

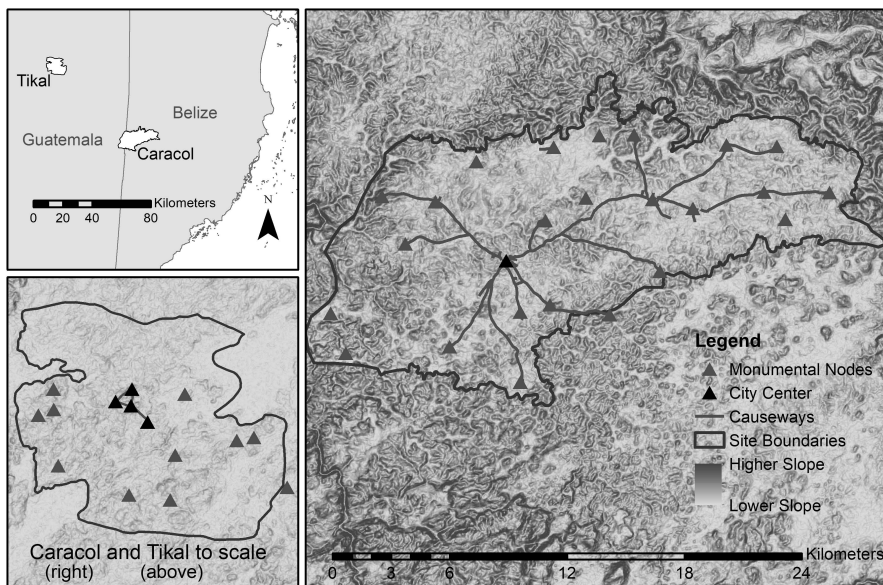
## Caracol, Belize, and Tikal, Guatemala

### *Ancient Maya Human-Nature Relationships and Their Sociopolitical Context*

Arlen F. Chase, Diane Z. Chase, and Adrian S.Z. Chase

A comparison of the ancient sites of Tikal, Guatemala, and Caracol, Belize, provides insight into the variability that existed among neighboring ancient Maya polities during the Late Classic period (550–900 CE) in the southern lowlands of the Yucatán Peninsula. This comparison underscores the alternative human-environment trajectories that are possible even among neighboring polities. Significant differences in water management and agricultural sustainability exist at these two sites. While some of these characteristics may be related to micro-environmental differences, others are likely due to variability in past human decision-making and the resultant adaptations. The ancient cities of Caracol and Tikal, located some 76 km apart from each other, are two of the largest and most important cities of the Maya southern lowlands during the Late Classic period. However, there are marked differences in their natural settings that may have contributed to their varying trajectories of development. Compared to Caracol, Tikal is located in a relatively low and flat karst environment that is surrounded by *bajos* (natural depressions that seasonally fill with water) on two of its sides. In contrast, Caracol is located in an elevated region in the foothills of the Maya

<https://doi.org/10.5876/9781646422326.c007>



**FIGURE 7.1.** Comparison of Caracol and Tikal landscapes showcasing the difference in slope between both cities.

Mountains, where there are many hills with fairly steep slopes separated by deep valleys but not the extensive bajo areas found at Tikal (figure 7.1). Particularly distinctive are their differences in approaches to water management—Tikal focused on the central control of water, while, in contrast, Caracol focused on the widespread dispersion of water storage facilities among residential groups. Differences also appear in agricultural strategies and site organization, potentially related to microenvironmental variations (e.g., soils, elevation, rainfall) associated with the two locations. Both cities had the benefit of being venues of long-term archaeological projects and we have a detailed understanding of both of these urban areas over time.

Both places also have fairly extensive hieroglyphic records that provide Maya written histories for their elite rulers over time, suggesting an intertwined history between the two cities. Once within Tikal's sphere of influence, Caracol overcame Tikal through ritual warfare and gained its independence at the onset of the Late Classic period (562 CE) (A. F. Chase 1991). The archaeology at Tikal further suggests that Caracol directly impacted Tikal during the first half of the Late Classic period, following Caracol's takeover of that center. Thus, a comparison of these two places yields striking information about the interconnectedness of Late Classic sites during the apogee of Maya civilization. Yet, while Tikal and Caracol had an intertwined history, they varied in other aspects of social and

ritual organization and provide two very different expressions of ancient Maya city planning and urban culture. How much these different urban forms and organizations were influenced by their landscapes and environmental settings (e.g., A. F. Chase and Scarborough 2014) remains an open question and one of great significance for understanding the evolutionary trajectories of the ancient Maya in the Southern lowlands.

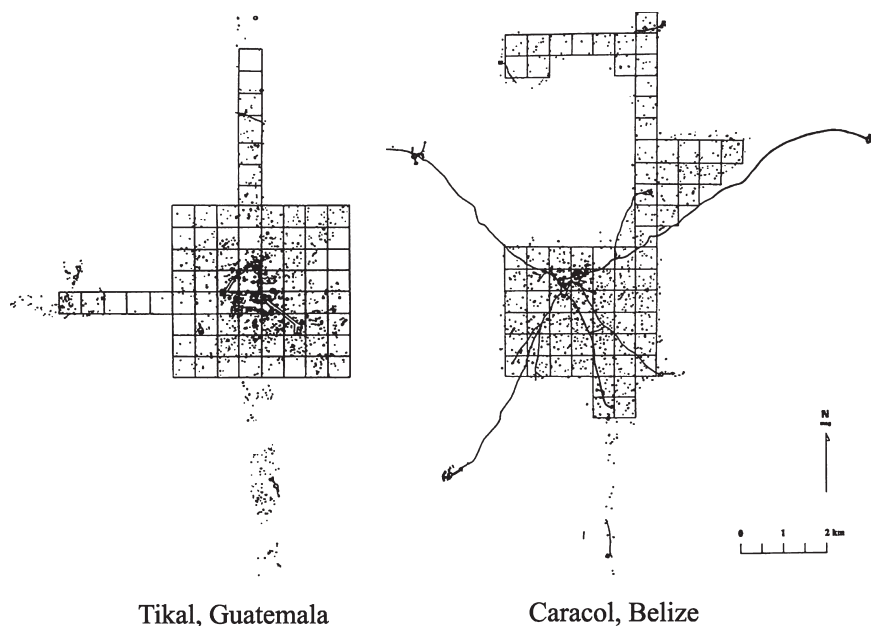
Looking first at their environmental settings, it is possible to see some significant differences between the two sites. Tikal is located on a relatively flat terrain, albeit with some “higher slopes” (Murtha 2015, 91) and is situated approximately 200 m above sea level. It is bounded to its east and west by areas of extensive bajo, or swamp, that was seasonally inundated with water. While the margins of some bajos were agriculturally productive (Culbert, Levi, and Cruz 1990; Kunen et al. 2000), precisely how and when these features were exploited by the ancient Maya are not clear (Dunning et al. 2015, 122); however, when filled with water the bajos could have been traversed by canoes, facilitating trade and the transport of bulk goods (especially to the east of Tikal; e.g., Dunning et al. 2017). Canopy in the upland areas of Tikal consists of broadleaf trees with a canopy height approaching 40 m; the canopy height in the Caracol area only approaches 25 m (A. F. Chase, Lucero et al. 2014, 18, 20). Caracol is located in a very karstic, hilly environment that ranges from approximately 450 to over 600 m above sea level. Because of the broken limestone, most water percolates down into deep caves; thus, bajos are not at all common at Caracol. The differences in absolute elevation also mean that Caracol is cooler (ranging from as low as 6°C to as high as 39°C, with an average temperature of 26°C) than Tikal (an average temperature of 30°C and a maximum of 39°C). Both sites were dependent on rainfall for their primary water sources, but Caracol generally receives 25 percent more rain than Tikal—an average of 2,400 mm per year as compared to 1,800 mm per year at Tikal; Vernon Scarborough and Gary Gallopín (1991, 659) report a range of 1,350 to 2,000 mm per year at Tikal. Caracol’s position in the western foothills of the Maya Mountains also afforded ready access to metamorphic rock resources that were exported to other parts of the Maya area in the form of groundstone manos and metates (A. F. Chase, D. Chase et al. 2014).

## ARCHAEOLOGICAL RESEARCH AT TIKAL AND CARACOL

Both Caracol and Tikal have been the focus of long-term archaeological research projects that have resulted in substantial on-the-ground surveyed maps for the two sites (figure 7.2).

### Tikal

The University Museum of the University of Pennsylvania began a long-term excavation project at Tikal in 1956, which continued through 1969 (Coe and



**FIGURE 7.2.** Mapped areas of Tikal (after Carr and Hazard 1961 and Puleston 1983) and Caracol (after A. F. Chase and D. Chase 2001) compared for scale (see also A. F. Chase, D. Chase, and Smith 2009).

Haviland 1982; Sabloff 2003), at which point work was continued by Guatemalan researchers (Laporte and Fialko 1995). The University Museum Project resulted in the production of the first extensive map of a Maya site and its settlement, eventually covering a total of 23 km<sup>2</sup> (Carr and Hazard 1961; Puleston 1983). The University Museum excavations at Tikal investigated 4 main architectural complexes intensively (North Acropolis / Great Plaza; Central Acropolis; West Plaza; and East Plaza), 29 residential groups intensively (examining 83 structures), 17 residential groups with minor excavations, and 89 other residential groups with test pits. In addition, several other central architectural groups were tested for “recurrent layouts” (e.g., Twin-Pyramid Groups) and “structural peculiarities” (e.g., sweat baths) (Coe and Haviland 1982, 28–39; Haviland 2003, 114). As a result of the University Museum investigations, some 207 burials (177 minor burials; 11 crypt; 19 chamber) (Moholy-Nagy 2008, 17), 209 caches (Moholy-Nagy 2008, 17), and 223 problematical deposits (Moholy-Nagy 2008, 68) were recovered at Tikal. These totals have been increased substantially by subsequent Guatemalan Projects (e.g., Laporte 2003; Laporte and Fialko 1995).

## Caracol

From 1950 through 1953 Caracol was an opportune location for research by the University Museum. Its investigations led to the acquisition of a series of Maya stelae and altars for display in Philadelphia (Beetz and Satterthwaite 1981). A subsequent program of investigation and excavation by the Caracol Archaeological Project (CAP) began at Caracol in 1985 and has continued on an annual basis to this day (A. F. Chase and D. Chase 1987; D. Chase and A. F. Chase 1994, 2015, 2017). This program has resulted in the transit mapping of some 23 km<sup>2</sup> of the site (A. F. Chase and D. Chase 2001), now augmented by Light Detection and Ranging (LiDAR) data to demonstrate that the city of Caracol covered more than 200 km<sup>2</sup> (A.S.Z. Chase 2016b, 2021; A. F. Chase, D. Chase, and Weishampel 2010; A. F. Chase et al. 2011; A. F. Chase, D. Chase et al. 2014). As of the conclusion of the 2020 field season, CAP has excavated in all of the “downtown” architectural groups as well as in 153 residential groups (54 of these groups intensively), resulting in the recovery of 398 interments containing 803 individuals (associated with 1,419 pottery vessels) and 363 formal caches (associated with 808 pottery vessels). An additional 356 reconstructible pottery vessels were recovered from the floors of plazas and structures (along with substantial use-related remains). Crafting areas have been identified throughout the site (minimally 33 for lithic production, 5 for working conch shell, 2 for working bone, 31 for textile production, 2 potential spondylus production areas).

## Tikal and Caracol Time Lines

The archaeological data from both Tikal and Caracol are overlapping and complementary. Occupation of both sites began in the Middle Preclassic period, with initial occupation at Tikal slightly predating Caracol with a projected origin date based on ceramics of approximately 800 BCE (Culbert 2003, 54) as opposed to approximately 600 BCE for Caracol (A. Chase and D. Chase 2006). Both sites appear to have had contact with peoples across and beyond the Maya area. In the middle of the Early Classic period (between 300 CE and 450 CE), individuals from the Mexican site of Teotihuacan in central Mexico were likely among the city inhabitants at both Tikal (see Iglesias Ponce de León 2003) and Caracol (A. F. Chase and D. Chase 2011). Both sites fluoresce in the Late Classic period, becoming sizeable urban centers, though they were somewhat divergent in their internal socioeconomic structures and urban organization, as will be discussed below. Tikal supported anywhere from 40,000 to upward of 80,000 people (Haviland 2003; Murtha 2015) and Caracol supported over 100,000 people (A. F. Chase and D. Chase 1994; D. Chase and A. F. Chase 2017). Both cities were largely abandoned by 900 CE, though Tikal has evidence for Postclassic visitations probably from populations living in the Lake Petén area (Culbert 2003, 64–65).

Changes in the structure and functioning of Caracol are apparent at the end of the Classic period.

Caracol has evidence of status-linked ceramic subcomplexes in the Terminal Classic period (A. F. Chase and D. Chase 2004, 2007), just before its collapse, and it is possible that a similar phenomenon also existed at Tikal during Eznab times (A. F. Chase and D. Chase 2008, 27–29). At Caracol, it is clear that the palace elites were using a different ceramic subcomplex from that used by the rest of the population; this high-status palace ceramic subcomplex employs vessel types, such as modeled-carved pedestalled vases, that are widely distributed in the eastern lowlands at the time of the collapse. There is also evidence of rapid abandonment in the Caracol epicenter, presumably due to conflict (A. F. Chase and D. Chase 2020a). At Tikal, similar vessel types were included within the Eznab Ceramic Complex, the distribution of which correlated with stone buildings located in epicentral locations. At Caracol, this late subcomplex also occurs within epicentral stone buildings, but extensive excavation in residential groups was able to demonstrate that the more localized Late Classic ceramics continued in use alongside the high-status subcomplex outside the epicenter. At Tikal, however, the association of Eznab ceramics with stone buildings and not in residential groups was interpreted to mean that there was a significant reduction in population (Culbert 1973, 1974, 107, 1988). We, instead, suggest that the situation at Caracol and Tikal was similar.

During the Terminal Classic period, the high-status groups at both centers most likely differentiated themselves from the rest of the population through the use of status-linked ceramics (see A. F. Chase and D. Chase 2004, 2005). This interpretation means that it is difficult to identify the Terminal Classic period outside of high-status contexts (A. F. Chase and D. Chase 2008, 27–29), implying that there likely was not as significant a reduction in population at Tikal during this era as has been previously argued. (Culbert et al. [1990, 120] suggest only 14.2 percent of the population in Central Tikal and 21.4 percent of the total population was present in Eznab times based on ceramic assessment; for comparative purposes, almost all epicentral contexts at Caracol have produced Terminal Classic ceramics, and at least 39.4 percent of the residential groups were occupied.) The nature of the final occupations for these two sites clearly has significant impact on interpretations of depopulation and lack of agricultural sustainability relative to the Classic Maya collapse.

## HIEROGLYPHIC HISTORY

In combination with the archaeological data, epigraphic records provide the strongest confirmation that the histories of Caracol and Tikal were intertwined. Tikal emblem glyphs appear in the early monuments of Caracol and indicate that Caracol was under the sway of Tikal during the end of the Early Classic

period (Martin and Grube 2000). Caracol gained its independence from Tikal in 562 CE by means of a star-war (A. F. Chase 1991; D. Chase and A. F. Chase 2003), at which time the dominating relationship shifted to Caracol. Caracol maintained a complicated relationship with Tikal until Naranjo bested Caracol with a star-war in 680 CE.

Both sites have long dynastic records. Tikal's goes back to at least 292 CE, and Caracol's goes back to 331 CE; based on ruler counts, Tikal had at least thirty-two rulers and Caracol had at least twenty-nine (Martin and Grube 2000). An argument has also been advanced for the instillation of an individual from Teotihuacan as an Early Classic ruler at Tikal in 379 CE, following the execution of the previous dynastic ruler by the interlopers (Stuart 2000). The 562 CE star-war had similarly severe implications for Tikal. We have provided multiple, reinforcing lines of evidence that two Caracol rulers assumed rulership at Tikal and were interred in the North Acropolis after this event during Tikal's epigraphic hiatus (A. F. Chase and D. Chase 2020b; D. Chase and A. F. Chase 2017; see also Moholy-Nagy 2016 for a general discussion of monuments and hiatuses). The latest-known monumental dates from the two sites are 869 CE at Tikal (Martin 2003) and 884 CE at Caracol (D. Chase and A. F. Chase 2017).

However, while both Caracol and Tikal have extensive dynastic histories, these histories are not equivalent; in fact, the hieroglyphs themselves suggest differences between the two sites. Caracol uses a variant emblem glyph that is often portrayed without the traditional water affix, which is translated as the Maya word *chulel* and believed to have signified divinity or holiness. The lack of this prefix at Caracol may have been associated with the attempts to lessen the distinctions between elite and others at the site, intentional patterns identified in the archaeological record (A. F. Chase and D. Chase 2009). Just as the hieroglyphs suggest differences between the two sites, the ability to compare and contrast these two sites in terms of their spatial layouts, their archaeological records, and their human-nature relationships permits significant insights into the sociopolitical variability that existed among the ancient Maya.

## AGRICULTURE

Although the inhabitants of both sites were rainfall dependent, the agricultural systems for the inhabitants at Tikal and Caracol differed. While households at both sites may have engaged in kitchen gardens, it would appear that Tikal focused more on extensive agriculture with possibly some intensive agriculture at the edges of its bajos (see Dunning, Beach, and Luzzadder-Beach 2006). Residential groups at Tikal are distributed in "fragmented clusters" that resulted in "less space around each household" but that left "large tracts of uninhabited areas interspersed between settlement clusters" (Murtha 2015, 91). Because there are no (or minimal) agricultural terraces at Tikal, this implies a different

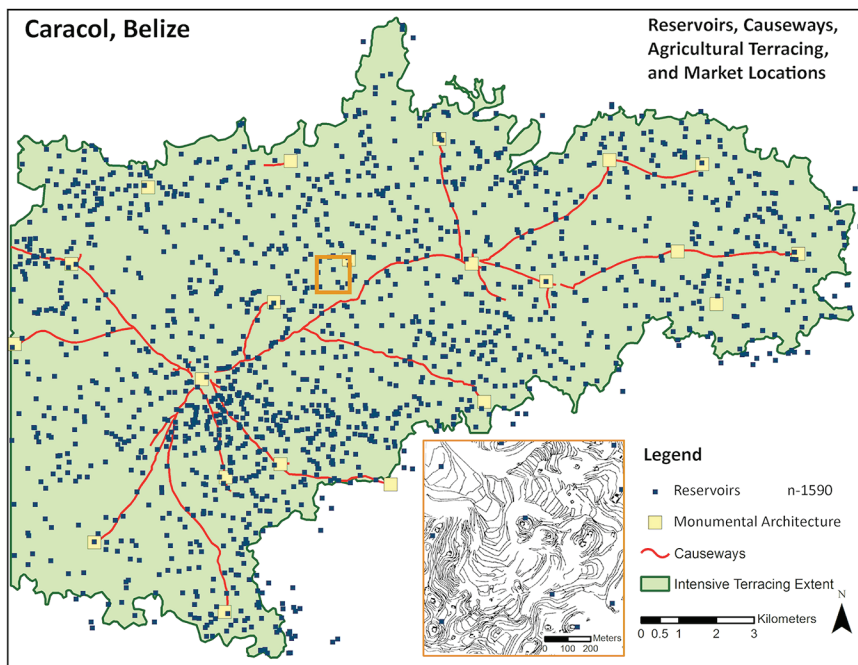
agricultural strategy than Caracol's for supporting that site's population, one that likely focused on "cooperative labor exchanges meeting the maintenance demands of weeding and harvesting" (Murtha 2015, 92). While Tikal's households may have had kitchen gardens immediately surrounding them, no Phosphorous (P) tests exist to confirm these.

In contrast to Tikal, Caracol focused on terraforming the landscape with agricultural terraces (figure 7.3) to carry out more intensive agriculture, and the extent of Caracol's agricultural terracing (over 160 km<sup>2</sup>; D. Chase and A. F. Chase 2014a, 2017) is reflective of a fully anthropogenic and managed landscape that incorporated agriculture into an urban framework (A. F. Chase and D. Chase 2016a, 2016b). Further, at Caracol, P tests suggest that "the landscape surrounding houses was substantially enriched with household wastes" (Murtha 2015, 86). While probably initially prompted by the need to manage soil loss and water flow in hilly terrain to be agriculturally sustainable, the ancient Maya at Caracol used their technological prowess to completely modify the landscape. Given the care that the ancient Maya gave to constructing the agricultural terraces at Caracol directly on bedrock (A. F. Chase and D. Chase 1998), which permitted them to manage the flow of water over the landscape (A.S.Z. Chase and Weishampel 2016), it is likely that the Caracol Maya provided the same care to managing plants and trees throughout the site (in accord with the tenets of Ford and Nigh's [2009] "forest garden").

Both Caracol and Tikal practiced rain-dependent agriculture. Both were located in environments lacking permanent bodies of standing or flowing water, but the two sites approached their landscapes differently. Caracol aggressively terraformed its environment, while Tikal was more passive, with the possible exception of water flow into its large centrally constructed reservoirs. As noted above, Caracol also received more rain. Thus, while both sites engaged in maize agriculture, Caracol's terracing, in combination with an increased rainfall total, likely permitted more than one crop per season (with crops being cycled or mixed for nitrogen fixation), indicating that the site was agriculturally self-sustaining (Murtha 2009, 2015). This may not have been the case with Tikal, which likely imported agricultural products into its confines during the rainy season by using its associated bajos as canoe transit highways (Dahlin and Chase 2014).

## **WATER**

Discussion of water in the Maya area has largely focused on the lack of permanent natural bodies of water within the confines of many of the largest sites of the Classic period; this emphasis is true for both Tikal and Caracol. Because these sites were dependent on rainfall, some researchers have focused on large epicentral reservoirs and argued that elite power in Classic period society was embedded in the control of water and water rituals (Lucero 2006; Lucero and



**FIGURE 7.3.** Map of the areal extent of Caracol, showing reservoir distribution, monumental architecture and public plaza distribution, extent of the intensive agricultural terracing, and the causeway system at the site (after A.S.Z. Chase 2016a).

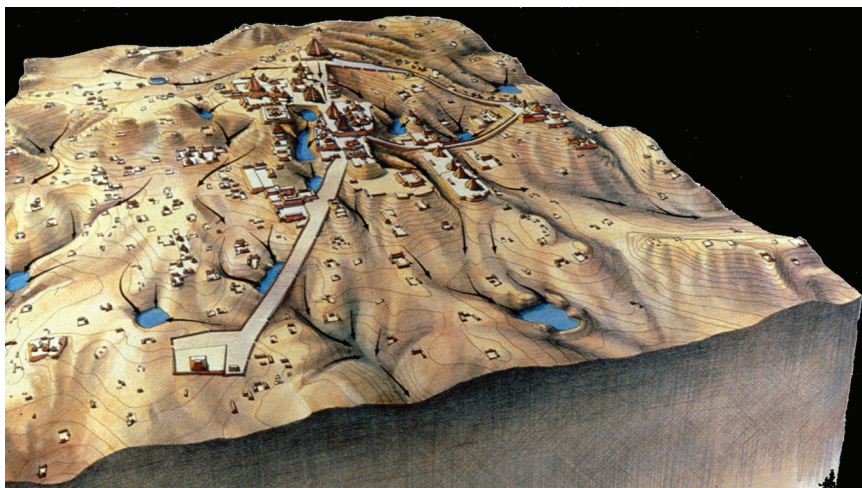
Fash 2006), while others recognized that the full monopolization of this kind of power was unlikely (Johnston 2004, 266; Scarborough 2003, 113). An examination of strategies of water control and management at Caracol and Tikal reveals different approaches to capturing and distributing potable water, probably because of differences in the environmental settings of both sites (A.S.Z. Chase and Cesaretti 2019).

Scarborough and Gallopin (1991, 659) defined three kinds of reservoirs for Tikal (figure 7.4): large central precinct reservoirs, residential reservoirs, and bajo-margin reservoirs. While it is implied that the majority of these were constructed and modified, it is crucial to distinguish between constructed reservoirs and naturally occurring *aguadas* (reservoirs) (see Gallopin 1990, 19). Gallopin (1990, 19) followed the typology established by the Tikal mappers (Carr and Hazard 1961, 13), which established six types of reservoirs: deep-dug or constructed, modified *aguadas*, natural *aguadas*, quarry pits, *pozas*, and special cases. Within the three-division schema used for Tikal, 9 reservoirs (6 central-precinct and 3 residential) were deep-dug or constructed, and four bajo-margin reservoirs were modified *aguadas*; 47 small *pozas* were associated with structures and

were likely constructed; 15 natural aguadas and “other small reservoirs” were not associated with structures (Scarborough and Gallopin 1991, 661). Whereas Tikal’s noncentral reservoirs include a mix of constructed reservoirs and natural (nonconstructed) aguadas, the vast majority—if not all—of Caracol’s minimally 1,590 residential reservoirs (see figure 7.3) are formally constructed features (A.S.Z. Chase 2016a). Because of the extensive modification of Caracol’s landscape by the construction of agricultural terraces (A. F. Chase and D. Chase 1998; A.S.Z. Chase and Weishampel 2016; D. Chase and A. F. Chase 2014a, 2017), naturally occurring aguadas were minimized and completely bounded within the agricultural fields, often being modified like those at Tikal (see Crandall 2009). It is clear that Caracol’s anthropogenic landscape (A. F. Chase and D. Chase 2016b) was different from the bajo-dominated landscape of Tikal (see A.F.Z. Chase and Cesaretti 2019; Lentz, Dunning, and L. Scarborough 2015a). It has also become evident that a spectrum of water management strategies existed throughout the Maya lowlands, which are not always as easy to define as the Caracol example (see, e.g., Brewer et al. 2017 for the difficulty in defining natural versus constructed features in the region of Yaxnohcah, Mexico; see also Dunning et al., chapter 2 in this volume).

By far the largest and most important reservoirs at Tikal were those located in the central precinct of the site amidst the large public architecture and broad causeways (see figure 7.4). These six reservoirs held the bulk of Tikal’s water and were extensively engineered to direct water flow and filter potable water (Harrison 2012; Scarborough et al. 2012). The concentration of water in the center of Tikal has led to an argument for the centralization of power. “At Tikal water management allowed resource control and therefore political control by a central-precinct elite” (Scarborough and Gallopin 1991, 661). At Caracol, water management also allowed resource control but did not imply complete political control, as reservoirs were also located within residential settlement (A.S.Z. Chase 2016a). Built reservoirs occur at both Tikal and Caracol, but at Tikal they tend to be fairly large and to contain the bulk of the water needed by the site’s inhabitants (Scarborough and Gallopin 1991; Scarborough et al. 2012). At Caracol, the situation is inverted. While eight large reservoirs are associated with widely dispersed public architecture at Caracol (see A.S.Z. Chase 2016b, figs. 3 and 4, table 2), there is a far more extensive body of constructed household reservoirs; as previously mentioned, minimally 1,590 built reservoirs are distributed over the landscape along with four natural aguadas.

The distribution of water features at these two sites is significant in identifying how their populations were organized and governed. As noted above, Scarborough (2003) would argue that there was centralized management of water through Tikal’s large reservoir system; Lisa J. Lucero (2006) would argue that this and water ritual were the source of elite power. At Caracol, although



**FIGURE 7.4.** *Reconstruction of central Tikal showing the articulation of reservoirs with the landscape and the central architectural features (after Scarborough, Chase, and Chase 2012).*

there is usually one large reservoir associated with each older major architectural concentration, the distribution of reservoirs throughout the landscape in association with residential groups strongly suggests that a different governing strategy and source of elite power existed (A.S.Z. Chase 2019). At Caracol, large bodies of water in the epicenter could demonstrate elite ability to harness valuable water resources, but individual households also controlled their own water resources. The residential settlement at Caracol is distributed amidst a continuous landscape of agricultural terracing, and at least one-sixth of the residential groups at the site were associated with constructed reservoirs. This arrangement suggests that control of both of these resources, agricultural land and water, were more localized at Caracol; while there may have been centralized input in disputes, the placement of these features on the landscape are suggestive of a less-centralized strategy regarding land and water than is seen at Tikal.

## **CITY FORM AND FUNCTION**

There were also significant differences in lifestyles between Tikal and Caracol.

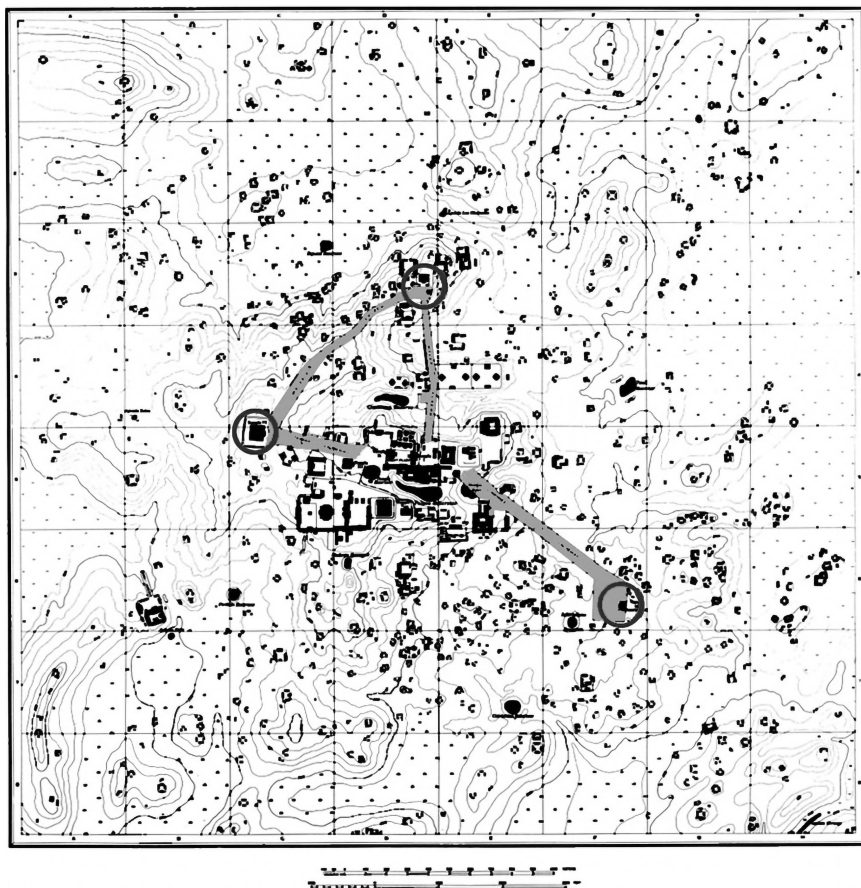
### **Households**

These differences can be seen primarily in the physical layouts of residential groups, but also in the material culture and burial patterns associated with these residential groups. Only 14 percent of the residential groups at Tikal contained an eastern shrine, known as a Plaza Plan 2 arrangement (Becker 2003, 259). At Caracol some 70 percent of the residential groups include an eastern shrine

containing interments and caches (A. F. Chase and D. Chase 2009; D. Chase and A. F. Chase 2017); many of these structures are also associated with centrally located stairway niches or with centrally placed architectural stair balks, indicative of ritual activity areas. While Tikal sees eastern shrine groups as being somewhat special, the Caracol data instead suggest that ritual was incorporated into the majority of that site's residential units (D. Chase and A. F. Chase 2017). The burials that are associated with the eastern shrines at both sites have been interpreted as representing a focus on "ancestor" veneration; yet, the archaeological contexts from Caracol suggest that the ritual focus was actually one that commemorated cyclical time (A. F. Chase and D. Chase 2013; D. Chase and A. F. Chase 2011, 2017, 2023). At Tikal, most burials contained a single extended individual with head to the north; at Caracol, at least half of the burials contain multiple individuals in varying degrees of articulation, and extended burials are found with head to both the south and north. While the majority of the tombs known from Tikal are associated with public architecture in the site center, Caracol tombs are also located in most residential groups (25 tombs in the site epicenter; 105 tombs in 75 different residential groups). Formal caches in specially made pottery containers also commonly occur in residential groups at Caracol (recovered in 81 different residential groups outside of the site epicenter through the 2020 field season) but are not generally found in residential groups at Tikal; rather, formal pottery cache containers at Tikal are correlated with the large central architecture (e.g., Culbert 1993, 2003). These data can be used to infer that social differences and inequality were more ingrained at Tikal, with a Gini coefficient of 0.62 (Kohler et al. 2018, table 11.3), than at Caracol, with a Gini of 0.34 (A.S.Z. Chase 2017, table 2), again having ramifications for the organization of society. Caracol appears to have focused on more collective decisions for the good of the broader population, whereas Tikal appears to have focused on the prerogatives of the elite. Based on the available archaeological data, house-hold crafting appears at both sites but appears to be more widespread at Caracol (Becker 1983; A. F. Chase and D. Chase 2015).

## Architecture

There are also significant architectural differences between the two sites that can be used to infer broader city organization. The causeway system at Tikal links the epicenter of the site together, whereas the causeway system at Caracol integrates the full extent of the urban area. At Tikal the causeways formed a closed system, integrating the central architecture of the site with three different temples (figure 7.5). At Caracol the causeway system unites the landscape, integrating the site epicenter with a series of large open plazas with nonpermanent range building substructures that served administrative and market purposes (see figure 7.3); the Caracol causeways also integrated previously independent



**FIGURE 7.5.** The central 16 km<sup>2</sup> of Tikal (from Carr and Hazard 1961), showing the integration of broad causeways (shaded) and temples (circled) in the site epicenter (map of the ruins of Tikal used with permission of the University of Pennsylvania Museum of Archaeology and Anthropology).

early sites into Caracol's metropolitan area. The difference in market locations and access is also striking. At Tikal, there was a single built market in the site epicenter complete with stone vaulted rooms (Becker 2015; Jones 2015); while goods were clearly made available to the populace (e.g., Masson and Freidel 2012), the built environment implies rigid control by the central Tikal elite. There is a possibility that there were markets at a series of minor centers located outside of the Tikal epicenter (see A. F. Chase and D. Chase 2003), but these were not formally integrated into a single system by causeways, as at Caracol. Robert Fry (2003) argues that there were local markets at Tikal based on the distribution of

utilitarian pottery. At Caracol, foreign goods were probably widely available in its local markets (A. F. Chase et al. 2015; D. Chase and A. F. Chase 2014b).

Two other architectural assemblages speak to differences between the two cities: E Groups and Twin-Pyramid Groups. Some nine Twin-Pyramid Groups are known from Tikal (Jones 1969); three others are known from Yaxha, Uolantun, and Chalpate (Becker 2003, 258); none occur at Caracol. These are highly standardized structural arrangements and consist of two radial temples located on the eastern and western sides of large plazas. No structures crowned these pyramids, and plain stelae and altars were set in a row in front of the eastern pyramid. A vaulted range building with nine doorways defines the southern extent of the plaza, and an unroofed walled enclosure, holding a carved stelae and altar that celebrate the current *k'atun* (a unit of time in the Mayan calendar equal to 19.713 years), is located on the northern side of the plaza. These unique architectural complexes were constructed to celebrate *k'atun* endings at Tikal minimally from 9.10.0.0.0 (633 CE) through 9.18.0.0.0 (790 CE). Hattula Moholy-Nagy (2016, 264) notes that these complexes “were probable venues for elaborate ceremonies that linked the ruler’s place in social history with the great cosmic cycles of time.” Caracol also commemorated cyclical time but in different ways—marking larger periods of time in E Groups, an architectural assemblage that defines the earliest public architecture in the Maya area (Freidel et al. 2017; see also Inomata et al. 2021) and shorter periods of time with *k'atun* altars or ritual interments of burials and caches (A. F. Chase and D. Chase 2013; D. Chase and A. F. Chase 2011).

Both Caracol and Tikal had E Groups. At Caracol, the E Group continued to be utilized in recognizable form from the Late Preclassic through the Terminal Classic period (A. F. Chase and D. Chase 2017a). In the Early Classic period, the Caracol E Group was augmented with northern and southern pyramids. No formal buildings occur atop the southern or western pyramids in Caracol’s E Group, whereas the northern pyramid supports a vaulted building. At the end of the Early Classic, tombs are associated with the E Group eastern platform and its lateral buildings but not directly with the core central building in the E Group, which continues in unmodified architectural form through the time of the site’s collapse.

At Tikal, the eastern E Group platform morphs into a platform supporting three vaulted buildings that house a series of dynastic tombs and burials (Laporte 2003; Laporte and Fialko 1995). The three eastern structures in Tikal’s E Group are all converted into dynastic temples in the Protoclassic period, likely being the venue of that site’s royal burials for that era. In the Early Classic, there is a venue shift back to the North Acropolis for royal interments and the Main Plaza at Tikal, and the architectural temples located here are used to house dynastic burials through the Late Classic period. That there was a Late Classic focus on dynasty at Tikal is clear from the monuments lined up in the Main Plaza of Tikal



**FIGURE 7.6.** *Photograph of Tikal Temple 1 on the eastern side of the Great Plaza, looking southeast.*

in front of the North Acropolis temples. Tikal manifests a greater fusion of public ritual focusing on dynasty than is found at Caracol. The distribution of both Twin-Pyramid Groups and tall freestanding temples at Tikal in the Late Classic period—and their clear focus as dynastic symbols—differs from what is found at Caracol and is presumably reflective of a different governmental strategy focusing on the ruler in the late Late Classic period (after 680 CE).

### **Layout**

Temples at Tikal vary significantly in their placement from those at Caracol during the Late Classic period. At Tikal the temple structure carries over into the Plaza Plan 2 residential groups and the eastern shrine sometimes is a temple building (e.g., Tikal Structure 5G-8). While vaulted buildings on eastern pyramids do exist at Caracol (e.g., Caracol Structure K19), most eastern structures had flatter summits containing perishable buildings. At Tikal the public fusion of dynasty and architectural plan is seen in Temple 1, which functions as an exceedingly visible eastern shrine building (figure 7.6). This is significantly different from Caracol, where Late Classic temples are ensconced within relatively private locations that did not emphasize public access. For instance, although visible to some degree, the Late Classic temples associated with the summit of Caana (figure 7.7; see also A. F. Chase and D. Chase 2017b), the summit of the



**FIGURE 7.7.** Photograph of Caana, Caracol's central architectural complex, looking north.

Central Acropolis, and the summit of the Northeast Acropolis are not publicly accessible. Thus, unlike the highly accessible public temples of Tikal, the ones at Caracol are all integrated into residential households. Again, these data are relevant to the differences observed at the two sites; the architectural data from Tikal would support an interpretation of an integrated state religion focused on dynasty, something also suggested by the *incensario* (censer) distribution at that site (Rice 1999) and by the elaborateness of Late Classic royal tombs (e.g., Burial 116 and 196; see Coggins 1975 and Harrison 1999).

Caracol presents a different situation. Overall, material items and goods are more equally distributed throughout residential groups at the site, with most residential groups focused on their own shrine and not on royal temples. Late Classic royal tombs found in Caracol's epicentral buildings are not ostentatious; in fact, burials in residential groups often contain items as elaborate as those found in epicentral tombs, albeit sometimes with the remains of a larger number of individuals. Thus, there also appear to be significant differences in ritual practices between the two sites.

## DISCUSSION

So, how does this all fit together? We feel that the data demonstrate that different practices and adaptations were present at the two sites, guided not only by variations in their environmental settings, but also by human choices. The

distribution of the residential settlement, constructed agricultural fields, and constructed reservoirs at Caracol demonstrate a focus on long-term sustainability that represents a different strategy from the one used at Tikal. The two landscapes were used in different ways. Caracol's Late Classic environment is almost completely anthropogenic (or human made); the agricultural terraces constituted landesque capital and were used year after year, requiring maintenance to keep their fertility and usefulness (D. Chase and A. F. Chase 2014a); the site's abundant constructed reservoirs must have also required similar attention. Both Caracol and Tikal were focused on water drainage; at Tikal, this took the form of channeling the water into large catchment areas so that it could be used both for drinking and other purposes, with only a secondary interest on smaller constructed reservoirs (Scarborough et al. 2012; Scarborough and Gallopín 1991); at Caracol, while water was drained into larger reservoirs in areas of public architecture, there was a greater focus on channeling the flow of rainfall and dispersing water over the agricultural terraces to maximize water and soil retention (A.S.Z. Chase and Weishampel 2016) as well as the dispersed collection of potable water in some 1,600 constructed reservoirs (A.S.Z. Chase 2016a). At Tikal, while there may have been intensive cropping at the bajo margins (Dunning et al. 2015), there was not the same focus on agricultural production in the vicinity of the residential groups that is seen at Caracol; in fact, given the arguments regarding carrying capacity at Tikal (e.g., Lentz et al. 2015b), sustainability at Tikal may have been dependent in the Late Classic period on the importation of food across flooded bajos during the rainy season, presumably under centralized control. This practice also would accord with the more centralized focus on water seen at Tikal.

Thus, at Tikal, monumental architecture, reservoirs, and causeways focus on elite order and interests. The landscape was not significantly transformed for agriculture. The reservoirs were centrally located and larger in capacity; while some smaller ones occur in the landscape, they are nowhere near the number that are found at Caracol. Given its central location, size, and permanent structures, the central market at Tikal may also have been utilized as a source of power to control the economic distribution of goods at the site. Late Classic Tikal temples were the focal architectural points, visibly signifying both elite power and probably a state religious focus. In contrast, at Caracol there was a focus on top-down collective action, with the elites seemingly promoting the public good in terms of the distribution of goods and resources. Ritual and religion likewise were not narrowly focused on the dynastic line but rather on the temporal order of which all were a part. Agricultural intensification was widely practiced. Landscape modification provided agricultural sustainability with reservoirs also benefiting the broader population. Markets may have had central oversight but offered access to goods throughout greater Caracol. Thus,

the sociopolitical organizations of Late Classic period Tikal and Caracol were significantly different from each other and speak to the extent of cultural diversity in the Maya region. While hieroglyphs, iconography, and symbolism may at the surface appear to have been similar at the two centers, the archaeological record provides evidence that significantly different social customs and practices were followed at the two sites, which partially explains both the broader human-nature relationships that are evident and the differences in their societal trajectories.

The differences in site practices are especially surprising given the control of both cities by the Caracol elite in the early part of the Late Classic period. At the same time that Caracol “usurpers” (Haviland 1992, 73) ritually transformed the center of Tikal through the appropriation of Tikal Structures 5D32 and 5D33 for the interment of two of its rulers (A. F. Chase and D. Chase 2020b; D. Chase and A. F. Chase 2017), the broader populations at the two sites enjoyed very different access to resources, wealth, and ritual. The fact that little else changed within Tikal society may suggest that Caracol used Tikal as an extractive economy for its own purposes during the early part of the Late Classic period, much as Caracol may have been an extractive economy for Tikal during the late part of the Early Classic period (D. Chase and A. F. Chase 2020), that primary urban revenue sources at both city centers differed (*sensu* Blanton and Fargher 2008), or that a mix of various factors existed.

Caracol’s impact on the landscape of Tikal is primarily seen in the ritual transformation of that site. The tall Late Classic temples that came to dominate Tikal started with the construction of Tikal Structure 5D-33-1st for the interment of Caracol ruler K’an II. Also introduced were Twin-Pyramid Groups. These large standardized architectural complexes aligned well with the focus on cyclical time seen throughout Caracol’s residential groups (A. F. Chase and D. Chase 2013; D. Chase and A. F. Chase 2017) but represent an architectural elaboration not found at Caracol. That the “three earliest groups, constructed during the long hiatus, were partially demolished later” (Moholy-Nagy 2016, 264) suggests yet another ritual act. These Twin-Pyramid Groups would have been constructed by K’an II, and their ritual destruction would have been appropriate once Tikal was again independent. The fact that the new Tikal ruler, Jasaw Chan K’awill, erected his first monuments in Caracol style (e.g., a Giant Ahau altar) within the Twin-Pyramid Group built for the 9.13.0.0.0 k’atun ceremony (Jones and Satterthwaite 1982, 62)—and ritually defaced and destroyed the earlier examples of this architectural form—symbolically placed him within the cosmic cycles of time as the new and independent ritual overlord of Tikal. Yet, the broader population of Tikal was far removed from the standards of wealth and ritual found in his Late Classic tomb (e.g., Coe 1990, 604–609).

## CONCLUSION

Given the interconnectedness and proximity of these two sites, the extant variability is striking. Both Tikal and Caracol were founded in landscapes lacking natural, permanent bodies of water. Thus, both populations were forced to adapt the terrain to their subsistence needs. In terms of potable water, two different strategies were followed. At Tikal, there was the formal capture of large bodies of water in huge holding tanks adjacent to public architecture, seemingly augmented by the terrain. At hillier Caracol, while larger reservoirs were constructed in association with public architecture, many smaller reservoirs were also constructed throughout the landscape, thus lending a modicum of independence to the site's population in terms of this resource. Regarding agriculture, the residents of Caracol began to terraform the landscape by the Late Preclassic period, eventually constructing an almost continuous web of agricultural terraces. This did not happen at Tikal. Because of the early and continuous human labor poured into the fertility of Caracol's agricultural terraces, these features provided greater productivity and likely led to surpluses that could be exported elsewhere. While the bajo margins may have been similarly productive at Tikal, it is less likely that they yielded huge surpluses that could be exported outside of Tikal; it is more likely that some of Tikal's bulk food items came from some distance, possibly being transported in the rainy season when the bajos were full of water and canoe travel was a possibility. Ritual at Tikal seemed to center on the elite and the royal dynasty; the economic market was also centralized and controlled. The opposite was the case at Caracol, where markets were distributed over the landscape and most residential groups partook of their own rituals. Thus, the human-nature relationships at these two sites differed dramatically and were reflected both in the broader organization of the sites and in their social patterns.

There were unintended consequences in each of these paths. At Caracol, the terrace construction and independently constructed reservoirs, in combination with a system of distributed market locales all dendritically connected to the site epicenter by causeways, defined residential and agricultural space and helped the site to expand outward. At Tikal, the bajos constrained settlement expansion and probably productivity; yet, the site focus on centrality—as evinced in the placement of reservoirs, temples, causeways, and its single marketplace—also implied more direct control over its population. Thus, the two sites were idiosyncratic in their approaches to sustainability and social policy. More than any other aspects of their societies, however, access to and control of water defined their distinct trajectories: at Tikal, water was a resource that could be centrally controlled, much like that site's people and central architecture; at Caracol, water was a local resource that could be accessed and controlled by

individual residential groups, reflecting the structural differences that existed among Classic era polities.

## ACKNOWLEDGMENTS

---

The archaeological work that we have undertaken at Caracol over the past thirty-six years has been undertaken in conjunction with the Belize Institute of Archaeology and has involved five universities (University of Central Florida; University of Nevada, Las Vegas; Claremont Graduate University; Pomona College; and, Arizona State University) with sponsorship derived from a host of foundations and funding agencies, including the Alphawood Foundation; the Ahau Foundation; the Dart Foundation; the Foundation for the Advancement of Mesoamerican Studies, Inc.; the Geraldine and Emory Ford Foundation; the Government of Belize; the Harry Frank Guggenheim Foundation; the NASA Space Archaeology Program; the National Science Foundation; the Stans Foundation; UCF-UF—Space Research Initiative; the United States Agency for International Development; the Trevor Colbourn Endowment from the University of Central Florida; and private donations to the foundations at UCF, UNLV, and Pomona College. We would also like to note that the long-term archaeological work undertaken at Tikal was both an inspiration and a database for the research that we have done at Caracol—especially as two of us did both our undergraduate and graduate work at the University of Pennsylvania and were very familiar with the “Tikal Room.” Besides our own familiarity with Tikal and its archaeological history, part of the stimulus for comparing and contrasting Tikal and Caracol was the extensive work that Vern Scarborough has undertaken on water management and reservoirs at Tikal; his exploration of the Tikal system has led us to define a very different expression of water management for Caracol that expands our knowledge of ancient Maya technical prowess.

## REFERENCES

---

- Becker, Marshall J. 1983. “Indications of Social Class Differences Based on the Archaeological Evidence for Occupational Specialization among the Classic Maya at Tikal, Guatemala.” *Revista Española de Antropología Americana* 8: 29–46.
- Becker, Marshall J. 2003. “Plaza Plans at Tikal.” In *Tikal: Dynasties, Foreigners, and Affairs of State*, edited by J. A. Sabloff, 253–280. Santa Fe, NM: School of American Research Press.
- Becker, Marshall J. 2015. “Ancient Maya Markets: Architectural Grammar and Market Identifications.” In *The Ancient Maya Marketplace: The Archaeology of Transient Space*, edited by E. King, 90–110. Tucson: University of Arizona Press.
- Betz, Carl P., and Linton Satterthwaite. 1981. *The Monuments and Inscriptions of Caracol, Belize*. University Museum Monograph 45. Philadelphia: University of Pennsylvania.
- Blanton, Richard E., and Lane F. Fargher. 2008. *Collective Action in the Formation of Pre-Modern States*. New York: Springer.

- Brewer, Jeffrey L., Christopher Carr, Nicholas P. Dunning, Debra S. Walker, Armando Anaya Hernandez, Meaghan Peuramaki-Brown, and Kathryn Reese-Taylor. 2017. "Employing Airborne LiDAR and Archaeological Testing to Determine the Role of Small Depressions in Water Management at the Ancient Maya Site of Yaxnohcah, Campeche, Mexico." *Journal of Archaeological Science: Reports* 13 (June): 291–302.
- Carr, Robert E., and James E. Hazard. 1961. *Map of the Ruins of Tikal, El Peten, Guatemala*. Tikal Report 11. Philadelphia: University of Pennsylvania.
- Chase, Adrian S.Z. 2016a. "Beyond Elite Control: Residential Reservoirs at Caracol, Belize." *WIREs Water* 3 (6): 885–897.
- Chase, Adrian S.Z. 2016b. "Districting and Urban Services at Caracol, Belize: Intrastate Boundaries in an Evolving Maya Cityscape." *Research Reports in Belizean Archaeology* 13: 15–28.
- Chase, Adrian S.Z. 2017. "Residential Inequality among the Ancient Maya: Operationalizing Household Architectural Volume at Caracol, Belize." *Research Reports in Belizean Archaeology* 14: 31–39.
- Chase, Adrian S.Z. 2019. "Water Management among the Ancient Maya: Degrees of Latitude." *Research Reports in Belizean Archaeology* 16: 101–109.
- Chase, Adrian S.Z. 2021. "Urban Life at Caracol, Belize: Neighborhoods, Inequality, Infrastructure, and Governance." PhD dissertation, School of Human Evolution and Social Change, Arizona State University, Tempe.
- Chase, Adrian S.Z., and Rudolf Cesaretti. 2019. "Diversity in Ancient Maya Water Management Strategies and Landscapes at Caracol, Belize, and Tikal Guatemala." *WIREs Water* 6 (2): e1332.
- Chase, Adrian S.Z., and John F. Weishampel. 2016. "Using LiDAR and GIS to Investigate Water and Soil Management in the Agricultural Terracing at Caracol, Belize." *Advances in Archaeological Practice* 4 (3): 357–370.
- Chase, Arlen F. 1991. "Cycles of Time: Caracol in the Maya Realm." In *Sixth Palenque Round Table, 1986, Vol. VII*, edited by M. G. Robertson, 32–42. Norman: University of Oklahoma Press.
- Chase, Arlen F., and Diane Z. Chase. 1987. *Investigations at the Classic Maya City of Caracol, Belize: 1985–1987*. Monograph 3. San Francisco: Pre-Columbian Art Research Institute.
- Chase, Arlen F., and Diane Z. Chase. 1994. "Details in the Archaeology of Caracol, Belize: An Introduction." In *Studies in the Archaeology of Caracol, Belize*, edited by D. Z. Chase and A. F. Chase, 1–11. Monograph 7. San Francisco: Pre-Columbian Art Research Institute.
- Chase, Arlen F., and Diane Z. Chase. 1998. "Scale and Intensity in Classic Period Maya Agriculture: Terracing and Settlement at the 'Garden City' of Caracol, Belize." *Culture and Agriculture* 20 (2): 60–77.
- Chase, Arlen F., and Diane Z. Chase. 2001. "Ancient Maya Causeways and Site Organization at Caracol, Belize." *Ancient Mesoamerica* 12 (2): 273–281.

- Chase, Arlen F., and Diane Z. Chase. 2003. "Minor Centers, Complexity, and Scale in Lowland Maya Settlement Archaeology." In *Perspectives on Ancient Maya Rural Complexity*, edited by G. Iannone and S. Connell, 108–118. Cotsen Institute of Archaeology Monograph 49. Los Angeles: University of California.
- Chase, Arlen F., and Diane Z. Chase. 2004. "Terminal Classic Status–Linked Ceramics and the Maya 'Collapse': *De Facto* Refuse at Caracol, Belize." In *The Terminal Classic in the Maya Lowlands: Collapse, Transition, and Transformation*, edited by A. Demarest, P. Rice, and D. Rice, 342–366. Boulder: University Press of Colorado.
- Chase, Arlen F., and Diane Z. Chase. 2005. "Contextualizing the Collapse: Hegemony and Terminal Classic Ceramics from Caracol, Belize." In *Geographies of Power: Understanding the Nature of Terminal Classic Pottery in the Maya Lowlands*, edited by S. Lopez Varela and A. Foias, 73–91. BAR Monograph S1447. Oxford: British Archaeological Reports.
- Chase, Arlen F., and Diane Z. Chase. 2007. "'This is the End': Archaeological Transitions and the Terminal Classic Period at Caracol, Belize." *Research Reports in Belizean Archaeology* 4: 13–27.
- Chase, Arlen F., and Diane Z. Chase. 2008. "Methodological Issues in the Archaeological Identification of the Terminal Classic and Postclassic Transition in the Maya Area." *Research Reports in Belizean Archaeology* 5: 23–36.
- Chase, Arlen F., and Diane Z. Chase. 2009. "Symbolic Egalitarianism and Homogenized Distributions in the Archaeological Record at Caracol, Belize: Method, Theory, and Complexity." *Research Reports in Belizean Archaeology* 6: 15–24.
- Chase, Arlen F., and Diane Z. Chase. 2011. "Status and Power: Caracol, Teotihuacan, and the Early Classic Maya World." *Research Reports in Belizean Archaeology* 8: 3–18.
- Chase, Arlen F., and Diane Z. Chase. 2013. "Temporal Cycles in the Archaeology of Maya Residential Groups from Caracol, Belize." *Research Reports in Belizean Archaeology* 10: 13–23.
- Chase, Arlen F., and Diane Z. Chase. 2015. "The Domestic Economy of Caracol, Belize: Articulating with the Institutional Economy in an Ancient Maya Urban Setting." *Research Reports in Belizean Archaeology* 12: 15–23.
- Chase, Arlen F., and Diane Z. Chase. 2016a. "The Ancient Maya City: Anthropogenic Landscapes, Settlement Archaeology, and Caracol, Belize." *Research Reports in Belizean Archaeology* 13: 3–14.
- Chase, Arlen F., and Diane Z. Chase. 2016b. "Urbanism and Anthropogenic Landscapes." *Annual Review of Anthropology* 45: 361–376.
- Chase, Arlen F., and Diane Z. Chase. 2017a. "E Groups and the Rise of Complexity in the Southeastern Maya Lowlands." In *Maya E-Groups: Calendars, Astronomy, and Urbanism in the Early Lowlands*, edited by D. Freidel, A. Chase, A. Dowd, and J. Murdoch, 31–71. Gainesville: University Press of Florida.

- Chase, Arlen F., and Diane Z. Chase. 2017b. "Ancient Maya Architecture and Spatial Layouts: Contextualizing Caana at Caracol, Belize." *Research Reports in Belizean Archaeology* 14: 13–22.
- Chase, Arlen F., and Diane Z. Chase. 2020a. "Final Moments: Contextualizing On-Floor Archaeological Materials from Caracol, Belize." *Ancient Mesoamerica* 31 (1): 77–87.
- Chase, Arlen F., and Diane Z. Chase. 2020b. "The Materialization of Classic Period Maya Warfare: Caracol Stranger-Kings at Tikal." In *A Forest of History: The Maya after the Emergence of Divine Kingship*, edited by T. Stanton and M. K. Brown, 20–48. Boulder: University Press of Colorado.
- Chase, Arlen F., Diane Z. Chase, Jaime J. Awe, John F. Weishampel, Gyles Iannone, Holley Moyes, Jason Yaeger, et al. 2014. "Ancient Maya Regional Settlement and Inter-Site Analysis: The 2013 West-Central Belize LiDAR Survey." *Remote Sensing* 6 (9): 8671–8695.
- Chase, Arlen F., Diane Z. Chase, and Michael E. Smith. 2009. "States and Empires in Ancient Mesoamerica." *Ancient Mesoamerica* 20 (2): 175–182.
- Chase, Arlen F., Diane Z. Chase, Richard Terry, Jacob M. Horlacher, and Adrian S. Z. Chase. 2015. "Markets among the Ancient Maya: The Case of Caracol, Belize." In *The Ancient Maya Marketplace: The Archaeology of Transient Space*, edited by E. King, 226–250. Tucson: University of Arizona Press.
- Chase, Arlen F., Diane Z. Chase, and John F. Weishampel. 2010. "Lasers in the Jungle: Airborne Sensors Reveal a Vast Maya Landscape." *Archeology* 63 (4): 27–29.
- Chase, Arlen F., Diane Z. Chase, John F. Weishampel, Jason B. Drake, Ramesh L. Shrestha, K. Clint Slatton, Jaime J. Awe, and William E. Carter. 2011. "Airborne LiDAR, Archaeology, and the Ancient Maya Landscape at Caracol, Belize." *Journal of Archaeological Science* 38 (2): 387–398.
- Chase, Arlen F., Lisa J. Lucero, Vernon L. Scarborough, Diane Z. Chase, Rach Cobos, Nicholas Dunning, Joel Gunn, et al. 2014. "Tropical Landscapes and the Ancient Maya: Diversity in Time and Space." In *The Resilience and Vulnerability of Ancient Landscapes: Transforming Maya Archaeology through IHOPE*, edited by A. F. Chase and V. L. Scarborough, 11–29. AP3A Paper 24 (1). Arlington, VA: American Anthropological Association.
- Chase, Arlen F., and Vernon L. Scarborough. 2014. *The Resilience and Vulnerability of Ancient Landscapes: Transforming Maya Archaeology through IHOPE*. AP3A Paper 24 (1). Arlington, VA: American Anthropological Association.
- Chase, Diane Z., and Arlen F. Chase. 1994. *Studies in the Archaeology of Caracol, Belize*. Monograph 7. Pre-Columbian Art Research Institute, San Francisco.
- Chase, Diane Z., and Arlen F. Chase. 2003. "Texts and Contexts in Classic Maya Warfare: A Brief Consideration of Epigraphy and Archaeology at Caracol, Belize." In *Ancient Mesoamerican Warfare*, edited by M. K. Brown and T. W. Stanton, 171–188, Walnut Creek, CA: Alta Mira Press.

- Chase, Diane Z., and Arlen F. Chase. 2011. "Ghosts amid the Ruins: Analyzing Relationships between the Living and the Dead among the Ancient Maya at Caracol, Belize." In *Living with the Dead: Mortuary Ritual in Mesoamerica*, edited by J. L. Fitzsimmons and I. Shimada, 78–101. Tucson: University of Arizona Press.
- Chase, Diane Z., and Arlen F. Chase. 2014a. "Path Dependency in the Rise and Denouement of a Classic Maya City: The Case of Caracol, Belize." In *The Resilience and Vulnerability of Ancient Landscapes: Transforming Maya Archaeology through IHOPE*, edited by A. F. Chase and V. L. Scarborough, 142–154. AP3A Paper 24 (1). Arlington, VA: American Anthropological Association.
- Chase, Diane Z., and Arlen F. Chase. 2014b. "Ancient Maya Markets and the Economic Integration of Caracol, Belize." *Ancient Mesoamerica* 25 (1): 239–250.
- Chase, Diane Z., and Arlen F. Chase. 2015. "Thirty Years of Archaeology at Caracol, Belize: Retrospective and Prospective." *Research Reports in Belizean Archaeology* 12: 3–14.
- Chase, Diane Z., and Arlen F. Chase. 2017. "Caracol, Belize and Changing Perceptions of Ancient Maya Society." *Journal of Archaeological Research* 25 (3): 185–249.
- Chase, Diane Z., and Arlen F. Chase. 2020. The Economic Landscape of Caracol, Belize. In *Nuts and Bolts of the Real "Business" of Ancient Maya Exchange*, edited by M. Masson, D. Freidel, and A. Demarest, 132–148. Gainesville: University Press of Florida.
- Chase, Diane Z., and Arlen F. Chase. 2023. "The Materialization of Time in the Maya Archaeological Record: Examples from Caracol and Santa Rita Corozal, Belize." In *The Materialization of Time: Mythic History and Ritual Order in the Ancient Maya World*, edited by D. Freidel, A. Chase, A. Dowd, and J. Murdock. Gainesville: University Press of Florida.
- Coe, William R. 1990. *Excavations in the Great Plaza, North Terrace, and North Acropolis of Tikal*. 6 vols. Tikal Report 14. Philadelphia: University of Pennsylvania Museum.
- Coe, William R., and William A. Haviland. 1982. *Introduction to the Archaeology of Tikal, Guatemala*. Tikal Report 12. Philadelphia: University of Pennsylvania Museum.
- Coggins, Clemency C. 1975. "Painting and Drawing Styles at Tikal: An Historical and Iconographic Reconstruction." PhD diss., Harvard University, Cambridge, MA.
- Crandall, James. 2009. "Water and Mountains: Maya Water Management at Caracol, Belize." MA thesis, Department of Anthropology, University of Central Florida, Orlando.
- Culbert, T. Patrick. 1973. "The Maya Downfall at Tikal." In *The Classic Maya Collapse*, edited by T. P. Culbert, 63–92. Albuquerque: University of New Mexico Press.
- Culbert, T. Patrick. 1974. *The Lost Civilization: The Story of the Classic Maya*. New York: Harper and Row.
- Culbert, T. Patrick. 1988. "The Collapse of Classic Maya Civilization." In *The Collapse of Ancient States and Civilizations*, edited by N. Yoffee and G. Cowgill, 69–101. Tucson: University of Arizona Press.

- Culbert, T. Patrick. 1993. *The Ceramics of Tikal: Vessels from the Burials, Caches, and Problematical Deposits*. Tikal Report 25A. Monograph 81. Philadelphia: University Museum, University of Pennsylvania.
- Culbert, T. Patrick. 2003. "The Ceramics of Tikal." In *Tikal: Dynasties, Foreigners, and Affairs of State*, edited by J. A. Sabloff, 47–81. Santa Fe, NM: School of American Research Press.
- Culbert, T. Patrick, Laura J. Kosakowsky, Robert E. Fry, and William A. Haviland. 1990. "The Population of Tikal, Guatemala." In *Precolumbian Population History in the Maya Lowlands*, edited by T. P. Culbert and D. Rice, 103–121. Albuquerque: University of New Mexico Press.
- Culbert, T. Patrick, Laura J. Levi, and Luis Cruz. 1990. "Lowland Maya Wetland Agriculture: The Rio Azul Agronomy Program." In *Vision and Revision in Maya Studies*, edited by F. Clancy and P. Harrison, 115–124. Albuquerque: University of New Mexico Press.
- Dahlin, Bruce H., and Arlen F. Chase. 2014. "A Tale of Three Cities: Effects of the CE 536 Event in the Lowland Maya Heartland." In *The Great Maya Droughts in Cultural Context: Case Studies in Resilience and Vulnerability*, edited by G. Iannone, 127–155. Boulder: University Press of Colorado.
- Dunning, Nicholas P., Timothy Beach, and Sheryl Luzzadder-Beach. 2006. "Environmental Variability among Bajos in the Southern Maya Lowlands and Its Implications for Ancient Maya Civilization and Archaeology." In *Precolumbian Water Management: Ideology, Ritual, and Power*, edited by L. Lucero and B. Fash, 81–99. Tucson: University of Arizona Press.
- Dunning, Nicholas P., Robert E. Griffin, John G. Jones, Richard E. Terry, Zachary Larsen, and Christopher Carr. 2015. "Life on the Edge: Tikal in a Bajo Landscape." In *Tikal: Paleoecology of an Ancient Maya City*, edited by D. Lentz, N. Dunning, and V. Scarborough, 95–123. Cambridge: Cambridge University Press.
- Dunning, Nicholas P., Robert E. Griffin, Thomas L. Sever, William A. Saturno, and John G. Jones. 2017. "The Nature and Origins of Linear Features in the Bajor de Azúcar, Guatemala: Implications for Ancient Maya Adaptation to a Changing Environment." *Geoarchaeology: An International Journal* 32 (1): 107–129.
- Ford, Anabel, and Ronald Nigh. 2009. "Origins of the Maya Forest Garden: Maya Resource Management." *Journal of Ethnobiology* 29 (2): 23–236.
- Freidel, David A., Arlen F. Chase, Anne Dowd, and Jerry Murdock. 2017. *Maya E Groups: Calendars, Astronomy, and Urbanism in the Early Lowlands*. Gainesville: University Press of Florida.
- Fry, Robert E. 2003. "The Peripheries of Tikal." In *Tikal: Dynasties, Foreigners, and Affairs of State*, edited by J. A. Sabloff, 143–170. Santa Fe, NM: School of American Research Press.
- Gallopín, Gary G. 1990. "Water Storage Technology at Tikal, Guatemala." MA thesis, Department of Anthropology, University of Cincinnati.

- Harrison, Peter D. 1999. *The Lords of Tikal: Rulers of an Ancient Maya City*. London: Thames and Hudson.
- Harrison, Peter D. 2012. "A Marvel of Maya Engineering: Water Management at Tikal." *Expedition* 54 (2): 19–26.
- Haviland, William A. 1992. "From Double-Bird to Ah Cacao: Dynastic Troubles and the Cycle of the *K'atuns* at Tikal, Guatemala." In *New Theories on the Ancient Maya*, E. C. Danien and R. J. Sharer, 71–80. Philadelphia: University Museum, University of Pennsylvania.
- Haviland, William A. 2003. "Settlement, Society, and Demography at Tikal." In *Tikal: Dynasties, Foreigners, and Affairs of State*, edited by J. A. Sabloff, 111–142. Santa Fe, NM: School of American Research Press.
- Iglesias de Ponce de León, María J. 2003. "Problematic Deposits and the Problem of Interaction: The Material Culture of Tikal during the Early Classic Period." In *The Maya and Teotihuacan: Reinterpreting Early Classic Interaction*, edited by G. E. Braswell, 167–198. Austin: University of Texas Press.
- Inomata, Takeshi, Daniela Triadan, Rodrigo Liendo, and Keiko Teranishi. 2021. "Spatial and Temporal Standardization in Southern Mesoamerica during the Preclassic Period: New Discoveries from the Middle Usumacinta Region, Mexico." In *The Materialization of Time: Mythic History and Ritual Order in the Ancient Maya World*, edited by D. Freidel, A. Chase, A. Dowd, and J. Murdock. Gainesville: University Press of Florida.
- Johnston, Kevin J. 2004. "Lowland Maya Water Management Practices: The Household Exploitation of Rural Wells." *Geoarchaeology* 19 (3): 265–292.
- Jones, Christopher. 1969. "The Twin-Pyramid Group Pattern: A Classic Maya Architectural Assemblage at Tikal, Guatemala." PhD diss., Department of Anthropology, University of Pennsylvania, Philadelphia.
- Jones, Christopher. 2015. "The Marketplace at Tikal." In *The Ancient Maya Marketplace: The Archaeology of Transient Space*, edited by E. King, 67–89. Tucson: University of Arizona Press.
- Jones, Christopher, and Linton Satterthwaite. 1982. *The Monuments and Inscriptions of Tikal: The Carved Monuments*. University Museum Tikal Report 33A. University of Pennsylvania, Philadelphia.
- Kohler, Timothy A., Michael E. Smith, Amy Bogaard, Christian E. Peterson, Alleen Betzenhauser, Gary M. Feinman, Rahul C. Oka, et al. 2018. "Deep Inequality: Summary and Conclusions." In *Ten Thousand Years of Inequality: The Archaeology of Wealth Differences*, edited by Timothy A. Kohler and Michael E. Smith, 289–317. Tucson: University of Arizona Press.
- Kunen, Julie L., T. Patrick Culbert, Vilma Fialko, B. R. McKee, and Liwy Grazioso. 2000. "Bajo Communities: A Case Study from the Central Peten." *Culture and Agriculture* 22 (3): 15–31.

- Laporte, Juan Pedro. 2003. "Thirty Years Later: Some Results of Recent Investigations in Tikal." In *Tikal: Dynasties, Foreigners, and Affairs of State*, edited by J. A. Sabloff, 281–318. Santa Fe, NM: School of American Research Press.
- Laporte, Juan Pedro, and Vilma Fialko. 1995. "Un Reencuentro con Mundo Perdido, Tikal, Guatemala." *Ancient Mesoamerica* 6 (1): 41–94.
- Lentz, David L., Nicholas P. Dunning, and Vernon L. Scarborough. 2015a. *Tikal: Paleoecology of an Ancient Maya City*. Cambridge: Cambridge University Press.
- Lentz, David L., Devin Magee, Eric Weaver, John G. Jones, Kenneth B. Tankersley, Angela Hood, Gerald Islebe, Carmen E. Ramos Hernandez, and Nicholas P. Dunning. 2015b. "Agroforestry and Agricultural Practices of the Ancient Maya at Tikal." In *Tikal: Paleoecology of an Ancient Maya City*, edited by D. Lentz, N. Dunning, and V. Scarborough, 152–189. Cambridge: Cambridge University Press.
- Lucero, Lisa J. 2006. *Water and Ritual: The Rise and Fall of Classic Mayan Rulers*. Austin: University of Texas Press.
- Lucero, Lisa J., and Barbara Fash. 2006. *Precolumbian Water Management: Ideology, Ritual and Power*. Tucson: University of Arizona Press.
- Masson, Marilyn A., and David A. Freidel. 2012. "An Argument for Classic-Era Maya Market Exchange." *Journal of Anthropological Archaeology* 31 (4): 455–484.
- Martin, Simon. 2003. "In Line of the Founder: A View of Dynastic Politics at Tikal." In *Tikal: Dynasties, Foreigners, and Affairs of State*, edited by J. A. Sabloff, 3–45. Santa Fe, NM: School of American Research Press.
- Martin, Simon, and Nikolai Grube. 2000. *Chronicle of the Maya Kings and Queens: Deciphering the Dynasties of the Ancient Maya*. London: Thames and Hudson.
- Moholy-Nagy, Hattula. 2008. *The Artifacts of Tikal: Ornamental and Ceremonial Artifacts and Unworked Material*. Tikal Report 27A. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.
- Moholy-Nagy, Hattula. 2016. "Set in Stone: Hiatuses and Dynastic Politics at Tikal, Guatemala." *Ancient Mesoamerica* 27 (2): 255–266.
- Murtha, Timothy. 2009. *Land and Labor: Maya Terraced Agriculture. An Investigation of the Settlement Economy and Intensive Agricultural Landscape of Caracol, Belize*. Saarbrücken, Germany: DM Verlag Dr. Muller.
- Murtha, Timothy. 2015. "Negotiated Landscapes: Comparative Settlement Ecology of Tikal and Caracol." In *Classic Maya Politics of the Southern Lowlands: Integration, Interaction, Dissolution*, edited by D. Marken and J. Fitzpatrick, 75–98. Boulder: University Press of Colorado.
- Puleston, Dennis E. 1983. *The Settlement Survey of Tikal*. Tikal Report 13. Philadelphia: University Museum, University of Pennsylvania.
- Rice, Prudence. 1999. "Rethinking Classic Lowland Maya Pottery Censers." *Ancient Mesoamerica* 10 (1): 25–50.

- Sabloff, Jeremy A. 2003. *Tikal: Dynasties, Foreigners, and Affairs of State*. Santa Fe, NM: School of American Research Press.
- Scarborough, Vernon L. 2003. *The Flow of Power: Ancient Water Systems and Landscapes*. Santa Fe, NM: School of American Research Press.
- Scarborough, Vernon L., Arlen F. Chase, and Diane Z. Chase. 2012. "Low Density Urbanism, Sustainability, and IHOPE-Maya: Can the Past Provide More than History?" *UGEC Viewpoints* 8: 20–24.
- Scarborough, Vernon L., Nicholas P. Dunning, Kenneth B. Tankersley, Christopher Carr, Eric Weaver, Liwy Grazioso, Brian Lane, et al. 2012. "Water and Sustainable Land Use at the Ancient Tropical City of Tikal, Guatemala." *Proceedings of the National Academy of Sciences* 109 (31): 12408–12413.
- Scarborough, Vernon L., and Gary G. Gallopín. 1991. "A Water Storage Adaptation in the Maya Lowlands." *Science* 251 (4994): 658–662.
- Stuart, David. 2000. "'The Arrival of Strangers': Teotihuacan and Tollan in Classic Maya History." In *Mesoamerica's Classic Heritage*, edited by D. Carrasco, L. Jones, and S. Sessions, 465–513. Boulder: Westview Press.