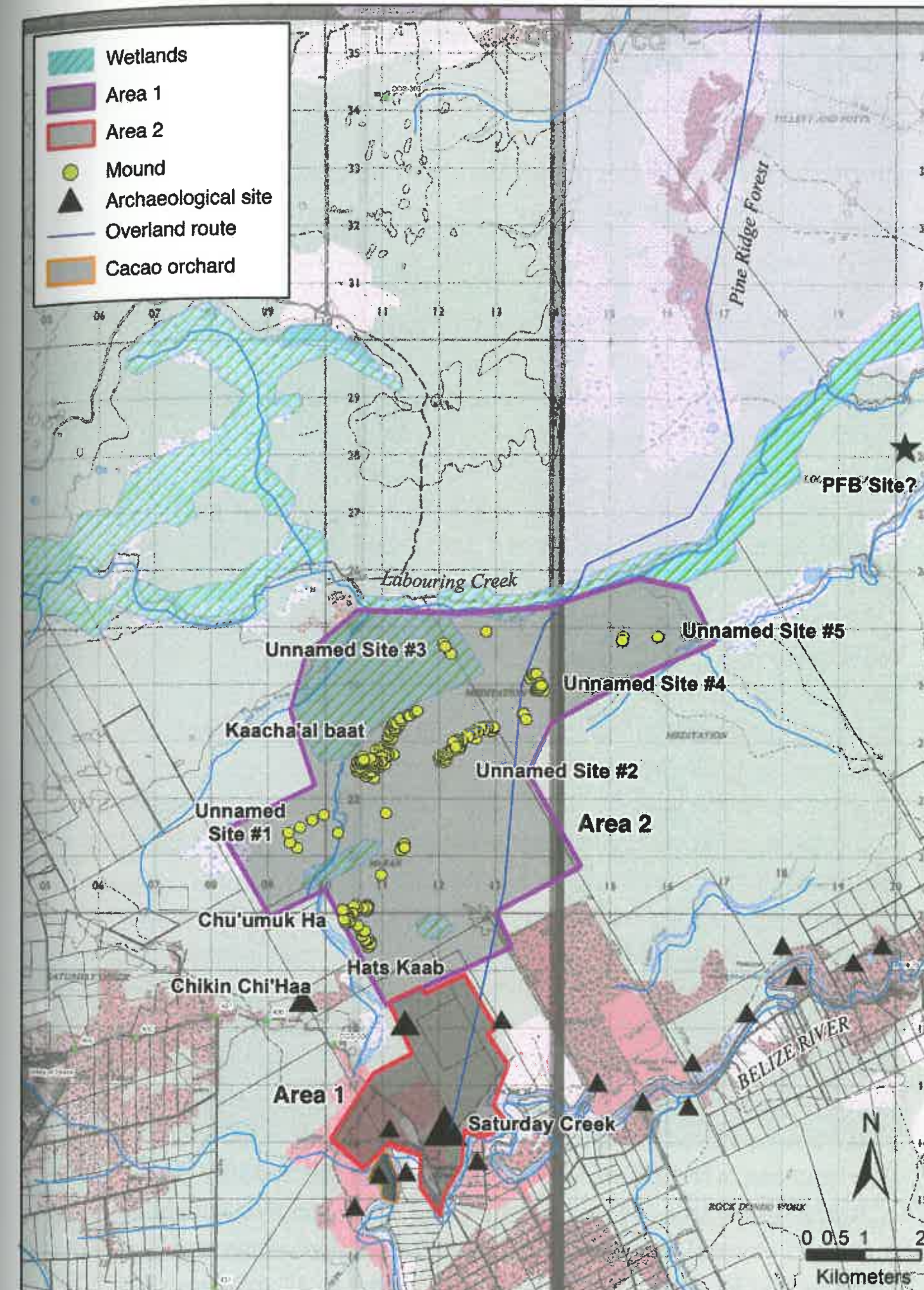

Plate 5.1. Projected overland route with wetland fields demarcated and sites shown trending north-northeast with approximate location of large site identified in the Programme for Belize survey (map prepared by M. Brouwer Burg).

drone imagery in some instances can pick up more subtle mound features than the naked eye can discern on the ground (see further below). Furthermore, the drone mapping produces a DEM that allows us to monitor the degree of mound destruction over time (for more details on the methods used in the drone mapping, including equipment, data collection, and data processing see Harrison-Buck, Willis, and Walker [2016]).

Mapping Results

Prior to flying the drones, we knew from pedestrian survey that the area was densely settled but had no idea how dense the settlement was until we saw the results of the drone imagery. After analyzing the 3D data, an unprecedented number of archaeological features were identified in the open fields, particularly north of Saturday Creek. Most of these appear to be small and low earthen mounds, which we interpret as the remains of ancient Maya residential structures. These mound features become more obvious in GIS when a virtual light source is used to illuminate the model from highly oblique angles. Figure 5.2 shows the subtle variations in surface topography that highlights what appear to be hundreds of mounds packed into this small area.

We produced a rectified map of the drone survey to capture the settlement density (Plate 5.2). This map is based on a combination of the aerial imagery, elevation data from the DEM, and ground-truthing. Plate 5.2 is a preliminary map that requires more systematic survey, particularly of the structures in blue, which have not been ground-truthed and firmly located with a GPS. The structures in yellow show the mounds that have been verified to be archaeological in nature via pedestrian survey. Not only did these locations contain evidence of mounded architecture but surface inspection revealed associated artifacts and/or daub scatters on nearly every mound feature. A cursory inspection of the diagnostic ceramic material found on the surface indicates that many of these structures were continuously occupied from Preclassic to Postclassic times (ca. 500 BCE–1500+ CE). Finally, the structures in red are those that have been mapped by BREA with a TDS.

In this 7 km² area, we estimate there are 328 structures, which includes the urban core of Saturday Creek as well as the peri-urban and rural settlements on the outskirts. This comes to a total of 47 structures/km². To put this settlement density in perspective, the recent lidar survey of the Maya Biosphere Reserve, a 2,144-km² area in northern Petén, Guatemala, yielded an average settlement density of 29 structures/km² (Canuto et al.

Figure 5.2. Drone DEM image of Saturday Creek hinterlands with oval highlighting location of Saturday Creek site core in bush (map prepared by Mark Willis).

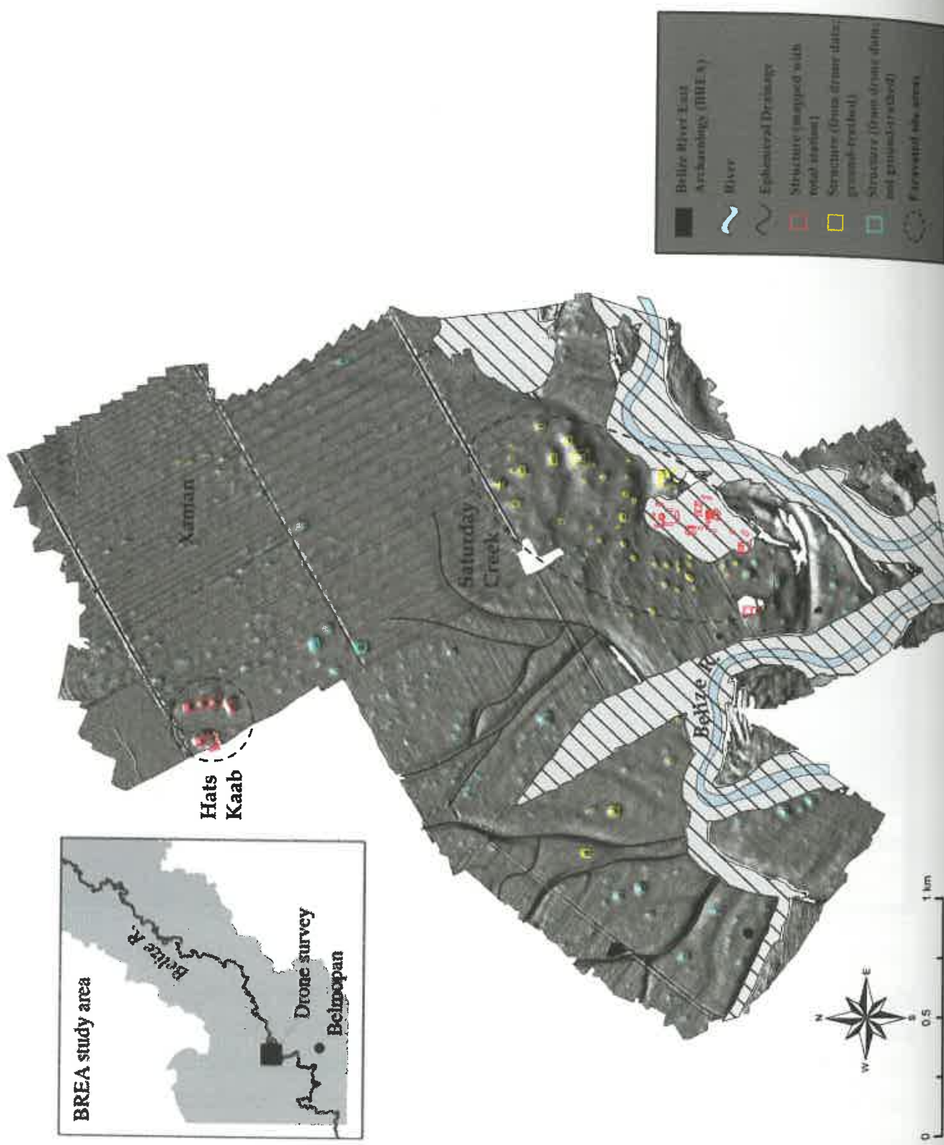

Plate 5.2. Rectified map of Saturday Creek and hinterland settlement (map prepared by *S. Murata*).

2018:1355). The Petén lidar survey area captures some of the largest Classic Maya cities, such as Tikal, with some of the most densely populated urban centers in all of the Maya Lowlands. That the average settlement density in and around Saturday Creek was 40% greater than the Petén average speaks volumes about the sheer density of occupation in this particular location in the middle Belize River Valley.

Of course, we cannot assume that all 328 structures were occupied at the same time or that they were all residential. The former issue is more difficult to resolve. Although calculations are not always considered accurate, scholars, in an effort to address the issue (relying on comparative ethnography), factor in a downward adjustment to account for nonsynchronous use of structures at any one time. Averaging multiple comparative sources, Marcello Canuto and colleagues (2018) propose a middle value of 83% of structures being contemporaneous, with a 17% downward adjustment. Using this as our index, we estimate that, of the 328 structures, only around 272 were used at any one time, making the average structure density around 39 structures/km^2.

Additionally, one cannot assume that all of these structures were necessarily residential. Averaging the ethnographic comparative sources, Canuto and colleagues (2018) propose a middle value of 81.1% of structures being residential, with an 18.9% downward adjustment for nonresidential buildings. Using this as our index, we estimate that only around 266 of the 328 structures were residential structures. If we assume that not all of these residences were occupied at the same time and apply the 17% downward adjustment of noncontemporaneous occupation, this means that 221 or 32 residential structures/km^2 were occupied at any one time. This number would increase by another 10% (N = 242 or 35 residential structures/km^2) if one factors in the invisible or hidden structures that are thought to be mostly residences (Canuto et al. 2018, see Supplementary Materials). If we use the middle value of 4.89 for the number of persons per household, as proposed by Canuto and colleagues (2018), and apply this number to 242 residences, the total population density at any one time can be estimated at just under 1,200 persons living in this 7 km^2 area or nearly 170 persons/km^2.

The drone imagery revealed hundreds of previously unrecorded mounds in the Saturday Creek hinterlands, particularly dense in the vicinity of the Hats Kaab Group (see Figure 5.2 and Plate 5.2). As noted earlier, Hats Kaab is a large ceremonial complex that resembles other ancient Maya E-Group architectural configurations. It contains a triangular arrangement of structures that may have served to commemorate astronomical events, among other functions (see Brouwer Burg et al. 2014, 2015, 2016; Runggaldier et al. 2013; for a broader discussion of E-Groups, see the contributions in Freidel et al. 2017). Although most of the hinterland settlement consists of small- to medium-sized mounds, the Hats Kaab complex represents one of the more substantial plaza groups in the hinterland area, located about 1 km to the north of the Saturday Creek urban core.

The Hats Kaab Group was cleared of forest about 10–15 years ago, and, according to locals, the mounds were bulldozed substantially. The BREA team identified the large mound complex in January 2011. The following summer the survey team, led by Satoru Murata (2011), mapped the Hats Kaab complex, which covers an area roughly 380 m x 350 m, with a Nikon TDS. This involved the collection of around 1,000 data points with the TDS, which took about two days (roughly 14 hours). During their January 2014 survey, Walker and Willis mapped this same area using drones in about three minutes. Figure 5.3 shows the comparison of the two maps of Hats Kaab. Both produced comparable contour maps of the mounds. Yet the map created with the TDS has the advantage of the archaeologist's trained "eye," catching precisely what is there and, in some cases, recording small details that are not picked up in the photogrammetric map. The map produced by the TDS is also "cleaner" than the photogrammetric image, omitting certain things, like plow furrows, which the drones do not filter out. However, the expedience of the UAVs is unparalleled. In less than two days (the total time it took to map Hats Kaab with the TDS), Willis and Walker were able to cover an area over 50 times the size of Hats Kaab and expediently map a monumental archaeological landscape that consists of a dense and expansive regional settlement. The results of this study leave little doubt that in high-risk situations, such as at Saturday Creek, where destruction of the archaeology is occurring at a rapid pace and time is of the essence, drones offer a fast and effective solution, providing detailed maps of a site in a fraction of the time it takes to map with a TDS.

The Urban Core of Saturday Creek

The urban core of Saturday Creek remains in bush and was mapped with a TDS over the course of two BREA field seasons in January and summer 2014 (Figure 5.4). The site contains the largest urban core in the middle Belize River Valley with a sizeable surrounding peri-urban and rural settlement area (see Plate 5.2). Prior to the BREA project, the Valley of Peace Archaeology project, under the direction of Lisa Lucero, produced a rectified

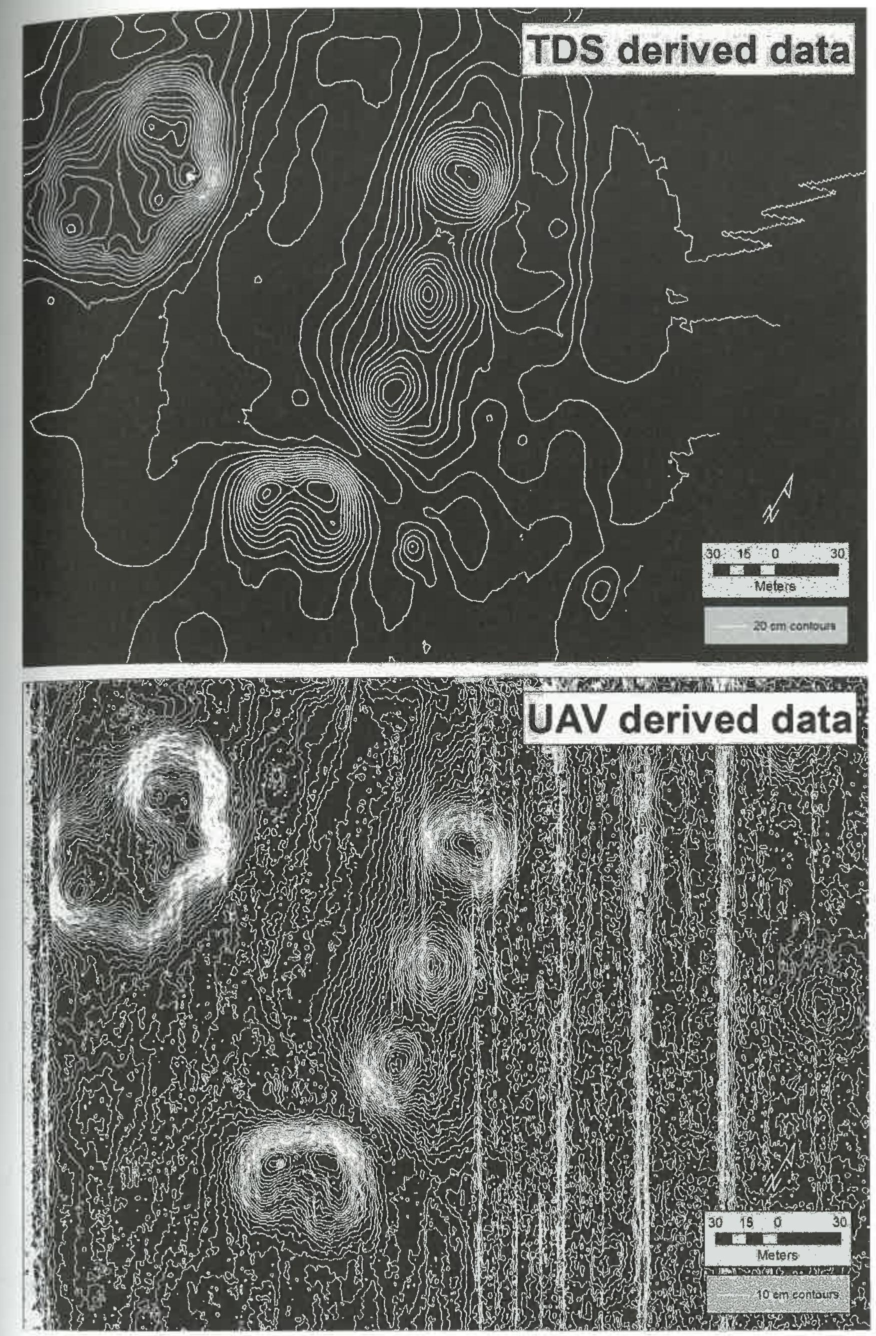

Figure 5.3. Topographic map of Hats Kaab E-Group showing differences between TDS (*above*) and UAV-derived data (*below*; maps produced by S. Murata and M. Willis).

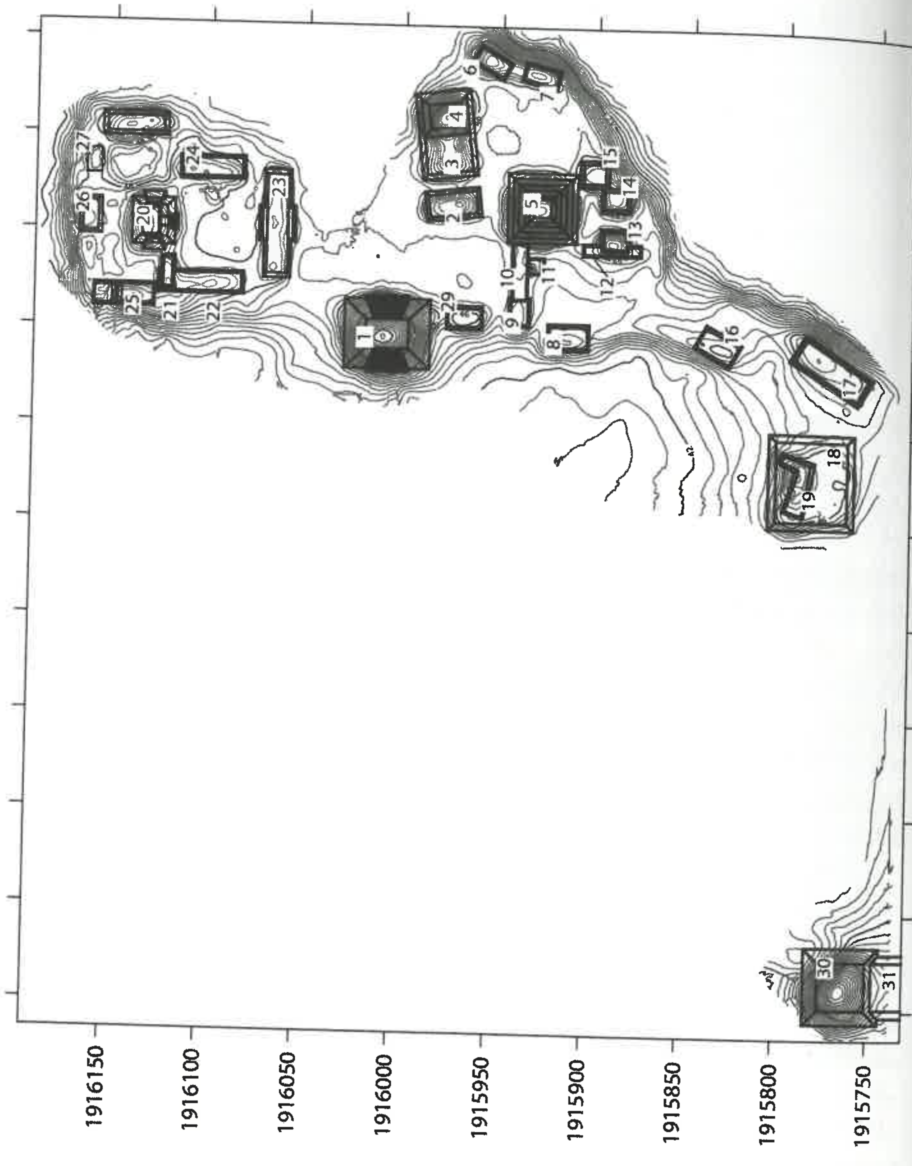

Figure 5.4. Topographic map of Saturday Creek site core (map prepared by S. Murata and B. Houk).

map of the Saturday Creek site core using an optical transit and stadia rod (Lucero 1999b:10; see also Lucero et al. 2004). Of the 100 mounds they recorded at Saturday Creek along the northern side of the river, Lucero noted that her survey team was only able to map 75 of them. The BREA survey team spent seven weeks total in 2014 surveying and remapping the site core of Saturday Creek using a Nikon TDS and Trimble GeoXH GPS unit (see Figure 5.4; Murata et al. 2015). This work has allowed us to record detailed topographic information for the site core (see Figure 5.4) and has allowed us to more accurately tie in the site to our existing GIS map of the BREA study area (see the site core superimposed on Plate 5.2). Saturday Creek has a sizeable urban core with a main elite residence to the north, three large pyramids, and a smaller pyramid with a ball court attached in the central plaza. In surveying the southern section of the site, which the Valley of Peace Archaeology project had not previously mapped, we identified another plaza group and several large structures, two of which appear to represent a second ball court at the site.

The Peri-Urban Landscape

Some of the urban core of Saturday Creek clearly extends beyond the bush to the north and was mapped with the drone. Some of these sizeable mounds have been the victims of repeated plowing and stone removal over the years. This urban core area is designated by a dashed oval line in Plate 5.2. Moving out in all directions from this urban core is a peri-urban zone where the ancient structures transition to more widely dispersed rural settlement. The density of settlement appears to pick back up in the area surrounding the Hats Kaab E-Group, which is about 2 km north of Saturday Creek. It is unusual to only have an E-Group with no other pyramidal or elite residential architecture nearby. It is possible that the E-Group is associated with Chikin Chi'Ha, another nearby secondary urban center located about 1 km west of Hats Kaab (Plate 5.1; Murata et al. 2018). The distance and the fact that there is a sizeable lagoon separating the two sites gives this architectural complex a sense of isolation and suggests that Hats Kaab is perhaps its own discrete peri-urban center, distinct from both Chikin Chi'Ha and Saturday Creek.

The Vacant Terrain: Defining the Heterotopia

In mapping the outskirts of the peri-urban landscape—the heterotopia—we can begin to examine how the "vacant" spaces in these fringe areas may have been variously used in the past and how they potentially related with the urban core area of Saturday Creek and other neighboring secondary centers like Hats Kaab and Chikin Chi'Ha. Among the usages of the vacant terrain examined below are an overland route that cut through this area, according to Spanish colonial accounts. Based on their descriptions, the middle Belize River Valley was an area rich in cacao, which grew right on the banks of the Belize River, likely in the floodplains. Below we present our investigations of the overland route as well as the potential for cacao cultivation and other vacant terrain activities, including the cultivation of modified wetland fields that have been detected in the hinterlands about 5 km north of Hats Kaab (Plate 5.1).

An Overland Corridor

Sixteenth- and seventeenth-century Spanish accounts describe a north–south route in northern Belize, which apparently extended from Chetumal Bay south to the headwaters of the New River, known as Ram Goat Creek. Here at the headwaters, the Spanish reported docking their canoes and walking south over *pinal*—a stretch of pine savannah that runs south to Labouring Creek (Jones 1989:Map 2). This trek from Ram Goat Creek to Labouring Creek is roughly a 13 km walk. The Spanish description of this north–south overland route, namely, the strip of pine ridge forest, closely aligns to what we have observed along the route outlined in Plate 5.1.

The Spanish describe crossing over Labouring Creek on a submerged "natural bridge" of travertine (Jones 1989:138, 312 [Note 35]; see also Scholes and Thompson 1977:45). Our reconnaissance team conducted a number of pedestrian surveys along Labouring Creek and identified a series of archaeological sites in the vicinity of several partially submerged natural bridges of travertine, one of which could feasibly be the crossing point referenced by the Spanish (Buck et al. 2013). From here it is another 10 km through a mix of riparian zone and wetland swamp to Saturday Creek. The Spanish reported walking through wetland swamp where they arrived at an entry point on the Belize River that was named "literally, 'the hamlet where Chantome had been'" (Jones 1989:287–288). Elsewhere, it has been suggested that Chantome may be the ancient Maya site of Saturday Creek, which was perhaps largely abandoned when the Spanish came through the area during the sixteenth and seventeenth centuries (Harrison-Buck 2010; Harrison-Buck et al. 2013). Notably, in the Southwest Plaza at Saturday Creek two cache deposits were identified that contained a mix of Maya and Spanish colonial artifacts, suggestive of periodic visitation during the

contact period (Harrison-Buck et al. 2015; Harrison-Buck, Brouwer Burg, et al. 2016; Kaeding and Harrison-Buck 2015). The archaeological evidence lends further support to this site's identification as Chantome.

Elsewhere we have presented the results of a least-cost path analysis conducted along several proposed overland routes (Brouwer Burg et al. 2014, 2015). BREA carried out several field seasons of reconnaissance along these projected overland routes between Saturday Creek and Labouring Creek to the north, identifying numerous sites along the way (Plate 5.1; see Buck et al. 2013; Gantos 2015; Gantos and Buck 2018; Harrison-Buck et al. 2012; Harrison-Buck et al. 2013; Harrison-Buck et al. 2015; Harrison-Buck, Brouwer Burg et al. 2016). Our survey, coupled with geospatial mapping, has helped us to refine one possible overland route based on the dispersal of the mounds identified in this area (shown in Plate 5.1).

Our reconnaissance teams regularly conducted surface collection at many of the sites along this route, and all of them revealed dense scatters of Terminal Classic ceramics, shedding light on the length of time this route may have been used. Saturday Creek and Chikin Chi'Ha both show evidence of Terminal Classic occupation. Saturday Creek, Hats Kaab, and Chum'umuk Ha are, thus far, the only sites where we have firmly identified earlier (Preclassic) material.

Wetland Fields

Extensive clearing in recent years in Area 2 north of Hats Kaab has revealed a series of settlement clusters that all seem to trend north-northeast (Plate 5.1). The settlement is situated on the slightly elevated ground between large swaths of vacant terrain consisting primarily of wetland swamps. Some of the settlement parallels a large expanse of wetlands that runs along the southern side of the Labouring Creek drainage. We refer to this system of wetlands collectively as Jaegar Wetlands (see Plate 5.1; Gantos 2015; Gantos and Buck 2018). All of these wetlands show evidence of modification in the form of ditched and drained fields (Harrison-Buck 2014; for some comparisons elsewhere, see Beach et al. 2015; Guderjan and Krause 2011; Luzzadder-Beach et al. 2012; Siemens 1983). The fields in Jaegar Wetlands have been identified using publicly available Google Earth imagery.

One clearly defined expanse of wetlands filled with ditched and drained fields in Jaegar Wetlands measures 2.87 km^2. This is equivalent to over 700 acres of wetland fields that were potentially cultivated by the ancient Maya. Although the modern sugar plantation has obscured large portions of this modified wetland system in Area 2, it is clear the wetland fields were more extensive in the past, possibly exceeding twice their preserved size. Ethnographic data varies, but most studies estimate that for every person, an average of 1–2 acres of cultivated land is required to feed them annually, although some have pushed this slightly higher to account for fallow cycles (Dumond 1961). Assuming an average of 1–2 acres/person, 700 acres could feasibly support between 350 and 700 people. However, if we are correct that the wetland system was actually double the size, it could easily have supported at least twice this population. Using the 4.89 persons/household index, this means the wetland fields could have supported somewhere between 143 and 286 households.

Thus far, we have recorded over 60 mounds in the settlement clusters found in Area 2—if Chikin Chi'Ha is included in this count, the number of structures rises to roughly 120, still well under the number of households the wetland fields could have supported. Based on the presence of such an expansive field system, we suspect that a large urban center exists somewhere in the vicinity of Jaegar Wetlands (see Plate 5.1). The BREA team has made several attempts to access the areas circumscribing the wetlands to the northeast, but due to the remote location and the seasonal inundation of the wetlands, it has proved to be incredibly challenging to access on foot or via canoe outside of the dry season when there is less flooding (Gantos 2015; Gantos and Buck 2018). According to an environmental survey published in 2000 by the Programme for Belize, there is reportedly a sizeable archaeological site in the tract of high ground to the northeast of Area 2 that is in bush just south of Jaegar Wetlands and north of White Water Lagoon in an area known as Logwood Caye (Programme for Belize 2000; see Plate 5.1). There the Programme for Belize reported a series of mounds, including a sizeable pyramidal structure measuring roughly 13 m in height (Programme for Belize 2000:10). We plan to continue our efforts at reaching this area for reconnaissance in future seasons.

As noted above, several other swaths of wetland fields have been observed in Google Earth imagery between other clusters of settlement. These strings of settlement, trending north-northeast, suggest to us that these hamlets may have been laid out explicitly to align with these tracts of wetland fields (and may also be oriented to an overland route that cut through this peri-urban settlement). It is possible these discrete clusters of settlement were independent communities. However, given the labor necessary to manage such a vast wetland system and the settlement distribution, all trending north-northeast in the direction of the Logwood Caye area, it is possible these settlements represent peri-urban sprawl associated with the larger center that purportedly exists in this area. If so, we would expect the site report by the Programme for Belize to have a substantial Terminal Classic occupation based on the surface finds from the north-northeast trending settlement. We also would suspect that the ditched and drained fields of Jaegar Wetlands date to this time period as well, although further archaeological investigation is needed to confirm this hypothesis.

Orchard Agriculture

In the middle Belize River Valley the Spanish recorded a series of contact period Maya settlements with sizeable cacao orchards planted right on the riverbank, which came under the control of the Spanish *encomienda* system during the early colonial period in the sixteenth and seventeenth centuries (Jones 1989). Based on the Spanish accounts, ethnohistorians Grant Jones (1989: Map 2) and Ralph Roys (1957) have suggested that at least six Spanish–Maya contact period sites (Chunukum, Lucu, Boxelac, Chantome, Zaczuz, and Petenzub) all cluster in the midsection of the Belize River Valley (Figure 5.1). As noted above, it is hypothesized that Saturday Creek may be the site formerly known as Chantome that the Spanish describe (Harrison-Buck 2010, 2017). The nearby town of Lucu was the said to be the most sizeable, and we speculate that it may be the dense settlement we refer to as Xaman (see Figure 5.1). Lucu was "rated an important settlement" by the Spanish (Jones 1989:287; see also Scholes and Thompson 1977:45, 47); Roys (1957:163) described it as a "prosperous place with many cacao groves . . ." planted along the riverbank.

Elsewhere we have reconstructed where and how much cacao could have potentially grown in the vicinity of Saturday Creek where Lucu and Chantome were likely located (Harrison-Buck 2017:112–113). Soil studies in the upper Belize River Valley by Daniel Muhs and colleagues (1985) suggest that the well-drained, loose, sandy soils of the floodplains are the most ideal soils for growing cacao. They examined the soils around the contact period settlement of Tipu in the upper Belize River Valley, where the Spanish also reported dense cacao orchards in the early colonial period. In our ground-truthing and inspection of satellite imagery around Saturday Creek, we have identified several large expanses of floodplains. Notably, these floodplains (one referred to as Otley's Flat and another huge expanse across the river known as Mount Pleasant) are virtually devoid of mounds. The configuration of the floodplain and surrounding dispersed settlement resembles Tipu as well as other sites like Barton Ramie, upstream on the Belize River, which Gordon Willey described as *the* typical settlement configuration for the Belize River Valley.

Cacao is a shade-loving understory tree. Today and in the past, cacao plantations function as complex agroecosystems, rich in biological diversity supporting a range of rainforest animals; in a floodplain, the shade trees act as a necessary riparian zone protecting the soils from erosion during flooding events. Laura Caso Barrera and Mario Aliphat Fernández (2006b:291) observe that areas with the highest production levels of cacao "are circumscribed to the fertile alluvial soils of the river systems." Unlike other cultivated plants, cacao trees thrive in such flood prone conditions. A high water demand plant, cacao grows best on the well-drained, alluvial soils with plenty of organic matter found in low floodplains, where there is a consistent hot and humid environment (Gómez-Pompa et al. 1990:249). These are the specific environmental conditions we find at Otley's Flat, Mount Pleasant, and other places along the middle Belize River Valley (Frey and Knorr 2013; Muhs et al. 1985).

Early Spanish colonial records report that the Maya typically planted cacao in orchards spaced about 12 to 15 feet apart; placing cacao trees too close together can inhibit production of fruit (Fowler 2006:314; Oviedo 1851–1855, 1:317). We estimate more than 1,200 cacao trees could potentially have been cultivated in Otley's Flat alone, spacing them conservatively 15 feet apart (Figure 5.5). The larger expanse of floodplain across the river at Mount Pleasant may possibly have supported twice this amount. We suspect that cacao was grown all along the banks of the Belize River on the floodplain terraces within a riparian forest that was intensively managed.

Discussion

Like the settlement occupation, we cannot assume that the activities, like cacao cultivation, taking place in the fringes of the peri-urban landscape remained constant through time. However, we do know that cacao was a staple in ritual feasts from Preclassic to Postclassic times and that the places where this tree crop can be productively grown are limited. Given that environmental conditions in the middle Belize River Valley are ideal for such tree cultivation, it seems likely that the Maya would have planted cacao here during prehispanic times, long before the Spanish arrived. In the case of wetland agriculture, we suspect this too was an activity dating to prehispanic times based on the evidence of Terminal Classic debris on

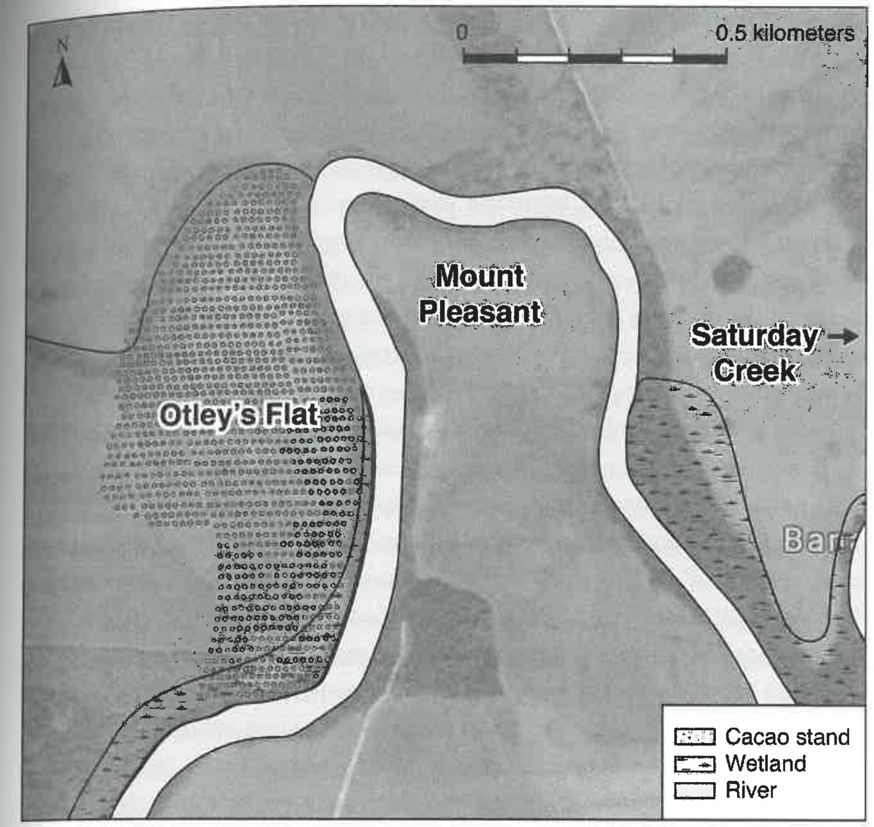

Figure 5.5. Closeup of Otley's Flat floodplain showing proposed locations of cacao orchards in the vacant terrain of the Saturday Creek hinterlands.

the surface of settlements that are in direct association with wetland fields. However, unlike cacao cultivation, wetland agriculture may not have continued into the contact period based on the Spanish descriptions of the wetland swamps that they trekked through in this area, which are described as rather inhospitable environments rather than well-managed landscapes.

It remains uncertain whether the overland corridor recorded by the Spanish was used in earlier times. However, the sandy pine ridge savanna environment offers a naturally high, dry, open north–south linear path that runs uninterrupted for over 70 km. From a practical standpoint, it seems likely that at least this portion of the route was used through time as an overland corridor. Still today, this terrain, although not formally paved, offers a route that is mostly drivable and still well-trod with a lot of overland foot traffic. Notably, the southern tip of the pine ridge corridor ends less than a kilometer from the largest expanse of the Jaegar Wetland fields (Plate 5.1).

The management of transportation corridors, cacao cultivation, and wetland agriculture are activities that all took place in the vacant terrain or heterotopia of ancient Maya monumental landscapes. These "fringe" activities are associated with the peri-urban and rural settlements but also may have been directly tied to neighboring urban centers—enabling the movement of people and goods and providing the foods necessary to support these dense populations. Advances in geospatial technologies are transforming our understanding of the relationship between urban centers and their neighboring peri-urban and rural settlement. Equipped with high-resolution lidar imagery, some scholars suggest the rural settlements in densely populated areas should be viewed as part of a "conurban" landscape where "landesque investments" like wetland agriculture are part of an "integrated totality across a continuous expanse" politically coordinated and "energized" by the urban core (Garrison et al. 2019:135). From a conurban perspective, peri-urban and rural landscapes are not separate from the urban core but actively integrated into "mainstream" cosmopolitanism.

From a heterotopian perspective, the activities in the peri-urban and rural areas may operate in relation to a specific urban center but may also resist the values or agenda of the ordered cosmopolitan space. For instance, the hinterland settlement running along the wetlands could have been working to create an agricultural surplus for one of the urban centers nearby but could also represent factional groups that broke off from a larger center (either voluntarily or forcibly) in Terminal Classic times and independently developed the modified wetlands during a period of increased stress and social upheaval. The heterotopian perspective considers the peri-urban fringes as aberrant places that are different from the urban monumental core and therefore less predictable. For instance, the isolated E-Group of Hats Kaab presents an aberrant monumental feature that does not align with the standard Preclassic layout of urbanized space and could be described (in Foucault's [2005 (1970):xxii] words) as "more confused, more obscure, and probably less easy to analyse."

Concluding Thoughts

Compared to the large core Maya centers of the northern Petén, Saturday Creek is a secondary ceremonial center, similar in size and configuration to Barton Ramie, where Willey performed his groundbreaking settlement pattern study nearly 70 years ago. Yet, while the urban core is smaller than the large urban centers of the northern Petén, when the peri-urban and rural settlements are considered, the density of settlement around Saturday Creek is substantial. The average settlement density in and around Saturday Creek is estimated at 49 structures/km^2. This is 40% more than the average settlement density (29 structures/km^2) found in the northern Petén area, which is considered to be the urban heartland of the Maya Lowlands (see Canuto et al. 2018). The photogrammetric survey around Saturday Creek using drones has revealed hundreds of preserved earthen mounds and other archaeological features that in many cases are almost imperceptible when standing on the ground surface. In optimal conditions like this, where we had broad aerial coverage in open areas with minimal vegetation, drones have the ability to fly low over the ground and to collect extremely high-resolution imagery, which can be used to produce aerial mapping and 3D landscape modeling with centimeter accuracy, equivalent if not exceeding the resolution of more expensive techniques like lidar.

The drone results from Saturday Creek—a site that has endured repeated plowing for as much as 25 years—demonstrate that these damaged archaeological landscapes are worth salvaging and can yield fruitful data that greatly enhances our understanding of the urban core and its relationship to the settlement and activities taking place on the outskirts of the peri-urban landscape. The results of the drone data presented here combined with the ethnohistoric accounts and archaeological findings suggest that the area around Saturday Creek marked an important node in the landscape. The heterotopia or vacant terrain was not ordered like the urban core but may have been what encouraged the population aggregation in this area, providing an important transportation corridor, vast tracts of wetland fields, and broad floodplains with rich alluvial soils well suited for cacao cultivation. This study highlights the importance of heterotopian spaces in the monumental landscape and the vital role they play in maintaining long-term, dense populations in the urban core and peri-urban centers of the Maya Lowlands.

As the geospatial data improves and our view of monumental landscapes becomes more detailed and nuanced, diverse parts of the monumental landscape appear seemingly more interconnected. A heterotopian approach considers these parts as complementary but also simultaneously separate and discrete parts of a whole, even potentially in opposition, challenging a neat and ordered model for understanding the complex and varied relationships that likely existed between rural and urban communities.

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6

Caracol's Impact on the Landscape of the Classic Period Maya

Urbanism and Complex Interaction in a Tropical Environment

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The ancient Maya operated within a variety of interrelated landscapes. The physical locations that they occupied were often completely transformed—water was captured and channeled; soils were excavated, manipulated, and transported; and the enveloping natural canopies were removed and replaced with useful plants, trees, and crops. Modifications to the physical landscape also resulted in changes to ground temperature and in some cases may have affected climate. Like the physical landscape, ancient Maya sociopolitical landscapes were also dynamic, with differential impacts on economic linkages and physical well-being in different parts of the Maya area at any one point in time. Late Classic period (ca. 550–800 CE) ancient Maya sociopolitical landscapes were engaged in what may be termed "global" relationships; this interplay left Caracol, Belize, in a position to incorporate, at least for a period of time, several distinct polities and their diverse environments into its broader political and ritual sway.

Adaptations by the ancient Maya were complex but to a large extent were conditioned by and responsive to local environmental and topographic factors. While not all adaptations were necessarily sustainable, one in particular—low-density urbanism—appears to have allowed the Maya greater resilience and, at least in some circumstances, the challenge and opportunity to develop their settlements at scale. The largest low-density settlements of the Classic period Maya were often located away from readily accessible water sources and in landscapes that today are considered largely inaccessible; the locations of these sprawling metropolises raise the question