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The Palm Landscape of Belize: Human Interaction with the Cohune Palm (*Orbignya cohune*)

Kendra McSweeney
University of Tennessee, Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Kendra McSweeney entitled "The Palm Landscape of Belize: Human Interaction with the Cohune Palm (*Orbignya cohune*)." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Geography.

Sally P. Horn, Major Professor

We have read this thesis and recommend its acceptance:

Ronald Foresta, Lydia M. Pulsipher

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

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Date 30 April 1993

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Master of Science
Degree
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Kendra McSweeney

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ABSTRACT

The cohune palm (*Orbignya cohune*) is a common and conspicuous member of the subtropical lowland forests of Belize, Central America. The palm also thrives in the open areas of human settlement; combined, the palm's dominance in both settings creates a rural "palm landscape". This thesis examines that landscape, addressing two ways in which humans and the cohune palm interact. First, apparently anomalous high-density cohune forests are examined for the role of ancient Mayan agriculture in their genesis. Data from this study show these stands may reach densities of 21,640 conspecific stems/ha. Cohune stands all over Belize were identified, their densities quantified, and their prehistoric and post-Columbian histories reconstructed. Did Mayan encouragement of this palm contribute to its present monodominance on edaphically rich sites in Belize? Despite the popularity of this anthropogenic explanation, the findings of this study revealed no uniquely similar histories among comparably dense cohune stands. Combined with an examination of their population size structures, it is argued here that such monodominant stands should be interpreted as natural expressions of particularly fertile edaphic conditions, and not as a "cultural" vegetation.

The second aspect examined of cohune-human interaction was the degree to which human use of the cohune matches its abundance in rural areas. Within the context of popular interest in extractive forest products, the cohune appears an ideal example: thatch, oil, and heart-of-palm are all extracted from cohune forests. This study reveals, however, that the degree to which these activities are still carried out is negligible, and typically makes use of forests slated

to be felled anyway. Although the study's survey was most thorough in the Cayo District, the results show a general pattern of very low use in Belize that is most defined at socio-economic extremes, with rural populations relying on cohune products in times of need, and urbanites occasionally "treating themselves" to cohune oil or *palmito*.

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Chapter 1

INTRODUCTION

Scientific interest in the conservation of neotropical rainforests has recently focussed on the economic value of standing forest, as measured by the products the forest provides to indigenous forest dwellers and non-native rural peoples (Jordan *et al.,* 1987; Fearnside, 1989; Peters *et al.*, 1989b; Dickinson and Putz, 1990; Balick, 1990; Lamb, 1991; Hecht, 1992). Forest products include plant and animal foods, medicines, and construction materials; they are ideally extracted in non-destructive, sustainable ways that maintain the forests' biological integrity. It is argued that where standing forests are profitable, the economic incentive to convert them to pasture or cropland is reduced (Gentry and Blaney, 1990; Prance, 1990; Anderson and Ioris, 1992; Godoy, 1992). Similarly, extraction from secondary forests or fallowed areas is said to remove the deforestation pressure from the primary forest frontier (Brown and Lugo, 1990).

Among the plant families of the neotropics, the Palmae is one of the most useful in an extractive context (Balick, 1990b; Balick and Beck, 1990; Phillips and Gentry, 1993). Common in both primary and secondary forests, palms often thrive in human-disturbed environments where other forest species cannot survive (Tomlinson, 1979; Uhl and Dransfield, 1987); in turn, palms play a key role in human subsistence in their provision of shade, fibers, fruits, and other resources. This reciprocal interaction between palms and people -- what Dixon (1985) calls a "symbiotic relationship" -- gives the palms a predominant place at the plant-human interface (Bates, 1988). This is most noticeable in palms' position within human settlements (Corner, 1966), exemplified by the association of *acai* palms (*Euterpe oleracea*) with riverside homes in Brazil (Strudwick and Sobel, 1988). Numerous other studies from South America also address the notion of palm-human interdependence (Bodley and Benson, 1979; Balick, 1984; Voeks and daVinha, 1988; Barfod *et al.*, 1990), the most exhaustive of which are those on the *babassu* palm (*Orbignya phalerata*) of Brazil (May *et al.*, 1985; Anderson *et al.*, 1991).

Several Central American palms also have been studied in terms of their role in human subsistence economies. Geographers have been particularly active in this area, describing the manifestation of the exchange between palms and people in space as "palm landscapes" (Eder, 1970[1]). Johannessen (1966) and Clement (1988) described peach palm (*Bactris gasipaes*) domestication in Costa Rica; Dixon (1985) detailed the diffusion of the exotic coconut (*Cocos nucifera*) along the north coast of Honduras; and Johannessen (1957) and Eder (1970) described the human role in the distribution of *Orbignya* ('*corozo*') palms in northern Central America and Mexico. Within this genus, the role of *O. cohune* in the formation of rich agricultural soils was addressed by Wright *et al.* (1959) and Furley (1975).

In fact, the abundance and conspicuousness of *Orbignya cohune* in the rural areas of the small Central American nation of Belize seem to typify a palm landscape. To a visitor, the cohune appears everywhere: fringing cane fields

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[1] Eder (1970:42): "The significant position of palms among tropical plants may have resulted not so much from mere areal or quantitative dominance as from the *personality* palms lend to the vegetation, often transforming it into a *palm landscape*."

and citrus orchards, growing tall in the garden-like settings of Maya ruins and pastures, and scattered among maize stems in the *milpas* of subsistence farmers. An early traveller to Belize summed up the cohune's dominance in the country's landscape as follows:

> Of plant life in British Honduras, there is nothing which so impresses the traveller as the abundance and profusion of palms which are everywhere seen. From the majestic cohune, which is, *par excellence*, the palm of the colony...(Morris, 1883:67).

The cohune's conspicuousness underscores a less visible dimension of the cohune landscape: the palm's usefulness. Indeed, the palm is often mentioned in the literature on economically important neotropical plants (e.g. Duke, 1989) as well as in the botanical works on Belize's forests (e.g. Standley and Record, 1936; Lundell, 1940). Otherwise, the cohune's ecology and ethnobotany are poorly documented (Furley, 1975). In particular, there has been no synthetic work on the palm's current role in human subsistence systems in Belize nor in any other country within the cohune's range.

This thesis is intended to help correct such omissions. Chapter 2 assembles disparate published data on the morphological and ecological traits of the cohune that have bearing on its distribution and use, and so comprises the most thorough review of the palm to date. The subsequent chapters use the results of two months of fieldwork on cohune ecology and ethnobotany in Belize to address two noteworthy themes in the literature on palm-human interaction. Specifically, Chapter 3 investigates the oft-cited human role in the genesis of high density cohune forests, and tests to what degree these palm stands are indeed a "cultural" vegetation. Chapter 4 reverses the association, to address the cohune's role in human subsistence by documenting the type and distribution of cohune use in modern Belize.

This thesis should prove a useful response to the call for "quantitative" ethnobotanical studies (Prance *et al.*, 1987; Phillips and Gentry, 1993), particularly those concerning subsistence-oriented populations and native palm species (Eder, 1970; Tomlinson, 1979; Bates, 1988; Hecht, 1988). It should also provide a practical reference for private and governmental conservation interests in Belize whose work is often hindered by lack of up-to-date information on important plant species (Belisle, pers. comm., 1992).

THE SETTING

Physical Setting

Belize lies on the Caribbean edge of the Central American isthmus, south of Mexico's Yucatan province and east of the Guatemalan Peten (Figure 1). Belize is the second smallest country in Central America, its effective land area being 21,400 km^2 when offshore cays and interior lagoons are discounted. Belize lies between 15° 53' and 18° 30' N and has a correspondingly subtropical climate, with average monthly temperatures of 16°C in winter and 24°C in summer. Average annual rainfall varies from 203 cm in the north to 406.4 cm in the extreme south. Most rain falls in the wet season between June and November (Hartshorn *et al.*, 1984) (Figure 2).

Belize may be divided into three physiographic

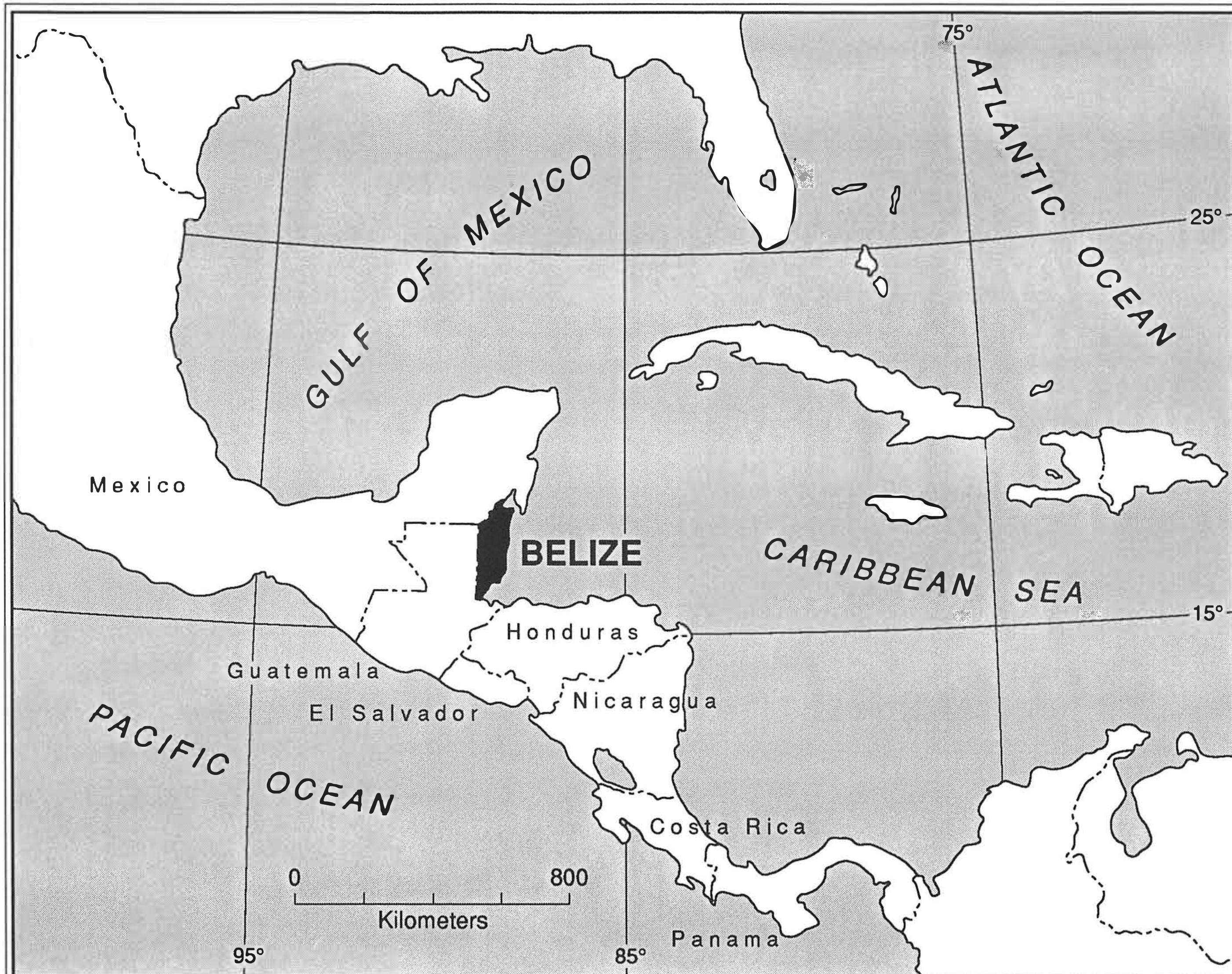

Figure 1 Location map of Belize in Central America.

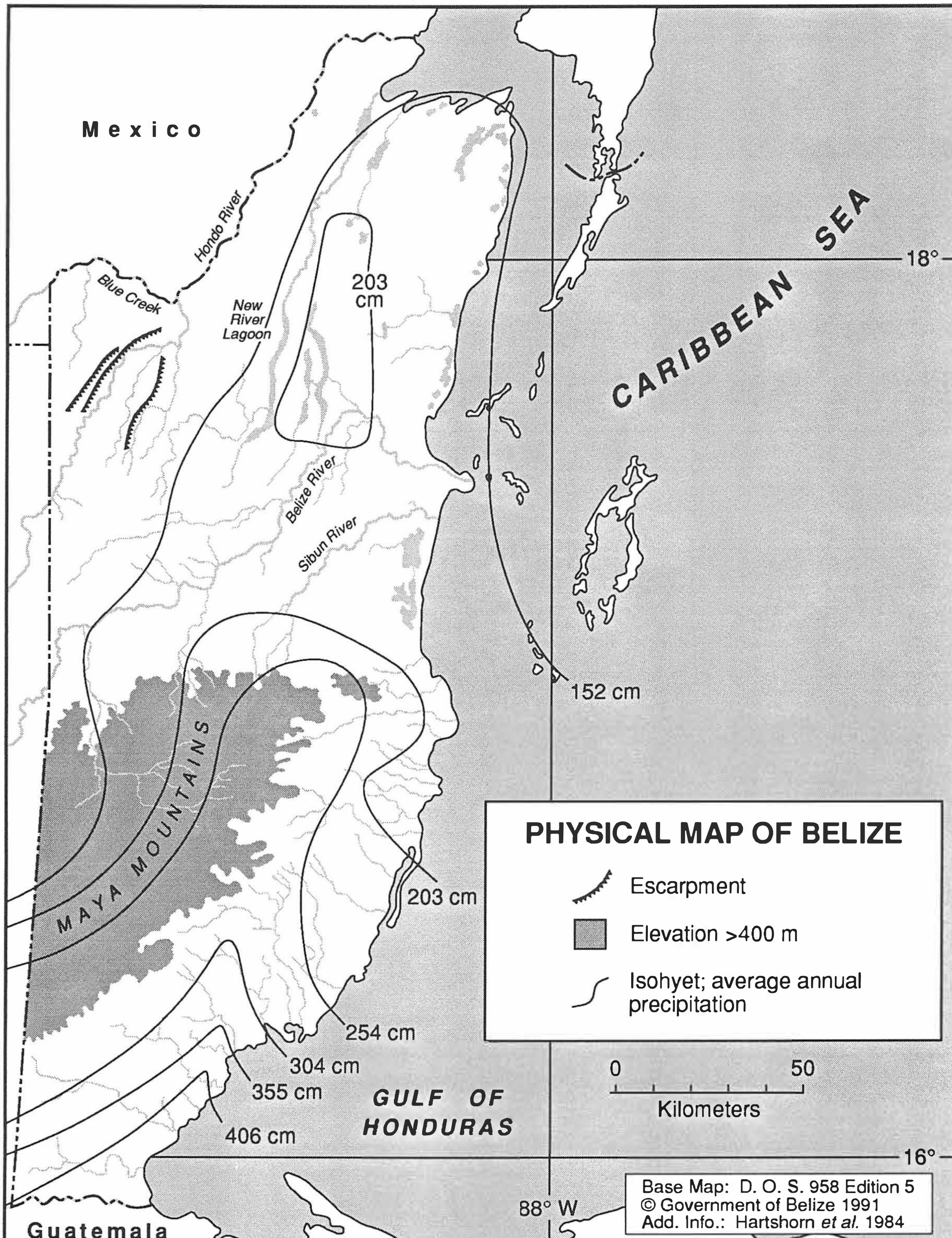

Figure 2 Physical map of Belize.

regions, to which climate and vegetation patterns roughly correspond. The north of the country is part of the Yucatan shelf, a heavily karsted Cretaceous platform distinguished by flat topography through which several rivers meander, including the Hondo, New, and Belize Rivers (Lambert *et al*., 1980). This is the driest part of Belize, with the natural vegetation dominated by deciduous broadleaf forests, edaphically determined pine-palmetto savannas, and extensive coastal mangrove lagoons (Hartshorn *et al*., 1984).

The Maya mountains dominate the south-central part of the country. Composed of granite and highly eroded Paleozoic sediments, they rise to a height of 1120 m at Victoria Peak. The region is drained to the east and north by several rivers. In the mountains' northern portion, low rainfall combines with highly eroded soils to create the distinctive "Mountain Pine Ridge," a vegetation association characterized by pine (*Pinus* spp.) and oak (*Quercus* spp.) (Furley, 1968). The southern part of the mountain range is better watered, and supports a diverse subtropical hardwood forest that is poorly known botanically (NYBG, 1989). The mountains give way on all sides to rolling topography characterized in the west by the calcareous "hill country" of the Cayo District.

The east and southeastern parts of the country are relatively flat, underlain by Tertiary-aged calcareous sediments in which karstic features -- especially limestone outcroppings and caves -- are common. This area receives almost three times the rainfall of Belize's north, averaging 400-460 cm annually. The tall, lush forest here is typified by ceiba (*Ceiba pentandra*) in the interior and red mangrove (*Rhizophora mangle*) along the coast.

The People

Belize's population is estimated at 191,000 (Belize Information Service, 1992), making the country the least populated in Latin America. Belize's population contrasts most sharply with that of El Salvador, a country smaller than Belize yet with 5.6 million people (Population Reference Bureau, 1992). Roughly half of Belize's population is town-dwelling, with 44,200 people living in Belize City, the country's cultural and economic center. Other urban areas include the capital at Belmopan (5,340 people), Orange Walk and Corozal in the north, San Ignacio and Benque Viejo in the west, and Dangriga and Punta Gorda in the south (Figure 3). Although Belize has a high birthrate and a correspondingly young population -- in 1990, 45% of Belizeans were under age 14 (BIS, 1992) -- overall population growth is low due to the country's high emigration rate. Most out-migration is from Belize City and Dangriga to the United States (Hartshorn *et al.*, 1984); it is common to hear that there are as many Belizeans in New York City as in Belize itself.

For its size, Belize's population is heterogeneous, reflecting a long history of immigration. Creoles of African descent predominate in Belize City and Belmopan, while in the west and north the population is primarily Mestizo (of mixed Spanish and native descent). The 1992 census revealed that Spanish-speaking Mestizos now outnumber anglophone Creoles (French, 1992). Garifuna settlements (with people of mixed Carib and African descent) are located exclusively along the coast, the largest being the town of Dangriga. Punta Gorda in the south is ethnically mixed, and includes a large East Indian and Arab population.

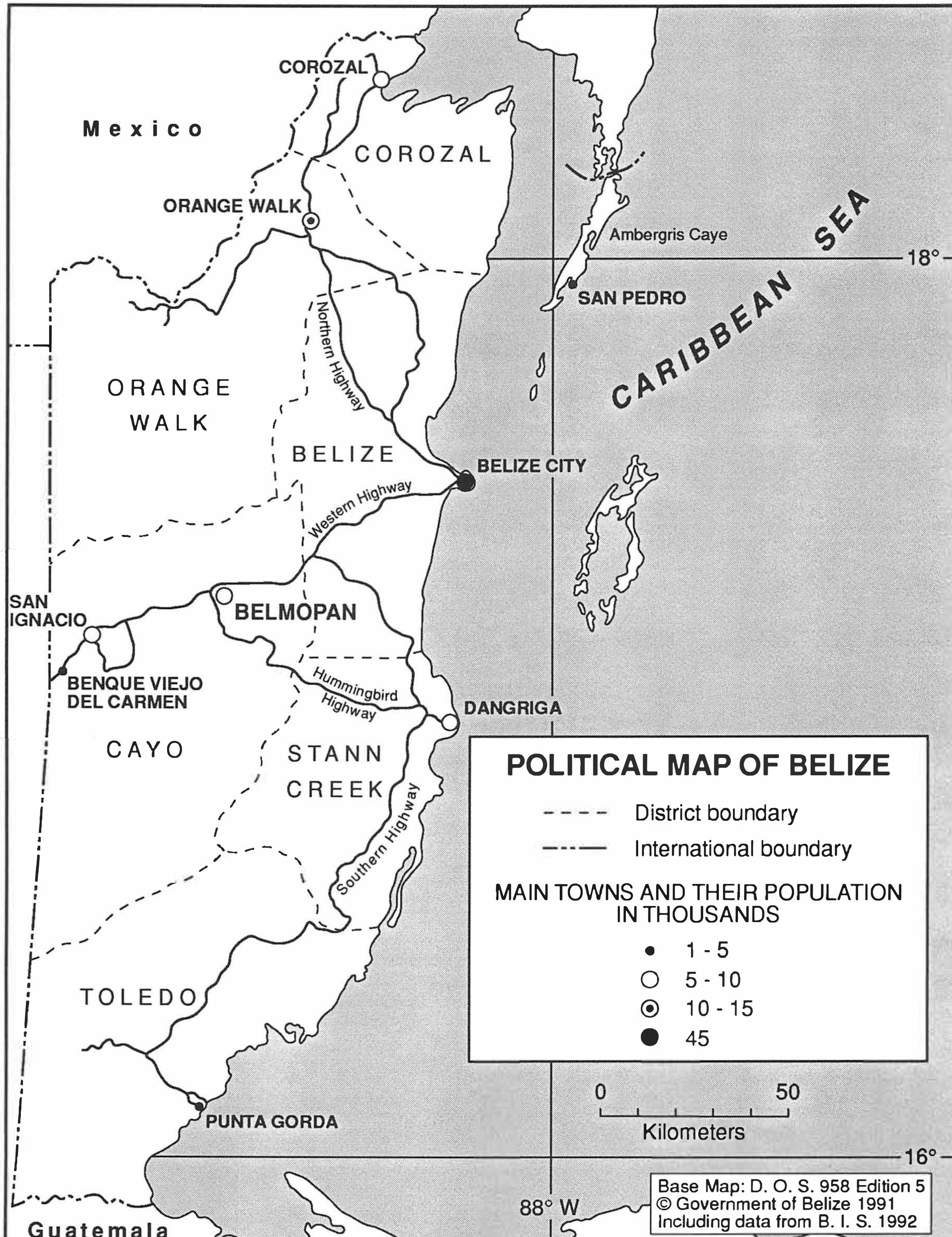

Figure 3 Political map of Belize.

Kekchi and Mopan Maya from Guatemala have traditionally settled in isolated communities in the southern Toledo district, while Yucatec Maya from Mexico are considered largely assimilated into the Ladino culture of the north. Mennonites -- from Canada *via* Mexico -- are concentrated in three specific regions in the Cayo, Orange Walk, and Corozal districts, each settlement distinguished by a different degree of orthodoxy.

Since the early 1980s, Belize's population has been augmented by refugees from Guatemala and El Salvador, and economic migrants from Honduras (Hartshorn *et al.*, 1984; Palacio, 1990; Montgomery, 1991). Estimates vary of the actual numbers of Central Americans that have entered the country in recent years. As early as 1984, Hartshorn *et al.* described almost 1,600 recent Salvadoran arrivals. By 1991, 4,789 refugees were officially registered with the government (BIS, 1992), although the number of unregistered arrivals may be considered comparable (Montgomery, 1991). Some scatter into rural areas to take up subsistence farming, others move to towns or work as wage laborers in sugar or citrus estates (Hartshorn *et al.*, 1984). There are some centers of refugee settlement, however, such as the United Nations-sponsored communities at the Valley of Peace and Las Flores in the Cayo district.

As a former colony of Britain, Belize was known until 1973 as British Honduras. The country gained independence in 1981, but its long association with Britain persists: Belize's official language is English, its government is parliamentary, and its schools are run on the British system. Britain also maintains a military force in Belize, ostensibly to protect the country from invasion by Guatemala, whose 300-year-old claim to Belize and its generous coastline was only recently resolved (Woodward, 1993).

Economy

Belize's economy is based overwhelmingly on agriculture, with most industries structured around the processing of agricultural goods (Bernsten and Herdt, 1977; Robinson, 1985; BIS, 1992). Despite its agricultural orientation, however, the country is a net food importer, a condition responsible for the country's increasingly negative trade balance (BIS, 1992). Belize is not meeting its perceived agricultural potential: it is estimated that of 38% of land considered suitable for agriculture, only 10-15% is in use in any one year (Hartshorn *et al.*, 1984; BIS, 1992).

The dominant crop is sugarcane, responsible for 50% of the country's foreign exchange earnings (BIS, 1992). Citrus is the second major contributor to export earnings, with 96% of the crop exported in the form of concentrate (Moberg, 1991). Most citrus is grown in the Stann Creek district, although other parts of Belize are being targeted for citrus expansion, especially the Cayo and Belize districts (Thomas, 1992; Jordan, pers. comm., 1992).

Bananas are another export crop, covering 600 ha of the Stann Creek and Toledo districts. After being virtually wiped out in the 1970s by hurricanes and disease, the banana industry has recently made a comeback, supported on the artificial base of a guaranteed British market (Hartshorn *et al.*, 1984). The proposed removal of such guaranteed markets by the European Economic Community leaves the future of Belizean bananas in doubt (Humphreys, pers. comm., 1993).

Belize's commercial fishing industry is also oriented towards export, particularly of lobster and shrimp to the U.S., Mexico, and Jamaica. Forestry, once the keystone of the nation's economy, now relies on the second-growth pine stands of the coastal Stann Creek and Mountain Pine Ridge areas. Dairy products are exclusively provided by Mennonite communities, which supply all of Belize's milk and butter, as well as the majority of eggs and broiler chickens (BIS, 1992).

In almost every economic sphere, Belize faces tough foreign competition. For example, the advent of the North American free trade zone and the European Economic Community threaten traditional markets for Belizean products. Nearby countries such as Honduras and Mexico have larger, lower-paid labor forces to encourage foreign investment; the global market for sugar is collapsing; and finally, Latin American countries can produce bananas and oranges more cheaply and on a much larger scale than can Belize.

The Belizean government is well aware of these problems (Hyde, 1993). To survive economically, the government must continue to parlay the substantial international aid it receives, primarily from the U.S., Canada, and Britain (BIS, 1992), into efforts to encourage industrial development and agricultural diversification. For example, Belize is attempting to capitalize on its proximity to the large Mexican beef market (Tzul, pers. comm., 1992). Cattle raising is currently being promoted by the government, which in conjunction with USAID has initiated a multi-phase livestock development project geared towards increasing the country's herd (Ministry of Agriculture *et al.*, 1989). Cattle and citrus promotion is resulting in more large, intensively managed farms, and increasing numbers of small-scale landholdings are converting from long-fallow systems to shorter fallows or permanent forms of mechanized agriculture (Hartshorn *et al.*, 1984; Tzul, pers. comm., 1992).

Other forms of agricultural diversification that have seen moderate success are the growing of rice and peanuts, and the production of honey (Tzul, pers. comm., 1992). Although such production is aimed at food self-sufficiency, much of the output from recent agricultural developments is exported (Humphreys, pers. comm., 1993).

Tourism is one sector that has been building consistently to Belize's advantage. Long an undiscovered haven of SCUBA-divers (Hain, 1988), Belize's reef now competes with the country's Mayan ruins and rainforest preserves to draw primarily North American tourists. For Americans, Belize is an inexpensive, ruggedly exotic, English-speaking location ideal for a 2 to 3 week vacation (Allendar, 1993). In 1991, 200,000 tourists passed through the country (BIS, 1992). Tourism has encouraged hotel, restaurant, and resort development, as well as numerous tourism-related employment opportunities.

The central theme in Belize's tourism promotion is 'ecotourism', an approach that emphasizes the country's natural history and heritage (Hyde, 1993). Among the most well-known of Belize's "environmental" attractions are the Hol Chan Marine Reserve, the Belize Zoo, the Howler Monkey Community Reserve, and the Cockscomb Basin Jaguar Preserve (Figure 4). Despite Belize's initial enthusiasm with ecotourism (Simons, 1988), the limitations of the "low-impact" aspect of this approach are being increasingly recognized (Higinio and Munt, 1993).

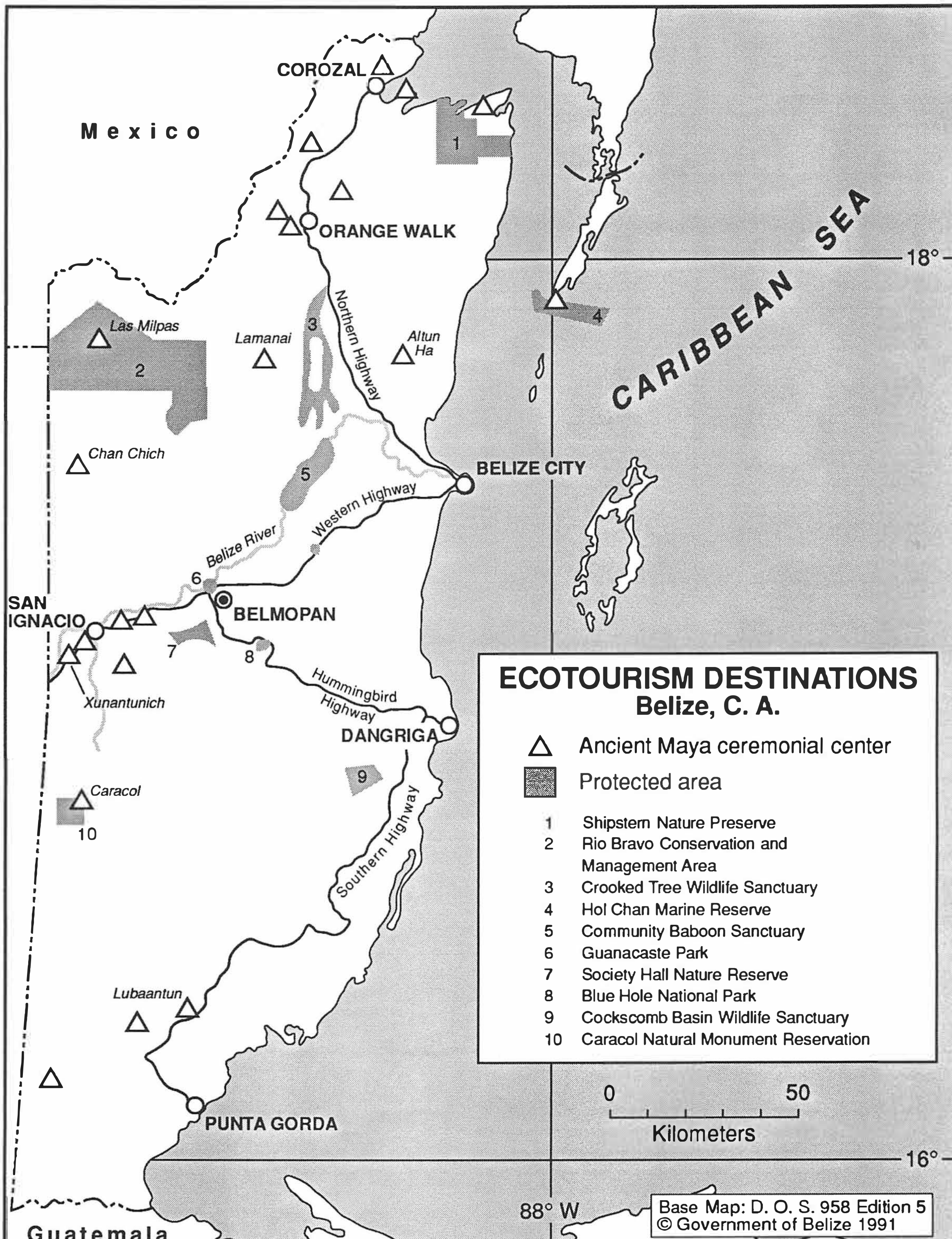

Figure 4 Ecotourism destinations in Belize, Central America.

Prehistory of Belize: 9000 BC - 1600 AD

The abundance of stone ruins in Belize testifies to the country's rich prehistory. The territory that is now Belize was once a part of the lowland region of the Mayan empire that also included the Yucatan and other parts of southeast Mexico as well as the Atlantic sides of Guatemala and Honduras. In this region as elsewhere in the Mayan empire, civilization in the Classic Period (250 AD to 900 AD) was characterized by sophisticated writing and calendar systems and the building of huge ceremonial centers (Healy *et al.*, 1983). Far from peripheral to Mayan greatness, Mayan centers in Belize served as production and trade centers vital to the spread of products from the coast inland (Hammond, 1972; McKillop, 1993).

Evidence of human occupance in Belize dates from the hunter-gatherer societies of 9000 BC, and there is evidence of fishing-oriented coastal settlements from 7500 BC. Cuello, a site in northern Belize, bears evidence of continuous occupation and trade in that area from 2500 BC onward (Hartshorn *et al.*, 1984). During the Classic, the number of Maya in Belize is conservatively estimated at 1 million (Hartshorn *et al.*, 1984), although densities of 180 people/km^2 have been suggested for parts of western Belize (Jacob, 1993), and Gomez-Pompa and Kaus (1989) cite Turner's (1976) estimate of 400-500 people/km^2 for rural areas of the Maya lowlands. The topic continues to be debated (Culbert and Rice, 1990), but it is agreed that the ancient Maya population of Belize was at least 5 times greater than the country's current population.

The florescence of Maya civilization in the Classic is most apparent in Belize in the ceremonial centers built at that time (see Figure 4). Altun Ha and Xunantunich were foci of trade networks that moved goods to and from the cities of the Guatemalan Peten; Caracol in the west was closely tied to the greatest of these cities, Tikal. The late Classic site of Lubaantun in the south had a sphere of influence encompassing some 1600 km^2 (Hammond, 1977).

Around 900 AD most ceremonial sites in Belize were abandoned (Harrison, 1978). Known as the Maya Collapse, this unexplained desertion of major population centers throughout the Maya region coincided with the end of an intense deforestation period (Jacobs, 1993). Palynological, stratigraphic, and archaeologic evidence all suggest that following the collapse, much of Mayan lands reverted to forest as the population fragmented into small chiefdoms clustered along lakeshores and rivers (Graham *et al.*, 1989).

Post Classic population levels are difficult to estimate because the period is characterized by little permanent architecture (Hartshorn *et al.*, 1984), but it is clear that Belize was not deserted when the first Spanish arrived in the north in the 1530s. Graham *et al.* (1989) found evidence of significant initial integration of Mayas at the colonial outposts of Lamanai and Negroman, and speculate that contact probably initiated a population decline after the Mayas were exposed to Old World illnesses. There is evidence of Mayan resistance to Spanish rule in 1638, by which time Belize's Mayan population was small and scattered.

Ancient Maya in the Natural Environment

Given their long occupance of Belize, their architectural and engineering sophistication, and their high population densities, the Maya must have had a profound impact on their environment (Whitmore and Turner, 1992).

Palynological and archaeological reconstruction of prehistoric environments in the Maya lowlands show Maya impact was typified by regional, episodic forest conversion events. Palynological evidence from Belize, for example, shows dynamic vegetation change as early as 3600 BP, when an increase in charcoal and disturbance-associated pollen suggest an intense clearing period (Jacob, 1993). Elsewhere, wetland margins were being manipulated as early as 2000 BP. Whitmore *et al.* (1990) estimated that Mayas had modified 75% of their environment by AD 800, when "large stretches" of the Peten region were "shaved clean by Maya...agriculture" (National Geographic Society, 1992). Some have suggested that the over-taxing of the environment may have been indirectly responsible for the Maya's cultural collapse (e.g. Ochoa, 1980; O'Hara *et al.*, 1993).

The deforestation of the Maya region throughout the Classic was reversed after the Maya collapse, such that "forest recovery was nearly complete when the Spanish arrived" (Whitmore *et al.*, 1992:414). After Spanish contact, the depopulation of Belize allowed the most complete hiatus in the forests' 600-year release from significant human disturbance. The forests of Belize around 1700 AD (just prior to first European settlement) were thus the least disturbed that they had been in several thousand years (Brokaw and Mallory, 1990).

The idea of ancient Mayan conversion of most of Belize's lowland forests challenges the popular notion of the ecologically savvy Maya who lived within the constraints of the tropical forest ecosystem (e.g. Demarest, 1993). Indeed, recent sediment studies from the Valley of Mexico point to an intensive agricultural prehistory that was probably more environmentally destructive than subsequent

Spanish agriculture (O'Hara *et al.*, 1993). As Whitmore and Turner (1992) pointed out, Mayan agriculture in the lowlands was geared towards meeting the Maya's short-term needs first, and environmental considerations later:

> ...both the pre- and post-contact landscapes of cultivation were constructed for the purpose of extracting from nature, and as the pressures for this extraction varied, so did the kind and scale of local landscape transformation. Where and when these pressures were high in Mesoamerica, extensive alterations of environments took place (Whitmore and Turner, 1992:419).

Modern History of Belize

The history of Belize since 1640 is closely tied to its forests. The first settlers in the country were British buccaneers who cut logwood (*Haematoxylon camechianum*) when not raiding Spanish galleons. The logwood was exported to Britain for processing into a dye, and was the main product of the colony until the introduction of synthetic dyes to Europe in the 1770s (Horwich and Lyon, 1990). With the collapse of the logwood industry, the English (then numbering some 800) and their African slaves (some 2600) began exploring Belize's interior for an increasingly lucrative commodity, mahogany.

Mahogany cutting was the economic mainstay of the colony throughout the 19th century. After abolition in the 1830s, freed slaves dispersed from the settlement center at Belize City into the interior and continued mahogany extraction. When the mahogany trade declined in the 1930s, another forest product, *chicle* (sap from *Manilkara zapota*), used for chewing gum, became the extractive focus of the country's economy (Hartshorn *et al.*, 1984).

During Belize's early days, the cultivation of crops for food was prohibited by the Crown under the Anglo-Spanish Treaty of 1786. This prohibition was officially upheld until the 1830s (Waddell, 1961), but Morris (1883) mentions its effective continuance in the strict trespass laws of mahogany proprietors. The ostensible purpose of the prohibition was to assuage Spanish fears of British settlement but it also served British purposes by preventing the diversion of a very scarce labor force from forestry and ensuring the purchase of British-supplied foods. The eventual result of this policy became almost complete reliance on imported foods, with apparently little or no clandestine cultivation. Today, Belize is unusual among former British colonies in the Caribbean basin for its lack of dooryard gardens or provision grounds (Masson, pers. comm., 1992).

Belize's forest history has resulted in a strong cultural familiarity among Belizeans with the forest and its products. Today, most Belizeans, rural and urban, recognize a wide variety of forest products for use as medicine, food, or in construction, to the point of overemphasizing the importance of these forest products in rural subsistence (see Chapter 4).

Belize's Forests Today

Belize's forests support a diverse flora of some 4,000 flowering plant species, including 700 trees and 250 orchids (Horwich and Lyon, 1990). Belize currently has the largest proportion of forested land area of any Central American or Caribbean nation (Nations and Kromer, 1983). The extent of remaining forest is a result of the country's low population density: Belize's forests remain intact because the country has lacked the population pressure to clear them, either for small subsistence plots or for large scale agribusiness.

Despite the extent of forest in Belize, the country's forests are as susceptible as any in Central America to a variety of pressures. The colonization of forest areas by immigrants is commonly mistaken as the primary agent of the country's deforestation (Nations and Kromer, 1983; Simons, 1989). As Hartshorn *et al.* (1984) pointed out, this is probably a construct of the high visibility of immigrant forest clearance, which occurs along highways. Though there is no question that immigrants have played a role in forest conversion, it is in fact agriculture, particularly citrus and cattle farming, that is probably contributing most to forest loss in Belize (Belisle, pers. comm., 1992; Thomas, 1992).

Estimates of the rate of deforestation in Belize, however, vary widely depending on the interpretation of "forest" (Nations and Kromer, 1983; Lugo *et al.*, 1987). The most pessimistic figures list Belize's land area as 45% forested (of a potential forest cover of 93%), with the annual deforestation rate at 90km^2 (NYBG, 1989). The head of Belize's Forest Conservation department, however, is not aware of any definitive figures of deforestation rates (Belisle, pers. comm., 1992), despite the government's assertion that "almost 60% of the Belizean land mass remains under forest" (BIS, 1992).

Chapter 2

THE COHUNE PALM

The cohune[1] is frequently mentioned in the botanical literature on the 'Maya region' (Stevenson, 1928; Bartlett, 1936; Standley and Record, 1936; Lundell, 1940), and is given much attention in Wright *et al.*'s (1959) exhaustive Land in British Honduras. But the species has been the exclusive subject of only four papers, concerning its taxonomy (Standley, 1932), its range and use in Belize (Stevenson, 1932), the potential for an industry based on its fruit (Mars, 1971), and its soil-forming properties (Furley, 1975). Furley (1975:35) pointed out how "relatively little is known or has been published about [the cohune's] ecology", and so to here establish a competent ecology of the species it is necessary to borrow from the literature on related species (e.g. Voeks and daVinha, 1988; Kahn and deGranville, 1992), particularly the comprehensive studies on the closely related *babassu* palm complex (May *et al.*, 1985; Anderson *et al.*, 1991).

TAXONOMY AND ECOLOGY OF THE COHUNE PALM

Orbignya cohune (Mart.) Dahlgren

The cohune belongs to one of several genera within the Attaleae sub-group of the Palmae (Corner, 1966). Members of

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[1] "Cohune" is a corruption of a slang Spanish word for the palm's fruits; the proper Spanish name is *corozo*.

the *Orbignya* have smooth stems[2] and upright leaves (Glassman, 1977), and are strictly neotropical, ranging from southern Brazil to Mexico. Estimates of the number of *Orbignya* species vary from 18 to 30 of which Glassman (1977) confirmed 18. Species of the *Orbignya* are typically tall forest palms of the upper canopy, although most are highly tolerant of open conditions (Uhl and Dransfield, 1987). The *Orbignya* are known for their economic importance (Corner, 1966), exemplified by the reliance of an estimated 2 million people in Brazil upon the production of oil from the fruits of *O. phalerata*, or *babassu* (Balick, 1984a).

The cohune is the most northern member of the *Orbignya* (Brücher, 1989) and its only member in Belize, although the country's flora includes 17 other palm species (Hartshorn *et al.*, 1984). The cohune is one of the few Belizean palms of the upper forest canopy, and may grow to 30 m or more. Leaves up to 18 m have been recorded (Morris, 1883), with each pinnate leaf composed of several hundred leaflets each up to 1 m long. An adult cohune may possess 10 to 20 living leaves, which grow vertically and taper at the tip, giving the palm's crown a distinctive 'featherduster' appearance (Figure 5). When a leaf falls off the stem, only a very faint leaf scar remains, precluding the use of leaf scars to determine the palm's age (Corner, 1966; Tomlinson, 1979; Uhl and Dransfield, 1987).

Details of the life stages of the cohune are scarce, despite the importance of such information to any industry based on the species (Nicholait, pers. comm., 1992), of which there have been several. Mars (1971) stated that the

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[2] Since cohunes, like all palms, are not dicotyledonous trees, they lack the bark-ringed bundle of tissue referred to as a trunk. They are supported by stems, no matter how large the individual.

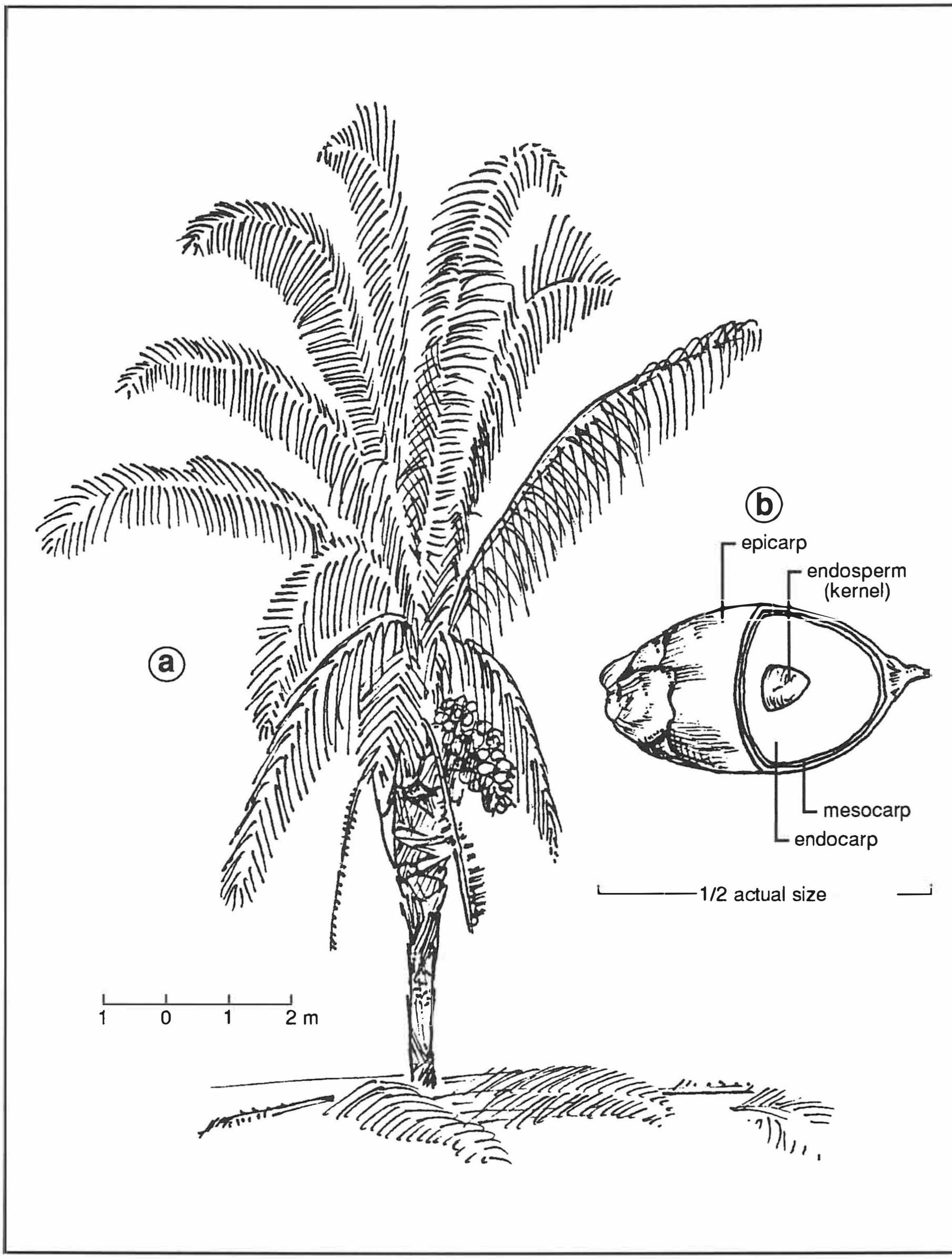

Figure 5 The cohune palm: a) mature adult; b) cross-section of fruit.

palm is expected to reach "full maturity" (i.e., be fruit producing) at 15 years in open sites, an estimate supported by a tended cohune in a garden (Benedict, pers. comm., 1992). The palm probably matures much later in forested settings, where the dense shade results in extremely slow growth, especially at the seedling stage (Anderson *et al*., 1991). Martinez (1936) stated that cohunes may grow well past 100 years, and Furley (1975) suggested 250 years as the species' maximum age.

The cohune is monoecious, and flowers in February (Duke, 1989). Pollination is effected by wasps and bees (Standley and Steyermark, 1958), and the resultant fruits develop in a 1.5 m bunch (panicle) and take from 4 to 5 months to mature. Goodban (1955, *in* Mars, 1971) recorded 790 palm fruits in a panicle, although the average is probably closer to 400; one palm may have 1 to 3 panicles per season.

The greenish fruit, often called a nut, is comprised of a thin outer shell (epicarp) surrounded by a woody endocarp which in turn encases from 1 to 5 kernels, or endosperm (Figure 5). Despite the fruit's hardness, it is common for some to be invaded by Bruchid beetles that bore into, and kill, the endosperm (Tomlinson, 1979; Duke, 1989). Nevertheless, a large proportion of fruit survives to germinate directly beneath the parent palm. In a random sample of 25 adult cohunes in mature forest in northwestern Belize, I found an average of 72 seedlings within a 2 m radius of the parents' base. Germination is probably aided by the removal of the epicarp by forest mammals such as the agouti (*Dasyprocta punctata*) and gibnut (*Agouti paca*), who eat the starchy mesocarp.

Although some animals manipulate the cohune fruits for food, their contribution to seed dispersal is poorly understood. In a limestone cave near Churchyard on the Sibun River, I found gnawed cohune fruits about 50 m from the entrance, surrounded by gibnut prints. This suggests that small animals may be at least short range dispersal agents, likely most active in forested environments where they are afforded the greatest cover. Indeed, rodents are important dispersers of the related *babassu* palm fruit in Brazil (Anderson *et al.*, 1991). Several authors mention the work that remains to be done to fully understand the dispersal of large-seeded palms (Uhl and Dransfield, 1987; Anderson *et al.*, 1991; Galetti *et al.*, 1992).

Cohune Ecology

Like many *Orbignya* species, the cohune is common in landscapes disturbed by humans (Uhl and Dransfield, 1987). Several morphologic and developmental traits contribute to this outcome, prominent among which is the hardiness of cohune seedlings. Although the seedlings' tolerance of deep shade is crucial for their survival in forests, they also survive in open, well-lit environments: "if shade is removed the plants seem to thrive equally well, and they are seen everywhere in their native regions in open places" (Standley and Steyermark, 1958:276). Few forest species can survive this transition from shade to full sun. Mahogany (*Swietenia macrophylla*), for example, dies in too open an environment (Kellman and Miyanishi, 1982). Cohunes not only survive the initial light exposure associated with forest clearance, but are able to persist for up to five years (Anderson *et al.*, 1991) in the dense shade of secondary growth, eventually outlasting fast-growing pioneer species (Hecht *et al.*, 1988).

Fire Resistance

In the rural Belizean landscape where fire is an important tool in forest clearing and weed control (Thomas, pers. comm., 1992), cohune's dominance is due in part to its resistance to fire[3]. Tomlinson (1979) and others point out that palms are common in fire "climaxes" because their stems do not possess a cambium layer and, "lacking this superficial, easily damaged, vital zone, can survive even if the stem is partly burned" (Uhl and Dransfield, 1987:51). But stem resistance only explains the survivorship of tall, stemmed cohunes; the other critical factor in cohune's success in burn regimes is its growth strategy. Like many of the Attaleae, the cohune exhibits "cryptogeal", or hidden growth (Cormer, 1966; May *et al*., 1985; Voeks and daVinha, 1988; Anderson *et al*., 1991). At germination, the growing tip (apical meristem) grows downwards, into the earth, where it then differentiates into stem and roots. Thus the point from which the stem originates is well below the ground surface, where in other plants this point is at or just below the surface. For example, in a seedling I unearthed near the Las Milpas ruins in northwestern Belize, the stem began 11.5 cm beneath the surface (Figure 6).

Because of this crypotogeal growth, seedlings and even cohunes whose leaves are several meters tall will survive fire and/or cutting. Only once the growing tip is above ground, usually after 7 to 10 years (May *et al*., 1985) can the palm be killed by the removal of its exposed parts. An

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[3] Voeks and davinha (1988) speculate on the origins of fire resistance in species native to subtropical lowland forests where natural fire is infrequent. Anderson *et al*. (1991) suggest that the adaptations of *Orbignya* spp. may have developed as a drought-protection strategy, although some suggest that their growth form is not adaptive but coincidental (Huston, pers. comm., 1993).

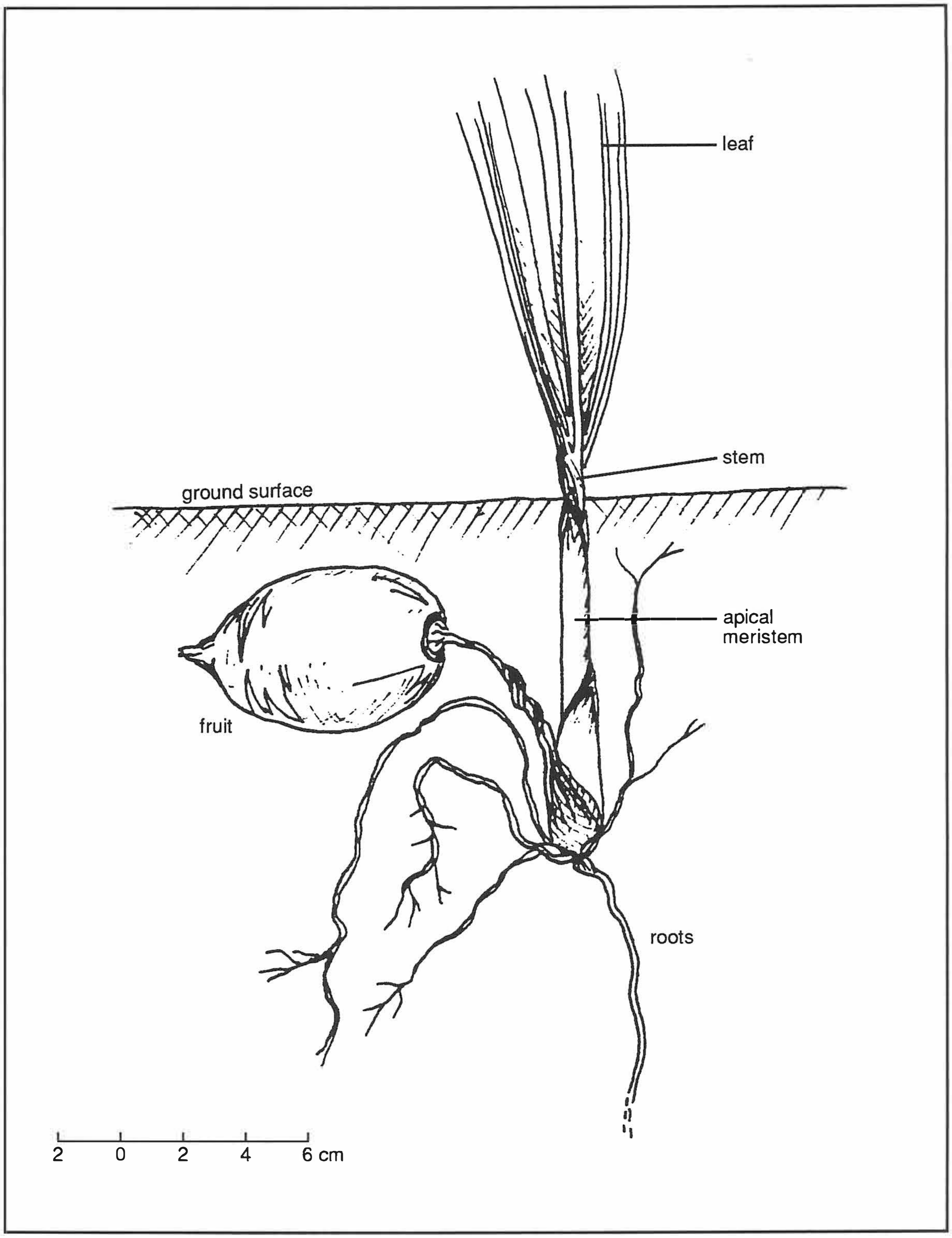

Figure 6 Cohune palm seedling exhibiting "cryptogeal" growth.

example from newly cleared forest at Churchyard on Belize's Sibun River illustrates the outcome of this trait. The site had been bulldozed and burned the previous month, but I found an average of 28 "new" seedlings and 22 juveniles between 0.3-0.6 m tall (with charred leaf tips), in three 100 m^2 plots. No other living tree species were present (Table 1). As Voeks and daVinha (1988) demonstrated with the closely related palm *Attalea funifera*, fire does not initiate germination, as folk wisdom maintains. On the contrary, most fruits in the sample plot were badly charred. Rather, bulldozing and fire failed to kill the below-ground apical meristem of the seedlings present in the original forest, and the surviving plants immediately sent up new leaves. In the absence of further disturbance, the seedlings would be at a competitive advantage over plants that lacked this "advanced regeneration" strategy. Furley (1975:36) stated: "cohune is more resistant to fire than most of its associated species, and may therefore have increased at the expense of other species." That fire resistance of palms facilitates their competitive displacement of other species and subsequent dominance in fire-controlled environments has been documented in Brazil for *Attalea funifera* (Voeks and davinha, 1988) and *Orbignya phalerata* (May *et al.*, 1985; Anderson *et al.*, 1991).

Cohunes and Soil

Although cohunes grow on a wide variety of soils, they are most commonly associated with, and grow in the greatest abundance, on deep alluvial loams high in organic matter (Stevenson, 1928; Bartlett, 1936; Wright *et al.*, 1959). Indeed, the connection between cohune-rich forest and fertile soils has long been recognized by agriculturalists (Bernsten and Herdt, 1977). For example, traditional farmers

Table 1 Regrowth of Cohune at Churchyard, Belize. Site bulldozed and burned one month previously. Sampled in 3 100 m^2 quadrats on a 40 m transect.

Plot	seedl. <0.3 m	juv. 0.3-0.6m	downed adults	Total living cohune stems
1	24	14	3	38
2	27	24	4	51
3	32	28	5	60

look for cohune when choosing a site for their *milpas*[4]: Wright *et al.* (1959) estimated that over 50% of all subsistence crops grown each year in Belize were planted on cohune-rich soils. Morris (1883:53) mentioned the "magnificent tracts of fine 'cohune ridge[5]', which are admirably adapted for the successful cultivation of most tropical plants", and other colonial travellers paid close attention to the species when assessing the country's land use potential (Swett, 1868; Bristowe and Wright, 1889). Among American citrus growers in Belize, cohune presence remains the key indicator of land worth buying (Jordan, pers. comm., 1992).

Wright *et al.* (1959) were the first to suggest that the cohune might actually *contribute to*, not merely flourish in, the rich, well-drained soil in which it is found. The authors pointed out that upon death, the central tissues of the cohune stem rot deep into the ground, leaving a cylindrical stump hole up to 58 cm deep[6], that "help[s] considerably to improve soil drainage" (Wright *et al.*, 1959:302). Furley (1975) added that the abundant litter from the surrounding palms gradually infills the hole, with the effect of reversing the soil profile by nutrient addition at depth. Furley was able to show that where cohunes are sufficiently dense, they might, over 1000 years

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[4] The term "milpa" technically refers only to a maize or corn field, but the term generally is more broadly interpreted to include any shifting cultivation plot (after Harrison, 1978).

[5] This term has no topographic implication: "ridge" is a Belizean term for a forest type.

[6] In a random sample of 11 natural cohune stump holes in primary forest in NW Belize, I found an average depth of 42 cm and an average diameter of 56 cm.

or more, serve to completely overturn the soil in a given area. He concluded with the statement: "It is a curious fact of the soil-plant relationship that the cohune appears to develop the soil in which it is best suited to grow" (Furley, 1975:35).

That stump holes are nutrient reservoirs is clearly demonstrated by orange trees that show markedly better growth when they are planted near or in a cohune stump hole (Thomas, pers. comm., 1992). But the soil ameliorating ability of a single palm is extremely local: it would be a mistake to think that cohune proliferation at a degraded site would quickly replenish lost soil nutrients, as is the case with legumes. The apparent success of cohunes in cleared sites results from morphological and developmental characteristics of the palm, and is exclusive of its soil-ameliorating ability, which is effective only over the long term.

COHUNES IN AGRICULTURAL SYSTEMS

The occurrence of cohune-rich forest on -- and its contribution to -- good agricultural soil combines with the palm's resistance to traditional clearing methods to make the cohune an integral part of shifting cultivation and pastoral farming systems in Belize, similar to the dominance of related palms in agricultural landscapes elsewhere (May *et al.*, 1985).

Cohunes in Milpa

The most traditional method of subsistence agriculture in Belize is the milpa, or shifting cultivation system. The traditional milpa process, and cohune's fate within it, was described to me by Mopan Maya farmer Jose Ico in his 2 ha milpa cut from cohune-rich secondary forest along Belize's Hummingbird Highway. His description is similar to those in Gann (1918) and Wright *et al.* (1959). First, he cut all underbrush, and trimmed the leaves of all tall stemmed cohunes to increase the fuel load. All large cohunes were then felled with an axe, for they threaten to shade developing corn plants or drop heavy leaves that crush crops. Medium-size, immature cohunes (up to 3 m tall) were trimmed of their leaves but left standing, because to cut them takes too much work. He then ignited the vegetation, the subsequent fire being "very hot": it killed most plants and seeds (including cohune fruits) but only singed stemmed cohunes. Three months after the fire, I tallied cohune densities in two 100 m^2 quadrats and found an average of 14 cohune stems/100 m^2 among the maize plants. No arboreal species other than cohune were present. The cohunes I found represented the uncut juveniles that had survived the burn as well as seedlings that had survived underground and subsequently resprouted; more may resurface with time.

Traditional milpa farming thus initially reduces the overall cohune densities from those found in the original forest, but may serve to preferentially select for the palm through time. Mr. Ico said that the cohunes will continue to come up for the next eight years before he abandons the plot, probably due to weed infestation as much as declining soil fertility (Lambert and Arnason, 1980). This process has been cited by some to explain increasing cohune concentration over time in areas where milpa and cohune forest coincide (Stevenson, 1932; Wright *et. al.*, 1959).

Although I could find no proof to support cohune proliferation under milpa conditions, anecdotal evidence suggests that cohunes do thrive -- and multiply at the expense of other species -- under human disturbance regimes, particularly those that involve fire. Standley and Record (1936), for example, noted that

> The quick return to the climax type is often due to the Maya practice of leaving the Palms, particularly Cohune (*Orbignya cohune*), standing in their plantations. Land abandoned after shifting cultivation is quickly occupied, and the prevalence of the Palms left standing soon gives the resultant forest the appearance of the original growth (Standley and Record, 1936:21).

Davidson (pers. comm., 1992) has also noticed this phenomenon over time in Honduras, and milpa farmers in Belize acknowledge the success of cohunes in their fields.

Studies of related palms also suggest that human disturbance facilitates both the invasion of palms into areas external to their natural habitat (Anderson *et al.*, 1991), and the concentration over time of *in situ* palm populations (Voeks and daVinha, 1988).

If human disturbance regimes can initiate the proliferation of cohunes in space, the question remains as to whether these higher density palm populations can persist once the human disturbance ceases. This question will be addressed in Chapter 3.

Cohune Pasture

The most conspicuous form in which cohune occurs in Belize is in "cohune pasture", a term appearing in Stevenson (1932:5). When clearing forest for pasture, farmers may leave the cohune standing. The result is not only aesthetically pleasing, but the cohunes provide shade for cattle, and in the open environment of a pasture the palms typically give more abundant fruits, which are easily collected (see Chapter 4).

To understand the genesis of cohune pasture, the farmer's rationale for and against maintaining the palm must be understood. I interviewed cattle farmers at 10 sites around Belize, and measured cohune presence in their pastures. Two types of pasture clearing emerged, in which the fate of cohune is very different.

Hand-cleared Pasture

This is pasture that is cleared by machete and axe, then burned. Land may be cleared directly from forest, or may have been in milpa. Most vegetation is cut and burned and the trash then piled into rows and reburned so that grassy species can colonize the site. The surface of a pasture cleared in this way is characteristically bumpy.

Since it is hand cleared, the farmer may opt to maintain in his pasture certain trees from the original forest: since cohune palms are both fire resistent and good shade trees they are typically kept. Very tall cohunes are not spared, on the premise that cattle tend to shelter around their base in storms and so may be killed if a tall, top-heavy cohune were to topple. Stemless cohunes (typically 3 to 6 m) are therefore favored. Although such reasoning prevails during the initial clearing phase, evidence from older pastures suggests that once these originally small palms grow large, they are maintained. The result is that most adult cohunes in pastures date from one clearing event and so are typically all of uniform size, which gives them the appearance of having been planted.

In a hand-cleared pasture, the resprouting of cohune seedlings from those present in the original forest is expected. Farmers attest to the fact that cohune seedlings will continually regrow, even once a pasture is planted in grass, and may be eaten by cattle in times of drought. Farmers rarely refer to the palms as weeds, however, for there are much more aggressive, unpalatable plants that persist in pasture, such as *Acacia* species.

Within pastures, cohune populations are thus typified by adults grown tall in the full sunlight of the cleared site (tall palms often host strangler figs), and several hundred seedlings, with few cohunes in between. Cattle trampling usually prevents extant seedlings from developing to any height in active pasture. Once the land is abandoned, however, cohunes may grow quickly, for there is both an *in situ* seed source and a seedling bank.

Mechanically Cleared Pasture

The second method of pasture clearing seems much less favorable to cohune persistence. A plot of forest is cleared in the following way: low bush is cut from the forest by hand, and a bulldozer used to fell the trees. The downed vegetation is then pushed into rows and burned, and attempts are made to avoid scraping the topsoil. The surface of pastures cleared in this way is flat, and may be intentionally levelled. By this method, it becomes awkward to leave desirable trees standing, and typically all trees are felled, including cohunes. Agricultural extension officers have no policy for or against the maintenance of any tree, including cohune, in pastures (Tzul, pers. comm., 1992).

Pasture creation by this method is usually associated with the large-scale clearing that is ongoing in much of Belize's cohune-rich forests (Thomas, 1992). But mechanical clearing for pasture is also becoming increasingly common in smaller farms, as small scale farmers seek to upgrade their extant pasture (Arnason *et al.*, 1982). In the Cayo district, Mennonite labor and equipment is typically hired to do the bulldozing, and the resultant pasture is usually devoid of trees, following Mennonite practice. It appears that bulldozing, and probably the application of herbicides, deprive cohune its usual seedling regeneration strategy as well as removing seed-contributing adults. Given the Belizean government's current promotion of "improved" cattle ranching (GOB, 1992), it appears that the cohune-less pasture will become increasingly frequent.

BIOGEOGRAPHY OF THE COHUNE PALM

Distribution of the Cohune Palm in Central America

In 1957, Johannessen stated that "the definitive study on the distribution of the Corozo [cohune] palm remains to be made" (Johannessen, 1957:31). This is still the case. The following section assembles the numerous records of cohune occurrence to outline the most precise range possible, given the absence of extensive field data (Figure 7).

The cohune palm is often referred to as one of the most abundant and distinctive trees in Central America (Standley, 1932; Furley, 1975; Horwich and Lyon, 1990). In fact, it has a limited international distribution, confined to the lowlands (below 600 m) on the Atlantic side of the isthmus in Mexico, Belize, Guatemala, and Honduras. Its range does, however, span two phytogeographic and physiographic provinces. In northern Belize, it is included in the Yucatan flora (Bartlett, 1936), and to the south is included

Figure 7 Distribution of cohune palm (*Orbignya cohune*) in Central America.

in D'Arcy's (1977:98) "tropical lowland forest that formerly stretched from southern Belize almost without interruption into South America." According to Duke (1989), the species can tolerate annual precipitation ranging from 64 to 403 cm, and annual temperatures between 21.3° and 26.5° C. The cohune's potential range thus includes most of Central America; its actual range is more restricted. The palm occurs as far north as Los Limones (19°N) in the Mexican state of Quintana Roo (personal observation); Johannessen (1957) cited its western extent on the Yucatan peninsula as Villahermosa in Tabasco state, though it is already infrequent in the state of Campeche and the Guatemalan department of Peten (Bartlett, 1936). Miranda (1952) does not include the cohune in his description of the palm groves of Chiapas, suggesting that state is the furthest western limit of the cohune's range. The palm's scattered distribution at the limits of its range contrast with the abundance in which it is found at the core of its range (see Figure 7).

Though the presence of the cohune within the geographic range outlined in Figure 7 is confirmed in the literature and by personal observation, I encountered frequent mention of its occurrence far outside that range. A thorough examination of the sources for these claims revealed that such citations more likely reflect taxonomic confusion and the repeated use of out-dated sources than the existence of rogue cohune populations. The Appendix reviews these erroneous statements of the cohune's range, with the intention of precluding their repetition.

Distribution of the Cohune Palm in Belize

Within Belize, moisture availability appears the primary constraint on the cohune's occurrence, as Wright *et al.* (1959) made clear:

> Cohune...cannot tolerate ground-water with a low oxygen concentration for long, nor does it like an overabundance of water, however well aerated. In the dry northern environment, cohune ridges occur in concave areas over gravel where the soils are deep and moist but at the same time well-drained. In the wet southern districts, the cohune grows best on low ridges underlain by sandstone or limestone (Wright *et al.*, 1959:305).

There are significant areas of Belize clearly hostile to cohune, including the swampy, pine-dominated coastal plains of the Stann Creek district and the hydric lowlands of the north. Higher sites with shallow soils are similarly unfavorable, but there is confusion in the literature regarding the palm's elevational limit. In the Cockscomb Basin area of central Belize's Maya Mountains, an area with few signs of prehistoric disturbance, little historic logging, and no settlement, Kamstra (1989) found the palm "virtually confined...to elevations below 200 m," an observation corroborated by Bellamy (1889): "the large Cohun palms were not seen after passing an elevation of 600 ft [approx 200 m]." But exploring the same basin, Oliphant and Stevenson (1929) only mention "the absence of the cohune leaf" at 1150 ft (approx. 350 m). If the wetter areas of southern Belize are considered, the palm's upper limit is pushed to 1800 ft (Stevenson, 1932), and finally to be "provisionally fixed at 2000 ft [approx. 600 m]" (Standley and Record, 1936). It is this latter estimate that has been most repeated in subsequent literature (Furley, 1975; Horwich and Lyon, 1990).

Below 600 m, the cohune is present in most forests where broadleaved tree species prevail (Brokaw and Mallory, 1990). Wright *et al.*'s (1959) vegetation map described the cohune's potential distribution in Belize, its cover totaling some 243,000 ha. This figure is the one of the few estimates of cohune cover since Morris suggested an "estimated extent of 1,280,000 acres of fine 'cohune ridge'" (Morris, 1883:17), although Standley and Record (1936:23) did estimate that 50% of the mainland vegetation consisted of "advanced forest...characterized by the prevalence of *Orbignya cohune*." Clearly the palm is an abundant and widespread component of Belize's native flora.

There is little doubt, however, that the extent of cohune-rich forest is less than its potential and certainly less than it has been historically. Although cohune pasture and milpa may locally encourage cohune density, I found consensus that on a national scale, the areal cover of cohune rich forest has shrunk significantly, especially in the past few decades, under intensified, large-scale agricultural expansion (Belisle, pers. comm., 1992; Thomas, 1992). The exact amount of loss, however, is extremely difficult to determine without aerial or satellite imagery (a landuse map of Belize based on satellite imagery is to be released shortly: Furley, pers. comm., 1993). For the time being, evidence for the shrinkage of cohune habitat is thus largely anecdotal. For example, the northern town of Corozal, named for a cohune grove, is now at least 6 km from the nearest cohune (personal observation), a result of the town's expansion and the extensiveness of surrounding sugar cultivation. In 1868, Swett found the land along the South Stann Creek to be "very rich, with the Cahoon palm the prevailing growth" (Swett, 1868:30). There is now little in that area but citrus. Mennonite farmers, who per capita probaby clear more acreage than any other Belizean group, have settled and cleared the once cohune-rich lands around Spanish Lookout.

Chapter 3

HUMAN ROLE IN THE GENESIS OF HIGH DENSITY COHUNE FOREST

An unusual characteristic of cohune distribution is the palm's high-density occurrence in parts of Belize's species-rich forest. It is typical for most tropical tree species, including cohune, to be scattered throughout the forest at low densities (Connell and Lowman, 1989), but the cohune also occurs in discrete monospecific groves (*corozales*) and at above average densities in lowland forests (cohune ridge).

Both 'corozal' and 'cohune ridge' are frequent Belizean toponyms, suggesting that the recognition of cohune dominated vegetation dates to early historic settlement. Indeed, colonial travellers such as Swett (1868) and Morris (1883) mentioned cohune's concentration in some forests. The cohune's dominance is also described in most of the early 20th century studies of the 'Maya region' (Gann, 1918; Standley, 1932; Stevenson, 1932; Bartlett, 1935; Standley and Record, 1936; Standley and Steyermark, 1958). Wright *et al*. (1959:301) considered cohune-dominated areas a distinctive vegetation and denoted some 124,612 ha of land in Belize (roughly 5% of the country's land area) as potential "Cohune Forest", where cohune either was or had the potential to be "dominant or prominent in the vegetation."

More recent studies of Belize's flora continue to recognize cohune dominance in some forests (Furley, 1975; IUCN, 1983; Hartshorn *et al*., 1984; Horwich and Lyon, 1990; Brokaw, pers. comm., 1992). Although there are few figures to define "cohune ridge," what data do exist suggest that cohune densities are comparable to those recorded for other monodominant forests found throughout the neotropics (Connell and Lowman, 1989; Hart *et al.*, 1989; Peters *et al.*, 1989a) (Table 2). No data exist for cohune's relative dominance at these sites, but personal observation suggests that adult tree species other than cohune are rare in high density cohune forests.

EXPLANATION OF HIGH DENSITY COHUNE FOREST: THE MAYA/MILPA HYPOTHESIS

The high density stands of cohune in Belize have traditionally been interpreted as relict vegetation formations marking ancient Mayan fields: indicators of past cohune-human interaction in an ancient palm landscape. This idea, what I call the Maya/milpa hypothesis of cohune stand genesis, is based on the observation that cohunes seem to thrive in modern milpa conditions, dominating sites as they are effectively selected for by successive clearing and fallow events (see Chapter 2). The hypothesis suggests that since modern milpas are probably analogous to ancient Mayan forms of agriculture, cohunes were also selected for in the ancient past. As Wright *et al.* (1959) put it:

> An inevitable result of shifting cultivation would be a tendency for cohune palm to increase in density until they may have become a serious obstacle to the ancient Mayan farmers (Wright *et al*, 1959:302).

The hypothesis predicts that upon abandonment of most agricultural land after the Maya collapse, the high cohune populations engendered under milpa conditions persisted to

Table 2 Recorded densities of the cohune palm (*Orbignya cohune*) in Belize.

Source	Location	Sample area (ha)	Plot size (ha)	No. of Cohune Stems						
				A	B	C	Total /plot	Total /100 m^2	Total adults/ha	Total stems/ha
Stevenson (1932)	T.O.P. Co.[1], Toledo	0.4	0.4	---	--	33	119	3.0	82.5	297.5
Goodban (1955) *in* Mars (1971)	" "	2.0	0.4	62	15	11	88	2.2	27.5	220.0
			"	36	36	27	101	2.5	67.5	252.5
			"	101	39	22	162	4.0	55.0	405.0
			"	53	27	11	91	2.3	27.5	227.5
			"	85	37	15	137	3.4	37.5	342.5
				AVERAGE				**2.9**	**43.0**	**290.0**
Mars (1971)	" "	2.8	0.4	--	50	21	71	1.8	52.5	175.0
			"	21	18	8	47	1.2	20.0	118.0
			"	5	2	11	18	0.5	27.5	45.0
			"	36	70	22	128	3.2	55.0	320.0
			"	87	48	17	152	3.8	42.5	380.0
			"	39	18	4	61	1.5	10.0	152.5
				AVERAGE				**2.1**	**33.2**	**213.2**
Furley (1975)	Roaring Creek, Belize R. Valley, Cayo	0.4	0.01	14	2	1	17	17.0	100.0	1700.0
			"	4	5	1	10	10.0	100.0	1000.0
			"	2	11	1	13	13.0	100.0	1300.0
			"	14	8	1	23	23.0	100.0	2300.0
				AVERAGE				**16.0**	**100.0**	**1600.0**

A: seedlings (undefined); B: juveniles (non-fruiting); C: mature adults (fruiting).
[1] Tropical Oil Products Co. Near modern Machacha Forest Station, Toledo District.

the present, as indicators of the locations of ancient Maya fields.

In modern milpas, cohunes are left standing because they are too difficult to cut, and it is these spared individuals, as well as persistent seedlings, that presumably allow cohune proliferation over time. Wright *et al.* (1959) argued that the ancient Maya, who had only stone tools, would surely have left the cohune standing also:

> To the ancient Maya, the cohune palm was well have been a source of embarrassment as well as a source of joy. As a source of oil for cooking and lighting...the palm would fulfil a useful role in their economy; but it is not a tree that is readily destroyed by fire nor can it be cut down easily by farmers armed only with stone tools...(Wright *et al.* 1959:301).

Furley (1975) also acknowledged that the palm's usefulness to the Maya might have been an incentive for the Maya to leave the palm in their fields, so that in fallow periods its fruits and leaves might be harvested.

From the literature, it appears that scholarly acceptance of the Maya/milpa hypothesis is widespread. Stevenson (1932:4) stated: "dense growth [of cohune] is explained by the fact that the aboriginal Maya Indians never destroyed the palms in the cultivation of these [areas]." Furley (1975:34) added: "if there has been a general effect here, it would be to accentuate the cohune concentration since Maya Indians, and more recently other cultivators, have tended to spare the tree." Similar reasoning prevails in Brokaw and Mallory (1990):

> Any native plant the Maya favored would have had a reproductive advantage in the centuries of regrowth, with major impact on the relative abundance of species in the current vegetation...the cohune palm was probably spared...accounting for its abundance in Río Bravo and throughout forested areas of Belize (Brokaw and Mallory, 1990:11).

Johannessen (1957) and Schnell (1987) made the same points in explaining high cohune densities in Belize's forests.

Evidence to support the Maya/milpa hypothesis is varied, and some of it more implied than explicit. For example, it is clear from the literature that cohune-dominated forest is perceived as unnatural, and therefore calls for human agency in its genesis (e.g. Schnell, 1987). Why unnatural? Because in most of Belize's forests, monodominance only occurs on edaphically marginal sites: pine stands on dry, shallow, nutrient-poor soils, or mangrove dominance in stressed, brackishly hydric sites. By contrast, cohune stands occur on deep fertile soils where a rich complement of other species could potentially grow.

The Maya/milpa theory garners additional support from recognition of the ancient Maya's probably profound impact on their environment (see Chapter 1). It seems impossible for the current vegetation not to bear *some* mark of its intensively disturbed prehistory, and the tendency is to directly connect certain presumed Mayan activities (such as milpa agriculture) with anomalous modern vegetation (cohune stands). This connection is apparently reinforced by more tangible evidence, such as the abundant remains of Maya settlements under cohune-rich forest (Thompson, 1930; Willey *et al.*, 1965; Johannessen, 1957). Modern farmers of cohune ridge continue to find Maya artifacts in their fields, including chert mounds and clay pots (Jordan, pers. comm., 1992). In fact, the association of cohune with ancient artifacts is sufficiently common that high cohune densities are used to identify archaeological sites (Mallan, 1991). This relationship was noted by most early writers, including Gann (1918):

> it is upon these 'cuhun ridges' that most of the mounds and other relics of the ancient inhabitants are found and that nearly all the villages of the modern Indians are built (Gann 1918:50).

Gann, like others after him, interpreted the spatial co-occurrence of cohune stands and Maya settlement as evidence of a Mayan role in the stands' genesis. The logic behind this is that if Maya settlements occur under cohune-rich forests, then so too did their fields. This logic is supported by Killion's (1992) data, which appears to show that Mayan tree gardens, if not all their agricultural, usually occurred *within* settlements.

The Maya/milpa explanation of cohune stand genesis is also supported indirectly by a large body of literature that similarly invokes ancient human activities to explain high density palm stands. For example, in 1944-45, Carl Sauer wrote:

> A number of palms [in Mexico] are good markers of former human habitation and cultivation. I am sure that these are either survivors of former settlement, as are lilac bushes in New England, or that they occupy old fields and thus form great groves that may hold themselves for many centuries" (*in* West, 1979:118).

Sauer later cited the "massive stands of *coquito* palms...as markers of once flourishing communities," and called them "archaeologic dominants...after four hundred years of abandonment of fields, certain trees (and palms) still identify the places of human habitation" (Sauer, 1958:192). Gómez-Pompa and Kaus (1989) argued similarly for an "anthropogenic origin" in the occurrence of palm stands in Mexico. Kahn and deGranville (1992:111) discussed how certain useful palms in Amazonia are "said to indicate previous human settlement." In fact, high densities of many non-palm tree species within the Maya region have been explained as persistent "imprints" of ancient human activity (e.g. Budowski, 1970; Barrera *et al.*, 1977; Gómez-Pompa, 1987).

TESTING THE HYPOTHESIS: LAND USE HISTORY OF CONTEMPORARY HIGH DENSITY COHUNE FORESTS

Despite the large body of support and the widespread adoption of this explanation for the genesis of high-density cohune forest, the Maya/milpa hypothesis has never been tested in Belize nor in any other part of the cohune's range. Like other aspects of cohune ecology, speculation has prevailed over research. The rest of this chapter describes my attempts to determine whether today's high-density cohune stands are indeed the result of ancient Maya agriculture.

To identify testable aspects of the hypothesis, it is helpful to review the assumptions on which it is based. They are that: a) cohunes do indeed proliferate under successive generations of milpa; b) once formed in milpa conditions, high-density cohune populations endured, *in situ*, such that they are coincident with areas that were intensively farmed under milpa; and c) that modern milpas -- and cohunes' fate in them -- are indeed analogous to ancient Mayan farming techniques.

I decided that the first two assumptions lent themselves to testing, and I isolated two questions in particular to address in my field investigations:

1. Do successive years of milpa agriculture at a site result in increased cohune density over time?
2. Do sites now covered in high density cohune forests show a history of successive years in milpa agriculture?

I approached the first question partly by informal observation, as already described in Chapter 2. These observations, bolstered by those of cohune in other parts of Central America (Davidson, pers. comm., 1992) and studies of related neotropical palms (Voeks and daVinha, 1988; Anderson *et al.*, 1991), strongly suggested that successive generations of milpa agriculture can indeed increase cohune densities over time. I had originally intended to test this phenomenon by substituting space for time and examining cohune densities in milpas of different ages (over homogeneous substrate) to look for density increases through time. This strategy proved unworkable, however, due to the difficulty of finding suitable time sequences of milpas, and to changes in cultivation practices that make contemporary milpas poor analogues for prehistoric milpas. Specifically, my intended empirical testing of increasing cohune densities in milpas was precluded by the following unanticipated factors:

a) an increasing trend away from shifting cultivation and towards intensification of milpa sites in Belize, such that most traditionally farmed milpas were in extremely remote areas (Tzul, pers. comm., 1992);

b) the tendency for milpa farming -- when it does occur in accessible areas -- to be carried out by recently settled refugees and immigrants unfamiliar with the vegetation history of an area;

c) the widespread use of herbicides and 'disc-ing' in weed control, even among subsistence farmers (Tzul, pers. comm., 1992), which immediately precludes making inferences about cohunes in milpas based on traditional styles of cultivation; and

d) the fact that "traditional" farmers in Belize do not necessarily follow shifting cultivation *per se*. More often, land cleared and farmed as milpa is not abandoned to a fallow regenerative stage but is put under cattle when crop yields decline (pasture grasses may even be planted under growing corn stalks).

In contrast to my inability to test question 1, I was able to address the second question in a detailed field investigation, as outlined in the next section. If, as the Maya/milpa hypothesis proposes, today's cohune stands have persisted since their genesis in ancient Mayan milpas, I predicted that the contemporary stands would show an agricultural land use history that was consistent with the theory: in sites that I determined to be historically undisturbed, I would find a prehistory in successive generations in Mayan milpa, and historically disturbed forest would show milpa agriculture in the past 200 years. I also anticipated that high-density stands would have the population structures typical of old, self-replicating stands. That is, stable populations have all life stages represented, and will show an exponential decrease in number towards the older/larger cohorts, indicating self-replication in light gaps from a persistent seedling bank (Anderson *et al.*, 1991; Pinard, 1993).

Methods

Site Selection

To test high density cohune stands for a history in milpa, I chose six sites in Belize in which cohune densities appeared higher than average (Figure 8); such visual conspicuousness is considered an appropriate initial measure of species density (Connell and Lowman, 1989; Anderson *et al.*, 1991). No attempt was made to regularize the type of areas sampled; the only criteria was that cohune density appear higher than average. This visually-based approach was based on a desire to isolate a common land use history among similarly monodominant stands irrespective of the environment in which they were found.

Measurement of Cohune Density and Population Structure

At each site, I measured the density of cohune stems in 10 x 10 m quadrats along 40 m transects through what I considered to be the densest part of the stand. The number of quadrats per site varied from 2 to 7, with fewer where the vegetation was literally impenetrable. I considered sites "high density" if the number of cohune stems exceeded 23/100 m^2, which is the highest density recorded in the literature (Furley, 1975). Furley's figure of 23 cohune stems/100 m^2 is considered conservative, as the site measured in his study was not chosen for its high cohune densities and was not considered the densest available cohune forest in the area (Furley, pers. comm., 1993).

To gauge the age of each stand I described their population (size) structure, assigning every cohune stem to one of 6 height/maturity classes within four general groups:

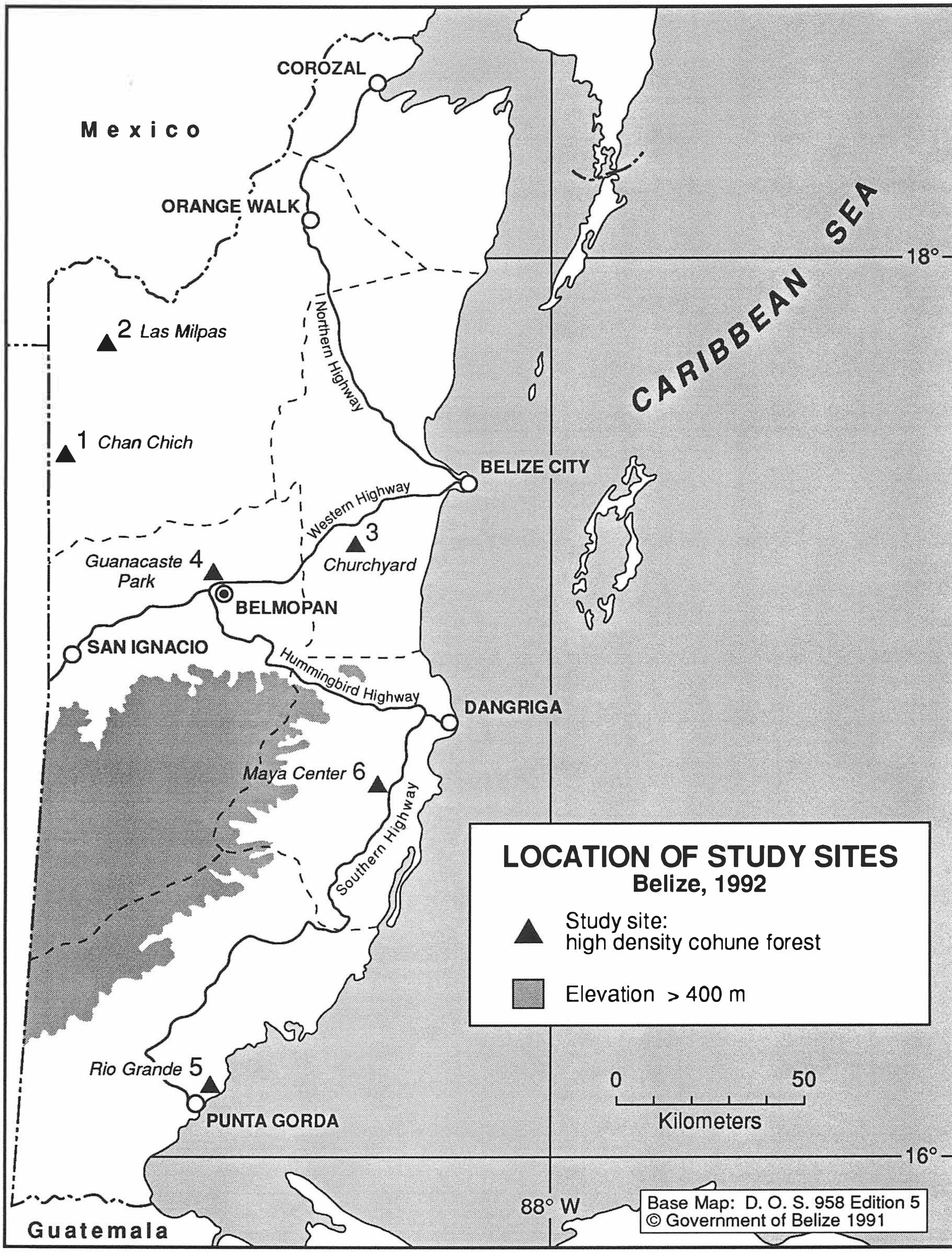

Figure 8 Location of six study sites (high density cohune forest) in Belize.

I Seedlings: 0-1 m
II Stemless juveniles: 1-3 m, 3-6 m, >6 m
III Stemmed juveniles: >6 m with visible stem
IV Mature adults: >6 m with stem and visible fruiting structures

Height of an individual cohune was determined from the base of the stem to the tip of the highest leaf (heights were estimated most crudely among adult palms: I did not distinguish between heights in excess of 6 m).

Reconstruction of Land Use History

I used a variety of sources to reconstruct the land use histories of each site; I was particularly interested in chronicling any disturbance events that would have impacted the vegetation of a site. My sources included observation of disturbance (charred stems indicate burning during the lifetime of an adult, for example), interviews with locals and government officials, archival materials (old maps, photographs, travellers' accounts), and archaeological evidence. Pinpointing specific disturbance events in a given area is not difficult in a country the size of Belize, especially since most of my sites were near (i.e., within 5 km of) some human settlement.

I defined disturbance as any human-induced perturbation to the natural system resulting in mortality of individual plants, cohune or others (after Huston, 1993). In this case, only human-induced disturbance is considered: natural tree falls, hurricane damage, lightning fires, etc., were assumed to have occurred at a relatively constant rate at all sites. I found some disturbances to be common near all of the sites, though my actual study plots were probably little affected. These disturbances include mahogany and logwood removal and *chicle* tapping in the historic period, and the ongoing cultivation of marijuana (Burley, 1992; Masson, pers. comm., 1992).

Site Descriptions and Results of Analysis

At each site investigated I found cohune stem densities well in excess of Furley's 23/100 m^2, so all stands qualified as *bona fide* "high density" stands. Density data from each site are summarized in Table 3. The stem densities of each site verify that visual conspicuousness is a good indicator of overall stem density: sites that look dense are.

The land use histories that I was able to reconstruct for each of the six sites are detailed below and summarized in Table 4; the population size graphs of each site are shown in Figure 9.

Chan Chich, Orange Walk District

I recorded the highest cohune densities in the northwestern flatlands within the ruined complex of the unrestored Mayan ceremonial center Chan Chich. 7 100 m^2 quadrats were sampled along two transects roughly 300 m from the main plaza. Average total stem densities came to 21,600/ha, or almost 10 times those reported by Furley (1975).

The Chan Chich site is as undisturbed as any forest in Belize. It is located within the Gallon Jug Agro-Industry lands and has been privately owned since the mid 1800s. Though a small logging settlement existed 5 km to the east at Gallon Jug earlier this century, there has been no historic agriculture nor permanent settlement anywhere in

Table 3 Cohune palm (*Orbignya cohune*) stem densities at six study sites in Belize, 1992.

Site	Location	No.of quadrats (100 m^2)	Cohune densities: average no. of stems/quadrat						Total stems /100 m^2	Total stems /ha
			A	B			C	D		
			<1 m	1-3 m	3-6 m	>6 m	>6 m	>6 m		
1	Chan Chich	6	197.0	12.6	3.2	1.6	0.6	1.3	**216.4**	**21,640**
2	Las Milpas	5	70.6	3.2	4.6	1.4	0.4	1.0	**81.6**	**8,160**
3	Churchyard	2	55.0	0.0	3.0	0.0	2.5	1.0	**61.5**	**6,150**
4	Guanacaste	2	105.0	---	4.0	--	7.0	1.0	**117.0**	**11,700**
5	Rio Grande	3	21.3	2.6	3.3	2.6	3.0	1.3	**34.1**	**3,410**
6	Maya Center	2	25	3.0	1.0	2.0	0.0	0.0	**31.0**	**3,100**

Size Classes:
A: Seedlings; B: Stemless juveniles; C: stemmed juveniles; D: mature adults

Table 4 Land use history at six study sites in Belize, Central America.

Site	Location	Prehistoric Disturbance (to 900 AD)	Historic Disturbance[1] (1700 AD to present)	Estimated No. of Years of Forest Regrowth
1	Chan Chich	Maya ceremonial center	none	approx. 1000
2	Las Milpas	Maya ceremonial center	none	approx. 1000
3	Churchyard	agriculture	agriculture (pasture)	approx. 150
4	Guanacaste	agriculture, settlement	mahogany works, banana plantation	approx. 60
5	Rio Grande	probably cleared	none	approx. 1000
6	Maya Center	agriculture, settlement	some local perturbation	probably 1000

[1] "Disturbance" refers to any human-induced perturbation that results in mortality of plants, after Huston (1993; in press).

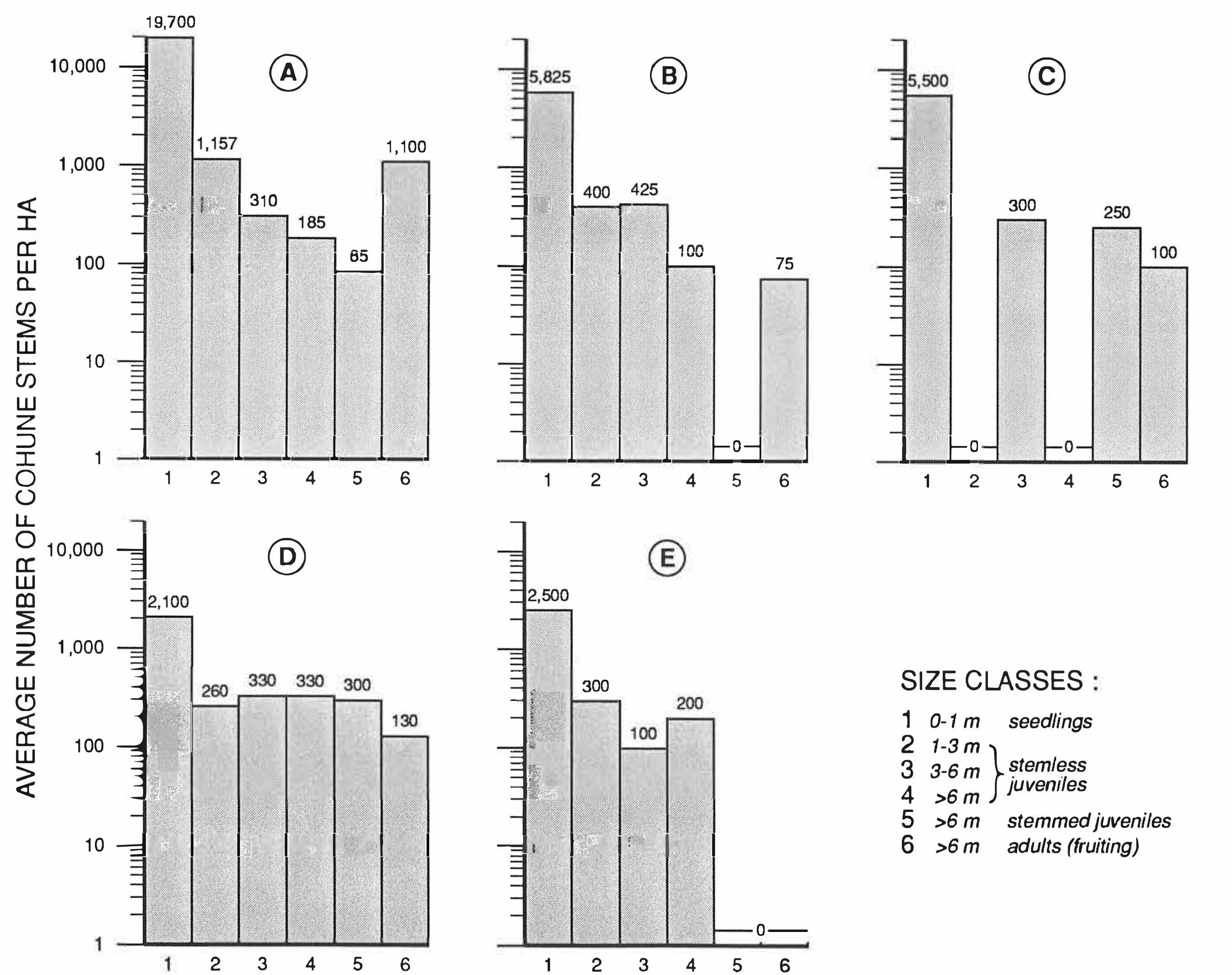

Figure 9 Size distribution graphs of five high-density cohune forests in Belize.

the region. Mahogany was systematically logged from the area until the early 1960s (Masson, pers. comm., 1992), and since then only poachers, *chicleros*, and looters have penetrated the area. The Chan Chich ruin complex itself dates from 250-800 AD and has likely not been used as a ceremonial center or focus of settlement for some 1000 years. The site is currently part of a controversial private ecotourism operation in which tourist accommodations have been built in the main plaza of the ancient city. The site and its development is considered "low impact" and disturbance to surrounding vegetation is minimal. The study plots were located within an area bisected by nature trails, and were approximately 200 m from the confluence of the Chan Chich and Little Chan Chich creeks with the Rio Bravo.

According to Wright *et al.*'s (1959) soil classification, the area is characterized by "a soil in which cohune palms have darkened the topsoil." Ecologists employed nearby consider the site to be "cohune-dominated" (Grant, pers. comm., 1992).

This site exhibits a classic life-stage distribution for a mature, stable forest (Figure 9a); it is comparable in shape and actual numbers to the primary, monodominant *babassu* forest described in Brazil by Anderson *et al.* (1991).

Las Milpas, Orange Walk District

The second-highest densities recorded were from a site within the ruins of another Mayan ceremonial center, Las Milpas. The site is currently being surveyed and excavated, the main plaza has been cleared of underbrush, marijuana has been cultivated in the past 20 years at several places around the site, and some milpas cut in the area (Masson, pers. comm., 1992; Burley, 1992). Nevertheless, I was able to select quadrats from areas that were historically undisturbed. Four quadrats were located on transects off the path leading into the site, and I accessed another high-density area (in an ancient reservoir) from a survey cut line.

The Las Milpas site lies within the 61,408 ha Rio Bravo Conservation and Management Area, held by the private conservation organization, the Programme for Belize. The area was part of a large parcel owned since the 1850s by the Belize Estate and Produce Company (Burley, 1992). Roughly 8.8% of the area is in cohune palm forest (Brokaw and Mallory, 1990). The ruins were first discovered in the 1920s and since then have been looted repeatedly. Ecologists and students regularly visit the ruins and surrounding forest but typically remain on survey lines and paths. It appears that the vegetation of this area has been developing over the past 900-1000 years relatively free of disturbance (Brokaw and Mallory, 1990), a history that is reflected in the stable life stage distribution of the cohune stands I measured (Figure 9b).

Churchyard, Cayo District

The plot I measured here averaged 60 stems/100 m^2 over two quadrats. The plot is located within the floodplain of the Sibun River, in a forest considered typical cohune ridge: a continuous strip of cohune-dominated vegetation paralleling the river. Residents of the area pointed to the presence of iron fences to show how this area was cleared as farmland sometime in the past 100 to 150 years.

The life-stage distribution of the site (Figure 9c) appears to reflect its disturbance history in the poor representation of the two middle cohorts, but the distinct seedling "bank" suggests that cohune is successfully (re)establishing itself here.

Guanacaste Park, Cayo District

I sampled 2 quadrats in a cohune-rich part of Guanacaste Park, a small conservation area on the Belize River, some 3.5 km northwest of Belize's capital Belmopan. Information I found on the area suggests it was extensively disturbed in prehistoric and historic times. For example, Willey *et al.* (1965:121) showed that this area was included in the high-density settlement area of the ancient Maya, whose numerous house mounds suggest they "concentrated densely around the river." Any prehistoric disturbance was subsequently updated in the last two centuries. In the late 1800s, Morris (1883:44) described the area at Orange Walk, some 0.2 km away, as a busy mahogany works with "numerous tracks converging on the settlement...reaching into the backwoods...with pasture surrounding." The area was later part of an extensive banana plantation that reached to the river's edge (Thomas, pers. comm., 1992). According to the park's warden, the current forest is estimated to be 40 to 50 years old, with the maximum possible age for the cohune stand to be 60 years. No age distribution graph was drawn for this site because the density and low stature of the cohune made it impossible to accurately assign each stem to an appropriate height class.

Rio Grande, Limestone knoll, Toledo District

I sampled three 100 m^2 plots over a 40 m transect at the hilltop, sideslope (40°) and base (28°) of a 50 m karstic remnant (limestone knoll) within a few hundred meters of the

Rio Grande on the southern coastal plain of the Toledo district. The average density of all stems was 34/100 m^2, and the average number of adults was 4.3/100 m^2.

The site lies well within the prehistoric "realm of influence" of Lubaantun, a late Classic ceremonial site some 22 km to the northwest (Hammond, 1972). Lubaantun controlled 1600 km^2 of the surrounding area, which was considered rich in a variety of natural resources. At its peak the region may have contained 50,000 people (Hammond, 1972). It is virtually impossible to determine the fate of the knoll during Lubaantun's heyday: whether it was farmed, kept in forest, or built upon. There is no sign of terracing of its sides, but its distance from Lubaantun and its rocky, 'skeletal' soils suggest it was highly unlikely to have been under milpa, in the ancient or more recent past. Whatever the knoll's fate, Lubaantun was completely abandoned around AD 850-900 (Hammond, 1972), and the surrounding region was presumably little occupied until the late 1800s, when Kekchi and Mopan Maya from Guatemala settled in the area (Thompson, 1930). It is likely that these people, as well as settlers at a later American colony nearby left the vegetation of the knoll intact (although shifting cultivation was occurring in the area: Laws, 1928); similar knolls photographed and described by Holdridge (1940) were maintained in their original vegetation. Since trees on the knoll show no signs of burning, it is thus likely that the forest sampled here has been relatively undisturbed for about 1000 years.

Cohune abundance at this site is anticipated by its topography. The inclination and almost pure limestone content of the substrate provides adequate drainage for optimal cohune growth in this high-rainfall area of Belize

(Hartshorn *et al.*, 1984). The age distribution at this site is unusual (Figure 9d), but may be explained by the extreme topography and shallow edaphic conditions.

Near Maya Centre, Southern Hwy, Stann Creek District

The plot I measured here was located about 0.5 km west of the village of Maya Centre, approximately 20 m into the forest from a citrus field. The height of the forest, and its status inside a protected jaguar preserve, suggest the site has been recently impacted but not historically cut. This was confirmed by inhabitants of the nearby village. Furthermore, the population distribution of the stand suggests a little disturbed, self-regenerating population (Figure 9e). No prehistoric settlement has been officially recorded for this area (Wright *et al.*, 1959) but Rabinowitz (1986) reported a Mayan ruin some 5 to 10 km uphill. Given Wright *et al.*'s classification of soils in this area as "a fine sandy silt loam, subject to occasional flooding," it is extremely likely that the area under this site was cultivated in prehistoric times. Nevertheless, edaphic conditions are such that cohune's presence here could be predicted by them alone: in Wright *et al.*'s vegetation classification the area is in Cohune/quamwood forest.

DISCUSSION

Milpa as an Explanation for High Cohune Densities at Field Sites

The cohune density data from each of my field sites are considerably higher than any previously recorded for the cohune palm. According to the Maya/milpa hypothesis, these sites should show a particularly long time under milpa agriculture -- either prehistorically or historically -- to correspond to their high densities. None does. Although each occurs in an area influenced by prehistoric human activity, their reconstructed site histories show that not one was under the successive generations of milpa agriculture required for cohune proliferation to be explained.

The site histories I have constructed fail to account for one period of time, however: the post-Classic, after ancient Mayan city-dwelling populations had scattered and the forest slowly regenerated. Although little work has been done to determine what actually happened to most Maya during this period, it seems that there was a fragmentation of the population (see Chapter 1), and probably a general movement towards resource-rich coasts and lakeshores (McKillop, pers. comm., 1993). Population densities were probably much less concentrated in this period than in the Classic, and the lack of permanent architecture suggests a relatively mobile population. It thus seems highly unlikely that during this period the Mayas would have farmed an area long enough to select for cohune in the way the Maya/milpa theory predicts.

Given the data from this study, then, it seems possible to reject the idea that cohune stands are relicts of cohune proliferation in ancient Maya milpas: the high-density stands do not coincide with areas of successive generations in milpa agriculture. Nevertheless, the stands that have been historically undisturbed do seem persistent, in that most have the typical population distribution associated with stable, long-established forests. Thus, whatever their genesis, it does seem that the undisturbed sites may be several centuries old.

Modern Milpa as an Analog for Mayan Agricultural Techniques

If the sites investigated in this study did not originate in Maya milpa, is it still possible that other high-density cohune forests have such origins? This seems highly unlikely: in the course of my investigations it became increasingly clear that the modern milpa is an inappropriate analog for ancient Maya forms of agriculture. Since this analogy is one of the tenets on which the Maya/milpa hypothesis of cohune stand genesis is fundamentally based, it is worthwhile to review the various reasons for its rejection.

First, it is unlikely that the extensive nature of milpa-based agriculture would have produced sufficiently high crop yields to sustain the population densities we know the Maya were able to support in the lowland region (Hammond, 1978; Puleston 1982; see Chapter 1). Rather, several alternative forms of intensive agriculture have been documented in Belize, including raised fields (Turner and Harrison, 1983), terracing (Thompson, 1931; Healy *et al.*, 1983), and tree-based garden systems (Lundell, 1942; Killion, 1992). It is therefore probably more accurate to envision the Classic Mayan landscape as one of intensive, long-term agricultural fields rather than a mosaic of small milpas in different stages of regeneration (Turner, 1978; Hammond, 1978; Wiseman, 1978).

Second, not only were population densities too high in some areas to be supported by a milpa system, it seems likely that milpas were not even used in remote, sparsely populated areas. Why? As discussed earlier, the proposed proliferation of cohune in Maya fields depends on the inability of the ancient Maya, equipped only with stone tools, to control the palms. But as Sauer pointed out

(1958:189), "the mastery of the forest by man requires no axe." In fact, it seems that the very *lack* of stone tools would have discouraged any type of shifting cultivation system, that required the repeated cutting of woody vegetation. Denevan (1991, *in* Doolittle, 1992:393) made this point in the context of the Amazon, suggesting that the difficulty of cutting forest with stone tools points to slash-and-burn agriculture as a post-Hispanic practice. Once a plot of land was wrested from the forest, ancient farmers everywhere would have maintained their fields for as long as possible.

Not only would milpa systems have been unlikely, Mayan allowance for cohune proliferation in any sort of agricultural setting is unlikely. Given that the Maya farmed Belize for some two millennia at least (Gómez-Pompa and Kaus, 1989; Denevan, 1992), and that they certainly knew of cohune's tenacity in their fields -- particularly its resistance to burning, their main form of clearing -- it is highly likely that the Maya would have been prompted early on to completely eradicate the cohune from areas where it was undesirable. This conclusion seems clearly supported by the Maya's impressive architectural record. To build the temples that persist to the present required not only architectural sophistication, but the quarrying and transportation of huge limestone blocks. To suggest that the culture capable of executing such feats was incapable of managing the profusion of a palm because they lacked iron tools is facile (presumably, the Maya were more willing to allot time and labor to religious endeavors than to keeping their fields cohune-free).

The arguments presented here *against* the analog of modern milpa to ancient Mayan agriculture are marshalled to show how high-density cohune stands did not result from Mayan allowance of cohune proliferation over 1000 years ago. The arguments, however, are not new: milpa as a form of Mayan agriculture was effectively discredited over a decade ago, after archaeological research suggested more intensive, long-term agriculture was widespread in the Maya region (Turner, 1978; Hammond, 1978; Puleston, 1978). As Puleston (1982) put it:

> The assumption that slash-and-burn maize cultivation provided the subsistence base for ancient Maya civilization is the keystone for the supporting arch of an entire superstructure of secondary assumptions and hypotheses, cultural reconstructions, and elaborate evolutionary schemes that have been developed over a period of more than 100 years...I intend to remove that keystone (Puleston, 1982:354).

Despite such solid refutation and the constant reinforcement of alternatives, the milpa analogy has proved extremely persistent. As recently as 1993, the archaeologist Demarest stated:

> [The Maya] cleared only small patches of forest, leaving the tallest trees standing to provide shade and enrich the soil...Of course, the Maya lacked the tools to cut down the larger trees (Demarest, 1993:111).

It is perhaps not surprising, therefore, that tenets based in this view of the ancient Maya landscape -- such "secondary assumptions" as those of cohune proliferation -- continue to be invoked.

Other Anthropogenic Explanations for High-Density Cohune Forest

If cohune stands do not owe their genesis to Mayan milpas, do the data from this study elucidate any other possible anthropogenic mechanisms for the creation of cohune monodominance?

One possibility is that high-density cohune stands are the persistent relics of plantings by the Maya elite, thus explaining their predominance around Mayan ruins. This 'relict' idea was suggested by early explorers in the Maya region (Bartlett, 1936; Lundell, 1940) and has since been invoked by Folan *et al.* (1979), Puleston (1982), Hartshorn *et al.* (1984), Gómez-Pompa (1987), and Gómez-Pompa and Kaus (1990).

Although two sites in this study *do* show high densities of cohune within the ruin complexes of Maya ceremonial centers, other data suggest that deliberate planting is an unlikely explanation for high density stands. For example, cohunes do not "cover the ruins" of Chan Chich and Las Milpas, as Johannessen (1957) claimed -- erroneously -- at Xanantunich. Rather, the palms occur at high densities only in specific microhabitats within the ruins, including places which they have obviously colonized, such as the bottom of the main reservoir structure at Las Milpas. Also, cohunes occur at comparably high densities in sites alien to any ceremonial center, such as at the ironically named Maya Center site and along the Rio Grande.

The 'relict' theory assumes that species in high densities on Maya ruins were planted because of their usefulness, such that Mayan elites would have appreciated their proximity. Although it does seem likely that cohunes were important to the Maya (see Chapter 4), it is impossible to know for sure if cohunes were any more useful than the myriad other plants not found in high densities around ruins. As Gómez-Pompa (1987:14) put it, "we may find that all the flora of the Maya area was used!"

The idea that cohune dominance on Mayan structures is a relict of priestly plantings is also ecologically weak, a fact that is apparently lost on its proponents. Puleston (1982), for example, cited a correlation of 0.86 (significant at the 0.01 level) he found between *ramón* trees (*Brosimum alicastrum*) and Maya structures to show "we were probably dealing with the descendants of an ancient Maya cultigen that had been grown in the vicinity of the residences" (Puleston, 1982:360). Did he really think that within the stone-floored plazas of Maya ceremonial centers were planted trees, or "silvicultural" gardens, as Gómez-Pompa (1987) argued? The basis of both Puleston's (1982) and Folan *et al.*'s (1979) work is the tight correlation between increasing distance from the center of a Mayan site and decreasing densities of the species under study. Nevertheless, the likelihood that the relationship is topographic (the "center" of Mayan ruins usually corresponds to high local elevation), appears as strong, if not stronger, than a cultural relationship. For example, the Rio Grande site discussed in this thesis is an area of high local topography composed primarily of limestone. These conditions combine to make it an effective mimic of a Mayan ruin, and indeed, cohune densities on this natural, elevated formation are comparable to densities measured on real ruins (i.e. Chan Chich).

Ecological Explanations for Cohune Monodominance

In the absence of any other plausible anthropogenic explanation for high-density cohune stands, they must be considered naturally occurring associations. Do the data suggest any factors that might elucidate an ecological explanation for their formation and persistence through time?

The population size graphs in Figure 9 suggest that each site, irrespective of age, has converged or is converging to a common population structure that suggests self-replication and permanence. Furthermore, the stands all occur where soil mapping by Wright *et al*. (1959) (using geologic data, not vegetation, as a basis for their edaphic classification) anticipated cohune success. For example, cohunes were found clustered in areas where soil was optimal for growth under prevailing precipitation conditions, rather than where a common disturbance regime prevailed. Not one of the high-density stands occurred as some outlying population exclusive of the cohune's natural range; rather, each occurred within general vegetation and soil regions in which Wright *et al*. (1959) allowed for presence, and in some cases, dominance, by cohune. For example, at the two ruin sites in the drier north, cohunes occurred at high densities in damp depressions only, although the palm is present in much of the surrounding forest (Brokaw and Mallory, 1992; personal observation). In the south, where rainfall is considerably higher (Hartshorn *et al*., 1984), cohunes occurred at high densities on a limestone knoll, a somewhat locally isolated cohune population, coincident with the better-drained topography. In some places, favorable edaphic conditions occurred on a large scale: where deep rich soils cover larger areas, as they do along the alluvium-enriched banks of Belize's rivers, cohune-rich forests were extensive.

In short, the data suggest that cohune populations can reach high-density stability where the substrate is optimal for cohune growth. In fact, cohune monodominance under such conditions is not an anomaly that must be attributed to human action; it is rather *predicted* by ecological theory. Huston (1993) illustrates how monospecific stands should be an expected outcome of growth on rich sites (those with high soil nutrient and moisture levels), as well as at very poor sites at the opposite end of the soil resource spectrum (i.e., the conditions in which mangrove and pine are found). In the absence of disturbance, the high productivity of optimal sites allows steady competitive exclusion by the dominant (i.e., best adapted) species. The fact that over time, cohunes may improve soil quality (Furley, 1975) is a facilitating factor that may further accelerate competitive exclusion by improving conditions for its growth.

Although Huston (1993) provides an attractive explanation for the *process* by which cohunes may become monodominant on optimal sites, the aspects of cohune morphology or growth that give it an initial competitive edge over other forest species remain to be elucidated. The most comprehensive discussions of the possible adaptations of palms that lead to low diversity palm forests are found in Connell and Lowman (1989) and Hart *et al*. (1989). All invoke some adaptive trait (aerial roots, for example) that allows monodominant palms to sequester resources that are unavailable to other species, and to thus dominate in edaphically stressed environments like riparian habitats (Balick, 1984b; Peters, 1989; Prance, 1989) or on low-nutrient soils (Faber-Langendoen and Gentry, 1991; Strudwick and Sobel, 1988).

The cohune, however, seems to lack morphological traits that would be specifically adaptive. Instead, its developmental characteristics are probably most important in facilitating its dominance at certain sites. Not particularly fast growing, the cohune edges out its forest competitors through its extreme hardiness in the seedling stage (Hecht *et al.*, 1988).

It is clearly beyond the scope of this thesis to address all potentially relevant ecological aspects in cohune's monodominance. An important starting point, however, is to recognize that high-density stands are not unique associations that require a unique explanatory mechanism, but rather are one possible vegetational outcome along an environmental gradient, such as soil moisture, along which diversity constantly varies.

Given the high level of recent interest in the ecology of monodominant stands, it seems odd that the cohune has largely been excluded from this literature (it is mentioned only in Anderson *et al.*, 1991). Data produced from this study clearly show that numerically, cohune stands in Belize are comparable in density, if not in scale, to those of the Amazon and other neotropical forests (Table 5). This thesis provides one more example of what Connell and Lowman (1989) and Hart *et al.* (1989) described as the least well understood tropical ecosystem, the monodominant forest.

CONCLUSION

There is no doubt that the ancient Maya had a profound effect on their environment, and that the current vegetation must in some way bear witness to that past disturbance. The data presented in this study, however, show that it is too simple to directly relate a particular Mayan activity in the past with a particular modern vegetation association when the two are separated by as much as 1000 years. Nevertheless, the pervasiveness of this directly causal type

Table 5 Monodominant palm forests of the neotropics: species density.

Source	Country	Species	Sample area	Total stems/ha	Max. juv.[1] /ha	Max. adults[2] /ha
McSweeney (unpub)	Belize	*Orbignya cohune*	0.01 ha	21,400	1714	142
Peters *et al.* (1989a)	Brazil	*Euterpe oleracea*	1 ha	n.d.	775	267
		Jessensia bataua	0.3 ha	n.d.	944	104
		Mauritia flexuosa	1.0 ha	n.d.	415	138
		Orbignya phalerata	1.0 ha	n.d.	757	223

[1] Juvenile is defined as any individual that is not yet fruit-bearing, and is >1m. After Peters *et al.* (1989a).

[2] Adult is defined as any individual with fruiting structures present, regardless of height.

of explanation is strong, in the geographical, anthropological, and ecological literature. The question thus becomes: why is this view of enduring vegetational "imprints" so persistent?

One possible explanation for the adherence to the idea of an ancient Mayan "imprint" on the modern vegetation is that this results from an overcompensation among scholars for the popular view of the "virgin" forest. Denevan (1992) best articulated the frustration of scholars in debunking this 'pristine myth.' In the wake of the Quincentennial of Columbus' voyage, he wrote: "[modification of the Americas by Indians]...may be obvious, but the human imprint was much more ubiquitous and enduring than is usually realized" (Denevan, 1992:374). The mistake is to take the endurance of the imprint too far by drawing *direct* connections between the current vegetation and its past manipulation by humans, failing to account for the myriad ecological processes operating on the flora in the interim. Ignorance of such factors results in a kind of reverse environmental determinism, where human agency controls plant distribution and community structure through millennia.

Neotropical deforestation may also have a hand in the persistence of the direct human-vegetation connection, for two reasons. First, neotropical rainforests are being destroyed at an extremely rapid rate (Nations and Kromer, 1983; NYBG, 1989; see Chapter 1 for figures on Belize), leading to increased academic interest in prehistoric forest "management" (i.e. use and destruction in the past). This interest has been ostensibly described as an effort to better understand the disturbance history of the present vegetation so we may predict the limits of its tolerance to clearing. Gómez-Pompa and Kaus (1990) exemplify this attitude:

> The effect of past civilizations on the structure and composition of today's forests is more than just an intriguing question: it is important to the current concern over deforestation. Even with modern-day scientific knowledge, our generation has failed to maintain the tropical biological diversity left us by previous generations. The persistence of forest resources and ecosystems following widespread human intervention indicates that a knowledge of the management techniques practiced by ancient civilizations could help in reverting current processes of landscape degradation in the tropics (Gómez-Pompa and Kaus, 1990:59).

Beneath this noble sentiment, however, lies the fact that it is inherently comforting to know that humans have deforested at a grand scale before, and that the forest returned. This view in some way minimizes our perceived responsibility for the destruction: vegetation associations that we explain by human agency remind us that humans were there before. Second, part of the role of rainforest scientists has been to engage the public in the forests' preservation. One way to do this is to humanize it, to see in its untold mysteries the mark of human influence: where the rainforest used to be untouched 'jungle', we now hear of vegetation that is a direct result of ancient human land use!

Chapter 4

HUMAN USE OF THE COHUNE PALM IN BELIZE

INTRODUCTION

Monodominant neotropical forests of useful palm species have received wide recognition in the past decade for their importance to rural populations, especially in Amazônia (Balick, 1979; Balick, 1984b; Anderson *et al.*, 1987; Strudwick and Sobel, 1988; Voeks and daVinha, 1988; May, 1990; Peters, 1990). For example, work by May *et al.* (1985) and Hecht *et al.* (1988) has detailed the reliance of some two million people in Brazil on the production of oil from the fruit of the *babassu* palm. Other studies have investigated the management implications of potential large-scale development of other lesser-known "natural monocultures" of palms (Anderson and Jardim, 1989; Prance, 1989).

Native palms are also considered important where they are not monodominant, but rather occur among other useful trees in species-rich forest, as described in Read (1988), Peters *et al.* (1989b), Peters (1990), and Pinedo-Vasquez *et al.* (1990).

The monodominant cohune forests of Belize have not received similar attention, which is not surprising considering the small size of Belize's population compared to those of South American nations. But Central American palms in general have received rare note in the recent literature on rainforest extractivism (e.g. Anderson *et al.*, 1991), and their ethnobotany is considered poorly known in modern conservation contexts (Bates, 1988).

The historic usefulness of the cohune to Belizeans, however, is well documented. Comprehensive descriptions of the palm's use are found in Morris (1883), and Stevenson (1932), the latter stating:

> The Cohune plays an important role in the life of the forest laborer in the south of the Colony. He uses the leaves (fronds) for thatch, and the leaf stems for the sides of his house, the top of his table, and his bed. He obtains oil from the nuts and food from the heart of the "cabbage" (Stevenson, 1932:4).

Cohune use by people is also recognized in Martinez (1936), Lundell (1939), Johannessen (1957), and Standley and Steyermark (1958), and the palm was the subject of a study by Mars (1971) on the feasibility of an oil industry based on cohune fruits.

More recent mention of the uses for cohune uses is extensive, but only within lists of other useful neotropical plants (Eckley, 1954; Usher, 1974; Duke, 1977; Williams, 1981; Lleras and Coradin, 1988; Brucher, 1989; Duke, 1989; Thomas, 1992). Mention of cohune use in this literature is not detailed, and most reference the original descriptions by Morris (1883) and Stevenson (1932). Where mention of cohune use is based on recent observation, it is usually applicable to only one part of Belize (e.g. Horwich and Lyon, 1990; Wilk, 1991).

The only context in which recent generalizations are made of cohune use throughout Belize is in the ecotourism literature, which seeks to promote Belize as a relatively undisturbed rainforest wilderness in which ecologically savvy Belizeans use a wide array of tropical forest products. Descriptions like the following from Mahler and Wotkyns (1991) are not uncommon (e.g., in Arvigo, 1991;

Mallan, 1991):

> The cohune palm...is one of the forest's *most useful* members. Its fronds are used as thatch in roofs, and a *valuable* oil can be extracted from its fruit. Husks from the tree's palm nut make *excellent* fuel, and the nut meat can be pounded into flour that will store *for weeks* without spoiling (Mahler and Wotkyns, 1991:246) [italics added].

Note how the hyperbole of the prose combines with the use of the term "can be" as opposed to "is" in the description of the palm's use: the *potential* uses of the cohune are well known, but the actual degree of modern use of the palm in Belize is not.

The following chapter presents the results of a two-month survey of the current status of cohune use in Belize. It is intended to update Stevenson (1932), the last comprehensive, observation-based study of the palm's use in the country. It is hoped that the data provided here will ground in fact future mention of cohune use in Belize.

THE SURVEY

To discover the nature and distribution of cohune use in Belize, I travelled through most of the county's populated areas and spoke with some 200 people. I visited areas irrespective of the presence of cohune in the surrounding vegetation, on the assumption that the palm's absence in a given area did not necessary preclude its use. Data were gathered from observation of obvious cohune use (thatch, for example), and by interviews in English and Spanish when the palm's use was not apparent (in the making of oil, for example). All interviews were conducted informally, because I noticed a tendency among interviewees to tell me what they thought I wanted to hear when they knew I was conducting a survey, and I elicited much more candid responses in casual conversation. In fact, this informal data gathering method is recommended for ethnobotanical research by Phillips and Gentry (1993). When known, the names of my informants are referenced in the text.

To gauge to what degree cohune use has changed over time, I collected data on the historic use of the palm from a variety of archival sources and from discussions with older people. The Belize Archives Department in Belmopan and the Bliss Institute in Belize City were particularly helpful in this regard.

Several factors led me to anticipate that use of cohune would be widespread and important to subsistence-oriented rural peoples in Belize. First, the literature suggested a strong history of cohune use in Belize's rural areas. I also knew that half of Belize's modern population is rural (B.I.S. 1992), and that settlement areas tended to coincide with areas of lowland forest in which the cohune was potentially present (Wright *et al.*, 1959). It therefore seemed likely that an abundant, useful palm would be widely exploited. Furthermore, people I spoke with in Belize all showed a high degree of familiarity with the palm and its products, which were often described as of excellent quality and highly desirable. Finally, the high degree of reliance on related palms among rural populations elsewhere in the neotropics (as described by May *et al.* (1985), and Anderson *et al.* (1991)) suggested that the cohune's use in Belize would also be extensive.

SURVEY RESULTS

All parts of the cohune for which I could confirm a particular use in Belize in 1992 are listed in Table 6. Of the uses listed, I chose to focus on the three most common: the use of cohune as a source of thatch, oil, and palm heart.

It should be recognized that the results presented here, and any conclusions drawn from them, apply exclusively to Belize, and not to Mexico, Honduras, or Guatemala, where the cohune is also used (Anderson *et al.*, 1991; Balick, pers. comm., 1992) but where different socio-economic and ecological conditions prevail.

Where I was able to determine an economic value for a particular cohune product, the value is given in Belize dollars (BZ$)[1]. For these values to be put into a meaningful context, it is helpful to know that the typical salary of a private sector worker is BZ$225/week; government employees make BZ$125/week, as do most laborers, though some get BZ$150/week.

Thatch

The use of cohune leaves for thatch is the palm's most common and conspicuous use. Removal of leaves from a cohune rarely if ever kills the palm, and leaves grow back within 4 to 5 years (Corner, 1966). Of the 10 to 20 leaves on a

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[1] The Belizean dollar has traditionally been held against the U.S. dollar at 2:1, but recent fluctuations have caused slight variations in this rate.

Table 6 Confirmed uses* of the cohune palm (*Orbignya cohune*) in Belize, 1992.

LEAVES

Construction Materials

- Thatch for roofing and walls
- Leaflets for ties
- Rachis for light construction and for "smoking" bees

Fibers

- Fans for ventilating fires

Agricultural

- Burned in forest clearing; trimmed for weed-control burns
- Used for in-field maize storage
- Seedlings used as cattle fodder during droughts
- Contribute large quantities of organic matter to soil
- Provide shade for cattle

FRUITS

Food

- Kernels as snack; unripe kernels as cooking "milk"
- Source of oil for cooking
- Mash from oil used for pig feed; discarded mesocarp used for poultry feed

Fuel

- Oil used in home lighting as kerosene replacement
- Broken endocarp and epicarp used for cooking fuel
- Entire fruit used for charcoal or for "smoking" bees

Other

- Oil used in sap manufacture
- Whole fruits used for ornamental purposes
- Fruits shipped for sale

* All uses are described in the text.
Format follows that in Anderson *et al*. (1991)

cohune, not all are cut: the smallest are spared, such that around some rural villages it is common to see "trimmed" cohunes which have only one or two leaves sticking up from a large stem. The Belizean government allows cohune leaves to be cut from Forest Reserve Lands for 2 cents/leaf from the Toledo Division of the Forestry Department and 4 cents/leaf at the Melinda Forest Station. Some people say that there is a correct moon for cutting thatch, but otherwise leaf harvest is not temporally defined.

To thatch a building, the leaf rachis (leaf axis, or thick central vein) is split and the leaf folded so all leaflets fall to one side. The leaves are then tied horizontally -- often with strips of leaflets -- to the house frame, which may be partially constructed of leaf rachis. Because of their rigidity, cohune leaves can not be used to thatch roofs with rounded corners: all homes thatched in cohune are thus distinguishable at a distance for their A-frame shape and the overlapping leaves at the roofs' ends (of which excellent photographs may be found in Thompson, 1930).

The closer together the leaves are laid the tighter and longer-lasting the thatch; the number of leaves required to thatch a house thus depends on the quality of the thatching job as well as the roof size. I was told 500 leaves were required for a house measuring 6 x 12 m, and that 800 were needed for a larger cattle shed. Each structure therefore used the leaves of some 30-60 individual cohunes. Occasionally, additional leaves are required if the walls are of cohune leaf (laid vertically): this is uncommon, and is usually reserved for sheds or rough shelters.

The life span of the roof depends on the tightness of the thatch but is limited by the tendency of cohune thatch to become brittle and ruffle up in a breeze. I was given estimates of the frequency of cohune thatch replacement that varied from 6 to 20 years. On the inside of a house, the cohune-thatched roof will gradually blacken with the smoke of cooking fires, but I was told ignition of the thatch is extremely rare.

Most people I spoke with, whether they had thatched roofs or not, agreed that in general, the thatched roof type is the quietest and coolest in the subtropical climate of Belize.

Historical Use and Distribution

I witnessed two thatching events in Belize, by Mestizo and Creole workers in the Cayo and Orange Walk districts respectively. Their technique was almost *verbatim* the process used by Mopan Maya in the southern Toledo district in 1930, as described by Thompson (1930). Clearly the thatching method has changed little in the intervening 60 years.

The distribution of thatch use, however, has changed significantly, though whether the actual number of cohune-thatched structures has declined proportionally to the population is impossible to determine. Most change has occurred in small towns over the past two decades: towns that were entirely composed of thatched homes in the 1960s (as photos of San Antonio and San Jose Succoths indicate for example), are now exclusively wood or iron-roofed. Similarly, Willey *et al.* (1965:23) recorded that "most of the stretch of highway between El Cayo and Roaring Creek is...lined, ribbon-fashion, by scattered settlement of small thatched houses." Today, not a single thatched home exists along this stretch; homes here are almost exclusively wooden, with corrugated iron roofs. People I spoke with confirmed that all over Belize, the use of cohune thatch in towns has decreased to virtually nil in the past few decades. Read (1988) described a similar phenomenon for much of the Caribbean.

Modern Distribution of Thatch Use in Belize

Cohune thatching today is a rural phenomenon (I saw cohune thatch only on the outskirts of towns or used in crude shelters at urban construction sites). Cohune thatch is hardly typical of all rural settlements, however, and is absent in all but the outbuildings of most of the long-established rural Mestizo and Creole communities of the north and west.

Cohune thatch predominates only in the rural settlements of recent immigrants to Belize and the relatively mobile settlements of the southern Maya. Cohune is the main thatch and roofing type at the refugee settlements at Las Flores, Salvapan, and the Valley of Peace, which have a combined population of some 5,000 people (Montgomery, 1991). Along the southern highway in the 22 km stretch between Silver Creek Village and Maya Center, I counted 327 cohune thatched homes, or roughly 75% of all structures visible from the road. The villages along this road are Kekchi and Mopan Maya settlements based on subsistence farming, settled in the past two decades when land pressure in the south forced people to move northwards (Davidson, 1984; Ico, pers. comm., 1992). Cohune thatch use persists in the established Mayan towns of the Toledo district, such as San Antonio and Blue Creek. Nevertheless, the percentage of thatched homes in San Antonio has certainly shrunk since Thompson's photos (1930) recorded every home as thatched in cohune.

Cohune is also an occasional roofing material in Garifuna villages: I saw cohune thatch used at Silk Grass Creek, Hopkins, and Sittee River. Cohunes occur rarely in the coastal vegetation, and since leaves from the abundant coconut are considered to give a poor thatch that rots quickly, cohune leaves are taken by boat to the coast from inland areas. For example, boats in Placencia Bay bring cohune leaves from South Stann Creek. Davidson (1974) and Dixon (1985) mentioned the preference for cohune thatch over that of other palms among the Garifuna of Honduras as well.

Alternatives to Cohune Thatch

Although thatch is a common use of the cohune, the cohune is not the preferred thatching palm of Belize. The leaves of the bayleaf palm (*guano*, or *Sabal mauritiformis*), are fan-shaped and considered easier to work with, longer-lasting, and more conforming to a variety of house shapes than cohune leaves. Nevertheless, two factors have combined to make the bayleaf palm increasingly scarce. First, the influx of refugees into rural areas of Belize over the past decade, especially around Belmopan, has led to the bayleaf's overexploitation and near local extinction (Thomas, 1992). At the same time, expansion of the tourist trade initiated the construction of rustic, circular *cabanas* for tourist accommodation, for which the preferred bayleaf was commercially harvested. Bayleaf is now "very scarce" in the Cayo district (Ryan, pers. comm., 1992), and its rarity has led to a price increase from 10 cents/leaf in 1984 to 70-80 cents/leaf today (Silva, pers. comm., 1992). The overall decline of bayleaf in rural areas has led people there to rely increasingly on the cohune. One woman at Las Flores refugee settlement said that when her family first arrived in Belize from Guatemala five years ago, there was plenty of *guano*, now there is none left, so they use the cohune.

The best kind of permanent roof in Belize -- other than cement or wood -- is the corrugated metal, or "zinc" roof. This is common in towns but is rarer in rural areas. The cost of metal roofs is often prohibitive (BZ$800 to cover a medium-sized house), and such roofs risk being stolen. In remoter areas, it is said that owners of zinc roofs must always leave someone at home on guard (Thomas and Jordan, pers. comm., 1992). "Tin" roofing is a thinner type of metal, and costs about BZ$14 per 8 ft sheet. Cheaper still is oil-soaked corrugated cardboard, a common roofing material and relatively cheap at BZ$2 per 1 m x 0.5 m sheet.

Discussion

Cohune thatch is clearly the roofing material of the poorest members of Belize's population; it is usually abundant, easily cut from the bush and simple to work with. It is essentially a free, wild resource, except when cut in Forest Reserves, where a minimal price per leaf is charged. Attendants at these reserves recognize, however, that a lot of "stealing" of leaves occurs, but they say it doesn't matter because leaf cutting doesn't kill the palm, which is so abundant anyway. With any increase in wealth, most people I spoke with said that purchasing a permanent roof was a top priority, though they acknowledged this was more due to the status implied by a permanent roof, and not because of the inadequacy of thatch roofs.

In the relatively prosperous, well-established communities of Belize, the use of cohune for thatch has clearly decreased over time as alternatives have become available. Among Belize's poorer and more recent rural communities, thatch prevails, providing a cheap, year-round source of roofing. It is ironic, however, that the use of the cohune palm for thatch in these areas has increased partly as a result of the depletion of a preferred thatch palm due to the increased demand for rustic tourist accommodation. Obviously, the best extractive products of a forest do not necessarily accrue to the most needy members of the population.

Cohune Oil

Figure 10 shows those parts of Belize where oil from cohune is processed and sold, and the areas are also listed in Table 7. My survey of oil use was most thorough in the Cayo District, where initial investigation showed cohune oil production to be most frequent. I include information from towns outside this district only if I visited them and was able to verify the status of cohune oil use. The only two uses of cohune oil that I was able to confirm in Belize are for cooking and lighting.

The production of cohune oil in Belize is more spatially fragmented than that of thatch use. Oil is only being made *on a regular basis* in three parts of Belize: Bullet Tree Falls-Santa Familia, Altun Ha/Rockstone Pond, and Maypen. In most rural areas, however, older people *professed* to make it occasionally, when they had time, usually for home use only. This practice spanned most ethnic groups, including Mestizo, Maya, Creole, and occasionally Guatemalan immigrants.

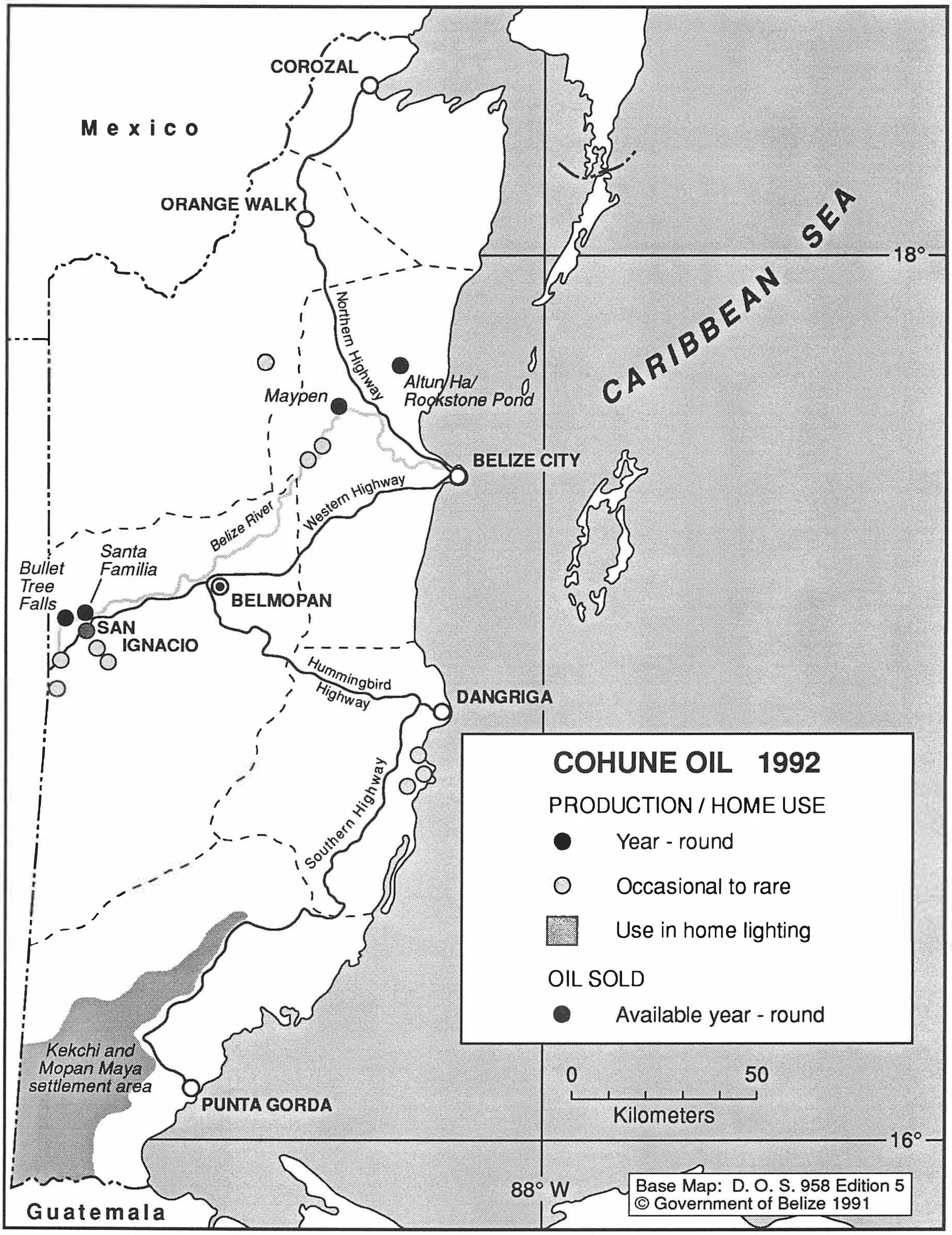

Figure 10 The distribution of cohune oil production and sale in Belize.

Table 7 Production and sale of Cohune oil by town, Cayo District, Belize, Summer 1992.

Town or Village	Oil Production, Household Use				Oil for Sale			Comments
	1	2	3	4	5	6	7	
Cotton Tree				X				
Orange Walk				X				
Roaring Creek				X				
Camelote			X					
Belmopan							X	
Las Flores			X					by Maya only
Salvapan			X					by Maya only
Valley of Peace			X					by Maya only
Teakettle				X				
Spanish Lookout								
Ontario				X				
Esperanza				X				
Santa Elena							X	
San Ignacio					X			
Trapiche				X				
Santa Familia	X					X		10 households*
Bullet Tree Falls	X				X			10 households
San Jose Succoths		X						5 households
Benque Viejo del Carmen			X					
Christo Rey		X						2-3 households
San Antonio		X						
Negroman				X				
Arenal			X					

1: year-round; 2: occasionally; 3: rarely; 4: no longer;
5: year-round; 6: occasionally; 7: never

* Refers to the number of households engaged in making cohune oil during the summer of 1992.

Cohune Oil

The oil is contained in the kernels of the palm fruit[2], which typically comprise 10% of the fruit's weight (FAO, 1989). Each of the 1 to 5 kernels is approximately 3 cm long, and is 64.5% - 71.8% oil (Eckley, 1954). The oil extracted from the kernels is a yellowish, non-drying oil (Duke, 1989) that is similar to coconut oil but has a lower melting point (FAO, 1989) and a smokier taste. Several Belizeans told me that the unrefrigerated oil goes rancid within two weeks (cf. Brücher (1989), who cites the oil's low tendency to become rancid in connection with its potential use for margarine manufacture). In Belize the oil is known as cohune oil, cohune fat, cohune lard, and *manteca de corozo*.

A single cohune palm may produce from 1 to 4 panicles of 150 to 800 fruits (Goodban, 1955, *in* Mars, 1971; Horwich and Lyon, 1990). The number of kernels per fruit varies between palms: the fruits of some are known to yield 2-3 times more kernels than others (Mars, 1971; Jordan, pers. comm., 1992). In older fruits, there is a greater chance of infestation by Bruchid beetle larvae, in which case kernels must be rejected. Data from Burns (1935) show that 943 tons of fruits were required to yield 75 tons (8%) of kernels. This is less than the average 10% that kernels comprise of total fruit weight, suggesting that the source area of this sample (the Toledo district) was a low-yielding or beetle infested cohune population.

Because of the variety in kernel number within and among cohune populations, the amount of oil yielded from a

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2 "Fruit," or infructescence, is used in *lieu* of "nut" or "seed" as the proper botanical name for the part of a plant developed from the flower; all terminology follows that of Corner (1966) and Anderson *et al*. (1991).

given weight of fruit varies. This genetic variability in yield is a common problem in wild-harvested resources (Schmink, 1988), and probably one of the reasons Lleras and Coradin (1988:201) cite "the sparse data on productivity of neotropical palms." Fruit-to-oil yields reported for the cohune in the literature and gathered in this study are summarized in Table 8.

Oil Production

I interviewed six families actively engaged in making cohune oil, and in some cases made multiple visits to see each step of the three-day process, summarized in Figure 11.

Collection

The ideal collecting period is from December to May, when fruits are dry but have not been on the ground long enough to become infested by beetles. Most collectors are familiar with the high-yielding palms in an area and will collect from them first.

Some families collect fruits year-round and store them in shelters near their homes. Collecting methods differ among households: if the collecting area is close to the house and there are storage facilities available, fruits are collected in sacks and carried to the house. If the distance is far or the quantity large, the fruits may be collected and broken in the field, so that only the kernels are brought back to the house. Collecting is described as easiest in cohune pasture where the fruits are easy to find and the fruit yields of each tree high. I was told that collecting was not done in dense secondary forest or even in partially regrown pasture because of the difficulty of

Table 8 Oil yields from cohune fruits, Belize.

Source	District	Fruit Quantity	Kernel Quantity	Oil Quantity
Morris, 1883	Toledo	100 fruits	n.d.	"1 quart bottle" (0.94 L)
Burns, 1935	Toledo	943 tons	75 tons	n.d.
Mars, 1971	Toledo	300 lbs	30 lbs	n.d.
Chan Family, unpub.	Cayo	6 buckets (1000 fruit)	1 bucket	5 wine bottles (3.75 l)

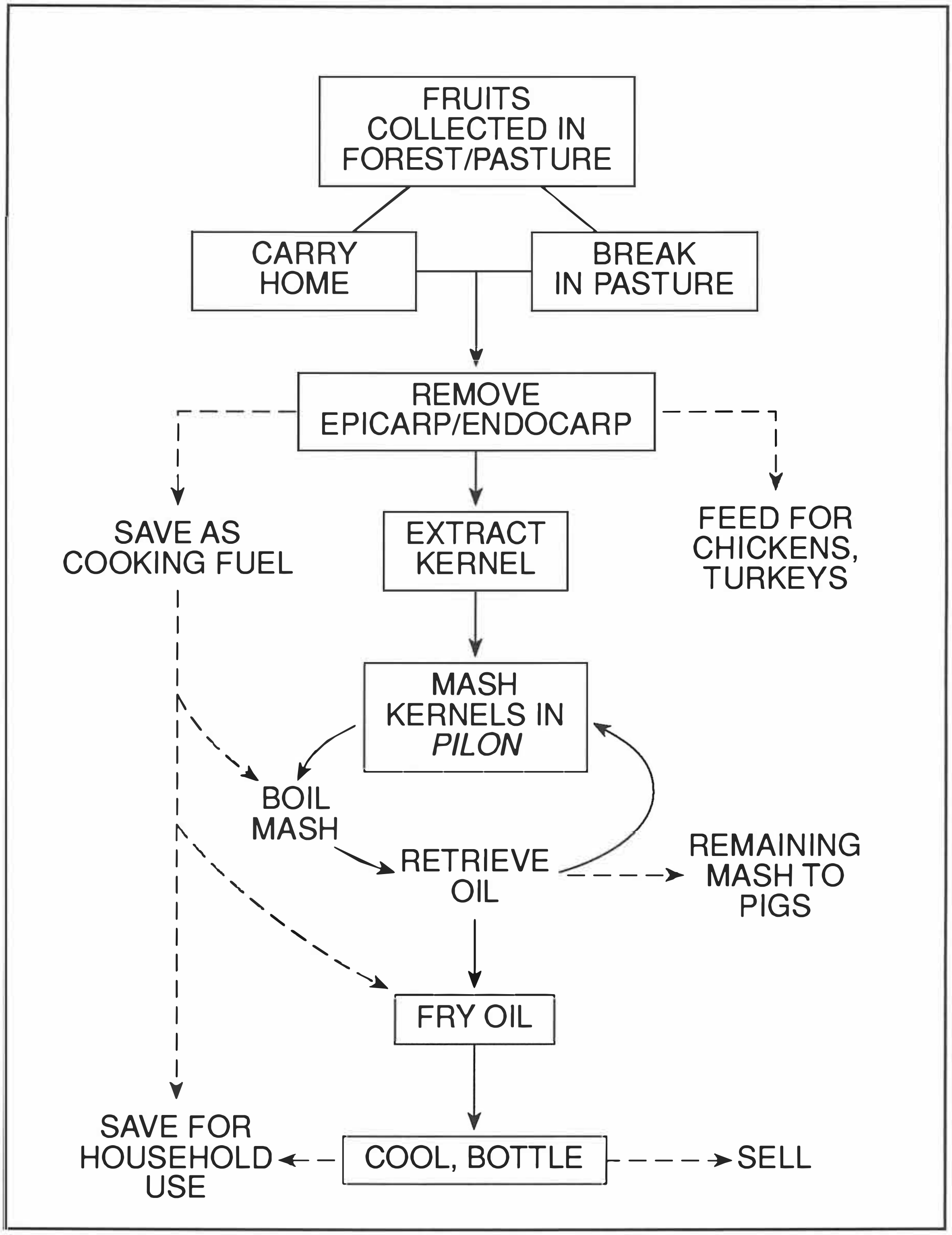

Figure 11 The manufacture of cohune oil. The process takes three days.

finding the fruits and because of the fear of snakes (Coc, pers. comm., 1992). If fruits are broken in the pasture, the discarded husks must be burned *in situ* so they do not get stuck in the hooves of cattle (Perez, pers. comm., 1992). Fruits and kernels are usually transported by foot in corn sacks.

Kernel Extraction

The extraction of the kernel requires the removal of the epicarp and the cracking of the woody endocarp by smashing the fruit repeatedly between the blunt end of a small axe and a rock. Though the fruits are easiest to break when dry, one woman I spoke with was breaking only the epicarp of green nuts in preparation for boiling the fruits to soften the endocarp for later cracking.

In the households I observed, children and old people did most of the fruit-breaking. One 10-year old girl broke 3 buckets of fruit (approximately 500 fruit) in 10 hours, to yield half a bucket of kernels. A 60-year old woman in Maypen cracked 500-600 fruits in 3 hours, or about 3 a minute.

Eckley (1954) estimated that one man could crack 100-125 lbs of fruit per day by hand if the fruits were well dried; Mars (1971) estimated that a private collector could do 300 lbs of fruit, to yield 30 lbs of kernels per day. Although I did not weigh any fruits or kernels, my data show 6:1 kernel:fruit ratios compared to Mars' 10:1 (1971), suggesting that the families I interviewed (who were familiar with the high-yielding palms in their area) get better oil yields than do large scale collectors who collect from a larger and more genetically diverse population.

"Mashing" the kernels

After removal from the endocarp, the kernels must be crushed, or "mashed" to remove the oil. I was shown converted feed grinders that are sometimes used for this purpose, but I witnessed only manual mashing of kernels. This is considered the hardest part of oil manufacture, and the only one in which men occasionally participate (Chan, pers. comm., 1992). The kernels are placed in a large wooden hourglass-shaped *pilon*, and are pounded with a large stick for several hours until fine.

Yielding the Oil

The ground kernels, or "mash" must then be boiled to liberate the oil. This is typically done outdoors in a large vat, with broken fruit husks used as fuel. It may take several hours of intermittent stirring for the oil to float to the surface, where it is skimmed off. The remaining greyish mash may then be recovered, dried and repounded to extract more oil. The collected oil is then fried over a kitchen fire to remove any water remaining from the boiling. The resulting pure oil is then bottled.

The process described here for making cohune oil is identical to that in Morris (1883), and Martinez (1936). The only recent innovation I was told of at the household level was the occasional use of manual or engine-driven feed grinders instead of the *pilon*, though kernels must be crushed slightly in a *pilon* anyway before they can go into a typical corn grinder (Perez, pers. comm., 1992). In Santa Familia and Double Head Cabbage, use of communal feed grinders costs BZ$3 per bucket of kernels (Careas, pers. comm., 1992), which oil producers say is a fair price.

Economic Benefits of Cohune Oil Production

The families with whom I spoke were usually among only a half dozen in their villages (village populations all exceeded 1000) who made oil regularly. All did so for the purposes of selling the oil to generate cash. Prices for cohune oil vary: in San Jose Succoths, one woman sells 750 ml bottles of oil for BZ$4.50 retail and BZ$4.00 wholesale. In the San Ignacio market, a woman from Bullet Tree Falls can get BZ$5 a bottle. Over the two weeks that I was in touch with her family, she sold BZ$19 worth of oil one week and BZ$20 the next, averaging 35% of this farming family's weekly cash income (Chan, pers. comm., 1992). A woman I spoke with in Maypen considered cohune oil production her main wage earning activity: she produced 8 bottles a week and earned BZ$35-$40/week (Joyce, pers. comm., 1992). The manufacture of cohune oil can thus produce significant returns for rural households; it is especially important in farming households where there may be few other sources of cash income available (Tzul, pers. comm., 1992).

Besides direct income generation, there are several indirect benefits from the production of cohune oil that are included in Figure 11. Since all oil-producing families I interviewed kept some oil for home use, the most obvious benefit was the reduced need for other oils. Nevertheless, all producers also used other fats, including lard, coconut oil, and other vegetable oils, saving the cohune oil for the frying of eggs, plantains, and black beans. One woman said that she would use cohune oil in all her cooking and frying if it were easier to make; she currently uses about 750 ml a week for her family of seven. In the Toledo district, cohune oil replaces kerosene as a lighting fuel when wage-earning opportunities are low and cash is scarce. In this case, cohune oil provides resource security in times of scarcity (Wilk, pers. comm., 1993).

Other benefits derive from the by-products of oil production, as outlined below:

a) The removal of the fruit's epicarp reveals the mesocarp, a thin orange carbohydrate-rich layer. Given to fowl, it is considered high quality feed that precludes the need to buy corn when oil production is sufficiently frequent.

b) The removed endocarp is saved in a bucket for cooking fuel; it provides a slow, even, intense heat and is particularly useful in the rainy season when dry wood is hard to get.

c) The boiled mash that remains after the oil is extracted from the kernels makes a rich pig feed, as reported by Morris (1883). Pigs may be completely raised on this mash, but must be taken off it at least three weeks prior to sale or their meat will have an unpleasant smoky taste.

There is a definite seasonality to the production of cohune oil: the process is much easier when the fruits are dry, and so predominates from December to May, except where fruits are stored for year-round production. Fruits, rather than bottles of oil, are stockpiled mainly because the oil can only be processed in small quantities and cannot be kept long without refrigeration, which is lacking in the homes of all the families with whom I spoke.

Distribution of Sale

Most producers of cohune oil sell it informally to their neighbors and more formally in market settings, either directly or through an intermediary. In all cases I encountered, the intermediary raised the price per bottle by nearly 40%, often decanting contents of one bottle into several smaller bottles. Thus a 750 ml bottle of cohune oil bought from a producer for BZ$4.50-$5.00 is sold for up to BZ$7.00.

I surveyed every established urban market in Belize for the sale of cohune oil; results are summarized in Table 9 and described below:

a) The Belize City provisional market was visited 3 times. Though seven stalls carried coconut or shark oil, none had cohune. I was told that it came occasionally from Maypen and Altun Ha (Rockstone Pond), or that it wasn't made any more.

b) The Belmopan permanent market was visited 3 times, and the four vendors selling coconut oil said they never sold cohune oil. The market is dominated by produce from the refugee settlements at Las Flores and the Valley of Peace.

c) The San Ignacio Saturday market was visited twice. The first time I found 24 produce vendors in all, of whom two were selling cohune oil. On the second visit I found 31 produce stalls of which three sold cohune oil. In both cases the oil had been bought from producers in Bullet Tree Falls and Santa Familia.

d) The San Ignacio permanent market carried cohune oil throughout the week, and was thus the only constant source of cohune oil I was able to find anywhere in Belize.

e) Neither the Dangriga nor Punta Gorda Saturday markets offered cohune oil, and I was assured by several people that they never did.

Who buys cohune oil? Primarily townspeople, as a luxury item or "treat" for which they are willing to spend up to BZ$7/bottle, compared with the BZ$3-4 that a bottle of coconut oil costs.

Table 9 Market survey for sale of cohune oil, Belize, June-July, 1992.

Market	No. of visits	Cohune oil for sale	Cohune oil sometimes available	Coconut oil available
Belize City Provisional	3	No	Yes	Yes
Belmopan Permanent	3	No	No	Yes
San Ignacio Saturday	2	Yes	Yes	Yes
San Ignacio Permanent	4	Yes	Yes	Yes
Dangriga Saturday	1	No	No	Yes
Punta Gorda Saturday	1	No	No	Yes

Modern Perceptions of Oil

Most Belizeans, in towns and rural areas, have heard of cohune oil even if they have not had it. People mentioned its good taste (comparable to coconut oil, but richer), and how it is particularly good for cooking beans, plantains, and heart-of-palm. To townspeople it is considered a luxury item, comparable perhaps to real maple syrup among residents of the U.S. and Canada. A commonly heard lament is that the oil is not made much any more, and that it is expensive.

Among rural people the use of cohune oil suggests an inability to afford other fats, though usually its producers are admired for their hard work and the fact that they are maintaining a traditional activity, and most producers with whom I spoke said that they preferred cohune oil over other oils.

People in both urban and rural areas expressed concern that the oil was high in "cholesterol" (by which they mean saturated fats). Indeed, lauric oils, of which cohune oil is one, are saturated fats that have been implicated in high cholesterol levels. I also found that Belizeans in all parts of the country had a poor sense of where the oil was produced. Some people were under the impression that it was no longer made, and others were convinced that most farming peoples made it. In the Stann Creek district, for example, several people told that though few people made the oil locally, it was abundant in the Cayo District (it is not); one woman in the north said she thought it was commonly made around Stann Creek.

Alternatives to Cohune Oil

In 1971, Mars stated that "cohune oil, processed in the home, is apparently the only alternative to imported oil and fats available in British Honduras" (Mars, 1971:v). That was not wholly true then and has become less so in the intervening two decades. Household-level oil production from cohune has a very real competitor in the coconut. This non-native palm (Villarreal *et al.*, 1993) is planted close to homes, and has easily collected fruits that yield large quantities of oil that is more easily processed than cohune oil (Dixon, 1985). All markets I surveyed in Belize carried home-made coconut oil (see Table 9), suggesting that its production is widespread. The coconut blight ("lethal yellowing"[3]) of the 1970s and '80s does not seem to have impacted on Belizean coconuts sufficiently to have increased the use of cohune oil. If the blight did have an effect on oil use in Belize, it has most likely been to strengthen the use of other oils. Imported vegetable oil from Guatemala is currently predominant in Belize, selling for about BZ$1-2/635 ml (vs. cohune oil at BZ$5/750 ml). The use of lard is also widespread, which is ironic given the cholesterol concerns among vegetable oil users. Lard will undoubtedly become cheaper in the near future, given the Belizean government's on-going efforts to increase the country's pig herd (Robinson, 1985; GOB, 1992). Lard is currently produced at Benque Viejo and Belize City, and costs approximately BZ$3.90 for a 3 lb tin, an amount that lasts some families two weeks. Lard is the preferred cooking fat for many foods, including tacos (August, pers. comm., 1992).

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[3] McCoy (1988) does not include Belize in areas ravaged by lethal yellowing, and no one I spoke with in Belize mentioned familiarity with it in interior Belize. Dixon (1985), however, mentions its transformation of the Honduran coast; it may have reached Belize's coast but not its interior.

Historic Use of Cohune Oil

Cohune oil use for lighting was described by several early visitors to Belize as widespread in rural areas. Morris (1883) mentioned, for example, that one pint of cohune oil (473 ml) burned as long as one quart (946 ml) of coconut oil, suggesting that it was both a main source of lighting and preferred over the main vegetable oil alternative. Gann (1918) mentioned a "cuhoon-nut oil lamp" used by Mayan women in southern Yucatan and northern Belize, areas that now have electricity. Oil use for lighting is now confined to the south as an occasional alternative to kerosene.

One by-product of oil production that has been useful in the past is the broken fruit shells that were shipped abroad to be made into charcoal. One use of Belizean cohune charcoal was in gas masks during World War I (Horwich and Lyon, 1990; Duke, 1989). Mars (1971) also states that an American company operating in southern Belize in the 1930s exported shells for the same purpose during World War II. The original sources of this information is unknown. Currently in Belize, there are rumors that charcoal derived from cohune shells is used by NASA as a high-quality packing material in spacecraft and that a German-funded project is using cohune charcoal as a stable fuel in bombs (Silva, pers. comm., 1992). Neither use of cohune charcoal is confirmed, though it is true that the density of the fruits' endocarp creates an usually stable and hot-burning charcoal with several industrial applications (Mars, 1971).

Several authors documented the widespread production of cohune oil for cooking purposes in rural areas during the 19th and early 20th centuries (Morris, 1883; Stevenson, 1932; Martinez, 1936). I was told by older people cohune oil production supplied local needs during World War II, and that it became especially important during a locust outbreak in 1941 and a hurricane in 1942. These events heavily damaged maize crops, and the by-products of oil manufacture were relied on to feed pigs and chickens.

Large Scale Historic Cohune Oil Production

All early large-scale attempts to process cohune oil were apparently carried out by foreigners for the purposes of export, mainly to Europe (Morris, 1883). All enterprises met with complete failure. Already in 1883, Morris discovered:

> the remains of a factory started with the intention of extracting oil from the seeds of the cohune palm...[it was] unsuccessful, possibly from want of judgement and capital as much as from the unsuitability of the country at the time for any undertaking requiring skilled manipulation and management (Morris, 1883:27).

In 1925, Hummel (1925:79) found "the cost of collecting nuts on a big scale is prohibitive." Stevenson (1932) reached the same conclusion, but suggested the activities of the Tropical Oil Products Co. of California might rectify the problem with its operations in the Toledo District. A 1935 letter from Belize's governor states that the company was employing 114 men in the harvest of 4000 tons of fruit and that processing at the "cracking plant" was underway; concluding "I am unable to learn when the kernels will be shipped" (Burns, 1935). The subsequent failure of the company's project is discussed by Mars (1971) as a result of the lack of capital available during the Depression. The fate of the company after this date is unknown.

A second American company commenced operations prior to

WWII for the purpose of exporting charcoal and kernels. The enterprise ceased, apparently due to an inadequate supply of fruit (Mars, 1971).

Reasons cited for failure of these operations are many. Overwhelmingly, it was not the lack of market for the oil or charcoal products but "lack of capital, misleading reports as to the number of palms fruiting per acre and the difficulty in nut collection" (Goodban, 1955, *in* Mars, 1971).

In 1971, the Tropical Products Institute of Britain sent a representative to Belize to study the feasibility of a cohune oil industry there. The rationale behind this investigation was that Belize's status as a net importer of cooking oil made the promotion of local sources necessary in light of a world shortage. The Institute's feasibility study represented the first assessment of cohune oil viability for the purpose of benefitting Belizeans. If, pending investigations into the suitability of other oil-bearing crops, the Institute found a cohune-based oil industry feasible, it would design a "decorticator", or shell remover, for the efficient processing of the oil. After a three-week survey, Mars concluded:

> It is recommended that ... no more work should be done at the Tropical Products Institute and that the Government of British Honduras should not lease or otherwise convey land to companies or issue licenses for the exploitation of the cohune (Mars, 1971:vi).

This damning recommendation did not spell the end for large scale attempts to exploit the cohune. In the mid 1980s a Belizean entrepreneur planned a widely-publicized endeavor to start a cohune plantation near Belmopan for the purposes of processing oil as a high-quality industrial lubricant for export, using the "trash" as animal feed and the shells as a charcoal for local sale. The project fell apart shortly after its inception with the international drop in fossil fuel prices (Silva, pers. comm., 1992).

Currently, cohune oil is being evaluated by the Lily Soap Factory of Belize for its potential in soap manufacture. The company is specifically assessing the feasibility of a crushing factory in Orange Walk, supplied by fruit from around the country. The oil is considered of a high quality and very appropriate for soap (Nunez, pers. comm., 1992). In fact, cohune oil has been used for soap manufacture on a small scale in the past: in the 1960s people from San Antonio would take kernels to San Ignacio to sell for 7 cents/lb, where they were processed for soap (Tzib pers. comm., 1992).

Discussion

The production and use of cohune oil over time has obviously decreased in absolute terms, and as a proportion of the total population of Belize it has dropped precipitously. It is an uncommon activity, measured by the fewer than 40 people who engage in it throughout the year in the Cayo district. The reasons for the decline in cohune oil production are numerous. Among them, land accessibility is cited by some oil producers, who say it is harder to get cohune fruits now, largely because agricultural intensification (itself a product of population increase) has reduced the number of palms available in pastures and fields (Tzib and Coc, pers. comm., 1992). A native of San Lazaro in the heart of northern Belize's sugar lands said that the cohunes are now too far outside the village to get.

Similar distance constraints related to the clearing of forests have been cited in the declining use of a wide variety of wild extracted products, especially from palms (Hecht *et al.*, 1988; Balick, 1990b; Barfod *et al.*, 1990; May, 1990; Anderson *et al.*, 1991).

Decline of cohune use over time is likely also due in part to increased planting of coconut palms. For example, early this century the Maya villages of the Toledo district grew few coconuts (Thompson, 1930), and the cohune was used widely for oil (Gann, 1918). Now coconuts are commonly planted in these villages (personal observation), and combined with increased availability of other fats, cohune oil is now rarely, if ever, made. The long, hard work involved in cohune oil production has also been a disincentive for rural peoples to persist in this activity. Already in Belize in 1971, Mars noted that "people are now less willing than in the fifties to do [the] monotonous work" of processing oil (Mars, 1971:v).

Given the difficulties involved in cohune oil manufacture, under what circumstances does cohune oil production persist? The social and geographic characteristics of the three areas in which cohune oil is produced year-round (see Figure 10), help to elucidate this question.

1. Availability of fruit. Clearly, access to abundant sources of cohune fruits is a prerequisite of oil manufacture. Each of the three areas is associated with cattle raising (Robinson, 1985; personal observation), and active (i.e., currently grazed) pastures are common around each village. In this open, anthropogenic setting (see Chapter 2), cohune yields are high and fruits easily collected. All the families I spoke with had access to

pasture, because they or relatives owned it, or because they had received the landowner's permission. In most cases the pasture was close to the producer's house, which facilitated transport of fruits or kernels.

2. History of village. All producer areas are located along the banks of the Belize River, indicating that they were established in the late 19th and early 20th centuries (Waddell, 1961), when the river was the main transportation artery of Belize. Each area is relatively ethnically homogeneous (Mestizo or Creole), with only a few recent immigrants from Guatemala and El Salvador at Bullet Tree Falls and Santa Familia (Montgomery, 1991; personal observation). Most occupants of these relatively traditional communities consider themselves third or fourth generation Belizeans who are thus culturally familiar with the use of the cohune, and it was common for older people to tell me how the palm was extensively used in the past. The communities' long establishment means that land ownership (and access to cohune pasture) is well-defined, and that there is a support community that takes pride in the maintenance of traditional activities (Joyce, pers. comm., 1992). This community spirit is best exemplified by Santa Familia's communal kernel grinder and Maypen's well known Women's Cooperative. Though each village appears relatively prosperous by rural standards, those households making cohune oil are typically among the poorest in the village.

3. Each of the three areas is relatively isolated, since most traffic now follows the main highways, not the river. Their inhabitants may therefore have less access to store-bought goods -- such as other oils -- that might discourage the use of cohune oil. Nevertheless, all areas are distinguished by their relative proximity to an urban

market, either Belize City or San Ignacio, in which the sale of cohune oil provides the economic basis for its production.

It is clear that the contemporary pattern of cohune oil production and use is geographically confined, centering on the unusual interplay between remote rural production areas and consuming urban areas. In general, it is older members of the population who make the oil, and they speak of a lack of interest among their children in the activity (Joyce, pers. comm., 1992).

There is also a marked socio-economic difference between the two cohune oil consumer groups: the oil is used in cooking and as fuel by the poor, rural people who manufacture it, and only as cooking oil by an urban elite who purchase it as a luxury item.

Future

Brücher (1989) and others (Lleras and Coradin, 1988) have discussed the current global shortage of edible oils, and argue for the oil self-sufficiency of small neotropical countries. In particular, they urge the development of New World palms, "which have until now been exploited in a rather rudimentary way by native collectors" (Brücher, 1989:129).

Cohune is the only native oil-bearing palm in Belize. Despite the cohune's abundance and its potentially high yields, it is unlikely to be the focus of any large scale oil industry. There is a lesson to be learned from the almost comical failures of historic attempts to process cohune oil in Belize at a large scale. One is that an industry based on wild plants is sure to run into yield problems that result from the genetic diversity of wild populations. This is an age-old problem of large-scale attempts at tree-based schemes in the neotropics (Schmink, 1988). The second problem is of the susceptibility of the economic affairs of so small a country as Belize to global financial downturns: two attempts, at large scale oil processing were stymied by depressions or recessions centered in the U.S.

Given the historic problems of large-scale cohune oil manufacture, the promotion of genetically engineered exotics like the coconut or African oil palm seems much more feasible.

Cohune Palmito

Cohune "heart", or *palmito* (the terms are used interchangeably), is the palm's apical meristem, or growing tip. Technically, palm heart is *only* the growing tip, a soft white tissue found within the palm's crown where the leaf bases meet the stem. Commonly, however, the cylindrical bundle of white embryonic leaves that arise from the meristem are considered part of the "heart," despite their discernible leafy form.

The growing tip of the cohune, like that of most *Orbignya*, remains underground for the first 7 to 10 years of growth (see Chapter 2). It is only upon the emergence of a discernable stem approximately 15 years after germination (Thomas, pers. comm., 1992) that palm heart emergence is assured. Removal of the heart is the only use of the cohune that results in its death: unlike other palm species, including *Bactris* spp. (Balick, 1984b), the cohune does not regenerate vegetatively (i.e., sprout from the roots) nor have multiple stems.

In Belize, palmito, or "cohune cabbage" as it is also known, is used almost exclusively as a human food, compared to other countries in the cohune's range where it is occasionally used as cattle feed. Several people with whom I spoke wondered at palmito's nutritional value, of which I could find mention only in Brücher (1989):

> The often-discussed nutritional value of palmhearts is not as low as is generally believed. Of course, most canned palmito is moisture (91%) but there are also 2.2% proteins, 5.2% carbohydrates and especially a fair amount of minerals...(Brücher, 1989:136).

Palmito Extraction

To harvest palmito, the cohune's leaves must be cut, and the bundle of leaf bases in which the heart is encased severed from the top of the palm stem. The palm heart thus lies within several layers of overlapping, woody leaf bases 6 to 10 cm thick. It is in this form that palmito is usually transported from the bush and kept for a maximum of two days until it can be processed, for upon exposure, the heart quickly discolors (Redmond, pers. comm., 1992). This woody bundle weighs roughly 20 lbs, making the cutting and hauling of cohune heart arduous work. The bundle is approximately 60 cm tall, and 72 cm in circumference. Once extracted, the heart itself weighs some 2 to 3 lbs, and is 30 cm tall and 19 cm diameter, broadening somewhat at the base.

Not all heart is "good"--some are occasionally infested with ants and must be rejected. Folk wisdom dictates that heart be cut during the dark phase of the moon when the juices are flowing best (Nicholait, pers. comm., 1992). The quality of the heart does not change with age: all stemmed cohunes have viable edible hearts. It is extremely difficult to harvest the heart once the palm grows past a certain size, however, and it is common for forests from which palm heart is frequently harvested to display a bimodal size distribution due to the selective mortality of only medium-sized, immature cohorts.

Several people in Belize's Cayo district told me that the harvest of palmito (from cohune and other palms) was illegal because it killed the palm. This was reiterated by a palm specialist who works in Belize (Balick, pers. comm., 1992), and such a prohibition is in place in Guatemala (Northrop, pers. comm., 1993). Nevertheless, I was told by the head of Belize's Forest Conservation department that the government has no such policy, and that anyone is free to cut palmito on their own or public lands (Belisle, pers. comm., 1992).

Palmito Preparation

Palm heart can be eaten raw, and is considered a refreshing and filling snack food (August, pers. comm., 1992). It may be eaten this way by people working in the forest, who extract the heart from felled palms. More typically, it is harvested to be cooked. It is known to absorb taste well, and is typically used in stews as a meat substitute. A common recipe is to boil the palm heart, add tomato sauce, black pepper, and onion. It is also used to replace meat in curries. It is commonly fried with onion and pepper, and in this form used to fill *tamales*. At one village on the Belize/Guatemala border, palmito is used to make *ceviche*, a fish-based dish.

Cohune heart is only processed on a large scale at one place in Belize, a private operation on a family-owned farm along the Western Highway. There, the palmito is "canned" in bottles in a weak vinegar solution and sold in this lightly pickled form.

Palmito Consumption

Distribution of cohune heart processing and consumption in Belize are presented in Figure 12. More than any other use of the cohune, palmito's consumption occurs over a range of social, cultural, and economic conditions. The following are the three contexts in which palmito consumption can be most expected.

1. As a delicacy. The "cultural" group that consumes palm heart in this way -- typically from pickled, canned heart added as a garnish to salads -- is tourists. Cohune is the only palm species currently used in this way in Belize. Consumption of this kind occurs within the restaurants of resorts or hotels, or by tourists who buy pickled heart to try out a Belizean "speciality". All palmito sold in canned form derives from the one processing center currently operating in Belize. Its output is available in the supermarkets of Belmopan and Belize City, and in shops in San Ignacio, and is slated for sale in a number of tourist resort gift shops (Redmond, pers. comm., 1992). It is also sold to restaurants in San Ignacio (San Ignacio Hotel) and Belize City (Ramada Inn), on Ambergris Caye (Ramon's, Paradise Hotel, among others), and at rural resorts in the Cayo (duPlooy's, Caesar's Place, Chaa Creek) and Orange Walk (Chan Chich lodge) districts.

2. As a food with religious associations. Among Mestizo groups, rural and non-rural alike, palmito is consumed mainly at All Saint's Day in November and at Easter in April. This is due partly to the connection with Palm

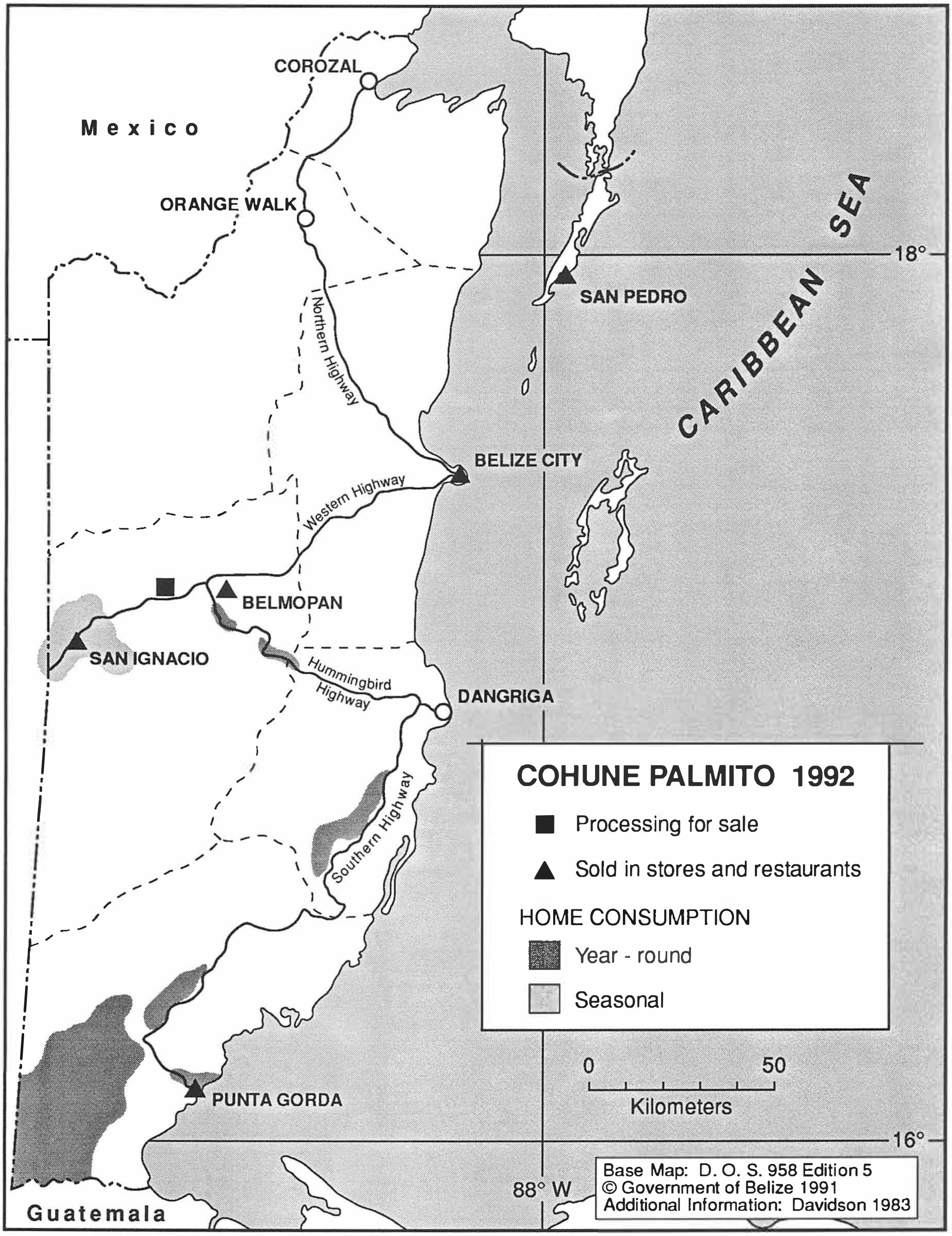

Figure 12 Cohune palmito: Distribution and consumption in Belize

Sunday and because meat consumption is prohibited during Lent, so meat substitutes like palmito are sought. This practice is exclusive to the Catholic Mestizo communities of the Cayo district and is apparently absent in the north of Belize among Mestizo populations of Corozal and Orange Walk. This may be a function of cohune availability as much as of proximity to Guatemala, where palmito consumption is more common. Palmito was formerly a significant part of a door-to-door Easter ceremony at San-Jose Succoths, but the practice has died out (Perez, pers. comm., 1992). The religious affiliation of palm heart means that its consumption in this context tends to transcend socio-economic levels; I found that town dwellers and rural people alike observed this custom.

3. As a year-round meat substitute. Though palmito has little protein value (Brücher, 1989), it is typically consumed as a meat replacement because of its texture and 'filling' quality. Within this context, palmito consumption is confined almost exclusively to two groups. One is Maya (Mopan and Kekchi) subsistence farmers, who traditionally use palmito "when we got no meat" (Ico, pers. comm., 1992). Palmito is not a common food among the Maya, but rather is one of many wild foods to be relied upon in times of scarcity (Wilk, pers. comm., 1993). The second group that commonly uses palmito is the East Indian community of Punta Gorda. Palmito is an occasional meat replacement in curries, with one restaurant specializing weekly in a "cohune cabbage curry".

Among the Creole population, rural and urban alike, cohune heart is not consumed, and I was told by many Creoles that they were simply unfamiliar with it.

Palmito Availability

Palmito's availability to rural populations is a function of the overall abundance of small cohunes in areas proximal to rural settlements, usually fallowed milpa or more advanced secondary forest. The extent of both environments is decreasing under increasingly intensified agriculture. In the Cayo district, where the palm is intensively exploited at certain times of year, several people cited the remoteness of second-growth forests. Where such forests do exist near towns, palmito may be overharvested, as at Trapiche, where virtually all medium-sized cohunes had been cut for heart. The one large-scale processor of palmito in Belize draws on a large network of farmers to ensure a steady supply of palm heart. Once she hears that land is being cleared, she contacts the landowner to ask for permission to send men in to remove palmito from the cohunes. In most cases the cohunes would otherwise be bulldozed in the clearing process and subsequently rot or be burned. In the summer of 1992 she was able to supply all her cohune needs from one 300 acre plot owned by a Mennonite farmer who was scheduled to clear the area in the following season. She often hears about the clearing of more cohune-rich forest than she is able to take advantage of (Redmond, pers. comm., 1992).

Thus palmito is supplied in at least one case by wild, cohune-rich forests that are slated to be cut. Though palmito removal kills the palm and may be considered a destructive form of rainforest extraction, in this case it actually represents the securing of a resource that would otherwise be wasted, "pushed into piles and burned" (Thomas, 1992:5). Thus currently in Belize, the removal of palm heart on a significant, year-round basis is a result of, and not an alternative to, rainforest conversion.

Economic significance of Palmito

The one enterprise in Belize that processes palmito on a large scale employs six laborers. Two men are paid BZ$5 each for fresh-cut heart, and harvested 16 to 20 per week in the summer of 1992 when demand was relatively low. They are paid for all hearts, including those that subsequently turn out to be ant infested. Because the small quota means they need only work one day, the BZ$50 they receive is considered a very good wage, twice what they could make elsewhere in a day. From the 20 hearts, the owner is able to process (can) some 5 cases, with 24 bottles/case. Bottles sell for BZ$8 retail, BZ$6 wholesale.

When a Belizean family requires heart, it is cut in the bush by a family member, or else a local person is paid BZ$2 to $3 to cut it instead.

Alternatives to Cohune Palmito

Several of Belize's 18 palm species (Hartshorn *et al.* 1984) have edible hearts. Cohune and Royal palm (*Roystonea oleracea*) heart is considered relatively sweet; some people with whom I spoke said they preferred the more bitter palmito from the bayleaf (*Sabal* spp.) and cabbage (*Euterpe macrospadix*) palms. Choice of the cohune over other species is thus a matter of taste as well as availability. In the western part of the country where I found palmito consumption most marked, cohune is virtually the only species used in this way because of its relative abundance. In the south, there appears a greater overall abundance of different palm species, and a corresponding relative decrease in the use of cohune (Wilk, pers. comm., 1993).

If non-Belizean palms are considered, alternatives to cohune palmito increase. The advantages of the cultivated peach palm, or *pejibaye* (*Bactris gasipaes*), for example, include its extremely fast growth and multiple stems which allow the repeated use of a single individual (Balick, 1984; Clement, 1988). An industry based on the planting of this species has recently been proposed in Belize (Thomas, 1992).

Despite alternatives, however, the quality of cohune heart is considered to exceed that of most other canned hearts, and is seen to compare favorably with most palmitos on the market (Redmond, pers. comm., 1992; Thomas, 1992).

Discussion

Similar to other aspects of cohune use, cohune heart consumption is most prevalent at the extremes of the socio-economic spectrum. On the one hand it is an expensive garnish for tourist salads, and on the other, a meat substitute for Mayan farmers.

Elsewhere in the neotropics, palmito overexploitation is a problem (Balick, 1984; Peters *et al*., 1991); some people in Belize fear what Balick (1984) describes in Costa Rica as the "decimation" of the native palm stands for palmito. This seems unlikely to occur in Belize. Though there is local depletion of harvestable palmito in forests around villages and towns, the overall demand for cohune heart is relative low. The only sector in which demand is likely to grow (tourism) will be adequately supplied for some time by cohune heart from forests that are to be cut anyway. If there is "decimation" of Belize's cohune stands, it will occur not because of palmito extraction, but rather as a result of citrus and cattle expansion into cohune-rich forests (Belisle, pers. comm., 1992).

Future of Palmito Extraction

There is increasing demand for palmito in the fancy-food market within the neotropics (Balick, 1984b) as well as globally (Brücher, 1989). Although ostensibly this could mean large-scale export-oriented cohune palmito extraction in Belize, economies of scale suggest otherwise. As long as vast stands of wild heart are being exploited in the Amazon basin, and countries such as Costa Rica explore the potential of fast-growing, multi-stemmed palm species for palmito processing (Balick, 1984b), Belize and the cohune are unlikely to ever be a part of the international palmito trade.

Current national levels of use at the household level are met by occasional extraction, but demand within tourist circles (hotels and restaurants) may continue to increase. It will probably be a long time, however, before demand is sufficient to finance the planting of alternative species (as proposed by Thomas, 1992).

Other Uses of the Cohune Palm in Belize

The other uses of the cohune that I confirmed in Belize are described below, and summarized in Table 6. I found no uses that are distinctively Belizean: most of the uses recorded here are also found among related palm species elsewhere in the neotropics (e.g., Strudwick and Sobel, 1988; Anderson *et al.*, 1991).

Snack Food

The coconut-flavored unripened kernels of the cohune fruit may be eaten as a snack, and are especially good when the nut is green. This use seems particularly prevalent among children, who claim to like the taste; I witnessed children eating fruits in the Maya villages on the Southern highway near Big Fall, and at Bullet Tree Falls, San Ignacio, and a Kekchi house in the Valley of Peace, and was told that snacking on the cohune is ubiquitous in Belize's rural areas. Fruits are sold for this purpose at one stall in the Belize market.

Among the Kekchi Maya of southern Belize, Wilk (1991) stated:

> Wild foods are an important supplement to the Kekchi diet...The most important snack foods are palm nuts of at least three species that are often eaten during breaks in agricultural work. Cohune nuts ... are the most important because they are also gathered in large numbers to make cooking oil (Wilk, 1991:150).

Flybrushes

The stem of the fruit panicle is used to create a high-quality and durable flybrush, traditionally used to deter mosquitoes and gnats while a person relaxes. This stem is trimmed of its branches and cut to a 70 cm length, and one end then beaten repeatedly for several hours to disengage the fibers of which it is composed. I recorded the making of flybrushes in four villages: San Jose Succoths, Rockstone Pond, Maypen, and Gayle's Point. Flybrushes produced in these areas (usually by one or two old people) are sold to middlemen for BZ$2.50-$4 who subsequently sell them for BZ$5-$6 in the Belize City market. Flybrushes are also sold locally in craft shops within producing villages for BZ$5 (McCullach, pers. comm., 1992).

Source of Medicinal Plant

Several Belizeans told me that a small epiphytic fern, called callawalla (*Polypodium* [Phlebodium] *decumanum*

Willd.), was a known cure for cancer and grew only in the leaf bases of the cohune (Careas and Silva, pers. comm., 1992). Several other people confirmed this. Although the fern is indeed found in the leaf bases of the cohune stem, and the cohune may be among the few plant supports available in pastures, the callawalla is documented to grow on a variety of substrates (Tyron and Tyron, 1982:691). Balick and Mendelsohn (1992) confirm, however, that the fern does alleviate conditions associated with "cancer," a *bona fide* disease concept among some Belizeans.

Charcoal

In some cases cohune fruits are collected and burned as charcoal for home use, a process exclusive of the burning of shells as a result of oil manufacture. Bee-keepers in particular use the fruit and dried leaf rachis for "smoking" bees, but the fruit tends to burn too hot, and bees' wings are often singed. A Peace Corps volunteer working with beekeepers in Belize is for this reason trying to discourage the use of cohune fruits for "smoking" bees.

Cow Lick

The stem of a large cohune is sometimes cut and/or burned to provide a cow lick. It is typical for a cut cohune stem to ooze liquid for several weeks (Thomas, pers. comm., 1992), and two farmers told me that their cattle are attracted to it because of its saltiness.

Fans

On two occasions I encountered small fans, used for fanning cooking fires, made from woven young leaflets of the cohune.

Ornamental Uses

The global market for exotic palms is currently good (Thomas, 1992; Bol, pers. comm., 1992), and cohune fruits have been sent around the world for cultivation by palm enthusiasts (Thomas, pers. comm., 1992). At least one container (40 ft long, 20 ft tall and wide) of non-viable cohune fruit has been sent to Florida for use in dried flower arrangements (Bol, pers. comm., 1992).

Unconfirmed Uses

Other uses of the palm in Belize for which I found only anecdotal evidence include:

* The making of palm wine from the fermenting of natural palm juices within a hole cut in the trunk. This process was described to me by a bush doctor in Punta Gorda. Production of cohune wine was said by many to once have been common in Altun Ha/Rockstone Pond, but I was unable to verify that fact. Balick (1990b) stated that one palm wine vendor in San Pedro Sula, Honduras, occasionally uses the cohune palm for this purpose.
* The use of fibrous material from the tree base for packing shot in guns (Ico, pers. comm., 1992).
* The use of milky unripened kernels as a frying medium, especially good for tortillas: oily endosperm is melted and used to cook.

DISCUSSION

For all features of cohune use, I found that the mechanics of harvest and manipulation have remained largely unchanged throughout the historic period, and in this respect early descriptions of cohune processing, such as those in Morris (1883), remain unchallenged. The variety and extent of cohune use, however, have both declined significantly since the 19th century. The findings of this survey thus provide an update to earlier work that stressed the commonness of the cohune's exploitation (Stevenson, 1932), and serve to correct recent citations that imply widespread modern use (Horwich and Lyon, 1990; Mahler, 1991). The major findings of the survey are summarized below.

1. *Wild extraction <u>does</u> exist with regard to the cohune in Belize.*

There is extraction of products from naturally-occurring, non-cultivated cohunes in monodominant forests, secondary forests, and pastures. In this respect the cohune can be said to support a wild-based extractive system such as those described by Peters *et al.* (1989) and Anderson *et al.* (1991), and at a lesser scale by Balick (1990b).

2. *The degree of use does not match the desired degree of use.*

It did not come as a surprise that foreigners overestimated the use of the cohune (e.g., Mahler and Wotkyns, 1991; Mallan, 1991), especially given their vested interest in promoting the palm's useful properties to ecotourists. It does seem noteworthy, however, that Belizeans had a poor sense of the degree to which cohune is used -- I was repeatedly told of the myriad ways in which the palm is important, especially to rural people.

Belizeans, rural and non-rural alike, take pride in the fact that many products can potentially be extracted from standing Belizean forest. I found an overwhelming interest among people in talking about the products of the cohune, particularly the oil, that was at odds with the degree to which the oil was produced or used. Like North Americans, the *idea* of wild-extracted goods is one that evokes a simpler, traditional way of life and is romanticized in a way that may not reflect the actual degree to which cohunes or other forest products are used. What is most often forgotten in the lore that builds around wild product extraction is what is most important to those engaged in it: it is hard work.

3. *For those few who use it, the palm is important.*

Among those engaged in the processing or consumption of cohune products at the household level, these activities often comprise a significant portion of their income or contribute in other ways to their household economies. In most cases, poverty was the driving factor behind the use of most cohune products; cohune was often described to me as a "free" product from the bush that could be manipulated for cash or to provide some household need, like a meat substitute or a roof.

Among a small segment of the Belizean population then, the cohune does "increase the chances of survival" (Tomlinson, 1979) and may be considered among other neotropical palms as a "subsidy from nature" (Hecht *et al.*, 1988; Anderson *et al.*, 1991).

4. *The apparent abundance of cohune is not matched by an abundant use.*

The most striking finding of this study is the disjunction between the abundance of cohune in the landscape and the degree to which it is used, such that use of the cohune could be described as negligible. This runs counter to the logic expressed for the *acai* palm in Brazil by Strudwick and Sobel (1988):

> Since acai is such an abundant plant in the region and produces so bountifully, it is natural that local people should use acai's products so much (Strudwick and Sobel, 1988:251)

Nor is the distribution of cohune use spatially coincident with the distribution of high-density stands, the latter of which I usually found in remote areas beyond walking distance from human settlements (see Chapter 2). Rather, its use was most apparent in highly humanized landscapes, where the cohune occurred only in secondary growth and in cohune pasture.

5. *Use of the cohune is most marked at the ends of the socio-economic spectrum.*

Unlike palm products described by Strudwick and Sobel (1988), cohune use is not common throughout all socio-economic levels. Rather, the use of cohune thatch occurs within the poorest and most itinerant members of Belize's population: use for oil occurs only among poor producer families and relatively wealthy townsfolk, and the consumption of palm heart is most common among tourists and Maya agriculturalists.

USE OF THE COHUNE BY THE ANCIENT MAYA

Whether the ancient Maya relied on the cohune is of interest because Mayan use of the palm is cited as a reason for why the Maya might have tolerated the palm's presence in their fields (Wright *et al.*, 1959; Furley, 1975; Scnell, 1987; see Chapter 3). Ethnographic analogy suggests cohune would have been important, since Maya in the historic period used the palm for a variety of purposes (Gann 1918; Thompson 1930; Lundell, 1936; Wilk 1991, pers. comm., 1993). For this reason it is assumed that "[it] is probable that pre-Columbian uses of the Corozo palm were roughly similar to modern uses" (Johannessen, 1957:32). Secondly, if Belize's contemporary forest composition includes all the species present two millennia ago, the ancients would have had few alternative sources of oil for lighting and cooking (not for frying, most likely as an ingredient): the cohune is the only native oil-bearing palm in Belize.

Direct evidence of cohune use by the ancient Maya in Belize is scarce. For example, there are no known depictions of cohunes on Mayan artifacts (Belize Department of Archaeology, pers. comm., 1992), though this may not be too significant as few identifiable plants other than maize are found in Mayan art. Wilk (pers. comm., 1993) suggests that some pottery vessels retrieved from archaeologic digs may be lamps for the burning of cohune oil (as described by Gann, 1918), that are currently being misinterpreted by archaeologists as incense burners.

The only direct evidence that Maya in Belize used the cohune comes from archaeological work off the coast of Wild Cane Cay. There, McKillop (1993) found significant remains of cohune epicarps and endocarps in middens associated with small-scale impermanent settlements dating from the Classic period (250-900 AD). These settlements were probably intended as seasonal salt production areas, from where the salt was traded inland. McKillop (1993) suggested that cohune shell presence indicates either long-distance exchange from cohune forests further inland, or more likely, that relative sea level rise has meant that areas now underwater were once in forest containing cohune (McKillop, pers. comm., 1993).

CONCLUSION

The findings of this study reveal very low levels of cohune use in Belize. Within this context, can cohune-based extraction be fit into the larger literature of extraction from tropical forests?

This is a difficult question. First, cohune product extraction rarely occurs from palms in either primary or advanced secondary rainforest, and so cannot be said to be an alternative to these forests' conversion, as promoted in the extractive literature. Rather, cohune extraction occurs overwhelmingly in agricultural contexts. Heart is cut from fallowed successional forests or from primary forest slated to be cut for agricultural expansion, and fruits are collected for oil manufacture from pastures. Thus the exploitation mainly occurs from palms that are tamed remnants of the original forest, now isolated within a humanized landscape.

Secondly, although the products extracted from cohunes do play a small role in the daily lives of many rural peoples, this extractor population is hardly at what

Dickinson and Putz (1990) call the "cutting edge of rainforest conversion". Rather, their use of cohune is a function of, not an alternative to, the conversion of Belize's cohune-rich forest mainly by citrus and cattle agribusiness (Thomas, Nicholait, pers. comm., 1992).

Even within Belize's extractive context, the cohune appears insignificant, as reflected by its omission from the only two projects in Belize that are attempting to apply the *bona fide* extractive reserve concept to the country's forests (Brokaw and Mallory, 1990; Henderson, 1990; Balick and Mendelsohn, 1992).

But why does a potentially useful, abundant palm have so small a role in Belize's extractive picture? The answer lies in a passage written over three decades ago in reference to Guatemalan palms (which include the cohune):

> If all Guatemalan palms were destroyed overnight, the life of the people would be little affected, because for most of these purposes other plants could be substituted (Standley and Steyermark 1958:58)

Substitutes -- other plants, or manufactured goods -- have moved the cohune to the sidelines of ethnobotanical curiosity: most products originally provided by the cohune are now challenged by more available alternatives. To ignore this fact is to ignore the past 500 years of global floral mixing known as the Columbian Exchange (Crosby, 1972), during which time the coconut arrived in Belize, to name but one of a myriad new species. Furthermore, modern Belize is tied to a global economic system through which it is able to procure manufactured goods like soybean oil and aluminum roofing. As Bates (1988:62) stated: "the isolation and independence of subsistence economies will decrease with increasing regionalization and internationalization of economic systems."

Does cohune have any future contribution to Central or South American ethnobotany? The most promising potential use of cohune populations is as germplasm reservoirs, to be used in the domestication of related, more important palm species. For example, Anderson *et al*. (1991) discuss the genetic manipulation of the Brazilian babassu and the cohune to exploit the latter's relatively thin shells and so improve the efficiency of babassu oil production.

The relegation of a once important palm such as the cohune to the role of a peripheral genetic support for a more widely used species is anticipated by Bates (1988). He provides an appealing framework in which the usefulness of cohunes and other palms may be focussed. He describes three "utilization pools", into which the coconut fits at the primary level and cohune at the tertiary level. At this lowest level, an "astounding variety of products are generally derived from wild stands and marketed locally, if at all" (Bates, 1988:60). He also foresees how the expansion of agriculture in most neotropical countries leads to "continuing decline in the use of wild species and thus contraction of tertiary pools" (Bates, 1988:62). This chapter has documented just such a contraction.

Chapter 5

SUMMARY

It has been the intention of this thesis to both provide a definitive synthesis of current knowledge of the cohune, and elucidate aspects of the cohune-human relationship in Belize.

Chapter 3 argues *against* a human connection with high-density palm stands within Belize's forest. In arguing for an ecological, not anthropogenic, interpretation for their genesis, I point out the flaws in using ancient human agency to explain anomalous plant distributions in the neotropics. Chapter 4 turns the cohune-human relationship around to address the palm's role in rural subsistence in Belize. Although the reliance on cohune products was once important to Belizeans, my data indicate that the exploitation of the cohune has shrunk to near insignificance. With this conclusion, it appears that for the cohune in Belize "the popular misconception of extractive activities as a moribund vestige of [the] past" (Hecht, 1992:383) is, in fact, appropriate.

Both chapters serve to deconstruct prevailing misconceptions about the tightness of the association between people and the cohune in Belize. The result is to illuminate the deception of the cohune "palm landscape," in which the conspicuousness and abundance of the palm in a variety of human settings implies a much greater degree of human interaction than actually occurs. From this perspective, I have come to see the cohune in agricultural settings as an incidental remnant, the only tree left to indicate where forest used to be. In this context, Belize's cohunes contrast most sharply with the coconut landscape that Dixon (1985) described on the Honduran coast. There, the intentional planting of this exotic palm by humans has created an actively used palm landscape. Compare this to the isolated cohunes that are not planted, but rather, revealed, as the forest trees around them are removed: a deconstructed palm landscape.

Beyond this conclusion, however, I hope that this thesis has shown how the study of a single palm transcends the species level to reveal patterns and processes that are occurring among a wide variety of plants. The cohune is not the only forest species whose use is decreasing in Belize (Balick, pers. comm., 1992) nor the only wild resource whose use is overestimated. Similarly, cohune stands are not the only natural associations whose origins are incorrectly interpreted (Lambert and Arnason, 1982). It is hoped that this thesis has provided an example of the problems inherent in attempts to understand or exploit wild resources that will resound within other ethnobotanical and ecological studies.

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APPENDIX

A History of the Study of Cohune Distribution

In 1932, Standley determined in his extensive botanical investigation of Belize, Mexico, and Guatemala that the tall native palm called *cohune* or *corozo*, which had been known scientifically as *Attalea cohune* since its naming by Martius in 1836 (Bartlett, 1935), belonged not to the *Attalea*, but to *Orbignya*[1], a genus then known only to South America. Standley's range for the new *Orbignya cohune* (Mart.) Dahlgren spanned the isthmus from east to west,

> ranging from British Honduras and probably Quintana Roo [Mexico] to Honduras and *perhaps also as far as Nicaragua or even Costa Rica*...it ranges northward through western Mexico to Jalisco, and is reported as particularly plentiful in the state of Oaxaca (Standley 1932:1) [italics added].

This distribution was repeated by Martinez (1936) and Dahlgren (1936), who included *O. cohune* in his list of Salvadoran palms.

In 1949 a Mexican report recognized for the first time that what had been considered one species, *O. cohune*, was in fact two: *O. cohune* and *O. guacuyule*, each with distinct, non-overlapping ranges (Glassman, 1977). This distinction was recognized by Johannessen (1957), who mapped the respective ranges of the species, showing *O. cohune* to exist only on the Atlantic side of the isthmus, from Mexico to no further south than Mosquitia. By comparison, *O. guacuyale* occurs only on the Oaxacan coast (Pennington and Sarukhan, 1968). In their Flora of Guatemala, Standley and Steyermark (1958) maintained that *O. cohune* only occurred in the Atlantic lowlands, but reiterated Standley's 1932

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[1] McCurrach (1960) and Usher (1974) are two authors who have used the older name *Attalea cohune*.

speculation that it occurred "perhaps as far south as Costa Rica." Despite no other author's mention of so southern a distribution, and Dahlgren's definite omission of *O. cohune* from Nicaragua and Costa Rica as early as 1936, the suggestion became "fact" in Furley (1975:32). In his article on the cohune, Furley closely paraphrased Standley's 1932 paper, stating "the cohune palm is mostly located in the wetter Atlantic lowlands from Jalisco and Oaxaca in Mexico south to Costa Rica and Nicaragua" (Furley, 1975). Not only is Oaxaca not in the "wetter Atlantic lowlands", *O. cohune*'s absence there had been confirmed since 1949.

Most likely as a result of Furley's (1975) prominent error (his article appeared in the widely-cited journal Biotropica), the incorrect range for *O. cohune* has persisted in the literature. Williams (1981) suggested the tree might be present "perhaps to Costa Rica", and a Belizean guide book to Guanacaste Park says the same. Despite the clear absence of the cohune from a checklist of Costa Rican trees (Hartshorn and Poveda, 1983), we continue to find references to a more southern distribution. For example, Brücher (1989) stated the tree occurred "from southern Mexico to Costa Rica."

The cohune's existence in Belize, however, is beyond question, despite FAO's (1989) failure to include the country in the species' range. Furthermore, it is the only *Orbignya* in the country and its unmistakable form makes it easily distinguishable from the 17 other palm species in the nation (Hartshorn *et al.*, 1984).

VITA

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