Chapter 5: Goods from the Woods: The Harvest of Timber and Non-Timber Forest Products in Belize

Robert Heinzman and Conrad Reining, with Michael J. Balick

The Logwood Period

The forests of Belize have been logged for over 300 years, primarily for export, beginning with British settlers in the 1600's (Munro, 1989). One of the earliest and most important species was logwood (*Haematoxylon campechianum* L.), also known as *palo tincta* or *ek*. This was used to produce a vegetable dye used by the European textile industry in the 18th century, with exports reaching their peak in 1756. Gibbs (1883, cited in Standley and Record, 1936) noted:

> "If, as by the adoption of her totem and appropriate motto [*sub umbra floreo*], the Colony of British Honduras would appear to consider herself indebted (if at all for past prosperity), mostly to another tree [Mahogany], it is to Logwood she certainly owes in the first instance her existence." (p. 28)

British privateers cruising the waters around Belize would seek to capture the Spanish traders bringing logwood to Europe, and, after offloading their cargo, set fire to their vessels. Gibbs (1883) continues,

> "But it so happened that a Captain James, the master of a letter of marque, having captured a Spanish vessel the cargo of which consisted of this wood, brought the ship and cargo into the Port of London. On endeavoring to dispose of the latter he was gratified as well as surprised to find for it a ready sale at an enormous price per ton. The crew, who had used up a portion of the precious freight to burn in the galley fire, had little idea that they were using fuel at a *hundred pounds* per ton during the voyage! The fame of this dyewood soon spread, and privateers were fitted out and dispatched to cruise off the Main, for the especial capture of Logwood-laden vessels, on their passage home to Spain from his Catholic Majesty's possessions in the 'Indies.' In course of time, as prizes became scarcer, protecting cruisers of the Spanish navy more abundant, the crews of the privateers found it more profitable to search for the wood on shore, cut it, and load their vessels with it." (p. 29)

In a fascinating book by Daniel Morris, director of "Public Gardens and Plantations," Jamaica, entitled *The Colony of British Honduras, its resources and prospects; with particular reference to its indigenous plants and economic productions* (1883), the author recounted his travels of over one-thousand miles of trails and rivers in Belize, undertaking studies of the native flora and agricultural production. He offered insights on the production of many of the economically important native plants of the day, and suggested potential crops for the Colony while at the same time expressing great concern for the conservation and rational use of the natural resources in the region— an unusual act at that time:

> "I am too deeply sensible of the results which usually follow the extensive and reckless cutting down of tropical forests, to advocate a wholesale denudation of crown lands in British Honduras. I trust, therefore, the question of retaining in permanent forest the chief watersheds of the country, as well as wooded belts in the neighborhood of streams and springs, will receive the earnest and careful attention of the legislature." (p. VI)

At one stop on his journey, he observed the production of logwood:

> "After the trees, which are seldom more than a foot in diameter, but often only half this size, are cut down, the outer or sap wood is removed, leaving nothing but the inner dark-coloured heart wood. When thus prepared, the logwood is carried on trucks or 'crooked' to the nearest bank, where to prevent it from sinking, it is packed in 'bark-logs' or light, buoyant cradles, capable of carrying a ton or two of logwood. An immense train of these heavily-freighted 'bark-logs' is often met with on its way down the river, or anchored at night in the middle of the stream." (p. 49)

Timber

From their peak in the mid-18th Century, exports of logwood declined, except for a brief period during the First World War, and mahogany (*Swietenia macrophylla* King.), also known locally as *chacalte* and *sutz'uj* became the primary timber exported from Belize (Duncan, 1968). With the rise of the synthetic dyes, logwood was forever consigned to minimal importance as a raw material for commercial industry. Interestingly, in recent times, there has been a resurgence of demand for logwood from Japan.

Shipbuilders in the United States and Europe, as well as furniture-makers, helped stimulate the demand for mahogany from Belize, which was valued for its appearance and workability (Munro, 1989). According to Standley and Record (1936), at that time mahogany comprised "nearly three-quarters of the total value of produce from the Colony." Gibbs (1883) noted that

> "Reliable returns are not procurable farther back than 1802, when 2,250,000 feet are mentioned in the quantity exported; 1803, 4,500,000 feet; 1804, 6,481,000 feet. In 1824 it had kept the same figure; in 1840 it was reduced to 4,500,000 feet…" (p. 117)

Morris (1883) described in great detail how trees of mahogany were identified, harvested and taken to market.

> "When it is intended to open a mahogany works on any part of an estate, the first step is to employ a 'hunter,' or experienced woodman, who spends several days alone prospecting in the forests. After an absence, longer or shorter according to circumstances, during which he often suffers many privations, the hunter returns and reports the number and character of suitable mahogany-trees to be found within easy reach of the works; the latter being always placed at a convenient spot on the bank of the river where the mahogany logs can be manufactured and easily tumbled into the river.
>
> The 'hunter' is paid so much for every tree, which, on examination, is found suitable for cutting, i.e., squaring 18 inches and upward. The next step is to open a tract to it and proceed to cut it down. Owing to the huge buttresses, which many mahogany-trees possess, a platform is sometimes erected so as to enable the men to cut the tree above them. When lopped, cleaned and sawn to the available length, the log is ready to be hauled to the works.
>
> During the dry months of the year the logs are carried on trucks drawn by bullocks. The truck is a ponderous framework, mounted on four broad wheels about

3 feet in diameter, with 9 inches of tread, the latter being made in a most primitive fashion by sawing pieces across from a log of Santa Maria. During wet weather, when the ground is too soft for the trucks to travel, mahogany is drawn on slides, or a kind of sleigh, which passes over 'skids.' The latter consist of long, hard wood posts, about 3 inches in diameter, placed across the track about a yard apart.

> Being imbedded in the mud, the fresh slippery bark affords a suitable and handy surface for the passage of the slide with its heavy load. Sometimes mahogany logs are drawn, in the manner above described, distances of 8 or 10 miles. Mahogany is always trucked in the middle of the night, the cattle not being able to perform such laborious work during the heat of the day. It is a picturesque and striking scene, this midnight trucking.
>
> "The lowing of the oxen, the creaking of the wheels, the shrill cries of the men, the resounding cracks of their whips, and the red glare of the pine torches in the midst of the dense, dark forest, produce an effect approaching to sublimity. At the works the logs are regularly squared and prepared for the market. If however, they are likely to be chafed and injured in transit, by going down shallow creeks, the squaring is done at Belize [City], or at the river's mouth."
>
> Trucking is generally carried on during the months of April and May, when the ground is hard after a long period of dry weather. About the middle of June, after the May 'seasons,' or rains, the rivers are swollen and advantage is taken of this opportunity to tumble the logs into the water, and float them down to about 10 miles from the river's mouth. Here a large iron chain, or 'boom,' is fixed, which stops the logs as they float down. At this point the several owners select the logs by their respective marks, form them into rafts, and so float them down to the sea, and ultimately to Belize, whence they are shipped abroad." (p. 47-48)

Spanish cedar (*Cedrela odorata* L.), in the Meliaceae, the same family as mahogany, was harvested from the forests of Belize as well. Its fragrant scent, durability and ease of workmanship made it ideal for furniture and dugouts, and it was exported for boat building and the manufacture of cigar boxes (Standley and Record, 1936). They report that, "During the four years from 1924 to 1927 the average exports were 46,293 cubic feet of logs, valued at £ 8172, or 2.6 per cent of the value of all forest produce."

Another historically important timber was rosewood, *Dalbergia stevensonii* Stand., a member of the Fabaceae. According to Standley and Record (1936), it:

> "… is one of the best-known timbers of the Colony, although the amount exported has never been very large and for the past forty years the use of the material has been confined chiefly to the making of bars for xylophones manufactured in the United States. It has been an article of export for about a century and there is a record of 118 pieces having been shipped in 1841." (p. 32-33)

Unlike logwood, when the natural dye market disappeared in the mid- to late-1930's, export volumes of rosewood did not drop (Table 5.1). Instead, rosewood became an important forest resource not as a natural dye, but as a decorative hardwood. The Forestry Report of 1934 mentions that demand for dyewood was diminishing in the face of competition from Madagascar wood (species uncertain), presumably a dyewood from that African republic. The report also states that trial commercial shipments of rosewood "undoubtedly drew the attention of the [hardwood] market to this wood."

That such attention resulted in increased exports of rosewood can be seen in 1935. Data in the years after 1935 are presented in Table 5.1, though it more reflects demand for timber rather than dyewood. Some dyewood is likely included in these exports, though the level of demand is uncertain.

Pinus caribaea Morelet var. *hondurensis* (Seneclauze) W.H. Barrett & Golfari is used locally in Belize as a construction material, fuel and medicine. This tall tree is harvested commercially and sawn for local use. It is one of the dominant vegetation types of the Mountain Pine Ridge area, although in recent times it has been destroyed by the Southern pine bark beetle. Reforestation efforts are needed to restore this important ecosystem. The aromatic resin that exudes from the trunks of fallen trees is prized as incense burned to ward off evil influences in homes and businesses. The same resin is soaked in rum with other plant species and taken as a virility tonic for men.

Over time, reserves of the main timbers exported from Belize have declined, and in the 1920's, the need for more careful management of local forests was recognized (Munro, 1989). This led to the formation of the Forest Department in 1922 (Standley and Record, 1936).
Management systems were implemented in Belize, and silvicultural programs developed for the major export tree species such as mahogany. However, as Munro (1989) concluded,

> "It is clear that the forest industry which was once the mainstay of the Belizean economy can no longer rely on the production of primary timbers. This fact has been realized for some time by those who have advocated the development of the domestic market for local timber and the use of a wide range of lesser known tree species, principally secondary hardwood timbers." (p. 112-4)

He also pointed out that the percentage share of domestic export income from forest products during 1969-80 had fallen from 7.2% to 2.4%. The advocacy of the use of secondary hardwoods from Belize began early with Hummel (1921), which he said were "very useful, but they have remained neglected" (Munro, 1989). Opposition to the use of secondary hardwoods was based on the cost of logging and transport, as well as the fact that these hardwoods hindered the regeneration of mahogany. As Munro points out, "The efforts of Hummel, Oliphant and Woods in the 1920's to promote the use of secondary hardwoods were finally to achieve some success 30 years later." By the 1960's, a domestic market was established for secondary hardwoods. He concludes that the evolution of timber production from a purely exploitative industry to one that is attempting to move towards sustainable yield is now taking place in Belize. In addition, the utilization pattern has gone from local use and export of a few primary timber species to the development of markets for:

> "… a wider range of lesser-known secondary timbers, many of which have a useful role in construction… The changes that have taken place have been born of necessity in the face of dwindling stocks of export earning Mahogany and Cedar. A reappraisal of forest resources has therefore been a vital part of the forest industry's strategy for survival since Hummel's 1921 report on the forests of British Honduras. The move towards an increased use of secondary hardwood timbers supplying both the domestic and overseas markets has, however, largely been a post-war phenomenon, only made possible by the dissemination of improved knowledge about the lesser-known species, the development of a sawmilling industry and the revolution in transport." (p. 125-6)

Table 5.2 lists the principal secondary hardwood timber species of Belize as compiled by Munro (1989). Data on timber production from 1977-1982 is provided in Table 5.3 (Hartshorn *et al*, 1984). The harvest of secondary hardwoods now exceeds that of mahogany, cedar, and rosewood.

TABLE 5.1 Export Data For Several Non-Timber Forest Products. Source: Forestry Reports (Government Information Service, 1922-1989)

Year	ALLSPICE *Pimenta dioica*	Value	CHICLE (a) *Manilkara achras* *Manilkara chicle*	Value	COHUNE (b) *Orbignya cohune* (lb.) (gal.)	Value
1923			244, 594	107,217		
1924		508	306,167	139,301		
1925		192	334,592	154,875		
1926		1,559	259,846	111,943		
1927		3,915	460,176	204,618		
1928		6,651	441,886	193,963		
1929		5,760	598,286	275,383		
1930		7,668	373,408	171,797		
1931		3,274	300,651	181,508		
1932		9,413	264,262	125,870		
1933		18,641	726,784	210,031		
1934		35,068	787,526	199,572		
1935		9,250	787,416	174,874		
1936		5,836	767,152	191,069	585,568	18,734
1937		5,363	659,916	189,186	224,070	11,107
					877,385	
1947		15,225	1,420,160	1,311,080		
1937-47**		11,228	1,084,000	833,962	288,000	
1950		12,646	806,100	1,002,451	298,300	31,933
			28,100		2,697	4,276
1951		29,536	835,551	950,347	175,800	20,666
					15,471	28,424
1952		22,323	612,721	624,838	320,000	41,716
					8,178	15,990
1953					7,938	16,444
1954			172,000	125,884		

1955		37,562	590,900	528,581	537,800	48,353
			54,800	54,150		
1956		21,536	461,400	470,333	216,373	46,663
			127, 000	102,543		
1959						
			169,006	121,221		
1962	82,000		350,000	391,546	1,000	73
			40,000	33,071		
1963			214,000	235,408	2,200	166
			28,000	24,971		
1964						
1965	145					
1966			196,900	187,808		
1968	94		107,800	104,374		
1969	6,285		62,000	56,753		
1970	3,824		137,000	130,699		
1971	28,486		137,000	130,699		
1983						
1984						
1985						
1986						
1987						
1988			110,569	378,000		
1989			200,000	600,000		

*All values are in Belize dollars for the year given. No adjustments for changes in currency value have been made. Values are assumed to be f.o.b.

** This is the annual average export over the period 1937-1947.

TABLE 5.1 (Cont'd)

Year	DYEWOOD Logwood Amt. (tons)	Value	Rosewood *Dalbergia stevensonii* Amt. (tons)	Value	ORNAMENTAL PLANTS Izote Amt. (#)	Orchids (c) Amt.(#)	Value	PINE SEEDS *Pinus caribaea* *Pinus patula* Amt. (lb)	Value	Tourism No.Tourists	Value
1923			23								
1924	820	13,125	20								
1925	609	15,225	24	5,362							
1926	667	16,531	76	2,315							
1927	332	8.405	137	2,925							
1928	1,046	25,564	435	9,601							
1929	200	5,986	249	6,118							
1930	225	5,130	62	1,870							
1931	268	5,803	6	135							
1932	103	1,545									
1933	136	1,702	36	730							
1934	105	1,180	37	637							
1935	183	1,997	263	6,864							
1936	156	1,745	297	8,518							
1937	114	3,382	251	7,672							
1947			320	13,042							
1937-47	10	435	142	8,951							
1950											
1951											
1952											
1953								226	2,260		
1954								209	2,086		

TABLE 5.1 (Cont'd)

Year	DYEWOOD Logwood Amt. (tons)	Value	Rosewood *Dalbergia stevensonii* Amt. (tons)	Value	ORNAMENTAL PLANTS Izote Amt. (#)	Orchids (c) Amt.(#)	Value	PINE SEEDS *Pinus caribaea* *Pinus patula* Amt. (lb)	Value	Tourism No.Tourists	Value
1955								96	955		
1956								194	1,940		
1959								1,640	16,400		
1960								1,036	15,540		
1962								200	2,500		
1963								461	6,915		
1964											
1965											
1966						4,134	150	247	1,960		
1967								516			
1968						4,571	526	1,279	23,438		
1969								1,297	23,909		
1970								6,947	43,351		
1971											
1983										8,120	11,197,480
1984										9,280	12,797,120
1985										12,905	17,795,994
1986										15,080	20,795,320
1987	78	42,000				800	4,000			17,690	24,394,510
1988						800	4,000			21,460	24,394,510
1989					720,000						29,593,340

(a) Reporting distinguishes between the latex of *M. achras* and *M. chicle* between the years 1950- 1963 only.
(b) All figures here for the years 1950-1953 are for exports of nuts and oil, listed in that order. Volumes are pounds and gallons, resp. For the year 1937, the figures given are for pounds of nuts and pounds of charcoal, resp.

(c) Number and value of plants exported in recent years are estimates.

TABLE 5.2

Common and Botanical Names of Principal Secondary Hardwood Timber Species (Munro, 1989)

Aguacatillo or Timbersweet	*Nectandra globosa* (Aubl.) Mez.
Balsam	*Myroxylon balsamum* (L.) Harms, var. pereirae (Royle) Harms
Banak	*Virola koschnyi* Warb.
Barba Jolote or Black Tamarind	*Pithecellobium arboreum* (L.) Urban
Billy Webb	*Acosmium panamense* (Benth.) Yakovlev
Bitterwood	*Vatairea lundellii* (Standl.) Killip
Black Cabbage Bark	*Lonchocarpus castilloi* Standl.
Black Maya	*Miconia* sp.
Black Poison Wood	*Metopium brownei* (Jacq.) Urban
Bobwood	*Annona glabra* L.
Boy Job	*Matayba oppositifolia* (A. Rich.) Britton
Bullet Tree	*Bucida buceras* L.
Bullhoof	*Drypetes brownii* Standl.
Cabbage Bark	*Andira inermis* HBK
Candlewood	*Dracaena americana* Donn. Smith
Carbon	*Tetragastris stevensonii*
Chicle Macho	*Achras chicle* Pittier
Cortez	*Tabebuia chrysantha* (Jacq.) Nicholson
Cotton Tree	*Ceiba pentandra* (L.) Gaertn.
Cramantee	*Guarea excelsa* HBK
Fiddlewood or Yashnik	*Vitex gaumeri* Greenm.
Glassywood	*Guettarda combsii* Urban
Gombolimbo, Red	*Bursera simaruba* L.
Gombolimbo, White	*Gilibertia concinna* Standl.
Granadillo	*Platymiscium yucatanum* Standl.
Hog Plum or Jobo	*Spondias mombin* L.
Ironwood	*Dialium guianense* (Aubl.) Steud. and Lapacea haematoxylon
Jobillo or Palo Mulato	*Astronium graveolens* Jacq.
Mahogany, Bastard	*Mosquitoxylum jamaicense* Krug & Urban
Mahogany, Southern Wild	*Tapirira guianensis* Aub.
Mammee Apple	*Mammea americana* L.
Mammee, Wild	*Alseis yucatanensis* Standl.
Mangrove, Red	*Rhizophora mangle* L.
Mapola	*Bernoullia flammea* Oliver
Mapola	*Bombax ellipticum*
Mayflower	*Tabebuia rosea* (Bertol) DC
Moho, Narrowleaf	*Belotia campbellii*. Sprague
Moho	*Heliocarpus donnell-smithii* Rose
Moho	*Heliocarpus mexicanus* (Turcz) Sprague
Mylady	*Aspidosperma megalocarpon* Muell. Arg.
Nargusta	*Terminalia obovata* (R. & P.) Steud.

Negrito	*Simarouba glauca* DC
Oak	*Quercus* spp.
Palacio	*Casearia beliziensis* Standl.
Palo de Sangre or Kaway	*Pterocarpus* spp.
Polak or Balsa	*Ochroma limonensis* Rowlee
Prickly Yellow	*Zanthoxylum kellermanii* Wilson
Provision Tree	*Pachira aquatica* Aubl.
Quamwood	*Schizolobium parahyba* (Vell.) S.F. Blake
Redwood	*Erythroxylum areolatum* L.
Redwood, Bastard or John Crow	*Sickingia salvadorensis* Standl.
Rosewood	*Dalbergia stevensonii* Standl.

Table 5.3

Recent timber production (m^3) statistics for Belize

	1977	1978	1979	1980	1981	1982
Mahogany and Cedar	9,571	13,662	13,441	15,148	14,220	17,215
Pine	4,307	2,943	3,797	2,151	4,123	5,850
2° Hardwoods	13,895	15,514	17,855	23,957	19,697	18,750
Rosewood	504	258	3,509	2,541	357	458
Ziricote	5	126	18	36	38	55
Logwood	-	-	-	-	-	132
Totals	28,282	32,503	38,620	43,833	38,435	42,460

***Data provided by O. Rosado, Forest Department**

Non-Timber Forest Products in Belize

Non-timber forest products (NTFPs), in the context of this study, are defined as all products and services of forested ecosystems with the exception of timber destined for dimensioned lumber. Thus, the discussion is restricted to natural forests. A natural forest, even one quite heavily modified or managed, retains a level of plant and animal diversity that far exceeds, often by an order of magnitude or more, plantations and simple agroforestry systems. Examples of NTFPs in Belize include latexes, spices, ornamental plants, resins, fruits, seeds, fibers, medicinal plants, charcoal, fuelwood, wood for artisanal purposes, and forest-based tourism. Ecosystem services such as watershed, soil, wildlife and germplasm protection, while also NTFPs, are not considered herein, nor are animals or animal products, such as skins, live birds, butterflies and honey. The data collected by Robert Heinzman and Conrad Reining for this chapter are the result of a three-week trip to Belize in 1989, interviewing local bushmasters, farmers, merchants, scientists, ecotourism operators, and governmental officials in Cayo, Corozal, Orange Walk, Toledo and Belize Districts.

The Importance of Non-Timber Forest Products

The high diversity of flora and fauna in tropical forests is well documented, especially as compared with temperate forests. Often, however, this diversity is perceived to be a hindrance to increasing the productivity of forestland. The result can be a vast reduction in diversity as highly simplified agricultural, silvicultural and livestock production systems are imposed that replace the original forest. Yet abundant research attests not only to the negative ecological impacts of forest conversion, but to the often short-term economic production derived from cleared lands. Such knowledge challenges those whose income depends of the forest to find ways of increasing the productivity of species-rich forest without sharply compromising the diversity of these forests.

By developing markets— or placing greater emphasis on existing markets— for large numbers of forest species, while carefully controlling exploitation, three results are achieved. The first result is an increase in the value of the intact, natural forest. Though individual products and services may not have substantial value, in combination that value may be significant indeed. Second, by using larger numbers of products, the rural producers, and the country as a whole, are more insulated from the vicissitudes of external markets, inadequate infrastructure, and natural disasters that can make dependence on a limited number of products and services a risky venture. Third, conservation of species-rich forests and associated ecosystem services does not conflict with the welfare of rural people and may help maintain, if not improve, the level of local and regional socio-economic wellbeing (May, nd).

Forest Reserves in Belize

Hartshorn *et al.* (1984) cited 6,368 km^2 (2,488 mi^2) of reserved forest in Belize, 6,219 km^2 (2,431 mi^2) of national lands, 282 km^2 (110 mi^2) of reserved land in Toledo District, 56 km^2 (22 mi^2) of conservation areas, and 8,397 km^2 (3,283 mi^2) of private land. This total of 21,322 km^2 (8,337 mi^2) was virtually all of the 21,555 km^2 (8,428 mi^2) mainland area of Belize. How much of each land category remains forested is unclear, but estimates in 1989 were that at least 60% of the country was covered by intact forest, with additional areas of disturbed forest (Steven Szadek, pers. comm.). With increases in population, spurred in part by Guatemalan and Salvadoran immigrants, combined with the expansion of export-oriented agriculture and pasture development, significant reduction in the country's forests has occurred. There have been several transfers of forested national lands and reserved forests to agricultural production (Tropical Forestry Action Plan, 1989).

Belize is part of a larger bioregion that includes Chiapas, Mexico and the Petén, Guatemala to the west and the Yucatán Peninsula to the north. It is referred to as the Maya Bioregion. Vegetation types are quite similar throughout this region, as are many of the forest-based economic activities. *Chicle* (*Manilkara zapota* (L.) van Royen), and *ramón* (*Brosimum alicastrum* Sw. subsp. *alicastrum*), mahogany, cedar, and cohune palms (*Attalea cohune* Mart.) are important forest components (Snook, 1988; Wagner, 1964).

Non-timber forest products fall into two categories. The first category is those products that are harvested for international or large national markets. These forest resources are relatively easy to identify, and quantitative data is readily available. The second category includes forest resources used in both national and local markets. Quantitative data for these products are often difficult to find, as both prices and volumes fluctuate from community to community depending on several factors: seasonality, relative abundance, and customs regarding collection times and processes. Indeed, some forest products are traded between individuals and communities rather than entering the commercial market, do not enter the public record, and are thus difficult to quantify.

In the list below, NTFPs are listed alphabetically by common name. Certain NTFPs are grouped within use categories (e.g. construction materials, palm products). These are listed alphabetically. Production data is presented in Table 5.1. Much of this information has been derived from Forestry Reports, first produced by the Forest Trust of British Honduras, and still later by the Forest Department of Belize. The final Forestry Report examined was from 1971, but that was a mirror copy of the report of 1970. Subsequent reports are somewhat cursory in nature.

Allspice (*Pimenta dioica* (L.) Merrill)

The fruits of this mid-canopy species are harvested when ripe, usually from mid-July through September, and are sold in local markets throughout Belize. The dried seeds are used in a variety of dishes and the green leaves make a refreshing tea. Exports are first mentioned in the Forestry Report of 1962, as summarized in Table 5.1. It is likely that exports continued beyond 1970, but as with many of the products in this list we could find no data for the period 1970-1987.

Harvesting has traditionally been by scaling the trees, in the manner of *chicle* harvesters, and cutting off fruit-laden branches. The tree grows a new canopy and can be harvested again after an undetermined number of years. Guatemala also has an established marketing structure that harvests, transports, processes and exports the spice to other countries. It appears that little allspice is exported from Belize. In addition, the Belizean populations of *Pimenta dioica* have suffered from the practice of felling trees to get access to the fruiting canopy, as have populations in other parts of the bioregion. Felling allspice trees for their fruit is not new— the Forestry Reports of 1962 and 1966 mention that several people were prosecuted for felling trees. Though some enforcement occurred in the 1960s, we are unaware of current efforts to curb illegal felling.

Chicle (*Manilkara zapota* (L.) van Royen; *M. chicle* (Pittier) Gilly)

Historically, the latex of this common forest emergent has been the most important NTFP extracted from the Maya Bioregion. Bolt (1961) noted that the Maya used this plant for the manufacture of chewing gum for centuries prior to the arrival of the Spanish. Santa Ana, the Mexican General of Alamo fame, introduced *chicle* gum to the United States. A Louisville druggist, John Colagan, was the first to add flavor to the *chicle* gum, developing the prototype of the modern chewing gum sold throughout the world today (Anon., 1957). *Manilkara* gum base was widely known by 1860, and the habit of chewing gum spread throughout the U.S. and following this, to Europe.

Harvesting probably started in the Petén, Guatemala (Soza, 1970) and in the forests of southern Mexico (Snook, 1988) in the 1880s. In Belize, which has dense populations of *Manilkara zapota* in the northern plains and *Manilkara chicle* in the southern Maya Mountains, it is less certain when tapping began. The Forestry Report of 1924, the earliest we could obtain, indicates substantial latex production in 1923. Thus, the industry was well developed by this time.

Production for the entire Maya Bioregion was 5.45 million kg annually from 1927-1929. In 1930, output of *chicle* rose to 6.4 million kg with a retail market value of US $70 million (Standley and Williams, 1967: 8(3): 222-228). Principal importing countries included the U.S., U.K., Canada, Italy and France. Output fell with a drop in demand during the economic depression of the early 1930s. Consumption in the U.S. alone dropped by 50% and, as most companies retained a reserve stock to last 3-4 years, demand remained curtailed according to The Forestry Report of 1933.

Prior to the closing of the Guatemalan border with Belize in 1934, most of the production of Guatemala was exported through Belize City. For example, 1928 production from the forests of Belize was 209,1171 kg but exports were 1,167,743 kg. In 1934, Belize produced and exported the same amount, though by 1937 it appears that the border once again became leaky and the Colony was re-exporting latex extracted from Petén. In the 1940s production peaked again. In 1942 Mexico produced a peak of 3.27 million kg (Snook, 1988). In 1947 Guatemalan production peaked at 2.23 million kg (Soza, 1970). From Table 5.1, it appears that the production of *chicle* in Belize also peaked during this period, with an average annual export from 1938 to 1947 of 0.5 million kg.

First mention of different grades of *chicle* appear in the Forestry Report of 1950, though the difference between grades is not consistently indicated until the Forestry Report of 1953. A distinction is made between the exportation of 'crown gum' and *chicle*. Crown gum is the lower quality latex of *Manilkara chicle*, harvested in the wetter, higher altitude south. *Chicle* is the higher quality latex of *Manilkara zapota*, which originates in the lower, drier forests of the north and west. The lower value crown gum was mixed with higher-grade *chicle* latex, or sold as secondary grade latex throughout the history of *Manilkara* exploitation.

By the mid-1950s, international demand for both classes began to decline. Petrochemical substitutes developed during World War II provided a less costly gum base of higher consistency and began to replace the more costly and variable natural forest product. For example, Mexican production dropped in 1952 to 0.68 million kg, a decrease of 80% from a decade before.

Despite such trends, demand for Belizean production remained relatively constant in the 1950s, perhaps because of the strong commercial ties with the U.K. and, more importantly, with the U.S. through the presence of international investment. However, the market was weakening in Belize, as reflected in the Forestry Report of 1956, which indicates that demand was shifting towards purer, higher quality latex of *Manilkara zapota*. Moreover, demand for first grade *chicle* had suffered because of adulteration, and therefore inconsistent quality, with second-class *Manilkara* latex and the latexes of other species such as mamey apple— *Pouteria sapota* (Jacq.) H.E. Moore & Stearn. One of the bushmasters we worked with told us that adulteration was so rampant that it also included black sap from the very toxic *Metopium brownei*. Such complaints of reduced quality through adulteration are echoed today by both importers of *chicle* from the region and contractors responsible for fulfilling contracts with exporters.

The drop in international demand was soon felt in Belize— production fell to 62,273 kg in 1970 and, by the mid-1980s, production was nearly zero (TFAP, 1989). Table 5.1 suggests that a resurgence in demand is occurring. Mexico exported 64,545 kg in 1987 (Snook, 1988), and Guatemalan production, though fluctuating in the 1980s between 61,818 and 124,090 kg per year, appears to be increasing (AGEXPORT, 1989). Demand was only for the latex of the highest purity and quality, hence only the latex of *Manilkara zapota* of the northern forests was being extracted. In 1988, this demand originated almost entirely from Japan and, to a lesser degree, Italy.

The value of production, as a percentage of total forestry exports from Belize during the late 1920's was approximately 10% (forestry production represented over 80% of all exports). This percentage increased to over 30% during the Great Depression as the higher value hardwood trade was more severely curtailed. Latex production in 1988 was again 10% of forestry exports, yet the entire forestry sector, approximately $6,000,000, represented only 3% of total exports.

The traditional way of tapping latex is described by Heyder (1930), cited in Standley and Record, 1936:

> "The tapping season is during the set months of the year, roughly from October to March, and it begins after the period of heaviest rain, which usually comes about mid-September. Tapping depends greatly upon climatic conditions and a dry year implies a very scanty yield of chicle. The natives who carry out the tapping are Spanish Indians; that is, Maya Indians with a varying admixture of Spanish blood… The equipment of the chicle tapper, or 'chiclero' as he is called, consists only of his 'machete,' which is a keen-edged cutlass with a 28 inch blade, a long coil of stout rope, a dozen small canvas bags proofed with rubber obtained locally from rubber trees (*Castilla elastica*) which grow wild in certain parts of the forest, and a few empty kerosene tins of about 3 gallons' capacity. The chicleros generally work together in parties of four or five, and they form camps in the forest, temporary shelters of sticks and palm leaves. They bring with them flour and beans sufficient to last several weeks and supplement this ration by shooting peccaries, curassow, and other small game. As their work progresses they move camp every week or ten days and thus cover large areas allotted to the contractor for whom they are working.
>
> The method of tapping Sapodilla differs considerably from methods used in rubber tapping, and is more analogous to the tapping of gutta-percha. There is no continuous flow as in the case of rubber, and the healing of tapping cuts and

replacement of latex is extremely slow. After one day's tapping the tree is usually allowed to rest for a period of three years or more, according to the area of bark, which has been cut. The method which is used generally in Central America is to make zigzag cuts in the bark, about eighteen inches apart, all the way up the tree, from about two feet above the ground to the first branch. The zigzag pattern of the cuts originates from the fact that it can easily be made with the 'machete', which every native carries in the forest in Central America… Where the zigzag cuts have been made for more than two-thirds of the way around the stem, or where the cuts have been made too deeply, as frequently happens, the cambium is killed, the bark loosens, and the tree slowly dies. A large percentage of the mature and middle-aged Sapodilla now standing in the forests is in a moribund condition due to these causes.

Tapping is generally done during the early part of the morning between 6 a.m. and 11 a.m., as the air is then still and humid in the forest. The latex coagulates very rapidly on exposure to sun or drying wind, and even without these adverse factors it generally ceases to flow within four to six hours from the time of cutting, so that the chicleros are usually back in their camp soon after midday with the result of their morning's work. Rain does not interfere with the tapping as the extra water can easily be evaporated from the latex.

During one morning a chiclero taps perhaps six to eight trees, hunting for these more or less in a big circle around the camp. By the time he has cut his last tree, he is able to return to the first one and remove the bag containing the latex, which will then have ceased to flow. The canvas bags containing the latex are emptied into large tins in the chichlero's camp, and when a sufficient quantity for the purpose has been collected, about 30 gallons or more, the chicle is 'cooked,' i.e., it is boiled to extract as much of the water content as possible… In cooking chicle, a large open cauldron holding about 40 gallons is used, and a small wood fire is placed below it. The chicle bubbles up, giving off a cloud of steam. All through the cooking process, a man stirs the chicle with a paddle, to prevent it from scorching against the sides of the cauldron. When the moisture has been much reduced, and the chicle has become a viscous mass which can hardly be moved with the paddle, it is dumped out of the cauldron on a piece of canvas, previously rubbed with soap to prevent sticking, and there moulded into an oblong or oval block of about 20 pounds' weight. The blocks are set aside to harden for a few days, and then packed into sacks, loaded on mules, and taken to the nearest river bank, whence they are dispatched by boat to the export depot in Belize, the capital town of British Honduras." (p. 41-42)

Production in 1989 amounted to approximately 90,909 kg of first grade *chicle* to be collected entirely in northern Belize by about 90 *chicleros*. Trees are harvested the same way as in previous times. In the camp, the collected latex is boiled until the desired moisture content is achieved (25-30%) and formed into 9 kg bricks. Each brick requires the latex of five or six trees. If the moisture content is too high, the latex is too elastic, and if too dry, the latex becomes brittle. Each *chiclero* stamps or carves his mark into his bricks so that he may be paid for his production.

On average, a *chiclero* can harvest between 23 and 32 kg a week, though some are capable of producing 45 kg. *Chicleros* are paid $4.40 per kg. The exporter receives $6.16 per kg for *chicle* with 30% moisture content, $6.60 per kg for 25% moisture content, f.o.b. Great care is taken to inspect the bricks for adulteration with the latex of other species and for the presence of rocks or other foreign objects. *Chicleros* tap trees only during the rainy season because dry season stresses reduce sap flow.

Because of the commercial importance of *Manilkara*, extensive research was initiated during the late 1920s. The focus of the research was to increase levels of sustained latex production as well as decrease the level of plant mortality resulting from inappropriate or over-tapping. This research led to regulatory efforts in the early 1930s. Though such research is discussed in the forestry reports, greater emphasis is placed on reporting the type of research conducted rather than the results. Even so, some interesting conclusions can be drawn. We also discuss the individuals, research institutions and publications mentioned in the reports.

Research was conducted by both the Forestry Trust and academic researchers from the U.S. in conjunction with the Chicle Development Corporation (CDC) and the Belize Estates Company. These two entities controlled the vast majority of forested lands in northern British Honduras. Such tenure has resulted in the present day ownership of areas of northern Belize by only a few private interests, including the Belize Estates and Produce Company and the Programme for Belize. The CDC enlisted the assistance of Dr. J.S. Karling of Columbia University and his student, C.L. Lundell, as well as P.C. Standley of the Smithsonian Institute, and W.D. Durland, a Yale School of Forestry graduate. It also appears that the Tropical Woods Research Foundation of Washington, D.C. played a role in research efforts, as did the Tropical Woods organization of the Yale School of Forestry. In the late 1920s, the CDC, in conjunction with Forestry personnel (of whom CDC made extensive use), established an experimental station at Honey Camp Jib Forest Reserve, now the only remaining forest reserve in northern Belize. Karling conducted tapping experiments on this land.

Research conducted included the following: determination of plant population and size class distribution; effects of improvement, such as clearing away competitive growth, on latex production and mean annual increment (MAI, a measurement of tree growth); impact of different types of tapping tools and techniques on latex production and tree mortality; determination of optimal recuperation time between tapping cycles; impact of changes in edaphic conditions (principally meteorological), season of year and time of day on latex production; and the success of seedlings in enriched plantings.

Results of this extensive research, as documented by earlier forestry repots, were significant. The density of *chicle* trees in one 670 ha. parcel of CDC land in northern Belize was 58 trees/ha. This compares to data quoted in Snook (1988) of 27 trees/ha., or 31% of the standing volume, in the ejido Noh Bec forest in Quintana Roo, Mexico, just north of the CDC land. Schwartz (1990), who has worked with *chicleros* to the west in Petén, Guatemala, reports average densities of 15 tapped trees/ha., and areas with as many as 50 trees/ha. Additional results include MAI for improved and unimproved trees, as well as the number and cost of trees improved. Unfortunately, only brief reference is made to the actual levels of latex production under different management regimes, variations in latex quality, and average worker production. In short, through experimentation and experience, it appears that a management prescription for sustained yield of latex, regeneration of plant populations, and distribution of benefits including labor and wage was described.

Regulatory efforts by Forestry included the use of appropriate tapping technique and tools, restrictions on the time between tapping each tree, provision of permits for harvesting and for the collection of Crown Taxes for subsequent harvest, investment in stand improvement, and regulations to prevent felling of *chicle* trees. The *Chicle* control act of 1935 regulated ownership of *chicle* resources and made it possible to punish individuals caught stealing *chicle*. The principal concern of Forestry appears to have been mortality resulting from inappropriate harvesting (cutting too deeply or harvesting too often), the use of inappropriate harvesting tools, and the lack of regulation. This concern appears in the earliest report examined (1924) and is echoed in 1935, and again in 1956. Much of the research already conducted is likely to provide valuable information for both the sustained extraction and regulation of future *chicle* harvesting. Additional references include Heyder (1930), Lundell (1933), and Karling (1934).

Construction Materials

A variety of forest species are used in the construction of houses, other structures, furniture and enclosures. Roofing material, or thatch, is discussed further on in the section on palm products. Volumes and values for these products are not easy to determine as production originates at the community level and remains, for the most part, undocumented. In theory, a forestry tax—still called a Crown Tax— is collected for every forest product that is harvested (Samuel Edwards, personal communication, 1989). While this tax is successfully collected for lumber and a variety of other forest products, data from each Forestry District is highly variable with regard to NTFPs. For this reason we present little quantitative data in this section, apart from a discussion of the individual species and their uses.

Gann (1918) offered the following description of Maya house building in the Southern Yucatan and Northern British Honduras:

> "First a number of straight trees about 8 inches in diameter at the base and crotched at the top are selected in the bush for posts. These are usually Santa Maria, chichem, sapodilla or some hardwood. They are cut down, and after having been peeled are dragged to the site of the new house, where they are firmly planted, one at each of the four corners and others, the number depending on the size of the house, at short intervals between the lines of the walls. In the crotches other slightly smaller poles 5 to 6 inches in diameter, also peeled, are laid; to these are attached still smaller poles, which run up to the ridgepole (*honache*), forming rafters (*winciche*). All this framework is firmly bound together by means of ropes of liana. Rows of long thin pliable sticks are next bound round the rafters, and to these are attached layer upon layer of *huana* (*shaan*) leaves till a thatch, sometimes 18 inches thick and quite impervious to rain, is formed. The walls between the posts are filled with *tasistas*, a small palm trunk, or in some cases with strips of split cabbage palm. The outer sides of the walls may be daubed with a mixture of mud and hair, or of chopped fiber (*pakloom*), and whitewashed, or they may be thatched with palm leaves. The floor is made of marl [lime-rich mud] dust pounded down to a flat hard surface. Doors and windows may be made of wickerwork of liana, of split cabbage palm, or of a frame of sticks thatched with palm leaves." (p. 26)

Posts and Polewood

The species most favored for the construction of house posts include the following secondary hardwoods, all characterized by their density and resistance to decay (Lamb, 1946). *Bucida buceras* L., locally known as bullet tree, is reputed to be the densest wood in Central America. *Calophyllum brasiliense* Cambess. var. *rekoi* Standl., locally know as Santa Maria, is the most important secondary hardwood used in the timber trade. Black cabbage bark, *Lonchocarpus castilloi* Standl. and Lignum vitae *(Guaiacum officinale* L.*)* are also commonly used post woods. *Chicle* (*Manilkara zapota* (L.) P. Royen) has a dense wood that is very resistant to decay. While it is illegal to fell live trees, dead trees, often killed by inappropriate tapping, may be used. Beams of this wood used in ancient Maya construction have lasted for over one thousand years. The black poisonwood (*Metopium brownei* (Jacq.) Urb.*),* a tree with a very toxic and irritating sap, is used only after the tree is girdled, in order to bleed out the black sap. Long, straight and flexible lengths of mylady (*Aspidosperma cruentum* Woodson), are favored for the construction of rafters and framing of houses.

Siding
Siding is a general term that refers to several species of small diameter trees harvested to make siding for structures. One very widely used species is *tasiste* (*Acoelorraphe wrightii* (Griseb. & H. Wendl.) H. Wendl. ex Becc.). In northern Belize the trunk of this palm is used for house siding. Near Sartejena, 100 poles sell for $40 (J.C. Meerman, pers. comm., 1989).

Vines
Forest vines are used to lash together posts, beams, rafters, and thatch. Such use is intensive: as many as 250 individual vines may be required for one 30-foot x 24-foot house. In many regions, locating such vines near permanent populations requires several hours of walking into primary forest, the result of past over-harvesting. Vines are used instead of wire because it is far easier to disassemble a house held together with vines. Houses or parts of houses may last for decades, but people move, recycle, or reconstruct houses frequently; hence, the ability to disassemble a house easily is highly prized.

Furniture
A number of native forest trees are used to produce furniture in Belize. These include mahogany (*Swietenia macrophylla* King), cedar (*Cedrela odorata* L.), balsam (*Myroxylon balsamum* (L.) Harms var. *pereirae* (Royle) Harms), Billy Webb (*Acosmium panamense* (Benth.) Yakovlev), bullet tree (*Bucida buceras* L.), and *copal chi* (*Ocotea veraguensis* (Meisn.) Mez). These are secondary hardwoods that, with the exception of balsam wood, provide a reddish-golden hue to the furniture.

Crafts
Several species of hardwoods are used in the fabrication of carvings, bowls, and other basic utensils. High quality carvings are seen throughout the country in hotels, gift shops and other tourist destinations. Three species are commonly used for these carvings, *sericote* (*Cordia dodecandra* A. DC.); *nargusta* (*Terminalia amazonia* (J.F. Gmel.) Exell); and cedar (*Cedrela odorata* L.). The Maya refer to the latter plant as '*ku che*' due to its use as a material to carve images of the gods (*ku*=god; *che*=tree). Early reports from the area indicate that the Maya villages had a profession of god-carvers who made statues for the household altars to be worshipped by the family. The wood is highly resistant to insect attacks, due to the presence of an aromatic oil. In contemporary times, the Maya use the wood to make altars and chairs for sacred ceremonies maintaining the ways of their ancestors. *Sericote* is the most sought after wood for carving artistic objects as it finishes up with a beautiful, dark and lustrous shine that brings life to the subjects represented.

Forest Fruits
There are many dozens of species of fruits harvested from forest trees in wilderness areas. We will mention only a few here; Chapter 4 contains more information on edible wild plant species. One commonly consumed fruit is from the *sapodilla* tree, also known as *chicle* (*Manilkara zapota* (L.) P. Royen). In addition to providing useful latex, this species yields a brown, sweet, cinnamon flavored fruit that also is found in the U.S. in specialty shops. Another species is the *ramón* (*Brosimum alicastrum* Sw. subsp. *alicastrum*), known as the breadnut or *chacox*. This was essential to survival in times of scarcity because it could be cooked and made into tortillas, tamales, or porridge, and eaten much like young potatoes. The outer portion of the fruit is a delicious, apricot-flavored gel that is a good

source of vitamin C. The seed is rich in starch and protein. When corn is scarce, women can gather *ramón* seeds, boil them and grind them to add to cornmeal, to make their supply last longer. When eaten raw the *ramón* seeds taste like almonds. They are also toasted on a bed of coals and eaten like roasted potatoes. Caches of stored *ramón* seeds were uncovered and reported by early historians of this region.

Wild avocado trees (*Persea americana* Mill.) are another source of protein-rich food from the forest. The fruits are smaller than the cultivated species, and bear abundantly from July until December. Wild avocadoes are still gathered to feed domestic animals—dogs, chickens, and turkeys—as they are abundant, rich in nutrients and quite fattening. The wild custard apple (*Annona reticulata* L.) is a sweet-tasting fruit that is appreciated by humans as well as many of the animals of the forest. Its bark is also used medicinally, by beating it with salt and applying it as a splint to sprains, fractures and broken bones. The *nance* tree, *Byrsonima crassifolia* (L.) H.B.K., bears a somewhat unusual-tasting fruit that is consumed by both children and adults. The fruits are yellow, about the size of cherries, and have a flavor reminiscent of cheese and apples in combination. Seedlings of wild trees are transplanted into yards, and the plant is cultivated with great success. Also known as *crabu*, the plant can be stored in sugar syrup for later consumption, as well as made into a sweet wine. The common guava (*Psidium guajava* L.) is a common and important forest fruit in Belize. It is a significant source of vitamin C, and the bark and leaves are used medicinally to treat diarrhea and other conditions (Arvigo and Balick, 1998).

Jewelry and Adornment

Seeds of several species of trees are used to make colorful jewelry when strung in various patterns. Principally, the seeds of the *tubroos* tree (*Enterolobium cyclocarpum* (Jacq.) Griseb., also known as the *guanacaste,* are used, whose brown coating with a black oval ring in the middle make them quite appropriate for jewelry. Another species, although dangerous due to its toxicity, is the John Crow bead (*Abrus precatorius* L), with its unusual and striking pattern of black and brilliant red.

Medicinal Plants

There are many species of medicinal plants that are gathered directly from the forest. The ethnobotanical treatment in this book provides details of many of the uses of these species, and a survey list of medicinally important taxa is found in Balick, Nee and Atha (2000). In this section we will mention only one of the hundreds of NTFPs used in traditional medicine, many of which enter local commerce, and are gathered by a specialized group of bushmasters known as *yerbateros*.

In the Forestry Report of 1959, there is a reference to the propagation of several species in the genus *Dioscorea*, a historically important NTFP in Mexico. These vines, arising from swollen tubers on the forest floor, contain the alkaloid diosgenin, used in making a birth control pill and other steroidal medications. The Report indicates that 25 species were distinguished, three to four of them with promising quantities of diosgenin. Further reported in 1960 is a note that efforts to propagate these economically valuable species were not successful. As the plant is a slow growing species, and Mexican populations were decimated by over-exploitation in the past, Guatemala prohibited the export of wild *Dioscorea* (Heinzman and Reining, 1989). If a market were to be developed for this NTFP, propagation methods must be developed. Koch (1966) conducted a survey of *Dioscorea* in Guatemala to determine which species produce diosgenin. Of the 14 species tested, only three had more than 4% diosgenin on a dry weight basis in the tubers. Two of the 12 species known to occur in Belize in which significant levels of diosgenin were detected were *Dioscorea floribunda* M. Martens & Galeotti and *D. spiculifolia* Hemsl. (reported as var. *chiapasense*).

Ornamental Plants

The species known as *izote* has been ascribed to two different genera— *Beaucarnea* and *Yucca*. The "Checklist" (Balick, Nee, and Atha, 2000) lists *Yucca guatemalensis* Baker (the correct name for the more commonly used *Yucca elephantipes* Regel) as an ornamental, with no such indication of use for *Beaucarnea pliabilis* (Baker) Rose, although it is also commonly called *izote*. In this work we, therefore, refer to *Yucca guatemalensis* as the *izote* harvested for commercial export. The plant, a mid-canopy tree that may attain a height of 30 feet, is found throughout Mexico and Central America (Standley and Steyermark, 1952). It grows in areas of thin, rocky soil and is likely favored by drought conditions. The stem is swollen at the base and is topped by a spiny growth of close-set leaves. Favored as a hedge plant that produces an edible panicle, it is commonly seen in Central American gardens and in Florida, where it has been propagated as an ornamental plant since 1956 (Morton, 1974).

Izote has been exported from Guatemala for many years. Growing principally in the Copán region, native populations have reputedly been greatly reduced from over-exploitation. At the time of the Heinzman and Reining visit to Belize in 1989, one permit had been issued by the Forest Department to harvest plants with basal diameters of 7-25 cm from the Vaca Plateau region of the northern Maya Mountains. Harvesting under this permit had been ongoing since April 1989, though illegal harvesting by Guatemalans, who cross the border at Arenal (13 km south of Benque del Carmen de Viejo) has been occurring for an unknown period of time. Such illegal extraction was thought to be extensive.

A visit to an *izotero* camp revealed stacks of cleaned and cut *izote* stems, each stem 60-90 cm in length, with the base cleaned of roots. There were approximately 10,000 stems at the camp. Forty to fifty men were involved in the extraction, estimated at up to 80,000 stems per month. All are being exported to West Germany, though given the high volume of trade, it seems reasonable to assume the shade tolerant, drought resistant species is sold throughout Europe as a house and office plant. The Government of Belize received a Crown Tax of $0.50 per plant. *Izoteros* were paid $0.035 per cm, at the widest point of swelling, per plant harvested.

Orchids and Bromeliads (Various Species)

Local markets for epiphytes have always been strong. Homes, hotels and businesses often have gardens that include a variety of orchids. Exportation of orchids is first reported in the Forestry Report of 1966, with 4,134 plants exported. At the time of our field study (1988), trade both domestically and internationally appeared to be dominated by Godoy and Sons, Ltd. of Orange Walk. They reported supplying several hundred to 1000 plants per year, by their own estimate, to the local market and have exported 800 plants internationally. Trees were climbed in the tradition of the *chiclero*, and the plants collected, cleaned of insects with Malathion, and sold internationally at a price of $5.00 each f.o.b. For the national market, plants were sold for the same price, or for $10.00 for the plant with a basket. At Christmas time, bromeliads were traditionally sold, usually for $15.00 in a basket. In addition to Godoy and Sons, there were several other very small scale collectors and sellers operating throughout Belize.

Palms

The plants in this family, as elsewhere in the tropics, are one of the most important, from the standpoint of utilization, providing so many of the elements necessary to life. Belize is no exception, with a rich palm flora of forty species that is used for food, fiber, construction, medicine, poison, forage, oil, ornament, and in ritual. As Morris (1883) observed during his early travels throughout Belize:

> "Of plant life in British Honduras, there is nothing which so impresses the traveler as the abundance and profusion of palms which are everywhere seen. From the majestic cohune, which is, *par excellence*, the palm of the Colony, down to the small, delicate chamaedoreas, there are all gradations in size, and all variations of form and habit" (p. 67)

Uses of a number of Belizean palms are discussed in the final section of this book. Here we consider only a few examples.

Basket tie-tie (*Desmoncus orthacanthos* Mart.)
Common to the forests throughout Belize, this vining palm is harvested and stripped of its spiny exterior. The stems sometimes reach several hundred feet (Standley and Steyermark, 1958), although the vines are much smaller in the disturbed forest sites. The core is quartered and the strands are woven into baskets, hats, floor mats and wall coverings. Ralaypayon (1989) has investigated the potential for this palm as a raw material used in the production of rattans. In comparison with the commercial palm genera (*Daemonorops, Calamus, Korthalsia*), *D. orthacanthos* was found to be quite porous and of low tensile strength with a tendency to disintegrate into granules upon drying and use. However, we have observed that local basketmakers employ this species extensively in their work, so perhaps they have another way of processing the case that makes it more durable.

Bay leaf (*Sabal mauritiiformis* [H. Karst.] Griseb. & H. Wendl. ex Griseb.)
Bay leaf palm provides the most desired thatch material in Belize. A roof of this material can last up to 15 years. Leaves cost as little as $0.10 to $0.12 each (1988 price) in northern Belize, where they were readily available, or as much as $0.50 each (as of 1988) on the Cayes, where they must be shipped by boat. A 46 m^2 structure requires approximately 500 leaves. In certain highly populated regions, such as the Maya areas in Toledo District, the population of this species has been substantially reduced, and people have switched to lower quality cohune leaves for thatch.

Cohune (*Attalea cohune* Mart.)
This tree is one of the dominant forest species over wide regions of Belize. When forests are cut and, cleared and burned, this species is often the only tree left standing in cleared areas. It is a highly valued species providing material for many products, including oil, charcoal, thatch, soap, and heart of palm. In Belize it is recognized for its multiplicity of uses and tolerance to harsh conditions. Population densities of cohune in mature forest can be oligarchic in nature (Peters *et al.* 1989), in low-lying, seasonally inundated areas (Stevenson, 1932), and/ or in well-drained areas (Standley and Steyermark, 1958). Stevenson reported that one inventory in northern Belize counted 280 trees/ha. of all size classes.

Fruiting panicles often weigh 45 kg and may contain hundreds of oleaginous fruits. This prodigious production once supported a substantial oil palm industry in Belize. Morris (1883) observed the traditional processing of the cohune palm, which is still practiced in the following manner at present:

> "Each nut is of the size and shape of a pheasant's egg, covered on the outside by a thin layer of fibrous husk and composed internally of a hard shell with three cells, containing as many horny oily seeds. These seeds yield a valuable oil, which is used locally for burning, and feeding pigs, the husk being given to fowls.

The country people extract oil from the cohune-nuts in the following manner. When the nuts are what they term full, they break between two stones the shell, which is very hard; they then pound the kernel for some time in a wooden mortar, and the mass is put into a boiler with water, and boiled down until all the oil, or fat, floats. They skim the oil off, fry it in an iron pot, so as to disengage all the aqueous particles, and then bottle it. By this simple process the average yield is one quart bottle of oil from one hundred nuts. When in full bearing a cohune palm bears one or two, and sometimes three, bunches of fruit, with an average of five hundred nuts to the bunch. …When properly prepared, however, the oil is said to be superior to that of the coconut, and to burn twice as long—that is, a pint of the former is said to burn as long as a quart of the latter." (p. 59-60)

Investment in commercial level production was initiated in November 1928 by the Tropical Oil Products Company in southern Toledo District. To increase production, cohune-rich forests were 'improved' by leaving only cohune standing (Stevenson, 1932). A crushing machine was developed, that could crack the very hard 8 × 4 cm oblong nut. Exports of cohune oil are first recorded in 1950, though cohune products were exported much earlier. Nuts were first exported in 1936 and charcoal in 1937. Exports ceased in 1963 (Table 5.1).

The cohune palm has historically been and continues to be important in the domestic economy. Production of oil is in decline, but when available it was sold for $5.00/lt (1988). The leaves provide good, but not the best, thatch. It seems to disintegrate much faster than that from *Sabal*. The leaves are tied together to make walls within a house, and the vines that grow naturally in the trees are used to tie them together. Fans and baskets are woven out of the young inrolled leaves, and the heart of palm (locally known as cohune cabbage) is eaten either cooked on a bed of coals, boiled in a stew, steamed, fried or eaten raw. There is a small domestic industry involving the processing of heart of palm, bottling it in brine and selling it in gift shops. The oil is used in cooking, for skin, hair, and for mixing with medicinal plants to use as plasters, poultices and infusions. The outer husks (epicarp and mesocarp) are used as fuel, often by the people who process the oil. It also makes an excellent charcoal, which was used during the Second World War in gas mask filters. Leaves are always present at national and domestic celebrations, lining bridges, roads, doorways and forming the entrance for the bride and groom as they enter and exit the church. In the bush, the midribs of the leaves are used to form makeshift splints for broken bones and as stretchers to carry injured persons in need of medical attention. Cohune palms are left standing in cattle pasture as a shade tree, as well as for the large volume of organic material they supply to the soil. It is considered good fortune to have cohune palms in one's agricultural lands, as they help build the soil.

Panama hat palm (*Carludovica palmata* Ruiz & Pav.)

Although not a palm, the *jippy jappa* as it is known locally, has an appearance similar to plants in this family, and is thus locally called a 'palm'. It is in the family Cyclanthaceae. The young, broad, fibrous leaves produce a high quality fiber used in the fabrication of baskets, mostly by Maya women in the southern rural areas, where it is common in the wet forest areas. The baskets are light colored and very durable, woven in a variety of shapes and sizes. The fiber does not absorb the tropical moisture, so goods stored in these baskets do smell of mold or begin to rot after time, as is common with other vessels used for storage. The young shoots are eaten and sold in the market in Punta Gorda (personal communication, J. De Gezelle 2010).

Xate (*Chamaedorea* spp.)

This palm genus is the source of foliage used by florists in the U.S. and Europe to mix with cut flowers, in bouquets and arrangements. It is harvested from the forests in the Petén of Guatemala, as well as Belize. There is a great deal of unregulated overharvesting of these palms near the border with Guatemala. Mr. Louis Thomas, of Teakettle Farms, grows various species of *Chamaedorea* for their seed production, which is sold both domestically and abroad.

Miscellaneous Seeds

Pine seeds [*Pinus caribaea* Morelet var. *hondurensis* (Sénéclauze) W.H. Barrett & Golfari, *P. oocarpa* Schltdl.]

The seeds of these two species have given rise to plantations throughout the tropics. First reported in 1953, exploitation of pine seeds resulted in exports to several countries (Table 5.4).

Table 5.4
Volume, value, and countries of destination for *Pinus* spp. seed exports in 1955 (Forestry Report 1955)

Amount (Kg (lbs))	Value (1955 Belize $)	Destination
9.5 (21)	210	Australia
5.7 (12.5)	125	Br. W. Indies
5.9 (13)	130	Kenya
9.1 (20)	200	Rhodesia
4.5 (10)	100	Fiji
2.3 (5)	50	Ceylon
2.3 (5)	50	Nyasaland
1.8 (4)	40	Br. Guiana
0.9 (2)	20	Fr. W. Indies
0.5 (1)	10	Gold Coast
0.5 (1)	10	U.S.A.
0.2 (0.5)	5	Fr. Guiana
0.2 (0.5)	5	Belgian Congo
Total 43.4 (95.5)	955	

Seeds were harvested from the Mountain Pine Ridge Forest Reserve. Exports during the 1970's declined to zero. Nevertheless, the level of deforestation throughout Central America makes the Belizean forests even more valuable as a source of seed. While there are probably enough plantations of *Pinus caribaea* scattered throughout Central America to accommodate demand, the difficulty of protecting those provenances from encroaching agriculture indicates a small but significant demand for wild Belizean seed. A similar, though more persuasive, argument can be made for the *P. oocarpa* seed, which has performed well in other areas of Central America, but is in greater demand because fewer plantations exist.

Resins

Flores and Ricalde (1996) list 48 species of exudates and secretions used in traditional medicines by the Maya of the Yucatan region. Most of these are applied directly to the skin, to treat infections and other conditions. Three species of Burseraceae are cited in this chapter, including *copal* (*Protium copal* (Schltdl & Cham.) Engl. The sap of this tree has long been used as incense throughout the Maya Bioregion. Commonly seen in Catholic religious processions and churches (Standley and Steyermark, 1946, 5:435) in southern Belize, the smoke of the resin is used as an offering to ensure plentiful agricultural production. In addition, varnish has been made in commercial quantities in England from the sap. Today, copal is sold in various grades, the finest being pale colored, untreated, small balls about the size of a cherry tomato, wrapped in a tube made from the leaves of maize and burned in many local ceremonies, such as the *primicia*. It is a sacred plant to the Maya, who burn it in the belief that its highly fragrant aroma can chase away evil spirits; attract good spirits; serve as an offering, a supplication, and a way of giving thanks to the benevolent spirits. The local custom is to harvest the resin by cutting the tree bark on a night when the moon is full. If the collector then goes home and drinks a hot cup of corn *atole* prepared by a woman*,* then the resin will run freely. In the *chicle* camps, when a person had a painful cavity, a piece of resin was stuffed into the cavity and, in a few days, it swelled and broke the tooth apart, allowing the tooth to be removed and the problem resolved (Arvigo and Balick, 1998).

Rubber Tree (*Castilla elastica* Sessé subsp. *elastica*)
This plant was recognized as having great potential for Belize by Morris (1883), who felt it could compete with Brazilian *Hevea*, as he observed:

> "Next to cacao, the most interesting plant found wild in the forests of British Honduras is the indiarubber-tree, called by the natives 'Toonu.' This tree (*Castilla elastica*), a member of the bread-fruit family, and whose produce is known in commerce as Castilloa, or Central American rubber, should become, in course of time, one of the most important cultivated trees in the Colony. The large and increasing demand which arises for indiarubber of all kinds of appliances in arts and manufactures renders the production of this article an industry of great value… The Toonu in British Honduras is found in most of the cohune-ridges of the country, and especially along the banks and in the valleys bordering Mullin's River, Sittee River, and the Rio Grande, in the south; as well as along the Sibun River and the upper waters of the Belize River in the west… The proper season for tapping the trees is after the autumn rains, which occur some months after the trees have ripened their fruit, and before they put forth buds for the next season. The flow of milk is most copious during the months of October, November, December and January. The rubber-gatherers commence operations on an untapped tree by reaching with a ladder, or by means of lianes [lianas], or tie-ties, the upper portions of its trunk, and scoring the bark the whole length with deep cuts, which extend all around. The cuts are sometimes made as to form a series of spirals all round the tree; at other ties they are shaped simply like the letter V, with a small piece of hoop-iron, the blade of a

> cutlass, or the leaf of a palm placed at the lower angle to form a spout to lead the milk into a receptacle below. A number of trees are treated in this manner, and left to bleed for several hours. At the close of the day, the rubber-gatherer collects all the milk, washes it by means of water, and leaves it standing till the next morning. He now procures a quantity of the stem of the moon plant (*Calonictyon speciosum)* [a species of *Ipomoea*], pounds it into a mass, and throws it into a bucket of water. After this decoction has been strained, it is added to the rubber-milk, in the proportion of one pint to a gallon, or until, after brisk stirring, the whole of the milk is coagulated. The masses of rubber floating on the surface are now strained from the liquid, kneaded into cakes, and placed under heavy weights to get rid of all watery particles. When perfectly drained and dry, the rubber cakes are fit for the market, and exported generally in casks. …A large tree of Castilloa, say 2 feet in diameter, is said to yield eight gallons of milk when first cut. Each gallon of milk, in the proper season, will make about two pounds of rubber." (p. 74-78)

The hope that Morris had for *Castilla* as a major export for Belize was never realized. No more than 200 tons of the latex of this common forest species has ever been exported from the Maya Bioregion. Even at the height of the natural rubber industry, the superior latex of *Hevea* spp. dominated the market (Standley and Steyermark, 1946). Use in 1988 appears to have been restricted to waterproofing the collection bags of the *chicleros* (Heinzman and Reining, 1989).

Tourism

Tourism in Belize grew from 28,000 visits in 1983 to 74,000 in 1988; to 225,000 in 1992; and 251,000 visits in 2007. At least one third of the tourists come for forest-related visits: natural history (ecotourism), and archeological tourism. It appears that the two are somewhat combined—certainly without forests it is unlikely that Maya ruins would attract as many people. The average tourist in 1988 spent approximately $689.50 (Siegfried Loeper, pers. comm. 1989). Hence, during that time, forest-based tourism, assuming around a third of the tourists came to Belize for forest-based activities, produced around $30 million, approximately 15% of all foreign receipts. By comparison, the entire forestry sector, timber and non-timber products alike, produced approximately $6 million, or 3% of all export value. The significance of forest-based tourism is higher at present, as tourism visits are far in excess of those in the late 1980's. Thus, we can consider ecotourism a valuable product derived from the natural forests of Belize, and one of the compelling forces behind conservation efforts in some areas.

Discussion

Throughout the forested tropics, traditional paths to development have, for the most part, resulted in the conversion of forested land to other uses. In addition to a drastic reduction in species diversity, and the elimination of ecosystem services, abundant research attests to severe social and economic problems that often erupt in the wake of large-scale deforestation (see for example Leonard, 1988).

Yet is the economic contribution of NTFPs significant enough to justify protection of large forested areas? In 1989, NTFPs represented, in gross sum and excluding tourism, about 1% of the value of exports from Belize. Given the large land base from which these products originate, the value seems relatively small. If forest-based tourism is included, the overall value of exports from Belize was about 17% of total foreign revenue sources in 1989. It should be understood that this figure is conservative. Under-assessment of forest resources is more the rule than the exception: often, quantification of NTFPs requires extensive ethnobotanical research. Even with such research, valuation of forest productivity for agriculture in the form of fodder, mulch, fuel and construction materials is difficult because commercial exchange does not occur. Our estimates have focused on exports or sources of foreign revenue and have ignored any contribution forests make in domestic markets. In this study only *chicle* and *izote* have been quantified as NTFPs, as well as tourism. There is much greater value to be obtained if the income from all the NTFPs could be calculated. The market for some NTFPs is growing— demand from Japan, for example, for orchids, *chicle*, and logwood, and European demand for *izote* are examples of this, although sustainability is a serious issue for NTFPs that require long growing periods or cannot be easily propagated.

Returning to the initial question, "does the value of the forests, based upon NTFPs, warrant the conservation of large tracts of land?" The answer is clearly "yes," when all factors, markets, and values are considered. We make no assertion that the implementation of the development of NTFPs is easy, nor that the diverse botanical resources of Belize's forests will provide the greatest short-term profit relative to other land uses in all areas. In certain areas, especially tourist destinations, this certainly is the case. Yet if forested habitats are to be wisely exploited or are to be protected outright, use of diverse forest species, products and benefits is essential. This is a significant departure from past management efforts that have borrowed too much from management models based on species-poor temperate forests. But this departure is necessary if the remaining Central American forests are to be protected while still providing people's needs. Moreover, if the opportunity to implement an ecological path to development is ignored, future generations will find the destruction of forests, and of the life therein, incomprehensible.

The Peters Principle - Implementing Sustainable Harvest

If sustainability is the watchword, and key to successful management of these ecosystems, what are the methods by which this goal can be achieved? Charles Peters (1994) suggests six steps for exploiting NTFPs in a sustainable fashion. First, the species to be exploited should be carefully selected, after such factors as the ease of harvesting and resilience of natural populations to disturbance are considered. A tree valued for its roots will be harder to protect that one valued for its fruits, and the harvest of a species that produces fruits in massive quantities at one time of the year will be easier to manage than the harvest of a species that produces fruits sporadically throughout the year. Once the species has been decided upon, a forest inventory should be undertaken to learn where the resource is found in greatest abundance and the number of productive plants per hectare. Investigators then should estimate the quantity of the resource produced by the species in its various habitats and by trees in all size classifications, to determine which trees in which habitat it is best to harvest.

When these three steps have been taken, the harvesting of the resource can begin, but the careful measurement should continue. The status of the population should be monitored for signs that the forest is being overharvested. People should examine the status of adult trees periodically to determine whether the flowers are being pollinated, whether predators are consuming large numbers of fruits, and so on. If problems arise, the harvest should be adjusted to keep its level below the rate that would threaten sustainability.

When necessary, people may replant areas that do not seem to be regenerating, clean out competitive species, or open up the forest canopies to allow more light to reach the young trees and thus speed their regrowth. The precise measurements that Peters recommends are expensive and time-consuming, and very few species have been studied from this perspective. However, plant populations may be threatened if harvests are determined by the demands of the marketplace rather than the needs of the ecosystem. As Peters notes, "nature does not offer a free lunch." In our enthusiasm to support conservation of the natural world by focusing on its usefulness to economies, we are perhaps inadvertently dooming elements of it to extinction. Only when ecologically sound management plans based on scientific studies are developed for resource extraction will the use of those resources be able to contribute to the conservation of biological diversity (Balick and Cox, 1996).

Acknowledgments
M.J. Balick would like to thank the various libraries of The University of Oxford, U.K. (including the Bodleian, Rhodes House and Forestry Department) and Green College for their kindness and generosity shown during his stay at Green College, University of Oxford, during the preparation of this chapter.

Bibliography

AGEXPORT 1989. Asociación Gremial de Exportadores de Productos no Tradicionales 1986-1988. Guatemala City, Guatemala.

Anon. 1957. How do they make chewing gum? New York Mirror, May 16.

Arvigo, R. and M. Balick. 1998. Rainforest remedies: one hundred healing herbs of Belize. 2nd ed. Lotus Press, Twin Lakes, Wisconsin.

Balick, M.J. and P.A. Cox. 1996. Plants, people and culture: the science of ethnobotany. W.H. Freeman, Scientific American Library, New York.

Balick, M.J., M.H. Nee, and D.E. Atha. 2000. Checklist of the vascular plants of Belize, with common names and uses. Memoirs of The New York Botanical Garden 85. The New York Botanical Garden Press, Bronx, N.Y.

Bolt, A. 1961. Chicle, chewing gum from British Honduras. World Crops 13(2):58-59.

De Gezelle, J. 2010. Personal communication.

Duncan, K. 1968. Aspects of the hardwood forest industry in British Honduras. In P. Furley, ed. Expedition to British Honduras and Yucatan, 1966: general report, pp. 52-62. University of Edinburgh Press, U.K.

Edwards, Samuel. 1989. Personal communication.

Flores, J.S. and R.V. Ricalde. 1996. The secretions and exudates of plants used in Mayan traditional medicine. Journal of Herbs, Spices, and Medicinal Plants 4(1):53-59.

Gann, T. 1918. The Maya Indians of Southern Yucatan and Northern British Honduras. Bureau of American Ethnology, Government Printing Office, Washington, DC.

Gibbs, A.R. 1883. British Honduras: an historical and descriptive account of the Colony from its settlement, 1670. London.

Hartshorn, G.S., L. Nicolait, L. Hartshorn, G. Bevier, R. Brightman, J. Cal, A. Cawich, W. Davidson, R. Dubois, C. Dyer, J. Gibson, W. Hawley, J. Leonard, R. Nicolait, D. Weyer, H. White and C. Wright. 1984. Belize: country environmental profile: a field study. Robert Nicolait Associates Ltd., Belize City, Belize.

Heinzman, R.M. and C.S. Reining. 1989. Non-timber forest products in Belize and their role in a biosphere reserve model [a report prepared for the Institute for Economic Botany, NYBG].

Heyder, H.M. 1930. Sapodilla tapping in British Honduras. Empire Forestry Journal 9(1):107- 113.

Hummel, C. 1921. Report on the forests of British Honduras, with suggestions for a far reaching forest policy. London.

Karling, J.S. 1934. Dendrographic studies on Achras zapota in relation to the optimum conditions for tapping. American Journal of Botany 21(4):161-193.

Koch, W. 1966. Las Dioscoreas de Guatemala. Ceiba 12(1):58-60.

Lamb, A.F.A. 1946. Notes on forty-two secondary hardwood timbers of British Honduras. Forest Department Bulletin No. 1, Forest Department, British Honduras.
Leonard, J. 1988. Economic development and natural resources in Central America, 2nd ed. Transaction Publishers, Washington, DC.
Loeper, Siegfried. 1989. Personal communication.
Lundell, C.L. 1933. Chicle exploitation in the Sapodilla forests of the Yucatán Peninsula. Field and Laboratory 2(1): 5-21.
May, P. n.d.. Commons, small-scale extraction, and social consequences of change in resource access. Unpublished manuscript.
Meerman, J.C. 1989. Personal communication.
Morris, D. 1883. The Colony of British Honduras: its resources and prospects; with particular reference to its indigenous plants and economic productions. Edward Stanford, 55 Charing Cross, London.
Morton, J.F. 1974. 500 Plants of South Florida. E.A. Seamann Publishing, Miami, Florida.
Munro, D.M. 1989. Ecology and environment in Belize: an account of the University of Edinburgh expedition to Belize, C.A. 1986. Occasional Paper No. 12, Department of Geography, University of Edinburgh, UK.
Peters, C.M. 1994. Sustainable harvest of non-timber plant resources in tropical moist forests: an ecological primer. Biodiversity Support Program, Washington, DC.
Peters, C.M., M.J. Balick, F. Kahn and A. Anderson. 1989. Oligarchic forests of economic plants in Amazonia: utilization and conservation of an important tropical forest resource. Conservation Biology 10:1-12.
Ralaypayon, W.R. 1989. Feasibility study for rattan production in Belize. RDA International Report for U.S. Agency for International Development, Belize. [Contract Number 505-0012-C-00-9308-00.]
Schwartz, N.B. 1990. Forest society: a social history of the Petén, Guatemala. University of Pennsylvania Press, Philadelphia.
Snook, L. 1988. Regeneration and growth of mahogany (Swietenia macrophylla King) in mixed natural stands in Quintana Roo, Mexico [Ph.D Dissertation Proposal]. Yale School of Forestry and Environmental Studies.
Soza, J.M. 1970. Monografia del Departamento de El Petén, Ministerio de Educacíon, Guatemala.
Standley, P.C. and S.J. Record. 1936. The forests and flora of British Honduras. Publications of the Field Museum of Natural History 350(12):1-432. Field Museum of Natural History Press, Chicago.
Standley, P.C. and L.O. Williams. 1961-69. The flora of Guatemala. Fieldiana: Botany 24(7-8). Museum of Natural History, Chicago.
Stevenson, N.S. 1932. The cohune palm in British Honduras. Tropical Woods, Paper #30. Yale School of Forestry, New Haven, Connecticut, pp. 3-5.
Szadek, Steven. 1989. Personal communication.
Tropical Forestry Action Plan (TFAP) for Belize. June 1989 [Draft manuscript].
Wagner, P.L. 1964. Natural vegetation of Middle America. In R.Wauchope, ed. Handbook of Middle American Indians, pp. 216-263. University of Texas Press, Austin.