Transportation corridors and political evolution in highland Mesoamerica: Settlement analyses incorporating GIS for northern Tlaxcala, Mexico

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Received 10 October 2006; revision received 2 May 2007
Available online 12 June 2007

Abstract

Investigations of the functional utility and social elaboration of natural transportation corridors contribute to generating more comprehensive understandings of complex macroregional phenomena such as political evolution. In this article, highland central Mexican transportation corridors are analyzed through GIS applications and a reconsideration of settlement data from an important corridor in northern Tlaxcala. The location of the study region, within the corridor connected to the north-eastern Basin of Mexico, makes it particularly relevant for examining interregional exchanges and the transformation of a more rural landscape adjacent to core areas of urbanization and state political expansion. Conclusions drawn from the study are largely complementary to the interpretations made by the surveyors [Merino Carrión, B.L., 1989. La Cultura Tlaxco. Serie Arqueológica, Colección Científica 174, Instituto Nacional de Antropología e Historia, Mexico City], but provide an updated assessment of prehispanic political evolution ca. 900 BC–AD 1519. Specifically, the study tracks the evolution of early ceremonial centers, Teotihuacan’s territorial expansion through the region, political balkanization following the collapse of Teotihuacan, and the establishment of small, independent polities encountered by the Spanish. New contributions include quantitative measures relevant to assessing the systemic integration of the region and the social value of the corridor during different chronological phases, elucidating the differing expansionary trajectories of Teotihuacan and the Aztec Empire.

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Keywords: State expansion; Settlement analysis; GIS; Cost path; Transportation corridor; Mesoamerica

Highland peoples across the world negotiate the rugged terrain around them through natural transportation corridors that facilitate the movement of individuals, goods, and ideas within highland environments and between highlands and lowlands. Such corridors expedite the cumulative processes of cultural exchange, becoming important nodes in political evolution and frequent targets for control by dominant polities. The highland civilizations of prehispanic Mesoamerica developed particular strategies for establishing interregional contacts through inter-montane corridors, without the assistance of pack animals or wheeled vehicles. These exchanges included economic and ideological relations between largely autonomous Formative...
polities (ca. 1200 BC–AD 100), and the more extensive political entanglements centered on the urban states and empires of the Classic and Postclassic periods (ca. AD 100–1519) (Fig. 1).

In this study, we incorporate settlement analyses assisted by GIS applications and new data from recent excavations at the largest Formative period center in northern Tlaxcala, a region which straddles an important transportation corridor leading from the Basin of Mexico to points east and south (Fig. 2). We consider social processes of varying scales, including internal political dynamics and the effects of multiregional phenomena such as urbanization and state expansion centered in regions adjacent to the study area. Drawing on multiple lines of evidence, our study illuminates political processes that affected prehispanic central Mexico at several levels, with general implications for the study of ancient cultural geography, polity formation, and political expansion.

Transportation corridors and political evolution

Archeologists have identified several important commonalities among cases of political evolution in past societies. Significant among these is the relationship between decision-making infrastructure, transportation capabilities, and polity size. Whereas
polities lacking internally specialized bureaucratic institutions that could effectively administer distant communities were restricted to control radii consistent with a one day journey from the political capital, those that evolved or adopted such institutions were capable of consolidating much larger territories into expansive states or empires (Spencer, 1990, 1998; Wright, 1984, 1986). Several historically and archaeologically well-documented cases support the proposition that territorial expansion provided the initial stimuli for the evolution of bureaucratic control institutions (Algaze, 1993; Flannery, 1999; Tilly, 1990; Wright, 2006). In these cases state political institutions followed cycles of sustained conflict as a means of initiating tributary payments and/or securing access to distant, valued resources.

Other dynamics in the processes of political evolution are more temporally and spatially contingent. They include the relative degrees of administrative complexity of neighboring communities and societies; the myriad goals and motivations of individuals along the sociopolitical and settlement spectrum; regional distributions of resources, and natural and technological factors involved in accessing them. The effective balancing of such considerations for particular archaeological sequences requires multi-scalar approaches that successfully account for observable patterning at the community, regional, and macroregional levels.

Comparative multi-scalar approaches are often useful in illustrating general trends that are relevant to investigating political evolution and to anthropological model building. For instance, in discussing early Andean state expansion Schreiber (1987) and Stanish (2003) note the importance of the particular historical conditions separating their cases from later Inca imperial expansion. At a broad level, however, both authors accentuate the significance of lower pre-existing complexity to the expansionary strategies pursued by Wari and Tiwanaku leaders, respectively, and the manner in which these differed from Inca imperial policies (see also Jennings and Craig, 2001).

Interest in the dialectic between political power and resistance has moved to the forefront in archaeology as a result of the increased attention focused on past human agency, and the proliferation of excavations away from ancient political capitals. We echo the sentiments of a number of researchers regarding the necessity of considering the array of motivations and/or constraints on the inhabitants of expansionary polities, as well as those of the smaller polities that were subject to, or threatened by such expansion (e.g., Falconer and Savage, 1995; Gledhill, 1988; Stein, 2002). Resistance strategies and the differing motivations of political subordinates are often elusive in cases lacking textual evidence; however, robust archaeological datasets provide multiple dimensions for considering their roles more carefully. For example, archaeologists working in Oaxaca, Mexico, combine multiple lines of evidence in documenting the more erratic, less incremental expansion of the Monte Albán state, the prioritization by state leaders of controlling key transportation corridors, and the varied reactions of neighboring communities organized at differing levels of complexity (Balkansky, 2002; Marcus and Flannery, 1996, pp. 195–207; Spencer and Redmond, 2006).

Territorial expansion and strategies of control pursued by political elites were frequently shaped by the rapidity by which goods, armies, and information could move across the surrounding landscape. What constitutes a transportation corridor may vary widely among societies (i.e., rivers, straights, mountain passes). Their desirability is related to their proximity to valued resources and exchange networks, existing transportation technologies, and other contingent factors such as those mentioned above. Because of their importance for channeling human exchanges, the identification of desired transportation corridors, and the explanation of changes in their usage over time, significantly contributes to understanding macroregional phenomena such as political evolution (Algaze, 1993; Burghardt, 1971; Hirth, 1978a; Sherratt, 2000). Contemporary GIS applications assist in the accurate recognition of important corridors, and allow us to reanalyze settlement patterning within and surrounding them from preexisting survey projects, providing another compelling line of evidence for elucidating larger-scale processes.

Political evolution and the Mexican altiplano

Although likely apocryphal, the often repeated story of Cortés crumpling a piece of paper before Carlos I as a visual representation of New Spain nicely illustrates that its contoured landscape has long been recognized as circumscribing human movements (Melville, 2000, pp. 215–216; see also Cortés, 1519/1986a, p. 29). The wide basins, valleys, and plains of the Mesoamerican highlands are separated by volcanic ranges often rising 500–2000 m from their floors and channeling movement through the corridors between them. Coupled with the exclusive reliance on human portage for overland movements of goods,
this ecological setting provided particular structural conditions within which highland peoples pursued strategic economic and political interactions with their neighbors and more distant societies. Among these, many researchers have emphasized the role of transportation corridors in interregional exchange and the expansionary strategies pursued by the leaders of highland state polities, including Teotihuacan and the Aztec (Triple Alliance) Empire (e.g., Charlton, 1978, 1991; Drennan, 1984; García Cook and Merino Carrión, 1977, 1996; Hassig, 1985; Hirth, 1978a; Litvak King, 1978; Santley and Pool, 1993). These highland polities politically integrated large portions of central Mexico and leveraged access to desired resource zones elsewhere in Mesoamerica in a variety of ways, all ultimately backed by large, well-organized armies. The multiregional political strategies of the ethnohistorically documented Aztec are much better known to us than is the case for Teotihuacan, whose political influence outside the Basin of Mexico has been reconstructed primarily through settlement analyses and the presence of Teotihuacano products or styles abroad (compare Millon, 1988; Smith and Hodge, 1994).

Whether considering large expansionistic states or smaller polities that nevertheless interacted frequently with other regions, Mesoamerican scholars recognize the importance of multiregional social phenomena in stimulating settlement changes in one particular region or sub-region (Balkansky, 2006). We follow in this tradition by reconsidering settlement patterns from northern Tlaxcala within the context of large-scale developments that likely affected them—as was also done by the original surveyors of the region (García Cook, 1981; García Cook and Merino Carrión, 1996; Merino Carrión, 1989). Additionally, we contribute new insights based on excavation data and analytical methods not available to the surveyors at the time their work was undertaken.

Important multiregional phenomena likely to have affected communities in northern Tlaxcala include: (1) highland–lowland exchanges in goods and ideas running east–west through the region; (2) the urbanization of central Mexico during the first few centuries BC; (3) Teotihuacan’s political/territorial expansion and provincial administration during the first six centuries AD; (4) macroregional balkanization into competing city-states following the collapse of Teotihuacan; and (5) regional resistance to Aztec imperial expansion prior to the Spanish Conquest. In reconstructing the political evolution and interregional interactions of northern Tlaxcalan communities we gain an improved appreciation for the macroregional scale of these developments, away from their more archaeologically conspicuous centers.

The study region and database

The database used in this study was compiled through intensive survey in 1972–1975 by the Proyecto Arqueológico del Norte de Tlaxcala (PANT) under the direction of Ángel García Cook (published by Merino Carrión in 1989). The study area covers 1200 km² of northern Tlaxcala and Merino Carrión (1989, pp. 27–30) estimated that 90% of the study region was covered by the survey, documenting approximately 95% of archaeological sites.²

² García Cook (1972) described spacing between surveyors as not having exceeded 200 m, yet does not mention the most commonly used interval. When sites were encountered, their locations were recorded on a 1:50,000 scale aerial photos. Intensive site walking established their boundaries, chronological classifications were based on surface artifacts gathered by spot collections, and environmental, architectural, and artifactual information was recorded for each site (forms are reproduced in García Cook, 1972 and Merino Carrión, 1989). The PANT surveyors incorporated sites identified by Snow, who had published the results of his partially overlapping survey prior the initiation of the PANT project (Snow, 1966, 1969). They added to his list and recorded over twice the density of sites in areas where the two surveys overlap (approximately 0.12/km² and 0.05/km², respectively). Total site density is over nine-times lower for the PANT region when compared to the density recorded for 3500 km² in the Basin of Mexico (approximately 1.10/km²; Sanders et al., 1979, p. 185). However, we contend that this discrepancy reflects the different demographic histories of these two regions, rather than any serious variability in the site recovery rates of the two surveys.

The estimated 90% survey coverage and 95% settlement recovery cited by Merino Carrión are not elaborated on further. We assume that the unsurveyed portions include areas that were covered in modern habitation during the mid-1970s, and the upper regions of the Sierra Tlaxco and Sierra Terrenate, which provide a natural boundary for the survey region and state of Tlaxcala running northwest to southeast. This boundary is meaningful in terms of containing settlement, and the study region as a whole is generally a coherent unit consisting of the Continental Divide, with the upper portions of the Zahuapan and Apulco drainages. Nevertheless, the western and southern boundaries of the survey region are arbitrarily defined, and simply represent the final swath of the greater Tlaxcala–Puebla region to be surveyed by García Cook’s team. Unfortunately, data from adjacent areas acquired by García Cook and INAH Tlaxcala are not available in a format that would allow us to extend our analyses in these directions—the primary data of the former not being published in an accessible format such as was done by Merion Carrión, and the latter being chronologically coded into overly broad Formative, Classic, and Postclassic phases. However, as we argue in our interpretations of the data, we believe that the large majority of PANT settlements represent a meaningful unit of analysis, except for occasional clusters of sites in the southwestern portion of the study region, which we comment on in the main text.
Although the region is slightly more marginal for agriculture than the southern central highlands—with a valley floor over 2500 m.a.s.l. receiving approximately 80 cm of precipitation a year—its prehispanic inhabitants were continuously connected to the macroregional interaction spheres of greater central Mexico (García Cook, 1981). Presently, the railroad and freeway connecting Mexico City to the port of Veracruz run through the southern portion of the study region, offering a modern analogy to its importance as a trade corridor in prehispanic times.

One of the many interesting patterns documented by Ángel García Cook in his archaeological survey of the Puebla–Tlaxcala region was the dramatic shift in settlement coinciding with Classic period urbanization at Teotihuacan and Cholula—which arose at alternate ends of the region to the northwest and south, respectively (García Cook, 1981; García Cook and Merino Corrión, 1996; García Cook and del Carmen Trejo, 1977). García Cook characterized northern Tlaxcala as possessing a “Teotihuacan Sphere,” consisting of northwestern sites exhibiting strong material affinities to the city, which likely formed the eastern portion of the core of the polity (see also Millon, 1988). He also designated a “Teotihuacan Corridor” running northwest to southeast through northern Tlaxcala, consisting of sites exhibiting weaker material affinities to the city, but which differed significantly from the local Tenayecac phase culture (AD 100–600) found outside the natural corridor of transportation (see also Vega Sosa, 1981).

The PANT survey region consists of this natural transportation corridor—which we refer to hereafter as the Tlaxcala Corridor, as we discuss it within the context of developments preceding and following Teotihuacan—and the mountain ranges that enclose it to the north (Fig. 3). The eastern portion of the study region is located at the opening to a second natural transportation corridor, extending

![Fig. 3. Northern Tlaxcala study region with transportation corridors.](image-url)
southwest to northeast from the Tlaxcala Corridor into northern Puebla through these mountain ranges, between the western Sierra of Tlaxco and the eastern Sierra of San Nicolás Terrenate. This canyon was cut by the Apulco River and is best known to central Mexican scholars as Cortés’s likely point of entry into independent Tlaxcala, arriving from the town of Ixtacamaxtitlan en route to Tenochtitlan (Angulo Ramírez, 2004, p. 15; Cortés, 1519/1986b, pp. 56–58; Davies, 1968, p. 67; García Martínez, 2001; Muñoz Camargo, 1584/2000, pp. 104–105). We will refer to this second transportation corridor as the Apulco Canyon.

Research methods

Our analyses incorporated a multi-scalar approach: (1) quantifying the utility of the Tlaxcala Corridor for interregional transportation relative to other potential corridors; (2) examining spatial distributions between sites in the PANT survey region during different chronological phases to assess potential hierarchical relationships between contemporaneous sites, and site locations relative to the Tlaxcala Corridor; and (3) calculating rank-size distributions for each phase in the region using the A coefficient with bootstrapped error ranges following the work of Drennan and Peterson (2004).

We met these objectives through the construction of a GIS database for central Mexico, and by manipulating and modifying the PANT data so that it could be incorporated into the database and rank-size analyses. In constructing the GIS database we used a surface elevation mosaic with finished three-arc-second raster data (90 m elevations) acquired from the Shuttle Radar Topography Mission (www.seamless.usgs.gov). This step allowed for the production of detailed topographic maps on which spatially referenced data could be projected and analyzed.

The least cost path analysis involved calculating the least accumulative cost of travel between features for each cell in the raster dataset, taking into account surface distance, horizontal-cost factors, and vertical-cost factors. Specifically, we utilized the hiker function developed by Tobler (1993) in conjunction with the Pathdistance tool in ArcInfo (ESRI, Inc.) to create an anisotropic friction surface representing the time in hours of foot travel from various features, as well as a second surface representing the most efficient direction of travel. These surfaces were then used with the cost path tool in ArcGIS (ESRI, Inc.) to plot the routes with the least travel time. Our methods are similar to those used by Jennings and Craig (2001), but we were interested in calculating travel time as a means of defining important transportation corridors, rather than in defining political boundaries.

It should be noted that this type of least cost analysis has a number of potential errors, owing to limitations on the manner in which the accumulated costs and directions are calculated (see Conolly and Lane, 2006, pp. 221–224; Wheatley and Gillings, 2002, pp. 154–158). Nevertheless, we believe that the least cost path analysis provides a reasonably accurate relative estimate of the difficulty of foot travel across the landscape, as well as the most likely routes of travel for the region’s inhabitants (see Aldenderfer, 1998; Kantner, 1997). Physiographic factors such as rivers and vegetative cover have not been considered in our analysis. However, the narrow rivers and streams of the region provide relatively few impediments, and vegetation is most dense on the slopes of its volcanic ranges—only augmenting the relative costs of slope travel.

Our features included sites from the PANT survey, other important central Mexican sites outside of the survey region, Monte Albán, and four points located along the Gulf Coast spaced at 100 km intervals. We chose arbitrary points along the coast rather than actual archaeological sites because we were more interested in gauging central Mexican access to coastal resources over the entire sequence, rather than particular site connections during certain phases.

We incorporated the PANT settlement data reported in the maps and tables published by Merino Carrión (1989) into the GIS database as layers corresponding to each chronological phase. The omission of six sites registered in the data tables but not on the map of sites (Merino Carrión, 1989, Fig. 6) resulted in a total of 126 sites for all phases. We do not consider the loss of these few rural sites to significantly affect our analyses and interpretations. Our most noteworthy modification of the data was to increase the size estimates for site T-491, which affects the rank-size analysis. This site, La Laguna, has recently been investigated by Carballo and Aleksander Borejsza, as part of projects directed by Richard Lesure (2003–2004) and Carballo (2005–2006). It was first documented in the archaeological literature by Snow (1966, 1969), who registered it as the largest Formative period site in his 1500 km² survey of central and northern...
Tlaxcala, which partially overlaps the PANT survey region. Carballo mapped the site in 2004–2005. The mapping program, excavations, and numerous inspections of surface artifact densities result in our revised size estimates for La Laguna as covering approximately 100 ha during the Tezoquipan phase occupation. Our revised estimate of 66 ha as the community’s size during the Texoloc phase is conservative, and represents a middle ground between the extent of the site at its height and where Texoloc phase features have been excavated. It is likely that the PANT surveyors underestimated the size of La Laguna (listing it as 30 ha during both phases) because of its positioning within the saddle between three surrounding hills, which has resulted in substantial colluvial blanketing, leaving far fewer artifacts visible on the surface than is usual for highland Mexico.

Several analyses were undertaken without further reclassification of the data, while certain spatial analyses and the phase-by-phase settlement maps employed a hierarchical ranking scheme based on the number of ceremonial structures documented for each site. We consider the relative frequencies of ceremonial architecture at contemporaneous sites within a survey region to be a reliable index of hierarchical relationships between past communities (see Balkansky, 1998; Blitz, 1999; Steponaitis, 1978). Mounds are conspicuous features on the central Mexican landscape, making them easier to reliably quantify than are site boundaries defined by sherd scatter, which are more likely to have been affected by post-depositional processes such as plowing and slope erosion.

Our site classifications based on ceremonial architecture created the following ordinal categories: (Tier 4) no visible ceremonial mounds; (Tier 3) at least one ceremonial mound; (Tier 2) at least twice the number of ceremonial mounds of any third-tier site for the same phase; and (Tier 1) at least twice the number of ceremonial mounds of any second-tier site for the same phase. The motivation for developing this scheme was to create simplified categories that would be useful in examining how different types of sites (ceremonial centers of different sizes versus non-ceremonial centers) spatially articulated with each other on the regional landscape. If the quantity of public ceremonial architecture is a reliable proxy for the number of administrative functions of a community, then ceremonial centers should generally be more dispersed over the landscape so that they are more optimally located for the greatest number of people (Balkansky, 1998, p. 54; Blitz, 1999, p. 583).

Such an index can be calculated through nearest-neighbor analysis, which measures the observed spacing between sites in a defined area, its relative deviation from clustered or maximal dispersal, and changes in these measures for a region over time (e.g., Earle, 1976). Greater articulation between different tiers of the hierarchy, measured as mean distances between sites, are also assumed to be indicative of a more integrated settlement system (e.g., Haggett, 1966). As Conolly and Lane (2006, pp. 164–166) note, however, nearest neighbor analysis has several limitations. First, it was designed to detect spatial patterning of first nearest neighbors, and thus may not be sensitive to clustering at other scales. The nearest neighbor index is also influenced by the size of the surrounding area included in the analysis. As an alternate line of evidence therefore, relative degrees of integration and hierarchical relationships between sites in the study region were also examined through rank-size analysis.

Our rank-size analyses used total site area rather than mound count (including the revised values for La Laguna) for comparative purposes, as this has been the criterion used by most settlement analysts. Following conventional rank-size analyses practiced by geographers and archaeologists, the degree of departure from log-normality in rank distributions of settlement sizes has served as a useful measure in assessing the level of integration exhibited by particular settlement systems (Haggett, 1966; Hodder and Orton, 1976; Johnson, 1977; Paynter, 1983; Zipf, 1941, 1949; see concerns by Smith and Schreiber, 2006, pp. 15–16 regarding the inclusion of non-urban settlements). Recently Drennan and Peterson (2004) have proposed a valuable means of quantifying relative departure from log-normality by summing the area (A coefficient) over and under a log-normal regression line, measured as the shape of the deviation from a straight transverse line through a rectangular plane. An A value of zero denotes a log-normal pattern; positive or negative values can denote the area of a convex pattern (positive), concave/prime pattern (negative), or the summed values of a prima-convex pattern (concave at upper left and convex at lower right) (Drennan and Peterson, 2004, p. 534). A values and error ranges employing Drennan and Peterson’s bootstrapping method were calculated for each PANT phase dataset through the RSBOOT program they have made available online (www.pitt.edu/~drennan/ranksize.html).
Four of the 78 sites from the Tlaxco phase were omitted from the rank-size analysis because they lack size data. Three of these were listed as small observatories and the fourth is a small Postclassic reoccupation of the dominant Teotihuacan phase center (Merino Carrión, 1989, Cuadro 8); therefore, we do not believe that their omission significantly alters our analyses or interpretations of the Tlaxco phase system. In addition to the modification of La Laguna’s recorded size, one site from both the Teotihuacan and Early Acopinalco phases were assigned sizes based on estimated population and/or the ranking given by Merino Carrión, because they lacked size data.\(^3\)

### General results

#### Relative value of the Tlaxcala Corridor

Our least cost path analysis supports García Cook’s (1981) identification of the Tlaxcala Corridor as an important artery of communication for prehispanic central Mexican civilizations, particularly during the Classic period. From Teotihuacan, the corridor provides the easiest route to points east and southeast, running from central Veracruz to the Maya region. The northernmost point on the Gulf Coast (GC 1) is better accessed by a northeastly route, identified by Charlton (1978, 1991) for its importance to Classic period obsidian exchange, and its continued usage in the Postclassic and Colonial periods. The remaining Teotihuacan–Gulf Coast routes all run through the PANT survey region. Whereas GC 2 projects a route that makes partial use of the Apulco Canyon, the route to GC 3 mirrors the modern Mexico City–Veracruz railroad and freeway, and GC 4, in the Tuxtla Mountains, is near to the Teotihuacano enclave at Matacapan (see Santley and Pool, 1993). The best route from Teotihuacan to Monte Albán begins in the Tlaxcala Corridor but branches south before the study region.

Least cost path analyses originating from prominent central Mexican political capitals during other periods are summarized in Table 1. An interesting point of contrast is the utility of the corridor for travel east and south from the southern Basin of Mexico (Cuicuilco and Tenochtitlan) versus from the northern Basin (Teotihuacan, Texcoco, and, to the north, Tula). Whereas the least cost path originating from the southern Basin follows the route of the modern toll highway between Mexico City and Veracruz, traversing the high terrain between Iztaccihuatl and Cerro Tlaloc into southern Puebla, those that originate from the northern Basin skirt this range to the north and continue through Tlaxcala, often passing through the study region.

![Table 1](Image)

<table>
<thead>
<tr>
<th>Site</th>
<th>Political apogee</th>
<th>Least cost path through study region (yes/no)</th>
<th>Estimated travel time in hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>GC 1</td>
<td>GC 2</td>
</tr>
<tr>
<td>Cuicuilco</td>
<td>Late formative</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>59.71</td>
<td>63.50</td>
</tr>
<tr>
<td>Teotihuacan</td>
<td>Classic</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48.89</td>
<td>57.26</td>
</tr>
<tr>
<td>Tula</td>
<td>Early Postclassic</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>57.57</td>
<td>70.69</td>
</tr>
<tr>
<td>Texcoco</td>
<td>Late Postclassic</td>
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<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>51.85</td>
<td>58.24</td>
</tr>
<tr>
<td>Tenochtitlan</td>
<td>Late Postclassic</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>57.24</td>
<td>63.46</td>
</tr>
</tbody>
</table>

Key: (GC 1) Gulf Coast point one, the northernmost, near El Tajín; (GC 2) Gulf Coast point two, 100 km southeast of GC 1; (GC 3) Gulf Coast point three, 100 km southeast of GC 2, south of modern city of Veracruz; (GC 4) Gulf Coast point four, the southernmost, 100 km southeast of GC 3, and near Matacapan; (MA) Monte Albán.

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\(^3\) The modification of size estimates from the charts in Merino Carrión (1989) were as follows: Texoloc phase—T-491 (La Laguna) from 30 to 66 ha; Teroquian phase—T-491 (La Laguna) from 30 to 100 ha; Teotihuacan phase—T-164 from not recorded to 20 ha (based on possessing three ceremonial structures and being classified as a “primary” center); Early Acopinalco phase—T-529 from not recorded to 1.5 ha (based on being classified as “rural” with an estimated population of 60); Tlaxco phase—omitted T-85, T-509, T-686A, and T-710.
because we are interested in much longer-distance travel outside the Basin, and because it would involve the addition of multiple assumptions that move us too far away from the primary dataset. As noted earlier, we also did not consider altitudinal factors such as vegetative cover and weather. However, the addition of considerations modeling these factors would only serve to increase the value of the relatively flat Tlaxcala Corridor, particularly compared with the high-slope travel of the southerly Basin–Puebla route. With these caveats in mind, our analyses provide strong evidence that the differences in the relative utility of these alternate transportation corridors served to structure the expansionary strategies of central Mexican polities differently, Teotihuacan and the Aztec Triple Alliance in particular, together with the sociopolitical geography of the time, as is discussed as part of the social implications of the analyses.

Site phases and continuity

Continuity in occupation of sites between sequential phases provides a general indication of how disruptive certain periods in the history of the study region were. A limitation of the PANT data-set, however, is the irregular length of its occupation phases. While the Acopinalco phase is sub-divided into two very manageable centuries, the Tlaxco phase spans an unwieldy 600–650 years. Although problems of determining contemporaneity of occupation affect all settlement surveys (Schacht, 1984), this attribute must be considered particularly when interpreting longer phases, which likely involved fusion–fission and political cycling that are undetectable at this level of resolution (Anderson, 1994; Blitz, 1999). Keeping irregular phase length in mind, the simple exercise of plotting the frequencies of sites with occupation spanning two successive phases provides another line of evidence suggestive of the impacts of macroregional developments. By this measure, the Teotihuacan and Late Acopinalco phases appear to have been the most disruptive as they present sizeable decreases in site continuity, with nearly half having been abandoned in both cases (Fig. 5a). We believe this pattern to be significant irrespective of contemporaneity issues in both cases because recent excavations confirm that La Laguna (the largest Tezoquipan center) was abandoned during the Tezoquipan–Teotihuacan phase transition, and the Early to Late Acopinalco transition bridges two short and well-defined chronological periods.

Site location and spacing

Nearest-neighbor values were calculated through the GIS for each phase to gauge the degree of spacing between sites in the study region, and their relative tendencies towards clustering or dispersal. The two most noteworthy patterns to emerge from the analyses were (1) a general propensity of sites to cluster during all phases, and (2) greater dispersal of sites with ceremonial architecture (Tiers 1–3 of our classification) relative to those without such structures in all phases except one (Fig. 5e). The first pattern indicates communities in the region were either drawn to particular features of the landscape or to other communities; the second supports the analytical distinction we have drawn regarding the presence/absence of ceremonial architecture, and suggests that its presence is an index of higher-order social functions (e.g., Smith, 1976), as is discussed in the next section.

The tendency towards clustering lessens in the region over time, but sites remain significantly clustered relative to their expected mean distribution (Euclidian distance) in all phases. The slight tendency to greater dispersal corresponds with a northward migration of the center of gravity (centroid) of the settlement region, calculated through the GIS as the mean center of all sites (Fig. 5c). The northward migration of the settlement centroid corresponds to an increase in the mean elevation of sites and a sharp spike in the occurrence of fortifications (Figs. 5b and d). Whereas no sites are documented as fortified or military observatories during the Formative and Classic periods, approximately one quarter of sites are during the Epiclassic and one-third of sites are during the Postclassic.

Initial site clustering during the Formative phases is associated with the southern portion of the study region, containing a higher proportion of sites at a lower elevation along the Tlaxcala Corridor. The center of gravity of the settlements in the region moves northward in all periods until the Early Acopinalco phase, when it plateaus. The marked shift to more sites in the foothills of the northern mountain ranges bounding the Tlaxcala Corridor begins in the Tezoquipan phase and continues during the Teotihuacan phase; however, the dominant centers during these phases remain in the center of the corridor, unlike later phases when they are north of it. The
Fig. 4. Cost path analyses originating from five dominant central Mexican political centers, and depicting survey region (shaded), Monte Albán, and points along the Gulf Coast (GC 1–4 from north to south). (a) Teotihuacan; (b) Cuicuilco; (c) Tula; (d) Texcoco; (e) Tenochtitlan.
combination of these three patterns reveals a strong tendency for communities to become located in the foothills of the Sierras of Tlaxco and San Nicolás Terrenate, and to fortify themselves, particularly following the collapse of the Teotihuacan system.

Site hierarchies and administrative functions

Potential hierarchical and administrative relationships between sites were assessed through several independent lines of evidence with the following results. (1) Nearest-neighbor analyses demonstrate greater spacing between higher-order sites (Tiers 1–3) relative to Tier 4 sites in all phases except the Tezoquipan phase (Fig. 5e). (2) Mean spacing between sites and their closest higher-order center suggests lower integration among communities prior to the Teotihuacan phase, followed by a pattern consistent with high integration during the Teotihuacan phase. The region witnesses a return to lower integration during the Late Acopinalco phase, with greater integration once again in the
subsequent Tlaxco phase (Fig. 5f). (3) Rank-size distributions suggest greater integration of the regional system during the Tezoquipan, Teotihuacan, and Early Acopinalco phases, and lower integration in the phases preceding and following them (Fig. 6).

General consistency exists regarding the low indices of inter-community and regional integration during the earliest phases (Tlatempa and Texoloc), the much higher indices of integration associated with Teotihuacan and its initial period of decline (Teotihuacan and Early Acopinalco phases), marked ruralization during the Late Acopinalco phase, and the existence of multiple polities in the region during the centuries prior to the Spanish Conquest (Tlaxco phase). A more ambiguous issue derived from these data is the degree of integration during the Tezoquipan phase, just prior to the Teotihuacan phase. Measures of site spacing,
particularly between non-mound sites (Tier 4) and those with ceremonial architecture (Tiers 1–3), are suggestive of relatively low administrative integration, while the rank-size distribution of the region suggests an integrated system with La Laguna as the dominant center. These issues and others are discussed in the following section, where we consider the social implications of the analyses.

Social implications of the analyses

Exchange and polity formation during the formative period

Formative period settlement in the PANT region was closely associated with the Tlaxcala Corridor, with half of all sites and all ceremonial centers located within it. The earliest sedentary villages were significantly clustered (Fig. 7), and the lowest $R$ value (all sites $R = 0.50$; Tier 4 $R = 0.52$) coinciding with the Tlatempa phase is probably indicative of early fissioning events resulting in groupings of linked communities, as Earle (1976) documented for the eastern Basin of Mexico (see also Bandy, 2004; Blitz, 1999). A two-tier hierarchy developed in the southwest of the survey region associated with a community possessing two ceremonial structures ($A = .251$). Village autonomy may have been maintained by all communities during the Tlatempa phase, or a small multi-village chiefdom may have evolved including the Tier 3 site (T-505) and adjacent Tier 4 sites.

The two primary settlement clusters of the Tlatempa phase grew in the Texoloc phase, exhibiting a discernable shift in population eastward and the development of a Tier 2 site at La Laguna (Fig. 8). La Laguna was strategically situated at the junction of the Tlaxcala Corridor and Apulco Canyon. Its placement and significantly higher concentration of ceremonial architecture suggest that exchange and ritual functions were important factors in its becoming the dominant Formative center in the region, as was first suggested by Snow (1976, p. 10). Although spatial measures such as $R$ value and mean distance between higher- and lower-tier sites are suggestive of low levels of integration during the Texoloc (all sites $R = 0.55$; Tier 4 $R = 0.58$; Tiers 2–3 $R = 0.83$) and Tezoquipan (all sites $R = 0.58$; Tier 4 $R = 0.62$; Tiers 2–3 $R = 0.60$) phases, the rank-size analysis is indicative of a significant increase in regional integration, with the rank-size line changing from convex to primo-convex (Texoloc $A = .249$; Tezoquipan $A = .105$). The Tezoquipan $A$ value is also the second closest to

![Fig. 7. Tlatempa phase settlement.](image-url)
zero of the seven phases, approaching log-normality and suggestive of a slightly more integrated system than during the Texoloc phase.

The spatial analyses may be poor indices of community integration and regional centralization during the Tezoquipan phase (Fig. 9) because all the higher-tier centers (Tiers 2 and 3) were arranged in a strongly linear distribution running east–west through the Tlaxcala Corridor. This distribution accounts for the lower degree of dispersal of these ceremonial centers, and the greater mean distance between them and Tier 4 sites. It also supports the notion that trade through the Tlaxcala Corridor was a major determinant in where larger communities developed. As La Laguna sits near the southeastern corner of the survey block, the spatial analyses register it as being peripherally located in relation to most Tier 3 sites—a boundary phenomenon that requires survey data from adjacent areas, which is currently unavailable in a format that is reconcilable with the PANT database. According to our analyses, the Tlaxcala Corridor would not have served as the least cost path between the largest Formative central Mexican centers and the eastern/southeastern Gulf Coast. Indeed the linear distribution of the major Formative period sites—such as Cuicuilco, Tlapacoya, Tlalancaleca, and Xochitecatl (see Fig. 2)—nicely fits the projected least-cost route running between Cuicuilco and these sites.

In this light, the Tezoquipan settlement pattern is generally consistent with the political autonomy of the study region as a whole, and the formation of small regional polities that benefited from their positioning along the corridor. The location of the Tezoquipan settlement centroid in the center of an unoccupied region 15 km to the west of La Laguna may be indicative of a buffer-zone between the polity it controlled and one or more polities associated with the cluster of Tier 3 sites in the southwestern portion of the survey area. Although this boundary line is speculative, its distance from La Laguna would be consistent with a reasonable area of administration for a polity lacking state-level bureaucratic administration, being located between 12 and 16 km away, under a single day’s journey by foot (e.g., Spencer, 1998). The nearest sites in the southwestern cluster are within 25–30 km of Xochitecatl and Tlalancaleca, and may represent the northeastern limit of one of these polities. Again, due to the length of occupation phases we must also envision the operation of a more fluid settlement system and allow for the possibility that fissioning processes and political cycling (e.g.,
Anderson, 1994; Love, 2002) affected the southwestern cluster of Tier 3 sites, as well as La Laguna, where excavations suggest a period of abandonment or significant depopulation during the early Tezoquipan phase.

**Impacts of the urbanization and political expansion of Teotihuacan**

A major reorganization of society in northern Tlaxcala associated with the rise and expansion of Teotihuacan are discernable through several lines of evidence: (1) the lowest level of settlement continuity for all phases between the Tezoquipan and Teotihuacan phases (53% of sites); (2) the abandonment of the largest center (La Laguna) from the preceding phase; (3) the establishment of a new dominant center that is the largest in size and number of ceremonial structures for all phases; (4) the appearance of the only concave rank-size pattern in the entire sequence (\( A = -0.240 \)), with bootstrapped error ranges indicative of the first significant departure in settlement system organization; and (5) the regular distribution of Tiers 1–3 (\( R = 0.64 \)) sites relative to Tier 4 sites (\( R = 0.55 \)), suggestive of a nested hierarchy around the primary center (all sites \( R = 0.55 \)) (Fig. 10). The primary center—T-85, Cerritos de Guadalupe—was located directly in line with the least cost path originating from Teotihuacan to the southern Gulf Coast, and the Maya region (GC 3 and GC 4). The site also possessed strong material affinities to Teotihuacan (Merino Carrión, 1989, p. 75), and was the only Tier 1 site to develop in northern Tlaxcala during the entire sequence, following our classification scheme. Its 40 ceremonial structures greatly surpass the number recorded for the second largest site of the phase, with 7 mounds, as well as those recorded for the largest sites during all other phases, with 13.\(^4\) The combination of these lines of evidence strongly support a dramatic restructuring of society in northern Tlaxcala associated with Teotihuacano political expansion and territorial administration.

Teotihuacano political expansion is generally understood as having been selective and strategic, involving direct control of a relatively modest core

\(^4\) Surface mounds at T-85 were bulldozed in the 1970s, their rubble being used in the construction of the dam for the El Centenario reservoir. Therefore, there is no way of currently verifying the count of 40 ceremonial structures recorded by Merino Carrión (1989). However, visible surface artifact cover supports her 150 ha estimate.
area, more indirect control of the transportation corridors leading from the core to other parts of Mesoamerica, and debated degrees of influence over societies outside of this core and corridors (e.g., Cowgill, 2003; Hirth and Angulo Villaseñor, 1981; Millon, 1988; Santley and Pool, 1993; Smith and Montiel, 2001). The Tlaxcala Corridor would have served as the most efficient transportation artery connecting Teotihuacan to large portions of the Gulf Coast, Valley of Oaxaca, and Maya region; and during this period García Cook’s term Teotihuacan Corridor truly applies. Classic period societies in these regions possessed close connections to Teotihuacan, varying from economic and ideological exchanges to more asymmetrical political relations (e.g., Braswell, 2003; Marcus, 1983; Ruiz Gallut and Pascual Soto, 2004). It is likely that a majority of these connections would have been channeled through the Tlaxcala Corridor.

Although sites in the Teotihuacan phase in northern Tlaxcala do not become fortified, their spatial segregation suggests that Teotihuacano policy was to control movement through the corridor without concern for the direct administration of the entire region. The largest centers were located in the Tlaxcala Corridor, while many rural sites were located at higher elevations in the foothills of the Sierra of Tlaxco. The relatively high degree of site continuity between the Teotihuacan and Early Acopinalco phases (80%) may also be indicative of more ephemeral Teotihuacano control of settlements north of the corridor, as the greatest continuity after the Teotihuacan phase is registered in the foothills of the Sierra of Tlaxco. This area becomes the center of regional developments in the Early Acopinalco phase (Fig. 11), while communities become scarce in the Tlaxcala Corridor, including the abandonment of T-85 and the reduction of the second largest Teotihuacan phase site (T-497) from a Tier 2 center to a Tier 4 hamlet.

Macroregional balkanization and the rise of postclassic señoríos

By several measures, Early Acopinalco settlement presents the most regionally integrated phase in the PANT sequence. At first glance this may seem inconsistent with characterizations of the Epiclassic period of central Mexico as one of political regionalization or “balkanization” (e.g., Hirth, 2000, pp. 244–269; Hodge, 1984, p. 13; Marcus, 1989), but is yet another example of how multiregional...
phenomena and proper scales of analyses must be considered for settlement interpretations. The highly integrated settlement cluster that developed in northern Tlaxcala in association with the decline of Teotihuacan was safely buffered from the small city-states surrounding it on three sides: Teotihuacan (still a city of approximately 40,000), Cacaxtlá, and Cantona (see Cowgill, 2000; García Cook and Merino Carrión, 1998; Piña Chan, 1998). Merino Carrión (1989, pp. 79–89) noted significant Gulf Coast influences during the Early Acopinalco phase, possibly associated with the coastal site of El Tajín, or with Cacaxtlá or Cantona, both closer highland centers with clear connections to Gulf Coast societies. The Early Acopinalco settlement centroid reaches its northern latitudinal extreme, with a corresponding spike in mean elevation of higher-order centers and the first appearance of fortifications, suggestive of increased hostilities. Rank-size and site-spacing indices are consistent with a nested hierarchy of sites in the foothills of the Sierra of Tlaxco centered on site T-606, San Miguel de las Pirámides ($A = −.061$; all sites $R = 0.67$; Type 4 $R = 0.67$; Type 2–3 $R = 0.78$).

Although it is possible that Early Acopinalco communities were subordinate to a larger polity such as Cacaxtlá, Cantona, or Teotihuacan, it is more likely that a small polity centered on T-606 successfully retained its independence from centers outside the study region. The sparse settlement within the Tlaxcala Corridor suggest that none of these polities directly administered it, and it is likely that competition over the corridor on the part of multiple factions contributed significantly to the destabilizing and eventual collapse of the Teotihuacan system (García Cook and Merino Carrión, 1996; Millon, 1988). Thus individuals of the Early Acopinalco polity likely acted as contributing agents of change in the macroregional political dynamics of the time, representing at the broadest scale one of the most significant ruptures in the history of Mesoamerica.

At the scale of the PANT region only, the Early to Late Acopinalco phase transition is characterized by widespread abandonment (only 55% of sites continue) and ruralization (with only two mound centers). A notable exception is the largest Late Acopinalco center (T-492, Tecoac, or Santa María Capulac), which bridges the phase transition while T-606 is abandoned (Fig. 12). Having the benefits of relatively short Acopinalco sub-phases and excavation data from T-492, we are better positioned to

![Fig. 11. Early Acopinalco phase settlement.](image-url)
suggest that political cycling at the regional level can be detected between the phases. Based on its ceremonial structures, T-492 was a Tier 3 center (with five structures) while T-606 was a Tier 2 center (with 13) during Early Acopinalco. In the Late Acopinalco phase T-606 was unoccupied while T-492 becomes a Tier 2 center in our classification by virtue of its eight structures (Merino Carrión, 1989, p. 90, mislabeled as domestic in Cuadro 7).

The spike in higher-order center nearest-neighbor value (all sites $R = 0.55$; Tier 4 $R = 0.55$; Tiers 2–3 $R = 1.10$) for the Late Acopinalco phase should not be taken as indicating it was the most integrated system in the sequence, but is rather the result of there only having been two ceremonial centers at a distance from one another. Indeed mean-distance and rank-size values characterize Late Acopinalco as a period of regional decentralization. Most compelling in this regard is the rank-size hierarchy, with the $A$ coefficient moving to a strongly positive value ($A = .378$) and a bootstrapped error range near 80% confidence that it exceeds the mid-values of all prior phases. Whereas Early Acopinalco can be characterized as regional centralization during a period of macroregional balkanization, Late Acopinalco can be characterized as regionally balkanized.

The over 600 year duration of the Postclassic Tlaxco phase makes settlement interpretations particularly suspect for the issues of contemporaneity mentioned previously. Nearest-neighbor indices are similar to those for the Teotihuacan phase (all sites $R = 0.57$; Tier 4 $R = 0.59$; Tiers 2–3 $R = 0.67$). The rank-size distribution is strongly convex ($A = .524$), which could be indicative of one of the following, non-exclusive possibilities: (1) the long duration of the phase obscures the sequential occupation of sites; (2) the area was peripheral to the larger, imperial Aztec political economy; or (3) the convexity registers the pooling of multiple, generally contemporaneous systems (see Johnson, 1977, 1980; Paynter, 1983). Fortunately, some of the limitations of the lengthy Tlaxco phase can be partially offset by ethnohistoric data from the time of the Spanish Conquest.

Smith and Berdan (2003; Berdan, 2003) characterize Postclassic Puebla–Tlaxcala as a dispersed, yet actively competing core zone to the Aztec Triple Alliance imperial core centered in the Basin of Mexico. During the later Postclassic, however, independent Tlaxcala existed as a very different type of cultural core; it was comprised of numerous small Nahua and Otomí polities who confederated to

Fig. 12. Late Acopinalco phase settlement.
resist incorporation by the Aztec Empire, which had encircled them in an effort to deprive their inhabitants of desired resources such as salt and cotton. These hostilities may be registered by the fortification or elevated positioning of one-third of all sites in northern Tlaxcala. García Cook and Merino Carrión (1977, 1988, 1989) contended that three historically documented Otomi centers of the region, which allied with the Tlaxcalan Confederation at the time of the Conquest, can be archaeologically traced from the beginning of the Tlaxco phase. The three proposed Tlaxco phase centers are: (1) Atlancatepec in the northwest, (2) Tilihuitaquitepec in the center, and (3) Tecoac in the southeast (Fig. 13) (García Cook and Merino Carrión, 1988, 1989; Merino Carrión, 1989, pp. 93–125). All three may have been the capitals of independent señoríos, or Atlancatepec may have been subordinate to another polity (see also Anales de Cuauhtitlan 34:12, 45:11; Davies, 1968, pp. 66–155; Durán, 1581/2002, p. 289, 383, 395, 399, 405, 599).

Based solely on public architecture the settlement data does not support the existence of three independent polities, casting more doubt on the prehispanic autonomy of Atlancatepec. One of the western Tier 3 sites would be the most likely candidate for Atlancatepec, as they are near the modern town of the same name. The two Tier 2 Tlaxco phase centers, however, correspond convincingly as the centers of Tilihuitaquitepec (T-630) and Tecoac (T-492, Santa María Capulac, the largest Late Acopinalco phase as well; see also Trautmann, 1984). The latter señorío is of particular interest for its potential as the point of entry into independent Tlaxcala by Cortés and his soldiers, passing through the Apulco Canyon from the town of Ixtacamayxtitlan, and first battling an Otomi army before fighting and then forming an alliance with the Tlaxcalteca against the Aztec Empire (Cortés, 1519/1986b; Díaz del Castillo, 156, pp. 121–164; Muñoz Camargo, 1584/2000, pp. 239–242). We strongly reiterate Merino Carrión (1989, p. 98) assertion that historical Tecoac was definitively not the La Laguna site, as has been reported by several authors following Angulo Ramírez’s history of Tlaxcala from the middle of last century (Angulo Ramírez, 2004, pp. 110–112). Merino Carrión rightly noted that small Postclassic settlements on the hills surrounding La Laguna are spatially and chronologically disassociated with the Formative ceremonial center.

Considering that the ethnohistoric sources report between two and three small Postclassic polities in the region, settlement convexity is more likely

Fig. 13. Tlaxco phase settlement.
attributable to the pooling of contemporaneous, relatively peripheral systems, rather than chronologically sequential occupations. The highest ranked centers display a convex distribution within the 90% confidence zone. Lower ranked sites follow a distribution that is roughly parallel to the expected, log-normal line, a characteristic more suggestive of pooling than peripheral status (Paynter, 1983, p. 259). Further, we consider the 99% bootstrapped error range for Tlaxco phase settlement having been more convex than Teotihuacan phase settlement as one of the most significant results of the study, and illustrative of the differing expansionary trajectories of Aztec Triple Alliance and Teotihuacan.

Prior to the arrival of the Spanish, the imperial Aztec stranglehold rendered the Tlaxcala Corridor obsolete for interregional exchange. It was sparsely occupied during the Tlaxco phase except for a cluster of ten sites in the southwest, recorded as having closer material affinities to the contemporaneous Texcalac and Tlaxcala phases of the confederated Tlaxcalan señoríos (Merino Carrión, 1989, Cuadro 8). Aztec imperial strategy appears to have prioritized securing easterly passage through the southern Puebla transportation corridor by conquering this region’s prosperous city states, such as Cholula and Huejotzingo, over the Tlaxcala Corridor— which our least cost path analyses suggest was a slightly more valuable route from Texcoco but not from Tenochtitlan. It is likely that tributary and political considerations were ultimately of greater significant in these decisions; although the relative costs to the empire in subduing several small, loosely confederated, fortified polities bent on resisting incorporation must also be weighed (see Smith, 1996). Settlement in the Apulco Canyon included three Tier 3 centers which may have participated in interregional exchanges prior to Aztec imperial expansion, but this corridor was likely of little importance to Late Postclassic economies (García Martínez, 2001).

Conclusion

Our multi-scalar reassessment of the PANT settlement data draws heavily on GIS and rank-size determinations not available at the time of the survey project in the 1970s; however, our social interpretations are largely complementary. New insights resulting from the study include our quantification of the relative values of transportation corridors to interregional exchanges passing between central Mexico and points east and south, and the importance of exchange to the development Formative chiefly centers such as La Laguna, which we suggest to have been the center of a polity comprising much of the eastern half of the study area.

Our reanalysis of the data is supportive of a model of intensive administrative restructuring of the region related to Teotihuacan urbanization and state expansion. Settlement changes associated with Teotihuacan include widespread abandonment, the establishment of a new regional hierarchy centered in the Tlaxcala Corridor at the largest community in the sequence, and the movement of smaller sites into the foothills of the Sierra de Tlaxco. Although better illumination of the social processes associated with Teotihuacano administration of the region awaits further excavations, we propose they were the strongest macroregional developments to have affected northern Tlaxcala, implying relatively direct control of this portion of Teotihuacan’s outer hinterland (see Hirth, 1978b, p. 331; Millon, 1988, pp. 113–114).

In stark contrast, Aztec imperial expansion did not involve control of the Tlaxcala Corridor for the following geographic and historic reasons: (1) the corridor was a relatively less valuable route from Tenochtitlan compared to Teotihuacan, whereas an alternate route was more valuable; (2) this alternate, southerly route included rich city-states that made more desirable tributary provinces than the small polities of northern Tlaxcala; and (3) the lack of centralization of the small polities in northern Tlaxcala, together with their active efforts at resistance through fortifications and elevated positions, likely increased the costs of conquering the region.

Methodological contributions of the study include the use of GIS applications to derive additional information from previously published data, particularly in terms of calculating transportation efficiencies of regional landscapes, and interpreting spatial relationships among sites, and between sites and natural transportation corridors. We advocate that regional hierarchies based on ceremonial architecture serve a complementary function to those based primarily or wholly on site size; the former has been common practice among Southeastern archaeologists, but infrequently used by Mesoamericanists. By combining these two indices as we have done, settlement analysts have richer lines of evidence at their disposal from which to base their social interpretations of particular datasets.
Multi-scalar approaches incorporating GIS offer greater resolution regarding transportation corridors, and regional dynamics in areas adjacent to core areas of urbanism and political evolution. More rural regions such as northern Tlaxcala should be considered peripheral to such developments only in the sense that no major cities or state capitals developed there. By taking a macroregional perspective of settlement changes, however, we gain a greater appreciation for the importance of major transportation corridors, the participation of their inhabitants in the large-scale social transformations of interest to archaeologists, and the broader context at which political evolution operated.

Acknowledgments

We thank Aleksander Borejsza, Jennifer Carballo, and four anonymous reviewers for their helpful suggestions regarding the content and presentation of the article. Any inaccuracies or misrepresentations of the data are our own. We are additionally grateful to John O’Shea and the journal’s editorial staff for their assistance, and the University of Oklahoma College of Arts and Sciences for Faculty Enrichment Awards, which allowed us to present the initial results of our study at the 71st Annual Meeting of the Society for American Archaeology. Carballo thanks the National Geographic Society and the Foundation for the Advancement of Mesoamerican Studies, Inc., for their support of the Proyecto Arqueológico La Lagua. We are appreciative of the pioneering efforts of Ángel García Cook and Beatriz Leonor Merino Carrión, who originally assembled the data used in this study.

References

Balkansky, A.K., 1998. Montane Foragers: Asana and the South-


