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The Forest Resources of St. Vincent, West Indies

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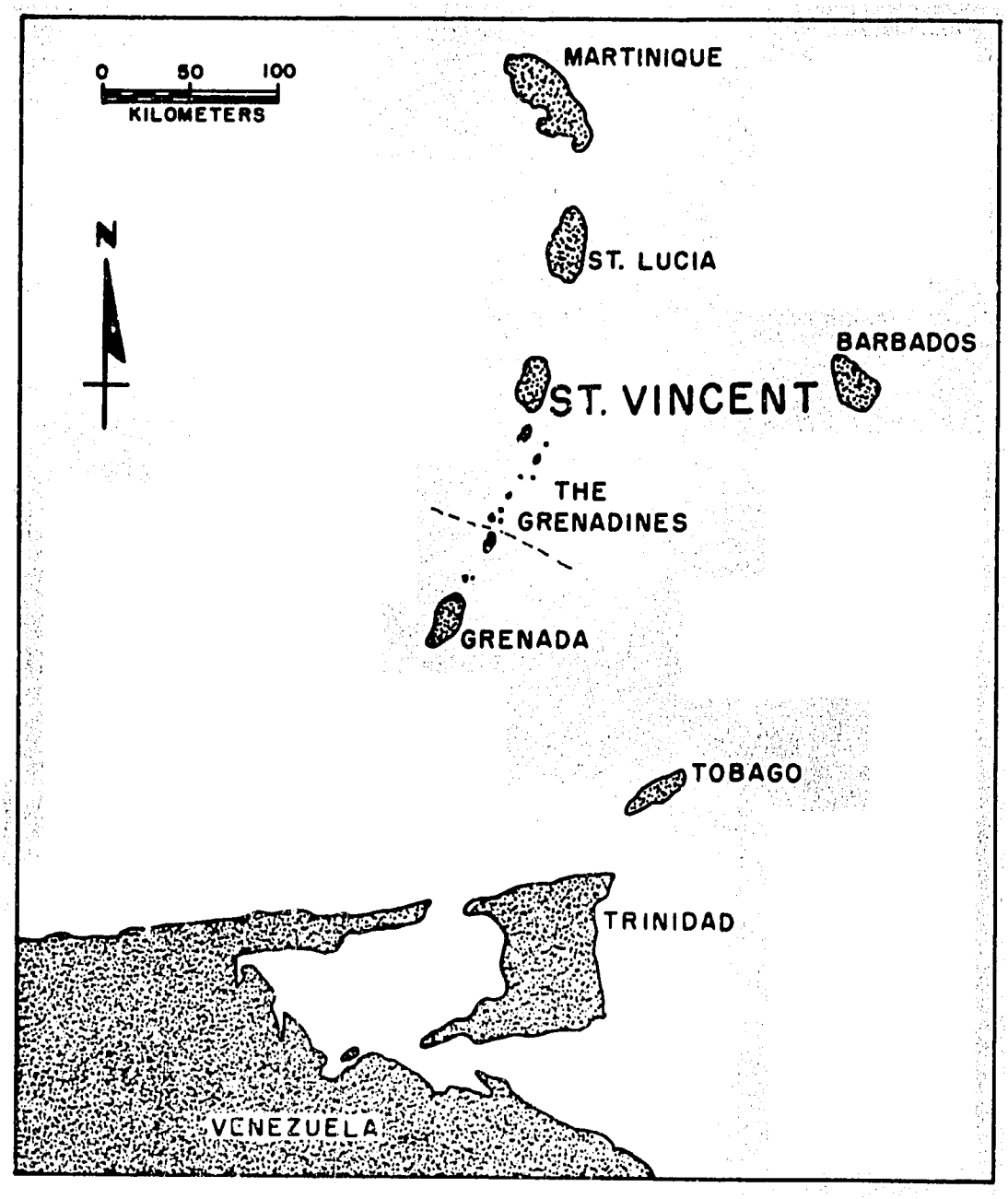

SUMMARY

Forest vegetation covers 13,000 ha or 38 percent of the land surface of St. Vincent Island. More than half of the forest area is successional, and there are substantial areas of palm, dwarf, and dry scrub forests. Nearly 5 percent of the land area is composed of mature, mostly undisturbed primary forest. *Inga vera, Licania ternatensis, Dacryodes excelsa,* and *Cecropia peltata* are common tree species in natural forests. *Hibiscus elatus, Pinus caribaea,* and *Swietenia macrophylla* are tree species that have been planted in St. Vincent. *Pinus caribaea* has attained the best growth rates.

ACKNOWLEDGEMENTS

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INTRODUCTION

This study was part of a comprehensive investigation titled "Forests of the Caribbean Islands: their role in development and their response to human and natural perturbations." The investigation had two major objectives. The first was to contribute to the assessment of natural resources (forests and watersheds) of selected Caribbean Islands by describing how these resources respond to environmental and human perturbations and by developing management prescriptions for these resources. The second objective was to provide training for natural resource agency personnel from Caribbean Islands.

This study responds to the first objective by providing a comprehensive overview of the forest resources of St. Vincent. St. Vincent was selected for detailed study because the island lacked quantitative forest resource information, and the island's forest resources are similar to forest resources of other Caribbean Islands. The second objective was supported during fieldwork when several St. Vincent Forestry Division employees were trained in forest measurement techniques. This report is intended to assist St. Vincent natural resource planners make rational and informed decisions regarding the development and use of forest lands.

Funding to conduct fieldwork in St. Vincent was provided by the United States Agency for International Development (U.S. AID). The work was carried out by personnel from the U.S. Forest Service, Southern Forest Experiment Station, in cooperation with the St. Vincent Forestry Division.

HISTORICAL PERSPECTIVE

The Arawak Indians apparently occupied many of the Caribbean Islands as early as 100 B.C. (Bennett 1975). They were sedentary and derived their subsistence from the cultivation of maize and root crops and through fishing. Around 1000 A.D., the Carib Indians from South America began to invade the islands from the south and by 1492 had reached the eastern end of Puerto Rico. This migration ceased with the arrival of the Europeans. By the 16th century, most of the Amerindian population had been exterminated.

The British, French, and Dutch invaders that arrived after St. Vincent's discovery were interested mainly in commercial agriculture and needed labor to operate the plantations. Slaves were brought from Africa, and by the 18th century, plantation agriculture reached its apex under the British. Subsequent migrations and intermarriage have resulted in the following ethnic population groupings in St. Vincent (U.S. AID 1982): African Negro, 65 percent; mixed, 20 percent; East Indian, 5 percent; European White, 4 percent; Amerindian, 2 percent; others, 4 percent.

Population growth on the Island since the mid-1800's has been classified into four major periods (Byrne 1969). From 1851 to 1881 and from 1911 to 1931, growth was moderate (fig. 1). The intervening period had little population growth. Starting in the 1930's, and in particular after World War II, population growth accelerated. The 1979 census showed 111,170 inhabitants for St. Vincent and the Grenadines, or a population density of about 285 people per square kilometer. About 7,000 people live in the Grenadines, a chain of islands belonging to St. Vincent.

The following is a brief sketch of major social events that have influenced the Island and its economy (Duncan 1970):

- 1498—St. Vincent was discovered by Columbus on the feast day of St. Vincent, according to the Spanish calendar, and was named in his honor.
- 1627—King Charles I of England assumed ownership of the island.
- Before 1750—Settlement began in the vicinity of Kingstown.
- 1763—Constitution bestowed by King George III, probably the day on which Kingstown was named.
- 1765—Botanical garden established in Kingstown for introduction of tropical species from other regions.
- 1793—Captain Bligh introduced breadfruit to the botanical garden, from which it spread to other areas in the neotropics.

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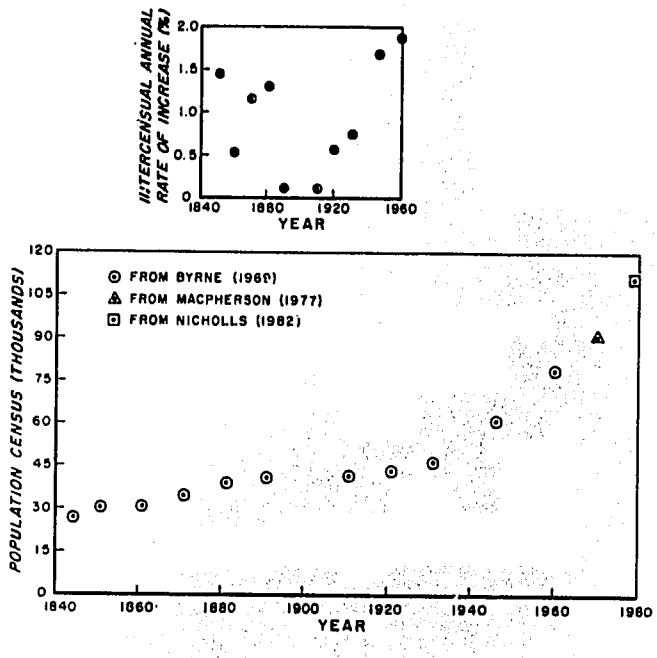

Figure 1.—*Population increase on St. Vincent, 1844 to 1979. Intercensual rate of increase balances birth, death, and migration.*

- 1822—Trade began with the United States.
- 1850—A decrease in the market price of sugar led to widespread planting of arrowroot on the island.
- 1930's—Population growth began to accelerate.
- 1953-54—Government warehouse in Kingstown was built. Bananas became the leading export crop.
- 1979—St. Vincent and the Grenadines became an independent State within the British Commonwealth after 10 years as an Associated State of the United Kingdom (U.S. AID 1982).

The botanical garden outside Kingstown, the oldest in the new world, deserves mention. It was established for "the cultivation and improvement of many plants now growing in the wild and the importation of others from similar climates" (Howard 1954). Alex Alexander was appointed director in 1785, and under his direction the garden reached its peak of maintenance and inventory, including 1,170 species of commercial and medicinal plants, esculents, fruits, valuable woods, and ornamentals (Howard and Howard 1983). Among the most renowned introductions were nutmeg and breadfruit trees from Captain Bligh's voyage after the Bounty mutiny. In the early 1900's agricultural experimentation was carried out in the garden, but by 1920, these functions had been transferred to nearby Camden Park. Currently, the botanical garden is a place of beauty with many interesting and economically important plants.

THE FOREST ENVIRONMENT

St. Vincent is located at 13°15′ N. latitude and 61°12′ W. longitude in the Caribbean Sea. The Island measures about 29 km long and 18 km wide at its maximum dimensions and encompasses about 345 km^2. The St. Vincent Grenadines, politically part of St. Vincent, consist of seven main islands stretching about 60 km to the south toward Grenada and occupy a total of 44 km^2. The largest and most proximate to St. Vincent is Bequia, which covers 18 km^2.

St. Vincent lies about 175 km west of Barbados and about 300 km north of the Paria Peninsula of Venezuela. The interior of the Island is steep and rugged and has not yet been traversed by a road. This land remains undisturbed and contrasts with the coastal zone and lower elevations where the Island's population resides.

The interrelations of geology, physiography, climate, and soils influence the structure and composition of the forests. Recurrent hurricanes and volcanic eruptions have had a considerable impact on the Island's vegetation, agriculture, and population.

Geology and Physiography

St. Vincent is entirely volcanic in origin (Evans 1973; Macpherson 1977). Its volcanoes have developed on a subsiding narrow submarine ridge about 1500 m below the current sea level (Hardy 1939). The first volcanic eruptions apparently occurred during the late Miocene and have continued intermittently, producing a series of volcanic piles, the oldest of which are in the southern part of the Island.

Soufriere in the north rises to 1220 m within 3 km of the coast (fig. 2). A deep trough across the Island separates the solitary cone from the remaining mountains to the south. The southern range extends for about 15 km. Highpoints are Richmond Peak at 1075 m, in the northwest; Mount Bisbane at 930 m, near the middle of the Island; and Grand Bonhomme at 960 m, in the south central part of the Island. The main ridge that runs down the central axis of the Island never dips below 600 m in elevation. Andesitic and basaltic agglomerates are common (Earle 1928). All rocks are Pleistocene to recent in origin (Watson and others 1958).

Soufriere, which dominates the northern part of the Island, erupted in 1718, 1812, 1902 (Howard 1962), and again in 1979 (Rowly 1979). It has apparently been erupting violently about once every 100 years for the last millennium. Historic eruptions have been characterized by nuees ardentes, or incandescent avalanches, that carbonize material in the absence of oxygen as they rush downslope. These eruptions have been accompanied by ashfall and mudflows. The

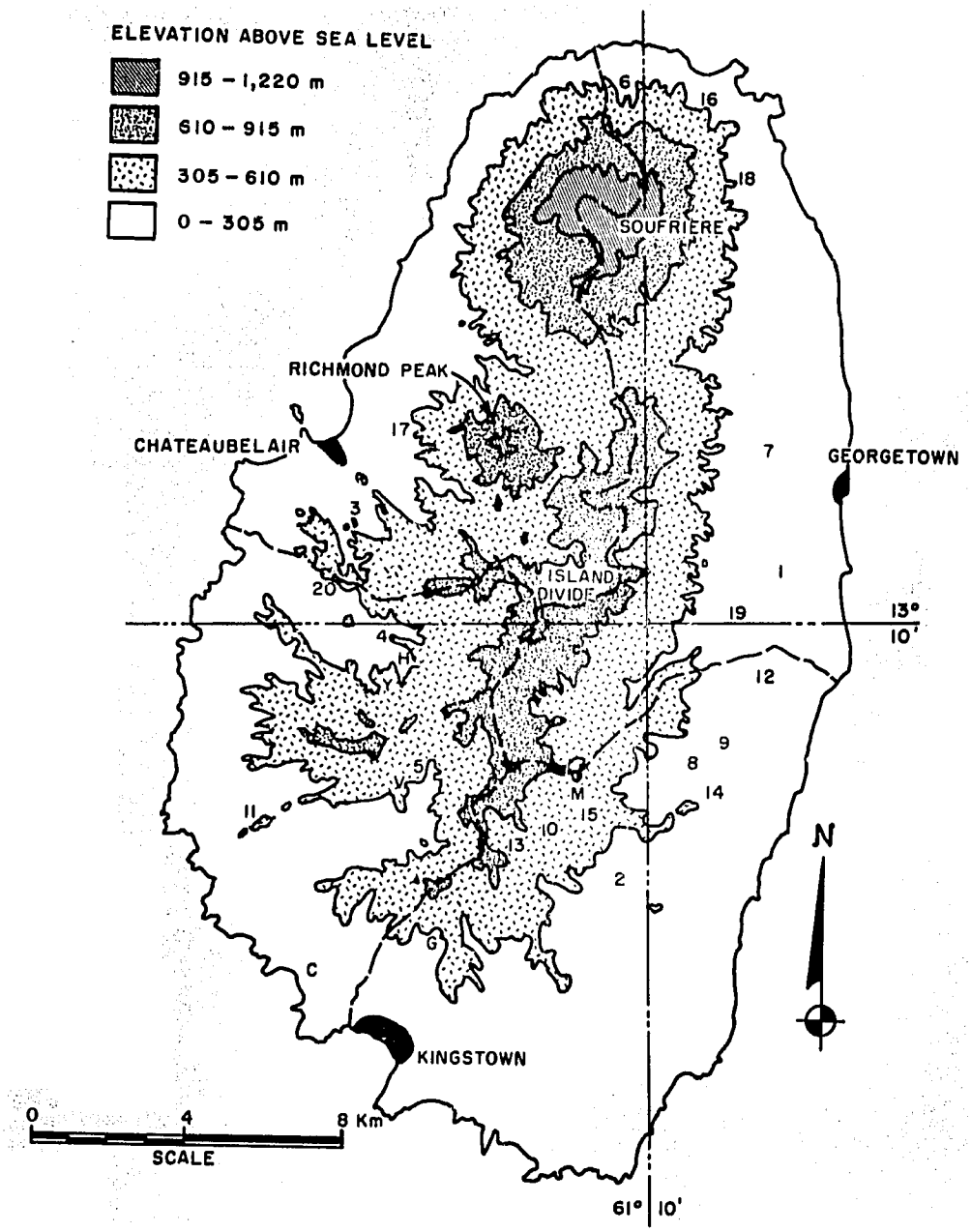

Figure 2.—*Topography of St. Vincent, with delineation of watershed regions (dashed lines). Location of water supply sources and hydropower sites are noted by numbers and plantations surveyed are noted by letters. Numbers are keyed to table 1 and letters are keyed to tables 2 and 3.*

crater lake inside the volcano disappeared after the 1979 eruption. Today deep, largely unvegetated gullies radiate from the summit.

During the Pleistocene, more than half a million years ago, St. Vincent was subject to marine submergence and intermittent uplift, creating a series of flat-topped terraces, of which seven are evident in the southeast (Watson and others 1958). Subaerial erosion has modified the terraces, producing a rolling landscape.

Towards the south, the land becomes progressively older and more mature, with deeper and wider valleys and lower ridges. The central mountains are characterized by sharp ridges and deep, steep-sided valleys. Numerous lateral ridges emanate from the central mountains. In the west, these are steep and separated by deep, narrow gorges. To the east, they slope more gently with wider, flatter valleys that form fairly extensive coastal plains in a few areas (Beard 1949).

Nearly 60 percent of the land surface lies below the 300-m contour and slightly more than one percent lies above 900 m. About 27 percent of the land lies between 300 and 600 m, with 13 percent between 600 and 900 m.

Climate

Daily and annual temperature fluctuations are minor because of the influence of the surrounding ocean. The 10-year record at the Botanical Garden in Kingstown showed a mean annual temperature of 26.7 °C, with a maximum of 31 °C (Wright 1929). The annual range of mean monthly temperatures was only about 2 °C, while the diurnal range of temperature was about 5 °C (Walker 1937).

The Island is influenced by tradewinds, particularly during the winter months. The annual migration of the equatorial convectional rains, however, provides a well-defined June through November rainfall maxima (fig. 3). Mean annual rainfall for the Botanical Garden determined from a 30-year record between 1894 and 1927 was 2615 mm and ranged between 2030 and 3500 mm (Wright 1929). The comparatively dry season from January to early May tends to be accentuated by soil porosity, steep slopes, and exposure to wind and sun (Beard 1944a).

St. Vincent lies just within the hurricane belt and averages one hurricane about every 25 years. The earliest on record occurred in 1780 and did a great deal of damage (Beard 1945). There was a storm of lesser intensity in 1819, severe ones in 1830 and 1886, a slight one in 1897, and a severe one in 1898. A moderate hurricane struck the Island in 1921. On September 8, 1967, and on August 8, 1980, respectively, hurricanes Beulah and Allen traversed the Island. During the latter 2 storms, only 2 people were killed, but more than 20,000 were affected by storm damage.

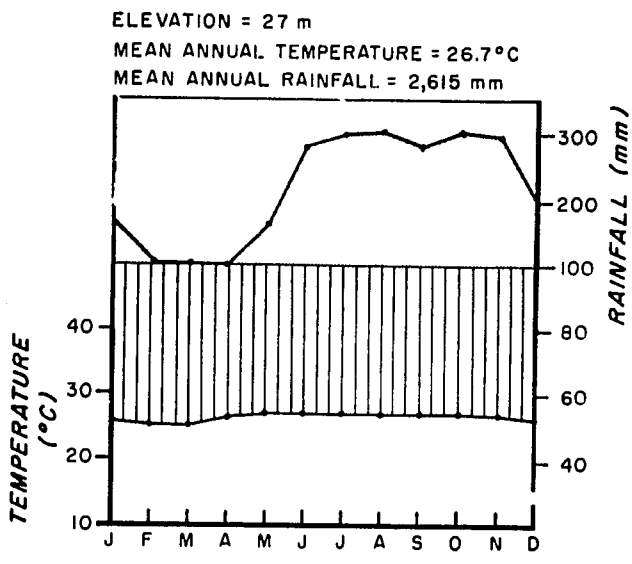

Figure 3.—*Climatic diagram for Kingstown, St. Vincent (adapted from Walker 1937). Temperatures are based on 10 years of record and rainfall on 30 years of record.*

The climate in the interior is cooler and wetter, but the lack of climatic stations means that estimates of rainfall are somewhat speculative. Available climatic maps (Macpherson 1977; Caribbean Conservation Association and others 1980) show a gradual increase in rainfall from about 1800 mm/yr in coastal areas to over 3800 mm/yr in most of the central mountains, with possible rainfalls in excess of 6000 mm/yr in the area surrounding the summits. Using the isohetal map (Caribbean Conservation Association and others 1980), assuming an average rainfall of 1800 mm/yr for the coastal areas and 6600 mm/yr for the summits, St. Vincent receives an average of about 3000 mm/yr over the entire island.

Examination of recent rainfall records shows several gaps in data collection that bias the data toward underestimates of total rainfall and make comparisons among stations tenuous. Similar observations were made at an earlier date (Walker 1937).

Soils

The soils of St. Vincent are derived mainly from loose, fragmental volcanic ejecta such as boulders, stones, cinders, sand, and ash (Hardy 1939). There are three major soil groups:

Coastal plain and valley alluvial soils—These soils occupy flatland near the coast, valley floors, and mouths of small estuaries. The material from which they are derived consists of loose, black, volcanic sand transported from higher elevations. They are fertile and subject to little erosion.

Recent volcanic ash soil—These are incipient soils recently derived from fragmental ejecta (in Hardy's 1939 study these soils were from the 1902 and earlier eruptions).

Yellow earth soil—These soils are found on the rest of the Island and display varying degrees of maturity and considerable variation in physical features and natural history.

In general, Island soils have been described as immature with a high content of unaltered minerals, markedly uniform in vertical profile, and containing low contents of weathered products. Furthermore, they are neutral to slightly acidic in reaction, contain medium-high amounts of organic matter, and are highly permeable to water. The rate of solution of mineral components is low, and the contents of available potash and phosphate are low. They have a low saturation capacity, low content of exchangeable bases, and a high degree of base saturation (Hardy and others 1934). Although such soils would not be

expected to erode rapidly because of their high permeability to water, sheet, rill, gully erosion, and landslip are observable today in different parts of the Island.

AGRICULTURE

St. Vincent's economy has traditionally been dependent on export crops. During the 1700's, sea-island cotton was grown extensively on the Island, but at the beginning of the 1800's, plantation-grown sugar cane became the foremost crop. After 1850, following emancipation, sugar production declined. Concurrent with its decline, the cultivation of arrowroot as a cash crop was started by many small farmers. At the turn of the century, arrowroot and cotton continued as the leading export crops of the island.

Before 1897, most of the agricultural land belonged to large estates. In that year, a Royal Commission recommended that the government purchase large estates and partition them among small farmers (Beard 1944a). The distribution of land by size of ownership as of 1944 for 177 km^2 of privately owned land was as follows: under 2 ha, 15 percent; 2.1 to 4 ha, 8 percent; 4.1 to 20 ha, 8 percent; 20.1 to 40 ha, 3 percent; 40.1 to 400 ha, 58 percent; and greater than 400 ha, 8 percent.

Current statistics from the Ministry of Trade, Industry and Agriculture (1981) concerning the production of agricultural crops on the Island were summarized for 1981 (fig. 4). About 4000 ha, or 86 percent of the area for which statistics were available, were planted in starchy root crops. Bananas, coconuts, sugar, and arrowroot were the next most common crops.

The total value of crop production for 1981 was $23,408,580 (U.S. dollars) for the 22 crops evaluated. Bananas were the most important, with about 48 percent of the total. Starchy root crops, with about 12 percent; coconuts, with over 11 percent; mangoes, with about 6 percent; and arrowroot and ginger, with about 5 percent each, were the next most valuable crops.

Dietary staples include rice, sweet potatoes, yams, and cassava, which are accompanied by fish, pulses, other vegetables and fruits, cheese and other milk products, and meats. Bananas, the most important export crop, and arrowroot, the second most important export crop, are grown on small farms that average between 0.5 and 1.0 ha in size. St. Vincent arrowroot produces a high-quality starch that is used for the manufacture of computer paper and in home and pharmaceutical products. Coconuts are grown principally on large farms while vegetable and fruit production takes place on small properties for home use and sale. Food crops include sweet potatoes, tannias, dasheen, eddoes, carrots, yams, pumpkins, and mangoes (U.S. AID 1982). The majority of agricultural

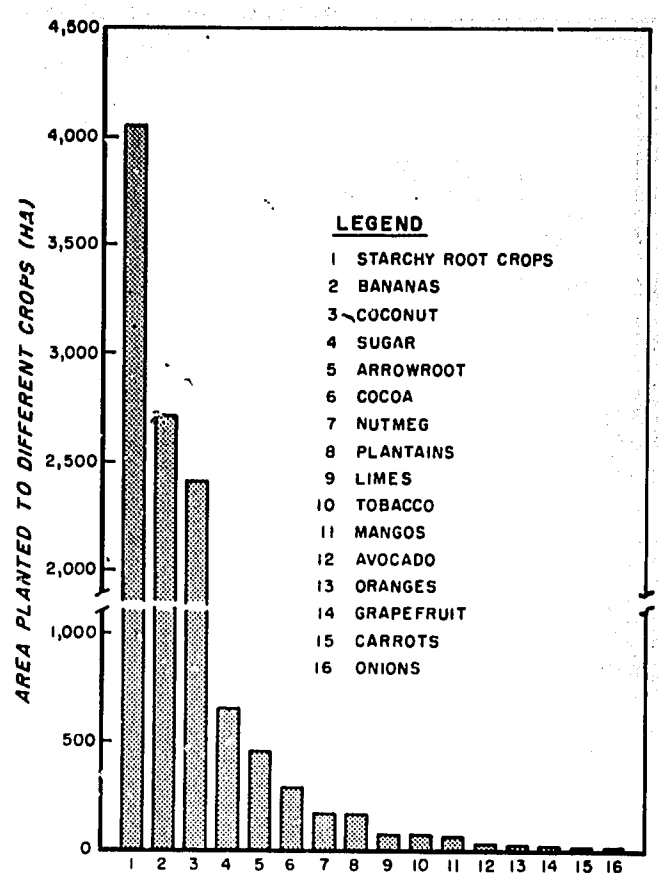

Figure 4.—*Agriculture production on St. Vincent. Data based on statistics compiled by the Ministry of Trade, Industry and Agriculture, 1981.*

production is aimed at the export market in the United Kingdom, other Caribbean islands, and North America.

WATER RESOURCES

St. Vincent is a small island with a high population density in the south. A continuous water supply is a basic need that must be met with the limited water resources available locally. Water supply problems on nearby islands indicate that St. Vincent's water resources should be carefully assessed.

The rivers of St. Vincent are short and straight. In the mountains, the steep courses run through deep, narrow valleys. At lower elevations, they broaden into small delta-shaped alluvial flats. The largest river on the Island is the Colonarie and the second largest is the Wallabou.

If the estimate of 3000 mm/yr of rainfall for the entire island is reasonably accurate, then St. Vincent receives 1.035×10^9 m^3 of water on its surface each year. No estimates are available for runoff, evapotranspiration, or ground water storage.

Twenty major water supply sources and hydropower sites are located in several watersheds circum-

scribing the central mountains (fig. 2, and table 1). Combined, these supply sources have a dry intake capacity of 17.1 million l/day and a wet intake capacity of 29.4 million l/day.

NATURAL VEGETATION

The "Flora of St. Vincent and adjacent islets" lists 1,150 species, with about 250 trees and shrubs (Anon. 1893). Subsequently, much botanical work was done in the forests of St. Vincent and elsewhere in the Caribbean (Beard 1942, 1944a, 1944b, 1944c, 1944d, 1949; Stehle 1945). The primary interest was in the trees and forests of the region. Later, the vegetation of the Grenadines was studied, including the islands belonging to St. Vincent (Howard 1952). Descriptions of many of the tree species found in St. Vincent, their locations elsewhere in the hemisphere, and their potential uses have been documented (Little and Wadsworth 1964; Little, Woodbury and Wadsworth 1974). Many have been classified as valuable native and plantation sawtimbers (Longwood 1961, 1962; Fraser 1957). The following summary of the natural vegetation is based on Beard's (1949) classification, which is still largely applicable (fig. 5).

Table 1.—*Water supply sources and hydropower sites on St. Vincent*[1]

Number[2]	Name	Number and type of intakes	Intake capacity[3]	
			Dry	Wet
1	Byera	1 spring	57	57
2	Camel	2 springs	151	163
3	Chateaubelair	1 river	303	454
		2 springs		
4	Cumberland River[4 5]	1 river	3,785	6,359
5	Dalaway[6]	2 rivers	5,678	10,220
6	Fancy	1 river	189	189
7	Georgetown	3 springs	360	360
8	Greiggs	2 springs	284	379
9	Higher Lowmans	1 spring	379	379
		1 river		
10	John Hill	1 river	644	946
11	Layou	1 spring	379	568
12	Lively	1 spring	76	114
13	Majorca	1 river	1,893	3,218
14	Maroon	1 river	151	757
15	Montreal	1 spring		
		4 rivers	1,514	3,785
16	Owia	1 river	189	189
17	Richmond[5]			
18	Sandy Bay	1 river	341	341
19	South Rivers[5]	2 springs	681	833
20	Spring Village	1 spring	106	106

[1]Forestry Division, Ministry of Trade, Industry and Agriculture, Kingstown, St. Vincent.
[2]Numbers are coded to figure 2.
[3]In thousands of liters per day.
[4]Includes Hermitage, Convent, and Grove.
[5]Hydropower sites.
[6]Located in the Vermont area.

Climax Communities

Rain Forest.—The rain forest occupies small areas between 350 and 500 m in elevation, principally in the headwaters of the Colonarie, Cumberland, and Buccament Valleys. The forest averages about 30 m tall, is closed and dense, has two strata of trees, and is somewhat patchy due to storm damage and topography. Windward and leeward forests are similar in composition with the exception of *Prestoea montana*, which forms about 35 percent of the stems to the windward and is virtually absent to the leeward. Other canopy dominants are *Dacryodes excelsa, Lauraceae spp., Meliosma herbertii, Micropholis chrysophylloides*, and *Sloanea caribaea*, which collectively constitute over 50 percent of the stems.

Elfin Woodland.—The elfin woodland or dwarf forest occupies exposed summits above 500 m on both sides of the central mountains. The forest is short, 4 m or less in height, and composed of gnarled trees that are covered with moss and epiphytes. The principal tree species include *Charianthus coccineus, Didymopanax attenuatum, Freziera hirsuta, P. montana, Inga laurina, Weinmannia pinnata, Ficus spp.*, and *Clusia spp.*

Littoral Woodland.—The littoral woodland is found in limited areas adjacent to the sea. The forest varies

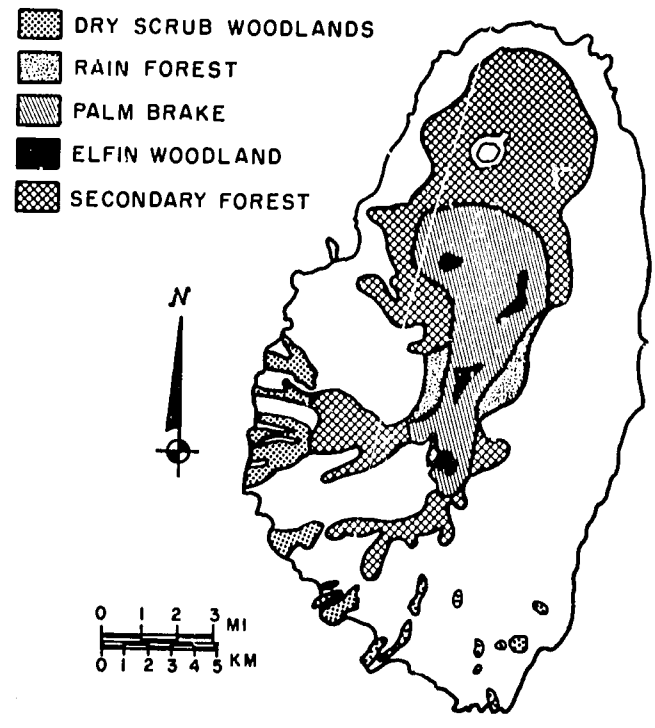

Figure 5.—*Location of major forest types on St. Vincent according to Beard's classification (1949).*

in height depending on exposure but usually does not exceed 8 m. *Coccoloba uvifera, Rheedia spp.,* and *Tabebuia pallida* are common dominants.

Mangrove Forest.—There is a very small area of mangroves on the south coast that contains *Rhizophora mangle* and *Avicennia germinans.*

Secondary Communities

Palm Brake.—The palm brake occupies exposed areas above 500 m on both sides of the mountains. About 70 percent of the stems are palms that reach 12 m tall in some places. The remaining species are second-growth pioneers or occasional trees from the rain forest.

Secondary Rain Forest.—The secondary rain forest is generally located above areas of permanent cultivation and below the rain forest. Several areas are partially cultivated by farmers and contain a large component of secondary species including *Chimarrhis cymosa, Sapium caribeum, I. ingoides, Cecropia peltata, Freziera hirsuta, Ochroma pyramidale, Cordia sulcata,* and *Lauraceae spp.* More advanced succession contains a greater number of rain forest species.

Dry Scrub Woodlands.—Dry scrub woodlands occupy uncultivable land on precipitous rocky slopes where luxuriant forest never existed. It has been heavily felled for timber and fuelwood. Dominant tree species include *Bursera simaruba, Pisonia fragrans,* and *Acrocomia spp.* King's Hill reserve in the southeastern part of the island is a unique exception. Largely undisturbed since its creation, a forest has developed that reaches 20 m in some areas. In addition to the hardwoods mentioned above, *T. pallida, Swietenia mahagoni, Hymenaea courbaril, Pouteria multiflora, I. laurina, Mastichodendron foetidissimum, Brosimum alicastrum,* and *Lauraceae spp.* are found as dominants.

With recurrent eruptions of Soufriere, the area surrounding the mountain is in a constant state of disturbance ranging from exposed soil immediately after eruption to fairly advanced stages of succession after many years without vulcanism. Because of the elevational gradient, plant communities that would become established in the absence of disturbance range from rain forest at the lowest elevations through elfin woodland at the summit. Succession follows a general displacement of communities upward as it progresses. This succession has been described by several authors (Anderson 1908; Beard 1945, 1949, 1976; Howard 1962; Sands 1912).

FOREST LEGISLATION AND LAND OWNERSHIP

The principal ordinances concerning forests on St. Vincent as listed in Beard (1944a) are:

The King's Hill Enclosure Ordinance 82 of 1926 (No. 5 of 1791): reserves about 22 ha of woodlands on King's Hill for "the purpose of attracting the clouds and rain . . . for the benefit and advantage of the owners and possessors of lands in the neighborhood thereof." Penalties are prescribed for cutting timber and squatting.

The Charcoal Ordinance 98 of 1926 (No. 5 of 1906): prescribes penalties for unlawful burning of charcoal and is used to control charcoal burning on crown lands.

Crown Land Ordinance 77 of 1926 (No. 3 of 1906): deals mainly with surveys and squatting on crown lands and also contains provisions for a "Superintendent of Crown lands"; a means of making regulations for management, sale, lease, and prevention of squatting on the lands and prescribes penalties for squatting and unauthorized cutting.

Proclamation of August 22, 1912: reserves all crown lands above 1,000 feet elevation to protect them from any act that would be prejudicial to forest conservation. This area has been estimated at 168 km^2, slightly less than half the island.

At the time Beard drafted his statements, it was felt that legal protection of the forests was inadequate. Since that time, cutting and clearing in the forest has continued, mainly for subsistence agriculture. Steep slopes, heavy rainfall, and lack of access roads, however, have restricted the invasion of crown lands. Lands classified as "alienated" or private total 177 km^2—slightly more than half the island.

FOREST PLANTATION SURVEY

Plantation Description

Of the 50.6 ha of plantations for which we could find records, *Hibiscus elatus* accounted for a little over 70 percent of the total area (fig. 6). *Pinus caribaea* and *S. macrophylla* accounted for another 18 percent of the plantations. About a third of the plantations were established in 1968-69 and about 40 percent in 1982, with a steady rate of 2 to 4 ha planted in most intervening years. The increase in activity starting in 1981 was mainly due to financial assistance from U.S. AID under its Basic Human Needs Program, administered by the Caribbean Development Bank. At the First Workshop of Caribbean Foresters, *H. elatus* was reported to occupy 75 ha on St. Vincent; *P. caribaea,* 30 ha; and *S. macrophylla,* 18 ha (Nicholls 1982).

Plantation measurements were made at 19 different sites (table 2). The methods used to determine standing volumes and growth rates were presented at the Second Workshop of Caribbean Foresters (Weaver and Valenta 1984). Stand volume varied considerably by species, site, age, and previous silviculture and ranged from 5.6 m^3/ha for 9-year-old *C. sulcata* at Government House to a surprising 575 m^3/ha for 21-

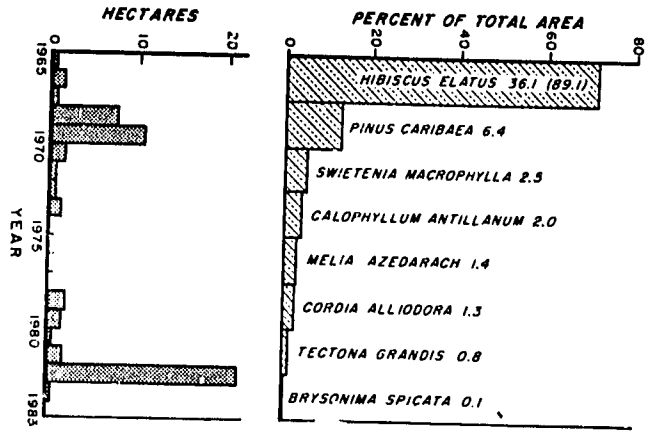

Figure 6.—*Planting records for St. Vincent. (Top) Percent of total area planted by species (species name followed by actual area planted in ha). (Bottom) Chronology of planting since 1965 without regard to species. Records may not be complete.*

year-old *P. caribaea* at Hermitage (table 3). In Young Man's Valley, where all the species were planted in 1969 and thinned in 1976, *P. caribaea* attained the greatest mean diameter, mean height, and total volume. At Hermitage, where plantings were done in 1962–63 and thinnings in 1976, again *P. caribaea* showed the largest mean dimensions and volume. The latter plantation was located on a terrace and appeared to have been well tended. Both of these factors contributed to the fine growth. The *S. macrophylla* plantations at Hermitage differed in mean diameter, mean height, and total volume, with the thinned stand showing better growth than the unthinned stand.

At Vermont, *Calophyllum antillanum, H. elatus,* and *P. caribaea* were established between 1971 and 1973 and had never been thinned. *Pinus caribaea* again had the largest dimensions and volume. *Hibis-*

Table 2.—*Summary of plantation species and sites surveyed; St. Vincent, 1984*[1]

Site and species[2]	Planted	Thinned	Trees	Plots	Comments
	------- *Date*[3] -------		--*No. measured* --		
Y- Young Man's Valley					
Cordia alliodora	1969	1976	22	3	midslope; stand open
Hibiscus elatus	1969	1976	20	1	bottomland; stand dense
Pinus caribaea	1969	1976	28	1	mid-to-upper slope; stand very dense
H- Hermitage					
H. elatus	1962–63	1975	25	2	midslope
P. caribaea	1962–63	1975	18	1	bottomland terrace
Swietenia macrophylla	1962–63	1975	19	1	midslope; stand dense
S. macrophylla	1962–63	.....	22	1	mid-to-lower slope; stand very dense
G- Government House					
C. alliodora	1975	.....	7	2	midslope; stand open
S. macrophylla	1969–70	1975	28	2	midslope
V- Vermont					
Calophyllum antillanum	1973	.....	9	1	midslope; trees branchy; understory
H. elatus	1971–72	.....	15	2	midslope
P. caribaea	1973	.....	33	2	mid-to-lower slope
M- Montreal					
H. elatus	1966–67	1974	12	1	steep midslope
H. elatus	1966–67	1974	11	1	bottomland
P. caribaea	1967	1979	14	1	gentle midslope
P. caribaea	1967	1979	25	1	gentle midslope
P. caribaea	1967	1982	20	1	exposed hilltop; considerable wind
C- Camden Park					
S. mahagoni	.....	.....	96	3	mid-to-upper slope
Tabebuia pallida	.....	.....	32		
Total			456	27	

[1]All are plantations except for Camden Park, which is naturally regenerated secondary forest. All plantations were originally planted in 1.8- by 1.8-m spacings.

[2]Letters preceeding site name are coded to figure 2.

[3]Dates derived from records and field personnel. Dashes indicate missing dates or no thinning.

[4]Both species at Camden Park were recorded from 0.1-ha plots.

cus elatus and *C. antillanum* had nearly equal diameter and volume, while the height of *H. elatus* averaged 2 m taller.

At Montreal, the plantations of *H. elatus* and *P. caribaea* were established in 1966 and 1967. The *H. elatus* was thinned in 1974. One of the *P. caribaea* plantations was thinned in 1979 and another in 1982, while the last plantation remained unthinned. The *H. elatus* growing on the slope had larger dimensions and volume than that on the bottomland. The *P. caribaea* thinned in 1979 had greater mean diameter and mean height but less volume than the unthinned stand, both of which were on gentle midslopes. The remaining *P. caribaea* stand, thinned in 1982, was situated in an area exposed to wind and had less height and volume than the other stands.

In a secondary forest at Camden Park, *S. mahagoni* constituted 75 percent of the stems (table 2). Mean diameter and height were considerably less than *T. pallida*. Basal area for both species combined was 17.8 m^2/ha, and the total volume was 134.8 m^3/ha.

Diameter growth rates ranged between 0.62 and 2.06 cm/yr, height growth between 0.66 and 1.80 m/yr, and volume growth between 0.42 and 28.76 m^3/ha/yr for all species and sites combined (table 3). In general, the best growth was attained by *P. caribaea* and the poorest by *Cordia alliodora*. *H. elatus* showed the least variation in diameter, height, and volume growth regardless of age, site, or silvicultural treatment. On the other hand, *S. macrophylla* appeared to have better diameter and volume growth when thinned.

Although the scope of this survey of forest plantations was limited, some preliminary observations are possible:

Swietenia macrophylla showed poor form on most sites, with low branching and excessive crown development. Most of this poor form is probably attributable to a shoot borer (*Hypsipyla grandella*) infestation. Lack of a clear stem will seriously reduce the stand value and utility at maturity.

About 70 percent of the stands have high basal

Table 3.—*Stand characteristics and growth rates of plantation species and sites surveyed; St. Vincent, 1984*

Site and species[1]	Mean dimensions and mean annual growth rates							
	Diameter		Height		Basal area[2]		Total woody volume[3]	
	Cm	*Cm/yr*	*M*	*M/yr*	*M^2/ha*	*M^2/ha/yr*	*M^3/ha*	*M^3/ha/yr*
Y- Young Man's Valley								
Cordia alliodora	15.4 (1.0)[4]	1.13 (0.07)	12.8 (0.4)	0.95 (0.03)	16.8	1.24	33.7	2.50
Hibiscus elatus	14.7 (1.0)	1.09 (0.07)	15.5 (0.7)	1.15 (0.05)	45.9	3.40	100.7	7.44
Pinus caribaea	23.4 (0.8)	1.74 (0.06)	18.4 (0.6)	1.36 (0.05)	64.3	4.76	281.3	20.84
H- Hermitage								
H. elatus	23.6 (0.8)	1.17 (0.04)	20.8 (0.4)	1.03 (0.02)	28.7	1.44	172.4	8.62
P. caribaea	35.6 (1.0)	1.78 (0.05)	27.3 (0.7)	1.36 (0.03)	41.3	2.06	575.2	28.76
Swietenia macrophylla	30.6 (1.4)	1.53 (0.07)	19.2 (0.4)	0.96 (0.02)	43.6	2.18	395.3	19.76
S. macrophylla	20.4 (1.0)	1.02 (0.05)	18.6 (0.5)	0.93 (0.02)	50.5	2.52	215.2	10.76
G- Government House								
C. alliodora	8.4 (0.7)	1.11 (0.10)	8.8 (0.5)	1.18 (0.07)	8.0	1.07	5.6	0.75
S. macrophylla	23.9 (0.9)	1.77 (0.07)	15.2 (0.3)	1.12 (0.02)	32.4	2.40	149.2	11.05
V- Vermont								
Calophyllum antillanum	11.7 (0.7)	1.23 (0.08)	10.8 (0.4)	1.13 (0.05)	20.6	2.17	23.1	2.43
H. elatus	12.1 (0.8)	1.10 (0.07)	12.7 (0.6)	1.15 (0.05)	17.2	1.56	23.2	2.10
P. caribaea	19.6 (0.7)	2.06 (0.07)	17.1 (0.6)	1.80 (0.06)	37.9	3.99	108.6	11.43
M- Montreal								
H. elatus	21.0 (1.1)	1.27 (0.07)	20.3 (0.7)	1.23 (0.04)	25.7	1.56	131.1	7.94
H. elatus	18.4 (1.4)	1.12 (0.08)	19.0 (0.7)	1.15 (0.04)	25.2	1.53	93.1	5.64
P. caribaea	21.2 (0.8)	1.37 (0.05)	19.2 (0.4)	1.24 (0.03)	32.1	1.94	115.0	7.42
P. caribaea	18.9 (0.4)	1.22 (0.03)	14.8 (0.4)	0.95 (0.03)	57.4	3.48	125.8	8.11
P. caribaea	18.9 (0.4)	1.22 (0.04)	12.0 (0.3)	0.77 (0.02)	45.9	2.78	82.8	5.34

[1]Letters preceeding site names are coded to fig. 2.

[2]Basal areas were read with a BAF 10 prism (each intercepted tree = 2.3 m^2/ha). Basal areas of harvested trees were not included.

[3]Above ground (branches + bole), outside bark volumes for dicots were determined by formula (Dawkins 1961). For *P. caribaea*, outside-bark bole volumes were derived by formula (Vorhoeve and Bower n. d.). Volumes of trees already harvested were not included.

[4]Numbers in parentheses are standard errors.

areas in excess of 25 m^2/ha. Although *P. caribaea* and *H. elatus* are narrow-crowned species able to tolerate high stem densities for several years, continued development without thinning will result in slower growth on the rotation trees and high stand mortality. Timber production on existing stands could be improved with thinning, but without studies using different spacings and thinning regimes on several sites, it is difficult to prescribe the best management practices for a complete rotation. Unthinned *S. macrophylla* at Hermitage has already begun to slow in diameter growth because of high stand density.

Incomplete records make assessment of growth, development, and stand volumes extremely difficult. Accurate data on plantation establishment dates, original spacings, dates and types of thinnings, and recurrent measurement of selected sample plots for growth analyses are needed.

Management Recommendations

Except for Government House, the forest plantations are concentrated high in upper watersheds where clearing and cultivation of subsistence crops is underway. Most of the land is government property that has been reclaimed through the establishment of plantations. Efforts to increase plantations in these areas should continue both for the provision of lumber and to deter further advance of cultivation into the interior of the Island.

Many of the plantations are very dense. The close spacing traditionally used throughout the Island offers a chance for selection of better stems after 4 or 5 years. Thinning at this time would enhance the development of better trees and maintain good growth over a longer period of time. Other spacings and thinning regimes should be studied. Perhaps the 1981-82 plantations established with U.S. AID assistance could provide a starting point for silvicultural research in cooperation with outside institutions.

An alternative method for the establishment of *S. macrophylla* should be investigated. The tree's high value and utility assure a ready market. Shoot borer infestation may be diminished by line planting widely spaced *S. macrophylla* interspersed with other fast growing timber species. In subsequent thinnings, the better formed trees could be favored.

1984 FOREST INVENTORY

The St. Vincent forest inventory was designed to provide two kinds of information: estimates of forest area for various forest classes and statistics describing the composition of "timberland" or forests with some commercial potential. The presentation of data in commercial terms should not be construed as a recommendation for exploitation or management of natural forests. Rather, the information is intended to be used as background material for planning and research concerning forest resources on the Island. Natural forests in St. Vincent have important functions, such as watershed and wildlife habitat protection and provision of tourism and recreation opportunities. Any decisions that affect these unique forests must be carefully made.

The inventory was designed as a reconnaisance survey to provide Island-wide forest resource information. The data were derived from photointerpretation and field observations at sample locations and represent "average" conditions within forest communities on the Island. Since the forests are quite heterogeneous due to varying levels of human impact and diverse site conditions, the information cannot be used to describe conditions or develop management plans for specific sites.

Methods

The data on forest areas, timber volume, and species composition were obtained by a sampling method involving a land-cover classification on aerial photographs and on-the-ground measurements. A dot count method was used to obtain an initial estimate of area by land-cover class. This estimate was adjusted on the basis of a ground check of actual land cover at each of the sample locations.

Sample locations were selected on a base map at the intersections of a grid of lines spaced 2 km apart. Each sample location was visited to determine cover class. The center of each forest location classified as timberland was located by running a computed azimuth and distance from an identified starting point. Detailed field measurements were taken at all accessible timberland locations.

A cluster of three permanent sample plots was established at each timberland location. Sample plots were located 25 m apart. At each sample plot, trees 12.5 cm and larger in diameter at breast height (d.b.h.) were tallied on a variable-radius plot, with each tree representing 2.5 m^2 of basal area per hectare. Trees less than 12.5 cm in d.b.h. were tallied on a fixed-radius plot of approximately 40 m^2 around the first sample plot and 15 m^2 around the other two sample plots. This sample plot design was determined to be efficient for similar forest conditions in Puerto Rico (Birdsey 1983).

Each sample location was classified by numerous site characteristics. Each sample tree 12.5 cm and larger in d.b.h. was measured and assessed to determine timber volume and quality. Species was determined for each sample tree. Detailed field measurements were assembled into a handbook. All definitions and inventory standards are listed in the appendix to this report, along with a species list and some useful conversion factors.

All field data were recorded on tally sheets, transferred to the computer, and edited for errors prior to compilation. Errors were kept to a minimum by careful training, diligent field work, and a detailed edit procedure that checks all items for consistency and reasonableness.

All field work was done in 1984 between January and April. Prior to field work, photointerpretation for area estimation was done using 1:25,000 scale panchromatic photography from a photographic mission in January 1981.

A total of 3,168 photo samples were classified, and 88 ground locations were checked. Detailed forest measurements were taken at 57 sample plots clustered at 19 sample locations.

Forest Classification

The forest classification corresponds to the natural vegetation communities described by Beard (1949). These communities can be recognized with reasonable accuracy on the aerial photographs and verified on the ground. Timberland is composed of those forest classes occupying sites that can be used for timber production. Timberland classes in St. Vincent include the primary forest and successional communities, divided into young secondary and secondary. Plantations are included in timberland since they are located on sites that would otherwise support one of the timberland classes.

Forest land other than timberland includes forest classes occupying sites that are sensitive to disturbance and would generally not be productive. This forest land includes the palm forest and dwarf (elfin) forest, found on exposed sites above 500 m; and the dry scrub forest, found on very steep, rocky slopes or adjacent to the sea. Maintenance of forest cover on these sites is critical to protect water catchments from severe erosion.

Table 4.—*Area by land class; St. Vincent, 1984*

Land class	Area	
	Hectares	*Percent*
Timberland		
Young secondary forest	3,570	10.5
Secondary forest	3,706	10.9
Primary forest	1,632	4.8
Plantation forest	34	0.1
Total	8,942	26.3
Other forest land		
Palm forest	1,734	5.1
Dwarf forest	952	2.8
Dry scrub forest	1,326	3.9
Total	4,012	11.8
Nonstocked land[1]	2,754	8.1
Nonforest land	18,292	53.8
Total land[2]	34,000	100.0

[1]Land deforested due to natural disturbance and not currently in nonforest use.
[2]Values for total land from Nicholls 1982.

Table 5.—*Proportion of forest land by watershed region and elevation; St. Vincent, 1984*[1]

Watershed region	Elevation[2]	
	Below 305 m	Above 305 m
	Percent	
Northwest	56	94
Southwest	36	69
Southeast	4	32
Northeast	6	83

[1]Forest land includes nonstocked land; watershed regions are outlined in figure 2.
[2]The 305 m used here equates to the proclamation that reserves all crown lands above 1000 ft.

Forest Area

Forests cover 13,000 ha or 38 percent of the land surface of St. Vincent (table 4). Secondary or successional forests account for more than half of all forest land. Nearly 5 percent of the land area is composed of mature, mostly undisturbed primary forest. This and the undisturbed palm and dwarf forests are among the largest remaining contiguous areas of relatively unaltered ecosystems in the Lesser Antilles (Putney 1982). Located in the rugged central mountains, the primary forest is the home of several endangered species, including the St. Vincent parrot *Amazona guildingii*. The parrot habitat is protected as a sanctuary, and these protected lands include all of the primary rain forest.

Forest area has declined slightly over the past 10 years, based on an FAO estimate of 41.2 percent of the land area in forest in 1974 (Food and Agricultural Organization of the United Nations 1975). The change is due to the 1979 eruption of Soufriere that resulted in 2750 hectares of nonstocked or bare land.

The distribution of forest land in St. Vincent is largely the result of settlement patterns. Most of the land suitable for agriculture is found at elevations below 300 m and has been cultivated for many years. Forest cover is nearly absent below 300 m on the eastern, or windward, side (table 5). The western, or leeward, side is much more rugged; the area below 300 m includes many pockets of forest on land too steep to cultivate. The northwest region is the most rugged and contains the highest proportion of forest.

Although all land above 300 m was reserved by law for many years to protect the forest, many parcels are leased for nonforest use. Few roads penetrate the interior, and despite encroachment problems, the remote area has retained a high proportion of forest cover. The main exception is in the Southeast, where only 32 percent of the land above 300 m is forest land. Here a fairly dense road network penetrates well into the reserved land. This region would likely be the first to experience water supply problems during a drought due to the high population density, sparse forest cover, and location of six water intakes.

Timberland Characteristics

Of the three major timberland classes, primary rain forests are located at the highest elevations and farthest distance from roads (table 6). Young secondary forests are more accessible and tend to be associated with recent agricultural activity. The average distance to water for all timberland is less than 100 m.

Both young secondary and secondary forests have similar basal areas, but the young secondary forests average nearly twice the number of stems (table 7). The younger forests have smaller average diameters and canopy heights. These statistics suggest that, in the successional process, the disturbed site is quickly occupied by a large number of small stems that compete vigorously until a secondary stand is well established. The secondary forest then matures over a long period, accumulating biomass to reach a potential basal area of more than 30 m^2/ha.

At some point during the maturation process, the number of small stems again begins to increase as shade-tolerant understory species and saplings of canopy species become established. The primary forest develops the appearance of two distinct strata, with the upper canopy height averaging more than 25 m above the ground. The basal area of saplings is significantly greater than that of poletimber, with large sawtimber-size trees clearly dominating the available growing space (fig. 7).

Wood volume steadily accumulates over time. Most of the volume in young secondary forests is found in large residual trees that have outlasted surrounding disturbances. Young secondary forests average two large trees per hectare in the 75-cm d.b.h. and larger classes, and no trees in the 50- to 70-cm d.b.h. classes (table 8). Secondary forests have 18 and primary forests 43 trees/ha whose d.b.h. is greater than 50 cm.

Much of the apparent variability in these statistics is due to the intermingling of the three timberland

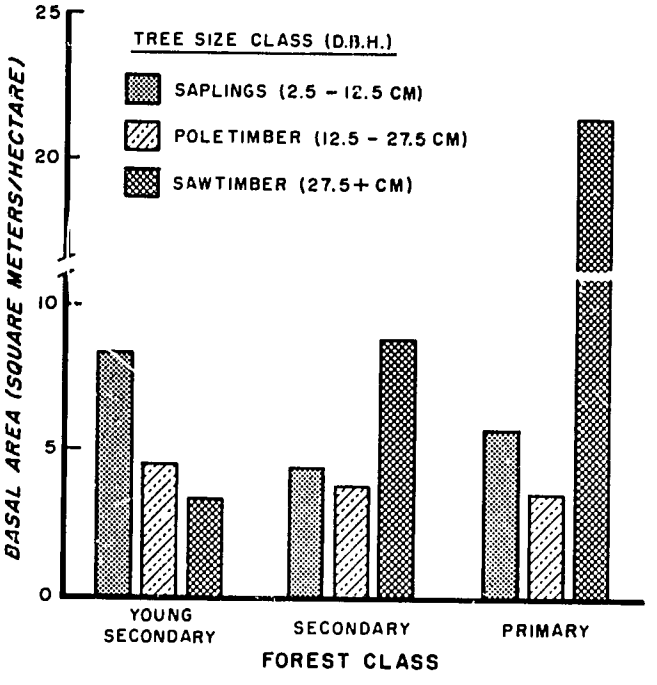

Figure 7.—*Average basal area by forest class and tree size class; St. Vincent timberland.*

Table 6.—*Physiographic characteristics by forest class; St. Vincent, 1984*

Characteristic (units)	Statistic	Forest class			All classes
		Young secondary	Secondary	Primary	
Elevation (meters)	Mean	327	379	490	377
	Range	220–390	130–690	390–550	130–690
Slope[1] (percent)	Mean	73	48	57	59
	Range	50–90	0–90	30–70	0–90
Distance to road[2] (meters)	Mean	120	214	373	204
	Range	100–290	70–500	100–800	100–800
Distance to water[3] (meters)	Mean	90	95	93	93
	Range	30–250	10–300	50–150	10–300

[1]Average slope at each plot location.
[2]Distance to nearest all-weather road.
[3]Distance to nearest stream or body of water.

Table 7.—*Forest characteristics by forest class; St. Vincent, 1984*

Characteristic	Statistic	Forest class			All classes
		Young secondary	Secondary	Primary	
Basal area[1] (m^2/ha)	Mean	16.3	16.9	30.7	19.0
	Range	3.3–25.7	8.3–23.7	19.7–38.2	3.3–38.2
Number of trees[1] (stems/ha)	Mean	2758	1506	2323	2129
	Range	67–5076	85–2453	1266–3743	67–5076
Mean diameter[2] (cm)	Mean	9.1	12.0	13.5	11.2
	Range	5.7–11.2	9.6–16.0	11.4–14.9	5.7–16.0
Mean canopy height[3] (m)	Mean	13.7	20.0	25.8	18.5
	Range	8.4–23.9	12.7–28.5	22.9–30.0	8.4–30.0
Total volume[4] (m^3/ha)	Mean	77.4	150.8	357.9	156.7
	Range	24.7–122.0	54.4–273.6	215.0–481.5	24.7–481.5
Timber volume[5] (m^3/ha)	Mean	52.7	98.6	251.4	106.2
	Range	11.8–97.9	53.9–171.6	130.5–342.2	11.8–342.2

[1]All trees 2.5 cm d.b.h. and larger.
[2]Quadratic mean at each plot location.
[3]Based on dominant and codominant trees.
[4]Total overbark volume of trees 12.5 cm d.b.h. and larger using equation by Dawkins (1961).
[5]All sound wood of trees 12.5 cm d.b.h. and larger, from stump to a 10-cm minimum diameter.

Table 8.—*Average number of live trees by diameter class and forest class; St. Vincent, 1984*

Diameter class	Forest class		
	Young secondary	Secondary	Primary
Cm	*Trees per hectare*		
5	1,788	967	1,687
10	763	334	422
15	113	86	38
20	49	47	49
25	26	22	24
30	5	14	16
35	5	7	11
40	4	8	20
45	2	5	14
50	*[1]	5	17
55	*	4	6
60	*	3	7
65	*	2	4
70	*	1	1
75+	2	3	8
Total[2]	2,758	1,506	2,324

[1]* = less than one tree per hectare.
[2]Column entries may not sum to totals due to rounding.

Table 9.—*Number of live trees by species and diameter class, ranked by basal area; young secondary forest, St. Vincent, 1984*

Use[1] code	Scientific name	Total basal area	Tree size class[2]			All size classes
			Sapling	Poletimber	Sawtimber	
		Square meters	*Thousand trees*			
2	*Inga vera*	6,147	430	95	16	541
2	*Licania ternatensis*	5,428	789	74	3	865
3	*Cyathea arborea*	4,729	574	34	.....	608
3	*Cecropia peltata*	4,069	72	78	9	159
3	*Myrcia deflexa*	3,780	287	57	.....	343
2	*Sloanea massoni*	3,238	502	94	.....	596
3	*Prestoea montana*	3,153	574	.....	.....	574
3	*Eugenia procera*	2,553	1,363	.....	.....	1,363
3	*Hedyosmum arborescens*	2,527	789	.....	.....	789
3	*Symplocos martinicensis*	2,337	143	72	.....	215
2	*Chimarrhis cymosa*	1,700	.....	.....	11	11
2	*Cordia sulcata*	1,513	413	.....	5	435
2	*Inga ingoides*	1,344	359	.....	.....	359
1	*Dacryodes excelsa*	1,275	.....	.....	2	2
2	*Sapium caribaeum*	1,275	.....	25	4	29
3	*Lonchocarpus violaceus*	1,275	.....	59	.....	59
....	*Pouteria multiflora*	1,202	143	11	*[3]	154
....	*Acanthaeaceae*	863	574	.....	.....	574
3	*Ochroma pyramidale*	850	.....	.....	4	4
2	*Nectandra coriacea*	726	143	9	.....	153
....	*Daphnopsis americana*	718	143	.....	.....	143
....	*Guettarda scabra*	702	359	.....	.....	359
2	*Citharexylum spinosum*	670	72	.....	*	72
....	*Ocotea leucoxylon*	579	287	.....	.....	287
3	*Ixora ferrea*	534	359	.....	.....	359
	14 other species	4,939	717	65	14	796
	All species[4]	58,125	9,107	673	67	9,847

[1]High-quality sawtimber = code 1; utility poletimber and sawtimber = code 2; currently unusable timber = code 3.

[2]Saplings are 2.5 to 12.5 cm d.b.h.; poletimber trees are 12.5 to 27.5 cm d.b.h.; sawtimber trees are larger than 27.5 cm d.b.h.

[3]* = Less than 500 trees.

[4]Column entries may not sum to totals due to rounding.

classes. Steep slopes, unstable soils, high rainfall, periodic storms, and volcanic eruptions create a very dynamic forest. Sample plots established randomly under these conditions reflect a great deal of this natural diversity.

Species Composition

Species composition varies considerably among the three timberland classes (tables 9, 10, 11). Although the classes represent three stages of a successional process, an orderly succession of species is not immediately apparent. Inventory sample plots were scattered over the island in different forest stands, so the data does not represent a series of observations of a changing forest, but rather a snapshot of current forests in different stages of development. Tropical species are seldom uniformly distributed over an area, and St. Vincent is no exception. Individual species tend to have a clustered distribution that enhances the stand and site variability associated with diverse stand origins, physiography, and disturbance.

Many of the species listed in the tables were sampled at only one location. It was not possible to install enough samples to intensively study individual species. Generally, the data on larger trees (poletimber and sawtimber) sampled with a prism are more accurate than the data on saplings. It follows that the species data for young secondary forests are least reliable, and data for the primary forest are most reliable. In the following discussion, only species that seem to have been reasonably well sampled are mentioned.

Young secondary forests are composed of pioneer saplings and poletimber such as *I. vera* and *Cecropia peltata*. Several species are common as saplings but absent from larger size classes. Scattered large trees are remnants of previous forests, including *Dacryodes excelsa, Chimarrhis cymosa,* and *Licania ternatensis.*

Table 10.—*Number of live trees by species and diameter class, ranked by basal area; secondary forest, St. Vincent, 1984*

Use[1] code	Scientific name	Total basal area	Tree size class[2]			All size classes
			Sapling	Poletimber	Sawtimber	
		Square meters	*Thousand trees*			
2	*Inga vera*	9,822	456	95	55	606
3	*Eugenia sintenisii*	5,037	326	71	10	407
3	*Prestoea montana*	4,736	326	104	.....	429
3	*Cecropia peltata*	4,663	586	26	15	628
2	*Ficus citrifolia*	4,246	.....	7	17	23
1	*Dacryodes excelsa*	3,474	.....	24	11	35
2	*Chimarrhis cymosa*	3,131	65	9	10	85
3	*Ficus obtusifolia*	2,702	.....	.....	11	11
1	*Guarea guidonia*	2,567	521	.....	.....	521
1	*Tabebuia pallida*	2,316	.....	.....	10	10
2	*Cordia sulcata*	2,301	521	.....	4	526
1	*Meliosma herbertii*	1,930	.....	36	5	41
3	*Artocarpus altilis*	1,544	.....	.....	8	8
2	*Sterculia caribaea*	1,493	195	77	.....	272
1	*Andira inermis*	1,195	65	24	6	96
....	*Rubiaceae*	1,050	456	.....	.....	456
2	*Nectandra coriacea*	802	130	.....	.....	130
2	*Citharexylum fruticosum*	772	.....	18	4	21
3	*Faramea occidentalis*	772	.....	44	.....	44
1	*Phoebe elongata*	772	.....	.....	3	3
2	*Sloanea caribaea*	772	.....	.....	3	3
1	*Freziera hirsuta*	772	.....	.....	3	3
	14 other species	5,735	1,172	37	14	1,224
	All species[3]	62,606	4,820	572	191	5,583

[1]High-quality sawtimber = code 1; utility poletimber and sawtimber = code 2; currently unusable timber = code 3.

[2]Saplings are 2.5 to 12.5 cm d.b.h.; poletimber trees are 12.5 to 27.5 cm d.b.h.; sawtimber trees are larger than 27.5 cm d.b.h.

[3]Column entries may not sum to totals due to rounding.

Secondary forests contain many of the same species, with pioneers reaching maturity and the longer-lived species beginning to form a canopy (table 10). *Inga vera* is clearly the dominant species, accounting for 16 percent of the basal area and 29 percent of all sawtimber trees. *Prestoea montana* and *C. peltata* have persisted and many have reached maturity. *Chimarrhis cymosa* and *Ficus citrifolia* are frequently observed with d.b.h. between 50 and 70 cm. Again, some species are present only as large residual trees from prior forest stands or old fields.

Primary forest composition is quite different from the composition of the younger successional forests (table 11). Short-lived pioneers and secondary species have been replaced or outgrown by overstory giants of many different species, and some new understory species adapted to the moist, shady environment beneath the canopy have appeared.

Dacryodes excelsa, L. ternatensis, Ormosia monosperma, and *Sloanea massoni* together account for 40 percent of the basal area and 33 percent of all sawtimber trees. Several species were encountered only as large sawtimber specimens with no evidence of reproduction under the canopy or in successional forest classes. Absent from the mature forest were several common successional species: *Inga vera, P. montana, Cecropia peltata, F. citrifolia,* and *Chimarrhis cymosa.*

For all classes of timberland combined, *I. vera* comprises the most basal area, followed by *L. ternatensis, D. excelsa,* and *Cecropia peltata.* The largest d.b.h. recorded was for a *S. massoni*, at 191.7 cm. The tallest tree was another *S. massoni,* at 48 m.

Timber Volume

Timber volume is the volume, inside the bark, of all sound wood, including bole and branch defects such as crook or large knots, of all tree sections with a minimum diameter of 10 cm and a minimum length of 1 m. This represents the wood volume removed from the forest for all forest products other than fuelwood. Growing-stock volume excludes the cull or rough sections and all of the wood in trees classified as rough or rotten due to excessive incidence of these defects. Growing-stock volume is the wood volume that the commercial logger would remove from the forest for

Table 11.—*Number of live trees by species and diameter class, ranked by basal area; primary forest, St. Vincent, 1984*

Use[1] code	Scientific name	Total basal area	Tree size class[2]			All size classes
			Sapling	Poletimber	Sawtimber	
		Square meters	*Thousand trees*			
1	*Dacryodes excelsa*	5,562	76	25	18	119
2	*Licania ternatensis*	5,517	1,683	22	9	1,713
1	*Ormosia monosperma*	5,024	76	.....	19	96
2	*Sloanea massoni*	4,080	.....	.....	10	10
2	*Talauma dodecaceptala*	3,173	.....	.....	11	11
....	*Rubiaceae*	2,821	76	30	9	116
2	*Sloanea caribaea*	2,764	76	.....	8	84
2	*Actinostemen caribeus*	2,720	.....	.....	14	14
3	*Symplocos martinicensis*	2,156	229	33	.....	263
1	*Micropholis chrysophylloides*	1,973	76	21	14	112
3	*Miconia virescens*	1,841	229	.....	.....	229
2	*Pithecellobium jupunda*	1,813	.....	.....	12	12
1	*Simaruba amara*	1,813	.....	.....	9	9
3	*Erythroxylon squamatum*	1,360	.....	28	4	32
3	*Cassipourea guianensis*	1,140	153	.....	1	154
3	*Ixora ferrea*	1,126	306	10	.....	316
2	*Canella winterana*	907	.....	12	1	13
3	*Eugenia sintenisii*	519	76	.....	1	78
....	*Meliosma herbertii*	507	76	.....	6	82
	10 other species	3,315	306	.....	23	329
	All species[3]	50,132	3,442	181	169	3,792

[1]High-quality sawtimber = code 1; utility poletimber and sawtimber = code 2; currently unusable timber = code 3.

[2]Saplings are 2.5 to 12.5 cm d.b.h.; poletimber trees are 12.5 to 27.5 cm d.b.h.; sawtimber trees are larger than 27.5 cm d.b.h.

[3]Column entries may not sum to totals due to rounding.

use as pulpwood, sawtimber, or veneer bolts. Sawtimber volume is the net volume of wood in all trees larger than 27.5 cm in d.b.h. that can be sawn into lumber. These trees must contain a saw log at least 22.5 cm in diameter outside bark and 3.5 m in length.

Timber volume in the young secondary forest averages 52.7 m^3/ha. The average rises to 98.6 m^3 in secondary forests and 251.3 m^3 in the primary forest. Although the majority of the volume is found in larger trees, all size classes show an increase in volume in the secondary and primary forest classes (fig. 8). Of most interest to the prospective logger is the volume in large sawtimber trees (d.b.h. larger than 47.5 cm).

Most of the usable volume in young secondary forests is found in the occasional large residual trees. This is best indicated by the sawtimber volume total, which averages 7.2 m^3/ha, mostly in *D. excelsa* and *L. ternatensis* (table 12). *Inga vera* and *C. peltata* account for more timber volume, but this is in smaller sawtimber and poletimber. *Inga vera* has some utilization potential for utility or construction grade products.

Inga vera is also the principal timber species in secondary forests (table 13). Sawtimber volume for all species averages 13.7 m^3/ha, with four species accounting for 72 percent of the total. Of these four, *D. excelsa* and *Chimarrhis cymosa* are present in large sawtimber sizes and would be the preferred harvest species.

Secondary forests are reasonably well stocked with timber; some individual stands carry as much as 44 m^3/ha of sawtimber. Factors that might limit the availability of this timber by making it uneconomical or impractical to harvest include accessibility, terrain

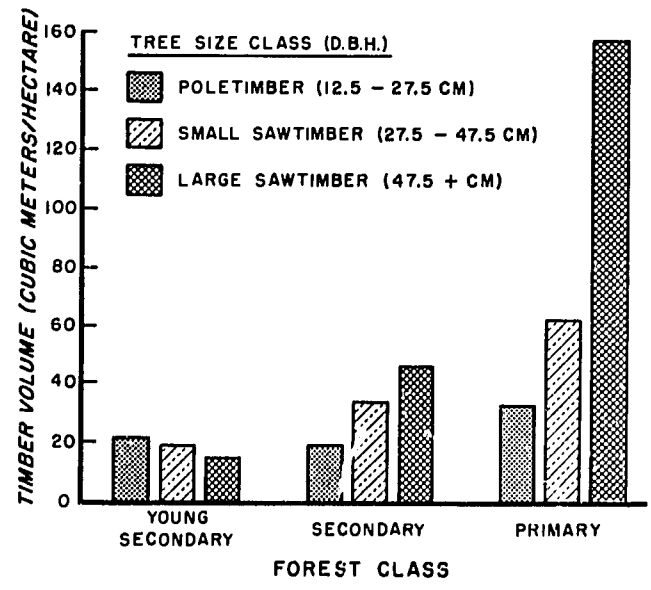

Figure 8.—*Average timber volume by forest class and tree size class; St. Vincent timberland.*

Table 12.—*Volume of timber, growing stock, and sawtimber by species and tree size class*[1]*; young secondary forest, St. Vincent, 1984*

Scientific name	Timber volume[2]			Growing-stock volume[3]			Sawtimber volume[4]
	Poletimber	Sawtimber	Total	Poletimber	Sawtimber	Total	Total
	Thousand cubic meters						
Inga vera	6.1	21.6	27.7	5.9	14.5	20.4	1.2
Cecropia peltata	15.9	8.6	24.5	15.8	5.0	20.8	1.4
Dacryodes excelsa	.....	17.3	17.3	.....	16.8	16.8	10.5
Licania ternatensis	5.6	10.5	16.1	5.6	9.2	14.8	5.4
Chimarrhis cymosa	.....	9.9	9.9	.....	6.6	6.6	2.1
Sapium caribaeum	4.8	4.3	9.1	4.3	3.0	7.4	.....
Cordia sulcata	.....	8.8	8.8	.....	6.7	6.7	.....
Pouteria multiflora	2.8	5.0	7.8	2.7	4.1	6.7	.....
Myrcia deflexa	6.5	.....	6.5	6.4	.....	6.4	.....
Cordia collococca	.....	6.4	6.4	.....	5.2	5.2	2.6
Ochroma pyramidale	.....	6.1	6.1	.....	5.1	5.0	2.2
Cyathea arborea	5.9	.....	5.9	.....	.....	.....	.....
Sloanea massoni	5.7	.....	5.7	5.7	.....	5.7	.....
Lonchocarpus violaceus	5.2	.....	5.2	5.1	.....	5.1	.....
Linociera caribaea	.....	4.7	4.7	.....	3.5	3.5	.....
Citharexylum spinosum	.....	3.8	3.8	.....	3.6	3.6	.....
Simaruba amara	3.8	.....	3.8	3.6	.....	3.6	.....
Meliosma herbertii	.....	3.7	3.7	.....	2.8	2.8	.....
Andira inermis	.....	3.4	3.4	.....	2.5	2.5	0.4
Symplocos martinicensis	3.1	.....	3.1	3.0	.....	3.0	.....
Nectandra coriacea	3.1	.....	3.1	3.0	.....	3.0	.....
5 other species	4.5	1.2	5.7	4.3	0.5	4.8	.....
All species[5]	72.9	115.2	188.1	65.4	89.1	154.5	25.8

[1]Poletimber trees are between 12.5 and 27.5 cm d.b.h., and sawtimber trees are greater than 27.5 cm d.b.h.

[2]Volume of all sound wood in all live trees to a minimum 10-cm diameter outside bark.

[3]Volume of sound wood (less sound cull volume) in growing-stock trees of potential commercial species to a minimum 10-cm diameter outside bark.

[4]Net volume of the saw log portion of sawtimber trees of potential commercial species, calculated according to the International rule.

[5]Column entries may not sum to totals due to rounding.

roughness and slope, and the ecological values of the forest. Much of the secondary forest is located in very rugged, uninhabited terrain that does not contain roads or even good trails. The forests are probably the result of natural rather than human disturbance. Physical difficulties limit the opportunities for log extraction. Of additional concern is the ecological value of these secondary forests and the role they may play as seed sources and habitats for many plant and animal species. The parcels are often located adjacent to or within mature timber stands as a part of a single, dynamic forest ecosystem.

The primary forest carries the high volumes usually reported for the tropical moist forest (table 14). Many different species are represented by large mature individuals that contain as much as 20 m^3 of timber. Sawtimber volume averages 65 m^3/ha, with high quality timber accounting for 44 percent of the total. *Dacryodes excelsa, O. monosperma, Actinostemen caribeus,* and *Talauma dodecaceptala* together comprise 59 percent of all sawtimber.

The dense timber stands are unlikely to be harvested soon due to the extremely rugged terrain and lack of roads or easy access. The primary forest, because of its limited distribution in the Antilles and the uniqueness of the vegetation on each island, may be the most valuable natural resource of St. Vincent. Besides helping to maintain the island ecosystem and sustain water supplies in the water catchments, the natural forests have the potential to attract tourists and provide habitat for interesting and endangered wildlife species. Since the mature tropical forest may take hundreds of years to fully regenerate, this resource should be managed with the greatest care.

The majority of the timber in young secondary and secondary forests is contained in rough cull trees (table 15). Successional species have a tendency to become crooked and limby because they grow under uncrowded conditions in early years. Some of the large, residual trees on abandoned agricultural land were open-grown as well.

In contrast, two-thirds of the timber in the primary forest is found in growing-stock trees. These trees have survived competition by growing tall and straight in early years and shedding lower branches. Because of the size of these trees, 20 percent of the

Table 13.—*Volume of timber, growing stock, and sawtimber by species and tree size class*[1]*; secondary forest, St. Vincent, 1984*

Scientific name	Timber volume[2]			Growing-stock volume[3]			Sawtimber volume[4]
	Poletimber	Sawtimber	Total	Poletimber	Sawtimber	Total	Total
	Thousand cubic meters						
Inga vera	17.3	55.9	73.3	14.2	40.5	54.7	10.1
Dacryodes excelsa	5.1	30.2	35.2	5.0	26.9	31.9	11.5
Ficus citrifolia	1.6	32.0	33.6	1.5	19.0	20.6	.....
Chimarrhis cymosa	1.6	25.5	27.1	1.6	18.4	20.0	8.7
Cecropia peltata	3.5	22.0	25.6	3.5	16.1	19.6	6.2
Ficus obtusifolia	.....	24.6	24.6	.....	16.6	16.6	2.5
Tabebuia pallida	.....	18.6	18.6	.....	12.8	12.8	.....
Eugenia sintenisii	6.4	10.3	16.7	5.8	7.6	13.3	1.1
Artocarpus altilis	.....	12.9	12.9	.....	11.1	11.1	3.9
Prestoea montana	11.0	.....	11.0	.....	.....	.....	.....
Cordia sulcata	.....	10.4	10.4	.....	6.9	6.9	.....
Sapium caribaeum	.....	9.1	9.1	.....	7.1	7.1	3.6
Freziera hirsuta	.....	7.8	7.8	.....	6.2	6.2	.....
Andira inermis	4.9	2.5	7.4	4.7	2.3	7.0	.....
Sloanea caribaea	.....	6.7	6.7	.....	4.9	4.9	.....
Phoebe elongata	.....	5.6	5.6	.....	4.0	4.0	.....
Sterculia caribaea	4.9	.....	4.9	4.9	.....	5.0	.....
Citharexylum fruticosum	1.2	2.9	4.1	0.6	1.9	2.5	.....
Actinostemen caribeus	.....	4.0	4.0	.....	2.8	2.8	0.8
Faramea occidentalis	3.8	.....	3.8	3.7	.....	3.7	.....
6 other species	10.1	13.2	23.3	5.8	10.2	16.1	2.3
All species[5]	71.4	294.1	365.5	51.3	215.4	266.7	50.6

[1]Poletimber trees are between 12.5 and 27.5 cm d.b.h., and sawtimber trees are greater than 27.5 cm d.b.h.
[2]Volume of all sound wood in all live trees to a minimum 10-cm diameter outside bark.
[3]Volume of sound wood (less sound cull volume) in growing-stock trees of potential commercial species to a minimum 10-cm diameter outside bark.
[4]Net volume of the saw log portion of sawtimber trees of potential commercial species, calculated according to the International rule.
[5]Column entries may not sum to totals due to rounding.

timber is contained in branches, forks, and large sections of the bole above the saw log.

For all timberland classes combined, *D. excelsa* has the highest growing-stock volume, followed by two successional species, *I. vera* and *C. peltata* (fig. 9). The other common species are generally located in or near the primary forest.

Dacryodes excelsa clearly has the highest grade of sawtimber, with 64 percent of the wood in grade 1 logs (table 16). For all other species the proportion of sawtimber in grade 1 logs is 19 percent, with 50 percent in grade 2 logs and 30 percent in grade 3 logs.

Management Opportunities for Natural Forests

With population growth, domestic water demands will increase. Likewise, future expansion of tourism or the introduction of small industry on St. Vincent will create greater demands for water. The continuous supply of good quality water throughout the year is dependent on maintaining forest cover on government-owned lands in the interior. These lands should be protected against further intrusion, and plantations should be established on steep slopes to conserve water and to reduce soil erosion and reservoir sedimentation.

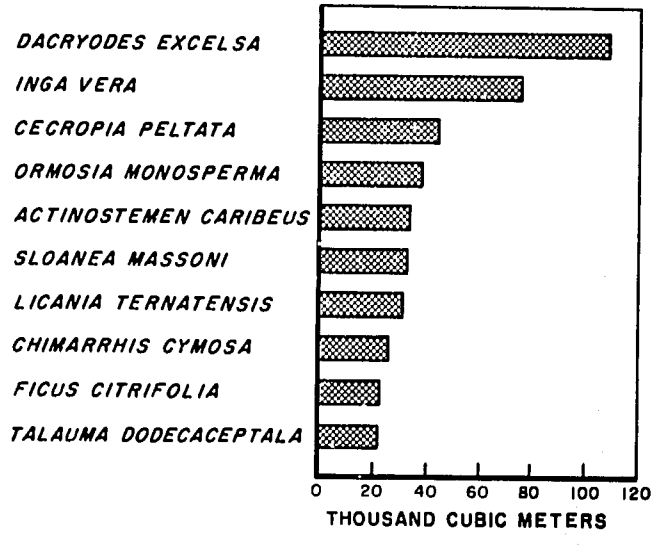

Figure 9.—*Growing-stock volume of 10 common tree species; St. Vincent timberland.*

Table 14.—*Volume of timber, growing stock, and sawtimber by species and tree size class*[1]*; primary forest, St. Vincent, 1984*

Scientific name	Timber volume[2]			Growing-stock volume[3]			Sawtimber volume[4]
	Poletimber	Sawtimber	Total	Poletimber	Sawtimber	Total	Total
	Thousand cubic meters						
Dacryodes excelsa	6.5	59.5	66.0	6.5	52.8	59.3	25.5
Ormosia monosperma	.....	51.1	51.1	.....	34.4	34.4	10.6
Sloanea massoni	.....	40.0	40.0	.....	26.7	26.7	4.2
Actinostemen caribeus	.....	37.1	37.1	.....	30.2	30.2	16.2
Talauma dodecaceptala	.....	30.0	30.0	.....	22.9	22.9	10.0
Sloanea caribaea	.....	26.3	26.3	.....	8.9	8.9	.....
Pithecellobium jupunda	.....	19.2	19.2	.....	15.3	15.3	5.2
Licania ternatensis	2.1	17.1	19.2	2.0	13.4	15.4	7.9
Rubiaceae (sp. unknown)	3.1	15.8	18.9	3.1	12.6	15.7	2.3
Simaruba amara	.....	18.8	18.8	.....	16.1	16.1	8.4
Sapium caribaeum	.....	11.0	11.0	.....	8.5	8.5	5.1
Micropholis chrysophylloides	2.4	8.4	10.8	2.5	6.8	9.2	2.0
Erythroxylon squamatum	6.1	3.2	9.3	5.9	2.3	8.2	.....
Symplocos martinicensis	8.0	.....	8.0	7.9	.....	7.9	.....
Guapira fragrans	.....	7.3	7.3	.....	6.0	6.0	3.1
Meliosma herbertii	.....	5.9	5.9	.....	4.2	4.2	2.5
Canella winterana	2.3	3.2	5.5	1.8	2.8	4.6	.....
Guarea guidonia	.....	5.3	5.3	.....	4.4	4.4	1.6
Linociera caribaea	.....	5.0	5.0	.....	3.6	3.6	1.2
Cecropia peltata	.....	4.3	4.3	.....	3.2	3.2	.....
4 other species	2.4	8.9	11.3	2.4	7.4	9.7	.....
All species[5]	32.9	377.3	410.2	32.1	282.4	314.4	105.7

[1]Poletimber trees are between 12.5 and 27.5 cm d.b.h., and sawtimber trees are greater than 27.5 cm d.b.h.

[2]Volume of all sound wood in all live trees to a minimum 10-cm diameter outside bark.

[3]Volume of sound wood (less sound cull volume) in growing-stock trees of potential commercial species to a minimum 10-cm diameter outside bark.

[4]Net volume of the saw log portion of sawtimber trees of potential commercial species, calculated according to the International rule.

[5]Column entries may not sum to totals due to rounding.

Table 15.—*Volume of timber by class of timber and forest class; St. Vincent, 1984*

Class of timber	Forest class		
	Young secondary	Secondary	Primary
	Cubic meters per hectare		
Growing-stock trees			
Sawtimber trees			
Saw log portion of bole	12.0	25.0	112.2
Upper stem of bole	1.9	7.3	22.4
Branches and forks	2.8	7.6	21.9
Sound cull	0.9	1.5	12.7
Timber volume	17.6	41.4	169.2
Poletimber trees			
Bole volume	6.2	5.8	15.2
Branches and forks	.....	.....	.....
Sound cull	0.2	0.7	.....
Timber volume	6.4	6.5	15.2
Rough and rotten trees			
Bole volume	23.1	33.9	42.9
Branches and forks	2.8	6.8	7.3
Sound cull	2.8	10.0	16.8
Timber volume	28.7	50.7	67.0
All timber[1]	52.7	98.6	251.4

[1]Column entries may not sum to totals due to rounding.

Table 16.—*Volume of sawtimber by species and log grade; St. Vincent, 1984*

Scientific name	Log grade[1] 1	2	3	4	All grades
	---- *Thousand cubic meters* ----				
Dacryodes excelsa	30.4	8.9	8.2	...	47.5
Actinostemen caribeus	...	16.2	0.8	...	17.0
Licania ternatensis	3.1	7.9	2.2	...	13.2
Ormosia monosperma	7.0	4.9	...	...	11.9
Inga vera	2.0	2.5	6.8	...	11.3
Chimarrhis cymosa	...	10.8	...	...	10.8
Talauma dodecaceptala	3.8	4.8	1.3	...	10.0
Sapium caribaeum	5.1	3.6	...	...	8.7
Simaruba amara	2.0	2.0	4.4	...	8.4
Cecropia peltata	...	4.1	3.6	...	7.7
Pithecellobium jupunda	...	1.5	3.7	...	5.2
Sloanea massoni	2.7	...	1.4	...	4.1
Artocarpus altilis	...	...	3.9	...	3.9
Meliosma herbertii	...	...	3.4	...	3.4
Guapira fragrans	...	3.1	...	...	3.1
Cordia collococca	...	2.6	...	...	2.6
Ficus obtusifolia	...	1.8	0.6	...	2.5
Rubiaceae (sp. unknown)	...	1.2	...	1.1	2.3
Ochroma pyramidale	...	...	2.2	...	2.2
Micropholis chrysophylloides	...	...	2.0	...	2.0
4 other species	...	...	4.4	...	4.4
All species	56.1	76.0	48.9	1.1	182.1

[1]Graded by hardwood log grade standards used in Southern U.S.

The minimum stocking standard for Puerto Rico is 250 saplings or 100 poletimber-size trees per hectare of desirable species to assure reasonable stocking of a timber stand at maturity. Young secondary forests in St. Vincent contain 10 times this standard of saplings and twice this standard of poletimber trees, but the vast majority are classed as rough cull trees and would not be good candidates for future crop trees (table 17). This proportion is much higher than the 45 percent found in young secondary forests of Puerto Rico. Such poor stocking, regardless of species, indicates that management of natural regeneration at this early stage of stand development would be premature. Replacement of young secondary forests with plantation species could be accomplished easily by clearing the small trees and other inhibiting vegetation.

Stocking improves somewhat for secondary forests that average 281 saplings and 45 poletimber growing-stock trees (table 17). There would be some stands with sufficient growing stock that could be improved by girdling or injecting rough cull trees and undesirable species. Species to favor because of wood quality would include *I. vera, F. citrifolia, D. excelsa, Chimarrhis cymosa, Tabebuia pallida, Guarea guidonia, Cordia sulcata, Meliosma herbertii, Sterculia caribaea, Andira inermis,* and *Nectandra coriaceae. Eugenia sintenisii* and *Cecropia peltata* should be removed or deadened, while some understory species such as *P. montana* would not compete in the long run with the larger species favored for timber production. These could be left untreated.

The much better stocking of growing-stock trees in the primary forest indicates that natural selection processes would eventually favor the larger timber species. Growing-stock basal area averages 64 percent of all stocking in the primary forest, compared with 34 percent in secondary and 16 percent in the young secondary classes (table 18). Although more

Table 17.—*Average number of trees by size class, tree class, and forest class; St. Vincent, 1984*

Size class and tree class	Forest class: Young secondary	Secondary	Primary	All classes
	---------- *Trees per hectare* ----------			
Saplings				
Growing stock	80	281	1,125	355
Rough and rotten	2,471	1,019	984	1,595
Total	2,551	1,301	2,109	1,950
Poletimber trees				
Growing stock	28	45	81	45
Rough and rotten	161	109	29	115
Total	188	154	111	160
Sawtimber trees				
Growing stock	8	25	77	27
Rough and rotten	11	27	27	20
Total	19	51	104	48
All size classes				
Growing stock	116	351	1,283	428
Rough and rotten	2,642	1,156	1,041	1,730
Total[1]	2,758	1,506	2,323	2,158

[1]Column entries may not sum to totals due to rounding.

Table 18.—*Average basal area by size class, tree class, and forest class; St. Vincent, 1984*

Size class and tree class	Forest class: Young secondary	Secondary	Primary	All classes
	------- *Square meters per hectare* -------			
Saplings				
Growing stock	0.3	0.7	2.8	0.9
Rough and rotten	8.2	3.6	2.9	4.3
Total	8.4	4.3	5.7	6.2
Poletimber trees				
Growing stock	1.0	1.1	2.5	1.3
Rough and rotten	3.6	2.7	1.1	2.8
Total	4.5	3.8	3.6	4.1
Sawtimber trees				
Growing stock	1.4	3.9	14.4	4.8
Rough and rotten	1.9	4.9	6.9	4.1
Total	3.3	8.8	21.4	8.9
All size classes				
Growing stock	2.6	5.7	19.8	7.1
Rough and rotten	13.6	11.2	11.0	12.1
Total[1]	16.3	16.9	30.7	19.2

[1]Column entries may not sum to totals due to rounding.

than half the saplings in the primary forest are classed as growing stock, many are suppressed and would probably not respond to release cutting.

In summary, the best prospects for management of natural forests to improve timber species' stocking would be in secondary forest stands with adequate stocking of desirable saplings and poletimber. Implementation of natural forest management requires a detailed survey of the species composition of a particular stand and some experience with how the individual species might respond to release. In the absence of additional applied research studies, it is not recommended that natural forest management be attempted in the forests of St. Vincent on the basis of this survey alone.

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APPENDIX

RELIABILITY OF THE DATA

Reliability of the estimates may be affected by two types of errors. The first type stems from the use of a sample to estimate the whole and from variability of the items being sampled. This is termed sampling error; it is susceptible to a mathematical evaluation of the probability of error. The second type—often referred to as reporting or estimating error—derives from mistakes in measurement, judgment, or recording and from limitations of methods or equipment. This type of error is held to a minimum by proper training, supervision, and precision.

Statistical analysis of the data indicates a sampling error of plus or minus 3.6 percent for forest area. Timber volume sampling error was estimated to be 19.1 percent. As these totals are broken down by species, tree size, or other classifications, the possibility for error increases and is greatest for the smallest subdivisions.

DEFINITIONS

Basal Area.—The area in square meters of the cross section at breast height of a single tree or of all the trees in a stand, expressed as square meters per hectare.

D.b.h. (diameter at breast height).—Tree diameter in centimeters, outside bark, measured at 1.3 m above ground.

Dry Scrub Forest.—Fine woody vegetation generally less than 10 m tall at maturity, found under dry conditions typical of the Subtropical Dry Life Zone and certain serpentine and limestone soils.

Dwarf Forest.—Also known as cloud forest or elfin woodland, the dwarf forest is found on the summits of the highest mountains and is characterized by densely packed, knarled trees less than 7 m tall.

Forest Land.—Land at least 10 percent stocked by forest trees of any size, or formerly having had such tree cover and not currently developed for nonforest use. The minimum area for classification of forest

land is 0.5 ha, and the minimum width for forest strips is 35 m. Unimproved roads and trails, streams, and clearings in forest areas are classed as forest if less than 35 m in width.

Growing-Stock Trees.—Sawtimber trees, poletimber trees, saplings, and seedlings; that is, all live trees except rough and rotten trees.

Nonstocked Land.—Commercial forest land less than 10 percent stocked with growing-stock trees. This includes areas covered by inhibiting vegetation (brush, vines, ferns, etc.) classed as forest land.

Other Forest Land.—Forest land incapable of yielding timber crops because of adverse site conditions, forest land withdrawn from timber utilization through statute or administrative regulation, or forest land with higher priority use.

Palm Forest.—Nearly pure stands of *Prestoea montana* that form in upper mountain regions.

Poletimber Trees.—Growing-stock trees, 12.5 to 22.5 cm in d.b.h. for softwoods and 12.5 to 27.5 cm for hardwoods, of good form and vigor.

Primary Forest.—Relatively undisturbed, mature, wet forest composed of mixed tree sizes. The canopy is generally higher than 7 m.

Rough and Rotten Trees.—Live trees that are unmerchantable for saw logs now or in the future because of defect or rot.

Saplings.—Growing-stock trees, 2.5 to 12.5 cm in d.b.h., and of good form and vigor.

Sawtimber Trees.—Growing-stock trees, 22.5 cm and larger in d.b.h. for softwoods and 27.5 cm and larger for hardwoods, containing at least one 3.5-m saw log.

Secondary Forest.—Forest resulting from the abandonment of cropland or pasture and forest resulting from the regeneration of previously cutover or disturbed forest land.

Timberland.—Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization.

Volume of Growing Stock.—Volume of sound wood (less cull volume) in the bole and branches of sawtimber and poletimber trees from the stump to a minimum 10-cm diameter outside bark or to the point past which a 1-m section meeting minimum qualifications can no longer be measured because of limbs or other cull.

Volume of Sawtimber.—Net volume of the saw log portion of sawtimber trees in cubic meters, calculated according to the International rule, 0.635 cm (1/4 inch) kerf.

Volume of Timber.—Volume of all sound wood (including sound cull) in the bole and branches of growing stock, rough, rotten, and salvable dead trees 12.5 cm and larger in d.b.h., from stump to a minimum 10 cm diameter outside bark. The minimum length of any section included is 1 meter.

Young Secondary Forest.—Secondary forest with most trees less than 10 years old.

Tree Species Tallied in St. Vincent, 1984

Scientific name	St. Vincent common name
Acanthaeaceae (sp. unknown)	
Actinostemen caribeus Griseb.	
Andira inermis (W. Wright) H.B.K.	Black plum, Jumbie mango
Artocarpus altilis (Parkinson) Fosberg	Breadfruit
Calophyllum antillanum Britton	Galba
Canella winterana (L.) Gaertn.	Wild cinnamon
Cassipourea guianensis Aubl.	
Cecropia peltata L.	Trumpet tree
Chimarrhis cymosa Jacq.	Waterwood
Citharexylum fruticosum L.	Fiddlewood
Citharexylum spinosum L.	Bastard fiddlewood
Cocos nucifera L.	Coconut
Conomorpha peruviana A.D.C.	
Cordia alliodora (Ruiz & Pav.) Oken	
Cordia collococca L.	Red manjack
Cordia sulcata DC.	White manjack
Croton populifolius Lam.	Black siege
Cyathea arborea (L.) J. E. Smith	Tree fern, jamen joe
Cyrilla racemiflora L.	Bloodwood

Tree Species Tallied in St. Vincent, 1984—Continued

Scientific name	St. Vincent common name
Dacryodes excelsa Vahl	Gommier
Daphnopsis americana (Mill.) J. R. Johnston	Local mahoe
Erythroxylon squamatum Sw.	
Eugenia procera (Sw.) Poir.	
Eugenia sintenisii Kiaersk.	Bashi guava
Faramea occidentalis (L.) A. Rich.	Wild coffee
Ficus citrifolia Vahl	Wild fig
Ficus obtusifolia H.B.K.	Fig
Freziera hirsuta Sm.	Gunstock
Guapira fragrans (Dum.-Cours.) Standley	Mapoo, loblolly
Guarea guidonia (L.) Sleumer	Black plum
Guettarda scabra (L.) Vent.	
Hedyosmum arborescens Sw.	
Hibiscus elatus Sw.	Blue mahoe
Inga ingoides (Rich) Willd.	Spanish ash
Inga vera Willd.	Spanish ash
Ixora ferrea (Jacq.) Benth.	Wild coffee
Licania ternatensis (Hook.) F.	Bois job
Linociera caribaea (Jacq.) Knobl.	Mastic
Lonchocarpus violaceus H.B.K.	Greenhart
Mangifera indica L.	Mango
Manilkara bidentata (A. DC.) Chev.	Bulletwood, balata
Meliosma herbertii Rolfe	Wild cocoa
Miconia virescens (Vahl.) Triana	Torchwood
Miconia elongata Vahl.	Candlewood
Micropholis chrysophylloides Pierre	Wild star apple
Myrcia deflexa (Poir.) DC.	Wild plumrose
Nectandra coriacea (Sw.) Griseb.	Sweetwood
Ochroma pyramidale Cav. Urban	Balsa, bafal
Ocotea leucoxylon (Sw.) Mez	Sweetwood
Ormosia monosperma (Sw.) Urb.	Sarinette
Phoebe elongata (Vahl) Nees	Sweetwood
Pinus caribaea Morelet	Pine
Pithecellobium jupunda (Willd.) Urb.	Wild tamarind
Pouteria multiflora (A. DC.) Eyma	Penny piece
Prestoea montana (R. Grah.) Nichols.	Palm
Rubiaceae (sp. unknown)	
Sapium caribaeum	Burn lime
Simaruba amara Aubl.	Board wood
Sloanea caribaea Kr. and Urb.	Santinay
Sloanea massoni Sw.	Boo wood
Sterculia caribaea R. Br.	Mahoe
Swietenia macrophylla King	Mahogany
Swietenia mahogoni Jacq.	Mahogany
Symplocos martinicensis Jacq.	Sweet leaf
Tabebuia pallida (DC.) Britton	White cedar
Talauma dodecaceptala (Lam.) Urb.	Wild breadfruit, wild almond

Metric Inventory Standards

Item	Metric standard
Prism size	BAF 2.5
Grid spacing	3 km
Cluster point spacing	25 m
Fixed plot size	40 m^2 (r=3.6 m)
	15 m^2 (r=2.2 m)
Breast height	1.3 m
Stump height	30 cm
Diameter classes	5 cm=2.5 to 7.5 cm d.b.h.
	10 cm=7.5 to 12.5 cm d.b.h.
	15 cm=12.5 to 17.5 cm d.b.h.
	20 cm=17.5 to 22.5 cm d.b.h. etc.
Tree size classes	
Sapling	2.5 to 12.5 cm d.b.h.
Poletimber (hardwood)	12.5 to 27.5 cm d.b.h.
Sawtimber (hardwood)	27.5 cm+d.b.h.
Sawtimber (softwood)	22.5 cm+d.b.h.
Minimum top d.o.b.	
Cubic volume	10 cm
Hardwood saw log	22.5 cm
Softwood saw log	17.5 cm
Sapling	2.5 cm
Minimum d.i.b. saw log	
Hardwood	20 cm
Softwood	15 cm
Minimum length	
Cubic section	1 m
Saw log	2.5 m
Sawtimber tree	3.5 m saw log