

Research Article

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Settlement Patterns and Urbanization in the Yauhtepec Valley of Central Mexico

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Abstract: We carried out a full-coverage survey of the Yauhtepec Valley in the 1990s to reconstruct demography and settlements and their changes through time. We investigated the extent to which well-documented developments in the adjacent Basin of Mexico were paralleled in Yauhtepec, as well as the impact of regional empires and economies on local society. Our analyses focused on Teotihuacan relations in the Classic period and relations with the Aztec empire and the Mesoamerican world system in the Middle and Late Postclassic periods. In addition to locating, mapping, and describing sites and taking grab-bag artifact collections, we also made a series of systematic intensive surface collections (5 × 5 m) and test excavations at samples of Classic and Postclassic sites. In this paper, we describe the survey and changing settlement patterns in the Yauhtepec Valley. We also present several analyses of changing patterns of urbanization through the Prehispanic era. We conclude with a synthesis of changing social and cultural dynamics in this region.

Keywords: survey, settlement pattern, Yauhtepec, urbanization, empires

1 Background

The Yauhtepec Valley is located in the central part of the state of Morelos in Central Mexico (Figure 1). Our full-coverage regional survey of the Yauhtepec Valley covered over 150 km² encompassing all the alluvial and foothill areas of the valley. We located 415 sites ranging in size from less than 0.1 to 130 ha, from the Early Formative through Colonial Periods (1500 BC–1520 CE). Many of these sites were occupied for multiple chronological phases. Several general trends observed throughout Mesoamerica are present, such as the appearance of large monumental centers during the Middle Formative, a rapid increase and decline of population in the Classic period, and a general Postclassic population increase interrupted by the Spanish conquest (A.D. 1521).

In this paper, we present the basic descriptive results of the survey with respect to changing patterns of settlement and demography through time. Our results provide important new data on cities and urbanism through time, and we report three related urban analyses: urbanization (the percent of the population living

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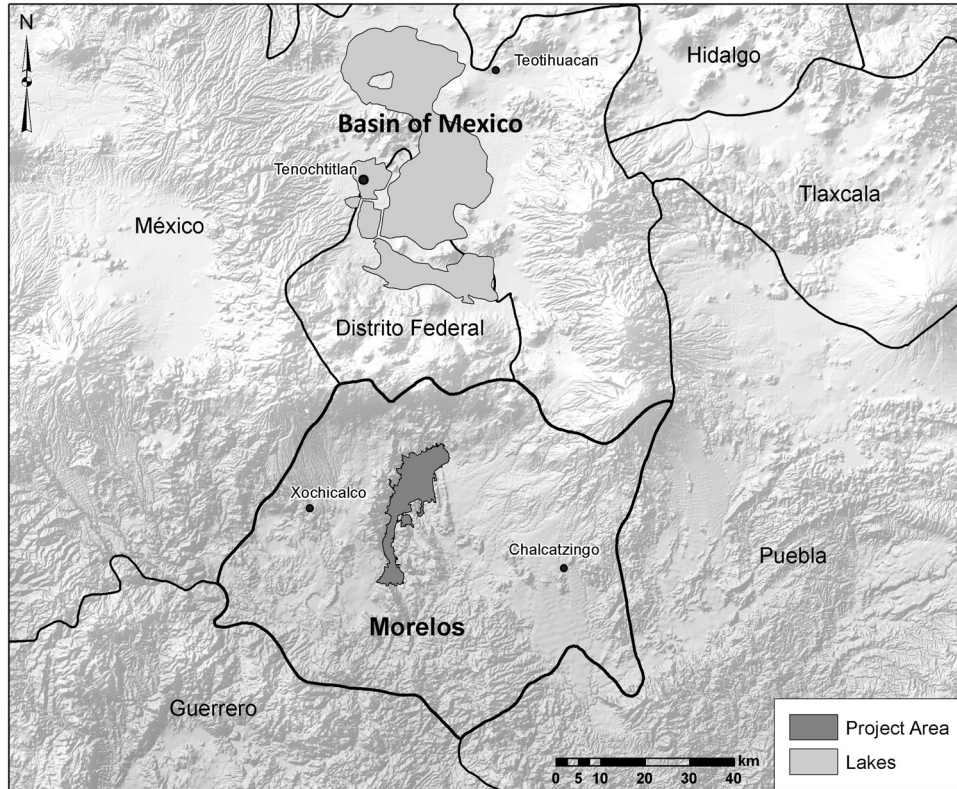


Figure 1: Location of the Yautepec Valley within Central Mexico.

in urban centers), settlement continuity (the level of continuity of settlement occupation across time periods), and off-site artifact distributions (these deal with changing land-use patterns around large settlements). Our fieldwork was part of a larger archaeological project, sponsored by the University at Albany (SUNY), centered at the Aztec-period city of Yautepec (in the modern town of Yautepec). Smith directed 6 months of excavations of residential features in Yautepec in 1993; the results are published in Smith (2019). The survey was initiated to both provide a regional context for the work at Yautepec and document settlement patterns throughout the entire pre-Spanish epoch. The survey was designed by Smith, Hare, and Montiel, and fieldwork and analyses (in 1994 and 1996) were directed by Hare and Montiel. The basic results are presented in a report to the Mexican government (Smith, 2006) and in the dissertations of Hare (2001) and Montiel (2010). We augmented traditional central Mexican methods of landscape survey (field walking, mapping, and artifact collecting) with limited test excavations and more intensive systematic surface collections.

The specific objectives of the survey were the following:

- (1) To conduct a full-coverage archaeological survey of the Yautepec Valley. This included making maps and systematic surface collections that permit quantitative analysis of the artifacts.
- (2) To conduct limited test excavations to establish the ceramic chronology of the Valley, particularly for the Classic and Postclassic periods.
- (3) To conduct quantitative spatial analysis of the collected data through statistical analysis and a geographical information system (GIS).
- (4) To reconstruct the demographic and political evolution of societies in the Yautepec Valley from the Formative through Colonial periods.

In this paper, we address the survey results that pertain to the first and fourth objectives.

1.1 Settlement Patterns, Urbanism, and Empires in Central Mexico

As in many regions, the archaeology of Central Mexico has historically focused on the core regions of state formation, in this case the Basin of Mexico, where modern Mexico City is located today. This has resulted in archaeological interpretations that are heavily weighted toward such core regions for many different processes of interest. Comparisons between processes in core regions and their surrounding regions can illuminate which patterns are local particularities, and which are truly representative of broader processes. We see this as one of the contributions of the Yautepec Valley of Morelos toward understanding processes of change in early central Mexico.

Central Mexican prehistory can be characterized as having a long initial period of increasing social complexity, followed by three cycles of major state formation based at the cities of Teotihuacan (100–500 CE), Tula (850–1150 CE), and the Aztec city-states in the Basin of Mexico (1300–1521 CE). These periods alternated with intervening periods of political fragmentation. From a broad comparative perspective, Mesoamerican empires were generally of the indirect-control type, sometimes called “hegemonic” empires (Smith & Montiel, 2001). Morelos is located outside of the core areas of all three major states. The eastern part of the state, including the Yautepec Valley, was conquered and administered by the empire of Teotihuacan. The smaller polity based at Tula did not reach Morelos; and during the Aztec period this region became an active interacting zone within a large area of city-states (1150–1450), conquered by the Triple Alliance empire of Tenochtitlan (1450–1521).

Over the course of the Prehispanic past, the regional population of central Mexico consistently increased over time, with possible minor plateaus or dips during periods of political fragmentation (Sanders, Parsons, & Santley, 1979, Figure 6.1), although some of these apparent dips in core population may have been counterbalanced by increases in population in more peripheral portions of the region (Sugiura Yamamoto, 2005). Economic networks for both bulk and luxury goods become increasingly integrated over time (Golitzko & Feinman, 2015; Huster, 2018, 2019). During periods of state control, finished goods in core region styles are found widely within and beyond imperial-controlled areas. In contrast, during periods of political fragmentation, trade is more multidirectional.

The Basin of Mexico is one of the largest contiguous survey areas in Mesoamerica. The Basin of Mexico Archaeological Survey Project, whose fieldwork spanned several decades, reconstructed the demographic and settlement history of the region, along with inferences about changing economic and political dynamics before the Spanish conquest. This research is summarized in Sanders *et al.* (1979), which remains a fundamental reference for the dynamics of settlement in ancient Central Mexico. One of the goals of our survey was to apply parallel methods to an area that was distinct from the Basin of Mexico, yet engaged in significant economic and political interactions throughout the pre-Spanish epoch.

Although research in the Basin of Mexico is almost always framed around the rise and fall of three regional states – Teotihuacan, Tula, and Aztec Tenochtitlan (Sanders & Santley, 1983) – our data from the Yautepec Valley reveal the clear imprint of only two of these (Teotihuacan and the Aztecs). In fact, these two periods had distinct political and economic configurations that influenced the development of local societies in the Yautepec Valley. Conquest of the Valley by the Teotihuacan empire had clear effects on local demography and settlement patterns. In comparison, the Aztec period witnessed a more complex political landscape across Central Mexico. City-states arose throughout central Mexico as part of a demographic surge in the twelfth century CE. Polities in most parts of the region shared key social and political traits, arising from both their common cultural origins and processes of intensive long-distance interactions (Smith, 2008, 2012). Smith has argued that these interactions had a more profound effect on local societies than did the relatively late imperial expansion of the empire based at Tenochtitlan (Berdan, Kepecs, & Smith, 2003; Smith, 2003). Our approach to urbanism differs from that used by most research in the Basin of Mexico, where this topic is dominated by discussion of the three large cities (Teotihuacan, Tula, and Tenochtitlan). We view urbanism as a regional demographic process, and our analyses track key quantitative aspects of urbanization in our survey zone through time.

1.2 The Yautepec Valley

The Yautepec Valley is located in the central part of the state of Morelos, Mexico (Figure 1). Morelos is located immediately south of the Basin of Mexico and separated from it by the Sierra de Ajusco, a recent volcanic mountain range. Elevation throughout the state drops from north to south from around 1,500 m above sea level in the north to approximately 800 m in the south. The Yautepec Valley is defined by the Yautepec River and the two north–south mountain ranges that delimit the valley on the east and west sides. The climate is subtropical. Rainfall averages between 800 and 1,100 mm per year, and the mean temperature falls between 20 and 24°C. The mean temperature increases from north to south.

In comparison with the Basin of Mexico, the Yautepec Valley offered a number of advantages for ancient agrarian population, including higher rainfall and warmer temperatures, as well as a large expanse of rich alluvial soil along the Yautepec River. Over 50 years ago, William Sanders described the central Mexican highlands – the Basin of Mexico and surrounding areas like Morelos – as the “central Mexican symbiotic region” (Sanders, 1956). He pointed to environmental differences among regions that stimulated local specialization and exchange between areas. For the population of the Basin of Mexico, the Yautepec Valley offered rich agricultural soils and the ability to grow cotton, a crucial crop that was used as currency in ancient Mesoamerica (Berdan, 1987). We suspect that, for the polities of the Basin of Mexico, securing access to cotton was an important impetus for both imperial conquest of, and exchange relations with, the Yautepec area.

1.3 Chronology

The sequence of chronological periods for the Yautepec Valley are equal to or better than the temporal resolutions used by other Central Mexican survey projects. Our chronological periods for the survey are shown in Table 1. These are ceramic phases, in that they are identified on the basis of ceramic types and forms. We began with the basic sequence of chronological periods established for the Basin of Mexico archaeological surveys (Sanders et al., 1979). We then examined collections of ceramics from these periods from Morelos, whether directly from archaeological projects or indirectly through publications. From this analysis, we identified the likely diagnostic types and attributes for the ceramic complex of each period. To assign dates for the periods, we used a combination of local excavations and the Basin of Mexico

Table 1: Chronological periods in the Yautepec Valley

Dates ^a	Yautepec Valley	Code	Period
1650–1820 AD	Late Colonial	Col-T	Late Colonial
1520–1650 AD	Santiago	S	Early Colonial
1440–1520 AD	Molotla	M	Late Postclassic, B
1300–1440 AD	Atlan	A	Late Postclassic, A
1150–1300 AD	Pochtla	P	Middle Postclassic
850–1150 AD	Epecapa	E	Early Postclassic
600–850 AD	Tenayo	T	Epiclassic
450–600 AD	Late Classic	LC	Late Classic
300–450 AD	Middle Classic	MC	Middle Classic
200–300 AD	Early Classic	EC	Early Classic
100 BC–200 AD	Terminal Formative	TF	Terminal Formative
500–100 BC	Late Formative	LF	Late Formative
1100–500 BC	Middle Formative	MF	Middle Formative
1500–1100 BC	Early Formative	EF	Early Formative

^aDates are based on calibrated radiocarbon dates.

chronological sequence. Finally, we reviewed recent chronological refinements in Morelos and the Basin of Mexico in 2020, and revised the dates of the periods as needed.

The details of all but the final stage are provided in our report to the Mexican government (Smith, 2006); here we summarize the major sources used in constructing our chronology. For the Formative period, we relied heavily on the ceramic chapter of David Grove's monograph on Chalcatzingo (Cyphers, 1987), other sites excavated by Grove (1974), the Gualupita site in Cuernavaca (Vaillant & Vaillant, 1934), as well as the surface sites from Hirth's (1980) survey near Chalcatzingo. More recent chronological work on the Formative in other parts of Central Mexico (Lesure, Carballo, Carballo, Borejsza, & Rodríguez López, 2014; Stoner & Nichols, 2019) has confirmed this general sequence, while demonstrating increased inter-regional variability in the dates of use for major marker types. For the Classic period, the lack of excavations in Morelos forced us to rely on Hirth's survey, as well as direct comparisons with the ceramics of Teotihuacan itself, which were confirmed with test excavations (Stage 3 below). George Cowgill helped Montiel identify relevant types and attributes in the Yautepec collections and provided dates in the Teotihuacan sequence. For the Epiclassic period we used published and unpublished studies of Xochicalco ceramics (Hirth & Cyphers, 1988).

The Epiclassic–Middle Postclassic period dates received minor changes in 2020. These changes are generally the result of earlier dates for the Epiclassic and Early Postclassic periods in the Basin of Mexico and Tula sequences (Anderson, Healan, & Cobean, 2015; Clayton, 2016; Nichols, 2016). The ceramics of the Early Postclassic period were the most difficult to characterize and date, because of both the lack of excavations in Morelos and uncertainties of the chronology of this period in the Basin of Mexico (Parsons, Brumfiel, & Hodge, 1996). For the three Aztec periods (Middle Postclassic, Late Postclassic-A, and Late Postclassic-B), we began with the ceramic chronology for excavated deposits at Yautepec (Hare & Smith, 1996), and adapted the periods for surface collections as the survey proceeded.

Lack of unmixed and stratified excavations in colonial period contexts, combined with the burial and disturbance of pertinent settlements by modern towns, hinders the precise dating of the early Colonial period. The identification of early colonial sites is based on our observations of shifts in type frequencies at the interface from the Late Postclassic and the appearance of distinctly colonial ceramic markers like glazed earthenware and majolica. Thus we can provide a map that shows many of the Colonial sites, but we are unable to include this period in our demographic calculations.

2 Methods

We used field methods based on previous surveys in highland Mesoamerica (e.g., Hirth, 1980; Parsons, Brumfiel, Parsons, & Wilson, 1982; Sanders *et al.*, 1979); see discussion below. Our methods differ from these projects in our more intensive methods of surface collections (see discussion of Stage 2 below). Lisa Montiel, Michael E. Smith, and Timothy S. Hare directed the project in 1994 and located over 300 occupation places, or sites, in an area of 109 km². Smith and Hare returned in 1996 to complete the survey of the Yautepec Valley. Together, the two surveys of the Yautepec Valley covered over 150 km² and located over 400 sites, including more than 900 period-specific site components. The dates of sites range from the Early Formative through the early Colonial periods.

The survey covered almost all modern fields and most of the modern towns in the valley. Sites were identified by the density of surface artifacts and/or visible features, including mounds, and we recorded site boundaries and principal features on 1:10,000 aerial photos. A variety of types of artifact collections were made from all sites. Grab-bag and 2 × 2 m intensive collections were made at all sites. 5 × 5 m intensive collections were made at a sample of sites to address specific research questions (Stage 2). Test excavations were conducted at a sample of Classic and Postclassic sites to aid in the refinement of the ceramic chronology and generate contextual data (Stage 3). All artifact collections included both ceramic (including figurines) and lithic artifacts.

2.1 Stage 1: Reconnaissance Survey

In stage 1, survey teams walked all fields in the area to locate sites, take preliminary surface collections, and define site boundaries. These methods are based on those applied by previous surveys in Mesoamerica (Fish & Kowalewski, 1990; Nichols, 1996; Sanders et al., 1979). Survey teams were composed of three to eight fieldworkers. Fieldworkers were spaced 10–20 m apart along a line depending on the shape of each field and surface conditions. Each team walked in a line across fields. Multiple passes were required for large fields. Within modern settlements, more ad hoc methods were applied and often involved acquiring permission to survey house lots, a practice that had been used in the earlier survey within the modern town of Yautepec (Smith et al., 1994).

One team member tracked the team's location on 1:10,000 scale air photos and recorded fields, site boundaries, and large features directly on the air photo. Another team member recorded environmental and archaeological data on forms. In addition to the written forms, a sketch map was drawn of site boundaries, artifact concentrations, architectural features, and modern features for all sites.

Settlements were identified by the observation of visible material remains including artifacts and features. Artifacts included lithic, groundstone, and ceramic remains. Features included mounds and exposed walls or floors. Sherds were the most common evidence for archaeological sites. Because of the ubiquity of sherds throughout most of the survey zone we set the minimum number necessary for identification of a location as part of a site at three sherds per square meter. This frequency is much lower than that used in the Basin of Mexico surveys (because of our expectations of lower population and urbanization in Yautepec) but it is higher than is applied in many areas. Site boundaries were identified by a drop-off in artifact density, a standard procedure in highland surveys (Drennan, Berrey, & Peterson, 2015). This method is analogous to one of the methods used to delineate contemporary cities using the quantitative drop-off of building density at the edges of settlements (Angel et al., 2016, p. 24; Oliveira, Furtado, Andrade, & Makse, 2018).

During stage 1, surface collections were made at all located sites. After sites were mapped, collection locations were described in reference to surface conditions, artifact frequencies, and site areas, and recorded on the site maps. In general, two collections were made at sites smaller than one hectare, and larger sites received more collections. Three types of artifact collections were made.

- (1) *Grab-bag collections* were made at all sites, following standard procedure in highland Mesoamerican surveys. Grab-bag collections are collections of all diagnostic and special artifacts within a roughly defined zone. The sizes of these zones were recorded roughly on sketch maps and depended on surface cover and artifact density. Grab-bag collections are of greatest utility in acquiring rare artifact types and for non-quantitative determination of chronological phase representation in an area. They cannot be used to create quantitative measures of artifact frequencies.
- (2) 2×2 m collections were made at most sites. In these collections, all artifacts within the square area were collected. Collection areas were standardized by the use of measured rope squares. Although resulting in quantitatively smaller collections, the 2×2 m provides a quantitative index of artifact density on the surface of every site. As fieldwork progressed, it became clear that these dimensions were inadequate to produce enough artifacts for quantification of artifact categories, hence
- (3) 5×5 m collections were primarily used during the second stage of the survey.

We used a classification of site types (Table 2) derived from that used in the Basin of Mexico Archaeological Survey Project (Blanton, 1972; Parsons, 1971; Parsons et al., 1982; Parsons, Kintigh, & Gregg, 1983; Sanders et al., 1979). Our classification differed from that system by not using the density of surface artifacts to classify sites. Because the density of artifacts on the surface of sites can be strongly influenced by post-depositional formation processes (Barker & Mattingly, 1999–2000; Kirkby & Kirkby, 1976; Schiffer, 1987), we chose not to use surface artifact density as a measure of population density within settlements. Sites were classified based on the size of the area covered by archaeological remains and the nature of the archaeological remains (such as mounds). This is a rough classification, and we do not want to read too much significance into the categories; the main purposes were to have some kind of site typology, and to be comparable with the Basin of Mexico survey

Table 2: Typology of sites

Type	Size (ha)	Archaeological remains
Isolated House (<i>Casa Aislada</i>)	<0.1	Residences
Hamlet (<i>Caserío</i>)	0.1 > 0.9	Residences
Small Village (<i>Aldea pequeño</i>)	1.0 > 2.9	Residences
Large Village (<i>Aldea grande</i>)	3.0 > 5.9	Residences and temple
Small Town (<i>Pueblo pequeño</i>)	6.0 > 19.9	More remains than villages
Large Town (<i>Pueblo grande</i>)	20>	More remains than villages
Isolated Ceremonial Center (<i>Centro ceremonial aislada</i>)	0-? ^a	Temple grouping
Ceremonial Center (<i>Centro Ceremonial</i>)	6>? ^a	Lots of public architecture
Provincial City (<i>Cabecera</i>)	Large	Temples, palaces, and public architecture
Estate (<i>Hacienda</i>)	? ^a	Residences and industry spaces

^a? indicates that site sizes are not known due to problems with preservation.

2.2 Stage 2: Intensive Artifact Collection

In stage 2, we returned to many sites to take intensive and quantifiable collections. Previous Mesoamerican surveys and regional studies used non-quantitative methods (Blanton, 1972; Kowalewski, Feinman, Finsten, Blanton, & Nicholas, 1989; Sanders et al., 1979). In these projects, quantitative artifact analyses are limited to the presence and absence of a limited set of diagnostic artifacts. Our project was the first regional survey in central Mexico to use fully quantifiable collections of ceramics, obsidian, and groundstone, enabling more artifact types and their frequencies to be used in studying spatial distributions. For the 5 × 5 m collections, we marked out a square of that size with measuring tapes, and picked up all artifacts larger than 1 cm². The sample of sites chosen for 5 × 5 m collections was selected as follows. First, we sampled only Classic and Postclassic sites; as the demographic peaks of occupation, these large periods were of primary interest to us. Second, we selected sites from all parts of the valley, and from all site size categories.

During the second field season in 1996, these methods were modified slightly. Because of constraints of time and vehicles, stages 1 and 2 were collapsed into a single stage. In addition, the ongoing laboratory analysis of the first survey season's ceramic sherds suggested that 5 × 5 m collections should be made more frequently and at more sites. Hence, in 1996, 5 × 5 m collections were made in almost all sites. The artifacts and settlements from the Classic period were analyzed by Lisa Montiel (Montiel, 2010), and those from the Postclassic period by Timothy Hare (Hare, 2001).

In addition to our site-based collections, we also made a series of standardized artifact collections along seven transects across the valley (see the section "Off-Site Artifact Distributions" below), to investigate off-site processes such as urban sprawl, and agricultural practices. We laid out seven transects across the valley, each with two characteristics: (1) the transect traversed more than one environmental zone; and (2) it passed through at least two major sites of the Classic and/or Postclassic eras. The idea was to have a contrast between on-site and off-site contexts. Along each transect, we collected sherds in 5 × 5 m² (the same units used in our Stage 2 intensive sampling), spaced every 100 m.

2.3 Stage 3: Test Excavations

Stage 3 consisted of the excavation of test-pits at key sites. Test excavations were made in seven sites from the Classic period and four sites from the Postclassic period to recover samples of artifacts to help refine the ceramic chronology for the Valley. No excavations were conducted at Formative sites. In general, excavations were 2 × 2 m units excavated by strata and by 10 cm arbitrary levels within strata. Artifacts were recovered using a 1/4-inch mesh screen, features were mapped, carbon samples collected, and soil samples taken. The excavations are described in Montiel (2010) and Hare (2001).

3 The Environmental Setting

The Yautepec Valley is bordered by north–south mountain ranges of limestone from the Cretaceous period. There are a number of flows of basalt from more recent volcanic activity (Pleistocene), primarily in the northern portion of the valley. In some parts of the valley, the limestone mountains have alluvial fans also dating to the Pleistocene era. The floor of the valley consists of alluvial soils. The basic structure of the valley’s landforms is illustrated in Figure 2. The image at the top is a general cross-section for the central and southern portions of the valley. It shows the limestone mountains (L), an alluvial fan on the western side of the valley (F), and the deep alluvial deposits (A) with three river terraces. The image at the bottom covers part of the north-western portion of the valley. In this area, there is a basalt flow (B) in place of the alluvial fan, and the alluvial deposit is much wider. This discussion of the geology of the valley is based on several sources (Fries, 1960; Vidal Zepeda, 1980), including fieldwork by geoarchaeologist Donahue (1994).

Based on the geology of the valley and environmental data from maps created by the Mexican government, we divided the survey area into five geological zones for the purpose of analysis; these are listed in Table 3 and their locations are shown in Figure 3.

Alluvium. This zone consists of deep alluvial soils located along the Yautepec River and its tributaries. This is the best agricultural land in the valley, and it has been heavily farmed from the Formative period until today. Historical documents tell us that much of this zone was irrigated at the time of Spanish conquest to grow maize and cotton (Maldonado Jiménez, 1984; Smith, 1994). The Spanish settlers quickly put the Aztec irrigation system to work growing sugarcane (Riley, 1973), a crop that remains important in the valley today. The primary sources of irrigation water have been the Yautepec River, and a large spring known as Las Estacas. The long-term flood regime of the Yautepec River has resulted in the burial of many Prehispanic sites (Borejsza, Frederick, Morrett Alatorre, & Joyce, 2014; Smith, 2019, pp. 116–119). Attempts to locate Aztec-period irrigation canals at Yautepec through excavation were not successful, although it is almost certain that the land in and around Aztec Yautepec was indeed irrigated before the Spanish conquest (Smith, 2019, pp. 114–116).

Basalt slopes. This is one of two piedmont zones in the valley. It consists of lava flows from the volcanoes in and near the valley. In the classification of Fries (1960, pp. 1225–131), these deposits are part of the Chichinautzin Group, which dates to the Pleistocene era. These are very rocky areas, with rough basalt deposits on the surface in many areas. Soils over this deposit, where they exist, are thin and poor for agriculture in comparison with the alluvium. The only periods with substantial occupation of this zone – Early

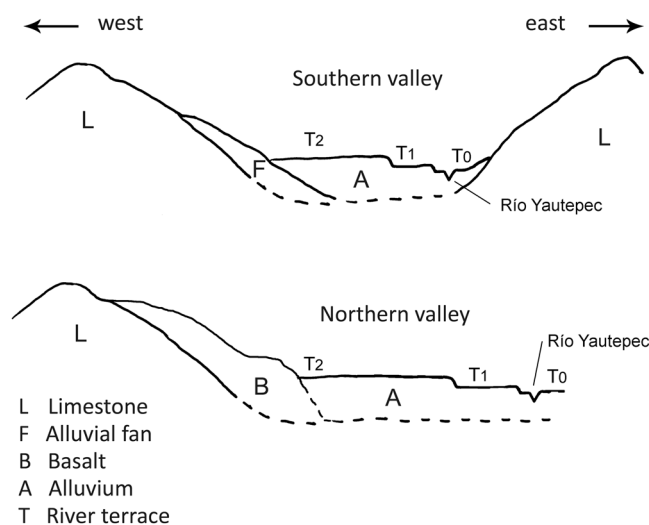


Figure 2: Cross-sections showing geological formations in the north and south parts of the Yautepec Valley.

Table 3: Geological zones in the Yautepec Valley

Zone	Abbreviation	Area (km ²)	No. sites
Alluvial soils	Alluv	94.2	1,155
Lower mountain slopes			
Basalt	Basalt	26.0	233
Alluvial fans	All. Fan	17.6	193
Limestone mountains	Mount	17.8	148
Other	Other	1.3	14

to Middle Classic and Late Postclassic – were the demographic peaks in the region. It is likely that larger numbers of people only moved onto these basalt foothill slopes during times of demographic pressure.

Alluvial fans. This second piedmont zone consists of clastic deposits of volcanic ash that have been redeposited by fluvial action. These alluvial fans, found in several parts of the valley, are part of the Cuernavaca Formation (Fries, 1960, pp. 119–125), dating to the Pliocene and/or the Pleistocene era. Geologists have studied the large alluvial fans of this formation west of Cuernavaca, the Buenavista Hills (Ortiz Pérez, 1977; Solleiro-Rebolledo, Sedov, Gama-Castro, & Flores-Román, 2003), and their descriptions apply to the alluvial fans in the Yautepec Valley as well. The conglomerate sediments are known locally as tepetate (Etchevers, Hidalgo, Prat, & Quantin, 2003; Nimlos, 1989; Williams, 1972). The soils on top of tepetate are not deep, and in comparison with the alluvium, they are not highly productive soils for agriculture. There are abandoned stone terrace walls in some areas, but it is not clear whether these were Prehispanic or recent in date. We also include in this category a small conglomerate deposit – initially distinguished as a separate hillslope zone (Smith, 2006). It may correspond to the Balsas Group of Fries (1960, pp. 91–101), dating to the Tertiary epoch.

Mountains. This zone consists of the middle and upper slopes of the parallel north–south limestone mountain ranges that define the Yautepec Valley. The mountains on the west side of the valley, which separate the Yautepec Valley from the Cuernavaca Valley, are part of the geological Morelos Formation of Fries (1960, pp. 41–60). They extend south from Tepoztlan and are known as the Tepoztlan range. The mountains on the east side of the valley are called the Cuautla Formation by Fries (1960, pp. 60–72). Outside of a few small locations, agriculture is impossible in this zone because of the steep slopes and thin soils, and there was little occupation.

Other. A final zone, consisting of mixed volcanic and sedimentary deposits (a breccia) known as the Sierra Tepozteco, is found along the northwest side of the Yautepec Valley. It appears to correspond to the category Continental Clastic Deposits of Fries (1960, pp. 131–141). A more detailed description is found in Ochoterena (1977), who dates the deposit to the Lower Pliocene. The ground is very steep and difficult or impossible for human use or settlement.

The Yautepec River runs from north to south, descending from approximately 1,100 m in elevation in the northeast to 900 m in the south. In most areas the alluvium has three terraces (Figure 2). Terrace T0 is the modern active floodplain deposit found in the active river channel. Deposits contain modern trash (plastic, glass) and some ancient ceramics. Terrace T1 appears to be date to the modern or recent historical period, and no archaeological sites were found on this terrace. Parts of terrace T2, on the contrary, were formed at some point in the Prehispanic past, and in some areas its surface contains archaeological sites from all time periods. In other areas, T2 may have formed in more recent times. The northern valley has the widest expanse of floodplain. The river probably meandered through this area in ancient times. The alluvial soils of T2, the highest terrace, are between 6 and 7 m in depth.

An excavation on the T2 terrace in the Yautepec neighborhood of San Juan, Unit 514 (Smith, 2019), encountered an alluvial deposit approximately 2 m in depth on top of a cultural deposit from the Epiclassic period, indicating significant alluviation since that period. No Late Postclassic deposits were encountered in this excavation, which was located in the atrium of the Capilla de San Juan, a church from the sixteenth century. The lower Yautepec Valley is much narrower than the northern portion (Smith, 2019,

Figures A1–9, A1–10). There is considerable variation in the presence of alluvial terraces along the river in this area.

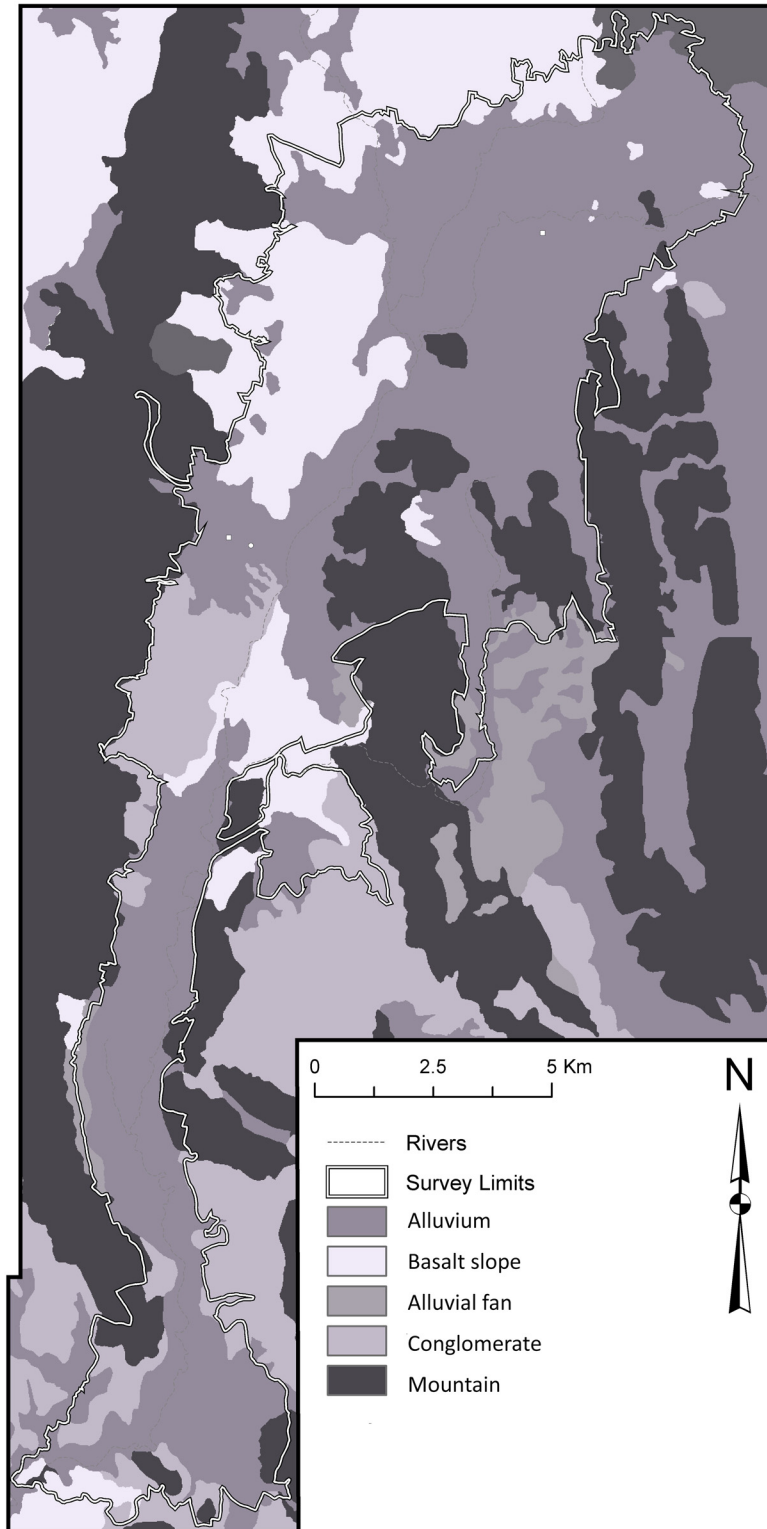


Figure 3: Extent of our survey in relation to environmental zones in the Yautepec Valley.

Although we can document only a single episode of significant alluviation (in unit 514 in Yautepec), it is likely that there were numerous such episodes in the past. Sites from the Formative period are rare, and many sites are probably buried under alluvium. Occupation and irrigation canals from the Middle or Late Formative periods were completely buried in the area of Ticuman (Morett Alatorre, Sánchez Martn ez, & Alvarado, 2000), and it is very likely that many other such sites were also buried in the past (Borejsza, Frederick, & Lesure, 2011; Borejsza *et al.*, 2014). Postclassic sites, on the contrary, are abundant in all parts of the valley, including the alluvium, so it is likely that much of the floodplain has been relatively stable since that time.

4 Major Processes of Change

The maps that follow show the locations of sites by site type for each period, from Early Formative through Molotla. Table 4 shows the numbers of sites by geological zone for each period, and Table 5 presents the total site area occupied by zone and period. We view site area as a proxy measure for population. In this section we review the major changes in demography and settlement patterns across this sequence, with some comments on major political and economic processes.

We located no clear evidence for occupation before the Early Formative period. For an active alluvial area, this is not surprising. Borejsza *et al.* (2014) discuss the difficulties in locating hunter-gatherer sites from the Paleoindian and Archaic periods in alluvial areas of highland Mesoamerica. Fieldwork by those authors, after our survey, did uncover several earth ovens near the Las Estacas spring, with two-sigma calibrated radiocarbon dates of ca. 6400–6200 cal BC and ca. 5900–6000 cal BC (Borejsza *et al.*, 2014, p. 289; Borejsza, Morett Alatorre, & Lohse, 2021, Figure 12.5), placing these features in the (pre-agricultural) Archaic period.

4.1 Formative Period: Colonization and Growth

The *Early Formative* period represents the initial colonization of central Mexico by agriculturalists (Nichols, 2015). Early Formative sites have been excavated in the Basin of Mexico (Nichols, 2015) and at Chalcatzingo and other sites in southeastern Morelos (Grove, 1974, 1987). We located only four small settlements from this period (Figure 4); we assume that this number underestimates the number of occupied sites. Nevertheless, the fact that we were able to locate numerous settlements from the Middle and Late Formative periods in the

Table 4: Distribution of sites among environmental zones

Period	Alluvium	Basalt slope	Alluvial fan	Mountain	Other	Total
Molotla	128	24	27	15	3	197
Atlan	110	21	27	12	3	173
Pochtla	98	14	13	8	1	134
Epecapa (EPC)	114	16	9	9	1	149
Tenayo (Epi)	94	10	4	10	2	120
Late Classic	90	27	20	15	1	153
Middle Classic	141	40	29	22	1	233
Early Classic	155	40	31	22	1	249
Terminal Formative	109	30	17	17	1	174
Late Formative	68	10	9	14	0	101
Middle Formative	45	1	5	4	0	55
Early Formative	3	0	1	0	0	4

Table 5: Distribution of total site area (population) among environmental zones

Period	Alluvium	Basalt slope	Alluvial fan	Mountain	Other	Zone uncertain ^a	Total
(a) Occupied area in hectares							
Molotla	478.5	144.6	69.7	47.0	3.2	0.2	743.2
Atlan	385.2	79.6	66.9	41.2	1.5	-36.2	538.2
Pochtla	179.7	31.6	53.1	20.3	2.5	4.0	291.2
Epecapa (EPC)	301.7	6.3	3.3	25.3	0.9	-14.6	322.8
Tenayo (Epi)	142.9	7.9	1.3	22.8	3.8	116.5	295.1
Late Classic	113.2	39.1	33.3	13.1	0.1	0.9	199.7
Middle Classic	366.9	160.6	234.7	70.5	0.1	4.1	836.9
Early Classic	397.8	187.3	242.9	70.7	0.1	0.6	899.4
Terminal Formative	198.4	60.5	59.5	25.9	0.1	0.0	344.4
Late Formative	112.3	9.4	48.7	23.1	0.0	0.1	193.6
Middle Formative	44.2	0.2	5.7	5.1	0.0	0.0	55.2
Early Formative	0.6	0.0	0.2	0.0	0.0	0.0	0.8
(b) Occupied area, percent of each period							
Molotla	64	19	9	6	0	0	100
Atlan	72	15	12	8	0	-7	100
Pochtla	62	11	18	7	1	1	100
Epecapa (EPC)	93	2	1	8	0	-5	100
Tenayo (Epi)	48	3	0	8	1	39	100
Late Classic	57	20	17	7	0	0	100
Middle Classic	44	19	28	8	0	0	100
Early Classic	44	21	27	8	0	0	100
Terminal Formative	58	18	17	8	0	0	100
Late Formative	58	5	25	12	0	0	100
Middle Formative	80	0	10	9	0	0	100
Early Formative	75	0	25	0	0	0	100

^aCoding errors resulted in some sites (particularly in the Epecapa period) lacking data for environmental zone, leading to under- or over-counting settlement areas for some periods.

alluvium supports the idea that artifacts from many early sites did appear on the ground surface, and thus the small number of Early Formative sites may not be too much of an underrepresentation of buried settlements from that period.

The *Middle Formative* period witnessed a major expansion of settlement in the alluvium of the Yautepec River, with 55 sites (Figure 5; Table 4). Most villages were concentrated in the alluvium in the northern end of the valley, although isolated households were spread along the river for its entire length. Borejsza et al. (2014) report two buried irrigation canals – one near Ticuman in the south-central valley and the other near Las Estacas – with radiocarbon dates of $2,459 \pm 51$ BP and $2,883 \pm 38$ BP, placing them in the Middle Formative period. These finds reinforce Nichols's (2015) observation for the Basin of Mexico that intensive agricultural methods such as irrigation were used as early as the Early and Middle Formative periods.

The Middle Formative period saw the maximal expansion of a chiefdom polity at Chalcatzingo (Grove, 1987), located immediately east of the valley (Figure 1). There are close similarities between artifacts of the Yautepec Valley and Chalcatzingo, including basic ceramic vessels (Cyphers, 1987) and figurines (Smith & Montiel, 2008). The lack of any large settlements that might have served as local political centers in the Yautepec Valley lends support to the views of Grove and Cyphers that the Yautepec Valley was likely under the control – or strong influence – of the Chalcatzingo polity. The prominence of Olmec styles in the Yautepec Valley – almost certainly related to Chalcatzingo – has been known since excavations at Atlahuayan in the early 1950s (Piña Chán & López González, 1952) turned up a well-published complete hollow figurine

(Figure 6); similar finds have been reported from Zazacatla, just west of the southern end of our survey area (Canto Aguilar & Castro Mendoza, 2010).

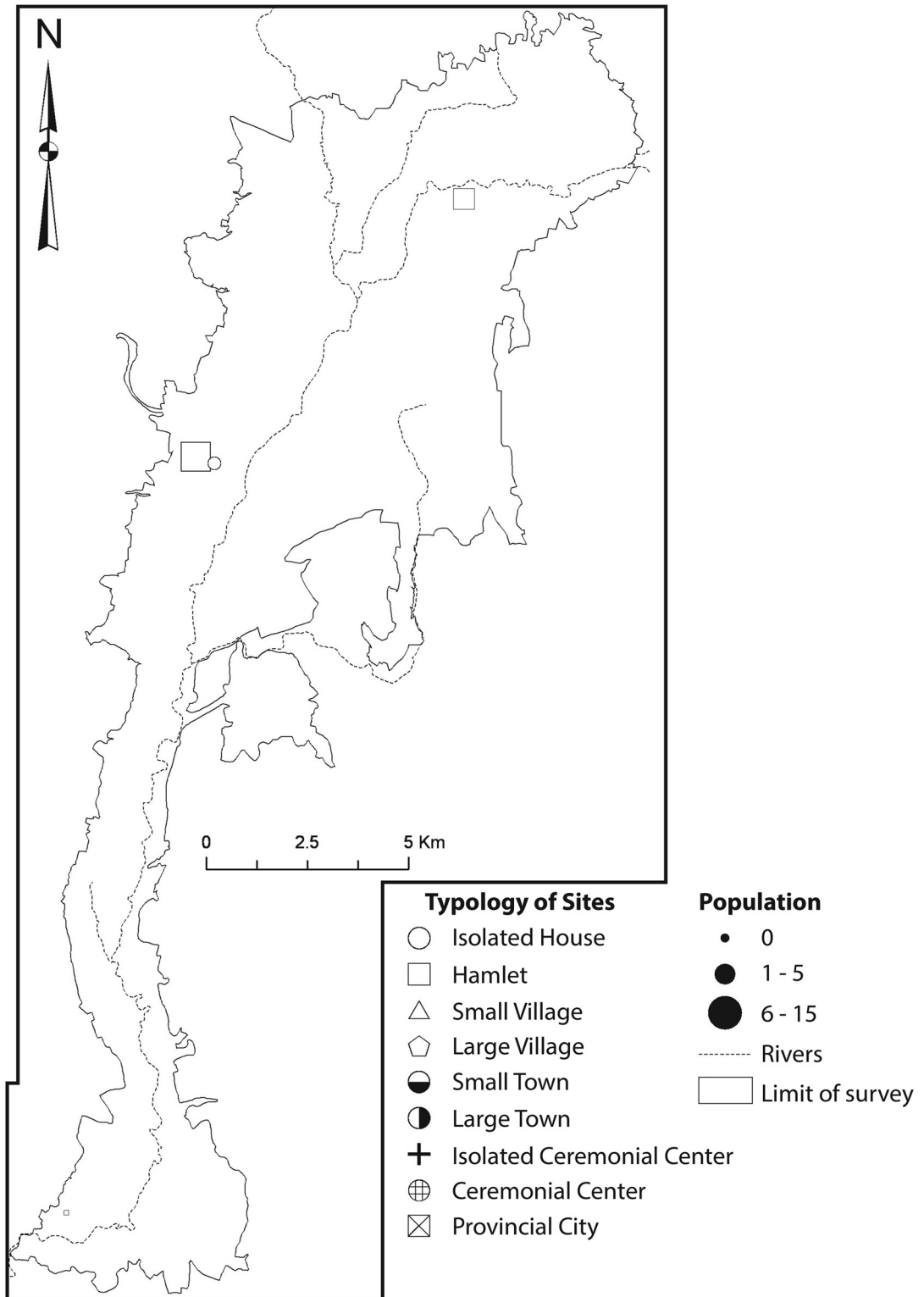


Figure 4: Settlement patterns of the Early Formative period.

Two dry caves near Ticuman in the lower valley – Cueva El Gallo and Cueva de la Chagüera – were excavated in the 1990s shortly after our survey (Morett et al., 2000), revealing deposits with remarkably well-preserved ethnobotanical remains and cotton textiles (Ochoa Castillo & Román Torres, 2017). These

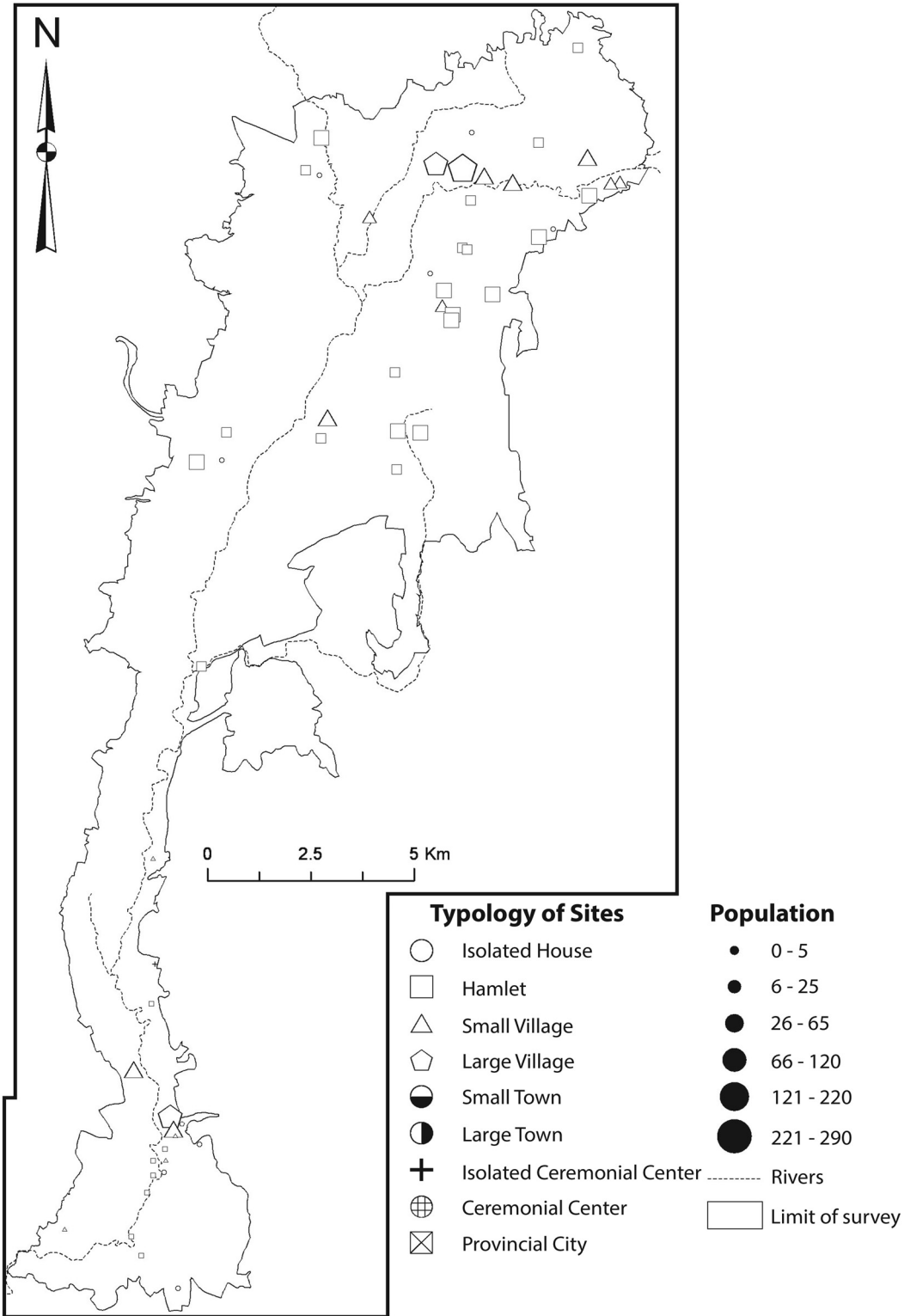


Figure 5: Settlement patterns of the Middle Formative period.



Figure 6: Hollow Olmec style ceramic figure, excavated from Atlahuayan, likely dating to the Middle Formative Period. Drawing by Fernando Botas, courtesy of Ann Cyphers.

remains – together with the irrigation canals and expansion of settlement – point to the establishment of a thriving society of early agriculturalists in the Middle Formative Yautepec Valley. Although the presence of cotton textiles does not necessarily imply that cotton was cultivated in the valley at this time, the presence of irrigation canals does lend support to the inference of cotton cultivation in the valley during the Middle Formative period.

Rapid population growth led to a four-fold expansion in the *Late Formative* population of the valley (as measured by site areas, Table 5), including the first major occupation of the piedmont areas (Figure 7). Total population, however, was still small compared with subsequent periods (Table 5). This period saw the development of the first large sites in the valley (sites 286 and 126, at 36 and 34 ha, respectively). Both were located in the large expanse of alluvium in the northern valley (Figure 7), and one or both were probably the capitals of petty polities of some sort. After the fall of the Chalcatzingo chiefdom, this may have been a period of more localized economic and cultural organization, parallel to the situation at this time in the Basin of Mexico (Nichols & Stoner, 2019).

The *Terminal Formative* period witnessed three trends in settlement and demography. First, population growth continued, with a near-doubling of the total occupied area of the valley (Figure 8). This demographic expansion included the initial major settlement of the basalt foothills zone, which became home to 18% of the population (Table 5). The use of this rocky zone then expanded further in the subsequent Classic period. The second trend was the growth of small-to-intermediate size centers throughout the valley. Most settlements were small; at the top of the size distribution were seven settlements between 10 and 23 ha (Figure 8). Third, many of the sites were newly occupied (see “Backward continuity” in Table 6). The distribution and size of settlements indicate the population was oriented around agricultural use of the fertile alluvium. Two ceremonial centers in the extreme south are quite large, with evidence of defensive terracing or walls, and these become even larger in the Early and Middle Classic periods that follow.

The Terminal Formative saw the introduction of Teotihuacan-related ceramics and figurines in the Yautepec Valley (Montiel, 2010, pp. 123–127). These include Thin Orange ware, Imitation Thin Orange, a

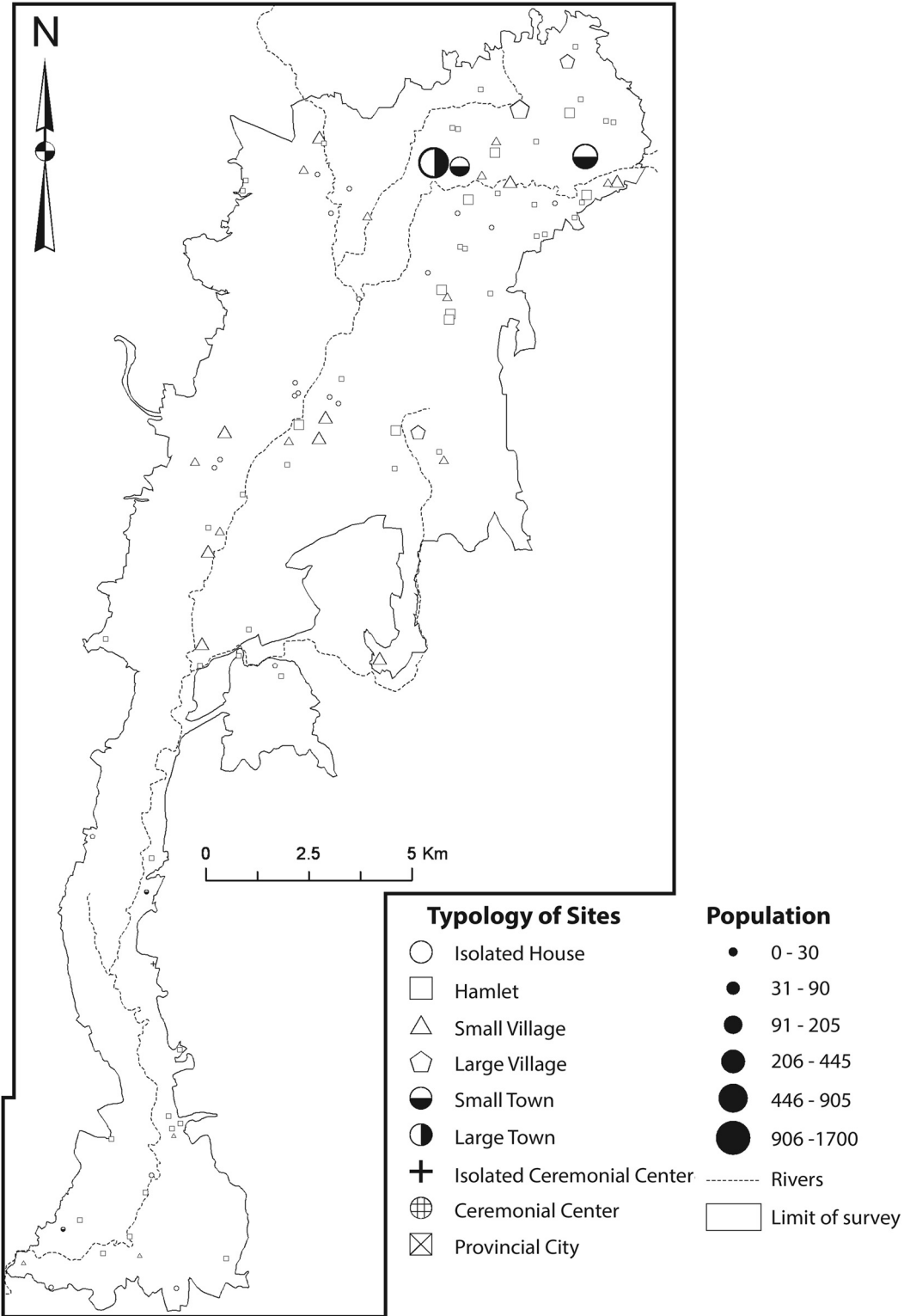


Figure 7: Settlement patterns of the Late Formative period.

variety of Teotihuacan-related bowl forms, and several characteristic figurine forms (Montiel, 2010; Smith & Montiel, 2008). Teotihuacan-controlled green obsidian dominated the lithic assemblage, probably arriving in the Valley in prismatic blade form. The Terminal Formative marks the beginning of strong interaction

with Teotihuacan, probably ceremonial and/or economic in nature and focused on the north part of the Valley. The majority of the material items are representative of local material culture but with ties to the Basin of Mexico.

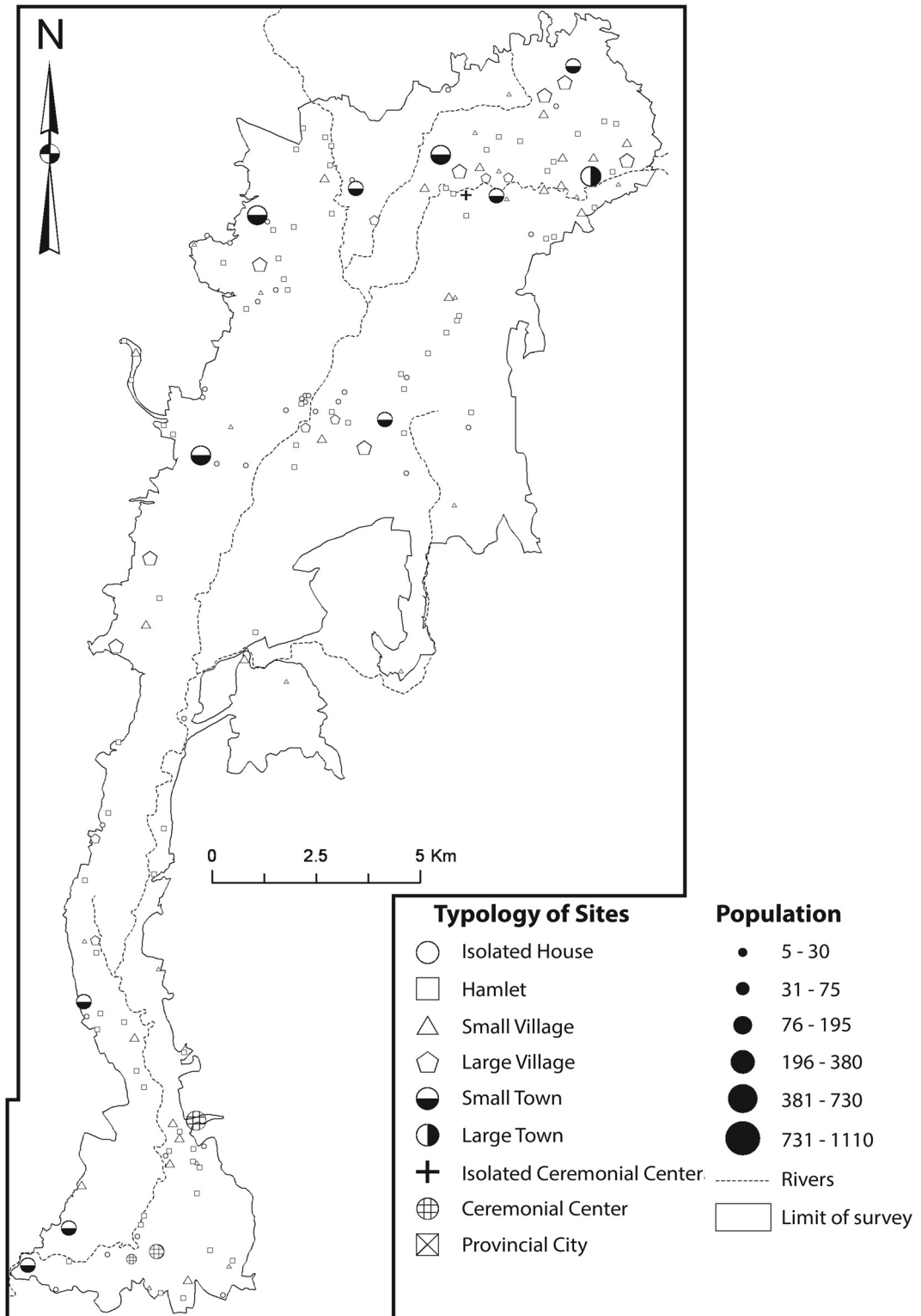


Figure 8: Settlement patterns of the Terminal Formative period.

4.2 Classic Period: Demographic Surge and Conquest by Teotihuacan

Changes in the *Early Classic* settlement pattern and material culture indicate the Yautepec Valley was directly administered by the Central Mexican Teotihuacan Empire. Population more than doubled (Table 5), reaching its highest point of the Prehispanic era. The alluvium was quite densely settled, and population also expanded greatly in the two foothill zones (Figure 9). There were now ten sites larger than 20 ha, with the largest site measuring 80.4 ha. Artifacts show an even closer relationship to Teotihuacan than in the Terminal Formative period, including both stylistic similarities and imports at all site types (e.g. Thin Orange, censers). One of the dominant ceramic types is a red-on-brown bowl almost identical to vessels from Teotihuacan. Neutron activation analysis of a sample of sherds from the Yautepec survey found that nearly all were manufactured locally, with a few having clay from an unknown source; none were sourced to Teotihuacan itself (Neff, Glascock, Montiel, & Smith, 2006). Similarly, 65% of the ceramic figurines from the Yautepec Valley resembled those of Teotihuacan very closely, although most were likely made locally (Smith & Montiel, 2008).

Other Teotihuacan-related ceramic types were imported, including Thin Orange cylindrical vessels; chemical sourcing showed that all tested Thin Orange sherds came from the same source area in southern Puebla that supplied Teotihuacan (Neff et al., 2006; Rattray, 1990). Ceramics from sites just north of the Yautepec Valley – El Tlatoani in Tlayacapan (García Maya & González Quezada, 2015) and Centeopa in Tepoztlan (Cook de Leonard, 1985) – also show strong similarities with materials from Teotihuacan. There are no local sources of obsidian. In the Classic Period, Teotihuacan controlled the production and distribution of green obsidian prismatic blades from neighboring Pachuca source (Pastrana & Domínguez, 2009). There are several sources of good-quality gray obsidian in Central Mexico, none of which appears to be controlled by political forces in the Classic Period, so its presence in the Yautepec Valley is indicative of foreign trade. The frequencies of green and gray obsidian increase in the Early Classic, though green obsidian is still arriving in the Valley in mostly prismatic blade form while gray obsidian may have been worked in the Valley, based on the higher frequencies of cores and flakes (Montiel, 2010, Table A.14).

In terms of demography and settlement location, the *Middle Classic* period (Figure 10) continued the patterns established in the Early Classic with few new sites established. Indeed, the forward continuity in site occupation between Terminal Formative and Early Classic, and then from Early to Middle Classic, are the highest values of any period in the entire occupation of the Valley (Table 6). The population decreases from the Early Classic as the sites abandoned in the Middle Classic were larger sites. The artifact patterns also show continuity across these periods with a high frequency of Teotihuacan imperial-controlled goods and imperial styles (Montiel, 2010, pp. 162–169); neutron activation of red-on-brown bowls and Thin Orange from this period show identical results to the Early Classic period. One notable change is a spike in the presence of military themes (headdresses, shields, and weapons) in the figurines of the Middle Classic (Smith & Montiel, 2008), consistent with Yautepec's integration into the Teotihuacan Empire. These two periods together constitute the longest interval of stability and continuity in the entire occupation of the Yautepec Valley (see discussion below).

The *Late Classic* period (Figure 11) witnessed a drastic population crash in all environmental zones, with a near depopulation of the south-central portion of the valley. This latter change was likely a result of the disruption in foreign trade involving Granular ware from the south. Overall population dropped to about one-quarter of its Early to Middle Classic peak (Table 5). Compared to the five large towns and five ceremonial centers in the prior Middle Classic period, these settlement types were absent from the Late Classic period. The foothill areas show the most drastic decline, and it appears that some of the former residents of those areas moved down to the floodplain. Teotihuacan-style goods declined in frequency, and among local types there is greater diversity with a proliferation of decoration techniques (Montiel, 2010, pp. 180–182). The settlement patterns and the material culture signal the likely disintegration of Teotihuacan administration of the Valley. Nevertheless, it appears that local people were still identifying with symbols of Teotihuacan through ideology, as reflected in the select material culture stylistic similarities, such as decorated Thin Orange vessels, and ceramic figurines (Montiel, 2010, pp. 183–185).

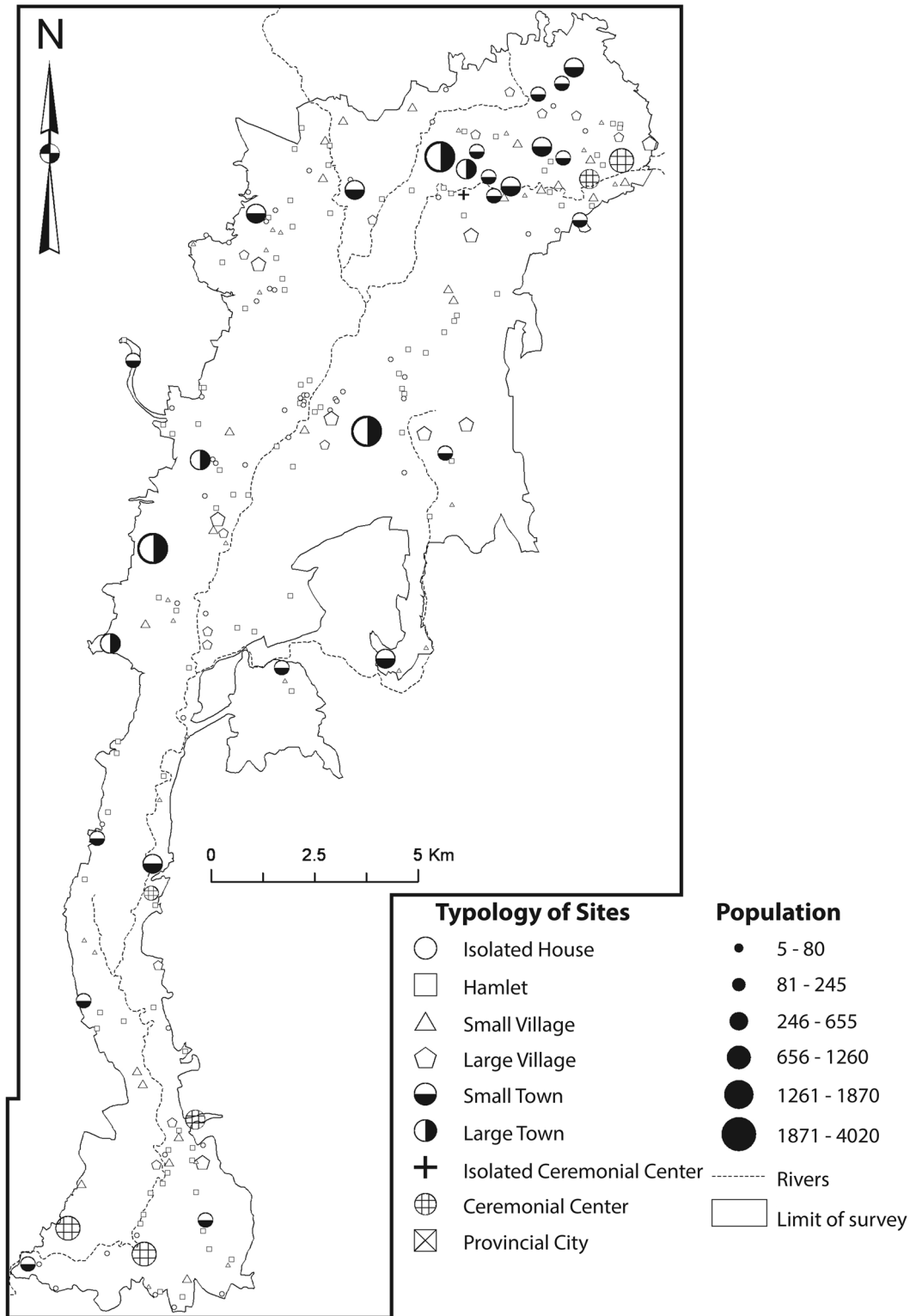


Figure 9: Settlement patterns of the Early Classic period.

To summarize, the archaeological results from the Yautepc Valley point to its likely conquest and administration by the Teotihuacan Empire, starting in the Early Classic. Trade relations between the two regions began in the Terminal Formative period. The population surge and re-organization of

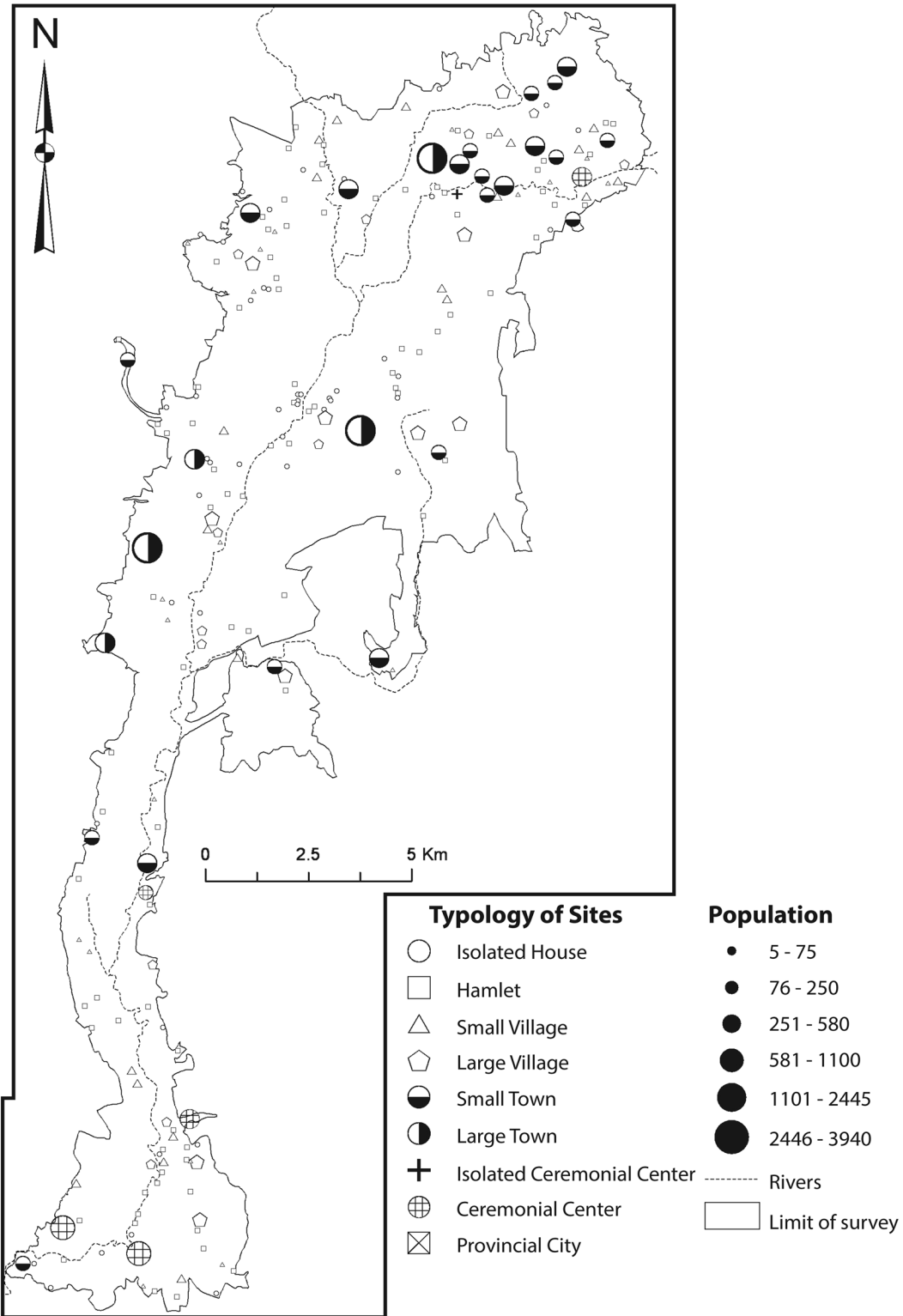


Figure 10: Settlement patterns of the Middle Classic period.

settlement patterns to strategic locations in the Valley, and the establishment of ceremonial centers in the Early Classic, likely resulted from the valley’s role as a directly administered provincial area of the Teotihuacan Empire (Montiel, 2010; Smith & Montiel, 2001). The southern half of the Valley saw the most dramatic decline in sites and population in the Middle Classic suggesting a disruption of Teotihuacan

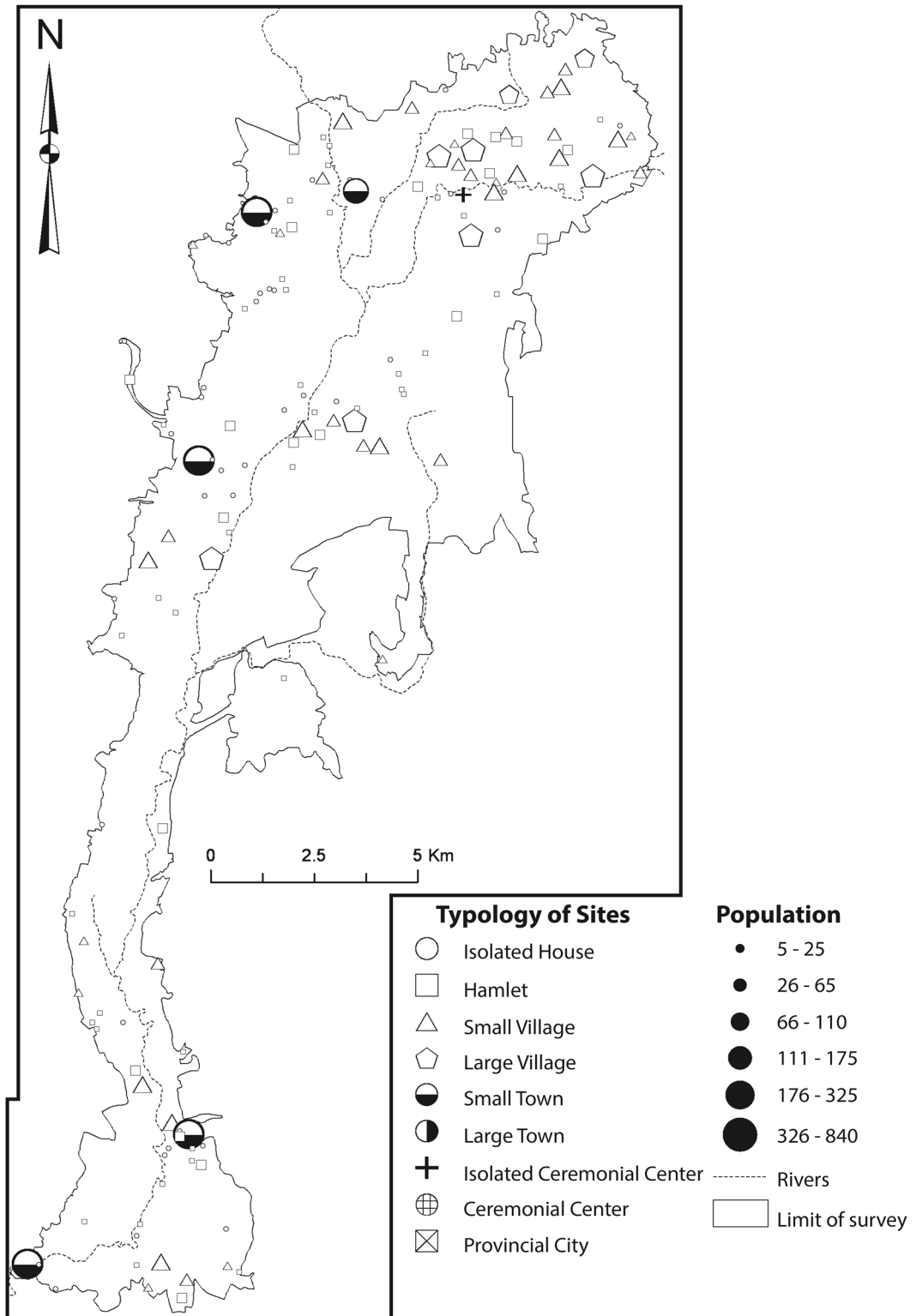


Figure 11: Settlement patterns of the Late Classic period.

interaction and foreign trade (likely related to Granular ware). While political–economic interactions with Teotihuacan declined after the Middle Classic, material culture suggests some level of continuing importance of ideological interactions in the Late Classic period (Montiel, 2010, pp. 231–240).

The changes from Middle to Late Classic almost certainly reflect the withdrawal of Teotihuacan control over the Yautepec Valley. A similar, though less pronounced transition can be seen in the Basin of Mexico, where many smaller, more rural Classic sites were abandoned during the cognate Xolalpan or Metepec phases (García Chávez, Gamboa Cabezas, & Vélez Saldaña, 2015). In contrast, the Toluca Valley – another provincial area under Teotihuacan control – shows a consistent increase in population through the later Classic and into the Epiclassic (Parsons & Sugiura, 2012). Recently, some geographers claimed that a “drastic drought period” between 600 and 700 CE contributed to the decline of the city of Teotihuacan (Park, Byrne, & Böhnelt, 2019, p. 116). Regardless of validity of that claim, the end of Teotihuacan influence in Yautepec occurred well before the onset of drier conditions.

4.3 Postclassic Period: Population Resurgence and Growth of City-States

The *Epiclassic period* saw a reorganization of settlement, with a 50% increase in overall population (Table 5) and an expansion of settlement on the alluvium at the northern end of the valley (Figure 12). Excavations in Yautepec recovered evidence for a period of major alluvial deposition (ca. 2 m with few artifacts) during or shortly after this period; in unit 514, the alluvial deposits contained Epiclassic sherds, and they covered an offering of Epiclassic ceramic vessels (Smith, 2019, pp. 118–119).

Ceramics during this period resembled closely those of the contemporaneous Gobernador period at Xochicalco in western Morelos (Cyphers & Hirth, 2000; Garza Tarazona & González Crespo, 2006). Hirth (2000, pp. 253–263) has argued that Xochicalco was capital of a large state, but available data are insufficient to evaluate this proposition for the Yautepec Valley. This is generally interpreted as a period of warfare and conflict in central Mexico, with major cities – like Xochicalco – located in defensible positions (Diehl & Berlo, 1989). Although sites in the mountains contained a higher proportion of the valley population than in other periods (Table 5), the level of occupation of that zone (12%) was not high.

The settlement and demographic trends initiated in the Epiclassic period continued into the *Early Postclassic* period (Figure 13): population growth, and continued expansion on the alluvium; fully 93% of the population was in this zone. Settlement on the alluvium was even more strongly clustered at the northern end of the valley, and the two piedmont zones were all but abandoned (Table 5). The ceramics of both the Epiclassic and Early Postclassic in the Yautepec Valley remain poorly understood, and excavations will be needed to advance our understanding.

Although some scholars have posited the existence of an Early Postclassic empire based at Tula, Smith and Montiel (2001) applied a model of imperialism and concluded that Tula ruled a relatively small polity, and that the Yautepec Valley was not part of that polity. Most of the ceramic types shared between Yautepec and Tula were widespread central Mexican types, and the most distinctive Tula-affiliated types (e.g., Macana red on buff) are quite rare in the Yautepec Valley. The demographic reconstructions presented below support the notion that developments at Tula had little effect in the Yautepec area.

The *Pochtla* phase (Middle Postclassic) marks the start of the “Aztec” period in the Yautepec Valley. All of the six historically documented city-state capitals in the valley (Smith, 1994) were settled at this time. Three – the city of Yautepec (Smith, 2019), Coacalco, and Tlatizapan – expanded greatly from smaller Early Postclassic settlements; two were founded newly in the Pochtla period (Atlhuelican or Atlihuatan, and Ticoman), and one – Ytzamatitlan – declined slightly in size. Although none of these settlements were very large, they were among the largest settlements in the valley during this and the subsequent Aztec periods (Smith, 2006: Cuadro D1-2). Hare (2004) discusses methods used to reconstruct the territory of the city-states subject to these six towns in the Pochtla, Atlan, and Molotla periods. These three periods, which correspond to the Aztec era, or the Middle and Late Postclassic periods of central Mexico (Hare & Smith, 1996), saw the development of common graphical styles, architectural forms, and other elements of elite-related religious and intellectual culture throughout central Mexico. In the Yautepec Valley, the reliefs known as the “Piedras de Coatlán” (Figure 14) were executed in the Aztec or Mexica style on a large outcrop in the survey area (Anders & Jansen, 1988; Robelo, 1912); these cannot be assigned to a specific period,

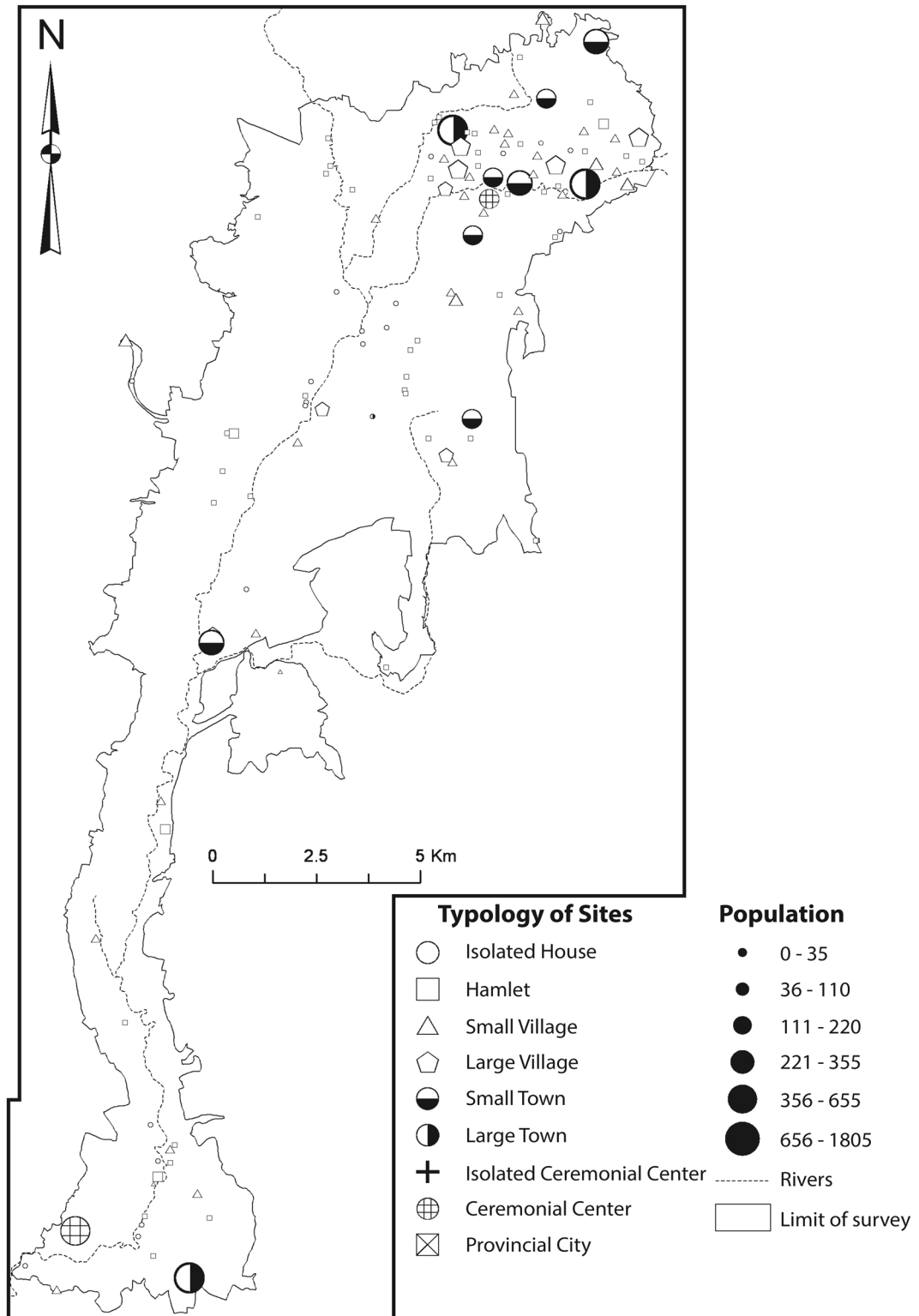


Figure 12: Settlement patterns of the Epiclassic period.

however. In the Pochtla period, the total population of the valley declined slightly (Table 5), with a major reoccupation of the piedmont slopes throughout the valley (Figure 15).

The population of the valley nearly doubled in the *Atlan* phase (Table 5). Most of this growth was in the alluvial zone, throughout the length of the valley (Figure 16). Two of the city-state capitals – Tlaltizapan

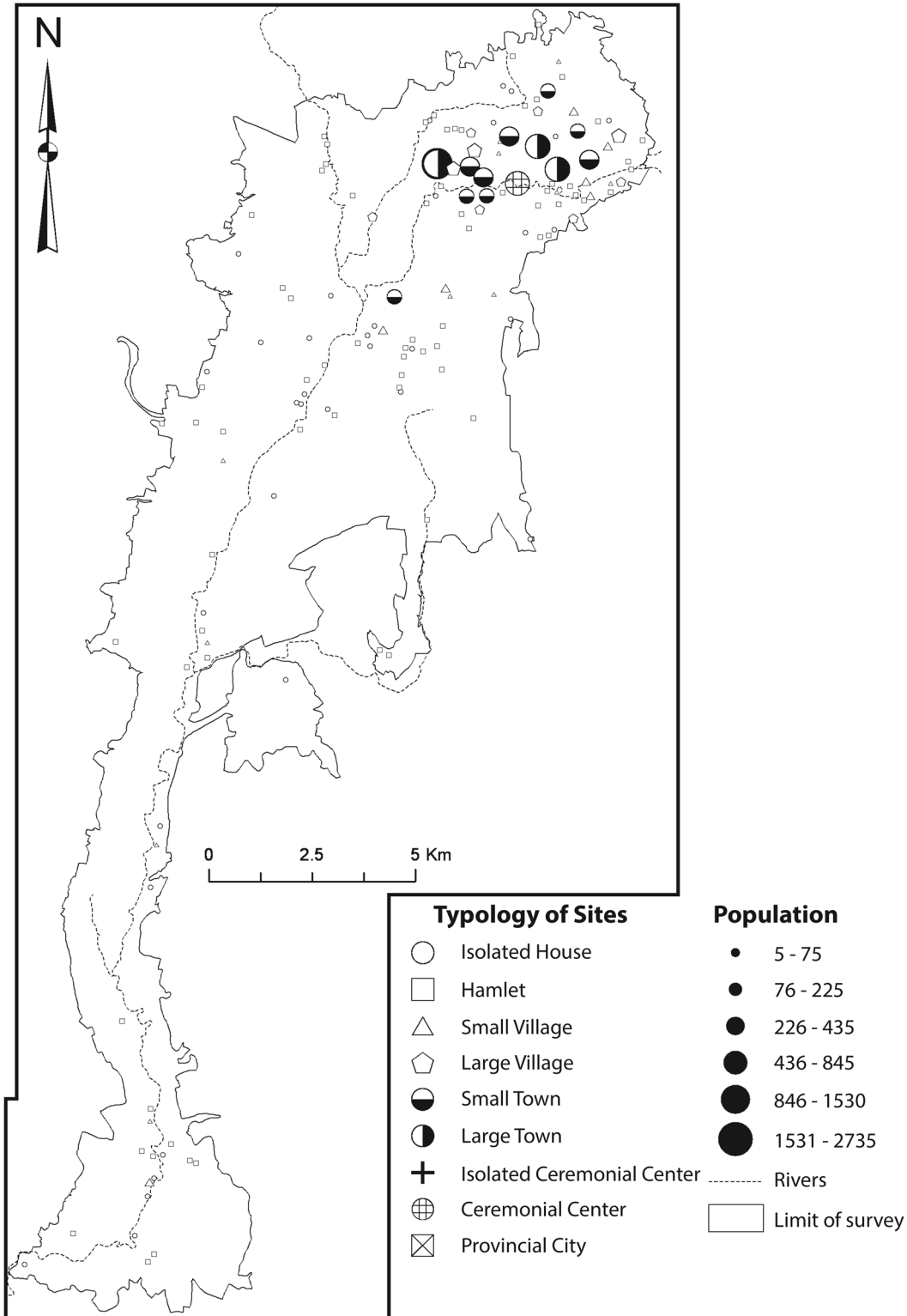


Figure 13: Settlement patterns of the Early Postclassic period.

and Ticoman in the southern half of the valley – moved to new locations within a few kilometers of their former sites (Figures 15 and 16). This was a time of major interregional exchange, economic expansion, and prosperity among the city-states of Morelos (Smith, 2004, 2016).

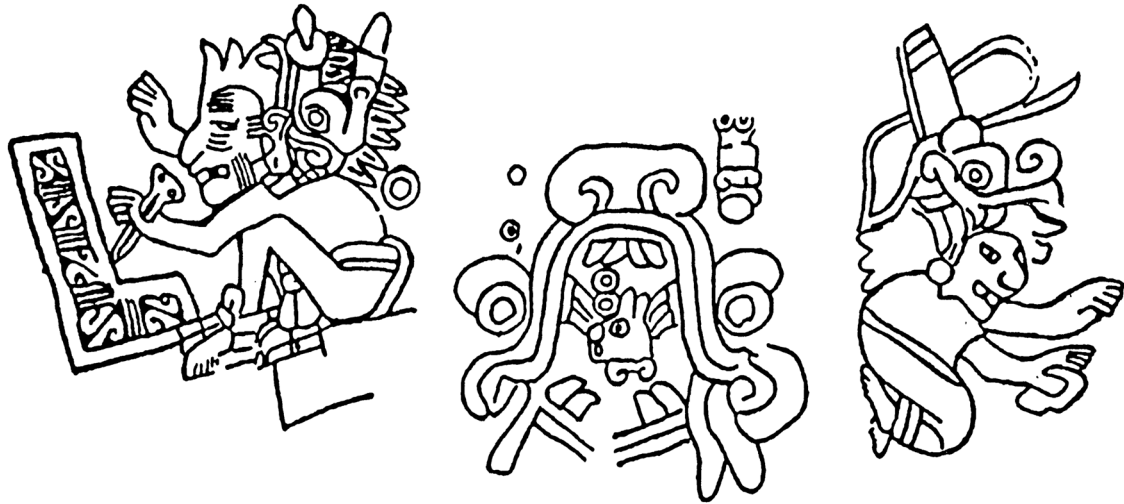


Figure 14: Aztec style carvings known as the “Piedras de Coatlán,” from the survey area. Drawing modified after Anders and Jansen (1988, p. 112).

The *Molotla* phase saw population reach its highest level since the Early and Middle Classic periods (Table 5). The proportion of the population in the Alluvial fans declined slightly, but occupation of all other zones increased significantly (Figure 17; Table 5). Although the Yautepec Valley was among the areas conquered by the expanding Aztec or Triple Alliance empire (Berdan *et al.*, 1996; Smith, 1994), the impact seems to have been minimal at the local level (Smith, 2016). As noted above, documentary sources report extensive canal irrigation of maize and cotton at the time of Spanish conquest, and cotton was probably the primary resource of interest to the Aztec empire.

The *Santiago* phase of the Early Colonial period presents many problems of data and interpretation. While we feel that our map of settlements (Figure 18) contains many or most sites from this period, we have little confidence in the sizes of those sites. The reduction in the number (and probably sizes) of sites in this period is not surprising, given the rapid drop in population from disease in the sixteenth century (Whitmore, 1992), and the reorganization of settlement as Morelos became incorporated in the estate of the conqueror Hernan Cortés (Riley, 1973). We identified the remains of at least one early Colonial sugar processing installation from its ovens and large numbers of distinctive ceramic forms used in the process of purging the milled cane (Figure 19). An illustration of an eighteenth-century Caribbean sugar purging house (Figure 20) shows how these vessels were used in processing the sugar. Sherds a and c (Figure 19) are parts of the upper vessel, the “form” (Figure 20(a)), and sherd b is part of the lower vessel (Figure 20(b)).

5 Cities and Urbanization

One of the long-term trends in the Yautepec Valley illuminated by our data is the development of cities and the urbanization process. In this section we discuss three aspects of this process: urbanization level, settlement continuity, and off-site artifact distributions.

5.1 Urbanization

Urbanization refers to the “proportion of the total population concentrated in urban settlements” (Davis, 1968, p. 3). This is an important numerical indicator for comparative analysis because the urbanization level can be an

indicator of agricultural efficiency, living standards, and prosperity (Bairoch, 1988; de Vries, 1984; Woods, 2003). The development of comparative indices is difficult, given large-scale variation in both urbanization and in the forms and functions of urban settlements across history and around the world. It is obvious that the

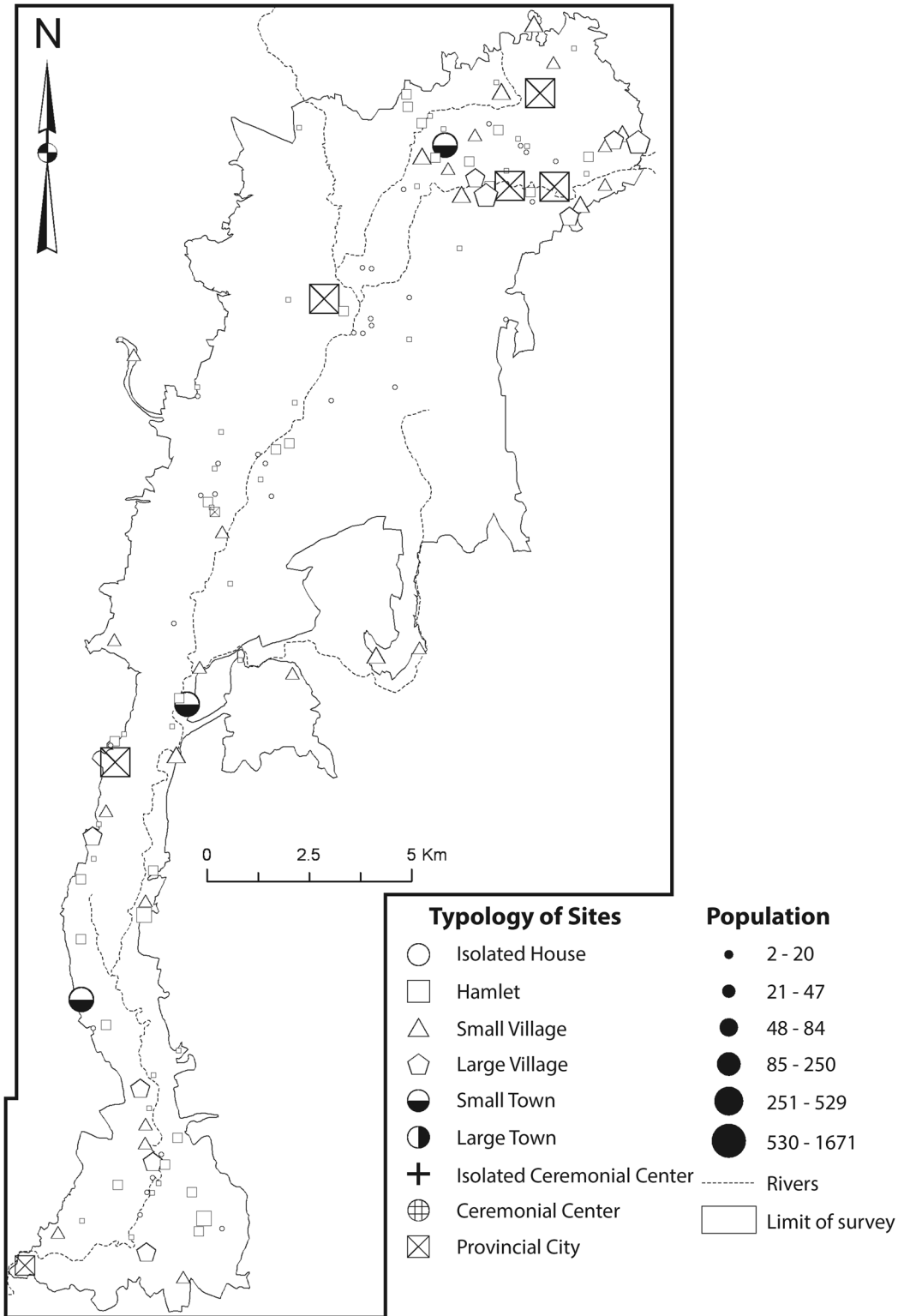


Figure 15: Settlement patterns of the Pochtla (Middle Postclassic) period.

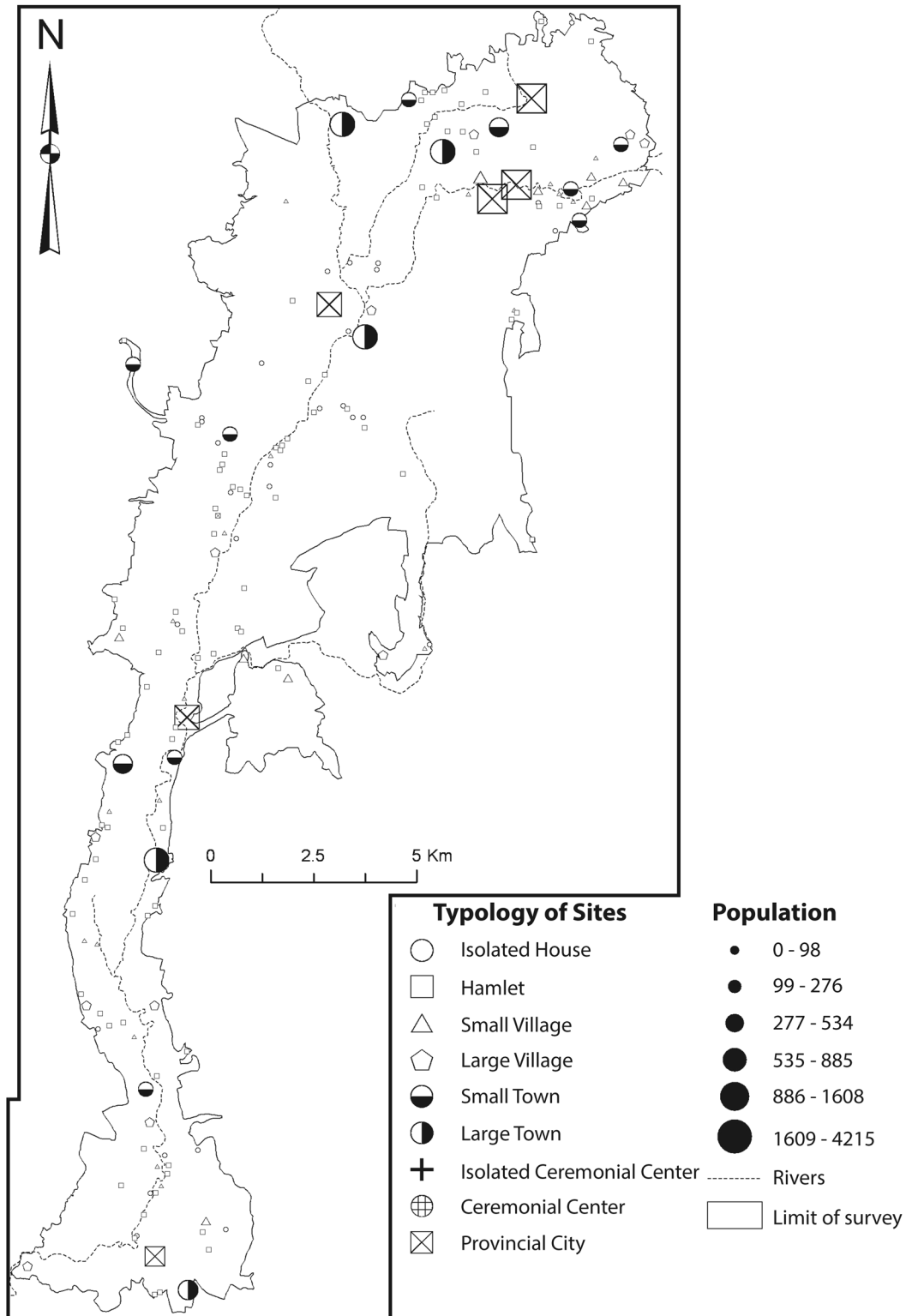


Figure 16: Settlement patterns of the Atlán (Late Postclassic, A) period.

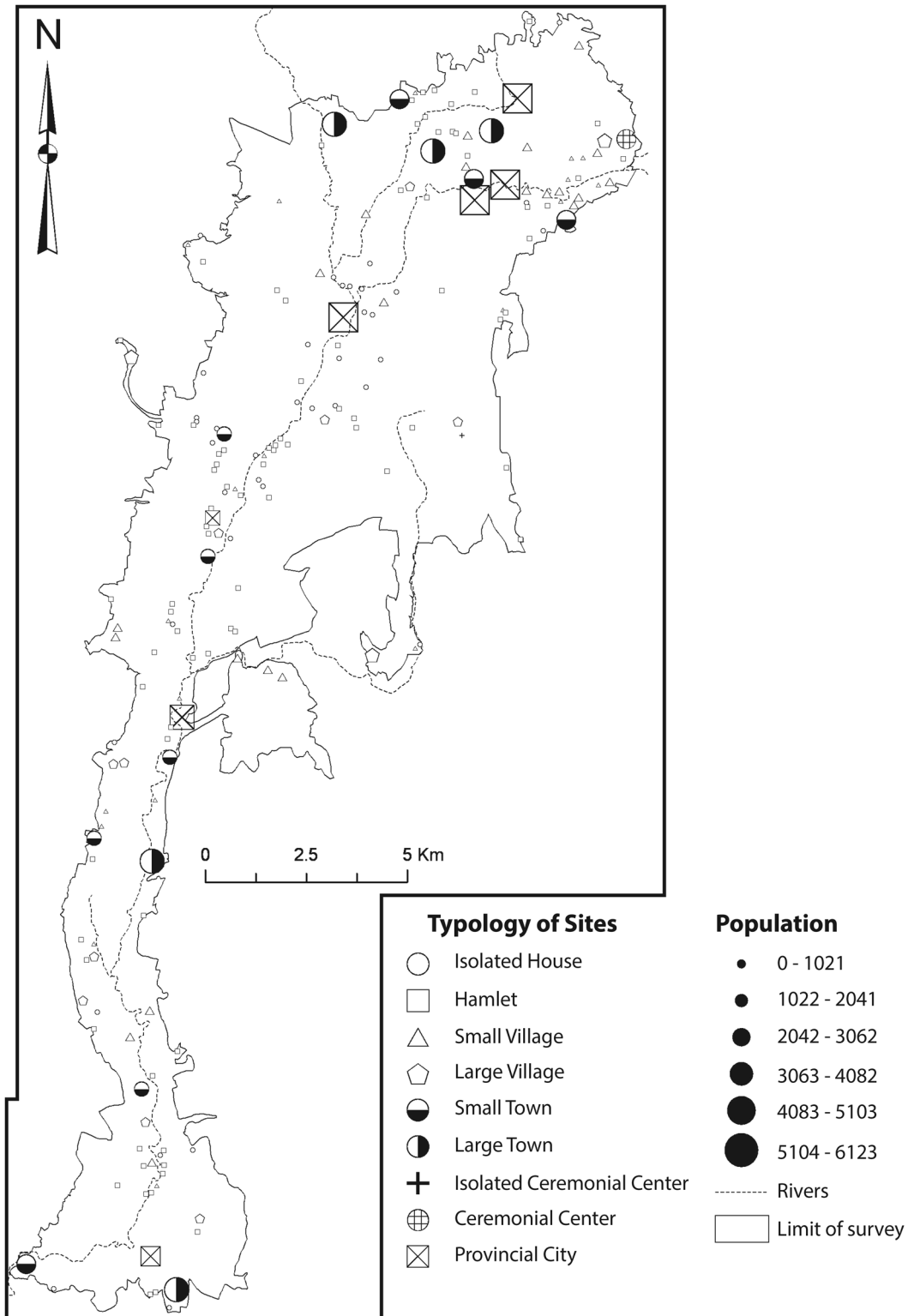


Figure 17: Settlement patterns of the Molotla (Late Postclassic, B) period.

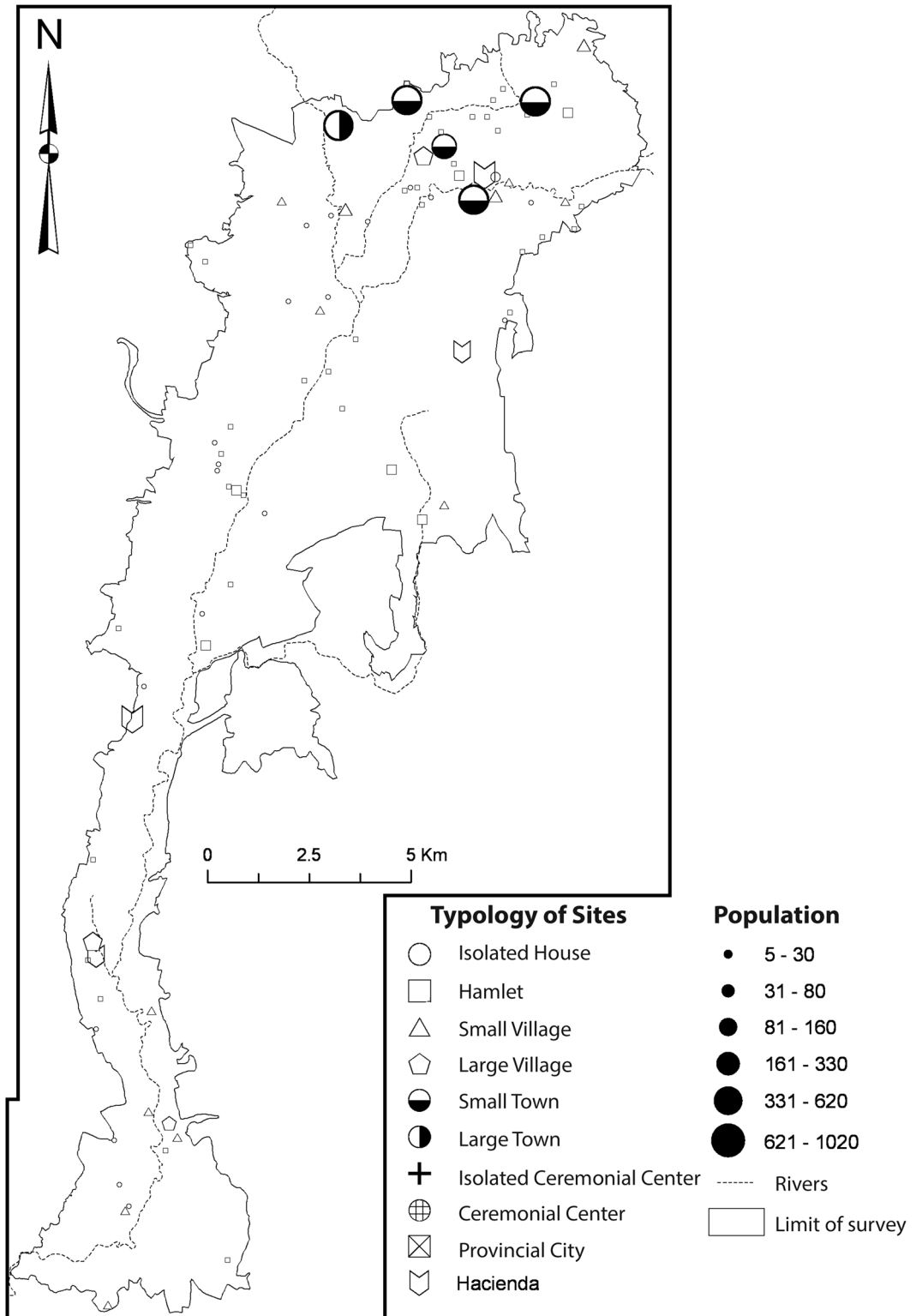


Figure 18: Settlement patterns of the Santiago (Early Spanish Colonial) period.

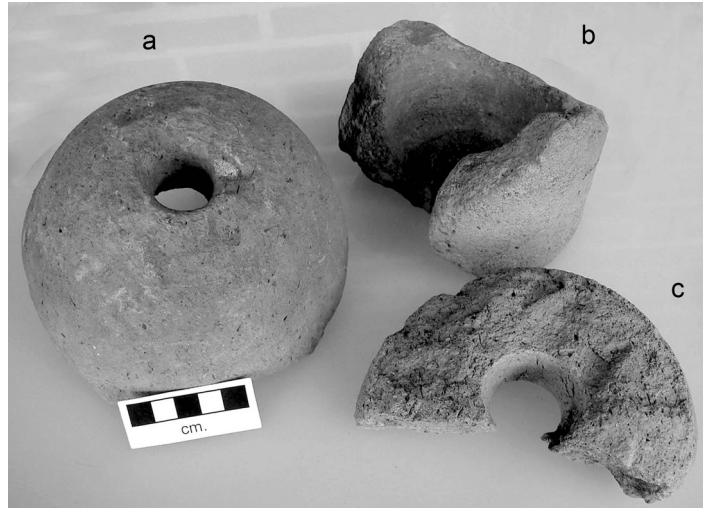


Figure 19: Sherds from large crude sugar-processing vessels, recovered from survey of an early sugar hacienda site in the valley.

higher the “urban” threshold used by the analyst (i.e., the minimal population need for a settlement to qualify as urban), the lower the level of urbanization. For this reason, many scholars provide multiple urbanization indices. In the most comprehensive study of European historical urbanization de Vries (1984) uses urbanization thresholds of 2,000, 5,000, and 10,000 residents. Bairoch (1988) generally prefers 5,000 residents, but points out that because settlements are smaller in “traditional societies,” a cut-off of 2,000 persons is appropriate.

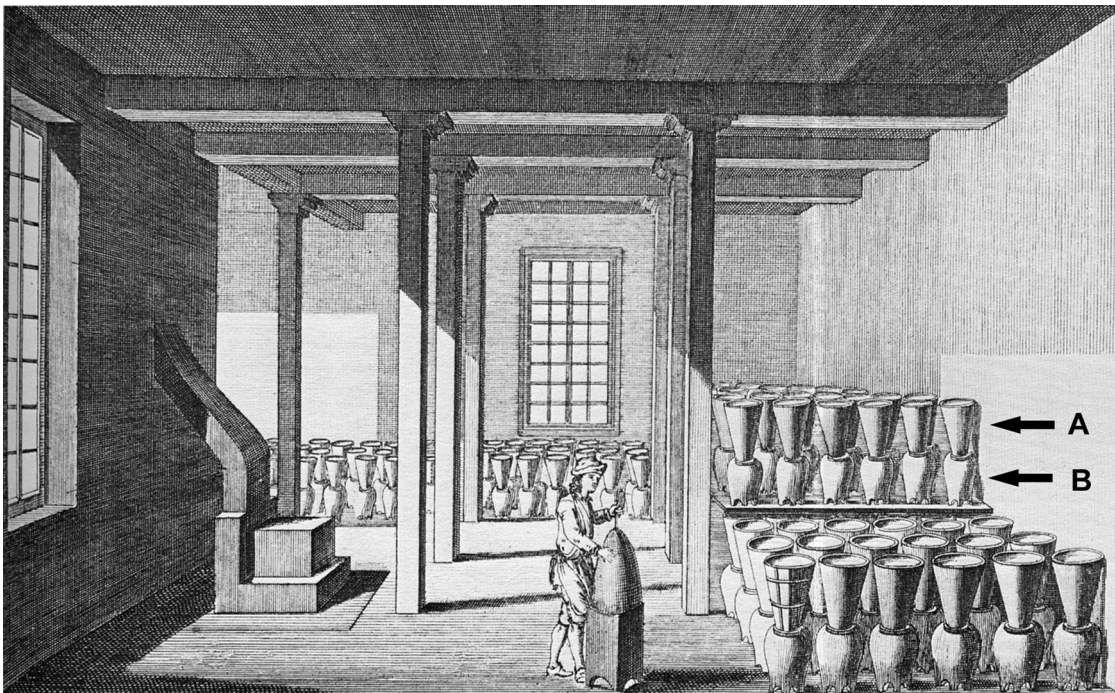


Figure 20: Eighteenth-century cane sugar purging house in the Caribbean, showing the use of ceramic vessels like those shown in Figure 19. (a) Vessels called forms, with a rounded, perforated base; (b) recipients for the syrup, with a closed flat base. Modified after Barrett (1970, Figure 13).

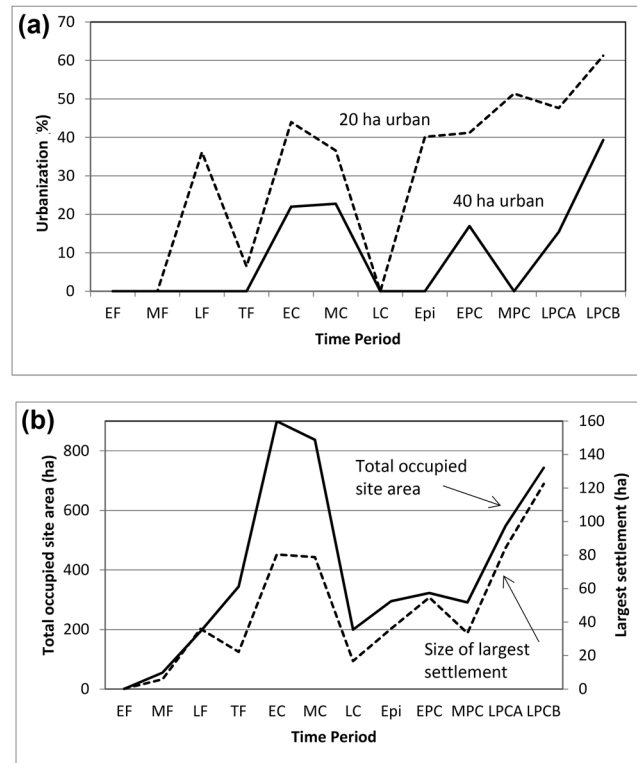


Figure 21: Urbanization trends in the Yauhtepec Valley. (a) Urbanization rates, calculated for urban thresholds of 20 and 40 ha. (b) Size of the largest settlement plotted against the total occupied area.

We present data using two urbanization thresholds: 40 and 20 ha (Figure 21a). For a rough conversion to population, we use the figure of 50 persons per ha; this is the median population density of Aztec city-state capitals (Smith, 2008, p. 152). The 40 ha limit thus denotes urban settlements roughly as those with more than 2,000 persons, and the 20 ha limit corresponds to 1,000 persons. The data from our survey show two urban peaks: in the Early and Middle Classic periods, and in the Atlan and Molotla periods. These peaks are notable because historical demographers have found few cases of urbanization rates above 15% before the Industrial Revolution (Bairoch, 1988; de Vries, 1984; Wrigley, 1990). For our more conservative measure (40 ha cut-off), urbanization rates top 20% during the Classic and Postclassic periods, reaching a high value of 39% in the Molotla period.

A second perspective on the urbanization process is illustrated in Figure 21b. The size of the largest settlement tracks total population (as measured by total occupied site area) quite closely, except in the Early and Middle Classic periods. During these periods, it appears that the size of the largest settlement may have been suppressed by the direct or indirect actions of the Teotihuacan empire. That empire likely imposed a series of intermediate-sized settlements as imperial administrative centers in the Yauhtepec Valley (see discussion of settlement continuity below), preventing the development of large regionally based cities through local, generative processes.

5.2 Settlement Continuity

The continuity of cities and other settlements across time periods provides a measure of the amount of movement and stability in the region, which in turn relates to changing political, economic, and social processes. For each time period, we calculate two measures. *Backward continuity* is a measure of the percent of sites that were also occupied in the prior period; *forward continuity* is the percent of sites that were also occupied into the subsequent period. These provide distinctive, yet related, information on settlement

Table 6: Site persistence and annual growth rate

Period	No. sites	Backward continuity (%) ^a	Forward continuity (%) ^b	Population growth rate ^c (%)
Molotla	178	79.2		
Atlan	157	51.0	89.8	0.23
Pochtla	113	40.7	70.8	0.41
Epecapa (EPC)	121	51.2	38.0	-0.03
Tenayo (Epi)	94	42.6	66.0	0.04
Late Classic	128	91.4	31.3	0.26
Middle Classic	210	96.2	55.7	-0.94
Early Classic	222	61.7	91.0	-0.07
Terminal Formative	145	37.9	94.5	0.32
Late Formative	102	43.1	53.9	0.14
Middle Formative	55	5.5	80.0	0.21
Early Formative	4		75.0	1.06

^a% of sites that continued in occupation from the prior period. ^b% of sites that continue in occupation in the next period.

^cCompound average annual increase.

change through time. We also calculate the population growth rate, expressed as average annual increase (Chamberlain, 2006, p. 19–24). For this calculation the initial year plus one is the starting date of the period, and the final year is the end date for the period. The initial population is the total occupied site area for that period, and the final population is the total occupied area for the subsequent period. The population data (occupied area) are presented in Table 5(a), and the growth rates and continuity figures are presented in Table 6.

Table 6 reveals the two major episodes of high continuity of occupation: from Terminal Formative through Middle Classic, and from Pochtla through Molotla. The highest levels of continuity occurred during these two episodes, and the starting periods in these two episodes had the valley's highest population growth rates (Table 6). During the first interval, the Yautepec Valley was almost certainly controlled by the macro-regional system (likely an empire) based at Teotihuacan (Montiel, 2010), and in the second interval the valley was integrated into the Middle to Late Postclassic Mesoamerican world system (Smith & Berdan, 2003).

There were two episodes of high settlement discontinuity in the Yautepec Valley. The first, from the Late Classic to the Epiclassic, has the lowest level of settlement continuity of any transition, 31.3% (Table 6). Population grew at this time, with a population increase of 26%. In the second transition of discontinuity, only 38% of Early Postclassic sites continue to be occupied in Pochtla, showing a major change in the specific locations occupied within the valley. The occupation of major zones changed at this time as well, with less occupation of the floodplain and greater occupation of foothill zones (Table 5a). This discontinuity marks the time at which Smith (1984) had postulated the arrival of Nahuatl speakers in central Mexico on the basis of historical documents and archaeological evidence. The relevant Nahuatl-speaking group for Yautepec was the Tlahuica (Smith, 2010a). This issue is too complex to treat here, but our data are consistent with that interpretation. These two intervals of settlement transition represent dramatic changes in settlement locations in the Yautepec Valley, but they otherwise have dissimilar circumstances.

5.3 Off-Site Artifact Distributions

As part of our fieldwork methods, we made a series of standardized artifact collections along a series of seven transects across the valley. Each transect was placed to cut through at least two major sites from the Classic or Postclassic demographic peaks. The possibility that these may be informative of processes of urban sprawl was discussed previously by Smith (2010b), based on calculations carried out by Huster. The transects were created to evaluate the possibility of intensive use of farmland by manuring or other

fertilization methods that may have included the transport of domestic debris to cultivated fields. This topic has a history of research in the Mediterranean region (Alcock, Cherry, & Davis, 1994; Wilkinson, 1989), and we wanted to know if it could be addressed in Mesoamerica as well. Unfortunately, our results were vague and inconsistent, most likely because of the nature of our sampling.

Figure 22 shows the results for Transects 601 and 602. In both cases, there are a few collections with “off-site” artifacts surrounding the on-site collections, but it is not possible to determine whether these arose from more intensive use of land around settlements, or from the effects of modern plowing in moving artifacts outward from sites. These results do not support the inference of a zone of sprawl surrounding the Classic or Postclassic settlements in the valley. They do point to a difference in the use of nonsite areas in the two periods, however. In Transect 601, only 5% of the off-site collections contain diagnostic Classic-period sherds, while 38% contain sherds diagnostic of the Middle-Late Postclassic. The Classic period sherds are tightly clustered within three collections (300 m) of the edge of their period site, while the off-site Postclassic sherds extend up to 11 collections distant from an identified site. The patterning in Transect 602 also shows the different extent of off-site scatter for the two periods; while both periods have the same number of off-site collections (7/28, or 25%), those for the Classic period are mostly clustered within three collections of their associated site, while those for the Postclassic extend up to seven collections away. The patterns seen in these two transects are representative of those across all transects, despite variation in their geomorphological settings, which suggests that the different is a true product of differing use, rather than an effect of formation processes acting on sites of different ages. This finding both confirms our subjective interpretation from fieldwork and matches the well-documented situation in the Basin of Mexico (Sanders *et al.*, 1979), where Aztec-period sherds are ubiquitous in fields today.

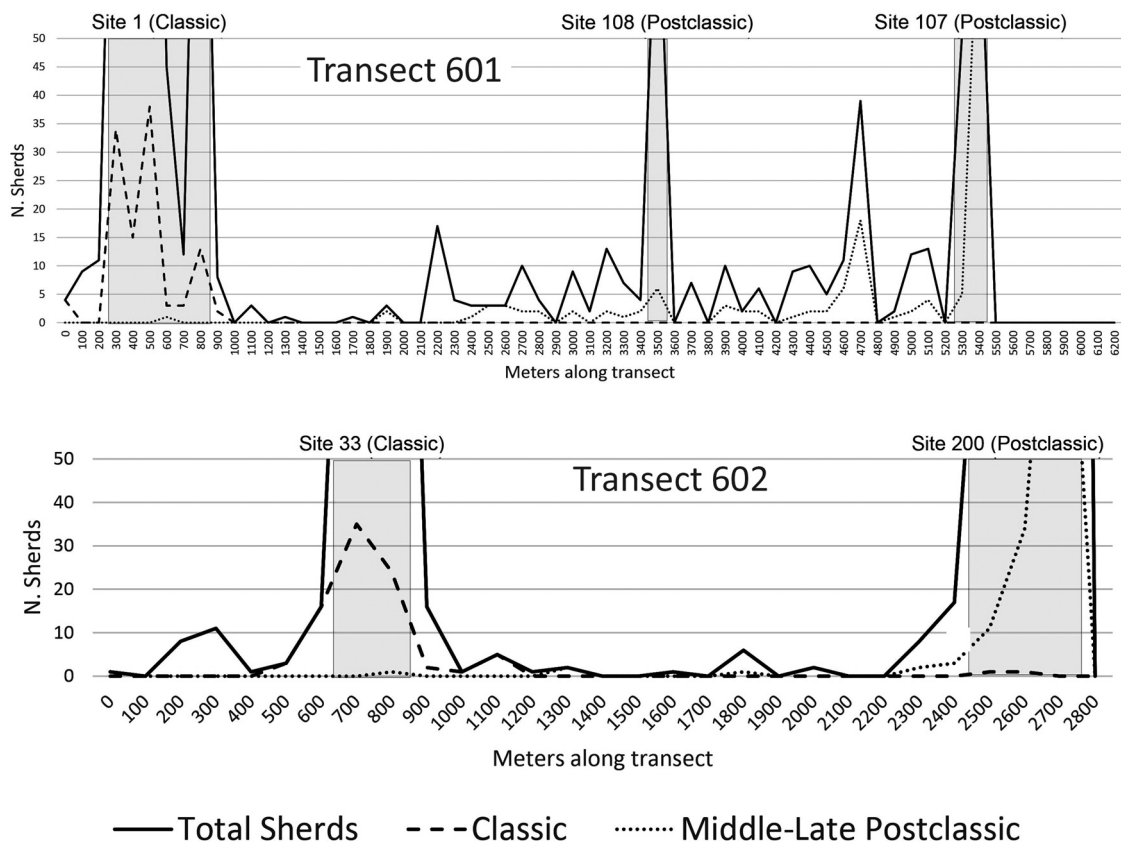


Figure 22: Sherd counts per collection along two systematic transects (nos. 601 and 602). For each collection, the total sherd count, number of Classic-period diagnostic sherds, and the number of Middle-Late Postclassic diagnostic sherds are shown. On-site collections are indicated by shading. The y-axis is capped at 50 sherds to emphasize the smaller off-site collection; many on-site collections have more than 50 sherds.

6 Processes of Change

Our survey of the Yautepec Valley of Central Mexico has revealed a long trajectory of changes over a period of more than 2000 years. Some of these changes paralleled those in other parts of the state of Morelos (Grove, Hirth, Bugé, & Cyphers, et al., 1976; Hirth, 2000; López Varela, 2009; Maldonado Jiménez, 1990; Martínez Donjuan, 1979; Nalda, 1997), while others were specific to the Yautepec Valley. Based on our descriptions of demography and settlement location by period, coupled with a focus on urbanization processes, we reconstruct the following major changes in the Valley. By “major change” we mean change that affected a large number of people, and/or a large area.

- (1) *Colonization and Growth of Agricultural Villages.* The earliest farming people moved into the Yautepec Valley at about the same time as other parts of the central Mexican highlands were colonized (Lesure, 2014; Nichols, 2015). In spite of evidence for irrigation technology at least as early the Middle Formative period (Borejsza et al., 2014), growth was slow. It took nearly a 1,000 years (until the Late Formative period) for the valley population to reach a level (ca. 200 occupied hectares, ca. 10,000 persons) that would remain a lower limit for the rest of the sequence (Table 5a, Figure 21b).
- (2) *The Imposition of Teotihuacan Rule.* All the available quantitative measure of settlement – population size and growth rate, continuity of occupation, and urbanization rates – support Montiel’s (2010) model for the incorporation of the Yautepec Valley into an empire based at Teotihuacan. The process began with economic and stylistic interaction in the Terminal Formative period, and then continued with incorporation as a provincial zone in the Early and Middle Classic periods. Teotihuacan control was evidently lifted in Late Classic times, although stylistic interaction with the distant metropolis continued.
- (3) *Change and Instability Between the Classic and Aztec Periods.* After the withdrawal of Teotihuacan from the Yautepec Valley (at the end of the Middle Classic period), the population and urbanization rate both crashed to low levels. Population and settlement location fluctuated for several centuries until the Aztec-period surge began. The degree and nature of interaction with external capitals – Xochicalco and Tula, respectively – is difficult to reconstruct, due at least partially to the lack of excavations of sites dating to this time in the Yautepec Valley.
- (4) *The Growth of City States and Empires in the Middle and Late Postclassic Periods.* The data from our survey are consistent with models developed earlier by Smith (Smith, 2001, 2003), and they illuminate an important local context for the major processes involved. This entire interval was a time of increased rainfall (Metcalf, 2006; Park et al., 2019), a development that Smith (2012, pp. 310–311) suggested might account for the growth of population at this time (Figure 21b). The major political–economic processes began with a growth in inter-regional trade within central Mexico during the Pochtla period, followed by the integration of central Mexico into a broad Mesoamerican world system in Atlán times. The Molotla period was when Morelos was incorporated into the Aztec empire. Finally, at the end of the Postclassic era, the Yautepec Valley and the rest of central Mexico were forcibly incorporated into the Spanish empire.

7 Conclusion

Our survey results suggest that the expansion and contraction of settlement, population, and urbanism were driven by distinct forces at different points in the Yautepec Valley sequence. Many of the settlement shifts – particularly movement onto and away from the floodplain – responded to demography and politics. The Valley was incorporated into two quite different spatially extensive political–economic systems: the Teotihuacan empire in the Classic period and the Mesoamerican world system in the Late Postclassic period. The political and economic dynamics were quite different in these two periods: imperial conquest and incorporation of the region under Teotihuacan in the Classic period, compared to patterns of local city-state growth parallel to other regions in the Late Postclassic period, incorporation into a broader realm of exchange, and then conquest by the Aztec empire. In spite of these differences in the macro-level dynamics

of these two periods, both saw population growth and significant urbanization in the Yauhtepec Valley. The urbanization level in both periods exceeded the level of urbanization in medieval and early modern Europe.

Our results support two general points about the value of systematic, intensive regional survey for studying past social dynamics in Mesoamerica. First settlement patterns, demography, and urbanization – as documented through quantitative data from the survey – allow the reconstruction of broad patterns of change through time. Excavations provide more intensive and detailed data about individual places, but surveys on their own can be highly informative about social patterns and changes in the deep past (Peterson & Drennan, 2012). Second, these results show the value of field research outside of the main core zones of Mesoamerica for understanding large-scale processes. The contrasts between the large-scale political–economic systems of the Classic and Late Postclassic periods – first recognized by fieldwork in the Basin of Mexico (Armillas, 1950; Sanders *et al.*, 1979) – are brought into greater relief through systematic surface survey in a nearby region that became incorporated into both systems.

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Conflict of interest: The authors state no conflict of interest.

Data availability statement: The datasets generated during and analyzed during the current study are available in the tDAR (the Digital Archaeological Record) repository, <https://core.tdar.org/project/459479/yauhtepec-archaeological-survey>.

References

- Alcock, S. E., Cherry, J. F., & Davis, J. L. (1994). Intensive survey, agricultural practice, and the classical landscape of Greece. In I. Morris (Ed.), *Classical Greece: Ancient histories and modern archaeologies* (pp. 137–190). New York: Cambridge University Press.
- Anders, F., & Jansen, M. E. R. G. N. (1988). *Shrift und buch im alten Mexico*. Graz: Akademische Druck- u. Verlagsanstalt.
- Anderson, J. H., Healan, D. M., & Cobean, R. H. (2015). Collapse, regeneration, and the origins of Tula and the Toltec State. In R. K. Faulseit (Ed.), *Beyond collapse: Archaeological perspectives on resilience, revitalization, and transformation in complex societies* (pp. 431–458). Carbondale: Southern Illinois University Press.
- Angel, S., Blei, A. M., Parent, J., Lamson-Hall, P., Galarza, N., Civco, D. L., ... Thom, K. (2016). *Atlas of urban expansion: 2016 Edition Volume 1: Areas and densities*. New York: New York University.
- Armillas, P. (1950). Teotihuacán, Tula y los toltecas: Las culturas post-arcaicas y pre-aztecas del centro de México. *Excavaciones y estudios, 1922–1950. Runa (Buenos Aires)*, 3, 37–70.
- Bairoch, P. (1988). *Cities and economic development: From the dawn of history to the present (C. Braider, Trans.)*. Chicago: University of Chicago Press.
- Barker, G., & Mattingly, D. (Eds.). (1999–2000). *The archaeology of Mediterranean landscapes*. Oxford: Oxbow Books.

- Barrett, W. (1970). *The sugar Hacienda of the Marquesas del Valle*. Minneapolis: University of Minnesota Press.
- Berdan, F. F. (1987). Cotton in Aztec Mexico: Production, distribution, and uses. *Mexican Studies/Estudios Mexicanos*, 3, 235–262.
- Berdan, F. F., Blanton, R. E., Boone, E. H., Hodge, M. G., Smith, M. E., & Umberger, E. (1996). *Aztec imperial strategies*. Washington, DC: Dumbarton Oaks.
- Berdan, F. F., Kepecs, S., & Smith, M. E. (2003). A perspective on late postclassic Mesoamerica. In M. E. Smith & F. F. Berdan (Eds.), *The Postclassic Mesoamerican world* (pp. 313–317). Salt Lake City: University of Utah Press.
- Blanton, R. E. (1972). *Prehistoric settlement patterns of the Ixtapalapa Region, Mexico* (Vol. 6). University Park, PA: Department of Anthropology, Pennsylvania State University.
- Borejsza, A., Frederick, C. D., & Lesure, R. G. (2011). Swidden agriculture in the Tierra Fría? Evidence from sedimentary records in Tlaxcala. *Ancient Mesoamerica*, 22(1), 91–106.
- Borejsza, A., Frederick, C. D., Morrett Alatorre, L., & Joyce, A. (2014). Alluvial stratigraphy and the search for preceramic open-air sites in Highland Mesoamerica. *Latin American Antiquity*, 25(3), 278–299.
- Borejsza, A., Morett Alaorre, L., & Lohse, J. C. (2021). Las Estacas: An early site in Morelos. In J. C. Lohse, A. Borejza, & A. A. Joyce (Eds.), *Preceramic Mesoamerica*. New York: Routledge.
- Canto Aguilar, G., & Castro Mendoza, V. M. (2010). Zazacatla in the framework of Olmec Mesoamerica. In J. Guernsey, J. E. Clark, & B. Arroyo (Eds.), *The place of stone monuments: Context, use, and meaning in Mesoamerica's Preclassic transition* (pp. 77–96). Washington, DC: Dumbarton Oaks.
- Chamberlain, A. T. (2006). *Demography in archaeology*. New York: Cambridge University Press.
- Clayton, S. C. (2016). After Teotihuacan: A view of collapse and reorganization from the Southern Basin of Mexico. *American Anthropologist*, 118(1), 104–120. doi: 10.1111/aman.12522.
- Cook de Leonard, C. (1985). Las almenas de Cinteopa. *Cuadernos de Arquitectura Mesoamericana*, 4, 51–56.
- Cyphers, A. (1987). Ceramics. In D. C. Grove (Ed.), *Ancient Chalcatzingo* (pp. 200–251). Austin: University of Texas Press.
- Cyphers, A., & Hirth, K. G. (2000). Ceramics of Western Morelos: The Cañada through Gobernador phases. In K. G. Hirth (Ed.), *The Xochicalco mapping project* (Vol. 2, pp. 102–135). Salt Lake City: University of Utah Press.
- Davis, K. (1968). The urbanization of the human population. *Scientific American*, 213(3), 3–16.
- de Vries, J. (1984). *European urbanization 1500–1800*. Cambridge: Harvard University Press.
- Diehl, R. A., & Berlo, J. (Eds.). (1989). *Mesoamerica after the decline of Teotihuacan, AD 700–900*. Washington, DC: Dumbarton Oaks.
- Donahue, J. (1994). Yautepec, Mexico: Preservation of Aztec and older sites within the Río Yautepec drainage system. *Paper presented at the 1994 Annual Meeting*. Geological Society of America.
- Drennan, R. D., Berrey, C. A., & Peterson, C. E. (2015). *Regional settlement demography in archaeology*. Bristol, CT: Eliot Werner Publications.
- Etchevers, J. D., Hidalgo, C., Prat, C., & Quantin, P. (2003). Tepetates of Mexico. In R. Lal (Ed.), *Encyclopedia of soil science* (pp. 1745–1748). New York: Marcel Dekker.
- Fish, S. K., & Kowalewski, S. A. (Eds.). (1990). *The archaeology of regions: The case of full-coverage survey*. Washington, DC: Smithsonian Institution Press.
- Fries, C. Jr. (1960). *Geología del Estado de Morelos y de Partes Adyacentes de México y Guerrero* (Vol. 60). Mexico City: Universidad Nacional Autónoma de México.
- García Chávez, R., Gamboa Cabezas, L. M., & Vélez Saldaña, N. V. (2015). Los sitios rurales y la estrategia expansionista del estado Teotihuacano para la captación de recursos en la Cuenda de México. *Ancient Mesoamerica*, 26(2), 423–442.
- García Maya, L. I., & González Quezada, R. F. (2015). Costumbres funerarias de cremación en El Tlatoani, Tlayacapan, Morelos. *El Tlacuache: Suplemento Cultural*, 686(Agosto 9), 1–4.
- Garza Tarazona, S., & González Crespo, N. (2006). Cerámica de Xochicalco. In B. L. Merino Carrión & Á. García Cook (Eds.), *La producción alfarera en el México antiguo, Vol. 3* (Vol. 502, pp. 126–160). Mexico City: Instituto Nacional de Antropología e Historia.
- Golitzko, M., & Feinman, G. M. (2015). Procurement and distribution of pre-Hispanic Mesoamerican Obsidian 900 BC – AD 1520: A social network analysis. *Journal of Archaeological Method and Theory*, 22, 206–247.
- Grove, D. C. (1974). *San Pablo, Nexpa, and the early formative archaeology of Morelos, Mexico* (Vol. 12). Nashville: Department of Anthropology, Vanderbilt University.
- Grove, D. C. (Ed.). (1987). *Ancient Chalcatzingo*. Austin: University of Texas Press.
- Grove, D. C., Hirth, K. G., Bugé, D., & Cyphers, A. (1976). Settlement and cultural development at Chalcatzingo. *Science*, 192, 1203–1210.
- Hare, T. S. (2001). *Political economy, spatial analysis, and Postclassic states in the Yautepec Valley, Mexico*. (PhD dissertation). University at Albany, SUNY, Albany.
- Hare, T. S. (2004). Using measures of cost distance in the estimation of polity boundaries in the Postclassic Yautepec Valley, Mexico. *Journal of Archaeological Science*, 31, 799–814.
- Hare, T. S., & Smith, M. E. (1996). A new Postclassic chronology for Yautepec, Morelos. *Ancient Mesoamerica*, 7, 281–297.
- Hirth, K. G. (1980). *Eastern Morelos and Teotihuacan: A settlement survey* (Vol. 25). Nashville: Department of Anthropology, Vanderbilt University.

- Hirth, K. G. (Ed.). (2000). *Archaeological research at Xochicalco. Volume 1, ancient urbanism at Xochicalco: The evolution and organization of a pre-Hispanic society. Volume 2, The Xochicalco mapping project*. Salt Lake City: University of Utah Press.
- Hirth, K. G., & Cyphers, A. (1988). *Tiempo y asentamiento en Xochicalco*. Mexico City: Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México.
- Huster, A. C. (2018). Regional-level exchange in Postclassic Central Mexico. *Journal of Anthropological Archaeology*, 50, 40–53.
- Huster, A. C. (2019). Looming deficits: Textile production specialization in Postclassic Mesoamerica. *Latin American Antiquity*, 30(4), 780–797. doi: 10.1017/laq.2019.74.
- Kirkby, A. V. T., & Kirkby, M. (1976). Geomorphic processes and the surface survey of archaeological sites in Semi-Arid areas. In D. Davidson & M. Shackley (Eds.), *Geoarchaeology* (pp. 229–254). London: Duckworth.
- Kowalewski, S. A., Feinman, G. M., Finsten, L., Blanton, R. E., & Nicholas, L. M. (1989). *Monte Alban's Hinterland, Part II: Prehispanic settlement patterns in Tlacolula, Etla, and Ocotlan, The Valley of Oaxaca, Mexico* (Vol. 23). Ann Arbor: Museum of Anthropology, University of Michigan.
- Lesure, R. G. (2014). Macroregional research topics for formative central Tlaxcala. In R. G. Lesure (Ed.), *Formative lifeways in central Tlaxcala. Volume 1: Excavations, ceramics, and chronology* (pp. 363–370). Los Angeles: Cotsen Institute of Archaeology Press.
- Lesure, R. G., Carballo, J., Carballo, D. M., Borejsza, A., & Rodríguez López, I. (2014). A formative chronology for central Tlaxcala. In R. G. Lesure (Ed.), *Formative lifeways in central Tlaxcala. Volume 1: Excavations, ceramics, and chronology* (pp. 315–362). Los Angeles: Cotsen Institute of Archaeology Press.
- López Varela, S. (Ed.). (2009). *La arqueología en Morelos: Dinámicas sociales sobre las construcciones de la cultura material* (Vol. 2). Cuernavaca: Poder Ejecutivo del Estado de Morelos/Universidad Autónoma del Estado de Morelos/Ayuntamiento de Cuernavaca/Instituto de Cultura de Morelos.
- Maldonado Jiménez, D. (1984). Producción agrícola en el Morelos Prehispánico. In H. Crespo (Ed.), *Morelos: Cinco siglos de historia regional* (pp. 49–72). Cuernavaca: Universitaria Autónoma del Estado de Morelos.
- Maldonado Jiménez, D. (1990). *Cuauhnahuac y Huaxtepec: Tlalhuicas y Xochimilcas en el Morelos prehispánico*. Cuernavaca: Centro Regional de Investigaciones Multidisciplinarias, Universidad Nacional Autónoma de México.
- Martínez Donjuan, G. (1979). *Las Pilas, Morelos* (Vol. 75). Mexico City: Instituto Nacional de Antropología e Historia.
- Metcalfe, S. E. (2006). Late quaternary environments of the northern deserts and central transvolcanic belt of Mexico. *Annals of the Missouri Botanical Garden*, 93, 258–273.
- Montiel, L. (2010). *Teotihuacan imperialism in the Yautepec Valley, Morelos, Mexico*. (PhD dissertation). University at Albany, SUNY, Albany.
- Morett Alatorre, L., Sánchez Martínez, F., & Alvarado, J. L. (2000). Ofrendas agrarias del formativo en Ticumán, Morelos. In J. Litvak King & L. Mirambell (Eds.), *Arqueología, historia y antropología en memorium, José Luis Lorenzo Bautista* (pp. 103–115). Mexico City: Instituto Nacional de Antropología e Historia.
- Nalda, E. (1997). El noreste de Morelos y la desestabilización teotihuacana. *Arqueología*, 18, 103–117.
- Neff, H., Glascock, M., Montiel, L., & Smith, M. E. (2006). Análisis por activación de neutrones en la cerámica clásica de la época clásica. In M. E. Smith (Ed.), *Reconocimiento superficial del Valle de Yautepec, Morelos: Informe final*. Report submitted to the Instituto Nacional de Antropología e Historia.
- Nichols, D. L. (1996). An overview of regional settlement pattern survey in Mesoamerica: 1960–1995. In A. G. Mastache, J. R. Parsons, R. S. Santley, & M. C. Serra Pucho (Eds.), *Arqueología Mesoamericana: Homenaje a William T. Sanders* (Vol. 1, pp. 59–95). Mexico City: Instituto Nacional de Antropología e Historia.
- Nichols, D. L. (2015). Intensive agriculture and early complex societies of the basin of Mexico: The formative period. *Ancient Mesoamerica*, 26(2), 407–422.
- Nichols, D. L. (2016). Teotihuacan. *Journal of Archaeological Research*, 24(1), 1–74.
- Nichols, D. L., & Stoner, W. D. (2019). Before Teotihuacan: Altica, exchange, interactions, and the origins of complex society in the northeast basin of Mexico. *Ancient Mesoamerica*, 30(2), 369–382.
- Nimlos, T. J. (1989). The density and strength of Mexican Tepetate. *Soil Science*, 147, 23–27.
- Ochoa Castillo, P., & Román Torres, R. L. (2017). Urdimbres enlazadas de Mesoamérica: Textil de la Cueva del Gallo, Morelos, México. In L. Bjerregaard & A. Peters (Eds.), *PreColumbian textile conference VII/Jornadas de textiles PreColombinos VII* (pp. 40–49). Lincoln, NB: Zea Books.
- Ochoterena, F. H. (1977). Origen y edad del Tepozteco. *Boletín del Instituto de Geografía*, 8, 41–54.
- Oliveira, E. A., Furtado, V., Andrade, J. S., & Makse, H. A. (2018). A worldwide model for boundaries of urban settlements. *Royal Society Open Science*, 5(5), 108468.
- Ortiz Pérez, M. A. (1977). Estudio geomorfológico del glacis de Buenavista, estado de Morelos. *Boletín del Instituto de Geografía, Universidad Nacional Autónoma de México*, 8, 25–40.
- Park, J., Byrne, R., & Böhnell, H. (2019). Late Holocene climate change in Central Mexico and the decline of Teotihuacan. *Annals of the American Association of Geographers*, 109(1), 104–120.
- Parsons, J. R. (1971). *Prehistoric settlement patterns in the Texcoco Region, Mexico* (Vol. 3). Ann Arbor: Museum of Anthropology, University of Michigan.
- Parsons, J. R., Brumfiel, E. M., & Hodge, M. (1996). Developmental Implications of Earlier Dates for Early Aztec in the Basin of Mexico. *Ancient Mesoamerica*, 7, 217–230.

- Parsons, J. R., Brumfiel, E. M., Parsons, M. H., & Wilson, D. J. (1982). *Prehispanic settlement patterns in the southern valley of Mexico: The Chalco-Xochimilco region* (Vol. 14). Ann Arbor: Museum of Anthropology, University of Michigan.
- Parsons, J. R., Kintigh, K. W., & Gregg, S. A. (1983). *Archaeological settlement pattern data from the Chalco, Xochimilco, Ixtapalapa, Texcoco, and Zumpango Regions, Mexico* (Vol. 14). Ann Arbor: Museum of Anthropology, University of Michigan.
- Parsons, J. R., & Sugiura, Y. Y. (2012). Teotihuacan and the Epiclassic in Central Mexico. In D. L. Nichols & C. Pool (Eds.), *The Oxford handbook of Mesoamerican archaeology* (pp. 309–323). New York: Oxford University Press.
- Pastrana, A., & Domínguez, S. (2009). Cambios en la estrategia de la explotación de obsidiana de Pachuca: Teotihuacan, Tula, y Triple Alianza. *Ancient Mesoamerica*, 20, 129–148.
- Peterson, C. E., & Drennan, R. D. (2012). Patterned variation in regional trajectories of community growth. In M. E. Smith (Ed.), *The comparative archaeology of complex societies* (pp. 88–137). New York: Cambridge University Press.
- Piña Chán, R., & López González, V. (1952). Excavaciones en Atlahuayan, Morelos. *Tlatoani*, 1, 12–14.
- Rattray, E. C. (1990). New findings on the origins of thin orange ceramics. *Ancient Mesoamerica*, 1, 181–196.
- Riley, G. M. (1973). *Fernando Cortés and the Marquesado in Morelos, 1522–1547*. Albuquerque: University of New Mexico Press.
- Robelo, C. (1912). Origen del Calendario Nahuatl. In *Apéndice, Reseña de la Segunda Sesión del XVII Congreso Internacional de Americanistas Efectuada en la Ciudad de México durante del Mes de Septiembre de 1910* (pp. 9–21). Mexico City: Imprenta del Museo de Arqueología, Historia y Etnología.
- Sanders, W. T. (1956). The Central Mexican symbiotic region: A study in prehistoric settlement patterns. In G. R. Willey (Ed.), *Prehistoric settlement patterns in the new world* (Vol. 23, pp. 115–127). New York: Wenner-Gren Foundation for Anthropological Research.
- Sanders, W. T., Parsons, J. R., & Santley, R. S. (1979). *The Basin of Mexico: Ecological processes in the evolution of a civilization*. New York: Academic Press.
- Sanders, W. T., & Santley, R. S. (1983). A tale of three cities: Energetics and urbanization in pre-hispanic Central Mexico. In E. Z. Vogt & R. Leventhal (Eds.), *Prehistoric settlement patterns: Essays in honor of Gordon R. Willey* (pp. 243–291). Albuquerque: University of New Mexico Press.
- Schiffer, M. B. (1987). *Formation processes of the archaeological record*. Albuquerque: University of New Mexico Press.
- Smith, M. E. (1984). The Aztlan migrations of the Nahuatl Chronicles: Myth or history? *Ethnohistory*, 31, 153–186.
- Smith, M. E. (1994). Economies and polities in Aztec-period Morelos: Ethnohistoric introduction. In M. G. Hodge & M. E. Smith (Eds.), *Economies and polities in the Aztec Realm* (pp. 313–348). Albany: Institute for Mesoamerican Studies.
- Smith, M. E. (2001). The Aztec Empire and the Mesoamerican world system. In S. E. Alcock, T. N. D’Altroy, K. D. Morrison, & C. M. Sinopoli (Eds.), *Empires: Perspectives from archaeology and history* (pp. 128–154). New York: Cambridge University Press.
- Smith, M. E. (2003). Economic change in Morelos households. In M. E. Smith & F. F. Berdan (Eds.), *The Postclassic Mesoamerican world* (pp. 249–258). Salt Lake City: University of Utah Press.
- Smith, M. E. (2004). Los hogares de Morelos en el sistema mundial Mesoamericana postclásico. *Relaciones (El Colegio de Michoacán)*, 25(99), 79–113.
- Smith, M. E. (2008). *Aztec city-state capitals*. Gainesville: University Press of Florida.
- Smith, M. E. (2010a). Regional and local market systems in Aztec-period Morelos. In C. P. Garraty & B. L. Stark (Eds.), *Archaeological approaches to market exchange in ancient societies* (pp. 161–182). Boulder: University Press of Colorado.
- Smith, M. E. (2010b). Sprawl, squatters, and sustainable cities: Can archaeological data shed light on modern urban issues? *Cambridge Archaeological Journal*, 20, 229–253.
- Smith, M. E. (2012). *The Aztecs* (3rd ed.). Oxford: Blackwell Publishers.
- Smith, M. E. (2016). *At home with the Aztecs: An archaeologist uncovers their domestic life*. New York: Routledge.
- Smith, M. E. (Ed.). (2006). *Reconocimiento superficial del Valle de Yautepec, Morelos: Informe final*. Report submitted to the Instituto Nacional de Antropología e Historia. Archived at: <https://core.tdar.org/document/380993/reconocimiento-superficial-del-valle-de-yautepec-morelos-informe-final>
- Smith, M. E. (Ed.). (2019). *Excavaciones de casas en la ciudad azteca de Yautepec, Morelos, México*. Oxford: Archaeopress.
- Smith, M. E., & Berdan, F. F. (Eds.). (2003). *The Postclassic Mesoamerican world*. Salt Lake City: University of Utah Press.
- Smith, M. E., Heath-Smith, C., Kohler, R., Odess, J., Spanogle, S., & Sullivan, T. (1994). The size of the Aztec city of Yautepec: Urban survey in Central Mexico. *Ancient Mesoamerica*, 5, 1–11.
- Smith, M. E., & Montiel, L. (2001). The archaeological study of empires and imperialism in Prehispanic Central Mexico. *Journal of Anthropological Archaeology*, 20, 245–284.
- Smith, M. E., & Montiel, L. (2008). Figurillas cerámicas e interacción interregional en el Valle de Yautepec desde el período Formativo al Postclásico. In A. Cyphers & K. G. Hirth (Eds.), *Ideología política y sociedad en el periodo formativo: Ensayos en homenaje al doctor David C. Grove* (pp. 249–282). Mexico City: Universidad Nacional Autónoma de México.
- Solleiro-Rebolledo, E., Sedov, S., Gama-Castro, J. E., & Flores-Román, D. (2003). Paleosol-sedimentary sequences of the Glacis de Buenavista, central Mexico: Interaction of late quaternary pedogenesis and volcanic sedimentation. *Quaternary International*, 106–107, 185–201.
- Stoner, W. D., & Nichols, D. L. (2019). The Altica project: Reframing the formative in the Basin of Mexico. *Ancient Mesoamerica*, 30(2), 247–265.

- Sugiura Yamamoto, Y. (2005). Reacomodo demográfico y conformación multi-etnica en el valle de Toluca durante el Posclásico: Una propuesta desde la arqueología. In L. R. Manzanilla (Ed.), *Reacomodos demográficos del clásico al postclásico en el centro de México* (pp. 175–202). Mexico City: Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México.
- Vaillant, G. C., & Vaillant, S. B. (1934). *Excavations at Gualupita* (Vol. 35, no. 1). New York: American Museum of Natural History.
- Vidal Zepeda, R. (1980). *Algunas Relaciones Clima-Cultivos en el Estado de Morelos*. Mexico City: Universidad Nacional Autónoma de México.
- Whitmore, T. M. (1992). *Disease and death in early colonial Mexico: Simulating Amerindian depopulation*. Boulder: Westview Press.
- Wilkinson, T. J. (1989). Extensive sherd scatters and land-use intensity: Some recent results. *Journal of Field Archaeology*, 16, 31–46.
- Williams, B. J. (1972). Tepetate in the Valley of Mexico. *Annals of the Association of American Geographers*, 62, 618–626.
- Woods, R. (2003). Urbanisation in Europe and China during the second millennium: A review of urbanism and demography. *International Journal of Population Geography*, 9(3), 215–227.
- Wrigley, E. A. (1990). Brake or accelerator? Urban growth and population growth before the industrial revolution. In A. van de Woude, A. Hayami, & J. de Vries (Eds.), *Urbanization in history: A process of dynamic interactions* (pp. 101–112). Oxford: Clarendon Press.