**Supplemental Materials to:**

**The Low-Density Urban Systems of the Classic Period Maya and**

**Izapa: Insights from Settlement Scaling Theory**

**by**

Michael E. Smith, Scott G. Ortman, José Lobo, Claire Ebert, Amy E. Thompson, Keith M. Prufer, Rodrigo Liendo Stuardo, and Robert M. Rosenswig

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**Supplemental Text 1: A Model for Agglomeration Effects (Introduction to Settlement Scaling Theory)**

The main text utilizes settlement scaling theory (SST) to suggest that the primary reason Classic Maya and Izapan settlements do not exhibit the densification effect that characterizes many other urban systems is that the spatial units archaeologists define as settlements represent zones over which social mixing occurred with a less-than-daily temporal rhythm. Space limitations precluded a thorough introduction to SST in the main text, and we recognize that this creates opportunities for misunderstanding regarding the assumptions of the approach, how it relates to existing research traditions in archaeology, economics and behavioral ecology, and what the approach does and does not attempt to do. To address these issues, we provide an introduction to SST that is tailored to the interests and backgrounds of archaeologists in the following pages.

Insights from anthropology, economics and sociology provide a strong foundation for viewing population aggregation as a process that emerges from the interplay of centripetal and centrifugal forces; specifically, the socio-economic advantages of concentrating human populations in space vs. the associated costs of doing so. The changes in average socio-economic properties, land-use patterns, and infrastructure characteristics that accompany this process have come to be known as “agglomeration effects”, and such effects have been a focus of research in archaeology (Birch 2013; Gyucha 2019; Ucko et al. 1972) and in economics (Brucker 2011, Fujita et al. 1999, Henderson 1988) for many decades. Our framework provides articulating arguments for this long-standing recognition that population is a key determinant of many socio-economic features of human settlements and their associated communities (Boserup 1981, Carneiro 2000, Dumond 1965, Ember 1963, Johnson and Earle 2000, Naroll 1956).

As is the case with any formal theory, SST is constructed on the basis of a few foundational assumptions. Although there is strong empirical support for these assumptions, they are not intended, nor expected, to be universally true of every group of humans everywhere and all times. Rather these assumptions identify what many research traditions consider to be the most basic processes behind the formation of human settlements. Importantly, these assumptions also facilitate the specification of *variables* and the formulation of precise statements (equations) concerning expected relationships among these variables. The equations in turn make it possible to seek evidence that either supports or invalidates the model. The goal of the model is to answer questions and provide explanations. If the results for a particular situation do not conform to the model, it could mean that the model is inadequate or inappropriate for the situation at hand, that the underlying assumptions are incorrect, or that the dynamics on the ground were systematically different from cases where the model has been applied previously. When a batch of new evidence does not conform to expectations of the model, it provides a basis for interrogating the details to see what is missing, what must be improved, or if the framework can be adjusted so as to take the new evidence into account.

With this background in mind, the first principles behind SST are that (a) human interactions are exchanges of material goods and information that take place in physical space; (b) the intensity, productivity and quality of individual-level efforts are mediated and enhanced through interaction with others (social networks); (c) any human activity can be thought of as generating benefits and incurring costs (especially the costs of moving people and things in physical space); (d) human effort is energetically bounded; and (e) the size (scale) of a human agglomeration is both a consequence and a determinant of the agglomeration’s productivity. These principles provide the micro-foundations for predicting aggregate scaling phenomena in terms of the behavior of individual agents and their (economic and non-economic) interactions (Janssen 2008). Note especially that the economic concept of utility and its maximization is not part of the theory, nor are capitalist markets or specific types of political organization. In this approach, spatially concentrated social networks and associated costs, which can take different institutional and cultural forms, are sufficient for generating agglomeration effects. Most fundamentally, the social networks embedded in physical space provide the channels and relationships through which settlement dwellers generate and share information (Meier 1962).

*Costs and benefits of interaction*

The settlement scaling framework has been presented in several previous publications (e.g. Bettencourt 2013, 2014, Lobo et al. 2020; Ortman et al. 2014). Here, we focus on the relationships that are most central to this paper. We begin by positing that when individuals arrange themselves socially in physical space, they do so in a way that balances the benefits of interacting with others with the costs of moving around to do so. When settlements are small and unstructured, the cost of such movement is given by , where is the energetic cost of movement and is the transverse distance (a generalization of a diameter) across the area over which people have settled. In this circumstance the distance is proportional to the square root of the circumscribed area containing the settlement, . The social benefits resulting from such movement, on the other hand, derive from the number of interactions a person has per unit time. This number of interactions is given by:

 , (S1)

where is the average length of the path traveled by an individual over that period, is the distance at which interaction occurs, and is the population density within this circumscribing area. These interactions are mostly intentional so that they can be translated into net benefits, *y*, by considering that there is some average net energetic consequence of an interaction, across all types of interactions that can occur , such that:

 . (S2)

Of course, each individual experiences a different set of interactions, the energetic benefits of different types of interaction vary substantially, and population densities are rarely homogeneous across an interaction area. But so long as the goal is to characterize the aggregate results of all the interactions in a network, the average outcome for the representative individual is sufficient.

*Balancing costs and benefits*

The key next step in constructing the model is the assumption that individuals, on average, seek to balance the costs and benefits of their interactions. Once again, not every individual achieves this balance, the time horizon over which the balance is achieved varies, and people can put energy into interactions that do not yield direct or immediate physical benefits, as in the case of gift-giving, ritual activity, and so forth. The effort of individuals to balance costs and benefits should also not be confused with the idea of maximizing or optimizing benefits or fitness. This latter idea is central to neoclassical economics and behavioral ecology (Charnov 1976; Dixit 1990; Kelly 2013; Parker and Smith 1990; Samuelson 1947), but it plays no role in SST. What SST does assert is that a balance of interaction benefits and costs emerges as an average result over a relatively short period of time, such that this balance can be viewed as a characteristic of the behavior of the representative individual. Ultimately, this view is grounded in an evolutionary perspective on human behavioral predispositions. But rather than focusing on the idea of maximizing reproductive fitness at an inter-generational time scale, SST focuses on the idea of homeostasis over shorter time scales. In all complex organisms, evolution has generated basic emotional drives that motivate individuals to seek to maintain homeostasis. Research in cognitive neuroscience suggests that humans recruit these evolutionarily ancient mechanisms to plan and strategize in ways that seek to maintain homeostasis over longer (but shorter than generational) time horizons (Damasio 1994; Kahneman 2011). At this scale, such efforts translate into a balancing of costs and benefits. Note also that this balance need not be direct or immediate or even conscious to individuals in context, as cultural and political concepts can motivate people to expend time and energy on activities that yield indirect benefits over time, in addition to immediate and direct benefits. Thus SST does not make any grand pronouncement about human nature, other that humans are satisficing entities—choosing among the best of available alternatives in the context of their preferences, constrains they operate under and limited information at their disposal (Simon 1957).

This homeostatic view of the representative individual is also embedded in urban economics via the notion of a spatial equilibrium. In any social network embedded in space, individuals experience different landscapes of interaction costs and benefits due to variation in the distribution of people, resources, infrastructure, goods, and services across their local area, and the travel and time (opportunity) costs of moving to access them. Models of urban land use in the tradition of central place theory generally assume that these costs and benefits balance at each location. The representative agent in these models has a budget which includes an income, transport costs, housing costs, and other-than-housing costs, and a budget constraint which specifies that costs and benefits must equilibrate. As a result, demand for specific locations, and thus land values and uses, adjust to take variation in travel costs into account, thus maintaining a balance of costs and benefits across the city (Alonso 1964; Von Thünen 1966; O’Sullivan 2011). Importantly, these models end up factoring the concept of utility out of the equation by assuming that it is constant across space, which is to say, the balance of costs and benefits holds at each location. These models have been celebrated for their ability to capture spatial patterns in cities (Brueckner 1987) and although they are typically presented using a different language, it turns out that they also incorporate the notion of a homeostatic balance of movement costs and interaction benefits.

Given this view of a spatial equilibrium, one can assume that, for the representative individual, movement costs and interaction benefits balance over a reasonably short time period, . One can then substitute the relations previously derived for and above to yield , and this simplifies to:

, (S3)

where . One can think of *a* as the net attractive “force” (resources per unit time per unit area, or the power density) that an individual exerts on others through his/her interactions.

Equation (S3) expresses the way in which a salient feature of a settlement, areal extent, depends non-linearly on population size. It hypothesizes that as the number of people who mix socially on a regular basis increases, the total area taken up by these people will grow more slowly than the number of people, such that the area taken up by each person will decrease. In addition, it makes a prediction regarding the rate at which area will increase, relative to population, in this case, with an exponent of two-thirds. Notice, however, that in order to see this process empirically one must be able to define the circumscribing area over which the social mixing of people occurs on a regular basis, and indeed, a circumscribing area needs to be a reasonable way of characterizing the area over which people are distributed. The pre-factor in Equation (S3) varies in accordance with the strength of social interaction and transport costs () and can change over time with changes in transport and social institutions, but it is independent of population.

*Defining the interaction area*

Equation (S3) applies to small and spatially unstructured settlements, but as settlements grow larger the inhabitants must increasingly set aside some of the land area, *An*, for roads, paths, public spaces and public infrastructure so that residents can continue to move around and mix socially. This is the area over which the spatial equilibrium of interaction costs and benefits actually occurs, and as a result it is necessary to specify the relationship between people and the “network” area, and also to actually measure the network area if possible. We assume that on average the distance between people is set in accordance with the current population density, such that *.* This can be justified by the observation that historically infrastructure has been built or expanded in urban areas *mainly* in response to population expansion (Angel 2012, Bertaud 2018, Glaeser and Xiong 2017, Southall 1998). Thus, one can think of *b* as the length and width of street-frontage per resident in a city. Under this model, the total area of the access network is:

. (S4)

From here, one can substitute for and simplify, leading to:

. (S5)

Equation (S5) implies that, as settlements in a society grow, movement and interaction become increasingly structured by the access network and its associated public spaces, and that the area of this network grows with population more rapidly than the circumscribing area, leading the exponent of the population-area relationship to transition from 2/3 to 5/6. There is still an economy of scale in space use per capita, but the exponent of the growth rate of the built area with population is slightly higher than it is with respect to a circumscribing area.

 It is important to emphasize once again that Equations (S3) and (S5) are “mean-field” models that predict the average rate of increase in the circumscribing or network area, respectively, relative to population, as specified by the exponent of . Another way of saying this is that they yield expectation values for the area of a settlement, given its population. This means that, if one examines the relationship between population and area across many settlements in a system, the average area of a settlement of a given size will be given by Equation (S3) or (S5), depending on how the type of area that is being measured.

*From interactions to socio-economic rates*

The final element of SST that we consider in the main text is the relationship between population, area, frequency of interaction, and socio-economic rates. The key assumption underlying this relationship is that per capita productivity is proportional to the number of interactions (the degree of an individual’s undirected socio-economic network) that an individual experiences per unit time. This notion, that increasing productivity derives from the concentration and intensification of social interaction, is the basic idea in economics models of agglomeration effects (Glaeser, et al. 1992; Glaeser, et al. 1995; Hausmann and Hidalgo 2011; Jones and Romer 2010). The notion that individual productivity is enhanced through an expansion in group size is also captured in Adam Smith’s famous dictum “That the Division of Labour is Limited by the Extent of the Market”. Smith argued than an expanding division and coordination of labor, tied to an expanding population, stimulates increases in the efficiency and thus the productivity of each worker through increased skill in performing specific tasks, and a reduction in the number of times individuals have to switch between tasks (Arrow 1994; Kelly 1997; Mokyr 2006). This basic idea has been augmented by other economists who note that the concentration and specialization of producers facilitates—through copying, imitation and social learning—the transmission and accumulation of improvements in production procedures and techniques (Arrow 1962; Auerswald, et al. 2000; Young 1928).

Within archaeology, the connection between specialization, exchange, and community size has played an important role with respect to the concept of craft specialization, where it is generally assumed that the empirical marker of increasing specialization is enhanced efficiency in production, reflected in increased standardization of products, which in turn implies increased individual productivity (Brumfiel and Earle 1987; Costin 1991; Costin and Hagstrum 1995). Given this, a broader and more sociologically rich interpretation of Smith’s dictum is that the productivity of an individual is systematically related to the number of people who regularly interact with each other, either directly or indirectly, in production processes (Ortman and Lobo 2020). From this perspective, the division of labor is not simply about the vertical integration of specialized tasks but about the distribution of tasks in networks that facilitate learning, knowledge flow and the integration (recombination) of information (Bettencourt 2014). These phenomena are of long-standing interest to anthropologists, archaeologists, sociologists and economists (Arrow 1994; Blau 1975; Boserup 1981; Carneiro 2000; Durkheim 1984; Johnson and Earle 2000; Naroll 1956), and SST builds on this assumption.

The assumption that individual productivity is most fundamentally driven by the number of interactions an individual experiences per unit time allows one to specify how the productivity of an individual worker changes with the size of the social group in which they work. From Equations (S1) and (S3), above, we can write:

, (S6)

where is the output of an individual worker per unit time. Again, notice that this output is the product of the outcome of each interaction , a person’s daily movement given by the path length , the distance at which interaction occurs , and the distribution of people across the network area . From here, one can substitute Equation (S5) for in Equation (S6) and simplify, leading to:

, (S7)

where reflects the baseline productivity of an individual working alone, and is the productivity of that individual when working in a social group of size . This relation predicts that, on average, the productivity of a worker will increase with the population size of the socio-economic network within which that person is ensconced raised to the one-sixth power. Although gains from the coordination of labor are modest for each individual, they nevertheless accumulate exponentially as the group size increases. Finally, the total output of the group is simply the product of per capita productivity and the population:

. (S8)

Notice that this model simply captures the effects of social mixing in space, and this process is sufficiently general that one might expect such effects to occur in any context where people concentrate themselves in space for productive activities. Indeed, the network area in Equation (S5) could be defined for forms of social mixing that take place less frequently, and even in varying locations. In such cases, one may be able to observe increasing returns to population scale, as specified by Equation (S8), for forms of social mixing that involve lower-frequency movement. This is the possibility explored with respect to Classic Maya and Izapan settlements in the main text.

In the models discussed above many parameters, including , are scale-invariant, meaning that their values are independent of . However, the values of these parameters need not be constant across systems or over time. Indeed, it is typically observed that baseline areas and socio-economic rates vary from year to year and across systems in contemporary societies (Bettencourt 2019). In addition, there are a range of additional factors one would expect to be involved in determining the properties of any specific settlement that are not included in SST models. Given these additional considerations, a more exact way of writing scaling relationships, using Equation (S5) as an example, is:

 , (S9)

where is standing in for . This notation indicates that the pre-factor of the scaling relationship is specific to a particular system at a particular time, and captures the range of contextual factors unique to each city that lead to a deviation of the network area in that settlement from the average expectation. This deviation is represented as an exponential so that it will take the form of a Gaussian random variable following natural log transformation. To see this, one can take the natural logarithm of Equation (S9):

, (S10)

and then express Equation (S10) as the ensemble average. Since by definition , it can be dropped from the ensemble average, leaving the following result:

. (S11)

This linear function is an exact expression that relates the mean of the log of the network area across settlements in a system at time to the mean of the log of population across those same settlements at that time. Equation (S11) helps to clarify what can and cannot be predicted using SST. One cannot exactly predict the properties of any given settlement based on its population, or vise-versa, but one can predict the average relationship and the relationship of the averages. Also, the average of the deviation of a particular property from the expectation value across cities should sum to zero, which is to say, the deviations should follow a standard normal distribution in log-transformed variables (and thus a log-normal distribution in the original variables). Finally, there is a concrete general prediction regarding the numerical value of the coefficient that relates population to network area for the log-transformed variables (and thus the exponent of the relationship for the original variables), but the numerical value of the intercept for the log-transformed variables (and the pre-factor for the original variables) is a system-specific and time-specific property that is independent of population and area. The same can be said for the relationship between population and socio-economic rates, although the value of the predicted coefficient (exponent) is given by Equation (S8) in that case. In the main text we focus on these predictions with respect to settlement systems in southern Mesoamerica.

The relationships between settlement population and area discussed above presuppose the ability to define areas over which daily interactions took place. For small and amorphous settlements, this is the area circumscribing the interacting population; and for larger cities, it is the area of residences, workplaces, shops, and transport infrastructure within which daily social mixing occurs. Given this, a key question is the extent to which the spatial units that are defined and measured in a given archaeological context correspond to the networks of interaction in space envisioned in these models. This question is addressed in the main text with respect to Classic Maya and Izapan settlements.

*Accounting for the southern Mesoamerican results*

In the main text we argue that Classic Maya and Izapan sites represent areas of interspersed residential and agricultural use, and that the residents within these areas congregated periodically in the site epicenter rather than mixing across the area on a daily basis. We can begin to account for this distinctive settlement pattern by illustrating how de-densifying settlement can emerge from periodic congregation for social mixing. In this situation, Equation (S2) can be re-written to reflect the fact that the mixing area is not the same as the settled area, and that perhaps only a fraction of the total population actually travels to the center for any given occasion:

 (S12)

The cost of mixing will remain because the distance to be traversed for mixing remains the overall area from which the population is drawn, but one might expect individual paths to traverse the mixing space as opposed to just a local portion of a larger city, such that . Given this, the overall scaling of area with population will be set by the rate at which the interaction area grows with increasing population. If, for example, , as is suggested by the results in the main text, then:

. (S13)

The overall area from which people are drawn will increase faster than the number of people who periodically congregate in the mixing space, but because the relationship between population and the mixing space will be as in the amorphous settlement model, increasing returns will also emerge from increasing connectivity within the mixing space, for those activities that take place within that space, relative to the temporal duration of mixing. This is just one possibility, but hopefully it is sufficient to show that the patterns identified in this study can be incorporated into the SST framework with additional work.

**Supplemental Table S1. List of mathematical symbols**

|  |  |
| --- | --- |
| Symbol | Interpretation |
|  | The energetic cost for an individual to mix socially per unit time. |
|  | The energetic cost of movement (e.g. calories per km per hour). |
|  | The transverse dimension of the area over which social mixing occurs. |
|  | The circumscribing area over which social mixing occurs. |
|  | The per capita (intensive) outcome of social interactions per unit time. |
|  | The baseline area taken up by a person in a mixing area. |
|  | The total (extensive) outcome of social interactions per unit time. |
|  | The baseline productivity of an individual in the absence of network effects. |
|  | The population within an area of social mixing. |
|  | The mean energetic benefit of an interaction, across all types that may occur. |
|  | The distance at which social interaction typically occurs within a mixing area. |
|  | The length of the path traveled by an individual for interaction, per unit time.  |
|  | The infrastructural area per capita within a mixing area. |
|  | The network, or infrastructural, area within which people move to interact. |
|  | The deviation of an individual settlement from the expectation value.  |
|  | Time.  |
|  | The epi-center area of social mixing. |
|  | The fraction of the population that travels to the epi-center to mix socially. |
|  | The baseline area of an epi-center for social mixing. |

**Supplemental Text 2: Descriptions of Survey Projects**

**Palenque**

 The *Proyecto Regional Palenque* (PREP) was conducted by Liendo Stuardo (2011). The goal of this project was to delineate the spatial extent of the Palenque regional state, and the nature of political and economic integration of the hinterland into that state. This full-coverage survey resulted in the identification of a total of 413 sites within an area of 450 km2. The sites included here date to the Balunté period, AD 750-850, which was the demographic peak in this area. The basic data are presented in Liendo Stuardo (2011); for additional context, see Liendo Stuardo (2005; 2014), and Barnhart (2008).

Sites were identified from the presence of mounds or other architectural remains, and then classified on the basis of their architecture and size. Two categories of architecture were recognized: dwellings and nonresidential structures. The dwelling category consists of small, low platforms and range structures (higher, elongate platforms with cut-stone facades). Non-residential structures include pyramids (identified from their square ground plan, a basal area usually larger than 120 m2, height more than 5 m, and high-quality construction material) and other specialized civic structures (ball courts, plazas and public platforms). Site populations were estimated using domestic residence counts. Thus, our units of population are households, not individuals. Site areas were measured as amorphous shapes that include all of the structures of a site. *Rank 1* sites describe the two largest and most complex settlements, Palenque and Chinikiha. These are the largest sites in the survey (see Appendix) and are interpreted as capitals of their associated polities. *Rank 2* includes thirteen sites that, like Palenque and Chinikiha, have large civic architecture (plazas, temples, ballcourts). These sites are interpreted as district capitals and are differentiated from the remaining sites (Ranks 3 through 5) by their civic architecture and their size. They present clear evidence that elite residences were closely associated with features having ceremonial-civic functions. *Rank 3* sites have more than one architectural group, and lack evidence of civic-ceremonial functions. These were most likely commoner settlements of groups larger than a household. *Rank 4* sites have a single patio group; these were classified into patio groups and informal groups. *Rank 5* sites consist of isolated platforms.

**Rosario**

 This dataset was compiled by Olivier de Montmollin for the Grijalva River Upper Tributaries, several hundred kilometers south of Palenque, in what can be called the southwest periphery of the Maya area (de Montmollin 1989, 1995). Much of this work was focused on the Greater Rosario Valley, and all sites were given Rosario Valley site numbers. Advantages of this area include the fact that Maya occupation was essentially limited to the Terminal Classic period, and that surface architectural visibility is excellent due to the local semi-arid climate. As a result, it is reasonable to view the results as a synchronic snap-shot of the settlement system (de Montmollin 1989). In addition, correspondence between remains of settlement and topographic boundaries suggest political boundaries between local polities, allowing one to group results into a variety of nested political units.

 Survey methods for this work combined Central Mexican (Sanders et al. 1979) and lowland Maya (Ashmore 1981) approaches. Site data for the Rosario Valley itself are reported in de Montmollin (1989), and survey data from adjacent areas of the Grijalva Upper Tributaries are reported in de Montmollin (1995). In the latter source, the author also summarizes the information collected from civic-ceremonial epicenters of important sites, including counts of structures by structure type (pyramids, range buildings, high platforms, ballcourts, altars, acropolis platforms, long platforms, U-shaped platforms, raised and fully-enclosed plazas), the total volume of civic-ceremonial architecture (based on compass and tape mapping), and the area in hectares of the epicenter (based on outlines on aerial photos). Finally, de Montmollin groups settlements into a three-tiered settlement hierarchy consisting of individual settlements, districts with district capitals, and polities with polity capitals. As a result, it is possible to estimate the number of dwellings associated with each level of the hierarchy and to link these populations to their respective epicenters. These data are summarized in Appendix 2.

**Belize Valley**

The upper Belize River Valley encompasses an area of approximately 125 km2, extending 25 km eastward and downriver from the Maya centers of Cahal Pech to Blackman Eddy. Gordon Willey and his colleagues initiated the earliest settlement studies in the region to examine the relationship between Classic period (AD 300-900/100) monumental centers and surrounding households (Willey et al. 1965). Beginning in 1988, the Belize Valley Archaeological Reconnaissance (BVAR) Project extended Willey’s study area through a block survey program designed for total coverage of the region, primarily documenting Late and Terminal Classic house mounds (Hoggarth et al. 2010). Airborne lidar survey for the BVAR study area was conducted in 2013 as part of the West-Central Belize Lidar Survey to supplement pedestrian survey (Chase et al. 2014). Quantitative spatial analyses of lidar data and subsequent ground verification have documented over 2,300 mounds in the upper Belize Valley (see Ebert et al. 2016).

Multi-dimensional scaling of attributes calculated from features documented via lidar (e.g., number and volume of structures, distance to major centers, surrounding population density) indicate that the local settlement system was organized into six tiers (i.e., groups) focused on several large Classic epicenters (Walden et al. 2019). Group 1 includes polity capitals sometimes described as “major centers,” such as Baking Pot, Cahal Pech and Lower Dover. They formed the civic-ceremonial epicenters of territorial polities during the Classic period. Intermediate elite centers are split into three categories, including multi-component centers (Group 2), medium-sized centers with a single plaza and an ancestral triadic shrine (Group 3), and small centers and high-status commoner households (Group 4). High-status commoner households without an overt ceremonial function characterized Group 5 sites (Walden et al. 2019). A sixth group includes lower status commoner settlements.

**Uxbenká**

Uxbenká and Ix Kuku’il are two neighboring polities located on the calcareous sandstone foothills of the southern Maya Mountains in Belize. Households in this region were primarily built on leveled hilltops or ridges near to arable land. These settlement choices were likely in response to high rainfall (>4000mm/year, flooding low lying areas), a steeply incised landscape, and the high agricultural productivity of hillslopes (Culleton 2012). Similarly, civic-ceremonial core plazas and district seats (sensu Smith 2010) were constructed on highly modified hilltops and ridgetops. The Uxbenká Archaeological Project (UAP) has conducted a decade of pedestrian settlement survey and excavations including ground-truthing sites detected with aerial lidar data and high-resolution satellite imagery (Prufer et al. 2015). Combined survey and excavations have produced a comprehensive diachronic settlement history of both polities. Both have their origins prior to the Early Classic and maximum populations during the Late Classic (Prufer et al. 2017; Thompson et al. 2018).

For Uxbenká and Ix Kuku’il, we define a domestic site as a discrete architectural cluster situated on a leveled hilltop or ridge. Household sites vary from single isolated domiciles to expansive residential clusters with multiple structures and plazas. Some outlying districts have small temples, hilltop shrines, and ballcourts, and extensive landscape modifications. The Uxbenká core is dispersed across several ridgetops and has 136 sites outside of the civic core while Ix Kuku’il has 106 sites outside of the single large civic core . The mean number of buildings per site at Uxbenká is 3.87 and the average area per site is 1730 m2. At Ix Kuk’il mean building per site is 3.3 buildings with an average area of 1512 m2. Civic core sites have the highest investments in landscape modification, primarily cut-and-fill to level and expand hilltops (Prufer and Thompson 2016), suggesting they were constructed to be the foci of group interactions. At Uxbenká the average core area contains 6.7 buildings each with a mean area of 6544 m2. In comparison, Ix Kuku’il the single civic core site contains 8 buildings and has an area of 10,201 m2.

**Izapa**

The site of Izapa is famous for its large mounds and elaborate sculpture, but nothing was known of the regional structure of the polity until Rosenswig initiated the Izapa Regional Settlement Project (IRSP) in 2011. Two 60 km2 survey zones were documented with lidar, and over 1,000 mounds were surface-collected and the periods of their occupation determined on a phase-by-phase basis (Rosenswig et al. 2018; Rosenswig et al. 2013). A second campaign of lidar data collection in 2015 brought the total coverage to almost 600 km2 and documented 40 lower-order monumental centers that were all occupied from 700-100 BC (Rosenswig and López-Torrijos 2018). Izapa was the capital city of this regionally-organized polity (Rosenswig 2019), and the dozens of lower-order centers all employed the same planning principles, defining a four-tiered settlement hierarchy based on site size and the range of architectural features (Rosenswig and López-Torrijos 2018). The Izapa kingdom centers encompassed an area of at least 450 km2 with the largest centers defensively arranged around the perimeter of the polity’s territory.

**References Cited**

Alonso, William

1964 *Location and Land Use: Toward a General Theory of Land Rent*. Harvard University Press, Cambridge, MA.

Arrow, Kenneth J.

1962 The Economic Implications of Learning by Doing. *The Review of Economic Studies* 29(3):155-173.

1994 The Division of Labor in the Economy, the Polity, and Society*.* In *The Return to Increasing Returns*, edited by J. M. Buchanan and Y. J. Yoon, pp. 69-84. The University of Michigan Press, Ann Arbor.

Ashmore, Wendy (editor)

1981 *Lowland Maya Settlement Patterns*. University of New Mexico Press, Albuquerque.

Auerswald, Philip, Kauffman, Stuart, Lobo, José, Shell, Karl (2000) The Production Recipes Approach to Modeling Technological Innovation: An Application to Learning-by-doing. *Journal of Economic Dynamics and Control*, 24: 389-450.

Barnhart, Edwin L.

2008 Palenque: Urban City of the Ancient Maya*.* In *El urbanismo en mesoamérica / Urbanism in Mesoamerica*, edited by Alba Guadalupe Mastache, Robert H. Cobean, Ángel García Cook, and Keneth G. Hirth, pp. 165-196. Proyecto Urbanismo en Mesoamérica / The Mesoamerican Urbanism Project, vol. 2. Pennsylvania State University and Instituto Nacional de Antropología e Historia, University Park and Mexico City.

Bettencourt, Luís M. A.

2013 The Origins of Scaling in Cities. *Science* 340:1438-1441.

2014 Impact of Changing Technology on the Evolution of Complex Informational Networks. *Proceedings of the IEEE* 102(12):1878-1891.

2019 Towards a Statistical Mechanics of Cities. *Comptes Rendus Physique* 20:308-318.

Birch, Jennifer (editor)

2013 *From Prehistoric Villages to Cities: Settlement Aggregation and Community Transformation*. Routledge, New York.

Blau, Peter M.

1975 Parameters of Social Structure*.* In *Approaches to the Study of Social Structure*, edited by P. M. Blau, pp. 220-253. Free Press, New York.

Boserup, E.

1981 *Population and technological change: a study of long-term trends*. Chicago: University of Chicago Press.

Bruckner, Jan K.

2011 *Lectures in Urban Economics*. Cambridge (MA): The MIT Press.

Brueckner, Jan K

 1987 The structure of urban equilibria: A unified treatment of the Muth-Mills model*.* In *Handbook of regional and urban economics*, edited by E. S. Mills, pp. 821-845. vol. 2.

Brumfiel, Elizabeth M. and Timothy K. Earle (editors)

1987 *Specialization, Exchange, and Complex Societies*. Cambridge University Press, Cambridge.

Carneiro, R.L.

2000 The transition from quantity to quality: a neglected causal mechanism in accounting for social evolution. *Proceedings of the National Academy of Sciences of the United States of America*, 97: 12926-12931.

Charnov, Eric L.

 1976 Optimal foraging, the Marginal Value Theorem. *Theoretical Population Biology* 9:129-136.

Chase, Arlen F., Diane Z. Chase, Jaime J. Awe, John F. Weishampel, Gyles Iannone, Holly Moyes, Jason Yaeger, Kathryn Brown, Ramesh L. Shrestha, William E. Carter, and Juan Fernandez Diaz

2014 Ancient Maya Regional Settlement and Inter-Site Analysis: The 2013 West-Central Belize LiDAR Survey. *Remote Sensing* 6: 8671-8695.

Costin, Cathy Lynne

1991 Craft Specialization: Issues in Defining, Documenting, and Explaining the Organization of Production*.* In *Archaeological Method and Theory, vol. 3*, edited by M. B. Schiffer, pp. 1-56. University of Arizona Press, Tucson.

Costin, Cathy Lynn and Melissa B. Hagstrum

1995 Standardization, Labor Investment, Skill, and the Organization of Ceramic Production in Late Prehispanic Highland Peru. *American Antiquity* 60(4):619-639.

Culleton, Brendan

2012 *Human Ecology, Agricultural Intensification and Landscape Transformation at the Ancient Maya Polity of Uxbenká, Southern Belize.* Ph.D. dissertation, Department of Anthropology, University of Oregon.

Damasio, Antonio

1994 *Descartes' Error: Emotion, Reason, and the Human Brain*. G. P. Putnam, New York.

de Montmollin, Olivier

1989 *Settlement Survey in the Rosario Valley, Chiapas, Mexico*. Papers of the New World Archaeological Foundation, vol. 57. New World Archaeological Foundation, Provo.

1995 *Settlement and Politics in Three Classic Maya Polities*. Monographs in World Archaeology, vol. 24. Prehistory Press, Madison.

Dixit, Avinash K. (1990) Optimization in Economic Theory. Oxford: oxford University Press.

Dumond, D.E.

1965 Population growth and cultural change. *Southwestern Journal of Anthropology*, 21: 302-324.

Durkheim, Emile

1984 *The division of labor in society*. The Free Press, New York.

Ebert, Claire E., Julie A. Hoggarth, and Jaime J. Awe

2016 Integrating Quantitative Lidar Analysis and Settlement Survey in the Belize River Valley. *Advances in Archaeological Practice* 4 (3): 284-300.

Ember, M.

1963 The relationship between economic and political development in nonindustrial societies. *Ethnology*, 2: 228-248.

Fujita, Masahisa, Krugman, Paul, Venables, Anthony J.

1999 *The Spatial Economy: Cities, Regions, and International Trade.* Cambridge (MA): The MIT Press.

Glaeser, Edward L., Hedi D. Kallal, Jose A. Scheinkman and Andrei Shleifer

1992 Growth in Cities. *Journal of Political Economy* 100(6):1126-1152.

Glaeser, Edward L., Jose A. Scheinkman and Andrei Shleifer

1995 Economic growth in a cross-section of cities. *Journal of Monetary Economics* 36(1):117-143.

Gyucha, Attila (editor)

2019 *Coming Together: Comparative Approaches to Population Aggregation and Early Urbanization*. State University Press of New York, Albany.

Hausmann, Ricardo and Cesar A. Hidalgo

2011 The Network Structure of Economic Output. *Journal of Economic Growth* 16:309-342.

Henderson, John Vernon

1988 *Urban Development: Theory, Fact and Illusion*. New York: Oxford University Press.

Hoggarth, Julie A., Jaime J. Awe, Evga Jobbová, and Christopher Sims

2010 Beyond the Baking Pot Polity: Continuing Settlement Research in the UPper Belize River Valley. *Research Reports in Belizean Archaeology* 7: 171-182.

Johnson, A.W., Earle, T.K.

2000 *The Evolution of Human Societies: From Foraging Group to Agrarian State*. Stanford: Stanford University Press.

Jones, Charles I. and Paul M. Romer

2010 The New Kaldor Facts: Ideas, Institutions, Population, and Human Capital. *American Economic Journal: Macroeconomics* 2(1):224-245.

Kahneman, Daniel

2011 *Thinking, Fast and Slow*. Farrar, Strauss and Giroux, New York.

Kelly, Morgan

1997 The Dynamics of Smithian Growth. *The Quarterly Journal of Economics* 112(3):939-964.

Kelly, Robert L.

 2013 *The Lifeways of Hunter-Gatherers: The Foraging Spectrum*. Cambridge University Press, Cambridge.

Liendo Stuardo, Rodrigo

2005 An Archaeological Study of the Settlement Distribution in the Palenque Area, Chiapas, Mexico. *Anthropological Notebooks (Slovene Anthropological Society)* 11: 31-44.

2011 *B'aakal: Arqueología de la Región de Palenque, Chiapas, México, Temporadas 1996-2006*. Paris Monographs in American Archaeology, 26. BAR, International Series, vol. 2203. British Archaeological Reports, Oxford.

Liendo Stuardo, Rodrigo, Javier López Mejía, and Arianna Campisani

2014 The Social Construction of Public Spaces at Palenque and Chinikihá, Mexico*.* In *Mesoamerican Plazas: Arenas of Community and Power*, edited by Kenchiro Tsukamoto and Takeshi Inomata, pp. 108-120. University of Arizona Press, Tucson.

Lobo, Jose, Luis M. A. Bettencourt, Scott G. Ortman and Michael E. Smith

 2020 Settlement Scaling Theory: Bridging the Study of Ancient and Contemporary Urban Systems *Urban Studies* 57(4):731-747.

Meier, R. L.

1962 *A Communications Theory of Urban Growth*. Cambridge (MA): The MIT Press.

Mokyr, Joel

 2006 Long-term economic growth and the history of technology*.* In *Handbook of Economic Growth*, edited by P. Aghion and S. Durlauf. North Holland, London.

Naroll, R.

1956 A preliminary index of social development. *American Anthropologist*, 58: 687-715.

Ortman, Scott G., Andrew HF Cabaniss, Jennie O. Sturm and Luís MA Bettencourt

2014 The Pre-History of Urban Scaling. *PLOS ONE* 9(2):e87902.

Ortman, Scott and José Lobo

2020 Smithian growth in a nonindustrial society. *Science Advances* 6(25):eaba5694.

O’Sullivan, A.

2011 *Urban Economics*. McGraw Hill, New York.

Parker, Geoff A. and John Maynard Smith

 1990 Optimality theory in evolutionary biology. *Nature* 348:27-33.

Prufer, Keith M. and Amy E. Thompson

2016 LiDAR Based Analyses Of Anthropogenic Landscape Alterations As A Component Of The Built Environment. *Advances in Archaeological Practice* 4 (3): 393-409.

Prufer, Keith M., Amy E. Thompson, and Douglas J. Kennett

2015 Evaluating Airborne LiDAR for Detecting Settlements and Modified Landscapes in Disturbed Tropical Environments at Uxbenká, Belize. *Journal of Archaeological Science* 57: 1-13.

Prufer, Keith M., Amy E. Thompson, Clayton R. Meredith, Brendan J. Culleton, Jillian M. Jordan, Claire E. Ebert, Bruce Winterhalder, and Douglas J. Kennett

2017 The Classic Period Maya Transition from an Ideal Free to an Ideal Despotic Settlement System at the Polity of Uxbenká. *Journal of Anthropological Archaeology* 45: 53-68.

Rosenswig, Robert M.

2019 The Izapa Kingdom's Capital: Formative-Period Settlement Patterns, Population and Dating Low-Relief Stelae. *Latin American Antiquity* 30 (1): 91-108.

Rosenswig, Robert M., Brendan J. Culleton, Douglas J. Kennett, Rosemary Lieske, Rebecca R. Mendelsohn, and Yahaira Núñez-Cortés

2018 The Early Izapa Kingdom: Recent Excavations, New Dating and Middle Formative Ceramic Analyses. *Ancient Mesoamerica* 29 (2): 373-393.

Rosenswig, Robert M. and Ricardo López-Torrijos

2018 Lidar Reveals the Entire Kingdom of Izapa During the First Millennium BC. *Antiquity* 92: 1292-1309.

Rosenswig, Robert M., Ricardo López-Torrijos, Caroline E. Antonelli, and Rebecca Mendelsohn

2013 LiDAR Mapping and Surface Survey of the Izapa State in the Tropical Piedmont. *Journal of Archaeological Science* 40: 1493-1507.

Samuelson, Paiul (1947) *Foundations of Economic Analysis*. Cambridge (MA): Harvard University Press.

Sanders, William T., Jeffrey R. Parsons, and Robert S. Santley

1979 *The Basin of Mexico: Ecological Processes in the Evolution of a Civilization*. Academic Press, New York.

Simon, Herbert A. (1956). Rational Choice and the Structure of the Environment. *Psychological Review*. 63: 129–138.

Smith, Michael E.

2010 The Archaeological Study of Neighborhoods and Districts in Ancient Cities. *Journal of Anthropological Archaeology* 29 (2): 137-154.

Thompson, Amy E., Clayton R. Meredith, and Keith M. Prufer

2018 Comparing Geostatistical Analyses for the Identification of Neighborhoods, Districts, and Social Communities in Archaeological Contexts: A Case Study from Two Ancient Maya Centers in Southern Belize. *Journal of Archaeological Science* 97: 1-13.

Ucko, Peter J., Ruth Tringham and George W. Dimbleby (editors)

1972 *Man, Settlement, and Urbanism*. Schenkman Publishing Company, Cambridge, Massachussetts.

von Thünen, Johann Heinrich

1966 *The Isolated State*. Pergamon Press, Oxford.

Walden, John P., Claire E. Ebert, Julie A. Hoggarth, Shane M. Montgomery, and Jaime J. Awe

2019 Modeling variability in Classic Maya intermediate elite political strategies through multivariate analysis of settlement patterns. *Journal of Anthropological Archaeology* 55.

Willey, Gordon R., William R. Bullard, John B. Glass, and James C. Gifford

1965 *Prehistoric Maya Settlements in the Belize Valley*. Papers, vol. 54. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, MA.

Young, Allyn (1928) Increasing retruns and economic progress. *The Economic Journal*, 38: 527-542.

**Supplemental Data Appendix**

**Appendix 1.** Site data from five settlement pattern surveys in southern Mesoamerica.

| **Survey** | **Site** | **Area (ha)** | **Domestic Structure Count** |
| --- | --- | --- | --- |
| Belize Valley | Atalaya | 0.0844 | 4 |
| Belize Valley | Bacab Na | 0.7169 | 4 |
| Belize Valley | Baking Pot | 5.1774 | 46 |
| Belize Valley | Bedran | 0.2542 | 4 |
| Belize Valley | Blackman Eddy | 1.9114 | 21 |
| Belize Valley | BR-147 | 0.1871 | 4 |
| Belize Valley | BR-180/168 | 1.0795 | 6 |
| Belize Valley | BR-19 | 0.1254 | 2 |
| Belize Valley | BR-260 | 0.1274 | 4 |
| Belize Valley | BR-96 | 0.2601 | 4 |
| Belize Valley | Cahal Pech | 2.8374 | 34 |
| Belize Valley | Cas Pek | 0.051 | 6 |
| Belize Valley | Ch'um Group | 0.1768 | 4 |
| Belize Valley | Ek Tzul | 0.8601 | 10 |
| Belize Valley | Esperanza | 0.5 | 6 |
| Belize Valley | Floral Park | 0.6163 | 8 |
| Belize Valley | Ixim Group | 0.1268 | 4 |
| Belize Valley | Lower Barton Creek | 1.0749 | 14 |
| Belize Valley | Lower Dover | 3.1321 | 52 |
| Belize Valley | Lubul Huh | 0.0945 | 3 |
| Belize Valley | Manbatty Site | 0.1834 | 4 |
| Belize Valley | Martinez Group | 0.1069 | 5 |
| Belize Valley | Melhado Site | 3.7686 | 5 |
| Belize Valley | Nohoch Ek | 0.6553 | 9 |
| Belize Valley | North Caracol Farm | 8.7611 | 11 |
| Belize Valley | Spanish Lookout | 0.3671 | 4 |
| Belize Valley | Tolok 1 | 0.0976 | 6 |
| Belize Valley | Tutu Uitz Na | 0.2409 | 5 |
| Belize Valley | Tuztziiy K'in | 0.4484 | 7 |
| Belize Valley | Xualcanil (Cayo Y) | 1.7158 | 15 |
| Belize Valley | Xunantunich | 9.9376 | 63 |
| Belize Valley | Yaxtun | 0.1128 | 3 |
| Belize Valley | Zinic | 0.2322 | 8 |
| Belize Valley | Zopilote | 0.4293 | 3 |
| Belize Valley | Zotz | 0.0369 | 4 |
| Belize Valley | Zubin | 0.2184 | 9 |
| Ix Kuku'il | 1 | 0.1369 | 1 |
| Ix Kuku'il | 2 | 0.2111 | 5 |
| Ix Kuku'il | 3 | 0.1436 | 3 |
| Ix Kuku'il | 4 | 0.1002 | 2 |
| Ix Kuku'il | 5 | 0.0297 | 2 |
| Ix Kuku'il | 6 | 0.0703 | 2 |
| Ix Kuku'il | 7 | 0.7298 | 2 |
| Ix Kuku'il | 8 | 0.0831 | 2 |
| Ix Kuku'il | 9 | 0.0336 | 2 |
| Ix Kuku'il | 10 | 0.1274 | 3 |
| Ix Kuku'il | 11 | 0.0562 | 3 |
| Ix Kuku'il | 12 | 0.0222 | 2 |
| Ix Kuku'il | 13 | 0.163 | 4 |
| Ix Kuku'il | 14 | 0.0241 | 1 |
| Ix Kuku'il | 15 | 0.117 | 6 |
| Ix Kuku'il | 16 | 0.1526 | 5 |
| Ix Kuku'il | 17 | 0.0774 | 3 |
| Ix Kuku'il | 18 | 0.0783 | 2 |
| Ix Kuku'il | 19 | 0.5782 | 10 |
| Ix Kuku'il | 20 | 0.2068 | 5 |
| Ix Kuku'il | 21 | 0.0339 | 1 |
| Ix Kuku'il | 22 | 0.1939 | 3 |
| Ix Kuku'il | 23 | 0.2318 | 2 |
| Ix Kuku'il | 24 | 0.2143 | 5 |
| Ix Kuku'il | 25 | 0.0897 | 1 |
| Ix Kuku'il | 26 | 0.0481 | 1 |
| Ix Kuku'il | 27 | 0.0682 | 3 |
| Ix Kuku'il | 28 | 0.0325 | 1 |
| Ix Kuku'il | 29 | 0.11 | 4 |
| Ix Kuku'il | 30 | 0.0914 | 1 |
| Ix Kuku'il | 31 | 0.0751 | 1 |
| Ix Kuku'il | 32 | 0.9274 | 9 |
| Ix Kuku'il | 33 | 0.3542 | 5 |
| Ix Kuku'il | 34 | 0.0331 | 3 |
| Ix Kuku'il | 35 | 0.1354 | 7 |
| Ix Kuku'il | 36 | 0.1797 | 3 |
| Ix Kuku'il | 37 | 0.0959 | 3 |
| Ix Kuku'il | 38 | 0.0231 | 3 |
| Ix Kuku'il | 39 | 0.0954 | 3 |
| Ix Kuku'il | 40 | 0.1157 | 3 |
| Ix Kuku'il | 41 | 0.1473 | 3 |
| Ix Kuku'il | 42 | 0.1736 | 2 |
| Ix Kuku'il | 43 | 0.1339 | 4 |
| Ix Kuku'il | 44 | 0.0429 | 4 |
| Ix Kuku'il | 46 | 0.0244 | 4 |
| Ix Kuku'il | 47 | 0.0447 | 4 |
| Ix Kuku'il | 48 | 0.058 | 4 |
| Ix Kuku'il | 49 | 0.0626 | 3 |
| Ix Kuku'il | 51 | 0.2036 | 10 |
| Ix Kuku'il | 52 | 0.0441 | 2 |
| Ix Kuku'il | 53 | 0.044 | 1 |
| Ix Kuku'il | 54 | 0.2638 | 1 |
| Ix Kuku'il | 55 | 0.148 | 3 |
| Ix Kuku'il | 56 | 0.0286 | 3 |
| Ix Kuku'il | 57 | 0.0329 | 4 |
| Ix Kuku'il | 58 | 0.1165 | 3 |
| Ix Kuku'il | 59 | 0.1843 | 9 |
| Ix Kuku'il | 60 | 0.4213 | 7 |
| Ix Kuku'il | 61 | 0.1625 | 5 |
| Ix Kuku'il | 62 | 0.0414 | 1 |
| Ix Kuku'il | 63 | 0.1625 | 5 |
| Ix Kuku'il | 64 | 0.1651 | 2 |
| Ix Kuku'il | 65 | 0.0338 | 1 |
| Ix Kuku'il | 66 | 0.121 | 4 |
| Ix Kuku'il | 67 | 0.1753 | 2 |
| Ix Kuku'il | 68 | 0.0455 | 4 |
| Ix Kuku'il | 71 | 0.0342 | 2 |
| Ix Kuku'il | 75 | 0.3313 | 2 |
| Ix Kuku'il | 76 | 0.0861 | 3 |
| Ix Kuku'il | 78 | 0.0667 | 1 |
| Ix Kuku'il | 79 | 0.27 | 3 |
| Ix Kuku'il | 80 | 0.0594 | 2 |
| Ix Kuku'il | 81 | 0.0917 | 3 |
| Ix Kuku'il | 82 | 0.063 | 1 |
| Ix Kuku'il | 83 | 0.1523 | 5 |
| Ix Kuku'il | 84 | 0.3663 | 4 |
| Ix Kuku'il | 85 | 0.0883 | 1 |
| Ix Kuku'il | 87 | 0.0299 | 2 |
| Ix Kuku'il | 88 | 0.1058 | 3 |
| Ix Kuku'il | 89 | 0.0516 | 1 |
| Ix Kuku'il | 90 | 0.1225 | 4 |
| Ix Kuku'il | 91 | 0.0438 | 2 |
| Ix Kuku'il | 92 | 0.0918 | 7 |
| Ix Kuku'il | 119 | 0.3107 | 5 |
| Ix Kuku'il | 120 | 0.1065 | 1 |
| Ix Kuku'il | 123 | 0.0484 | 2 |
| Ix Kuku'il | 124 | 0.0465 | 4 |
| Ix Kuku'il | 125 | 0.0236 | 2 |
| Ix Kuku'il | 126 | 0.236 | 2 |
| Ix Kuku'il | 127 | 0.9681 | 23 |
| Ix Kuku'il | 130 | 0.0535 | 5 |
| Ix Kuku'il | 131 | 0.0921 | 2 |
| Ix Kuku'il | 135 | 0.0583 | 2 |
| Ix Kuku'il | 136 | 0.1649 | 1 |
| Izapa | in Guatemala | 1.6 | 4 |
| Izapa | in Guatemala | 3.4 | 5 |
| Izapa | in Guatemala | 2.2 | 9 |
| Izapa | in Guatemala | 16 | 35 |
| Izapa | Iz | 229.0 | 89 |
| Izapa | Tp 1001 | 5.5 | 13 |
| Izapa | Tp 1082 | 8.7 | 21 |
| Izapa | Tp 1224 | 0.9 | 4 |
| Izapa | Tp 1231 | 3.6 | 7 |
| Izapa | Tp 1270 | 1.3 | 7 |
| Izapa | Tp 1367 | 1.6 | 5 |
| Izapa | Tp 1501 | 0.7 | 4 |
| Izapa | Tp 1502 | 1.8 | 5 |
| Izapa | Tp 1504 | 0.3 | 3 |
| Izapa | Tp 1505 | 1.4 | 4 |
| Izapa | Tp 1506 | 0.6 | 4 |
| Izapa | Tp 1507 | 2.9 | 6 |
| Izapa | Tp 1508 | 4.7 | 13 |
| Izapa | Tp 1509 | 3.0 | 11 |
| Izapa | Tp 1510 | 3.6 | 4 |
| Izapa | Tp 1511 | 2.6 | 11 |
| Izapa | Tp 1512 | 1.3 | 5 |
| Izapa | Tp 1513 | 2.2 | 5 |
| Izapa | Tp 1514 | 1.5 | 6 |
| Izapa | Tp 1515 | 1.2 | 4 |
| Izapa | Tp 1516 | 4.3 | 14 |
| Izapa | Tp 1517 | 1.5 | 5 |
| Izapa | Tp 1518 | 2.1 | 6 |
| Izapa | Tp 1519 | 4.5 | 9 |
| Izapa | Tp 1521 | 4.7 | 14 |
| Izapa | Tp 1521 | 14.1 | 26 |
| Izapa | Tp 1522 | 0.8 | 4 |
| Izapa | Tp 1523 | 1.1 | 4 |
| Izapa | Tp 1525 | 1.9 | 5 |
| Izapa | Tp 1527 | 1.2 | 5 |
| Izapa | Tp 1530 | 42.8 | 55 |
| Izapa | Tp 2013 | 3.3 | 6 |
| Izapa | Tp 2192 | 1.5 | 4 |
| Izapa | Tp 2241 | 2.5 | 8 |
| Palenque | Belisario Domínguez Norte | 3.872 | 10 |
| Palenque | Chancalá | 0.170 | 21 |
| Palenque | Chinikiha | 86.000 | 275 |
| Palenque | Ejido Reforma | 3.470 | 19 |
| Palenque | El Barí | 13.164 | 18 |
| Palenque | El Jabalinero | 2.900 | 4 |
| Palenque | El Lacandon | 21.800 | 72 |
| Palenque | El Sacrificio | 5.000 | 2 |
| Palenque | La Cascada | 4.439 | 24 |
| Palenque | La Concepción | 4.224 | 7 |
| Palenque | La Providencia | 4.500 | 15 |
| Palenque | Lindavista | 40.200 | 33 |
| Palenque | N1E1-40 | 0.033 | 3 |
| Palenque | N1E1-41 | 0.028 | 3 |
| Palenque | N1E1-42 | 0.026 | 3 |
| Palenque | N1E1-428 | 0.100 | 2 |
| Palenque | N1E1-45 | 1.390 | 12 |
| Palenque | N1E1-46 | 0.017 | 2 |
| Palenque | N1E1-47 | 0.100 | 2 |
| Palenque | N1E1-48 | 0.180 | 4 |
| Palenque | N1E1-50 | 0.200 | 5 |
| Palenque | N1E1-52 | 0.062 | 2 |
| Palenque | N1E1-55 | 0.015 | 2 |
| Palenque | N1E1-59 | 0.320 | 5 |
| Palenque | N1E1-61 | 0.006 | 2 |
| Palenque | N1E3-137 | 0.130 | 4 |
| Palenque | N1E3-141 | 0.110 | 4 |
| Palenque | N1E4-145 | 0.810 | 13 |
| Palenque | N1E4-148 | 0.350 | 5 |
| Palenque | N1E4-149 | 0.250 | 3 |
| Palenque | N1E4-155 | 0.019 | 2 |
| Palenque | N1E5-158 | 0.160 | 4 |
| Palenque | N1-E5-159 | 0.030 | 2 |
| Palenque | N1E6-380 | 0.044 | 2 |
| Palenque | N1W1-10 | 0.033 | 2 |
| Palenque | N1W1-15 | 1.520 | 38 |
| Palenque | N1W1-17 | 0.190 | 2 |
| Palenque | N1W1-18 | 0.400 | 8 |
| Palenque | N1W1-19 | 0.160 | 7 |
| Palenque | N1W1-21 | 0.015 | 2 |
| Palenque | N1W1-22 | 0.088 | 3 |
| Palenque | N1W1-23 | 0.022 | 5 |
| Palenque | N1W1-24 | 0.031 | 2 |
| Palenque | N1W1-25 | 0.025 | 2 |
| Palenque | N1W1-26 | 0.050 | 3 |
| Palenque | N1W1-29 | 0.210 | 3 |
| Palenque | N1W1-30 | 0.270 | 4 |
| Palenque | N1W1-31 | 0.043 | 6 |
| Palenque | N1W1-32 | 0.270 | 2 |
| Palenque | N1W1-36 | 0.002 | 2 |
| Palenque | N1W1-39 | 0.003 | 2 |
| Palenque | N1W1-4 (Michol Ridge) | 1.140 | 7 |
| Palenque | N1W1-402 | 0.040 | 3 |
| Palenque | N1W1-5 | 0.170 | 7 |
| Palenque | N1W1-6 | 0.003 | 1 |
| Palenque | Nututun | 4.600 | 26 |
| Palenque | Palenque | 210.000 | 1498 |
| Palenque | Rancho 5 de Mayo | 0.714 | 5 |
| Palenque | Reforma de Ocampo | 6.700 | 58 |
| Palenque | S1E10-271 | 0.100 | 3 |
| Palenque | S1E2-164 | 0.069 | 2 |
| Palenque | S1E2-167 | 0.205 | 6 |
| Palenque | S1E2-71 | 0.240 | 4 |
| Palenque | S1E2-72 | 0.030 | 3 |
| Palenque | S1E2-74 | 0.130 | 4 |
| Palenque | S1E2-76 | 0.050 | 3 |
| Palenque | S1E2-77 | 0.120 | 6 |
| Palenque | S1E2-78 | 0.550 | 4 |
| Palenque | S1E2-79 | 0.060 | 2 |
| Palenque | S1E2-92 | 0.870 | 3 |
| Palenque | S1E2-94 | 0.200 | 7 |
| Palenque | S1E2-95 | 0.047 | 3 |
| Palenque | S1E2-96 | 0.059 | 3 |
| Palenque | S1E2-97 | 0.021 | 3 |
| Palenque | S1E3-101 | 0.024 | 2 |
| Palenque | S1E3-103 | 1.100 | 12 |
| Palenque | S1E3-104 | 0.810 | 12 |
| Palenque | S1E3-105 | 4.500 | 24 |
| Palenque | S1E3-107 | 0.040 | 2 |
| Palenque | S1E3-108 | 3.400 | 31 |
| Palenque | S1E3-109 | 0.080 | 2 |
| Palenque | S1E3-110 | 0.110 | 5 |
| Palenque | S1E3-111 | 0.680 | 9 |
| Palenque | S1E3-112 | 0.005 | 2 |
| Palenque | S1E3-113 | 0.470 | 11 |
| Palenque | S1E3-114 (El Porvenir) | 3.960 | 31 |
| Palenque | S1E3-115 | 0.110 | 5 |
| Palenque | S1E3-116 | 0.330 | 7 |
| Palenque | S1E3-117 | 0.059 | 2 |
| Palenque | S1E3-121 | 0.043 | 3 |
| Palenque | S1E3-171 | 0.025 | 2 |
| Palenque | S1E3-98 | 0.084 | 7 |
| Palenque | S1E3-99 | 0.084 | 4 |
| Palenque | S1E4-122 | 0.300 | 4 |
| Palenque | S1E4-123 | 0.130 | 5 |
| Palenque | S1E4-124 | 0.370 | 8 |
| Palenque | S1E4-125 | 0.100 | 2 |
| Palenque | S1E4-127 | 0.180 | 5 |
| Palenque | S1E4-128 | 0.360 | 5 |
| Palenque | S1E4-129 | 0.570 | 6 |
| Palenque | S1E4-130 | 0.929 | 7 |
| Palenque | S1E4-131 | 0.561 | 10 |
| Palenque | S1E4-133 | 0.269 | 4 |
| Palenque | S1E4-134 | 0.016 | 5 |
| Palenque | S1E4-135 | 0.026 | 6 |
| Palenque | S1E4-136 | 0.180 | 9 |
| Palenque | S1E4-152(Francisco Villa) | 0.580 | 9 |
| Palenque | S1E4-370 | 0.675 | 4 |
| Palenque | S1E4-374 | 0.014 | 2 |
| Palenque | S1E4-375 | 0.011 | 2 |
| Palenque | S1E4-376 | 0.014 | 2 |
| Palenque | S1E5-356 | 0.045 | 2 |
| Palenque | S1E5-360 | 0.102 | 3 |
| Palenque | S1E5-361 | 0.046 | 2 |
| Palenque | S1E5-363 | 0.011 | 2 |
| Palenque | S1E6-336 | 0.200 | 3 |
| Palenque | S1E6-337 | 0.053 | 3 |
| Palenque | S1E6-338 | 0.034 | 3 |
| Palenque | S1E6-340 | 0.990 | 4 |
| Palenque | S1E6-343 | 0.148 | 1 |
| Palenque | S1E6-345 | 0.092 | 2 |
| Palenque | S1E6-349 | 0.234 | 2 |
| Palenque | S1E6-350 | 0.532 | 4 |
| Palenque | S1E6-352 | 0.083 | 3 |
| Palenque | S1E6-355 | 1.693 | 5 |
| Palenque | S1E7-313 | 0.089 | 5 |
| Palenque | S1E7-314 | 0.007 | 2 |
| Palenque | S1E7-317 | 0.225 | 2 |
| Palenque | S1E7-319 | 0.117 | 6 |
| Palenque | S1E7-320 | 0.840 | 3 |
| Palenque | S1E7-322 | 0.420 | 2 |
| Palenque | S1E7-323 | 0.265 | 4 |
| Palenque | S1E7-324 | 0.028 | 2 |
| Palenque | S1E7-325 | 0.066 | 2 |
| Palenque | S1E7-326 | 0.028 | 2 |
| Palenque | S1E7-327 | 0.008 | 2 |
| Palenque | S1E7-328 | 0.052 | 2 |
| Palenque | S1E7-329 (El Chinal) | 0.073 | 3 |
| Palenque | S1E7-330 | 0.008 | 2 |
| Palenque | S1E7-333 | 0.480 | 3 |
| Palenque | S1E7-389 | 0.180 | 2 |
| Palenque | S1E8-292 | 0.350 | 8 |
| Palenque | S1E8-296 | 1.033 | 7 |
| Palenque | S1E8-298 | 0.650 | 5 |
| Palenque | S1E8-309 | 0.580 | 3 |
| Palenque | S1E8-310 | 0.066 | 2 |
| Palenque | S2E10-275 | 0.440 | 9 |
| Palenque | S2E2-168 | 0.066 | 3 |
| Palenque | S2E3-178 | 0.173 | 5 |
| Palenque | S2E3-179 | 0.001 | 2 |
| Palenque | S2E3-180 | 0.030 | 2 |
| Palenque | S2E3-181 | 0.064 | 2 |
| Palenque | S2E5-188 | 0.077 | 3 |
| Palenque | S2E5-189 | 0.185 | 4 |
| Palenque | S2E5-190 | 0.111 | 2 |
| Palenque | S2E5-191 | 0.002 | 2 |
| Palenque | S2E5-192 | 0.007 | 2 |
| Palenque | S2E5-195 | 0.073 | 2 |
| Palenque | S2E5-196 | 0.029 | 2 |
| Palenque | S2E9-389 | 0.504 | 4 |
| Palenque | S3E6-202 | 0.026 | 2 |
| Palenque | S3E6-203 | 0.046 | 3 |
| Palenque | S3E6-204 | 0.051 | 2 |
| Palenque | S3E6-205 | 0.009 | 2 |
| Palenque | S3E6-206 | 0.039 | 3 |
| Palenque | S3E6-207 | 0.044 | 3 |
| Palenque | S3E6-208 | 0.014 | 2 |
| Palenque | S3E6-209 | 0.856 | 10 |
| Palenque | S3E6-210 | 0.041 | 3 |
| Palenque | S3E6-211 | 0.016 | 3 |
| Palenque | S3E6-213 | 0.220 | 4 |
| Palenque | S3E6-214 | 0.380 | 6 |
| Palenque | S3E7-218 | 0.240 | 5 |
| Palenque | S3E7-219 | 0.018 | 2 |
| Palenque | S3E7-220 | 0.500 | 3 |
| Palenque | S3E7-224 | 0.003 | 2 |
| Palenque | S3E7-225 | 0.007 | 2 |
| Palenque | S4E6-217 | 0.022 | 3 |
| Palenque | S4E7-228 | 0.219 | 8 |
| Palenque | S4E7-230 | 0.009 | 3 |
| Palenque | S4E7-235 | 0.420 | 5 |
| Palenque | S4E7-238 | 0.140 | 4 |
| Palenque | S4E7-241 | 0.012 | 2 |
| Palenque | S4E7-244 | 0.262 | 3 |
| Palenque | S4E7-246 | 0.147 | 4 |
| Palenque | S4E7-250 | 0.005 | 2 |
| Palenque | S4E8-254 | 0.170 | 5 |
| Palenque | S4E8-257 | 0.036 | 9 |
| Palenque | S4E8-258 | 0.650 | 4 |
| Palenque | S4E8-261 | 0.008 | 3 |
| Palenque | S4E8-262 | 0.160 | 6 |
| Palenque | S4E8-263 | 0.019 | 2 |
| Palenque | S4E8-269 | 0.534 | 7 |
| Palenque | S4E8-394 | 0.130 | 2 |
| Palenque | S4E8-395 | 0.080 | 4 |
| Palenque | S4E8-397 | 0.160 | 4 |
| Palenque | S4E8-400 | 0.100 | 3 |
| Palenque | San Juan Chancalaíto | 9.700 | 47 |
| Palenque | Santa Isabel | 9.900 | 41 |
| Palenque | Sulusum | 9.500 | 19 |
| Palenque | Xupa | 2.182 | 14 |
| Rosario | 215 | 1.12 | 9 |
| Rosario | 216 | 0.21 | 1 |
| Rosario | 217 | 0.76 | 12 |
| Rosario | 218 | 0.07 | 1 |
| Rosario | 219 | 14.15 | 149 |
| Rosario | 220 | 0.11 | 4 |
| Rosario | 221 | 0.5 | 11 |
| Rosario | 222 | 0.06 | 2 |
| Rosario | 223 | 0.04 | 1 |
| Rosario | 224 | 0.03 | 2 |
| Rosario | 225 | 1.24 | 15 |
| Rosario | 226 | 0.29 | 6 |
| Rosario | 227 | 31.38 | 128 |
| Rosario | 228 | 0.11 | 3 |
| Rosario | 229 | 0.66 | 10 |
| Rosario | 230 | 3.23 | 21 |
| Rosario | 231 | 0.2 | 5 |
| Rosario | 232 | 24.65 | 199 |
| Rosario | 234 | 14.74 | 154 |
| Rosario | 235 | 0.05 | 2 |
| Rosario | 236 | 0.1 | 2 |
| Rosario | 237 | 0.03 | 1 |
| Rosario | 238 | 13.93 | 72 |
| Rosario | 239 | 4.14 | 25 |
| Rosario | 240 | 0.27 | 4 |
| Rosario | 241 | 14.23 | 152 |
| Rosario | 242 | 62 | 402 |
| Rosario | 243 | 0.03 | 1 |
| Rosario | 244 | 2.39 | 28 |
| Rosario | 245 | 1.05 | 12 |
| Rosario | 246 | 1.37 | 22 |
| Rosario | 247 | 0.19 | 2 |
| Rosario | 248 | 0.15 | 3 |
| Rosario | 249 | 0.32 | 6 |
| Rosario | 250 | 8.23 | 70 |
| Rosario | 251 | 0.83 | 9 |
| Rosario | 252 | 0.33 | 5 |
| Rosario | 253 | 14.56 | 108 |
| Rosario | 254 | 0.02 | 1 |
| Rosario | 255 | 0.03 | 1 |
| Rosario | 257 | 2.47 | 27 |
| Rosario | 258 | 3.16 | 52 |
| Rosario | 259 | 0.07 | 2 |
| Rosario | 260 | 3.97 | 44 |
| Rosario | 261 | 6.02 | 70 |
| Rosario | 262 | 2.62 | 37 |
| Rosario | 263 | 1.39 | 17 |
| Rosario | 264 | 65.36 | 514 |
| Rosario | 265 | 5.25 | 44 |
| Rosario | 266 | 0.02 | 1 |
| Rosario | 267 | 0.2 | 5 |
| Rosario | 268 | 0.45 | 3 |
| Rosario | 269 | 0.49 | 10 |
| Rosario | 270 | 0.02 | 1 |
| Rosario | 271 | 9.53 | 96 |
| Rosario | 272 | 0.02 | 1 |
| Rosario | 273 | 0.12 | 3 |
| Rosario | 274 | 0.54 | 8 |
| Rosario | 275 | 0.75 | 7 |
| Rosario | 276 | 0.93 | 10 |
| Rosario | 277 | 0.48 | 4 |
| Rosario | 278 | 9.2 | 154 |
| Rosario | 279 | 1.65 | 16 |
| Rosario | 280 | 5.76 | 49 |
| Rosario | 281 | 0.39 | 8 |
| Rosario | 282 | 0.88 | 12 |
| Rosario | 283 | 0.08 | 3 |
| Rosario | 284 | 1.1 | 11 |
| Rosario | 285 | 3.23 | 31 |
| Rosario | 286 | 0.68 | 10 |
| Rosario | 287 | 2.27 | 15 |
| Rosario | 288 | 0.49 | 5 |
| Rosario | 289 | 8.27 | 42 |
| Rosario | 290 | 0.45 | 8 |
| Rosario | 291 | 0.1 | 2 |
| Rosario | 292 | 0.56 | 5 |
| Rosario | 293 | 3.14 | 30 |
| Rosario | 294 | 9.36 | 54 |
| Rosario | 295 | 0.54 | 11 |
| Rosario | 296 | 0.86 | 12 |
| Rosario | 297 | 0.89 | 14 |
| Rosario | 298 | 0.67 | 7 |
| Rosario | 299 | 0.16 | 3 |
| Rosario | 300 | 0.26 | 3 |
| Rosario | 301 | 3.78 | 41 |
| Rosario | 302 | 75.2 | 796 |
| Rosario | 303 | 3.95 | 24 |
| Rosario | 304 | 1.1 | 5 |
| Rosario | 305 | 1.17 | 12 |
| Rosario | 306 | 1.17 | 9 |
| Rosario | 307 | 1.99 | 15 |
| Rosario | 308 | 7.69 | 60 |
| Rosario | 309 | 12.73 | 53 |
| Rosario | 310 | 0.69 | 5 |
| Rosario | 311 | 0.02 | 1 |
| Rosario | 312 | 5.77 | 55 |
| Rosario | 313 | 1.18 | 7 |
| Rosario | 314 | 0.47 | 7 |
| Rosario | 315 | 3.9 | 20 |
| Rosario | 317 | 1.07 | 7 |
| Rosario | 318 | 0.19 | 2 |
| Rosario | 319 | 2.88 | 15 |
| Rosario | 320 | 0.71 | 10 |
| Rosario | 321 | 0.33 | 4 |
| Rosario | 322 | 1.86 | 10 |
| Rosario | 323 | 1.37 | 17 |
| Rosario | 324 | 2.11 | 14 |
| Rosario | 325 | 1.91 | 11 |
| Rosario | 326 | 0.49 | 5 |
| Rosario | 327 | 0.02 | 1 |
| Rosario | 328 | 2 | 10 |
| Rosario | 329 | 302 | 1730 |
| Uxbenka | 3 | 0.2244 | 5 |
| Uxbenka | 4 | 0.0269 | 1 |
| Uxbenka | 5 | 0.17 | 5 |
| Uxbenka | 9 | 0.3116 | 11 |
| Uxbenka | 10 | 0.1824 | 7 |
| Uxbenka | 13 | 0.2836 | 3 |
| Uxbenka | 18 | 0.0562 | 1 |
| Uxbenka | 19 | 0.2627 | 6 |
| Uxbenka | 20 | 0.1226 | 2 |
| Uxbenka | 21 | 0.1525 | 3 |
| Uxbenka | 22 | 0.068 | 4 |
| Uxbenka | 23 | 0.1533 | 5 |
| Uxbenka | 24 | 0.4097 | 6 |
| Uxbenka | 25 | 2.3159 | 35 |
| Uxbenka | 26 | 0.2266 | 13 |
| Uxbenka | 27 | 0.064 | 3 |
| Uxbenka | 28 | 0.7301 | 21 |
| Uxbenka | 29 | 0.1385 | 6 |
| Uxbenka | 30 | 0.0305 | 1 |
| Uxbenka | 31 | 0.0106 | 1 |
| Uxbenka | 32 | 0.0096 | 1 |
| Uxbenka | 33 | 0.1356 | 4 |
| Uxbenka | 34 | 0.1714 | 3 |
| Uxbenka | 35 | 0.4149 | 9 |
| Uxbenka | 36 | 0.0821 | 3 |
| Uxbenka | 37 | 0.3926 | 7 |
| Uxbenka | 38 | 0.0441 | 2 |
| Uxbenka | 39 | 0.0545 | 2 |
| Uxbenka | 42 | 0.3857 | 8 |
| Uxbenka | 43 | 0.2615 | 10 |
| Uxbenka | 44 | 0.2741 | 7 |
| Uxbenka | 45 | 0.0796 | 4 |
| Uxbenka | 47 | 0.1694 | 5 |
| Uxbenka | 48 | 0.0324 | 2 |
| Uxbenka | 50 | 0.0316 | 1 |
| Uxbenka | 51 | 0.0332 | 4 |
| Uxbenka | 52 | 0.0469 | 2 |
| Uxbenka | 53 | 0.071 | 2 |
| Uxbenka | 54 | 0.1175 | 2 |
| Uxbenka | 60 | 0.0731 | 5 |
| Uxbenka | 62 | 0.0851 | 4 |
| Uxbenka | 63 | 0.0688 | 4 |
| Uxbenka | 64 | 0.227 | 6 |
| Uxbenka | 65 | 0.064 | 4 |
| Uxbenka | 66 | 0.0326 | 1 |
| Uxbenka | 67 | 0.0471 | 1 |
| Uxbenka | 68 | 0.0741 | 2 |
| Uxbenka | 69 | 0.1429 | 3 |
| Uxbenka | 70 | 0.1609 | 1 |
| Uxbenka | 71 | 0.052 | 2 |
| Uxbenka | 72 | 0.0093 | 1 |
| Uxbenka | 73 | 0.7177 | 7 |
| Uxbenka | 74 | 0.2337 | 4 |
| Uxbenka | 75 | 0.1071 | 3 |
| Uxbenka | 76 | 0.444 | 5 |
| Uxbenka | 77 | 0.0643 | 3 |
| Uxbenka | 78 | 0.1203 | 2 |
| Uxbenka | 79 | 0.6485 | 9 |
| Uxbenka | 80 | 0.0964 | 2 |
| Uxbenka | 81 | 0.1609 | 1 |
| Uxbenka | 83 | 0.1964 | 4 |
| Uxbenka | 84 | 0.0939 | 5 |
| Uxbenka | 87 | 0.5444 | 7 |
| Uxbenka | 88 | 0.4817 | 2 |
| Uxbenka | 89 | 0.1411 | 2 |
| Uxbenka | 90 | 0.1345 | 1 |
| Uxbenka | 91 | 0.0302 | 3 |
| Uxbenka | 92 | 0.0589 | 2 |
| Uxbenka | 93 | 0.023 | 2 |
| Uxbenka | 94 | 0.0929 | 3 |
| Uxbenka | 105 | 0.0541 | 2 |
| Uxbenka | 106 | 0.0163 | 1 |
| Uxbenka | 107 | 0.2734 | 2 |
| Uxbenka | 108 | 0.0043 | 1 |
| Uxbenka | 109 | 0.0988 | 7 |
| Uxbenka | 110 | 0.0519 | 4 |
| Uxbenka | 111 | 0.1698 | 2 |
| Uxbenka | 112 | 0.0288 | 1 |
| Uxbenka | 113 | 0.0131 | 1 |
| Uxbenka | 114 | 0.1006 | 3 |
| Uxbenka | 115 | 0.0722 | 1 |
| Uxbenka | 116 | 0.0389 | 4 |
| Uxbenka | 117 | 0.044 | 2 |
| Uxbenka | 118 | 0.021 | 1 |
| Uxbenka | 119 | 0.0597 | 1 |
| Uxbenka | 120 | 0.0685 | 2 |
| Uxbenka | 121 | 0.1097 | 6 |
| Uxbenka | 122 | 0.0133 | 1 |
| Uxbenka | 123 | 0.0425 | 2 |
| Uxbenka | 124 | 0.1031 | 5 |
| Uxbenka | A | 0.4493 | 6 |
| Uxbenka | F | 0.2828 | 4 |
| Uxbenka | I | 0.7722 | 11 |
| Uxbenka | L | 0.1134 | 5 |
| Uxbenka | M | 1.2489 | 8 |
| Uxbenka | X100 | 0.1158 | 1 |
| Uxbenka | X101 | 0.0709 | 1 |
| Uxbenka | X102 | 0.0632 | 1 |
| Uxbenka | X103 | 0.1035 | 2 |
| Uxbenka | X104 | 0.0293 | 1 |
| Uxbenka | X105 | 0.1032 | 2 |
| Uxbenka | X106 | 0.1009 | 2 |
| Uxbenka | X107 | 0.2137 | 7 |
| Uxbenka | X108 | 0.1936 | 5 |
| Uxbenka | X109 | 0.1205 | 4 |
| Uxbenka | X110 | 0.0832 | 1 |
| Uxbenka | X111 | 0.0824 | 2 |
| Uxbenka | X112 | 0.0798 | 4 |
| Uxbenka | X113 | 0.0281 | 1 |
| Uxbenka | X114 | 0.1765 | 6 |
| Uxbenka | X115 | 0.4064 | 1 |
| Uxbenka | X116 | 0.0609 | 2 |
| Uxbenka | X117 | 0.0936 | 7 |
| Uxbenka | X118 | 0.1639 | 2 |
| Uxbenka | X129 | 0.0616 | 1 |
| Uxbenka | X133 | 0.0373 | 3 |
| Uxbenka | X134 | 0.0097 | 2 |
| Uxbenka | X93 | 0.0554 | 1 |
| Uxbenka | X94 | 0.0887 | 5 |
| Uxbenka | X95 | 0.3498 | 6 |
| Uxbenka | X96 | 0.1102 | 1 |
| Uxbenka | X97 | 0.1882 | 5 |
| Uxbenka | X98 | 0.1167 | 5 |
| Uxbenka | X99 | 0.1063 | 1 |
|  |  |  |  |

**Supplemental Appendix 2.** Mixing populations, epicenter areas, and civic architecture volumes for political units in four regional surveys. The Palenque data are from Liendo (2011:Table 4.4), the Rosario data are from de Montmollin (1995: Table 14, Table 10), and data for the other two regions were compiled from recent lidar surveys for this study. Mixing populations are the summed populations of all subject settlements based on the position of each center in the settlement hierarchy.

| **Epicenter Site** | **Region** | **Site Level** | **Civic area (ha)** | **Civic Architecture/phase (m3)** | **Site Dwellings** | **Mixing Population** | **Site Area (ha)** | **Notes** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 164 | R | 1 | 4.09 | 51879 | 260 | 3135 |  | Rosario Polity Capital |
| 217 | R | 3 | 0.36 | 502 |  | 203 | 0.76 | Population adjacent to the Ojo de Agua polity |
| 219 | R | 2 | 1.91 | 10331 | 149 | 325 | 14.15 | Ojo de Agua E District Capital |
| 227 | R | 2 | 4.77 | 20210 | 129 | 2722 | 31.38 | Ojo de Agua W District Capital |
| 230 | R | 2 | 1.02 | 5711 | 23 | 325 | 3.23 | Ojo de Agua E population |
| 232 | R | 3 | 0.21 | 718 | 201 | 201 | 24.65 |  |
| 234 | R | 3 | 0.38 | 660 | 153 | 153 | 14.74 |  |
| 238 | R | 3 | 0.09 | 360 | 73 | 73 | 13.93 |  |
| 241 | R | 3 | 0.49 | 1617 | 152 | 152 | 14.23 |  |
| 242 | R | 1 | 3.22 | 66939 | 435 | 3482 | 62 | Ojo de Agua Polity Capital |
| 244 | R | 3 | 0.14 | 381 | 29 | 29 | 2.39 |  |
| 250 | R | 3 | 0.13 | 778 | 70 | 70 | 8.23 |  |
| 253 | R | 3 | 0.22 | 634 | 108 | 108 | 14.56 |  |
| 261 | R | 3 | 0.05 | 519 | 70 | 277 | 6.02 |  |
| 264 | R | 1 | 1.73 | 7122 | 528 | 805 | 65.36 | Los Encentuaros Polity Capital |
| 278 | R | 1 | 3.45 | 63748 | 154 | 2520 | 9.2 | Conception Polity Capital, subject population estimated based on polity area and 70 houses/km2 |
| 285 | R | 3 | 0.23 | 218 | 43 | 43 | 3.23 |  |
| 286 | R | 3 | 0.1 | 360 |  | 93 | 0.68 |  |
| 289 | R | 3 | 0.56 | 414 | 42 | 42 | 8.27 |  |
| 294 | R | 3 | 0.03 | 97 | 54 | 54 | 9.36 |  |
| 302 | R | 1 | 2.81 | 11315 | 799 | 799 | 75.2 | Ontela Polity Capital |
| 308 | R | 3 | 0.29 | 784 | 60 | 60 | 7.69 |  |
| 309 | R | 3 | 0.21 | 977 | 52 | 52 | 12.73 |  |
| 312 | R | 3 | 0.16 | 232 | 55 | 55 | 5.77 |  |
| 320 | R | 3 | 0.2 | 197 |  |  | 0.71 | Unclear associated population |
| 328 | R | 3 | 0.08 | 467 |  |  | 2 | Unclear associated population |
| 330 | R | 2 | 2.95 | 13554 | 1756 | 1756 | 302 | Ojo de Agua W District Capital |
| 335 | R | 3 | 0.17 | 533 |  | 170 | 12 |  |
| 339 | R | 3 |  | 1177 |  | 197 | 13 |  |
| Palenque | P | 1 | 1.56 | 4452319 | 1498 | 2232 | 210 | Palenque Polity Capital |
| Chinikiha | P | 1 | 0.69 | 552449 | 275 | 426 | 86 | Chinikiha Polity Capital |
| Lindavista | P | 2 | 0.19 | 81849 | 33 | 73 | 40.2 | District Capital |
| La Cascada | P | 3 | 0.15 | 37617 | 24 | 24 | 4.44 |  |
| Nututun | P | 3 | 0.09 | 12284 | 26 | 26 | 4.6 |  |
| San Juan Chancalaíto | P | 3 | 0.12 | 41567 | 47 | 47 | 9.7 |  |
| El Lacandon | P | 3 | 0.09 | 24625 | 72 | 72 | 21.8 |  |
| Xupa | P | 3 | 0.09 | 15804 | 14 | 14 | 2.18 |  |
| Rancho 5 de Mayo | P | 3 | 0.03 | 3086 | 5 | 5 | 0.71 |  |
| Reforma de Ocampo | P | 3 | 0.1 | 17105 | 58 | 58 | 6.7 |  |
| Santa Isabel | P | 3 | 0.14 | 59922 | 41 | 41 | 9.9 |  |
| La Providencia | P | 3 | 0.1 | 22960 | 15 | 15 | 4.5 |  |
| S3E6-209 | P | 3 | 0.1 | 12363 | 10 | 10 | 0.86 |  |
| La Concepción | P | 3 | 0.05 | 6500 | 7 | 7 | 4.22 |  |
| N1E4-145 | P | 3 | 0.06 | 6993 | 13 | 13 | 0.81 |  |
| Sulusum | P | 3 | 0.07 | 9647 | 19 | 19 | 9.5 |  |
| El Barí | P | 3 | 0.02 | 2718 | 18 | 18 | 13.16 |  |
| N1E3-141 | P | 3 | 0.02 | 1823 | 4 | 4 | 0.11 |  |
| Atalaya | B | 3 | 0.02 | 607 | 4 | 4 | 0.08 | High-status commoner household, Baking Pot |
| Bacab Na | B | 2 | 0.32 | 12417 | 4 | 11 | 0.72 | Small IE center/household; no associated polity |
| Baking Pot | B | 1 | 1.3 | 94670 | 46 | 408 | 5.18 | Polity Capital; Population from Hoggarth et al. 2010 |
| Bedran | B | 2 | 0.07 | 2967 | 4 | 4 | 0.25 | Baking Pot Intermediate Elite Center |
| Blackman Eddy | B | 1 | 0.8 | 68421 | 21 | 144 | 1.91 | Polity Capital; primarily Preclassic-Early Classic |
| BR-147 | B | 3 | 0.08 | 596 | 4 | 4 | 0.19 | Small IE center/household, Barton Ramie |
| BR-180/168 | B | 2 | 0.19 | 5881 | 6 | 42 | 1.08 | Lower Dover Intermediate Elite Center |
| BR-19 | B | 3 | 0.02 | 356 | 2 | 2 | 0.13 | High-status commoner household, Barton Ramie |
| BR-260 | B | 3 | 0.04 | 293 | 4 | 4 | 0.13 | High-status commoner household, Barton Ramie |
| BR-96 | B | 3 | 0.07 | 1005 | 4 | 4 | 0.26 | High-status commoner household, Barton Ramie |
| Cahal Pech | B | 1 | 0.84 | 34046 | 34 | 140 | 2.84 | Polity Capital; Population from Ebert et al. 2016 |
| Cas Pek | B | 3 | 0.09 | 218 | 6 | 6 | 0.05 | Small IE center/household, Cahal Pech |
| Ch'um Group | B | 2 | 0.05 | 479 | 4 | 4 | 0.18 | Small IE center/household, Cahal Pech |
| Ek Tzul | B | 1 | 0.29 | 13583 | 10 | 15 | 0.86 | Polity Capital; not yet surveyed so numbers could be off; assume both periods |
| Esperanza | B | 2 | 0.11 | 1333 | 6 | 6 | 0.5 | Intermediate Elite Center; no associated polity (frontier site) |
| Floral Park | B | 2 | 0.19 | 4490 | 8 | 16 | 0.62 | Lower Dover Intermediate Elite Center |
| Ixim Group | B | 3 | 0.03 | 923 | 4 | 4 | 0.13 | High-status commoner household, Baking Pot |
| Lower Barton Creek | B | 1 | 0.6 | 6973 | 14 | 21 | 1.07 | Polity Capital; not yet surveyed so numbers could be off |
| Lower Dover | B | 1 | 0.87 | 148751 | 52 | 120 | 3.13 | Polity Capital; Late Classic Only, Population from Ebert et al. 2016 |
| Lubul Huh | B | 3 | 0.02 | 321 | 3 | 3 | 0.09 | Small IE center/household, Baking Pot |
| Manbatty Site | B | 2 | 0.01 | 2952 | 4 | 4 | 0.18 | Small IE center/household, Blackman Eddy |
| Martinez Group | B | 3 | 0.04 | 1813 | 5 | 5 | 0.11 | Small IE center/household, Cahal Pech |
| Melhado Site | B | 2 |  |  | 5 | 5 | 3.77 | Small IE center/household, Cahal Pech |
| Nohoch Ek | B | 2 | 0.31 | 8333 | 9 | 9 | 0.66 | Intermediate Elite Center; no associated polity (frontier site) |
| North Caracol Farm | B | 2 |  | 4027 | 11 | 39 | 8.76 | Baking Pot Intermediate Elite Center |
| Spanish Lookout | B | 2 | 0.08 | 3233 | 4 | 4 | 0.37 | Intermediate Elite Center; no associated polity (frontier site) |
| Tolok 1 | B | 3 | 0.06 | 352 | 6 | 6 | 0.1 | Small IE center/household, Cahal Pech |
| Tutu Uitz Na | B | 2 | 0.07 | 1242 | 5 | 5 | 0.24 | Lower Dover Intermediate Elite Center |
| Tuztziiy K'in | B | 2 | 0.21 | 3224 | 7 | 7 | 0.45 | Cahal Pech Intermediate Elite Center |
| Xualcanil | B | 2 | 0.59 | 13000 | 15 | 15 | 1.72 | Intermediate Elite Center, no associated polity, architecture mostly late classic |
| Yaxtun | B | 3 | 0.01 | 894 | 3 | 3 | 0.11 | High-status commoner household, Baking Pot |
| Zinic | B | 2 | 0.08 | 2945 | 8 | 8 | 0.23 | Cahal Pech Intermediate Elite Center; same catchment as Zopilote |
| Zopilote | B | 2 | 0.07 | 17296 | 3 | 29 | 0.43 | Cahal Pech Intermediate Elite Center; same catchment as Zinic, architecture mostly Late classic |
| Zotz | B | 3 | 0.02 | 148 | 4 | 4 | 0.04 | Small IE center/household, Cahal Pech |
| Zubin | B | 2 | 0.07 | 1064 | 9 | 9 | 0.22 | Cahal Pech Intermediate Elite Center |
| Uxbenka A-G, K (LC) | U | 1 | 2.51 | 400600 | 11 | 1264 | 4.01 | Late Polity Capital. Civic Architecture includes only B-G, K, M. |
| Ix Kuku'il | U | 1 | 0.44 | 110115 | 12 | 469 | 0.44 | Polity Capital . Only Group A counted as civic architecture.  |
| UXB 25 & M | U | 2 | 0.4 | 95933 | 2 | 162 | 1.83 | District Seat of UXB District 2. Civic architecture includes the temple in SG 25 and Group M.  |
| UXB I (EC) | U | 2 | 0.44 | 108841 | 1 | 110 | 0.78 | District Seat of UXB District 3. 1 ball court is present along with a temple.  |
| IKK F & 35 | U | 2 | 0.17 | 11970 | 5 | 55 | 0.24 | District Seat of IKK District 2. Group F is a receiving area and SG 35 has a ball court. Within this district, Group E is a hilltop shrine, Group D is a multi platform area not for residences, and a temple is present in SG 32.  |
| IKK 19 | U | 2 | 0.15 | 7776 | 1 | 71 | 0.3 | District Seat of IKK District 3. Civic architecture is limited to a plaza with a large temple. |
| IKK J & 61 | U | 2 | 0.15 | 13850 | 3 | 51 | 0.27 | District Seat of IKK District 4. Group I is a hilltop shrine, Group J has a large temple, and SG 61 has a small eastern triadic building.  |
| IKK K | U | 2 | 0.09 | 4584 | 2 | 50 | 0.25 | District Seat of IKK District 3. Group K has a large temple and is associated with the area of SG 92.  |
| UXB A, L, Ramp (EC) | U | 1 | 0.55 | 129875 | 6 | 607 | 0.82 | Early Polity Capital. Includes the ramp between A and L. |

Notes: 1) R=Rosario, P=Palenque, U=Uxbenká & Ix Kuku’il, B=Belize Valley; 2) 1=Polity capital, 2=District capital, 3=Local center.