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The Forest Resources of St. Vincent, West Indies

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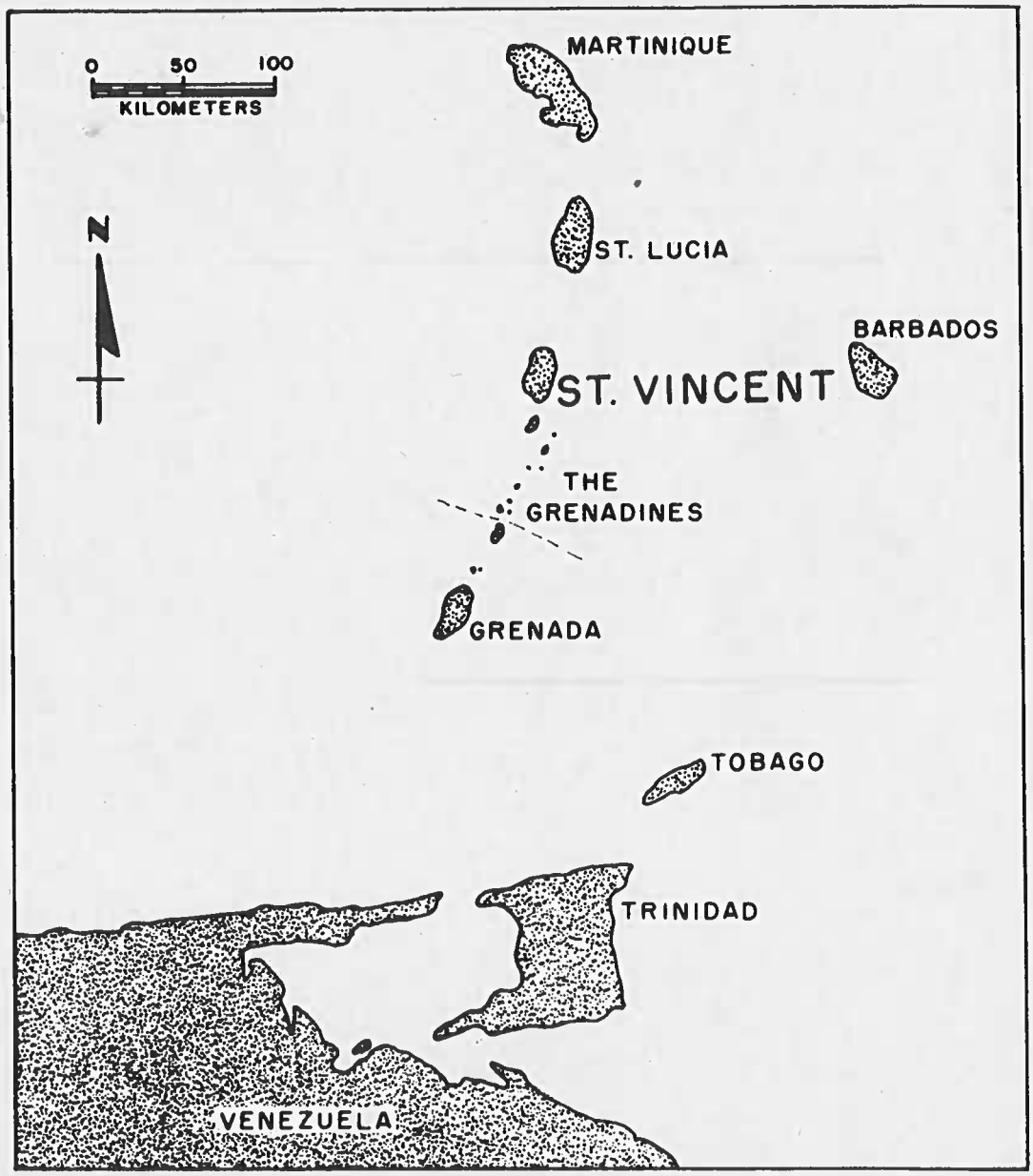

SUMMARY

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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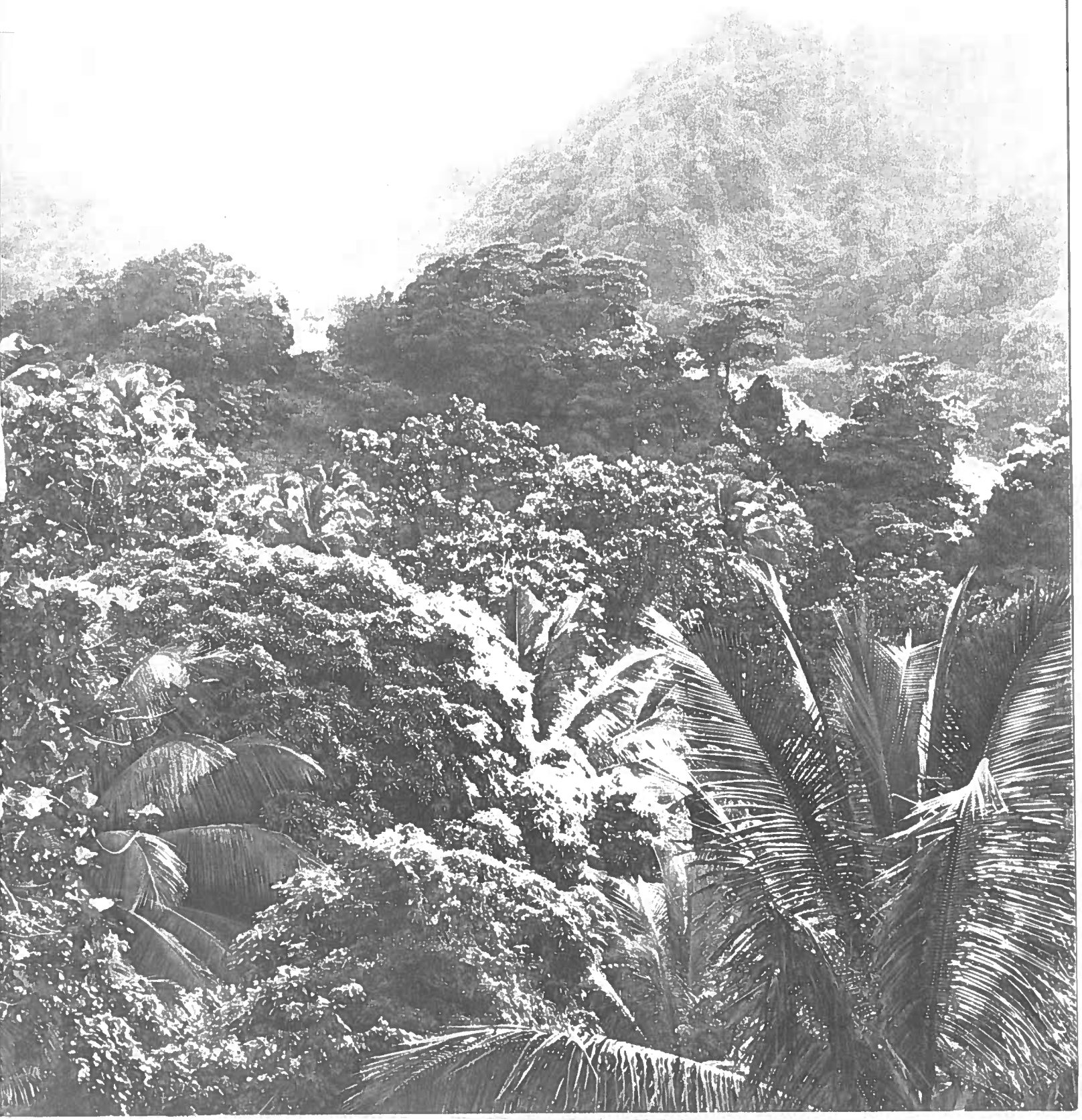
The Forest Resources of St. Vincent, West Indies



h all land above 300 m was reserved by law
ears to protect the forest, many parcels are
nonforest use. Few roads penetrate the inte-
despite encroachment problems, the remote
retained a high proportion of forest cover.
exception is in the Southeast, where only 32
the land above 300 m is forest land. Here a
se road network penetrates well into the
nd. This region would likely be the first to
water supply problems during a drought
e high population density, sparse forest
location of six water intakes.

nd Characteristics

ree major timberland classes, primary rain
located at the highest elevations and far-
nce from roads (table 6). Young secondary
more accessible and tend to be associated
t agricultural activity. The average dis-
ater for all timberland is less than 100 m.
ung secondary and secondary forests have
sal areas, but the young secondary forests
early twice the number of stems (table 7).
er forests have smaller average diameters
y heights. These statistics suggest that, in
sional process, the disturbed site is quickly
y a large number of small stems that com-
ously until a secondary stand is well estab-
e secondary forest then matures over a long
cumulating biomass to reach a potential
of more than 30 m^2/ha.
point during the maturation process, the
small stems again begins to increase as
rant understory species and saplings of
ecies become established. The primary
lops the appearance of two distinct strata,
per 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

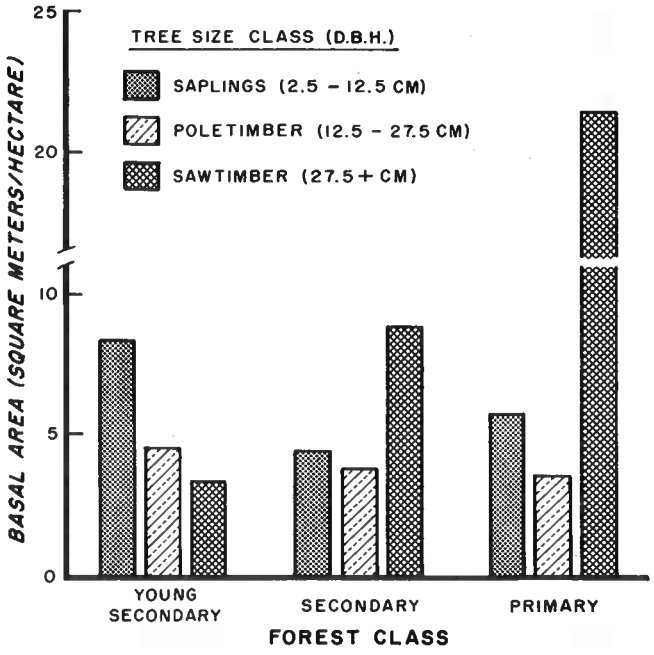


Figure 7.—*Average basal area by forest class and tree size class; St. Vincent timberland.*

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

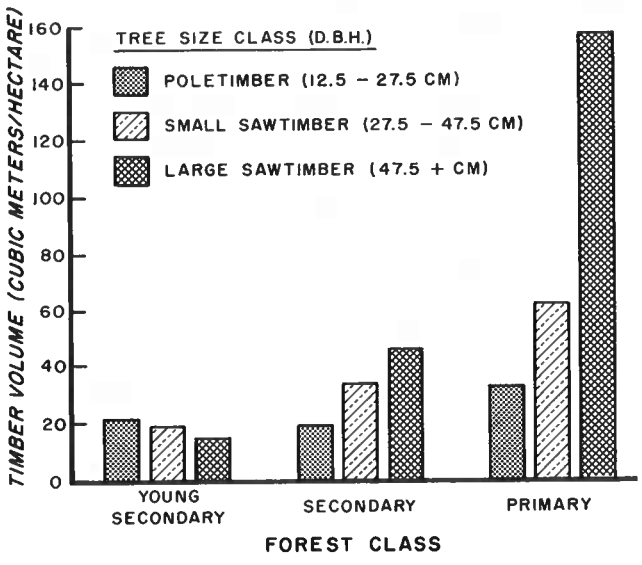


Figure 8.—*Average timber volume by forest class and tree size class; St. Vincent timberland.*

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.

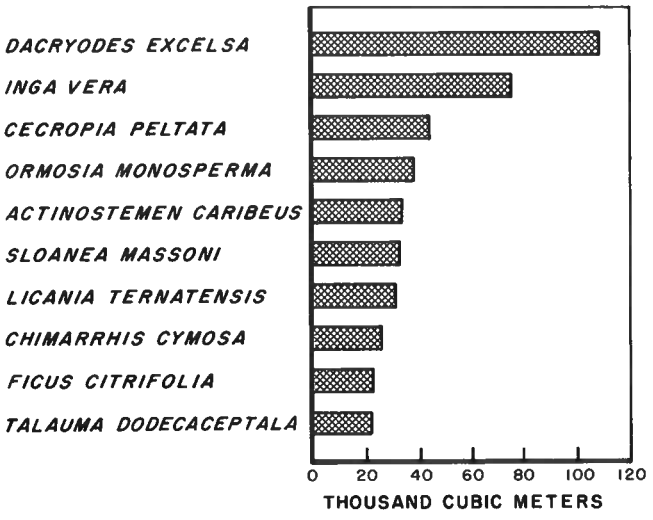


Figure 9.—*Growing-stock volume of 10 common tree species; St. Vincent timberland.*

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]				All grades
	1	2	3	4	
	---- *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			All classes
	Young secondary	Secondary	Primary	
	---------- *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			All classes
	Young secondary	Secondary	Primary	
	------- *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

Birdsey, Richard A.; Weaver, Peter L.; Nicholls, Calvin F. The forest resources of St. Vincent, West Indies. Res. Pap. SO-229. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1986. 25 p.

Presents the principal findings of a 1984 forest inventory of St. Vincent, one of the islands of the West Indies. Data covers plantations and natural forests. Plantation species include *Pinus caribaea, Swietenia macrophylla,* and *Hibiscus elatus.* Natural forest vegetation covers 38 percent of the land surface and consists of primary rain forest, secondary forest, palm forest, dwarf forest, and dry forest.

Additional keywords: timber volume, forest area, tropical forest management, Caribbean forests, island ecosystems.

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