Caribbean Journal of Science, Vol. 42, No. 1, 11-19, 2006

University of Puerto Rico, Mayagüez

Prehistoric Exploitation of the Swamp Palm (*Raphia taedigera*: Arecaceae) at Sitio Drago, Isla Colón, Bocas Del Toro Province, Panama

THOMAS A. WAKE

Zooarchaeology Laboratory, The Cotsen Institute of Archaeology at UCLA, Los Angeles, CA 900025-1510
twake@ucla.edu

ABSTRACT.—Carbonized *Raphia taedigera* endosperms are reported from Sitio Drago, an archaeological site on the northwest corner of Isla Colón, Bocas del Toro Province, Panama. Two specimens date to approximately cal AD 880-1050 and cal AD 900-1170. The presence of carbonized *R. taedigera* endosperms at Sitio Drago adds the species to a list of 50 palms reported from New World archaeological sites and provides further support for its pre-Columbian presence and use in the Neotropics.

KEYWORDS.—palms, *Raphia taedigera*, archaeology, Caribbean, subsistence, Neotropics

INTRODUCTION

Considerable debate has occurred concerning the origin and arrival of the New World raffia palm (*Raphia taedigera*: Arecaceae) in the Americas. Prior to 1997 many authors believed *R. taedigera* to be a post-contact introduction to the New World from Africa representing a traditional food source for slaves (Anderson and Mori 1967; Gentry 1993; Otedoh 1977). On the surface this contention seems plausible since some 20 *Raphia* species are known from Africa and only one (*R. taedigera*), a sister species to the African *R. vinifera*, is present in the New World (Corner 1966). A variety of food and other plants were indeed transmitted to the Caribbean as part of the African diaspora and the greater Columbian exchange (Crosby 1972). Recently, however, Urquhart (1997, 1999) has documented the presence of *R. taedigera* pollen, seed fragments, and by extension, raffia swamps in Caribbean Nicaragua some 2700 years ago, thus firmly establishing the pre-Columbian presence of the species in Central America. *Raphia taedigera* is also known as the 'swamp palm' in general and has a variety of indigenous names including *silico* and *matomba* (Panama), *yolillo* (Costa Rica), *pángana* (Colombia) and *jupatí* (Brazil). It is also referred to as the 'Amazonian bamboo palm' in Brazil.

Palms serve as sources of food, beverage, and raw materials throughout their distribution (e.g., Balick 1989; Balick and Beck 1990; Haynes and McLaughlin 2000). Pre-Columbian and ethnohistoric human exploitation of palms (Arecaceae) for a variety of purposes has been documented at several Central American archaeological sites and in various historical documents (Balick 1990; Lentz 1990, 1991; Lenz and Ramírez-Sosa 2002; Marcus 1982; Smith 1980; Voorhies 1982). Gordon (1982) notes several palm species were/are exploited for various purposes in Bocas del Toro, but does not include *R. taedigera*. No mention is made of the consumption as food of any part of *R. taedigera* in the Americas (Balick 1989; Balick and Beck 1990; Haynes and McLaughlin 2000). The first convincing evidence of pre-Columbian exploitation of *R. taedigera* endosperms, and by extension other parts of the species, as food items is found in recently excavated archaeological contexts at Sitio Drago, Bocas del Toro, Panama (Figs. 1-3).

MATERIALS AND METHODS

Carbonized *R. taedigera* endosperms have been recovered from two different areas of

ms. received April 25, 2005; accepted September 2, 2005

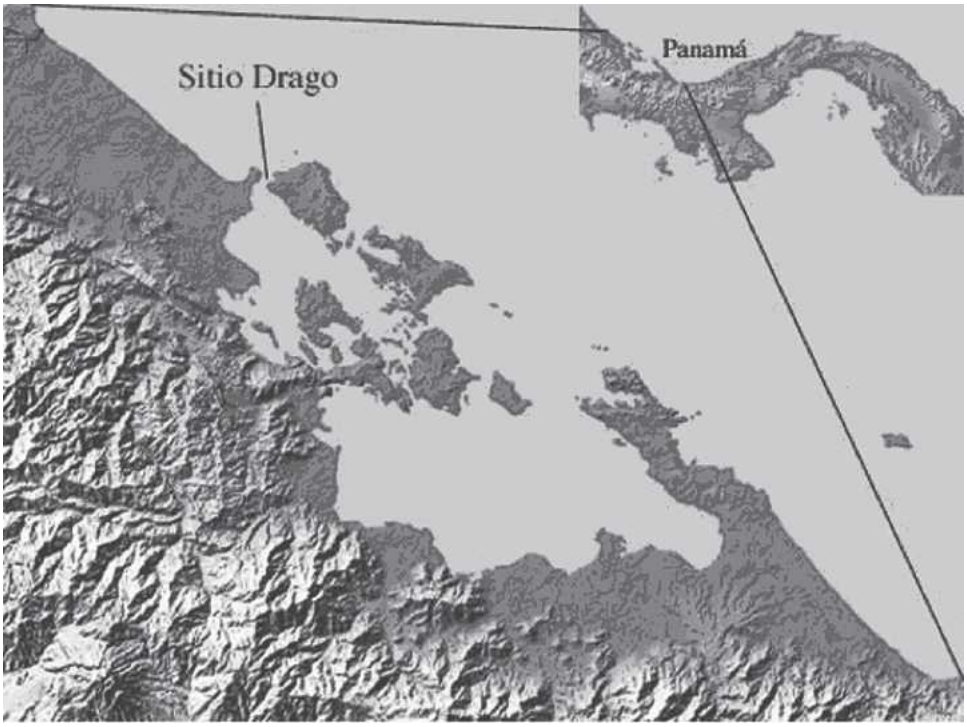

FIG. 1. Sitio Drago, Isla Colón, Bocas del Toro archipelago, Panama.

Sitio Drago, Unit 1, located near the apex of Mound 6, and from Unit 4, closer to the center of the site (Fig. 3). In 2003 thirty complete or mostly whole carbonized *R. taedigera* seeds were recovered from Unit 1,10 to 40 cm below the ground surface (Table 1). A concentration of 20 carbonized *R. taedigera* endosperms was encountered in the 20-30 cm level of the south half of the 1 x 2 m excavation pit placed near the center of Mound 6 (Unit 1, north [n] and south [s]), Fig's. 3, 4). Seven fragmentary *R. taedigera* endosperm specimens were recovered from Unit 4, 60-90 cm, during 2005 (Fig. 3).

The carbonized *R. taedigera* specimens from Units 1 and 4 are associated with a variety of artifacts including ceramics, ground and chipped stone, worked shell and bone, animal bone and shell, as well as charred plant material. All excavated deposits at Sitio Drago appear to represent classic artifact–rich shell middens (e.g., Gordon 1962, 1982; Stine 1993), possibly associated with individual residences or residence clusters (e.g., Linares and Ranere 1980). Based on 15 radiocarbon age determinations (Wake 2004, 2005; Wake et al. 2004), all excavated contexts represent contemporaneous occupation of the over 17 ha archaeological site.

The excavation and recovery strategy at Sitio Drago involved removal of soil by hand from individual $1m^2$ units in arbitrary 10 cm levels using trowels. Diagnostic artifacts, faunal remains, carbonized plant remains and *R. taedigera* endosperms were collected in the field with detailed three-dimensional location data where possible (see Table 1). Specimens not point plotted (Table 1) were recovered from field screens or from dried wet screened midden samples. All soil removed from the Sitio Drago excavation units was passed through 3 mm mesh screen in the field to remove as much sandy loam matrix as possible (Fig. 3).

Soils recovered from Mound 6 (Units 1n and 1s) in 2003 were dry-screened through 3 mm mesh and bagged in the field for further processing in the Institute for Tropical

FIG. 2. Crown of the Swamp Palm (*Raphia taedigera*), in natural habitat at Sitio Drago.

Ecology and Conservation (ITEC) field laboratory. The 2004 and 2005 samples were then wet screened through 3 mm mesh, dried, and hand sorted at the ITEC field laboratory. Carbon specimens greater in size than approximately 1 cm^3 were collected from the screen by hand and bagged separately in the field during the 2003, 2004 and 2005 seasons.

RESULTS

Identification

Raphia taedigera ranges from Brazil to Nicaragua, growing in virtually pure stands of dense clumps in poorly drained swamp-forest habitat. In Central America *R. taedigera* is found along the Caribbean coasts of Panama, Costa Rica, and Nicaragua, with an isolated population on the Osa Peninsula of Pacific southwest Costa Rica (Grayum 2003; Jantzen 1983; Urquhart 1997). Individual plants are surrounded at the base by dense mats of branching pneumatophores, their "trunks" consisting mainly of petiole bases. The species is known for its extremely long (5 m), pinnately compound leaf-blades. Each flowering *R. taedigera* stem produces several inflorescences over a relatively short period, and then dies. The elongate, pendulous inflorescences occur throughout the year and produce large, glossy, scaly fruits (Fig. 2) that are unique among all Central American palms. Grayum (2003) provides a detailed botanical description of *R. taedigera*.

The *matomba* is commonly found in the coastal lowlands of Bocas del Toro Province, close to Sitio Drago. The Archaeological specimens in question were identified to species based primarily on direct comparison of fruits harvested from extant *R. taedigera* trees in a raffia swamp adjacent to Sitio Drago. All of the complete and fragmentary archaeological specimens are ovate, oblong and exhibit the deep sinuous grooves on the outer surface of the endosperm characteristic of the genus. The trees were identified as *R. taedigera* following descriptions by Grayum (2003) and Stewart

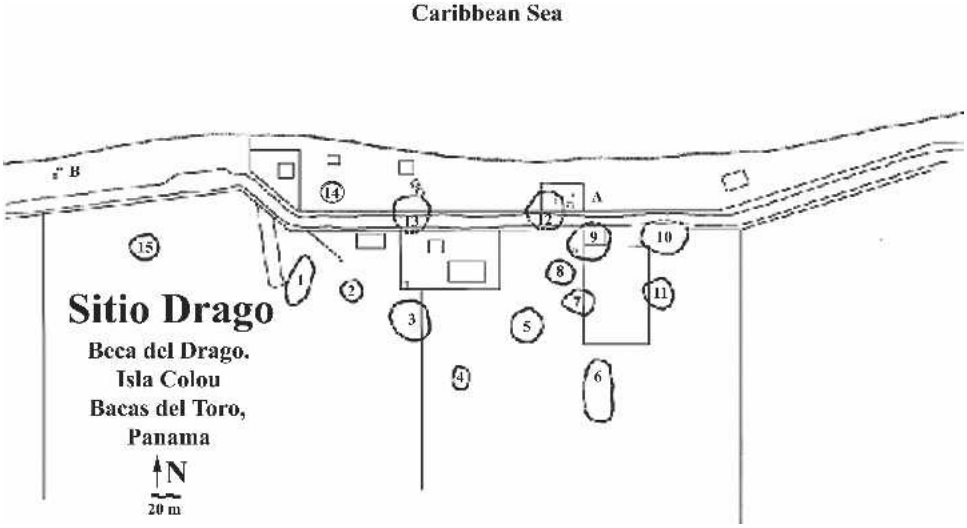

FIG. 3. Sitio Drago (BT-IC-1), Boca del Drago, Bocas del Toro, Panama. Ovals represent low occupation mound deposits, rectangles represent modern fence lines and structure footprints, numbered small black squares represent excavation units.

(1994). Other palm species observed close to Sitio Drago include *Astracaryum stanleyi, Bactris gasipaes* and *Cocos nucifera*.

Radiocarbon dating

Raphia endosperms are ideal dating material since they are produced only once each year (Stewart 1994). They do not represent the several years' accumulation of environmental carbon that carbonized wood fragments do. Two *R. taedigera* seeds recovered from Mound 6 were directly dated (Table 1).

These two samples were excavated by hand with pointing trowels, measured and photographed in situ, wrapped in aluminum foil and bagged in the field. The respective samples were sent to Beta Analytic, Inc., where they received acid/alkali/acid pretreatment and provided sufficient carbon for standard radiometric analysis.

The specimen from Unit 1S, Level 20-30, is dated to 1050+/−60, cal AD 880-1050 and cal AD 1095-1140 (Beta-182651). The specimen from Unit 1S, Level 30-40 dates to 1020+/-60, cal AD 900-1170 (Beta-182652). Calibrations are calculated by Beta Analytic, Inc. following Stuiver et al. (1998), and Talma and Vogel (1993). All calibrations represent 2 sigma (95%) confidence intervals.

DISCUSSION

Palms are exploited for food, beverage, and material purposes by indigenous peoples throughout the Americas (Balick 1989). Their fruits and hearts are consumed as food and the juices collected from the fruit and/or trunk provide both fresh and fermented beverages. The American oil palm (*Elais oleifera*) is especially important for oil extraction (Balick and Beck 1990; Haynes and McLaughlin 2000). One Palm species, the *pejibaye* (*Bactris gasipaes*), used for food and its hard wood (for blowguns, bows, and spears), was domesticated somewhere in the western Amazon basin and spread to Central America during Pre-Columbian times (Ford 1984:179; León 1984:169; Morcote-Rios and Bernal 2001). Marcus (1982) provides an overview of ethnohistoric subsistence plants used by various Maya groups.

Wild and semi-domesticated palms represent important food sources in Bocas del Toro. Gordon (1982) lists twelve genera and eleven species of palms exploited by the Bocas del Toro Guaymí, including *pejibaye*.

FIG. 4. Concentration of carbonized *R. taedigera* endosperms, Sitio Drago, Mound 6, Unit 1S, 20-30 cm.

Linares (1980), Smith (1980), Bort (1980) and Young (1980) mention several species of palms as currently being used in western Panama, especially *pejibaye*. However, none of the above mentioned authors make mention of the use of *Raphia taedigera* for any subsistence purpose. Johnson (1998) mentions only non-subsistence uses of *R. taedigera*.

The *matomba* has several closely related African sister species including *Raphia vinifera* and *R. hookeri* that are used for various purposes throughout their ranges (Engler 1895). The sweet sap from the trunk of *R. vinifera* is collected and fermented into palm wine in West Africa (Cook 1946; Engler 1895; Faparusi 1981; Haynes and McLaughlin 2000; Russell 1963; Vickery and Vickery 1979; Zevev 1972). The ripe mesocarps of *R. vinifera* are eaten throughout West Africa (Engler 1895; Otedoh 1977) and both American and African *Raphia* endosperms provide a non-drying oil (Bomhard 1946; Cook 1964; Engler 1895; Vickery and Vickery 1979). *Raphia vinifera* also provides "palm ivory" (Cook 1946) and fiber products such as piassava, horticultural bast, and construction materials in Africa (Otedoh 1975; Hillier 1910; Russell 1963).

Similar information for *R. taedigera* is rare. Allen (1956) mentions that sweet palm sap and sugar is extracted from *yolillo* palms in the Golfo Dulce region of Pacific southwest Costa Rica. *Jupatí* is used for various cordages and construction materials in Brazil (Williams 1981). No nutritional information is currently available for *R. taedigera*.

Archaeological evidence of Pre-Columbian exploitation of 29 genera and 50 species of palms in North, Central and South America and the Caribbean is reviewed by Morcote-Rios and Bernal (2001). Palm remains have been identified at 25 Olmec and Maya sites in Mexico, Guatemala, Honduras and Belize as well as in Costa Rica and Panama (Morcote-Rios and Bernal 2001: 335). The archaeological presence of *Coyol* (*Acrocomia mexicanum*) in particular, is documented from the Tehuacán Valley, Copán, Cerén, and other Mesoamerican sites (Lentz 1990, 1991; Lentz et al. 1994;

TABLE 1. Identified *Raphia taedigera* remains from Mound 6, Sitio Drago, Bocas del Toro, Panama.

Unit	Level	Object	Count	Condition	Provenience	RYBP	Calibrated date
1n	20-30	Carbonized endosperm	3	c	screen		
1n	20-30	Carbonized endosperm	1	f	screen		
1n	40-50	Carbonized endosperm	1	c	19s92e47bs		
ls	10-20	Carbonized endosperm	1	m	35s25e31bs		
ls	20-30	Carbonized endosperm	1	c	30s15e20bs	1050 ± 60	AD 990-1140
ls	20-30	Carbonized endosperm	2	c	37s84e36bs		
ls	20-30	Carbonized endosperm	1	m	63s70e29bs		
ls	20-30	Carbonized endosperm	2	c	58s92e30bs		
ls	20-30	Carbonized endosperm	10	c	59s90e31bs		
ls	30-40	Carbonized endosperm	1	c	20s70e35bs	1010 ± 60	AD 900-1170
ls	30-40	Carbonized endosperm	7	c	screen		
4	60-70	Carbonized endosperm	3	f	screen		
4	70-80	Carbonized endosperm	4	f	screen		
4	80-90	Carbonized endosperm	4	f	screen		
		Total	40				

Provenience data collected from NW corner of excavation Unit.
s = cm from N wall, e = cm from W wall, bs = cm below ground surface.
c = complete, m = most, f = fragment.
30s15e20bs = Beta-182651; 20s70e35bs = Beta-182652

Morcote-Rios and Bernal 2001; Smith 1967). Archaeological palm remains are also documented in Cuba and the Dominican Republic (Morcote-Rios and Bernal 2001).

In Panama, Cooke and Ranere (1992:123) identified carbonized fragments of several species of palms at sites occupied prior to 2500 BP in the Santa María River drainage on the Pacific slope. Smith (1980) identified both carbonized *Corozo pacora* (*Acrocomia* cf. *vinifera*) and *Corozo gunzo* (*Scheelea zonensis*) fruit fragments and casts from several sites on the Pacific slope in Chiriquí. Smith (1980), however, makes no mention of *Raphia* remains at Cerro Brujo or anywhere else (e.g., Linares and Ranere 1980).

Raphia does have an edible mesocarp (Engler 1895; Otedoh 1977), but not the fleshy fruit *Astracarym* or *Bactris* do, nor the milk filled interior of *Cocos nucifera*. Therefore, it is unlikely that *Raphia* fruits were used as a beverage source. *Raphia* seeds are quite large, solid to hard, oily and starchy, leaving open the possibility of their use as a food source. The possible use of *R. taedigera* as a source of sweet sap for chicha production should not be overlooked (Allen 1956; Faparusi 1981).

It is possible, but unlikely, that *Raphia* seeds could have been introduced to Sitio Drago by natural means. Some of the large Central American terrestrial mammals consume raffia fruits, serving as potential seed dispersal agents. Tapir and collared peccary are reportedly attracted to raffia swamps in Corcovado National Park, Costa Rica, "in the dry season when the palm fruits are falling (Jantzen and Wilson 1983)". Gordon (1982) mentions that many bird and mammal species consume and distribute palm fruits and their seeds in Bocas del Toro. The large seeds of *R. taedigera* are reportedly swallowed by tapirs and passed whole (Jantzen 1983). The natural occurrence of the *R. teadigera* specimens from Sitio Drago due to dispersal by peccaries or tapirs is mitigated by their carbonized condition, indicating purposeful roasting and subsequent burning, and their obvious archaeological context.

Exactly how *Raphia* arrived in and around the Osa Peninsula on the Pacific coast of Cost Rica has yet to fully explained. Ancient trans-Atlantic seed dispersal from Africa is suggested as an explanation for the occurrence of *Raphia* in Caribbean Panama, Costa Rica and Nicaragua (Urquhart 1997). *Raphia* seeds would have had to be physically transported from the Caribbean coast in order to establish the existing populations in Corcovado and southwest Costa Rica. Perhaps *Raphia* and

its seeds represented a resource important enough for humans to introduce the species to the Pacific coast.

Conclusions

Several (n = 40) whole and fragmentary carbonized *R. taedigera* endosperms have been recovered from midden deposits at Sitio Drago, Bocas del Toro. These specimens are directly associated with the remains of several ceramic cooking and serving vessels and a wide range of other discarded foodstuffs such as marine and terrestrial animal bone and various marine mollusk shells. Given the variety of uses for *R. vinifera* and related species in Africa, it is possible that *R. taedigera* could have provided starch and oil for consumption, sweet sap for chicha production, and thatch, cordage, and construction materials to the occupants of pre-Columbian Sitio Drago.

The presence of *R. taedigera* endocarps in the Sitio Drago midden deposits provides further support for Linares' (1980) conclusions concerning the exploitation of tree-crops in pre-Columbian Bocas del Toro, Panama. This report adds *R. taedigera* to the ever-lengthening list of plants exploited for food by indigenous Americans. Radiocarbon dating of two *R. taedigera* endosperms provides further support for the Pre-Columbian presence of the species in the New World (Urquhart 1997, 1999).

Acknowledgments.—I thank the American Philosophical Society, Franklin Grants program, for providing field and laboratory support for the 2004 Proyecto Arqueológico Sitio Drago season. David and Marvalee Wake and The Cotsen Institute of Archaeology at UCLA provided support for the 2003, 2004, and 2005 field seasons. I am grateful to Aristides "Bolo" Serracín, for continued access to Sitio Drago. The enthusiastic support and participation of Ana Serracín de Shaffer, and Willy and Juany Serracín is greatly appreciated. Carlos Fitzgerald, Tomas Mendizábal and Domingo Varela approved permits for the project's field and lab phases. I thank Pete Lahanas, ITEC Director, for his support of the project and provision of curatorial and field laboratory space. I thank Christina Campbell for her comments on this article, participation in the project, and for bringing Sitio Drago to my attention. 2003, 2004 and 2005 project participants included Brooke Basse, Jeannette Bond, Nathan Buck, Christina Campbell, Helen Campbell, John Daquioag, Jason de Leon, Doug Doughty, Tria Ellison, Casey Fichtner, Carlos Fitzgerald, Shirley Fonseca, Ora Gessler, Angela Harrington, Marillyn Holmes, Jerry Howard, Michael Kay, Elizabeth Kempton, Dawn Kolber-Grebe, Amber McLean, Tomas Mendizábal, Adam Ortiz, Ana Serracín de Shaffer, Joanne Snowden and Angela Tingey. I thank Virginia Popper, Carlos Ramirez-Sosa and two anonymous reviewers for their helpful comments on earlier versions of this paper. Of course, any omissions or errors are entirely my own.

Literature Cited

Allen, P. H. 1956. *The Rain Forests of Golfo Dulce*. Jacksonville: University of Florida Press.

Anderson, R., and S. Mori. 1967. A Preliminary Investigation of *Raphia* Palm Swamps, Puerto Viejo, Costa Rica. *Turrialba* 17:221-224.

Balick, M. J. 1989. The Diversity of Use of Neotropical Palms. *Ceiba* 30(1):21-46.

Balick, M. J. 1990. Production of Coyol Wine *Acrocomia mexicana* (Arecacae) In Honduras. *Econ. Bot.* 44:84-93.

Balick, M. J., and H. T. Beck. 1990. *Useful Palms of the World: A Synoptic Bibliography*. New York: Columbia University Press.

Bomhard, M. L. 1946. Brazil's oil-yielding palms. *Ag. in the Am.* 6:6-15.

Bort, J. 1980. Ecology and Subsistence on Opposite Side of the Talamancan Range. In *Adaptive Radiations in Prehistoric Panama*, ed. O.F. Linares and A.J. Ranere, 499-509. *Peabody Museum Monographs*, No. 8. Cambridge: Harvard University.

Cook, O. F. 1946. Africa needs palms as tree crops. *The Sci. Mo.* 31(Feb.):131-139.

Cooke, R. G., and A. J. Ranere. 1992. Prehistoric Human Adaptations to the Seasonally Dry Forests of Panama. *World Arch.* 24(1):114-133.

Corner, E. J. H. 1966. *The Natural History of Palms*. Berkeley: University of California Press.

Crosby, A. W. 1972. *The Columbian Exchange: Biological and Cultural Consequences of 1492*. Westport, Connecticut: Greeenwood Publishing Co.

Engler, A. 1895. *Die Pflanzenwelt ost-Afrikas und der NachbergebeiteTheil B. Die Nutzflanzen Ost-Afrikas*. Berlin: Geographische Verlagshandlung Dietrich Reimer.

Faparusi, S. I. 1981. Sugars identified in *Raphia* palm wine. *Food Chem.* 7:81-86.

Ford, R. I. 1984. Prehistoric Phytogeography of Economic Plants in Latin America. In *Pre-Columbian Plant Migration*, ed. D. Z. Stone, 175-183. *Papers of the Peabody Museum of Archaeology and Ethnology,* Vol. 76. Cambridge: Harvard University.

Gentry, A. H. 1993. Diversity and Floristic Composition of Lowland Tropical Forest in Africa and South America. In *Biological RelationshipsBetween Africa and South America*, ed. P. Goldblatt, 500-547. New Haven: Yale University Press.

Gordon, B. R. 1982. *A Panama Forest and Shore: Natural History and Amerindian Culture in Bocas del Toro*. Monterey: Boxwood Press.

Grayum, M. H. 2003. Arecaceae. In *Manual de Plantas de Costa Rica, Volumen II.—Gimnospermas y Monocotiledoneas (Agavaceae-Musaceae),* ed's. B.E. Hammel, M.H. Grayum, C. Herrera, and N. Zamora. Monographs in Systematic Botany 92. St. Louis, Missouri Botanical Garden Press.

Haynes, J., and J. McLaughlin. 2000. Edible Palms and Their Uses. *Univ. of Florida Ex., Inst. of Food and Agr. Sci. Fact Sheet* MDCE-00-50-1.

Hillier, J. M. 1910. Miscellaneous notes: African bass or piassava (*Raphia vinifera*, Beauv.). *Bull. of Misc. Info.*, No. 5, 24:169-171.

Jantzen, D. H. 1983. *Tapirus bairdii* (Danto, Danta, Baird's Tapir). In *Costa Rican Natural History*, ed. D. H. Jantzen, 496-7. Chicago: University of Chicago Press.

Jantzen, D. H., and D. E. Wilson. 1983. Mammals, Introduction. In *Costa Rican Natural History*, ed. D. H. Jantzen, 426-442. Chicago: University of Chicago Press.

Johnson, D. V. 1998. *Tropical Palms*. Non-Wood Forest Products Technical Manual, No. 10. Rome: United Nations Food and Agriculture Organization.

Lentz, D. L. 1990. *Acrocomia mexicana*: Palm of the Ancient Mesoamericans. *J. Ethnobio.* 10:183-194.

Lentz, D. L. 1991. Maya Diets of the Rich and Poor: Paleoethnobotanical Evidence from Copán. *Am. Ant.* 2(3):269-287.

Lentz, D. L., and C. R. Ramírez-Sosa. 2002. Cerén Plant Resources: Abundance and Diversity. In *Before the Volcano Erupted: The Cerén Village in Central America*, ed. P. D. Sheets, 3-42. Austin: University of Texas Press.

León, J. 1984. The Spread of Amazonian Crops in to Mesoamerica: The Botanical Evidence. In *Pre-Columbian Plant Migration*, ed. D. Z. Stone, 165-174. *Papers of the Peabody Museum of Archaeology and Ethnology,* Vol. 76. Cambridge: Harvard University.

Linares, O. F., and A. J. Ranere (ed's.). 1980. *Adaptive Radiations in Prehistoric Panama. Peabody Museum Monographs,* No. 8. Cambridge: Harvard University.

Marcus, J. 1982. The Plant World of the Sixteenth- and Seventeenth-Century Lowland Maya. In *Maya Subsistence*, ed. K. V. Flannery, 239-273. New York: Academic Press.

Morcote-Rios, G., and R. Bernal. 2001. Remains of Palms (Palmae) at Archaeological Sites in the New World: A Review. *Bot. Rev.* 67(3):309-350.

Otedoh, M. O. 1975. Raphia palms: the production of piassava in Nigeria. *Nigerian Field* 40(1):4-15.

Otedoh, M. O. 1977. The African Origin of *Raphia taedigera* – Palmae. *Nigerian Field* 42 (1):11-16.

Prance, G. T. 1984. The Pejibaye, *Guilielma gasipaes* (HBK) Bailey, and the Papaya, *Carica papaya* L. In *Pre-Columbian Plant Migration*, ed. D. Z. Stone, 85-104. *Papers of the Peabody Museum of Archaeology and Ethnology,* Vol. 76. Cambridge: Harvard University.

Russell, T. A. 1963. The *Raphia* palms of West Africa. *Kew Bull*. 19(2):173-196.

Smith, C. E. Jr. 1967. Plant Remains. In *The Prehistory of the Tehuacán Valley*, Volume 1, edited by D.S. Byers, pp. 220-255. Austin: University of Texas Press.

Smith, C. E. Jr. 1982. Plant Remains from the Chiriqui Sites and Ancient Vegetational Patterns. In *Adaptive Radiations in Prehistoric Panama*, ed. O. F. Linares and A. J. Ranere, 151-174. *Peabody Museum Monographs*, No. 8. Cambridge: Harvard University.

Stine, J. K. 1993 *Deciphering a Shell Midden*. New York: Academic Press.

Stewart, L. 1994 *A Guide to Palms and Cycads of the World*. New York: Harper-Collins.

Stuiver, M., et al. 1998 INTCAL98 Radiocarbon Age Calibration, 24,000-0 B.P. *Radiocarbon* 40(3):1041-1083.

Talma, A. S., and J. C. Vogel. 1993. A Simplified Approach to Calibrating C14 Dates. *Radiocarbon* 35(2): 317-322.

Urquhart, G. R. 1997. Paleoecological Evidence of *Raphia* in the Pre-Columbian Neotropics. *J. Trop. Ecol.* 13(6):783-792.

Urquhart, G. R. 1999. Paleoecological persistence of *Raphia taedigera* swamps in Nicaragua. *Biotropica* 31:565-569.

Vickery, M. L., and B. Vickery. 1979. *Plant Products of Tropical Africa.* London: Macmillan.

Voorhies, B. 1983. An Ecological Model of the Early Maya of the Central Lowlands. In *Maya Subsistence*, ed. K. V. Flannery, 65-95. New York: Academic Press.

Wake, T. A., J. de Leon, and C. M. Fitzgerald B. 2004 Prehistoric Sitio Drago, Bocas del Toro, Panama. *Antiquity* 78(300): http://antiquity.ac.uk/ProjGall/wake/

Wake, T. A., J. C. Bond, and C. M. Fitzgerald B. 2005. Archaeological Investigations at Sitio Drago, Bocas del Toro, Panama: Results of the 2004 Season. Report submitted to the Dirección Nacional de Patrimonio Histórico, Instituto Nacional de Cultura, Panamá.

Wake, T. A., J. de Leon and C. M. Fitzgerald B. 2004. Archaeological Investigations at Sitio Drago, Bocas del Toro, Panama: Results of the 2003 Season. Report submitted to the Dirección Nacional de Patrimonio Histórico, Instituto Nacional de Cultura, Panamá.

Williams, L. O. 1981. The useful plants of Central America. *Ceiba* 24(1-2):1-297.

Young, P. D. 1980. A Report on Ethnographic Research Among the Bocas Guaymí. In *Adaptive Radiations in Prehistoric Panama*, ed. O. F. Linares and A. J. Ranere, 491-498. *Peabody Museum Monographs*, No. 8. Cambridge: Harvard University.

Zeven, A. C. 1972. The partial and complete domestication of the oil palm (*Elaeis guineensis*). *Econ. Bot*. 26:274-279.