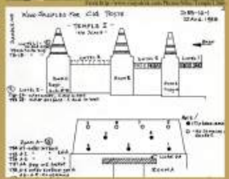
Constructional woods of Tikal:
Forest use and the end of time

Brian Hockaday[1], Xochitl Vinaja[2], David Lentz[2]

[1]The Colorado College, [2]Chicago Botanic Garden

CHICAGO BOTANIC GARDENS

Introduction



Tikal, located in the lowland rainforests of the Petén region of northeastern Guatemala, was perhaps the largest center of ancient Mayan civilization. At its height in the eighth century A.D., the city covered a minimum area of 123 km², with a population ranging from 45,000 (Haviland 1970) to 70,000 people (Hammond 1982). One of the most perplexing mysteries of ancient Mayan civilization is its sudden and unexplainable collapse at the close of the ninth century A.D. Although the cause is unknown, it has been suggested that conditions rendered under rapid population growth along with the taxing effects of clearcutting and swidden agriculture may have put undue strain on the ecology of the area (Hammond 1982; Haviland 1970; Lentz 1991; Montgomery 2001). Little analysis from the archeological record, however, has been formally analyzed to track these changes at Tikal.

To better understand how the Late Classic Maya were interacting with the forest and shed light on how its ecology may have changed, we analyzed 135 samples taken from remains of construction materials at all six of the polity's major temples as well as an elite residence from the Central Acropolis to determine what species were being exploited.

All samples were collected during the original excavation led by the University of Pennsylvania between 1956-1970 and are from either tie-beams, which support a structure's ceiling, or lintels, a series of beams that span and support doorways and often depict elaborately carved scenes. Lintel beam widths taken from remaining samples or imprints were analyzed to assess the size of trees available for construction at the time.

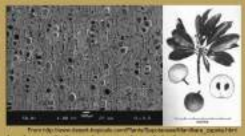
Methods

Samples were sawed, smoothed with a razor blade, and preliminarily analyzed using a Leica S6D stereomicroscope at low magnification (35X). They were then sorted into wood types based on specific morphological characteristics - arrangement of vascular tissue, ray cells and parenchymal structures. Representative samples of each wood type were sealed in aluminum foil, buried in a sand medium and heated in a covered metal pot over a propane stove for 3 ½ hours to carbonize. Carbonized samples were fractured, mounted with colloidal graphite, and scanned in an Amray 1810 scanning electron microscope at the Field Museum of Chicago. Micrographs were taken at 50x and 100x magnification. Finally, wood types were identified by Dr. David L. Lentz by comparison against his personal wood collections and reference texts.

Results

Tree Species

From our analysis, we found that the majority of samples were of *Manilkara zapota (L.)* and *Haematoxlum campechianum L.* with one occurrence of a species of the genus *Pouteria* (Figure 1).



Manilkara zapota (L.) (sapodilla) is used by modern Maya for its fruit, its milky latex (Mickelbart 1996), and its seeds and bark as a medicinal paste or tea (Balick 2000; Morton 1987). A tree of slow-to-moderate growth, it can reach heights of 30-40 m with a trunk diameter of 1.5 m. Although not easy to cut, its wood is hard and durable with fine-textured straight grain (Standley & Williams 1967). Requiring good drainage, it could have grown within the boundaries of the city and at higher elevations to the west and south.

Pouteria, like *Manilkara*, is a member of the family Sapotaceae and the two are close relatives. The wood of this species, though of coarser texture, is comparable to sapodilla, but the trees are smaller, standing 20-30 m tall with trunk diameters ranging from 20-50 cm with the exception of *P.campechiana*, whose trunk diameter can exceed 1m but is deeply and irregularly furrowed and ridged (Morton 1987; Standley & Williams 1967).

Haematoxylum campechianum L. (logwood) is a slow growing tree or shrub. Reaching a maximum height of 8m, its often-crooked trunk becomes fluted and gnarled with age (Standley & Williams 1967). The tree is covered in spines and requires clayey soil with deficient drainage (Rocas 2003), which would have restricted it to the city's surrounding swamplands. The heartwood is dense, hard to cut, and with an irregular grain, but is highly durable and finishes smoothly.

Structure dating followed the glyph translations and Gregorian date conversions of Peter Harrison as published in *Lords of Tikal* (1999). Because of the variability of dates inscribed on the lintels themselves (Coe 1961) estimated dates of construction were based on final dates inscribed on the building or the generally accepted date range gauged by style and references to the chronology of the reigning lord.

Beam Widths

Measurements of lintel beam widths for Temples I-IV and Str. 5D-52 contained in the original Tikal Project reports (Coe 1961) were analyzed using a standard ANOVA test. Differences between structures were found to be significant (F =11, p=0.00) with widths peaking at construction of Temple IV and dropping to the smallest diameter by Temple III. Mean beam widths are shown in Figure 2. A *student's t-test* was also applied between beam widths of Temple III and those of all other structures for which information was available (i.e., excluding Temples V or VI) and differences also were found to be significant (t =5.83, p= 0.00).

Figure 1

Figure 2

Discussion

Our results show that until lintel beam widths peaked in 741 A.D., sapodilla was the tree of choice for construction at Tikal and the only species used in construction of temples. After this point we found a seventy-year break in sapodilla use, with Temples V and VI built entirely of logwood. When use of sapodilla later returned in Temple III lintel beams were found to be significantly smaller and the presence of a *Pouteria* species was noted.

Although Tikal's population is thought to have peaked around A.D. 550 (Haviland 1970), the city also entered what is thought to have been a period of extended warfare known as 'the Hiatus' marked by many losses on the part of Tikal and a lack of surviving documentation (Harrison 1999). Therefore, it wasn't until the Late Classic that the city was likely to have supported its peak population. Along with the pressures certainly put onto the land by swidden (slash and burn) agriculture (Hammond 1982; Haviland 1970), the need for firewood fuel was likely the principal incentive for wood consumption (Lentz 1991).

Hasaw's reign and at least most of Yik'in's was a time of prosperity at Tikal (Harrison 1999) marked by victories against its warring neighbor Calakmul and the largest number of construction projects in the city's history indicating a high level of social organization. The increase in beam widths observed likely represents excavations into farther-reaching areas of the forest where the largest trees were preferentially selected. Eventually this too must have become too difficult - the Ancient Maya had no pack animals or use of the wheel – and they turned to other sources of wood. Though providing good wood for construction, the many difficulties involved in locating, extracting and processing heavy, thorned, and gnarled logwood of appropriate size from the swamplands likely made it a less preferable but necessary alternative. After social control had begun to slip by the ninth century (Harrison 1999) reigning lord Dark Sun was either unable to coordinate logwood exploitation or enough sapodilla had re-grown to permit their harvest in construction of Tikal's final temple. However, availability of sapodilla of even 30cm diameter was likely scarce as indicated by the incidence of *Pouteria*, a break in stylistic continuity hitherto unseen in Tikal.

While the influence of changes in aesthetic preference and levels of state control should not be ignored, changes in wood use patterns in Tikal likely indicate the changed in the availability of an overharvested resource. Further study encompassing a greater number and broader range of structure types from Tikal would likely yield additional information.

Acknowledgements

Betty Strack (Scanning Electron Microscopy, Field Museum)

Support from: NSF-REU 2004 Grant and the Chicago Botanic

References Cited

Balick, M. J., Nee, M. H., Atha, D. E.
2000 Checklist for the vascular plants of Belize with common names and uses. *Memoirs of the New York Botanical Gardens 85*. New York Botanical Gardens Press.
Coe, W. R., Shook, E. M., Satterthwaite L.
1961 The Carved Wooden Lintels of Tikal. Tikal Report No. 6 In *Tikal Reports Nos. 5-11*. Philadelphia: The University Museum, University of Pennsylvania.
Hammond, N.
1982 *Ancient Maya Civilization*. New Brunswick (N.J.): Rutgers.
Harrison, P. D.
1999 *The lords of Tikal: Rulers of an ancient Maya city*. London: Thames and Hudson.
Haviland, W. A.
1970 Tikal, Guatemala and mesoamerican urbanism. *World Archaeology*, 2: 186-198.
Lentz, D. L.
1991 Maya diets of the rich and poor: Paleoethnobotanical evidence from Copan. *Latin American Antiquity*, 2(3): 269-287.
Mickelbart, M. V.
1996 Sapodilla: A potential crop for subtropical climates. In J. Janick (Ed.), *Progress in new crops* (439-446). Alexandria, VA: ASHS Press.
Montgomery, J.
2001 *Tikal: An illustrated history of the ancient Maya capital*. New York, NY: Hippocrene Books.
Morton, J.
1987 Sapodilla. In J. F. Morton (Ed.), *Fruits of warm climates* (393–398) Miami, FL: Florida Flair Books.
Rocas, A. N.
2003 Haematoxylum campechianum. *Tropical Tree Seed Manual*. Washington, D.C.: USDA.
Standley, P. C., & Williams, L. O.
1967 *Flora of Guatemala, Fieldiana Botany 24*: part 8.