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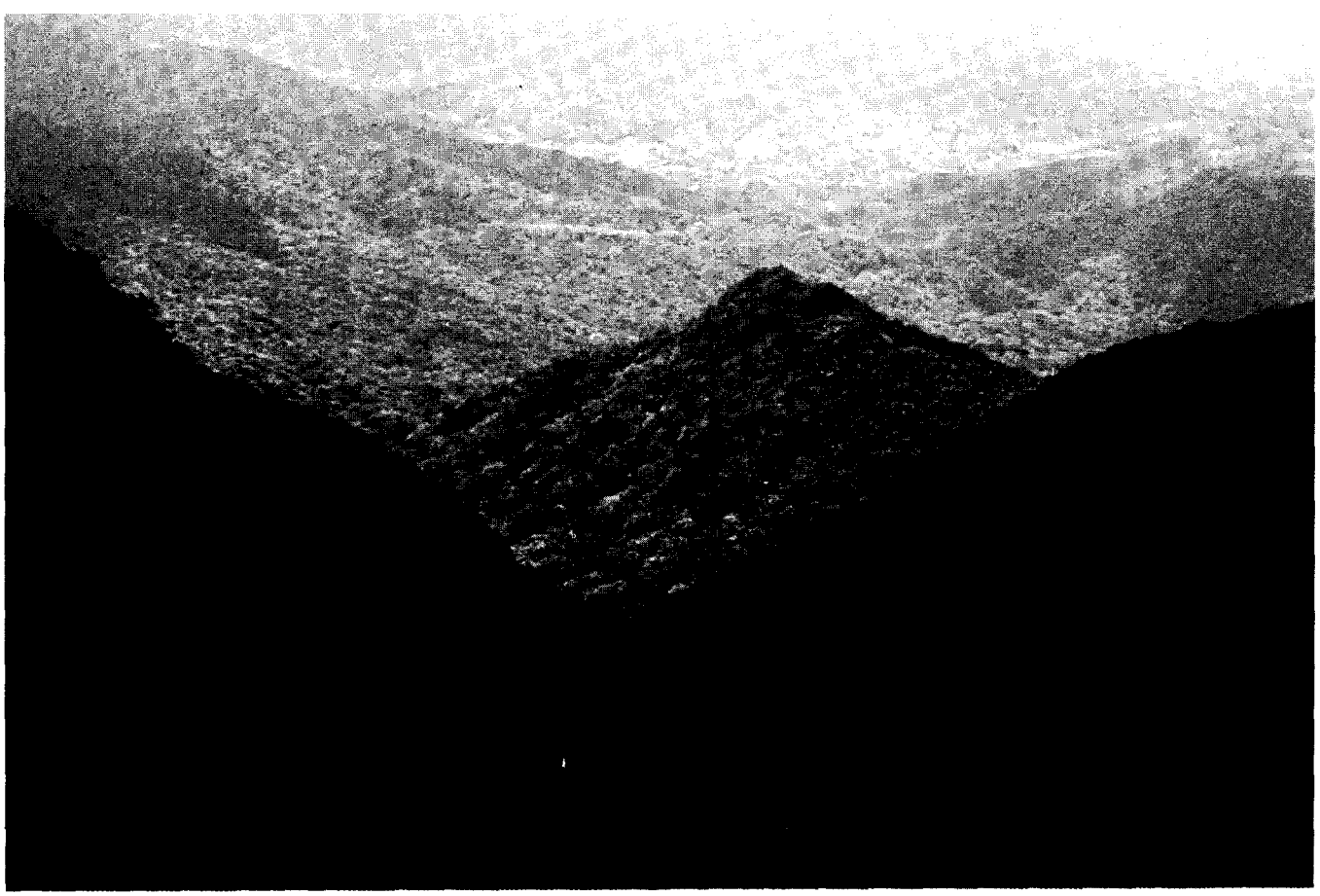
Forest Resources of Puerto Rico, 1990

Peter A. Franco, Peter L. Weaver, and Susan Eggen-McIntosh



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ERRATA

An error occurred in the preparation of camera copy for Resource Bulletin SRS-22, *Forest Resources of Puerto Rico, 1990* by Peter A. Franco, Peter L. Weaver, and Susan Eggen-McIntosh. On the inside front cover, the address for Peter L. Weaver should have read as follows: "Peter L. Weaver is a Research Forester with the International Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Río Piedras, PR 00928."

—SRS, October 1997

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Introduction

In 1980, the Southern Forest Experiment Station, Forest Inventory and Analysis Research Work Unit (SOFIA), in cooperation with the International Institute of Tropical Forestry, established a forest survey of the Commonwealth of Puerto Rico. The primary objective was to assess the timber-production potential of the island's forest resources. The main island, occupying about 8900 square kilometers, was partitioned into commercial and noncommercial survey regions (fig. 1). Field sampling was concentrated in the commercial survey region, which included all areas having the potential to produce commercial timber. The commercial region was delineated to exclude urban areas, agricultural lands, critical watersheds, areas with adverse site conditions, such as excessive rainfall and excessive slope, and other areas not likely, either for physiographic or economic reasons, to sustain commercial timber production.

Because complete photographic coverage was unavailable for the 1980 survey, aerial photography was acquired for a 1985 update of forest area estimates of both the commercial and noncommercial survey regions. The 1985 update provided more current estimates of forest area by detailed

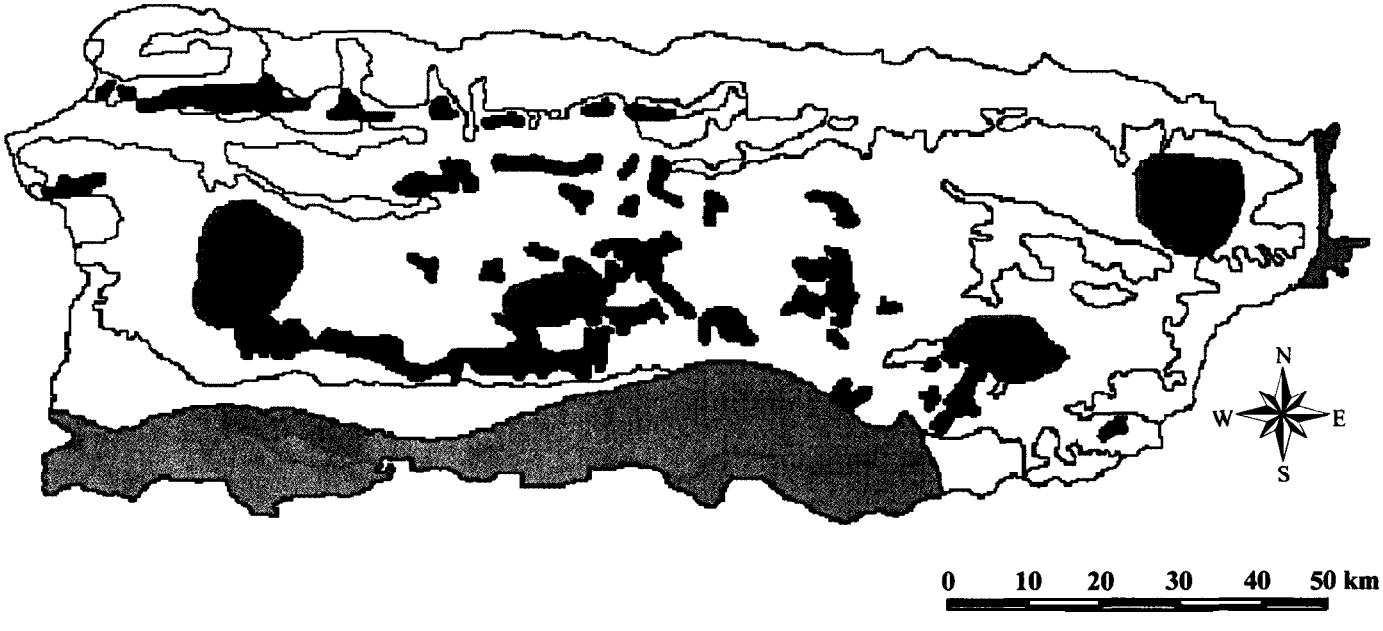


Figure l-Exclusions from the commercial survey region of Puerto Rico (adapted from Birdsey and Weaver 1982).

cover classes for the commercial region, refined forest area estimates for the noncommercial region, and estimated rates of change in the timberland area (Birdsey and Weaver 1987). In 1990, another forest survey was conducted in the commercial region of Puerto Rico. This publication describes the results of that survey and changes that occurred within the region between 1980 and 1990.

The forests of Puerto Rico were previously classified according to the Life Zone system (Ewe1 and Whitmore 1973, Holdridge 1967). The primary advantage of this classification system is that it provides a means of comparison among tropical forests based on climatic data (Birdsey and Weaver 1982). The commercial region is located in only two of the islands six Life Zones, the Subtropical Moist Forest and the Subtropical Wet Forest. The Subtropical Moist Forest occupies about 58 percent of Puerto Rico; the Subtropical Wet Forest covers about 23 percent.

Broad soil associations, which reflect geologic origin, formed the basis for stratifying the data within both Life Zones (fig. 2) because they yielded the most important prior knowledge of the commercial survey region (Birdsey and Weaver 1982). Four soil groups were recognized in the surveys. Soils of volcanic origin were divided into deep and shallow clays. Together, these soils make up about 70 percent of the commercial region. Granitic soils and limestone soils account for about 10 and 20 percent of the commercial region, respectively. Forest area statistics for both the 1980 and 1990 surveys were compiled using this stratification rather than the county-based system used in the United States.

Previous Forest Area Trends

In the early 16th century, Puerto Rico's 890000 hectares of land were covered with mature forests containing a wide variety of species. These forest formations were typical of the Caribbean region at the time of discovery (Durland 1929, Little and others 1974, Little and Wadsworth 1964). In the years that followed, European settlers cleared most of the

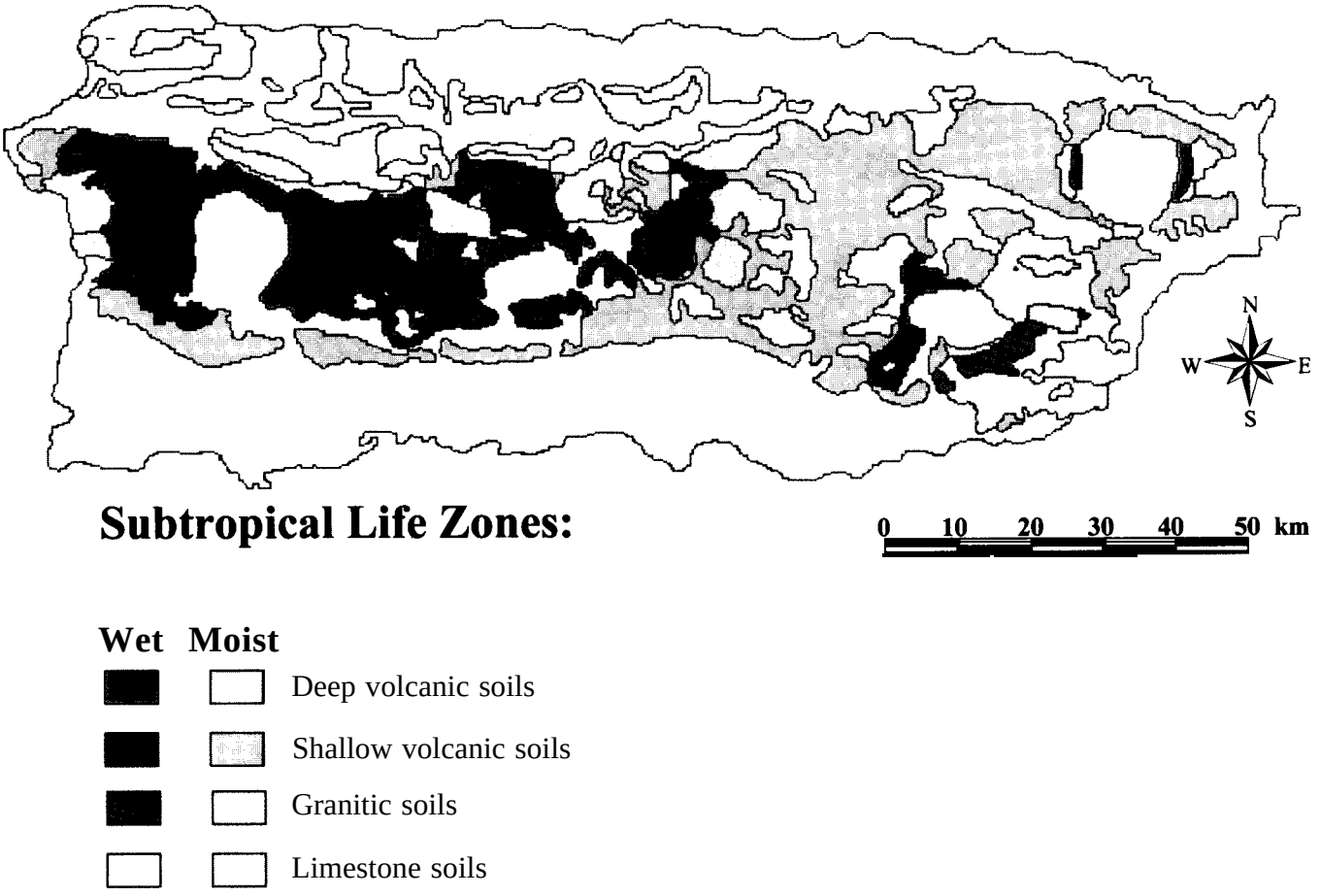


Figure 2-Life Zones and soil groups in the commercial survey region of Puerto Rico (adapted from Birdsey and Weaver 1982).

lowland and coastal forests for pasture and cropland. Although the clearing of forests for timber, fuelwood, and charcoal had modified the land, clearing for agriculture was by far the most destructive in terms of the area affected (Birdsey and Weaver 1982). By 1828, pasture and cultivated land represented one-third of Puerto Rico's total land area (Wadsworth 1950). To accommodate the rapidly growing population, most of the remaining mature forests were cleared in the 19th century (fig. 3). By 1899, forest cover was reduced to 182 000 hectares, with pasture alone accounting for 55 percent of the land area. Cultivating coffee beneath shade trees (coffee shade) had recently begun; this practice used an additional 77 000 hectares (Wadsworth 1950). Tree cover continued to decline slowly over the next 20 years, greatly diminishing the capability of the forests to provide products other than fuelwood and charcoal.

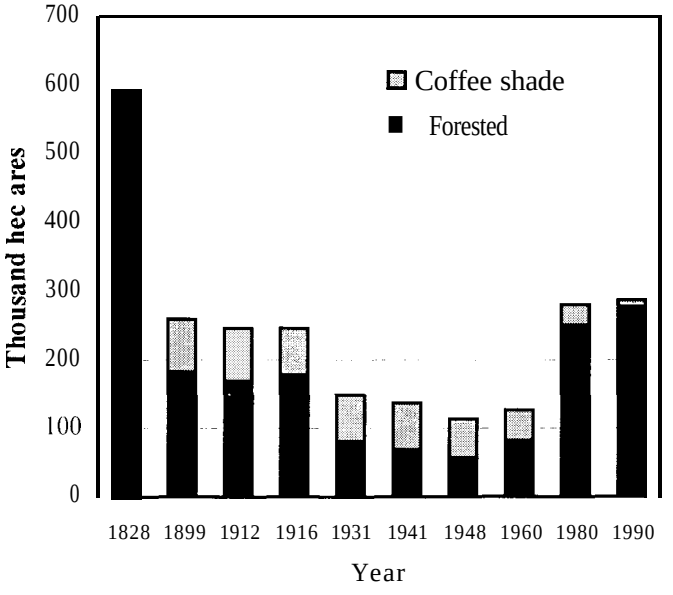


Figure 3-Area with tree cover in Puerto Rico for selected years 1828-1990 (adapted from Birdsey and Weaver 1987).

After 1916, another period of heavy cutting caused forest area to decline sharply, depleting tree cover to 81000 hectares by 193 1 (Gill 193 1). By the late 1940's, Puerto Rico's forests had dwindled to only 6 percent of the total land area, and coffee shade occupied about the same area (Koenig 1953). The 1950's marked the beginning of a period of recovery for the forests of Puerto Rico. Abandoned cropland and pasture on eroded hillsides began reverting to secondary forest during this time. Widespread reversion from agricultural land to secondary forest was the primary reason Puerto Rico's total forest area increased to over 30 percent by 1980. These reverted areas, mainly abandoned hillside farms in the mountainous region of the main island (Birdsey and Weaver 1982, 1987), comprise the forest resource addressed in this study.

Highlights

The 10 years between the 1980 and 1990 surveys was a period of major change in Puerto Rico's timberland, one that reveals a positive outlook for the future quality and utility of the islands timber resources. The most noticeable area1 trend was the substantial increase in secondary forests from less than one-half to more than three-fourths of the timberland area. Reverted cropland and pasture accounted for about two-thirds of the increase in secondary forest area. Reclassification of former abandoned coffee shade forest stands also contributed to this increase.

Accompanying the expansion of secondary forests was a reduction in the areas of both abandoned and active coffee shade forests. Most of the abandoned coffee shade lands not reclassified as secondary forest were converted to other agricultural uses. Some formerly active coffee shade areas were abandoned since 1980, but most of the decline in coffee shade forests resulted from the replacement of coffee with other agricultural crops.

Some of the most dramatic areal trends resulted from the reclassification of some forest types (coffee shade and secondary forest). This reclassification helps illustrate the frequently changing land use patterns found in Puerto Rico, where people recurrently clear their land for agriculture or pasture. The islands high population density (about 1,050 people per square mile) and the high proportion of privately owned land (95 percent) equate to many small landholdings, numerous property sales, and an ever changing mosaic of land uses. Previously abandoned lands, once sold, may be placed in agricultural use, such as fruit trees or vegetable crops, used for pasture, or developed for a homesite or commercial venture.

In terms of timberland coverage, sawtimber-size stands gained a slight dominance over poletimber stands, whereas sapling-seedling stands declined. In secondary forests, sapling-seedling stands gained 4600 hectares by 1990, though their proportion of secondary forest area fell from 43 to 26 percent. Poletimber stands covered only an additional 2700 hectares in 1990, the same area by which sapling-seedling stands decreased. These trends reflect the emergence of many of the former poletimber-size stands (the dominant stand size in 1980) into sawtimber-size stands and the ascendance of the former sapling-seedling stands into the poletimber stand-size class.

Trends in basal area and stocking showed an overall improvement in Puerto Rico's timber resource, both in terms of quantity and quality. The combined basal area of poletimber and sawtimber trees was substantially higher, increasing from 1 .0 to 1.5 million square meters. Average basal area per hectare of sawtimber-size trees rose most

sharply in secondary forests, whereas average basal area of poletimber had the greatest gains in abandoned coffee shade areas. The average basal area of sapling-size trees across timberland remained the same since 1980 but diminished slightly in secondary forests. The average level of stocking for both sawtimber-size and poletimber-size stands was higher in 1990. Sawtimber and poletimber stands with basal areas of 25 or more square meters per hectare covered 14500 hectares, compared to 8500 hectares in 1980. Timberland was not only better stocked, but stocked with better quality trees, as supported by a greater proportion of basal area in growing-stock trees. More than 70 percent of timberland basal area was comprised of growing-stock quality trees, compared to 50 percent in 1980.

Increases in volume from 1980 to 1990 were remarkable and offered further evidence of a higher quality timber resource. These notable gains in timber volume resulted from both the growth of the timber surveyed and the lack of commercial timber extraction. The average timber volume per hectare in timberland doubled, with growing-stock trees contributing the majority of this accrual. Furthermore, two-thirds of the timber volume in all forest classes was growing-stock volume. In secondary forests, growing-stock volume was about evenly divided between sawtimber and poletimber trees. Sawtimber volume in timberland approximately doubled, both in terms of total volume (2.6 million cubic meters) and volume per hectare (18 cubic meters). The volume of sawtimber on secondary forests nearly tripled to 1.8 million cubic meters, representing an increase from 11 to 16 cubic meters per hectare. On a per hectare basis, abandoned coffee shade forest had the greatest increase in timber volume (53 to 102 cubic meters) and growing-stock volume (28 to 66 cubic meters), whereas active coffee shade forest had the greatest increase in sawtimber volume (7 to 26 cubic meters).

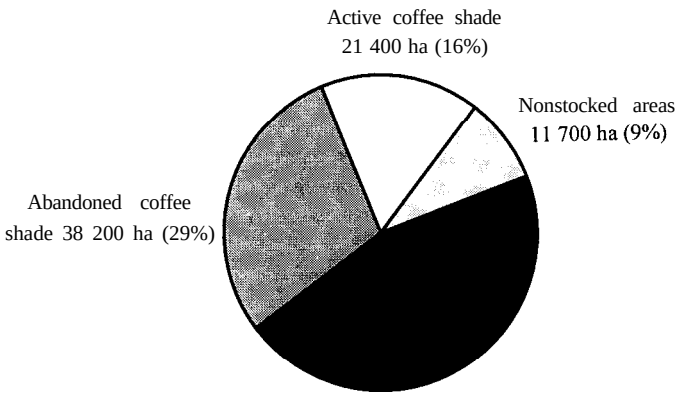
Much of the notable increase in sawtimber volume may be attributed to the ascendence of formerly poletimber-size trees into the sawtimber-size class. Likewise, many of the previously submerchantable trees have since crossed the threshold of merchantability into either the poletimber or sawtimber-size class. The lack of commercial timber harvesting on the island has particularly favored the accumulation of volume in the sawtimber component.

The 1990 Forest Survey

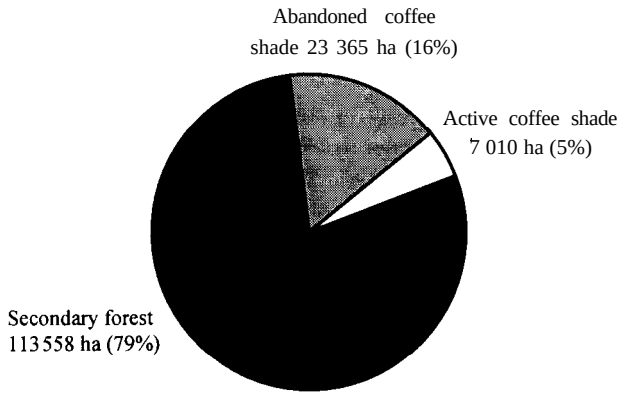
Area

Puerto Rico's total forest area increased from 279 000 hectares in 1980 to 287 000 hectares in 1990. Nonforest land uses amounted to 68 percent of the total land area, slightly less than in 1980. Forest area in the commercial region increased by more than 17000 hectares, whereas that in the noncommercial region decreased by about 9000 hectares. The positive net change in the commercial region's forested area resulted because reversions of cropland and pasture exceeded the clearing of forested areas to nonforest uses. Forest land classified as timberland increased to almost 144 000 hectares. Since 1980, about 35 000 hectares reverted from cropland, pasture, and other nonforest land uses to timberland. At the same time, about 21000 hectares of timberland were cleared for nonforest uses. Therefore, the net increase in timberland area was about 14000 hectares.

Nearly four-fifths of the commercial region's forests were classified as secondary forest compared to less than one-half in 1980 (fig. 4). The remaining 30000 hectares of timberland represented either former or current coffee producing areas (fig. 5). Over two-thirds of that timberland



1980 Timberland
(130 500 ha)



1990 **Timberland**
(143 933 ha)

Figure "Timberland area by forest class, Puerto Rico, 1980 and 1990

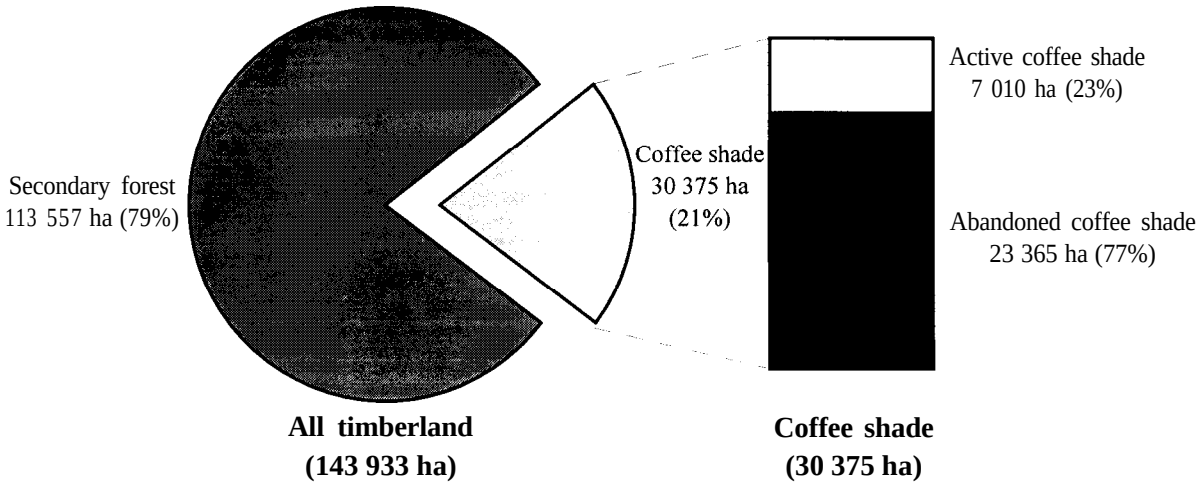


Figure 5—Distribution of components of timber volume, Puerto Rico timberland, 1990

area was secondary forest land resulting specifically from the abandonment of coffee production under shade trees (abandoned coffee shade). Only about 7000 hectares in 1990 supported forest stands, which were being used as coffee shade (active coffee shade). Reversions from nonforest land uses accounted for almost one-third of the 113 000 hectares of secondary forest land in the commercial region. Most of the other 67 percent of secondary forest land was classified as such in 1980. Other minor additions to secondary forest land came from the reclassification of active and abandoned coffee shade and other previously cutover areas to secondary forest. Unlike the 1980 survey, no areas were classified as nonstocked in 1990.

Additions to secondary forest land amounted to about 30000 hectares in the Subtropical Moist Forest and about 20000 hectares in the Subtropical Wet Forest. Secondary forests accounted for about two-thirds of the Subtropical Moist Forest's timberland area in 1980 but represented more than 90 percent of its timberland in 1990. The largest accretion in the Subtropical Moist Forest, about 15 000 hectares, occurred on shallow volcanic soils. In the Subtropical Wet Forest, the proportion of secondary forests in timberland increased from about one-third to two-thirds. Deep volcanic soils and granitic soils of the Subtropical Wet Forest each amassed about 10000 hectares.

The areas of both abandoned and active coffee shade forests decreased by about one-half. In 1980, both forest classes combined covered about 59000 hectares. By 1990, the estimated total area was 30000 hectares, of which 7000 hectares were in active coffee shade. These active coffee shade forests fell from 16 percent to 5 percent of all timberland. The Life Zone soil group stratum with the greatest loss of active coffee shade forest area, more than 10000 hectares, was the deep volcanic classification within the Subtropical Wet Forest. About one-half of the total reduction in active coffee shade area resulted from the conversion of these lands to alternative agricultural uses; the remainder was simply abandoned.

Many of the older, abandoned coffee shade areas are very difficult to distinguish from reverted pasture and cropland (Birdsey and Weaver 1987). The estimated area of forests classified as abandoned coffee shade decreased from 38 000 to 23 000 hectares between 1980 and 1990. About one-half of this decrease resulted from reclassifying these areas to secondary forest. About one-third of the abandoned coffee shade areas were converted to agricultural uses other than coffee production. The remaining 1.5 percent were either developed for nonforest land uses such as roads and rights-of-way or returned to active coffee production.

Deep volcanic soils of the Subtropical Wet Forest are the stratum encompassing the main coffee-producing region of the island. Consequently, this stratum had the most extensive coverage of abandoned and active coffee shade areas in both 1980 and 1990. By 1990, however, there were about 5500 fewer hectares of abandoned coffee shade and about 10 500 fewer hectares of active coffee shade than in 1980. Active coffee shade forests were also present, albeit to a lesser degree, on limestone and granitic soils in 1980. In 1990, the 7000 hectares of active coffee shade were confined only to deep soils of volcanic origin, with about 80 percent in the Subtropical Wet Forest and the remainder on the Subtropical Moist Forest.

Stand Size

In 1980, timberland was about evenly divided among sawtimber, poletimber, and sapling-seedling stands (fig. 6). By 1990, sawtimber stands occupied nearly 66 000 hectares and dominated Puerto Rico's timberland. These stands covered about 1.4 times the area of poletimber stands and 2.2 times the area of sapling-seedling stands.

The area of sapling-seedling stands on all timberland fell from 33 200 hectares to about 30 544 hectares, despite a 20-percent increase in the area of sapling-seedling stands in secondary forests. This decrease resulted from a large loss of sapling-seedling stands in abandoned and active coffee shade forests. Sapling-seedling stands in both coffee shade forests occupied more than 8000 hectares in 1980 but only 700 hectares in 1990, all in abandoned coffee shade forest. Moreover, poletimber stands in coffee shade forests decreased from 19 000 to 7000 hectares. By 1990, most of the poletimber stands were found in abandoned coffee shade forest. In contrast, sawtimber stands in abandoned and active coffee shade forests remained fairly stable, covering about 23 000 hectares in 1980 and 1990. The majority of these sawtimber stands were in abandoned coffee shade forest.

In secondary forests, the area of sawtimber stands almost tripled, and the area of poletimber stands more than doubled between 1980 and 1990. Poletimber and sawtimber stands combined occupied over 80 000 hectares, almost three-fourths of all secondary forest land. This total area was almost evenly divided between these two stand-size classes.

The increased coverage of poletimber and sawtimber stands is supported by comparison of the 1980 and 1990 diameter distributions (fig. 7). Numbers of live trees in the poletimber diameter classes (15, 20, and 25 centimeters) increased by an average of 37 percent. Numbers of live trees in the sawtimber diameter classes (30 centimeters and larger) increased by an average of 50 percent.

Species Composition

Ten species accounted for about one-half of all live basal area both in 1980 and in 1990. Nine of these species were the same in both surveys, while *Erythrina poeppigiana*

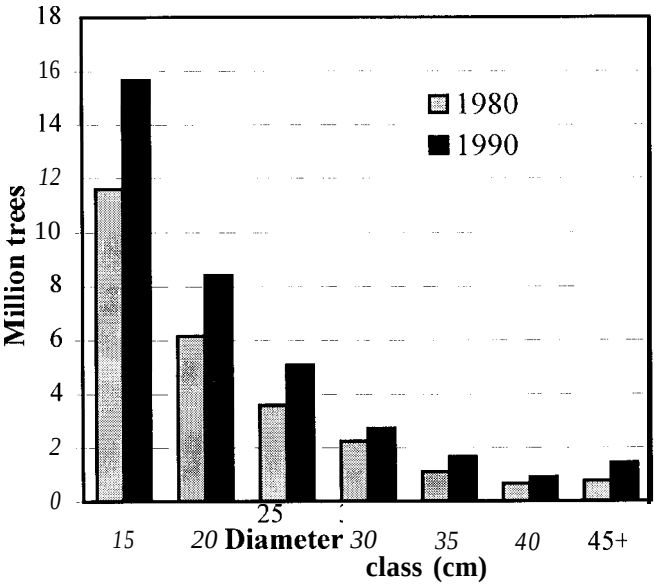
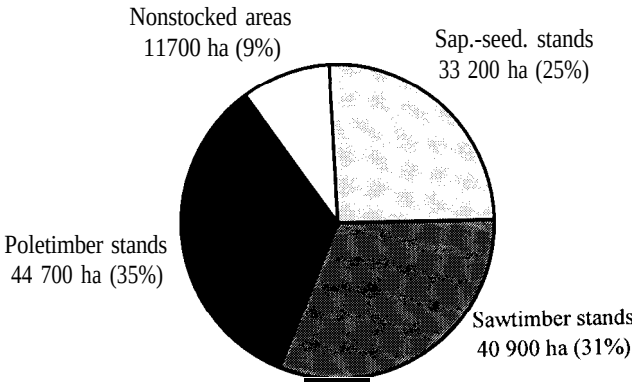


Figure 7-Number of live trees by diameter class, Puerto Rico timberland, 1980 and 1990.



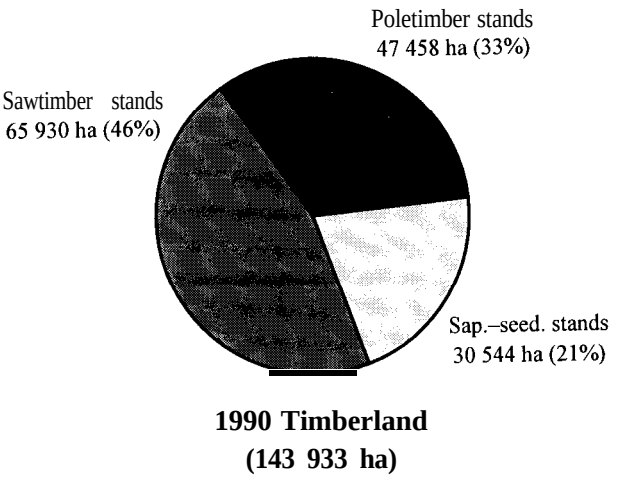


Figure 6-Timberland area by stand-size class, Puerto Rico, 1980 and 1990.

replaced *Cirrus sinensis* (fig. 8). However, their rankings by basal area plurality changed. Two species, *Inga veru* and *Sputhodea campanulata*, showed significant changes in their relative contributions to live basal area. *S. cumpanulata,* formerly ranked seventh in basal area plurality, replaced *I. vera* as the species with the most basal area. This species tripled its relative proportion of live basal area from 3 percent to 10 percent. The proportion of live basal area represented by I. *veru* decreased by about one-half to 5 percent. Furthermore, I. *vera* and I. *fagifolia* were the only two species for which basal area decreased.

In 1980, coffee shade forests were less complex than secondary forests, containing fewer than half the number of species found in the latter (Birdsey and Weaver 1982). This same trend in species diversity between coffee shade and secondary forests was apparent in 1990. The 10 most common species in secondary forests accounted for 47 percent of total basal area. In contrast, the 10 most common species in abandoned and active coffee shade forests accounted for 68 and 83 percent, respectively, of their total basal areas.

Basal Area Distribution

The Subtropical Wet Forest continued to carry a larger proportion of timberland basal area than the Subtropical Moist Forest; however, timberland basal area did become more evenly distributed between the two Life Zones. In 1980, timberland basal area in the Subtropical Wet Forest was almost twice that found in the Subtropical Moist Forest. By 1990, timberland basal area in the Subtropical Wet Forest was only about 1.5 times greater than in the Subtropical Moist Forest. Total timberland basal area in the Subtropical Moist Forest increased 78 percent to over 650000 square meters. Growing-stock quality trees accounted for 90 percent of that increase. In addition, average basal area increased from 6 to 9 square meters per hectare in the Subtropical Moist Forest and from 10 to 13 square meters per hectare in the Subtropical Wet Forest.

Total basal area changes in the Subtropical Wet Forest were most noticeable for sawtimber-size trees, which increased by 33 percent, whereas the total basal area of poletimber trees increased by 25 percent. Within the sawtimber tree-size class, basal area of the growing-stock component more than doubled, whereas that of the rough-and-rotten component decreased to almost one-half the amount present in 1980.

In 1990, about 60 percent of the sawtimber-size stands in timberland had basal areas >15 square meters per hectare. This reflects an improvement in the stocking of these stands since 1980 when over 50 percent of these sawtimber stands had basal areas < 15 square meters per hectare. Stocking levels in poletimber stands also showed improvement. The area of poletimber stands having basal areas >20 square meters per hectare increased from 10 000 to over 16 000 hectares since 1980.

The total area of sapling-seedling stands decreased by <10 percent, but no sapling-seedling stands had basal areas of >15 square meters per hectare by 1990. In addition, more

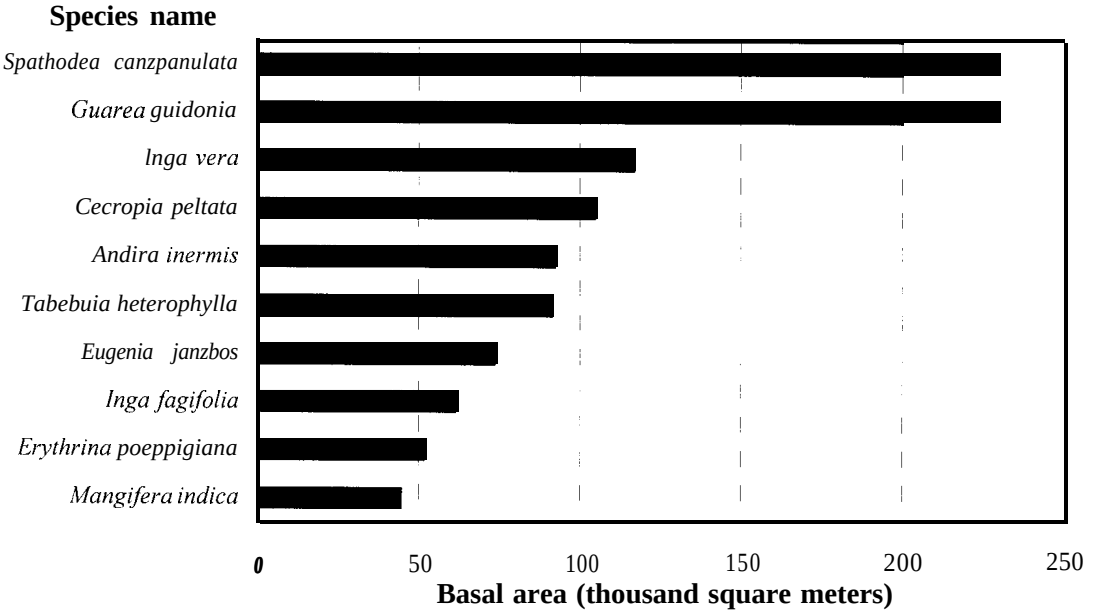


Figure X-Relative species importance by basal area plurality, Puerto Rico timberland, 1990.

than one-half of the 30 000 hectares of sapling-seedling stands had basal areas averaging <5 square meters per hectare.

The average basal area of all live trees in timberland increased from 13.2 to 15.2 square meters per hectare during the decade, with the poletimber and sawtimber-size classes each representing an increase of 1 square meter per hectare (fig. 9). The average basal area of sapling trees remained about the same at 4.3 square meters per hectare.

Of the three forest classes, abandoned coffee shade had the greatest increase in average basal area of all live trees, almost 3 square meters per hectare (fig. 10). An almost twofold increase in the basal area of poletimber trees effected this change (fig. 11). In active coffee shade forests, average basal area of poletimber trees increased by over 2 square meters per hectare. Average basal area of sawtimber-size trees decreased in abandoned coffee shade forests but remained the same in active coffee shade forests. In contrast, sawtimber-size tree basal area increased in secondary forests, whereas poletimber-size tree basal area remained stable.

In 1980, the ratio of growing-stock tree basal area to rough-and-rotten tree basal area for poletimber-size trees was about 1.5 to 1 .0; for sawtimber-size trees, about 1 to 1. Since 1980, the basal area of poletimber trees of growing-stock quality more than doubled, and the basal area of sawtimber-size, growing-stock trees almost tripled. As a result, the ratio of growing-stock basal area to rough-and-rotten basal area reached 2 to 1 for poletimber-size trees and 3 to 1 for sawtimber-size trees by 1990.

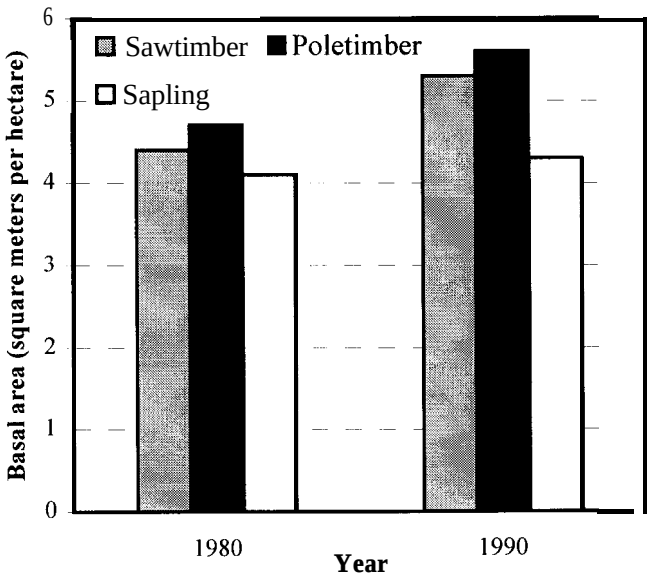


Figure 9-Average basal area by tree-size class, Puerto Rico timberland, 1980 and 1990.

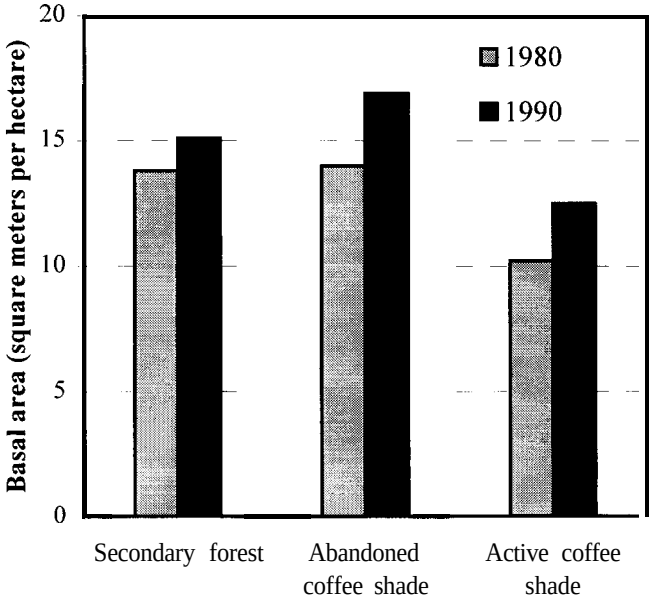


Figure l&Average basal area of all live trees by forest class, Puerto Rico timberland, 1980 and 1990.

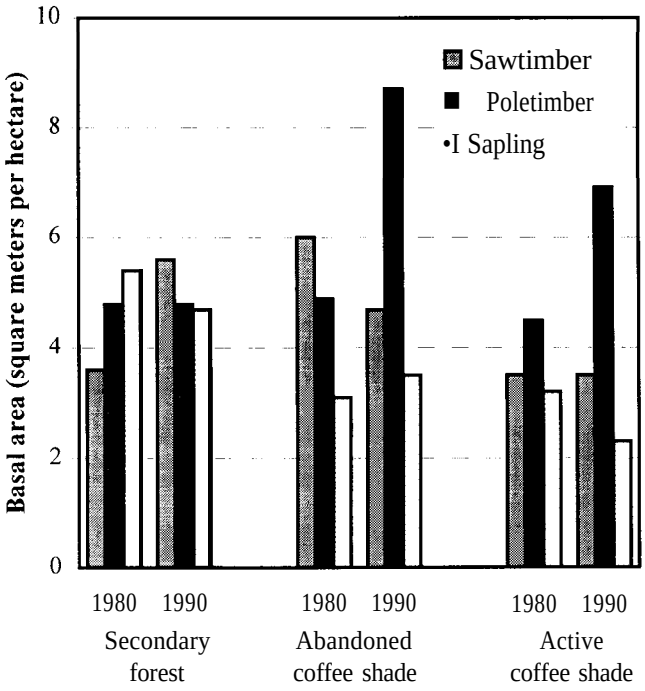


Figure 1 l-Average basal area by forest class and tree-size class, Puerto Rico timberland, 1980 and 1990.

Timber Volume

Average timber volume on all timberland increased from 42 to 80 cubic meters per hectare between 1980 and 1990. Ten species accounted for about 55 percent of all timber volume in both surveys (fig. 12).

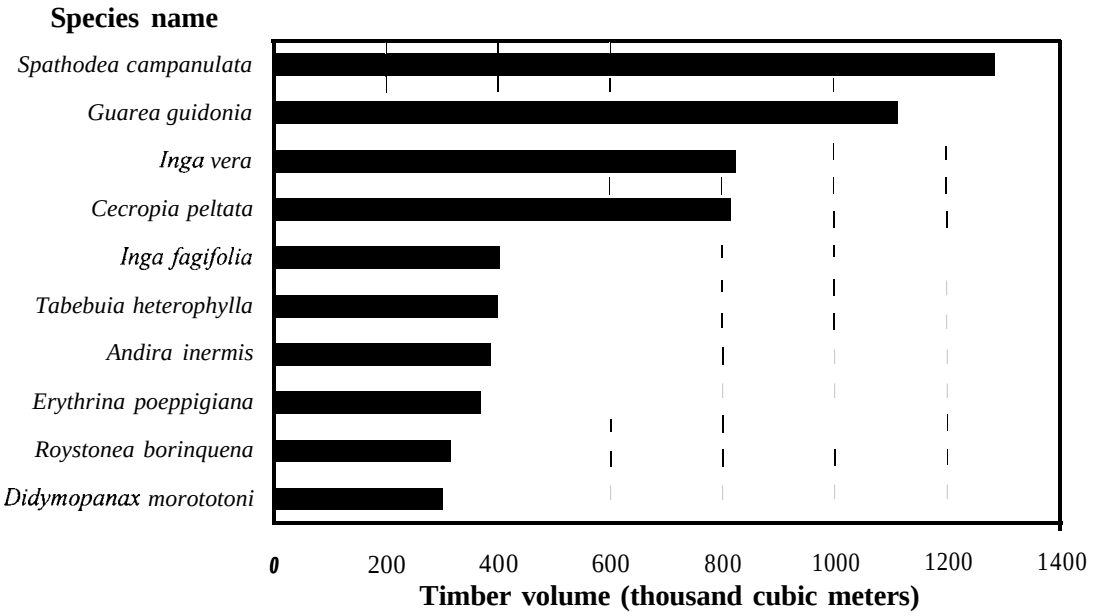


Figure 12—Relative species importance by timber volume, Puerto Rico timberland, 1990.

By 1990, the Subtropical Moist and Subtropical Wet Forests supported average timber volumes of 59 and 103 cubic meters per hectare, respectively, compared to 3 1 and 51 cubic meters per hectare in 1980 (fig. 13). Total timber volume became more evenly distributed between the two Life Zones. The timber volume ratio between the Subtropical Moist Forest and the Subtropical Wet Forest was 1.0 to 1.9 in 1980 and 1.0 to 1.6 in 1990.

The Subtropical Moist Forest, with 39 percent of the total timber volume by 1990, had more than doubled to 4.5 million cubic meters during the decade. Growing-stock quality trees, responsible for over 80 percent of this increase, almost tripled in timber volume. Within the growing-stock component, the volume of timber in sawtimber-size trees more than tripled to almost 2 million cubic meters.

The Subtropical Wet Forest, accounting for 61 percent of all timber volume, supported over 7 million cubic meters in 1990, almost two times the volume in 1980. Growing-stock trees, whose timber volume more than doubled to 5.4 million cubic meters, accounted for 90 percent of this increase. Timber volume of growing-stock trees in the Subtropical Wet Forest continued to be almost equally divided between poletimber and sawtimber-size trees.

The total volume of timber in sawtimber-size, growing-stock trees across all timberland increased from 1.8 million to almost 4.9 million cubic meters (fig. 14). Volume accretion in the saw-log portion of these trees contributed to almost one-half the total increase in timber volume. Branch and fork sections accounted for over one-fourth of the volume increase.

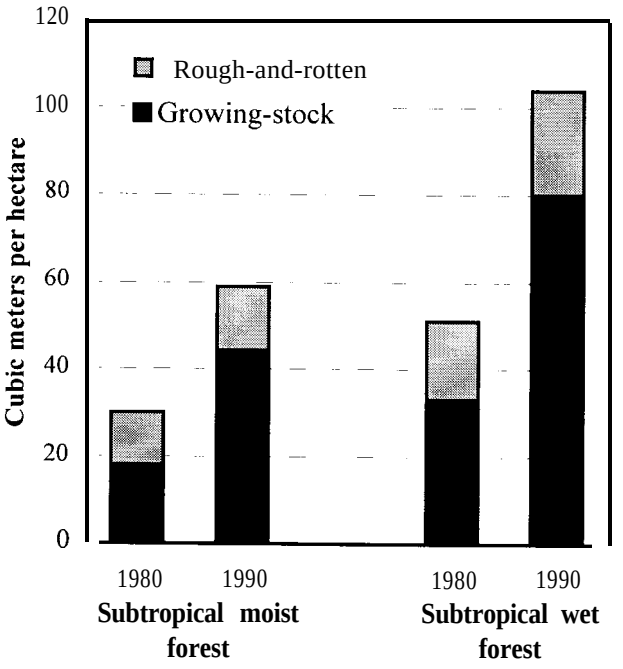


Figure 13-Timber volume by Life Zone and tree class, Puerto Rico timberland, 1980 and 1990.

In poletimber trees, volume increment in the bole sections accounted for about one-half the increase in timber volume (fig. 15); branch and fork sections and the sound cull component made up the remainder. Pronounced gains in the volumes of branches and forks (figs. 14, 15) are characteristic of stands in the late poletimber-early sawtimber stages of development.

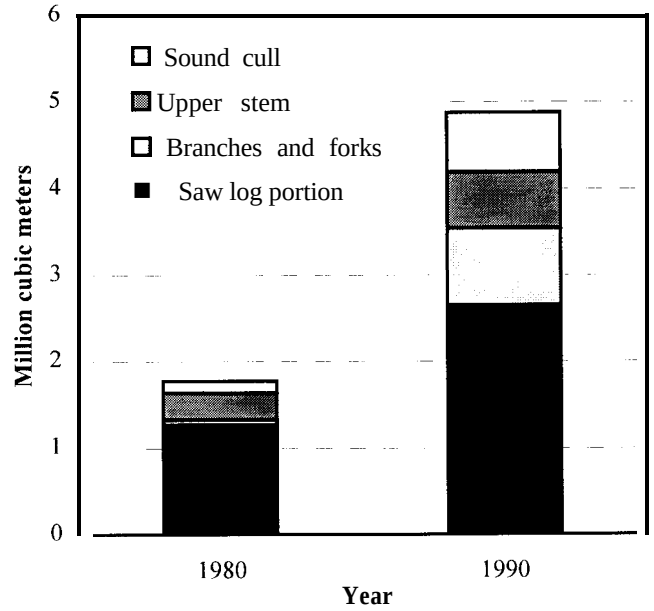


Figure 14—Distribution of components of timber volume in sawtimber-size, growing-stock trees, Puerto Rico timberland, 1980 and 1990.

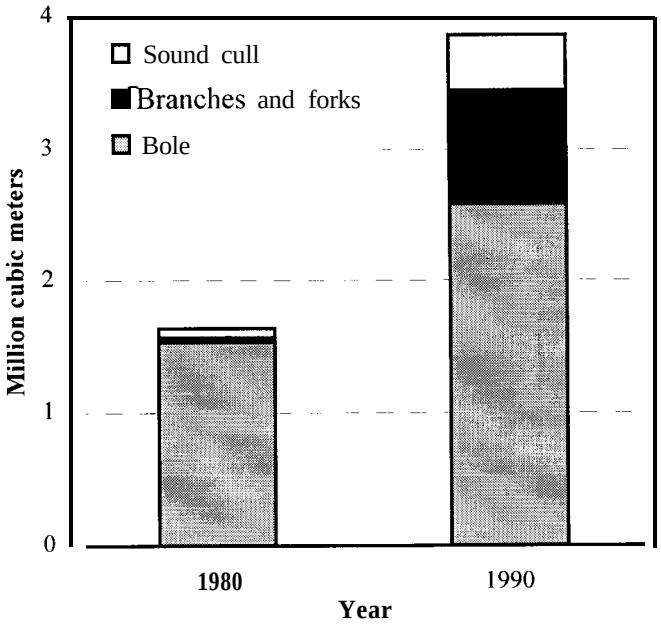


Figure 15—Distribution of components of timber volume in poletimber-size, growing-stock trees, Puerto Rico timbeland, 1980 and 1990.

Among the Life Zone-soil group strata, both the highest and lowest timber volumes were found in the Subtropical Wet Forest. The highest volume, 4.8 million cubic meters, occurred on deep volcanic soils, and the lowest volume, 140 000 cubic meters, occurred on limestone soils. About three-fourths of all timber volume was on slopes >25 percent. More than one-half of this portion occurred on slopes >45 percent.

The proportions of timber volume represented by sawtimber trees, poletimber trees, and rough-and-rotten trees showed similar patterns of change among the three forest classes (fig. 16). In all forest classes, the proportion of timber volume in sawtimber trees increased, whereas the proportion of timber volume in rough-and-rotten trees decreased. The proportion of timber volume in poletimber trees changed little or not at all.

Sawtimber Volume

Sawtimber volume, the volume in the saw-log portion of sawtimber-size trees of growing-stock quality, doubled from 1.3 to 2.6 million cubic meters across all timberland. Averaging 18 cubic meters per hectare, sawtimber volume accounted for about one-third of growing-stock volume and about one-fourth of timber volume (fig. 17). These sawtimber volume proportions remained relatively unchanged since 1980. Active coffee shade was the only forest class in which average sawtimber volume became a greater relative proportion of average growing-stock volume and average timber volume, increasing from 36 to 48 percent and 20 to 32 percent, respectively (fig. 18). Ten species represented slightly more than two-thirds of the total sawtimber volume in all timberland (fig. 19). Sawtimber volume in secondary forests almost tripled to 1.8 million cubic meters but stayed relatively unchanged in the remaining forest classes (fig. 20). Almost 80 percent of the total sawtimber volume, over 2 million cubic meters, was in

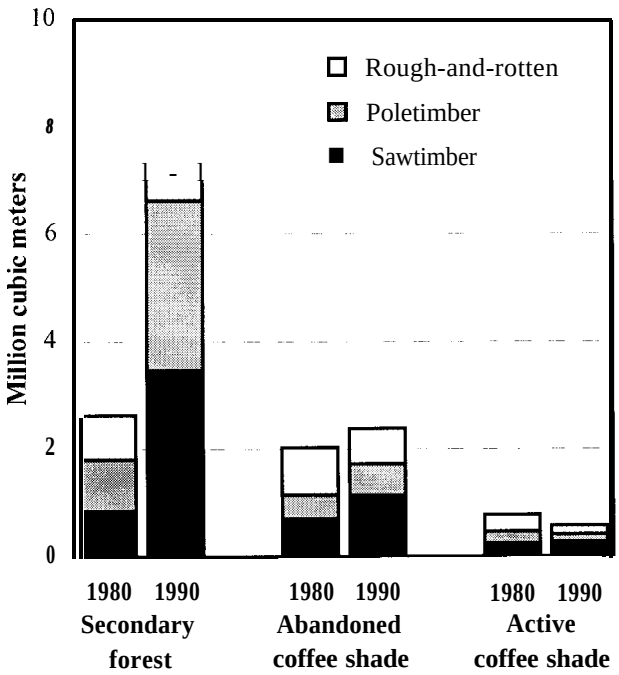


Figure 16—Timber volume by class of timber and forest class, Puerto Rico timberland, 1980 and 1990.

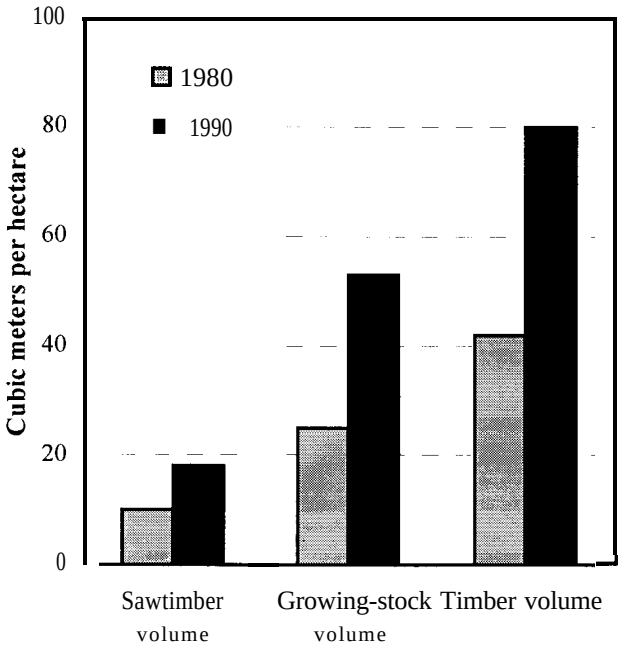


Figure 17—Average sawtimber, growing-stock, and timber volume, Puerto Rico timberland, 1980 and 1990.

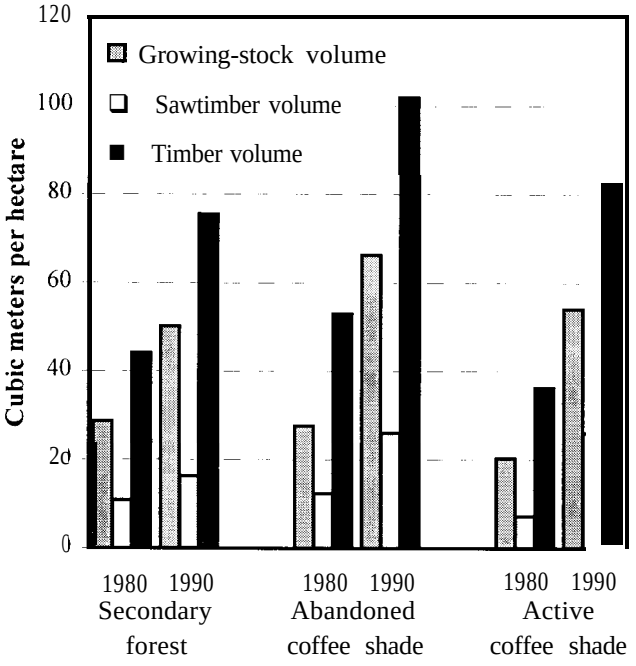


Figure 18—Average growing-stock, sawtimber, and timber volume by forest class, Puerto Rico timberland 1980 and 1990.

sawtimber-size stands. Over one-half the total sawtimber volume was present in trees belonging to the 30-, 35-, and 40-centimeter diameter classes. Forty-two percent of the sawtimber volume was present in trees with a butt log grade of 1 or 2. Over 80 percent of that volume was in log grade 2 trees. Only 7 percent of the total sawtimber volume occurred in trees having a butt log grade of 1.

Trends in Secondary Forests

The area of secondary forests nearly doubled during the decade to over 113 000 hectares. The net change in the basal area of all live trees was minor, increasing from 13.8 to 15.1 square meters per hectare. Average basal area of growing-stock trees increased from 5.0 to 7.6 square meters per hectare, primarily due to the growth of sawtimber trees. Basal area of the rough-and-rotten component fell from 3.4 to 2.8 square meters per hectare. The average combined basal area of all poletimber and sawtimber trees in secondary forests therefore rose from 8.3 to 10.4 square meters per hectare. The other component of all live basal area, sapling trees, decreased from 5.5 to 4.7 square meters per hectare.

With a total timber volume of 8.6 million cubic meters by 1990, secondary forests accounted for about three-fourths of the total timber volume of Puerto Rico's commercial region. Over three-fourths of that timber volume was found in growing-stock trees (fig. 21). Less than one-fourth of the timber volume in secondary forests was in rough trees, whereas rotten trees comprised only 1 percent. Growing-stock volume was 5.7 million cubic meters, about two-thirds of the total timber volume in secondary forests. That proportion was nearly the same in 1980; however, growing-stock volume was more evenly distributed between the poletimber and sawtimber-size classes in 1990. The remaining one-tenth of total timber volume found in growing-stock trees was sound cull volume. Sound cull amounted to 14 percent of the total timber volume present in growing-stock trees only. The total sawtimber volume of 2.6 million cubic meters reached by 1990 was comparable to the 1980 volume of all sound wood (timber volume) of sawtimber trees in all timberland.

Average timber volume increased from 44 to 75 cubic meters per hectare, and average growing-stock volume increased from 29 to 50 cubic meters per hectare in secondary forests. Sawtimber volume on the average hectare in secondary forests rose from 11 to 16 cubic meters, but its relative proportions of growing-stock volume and timber volume fell slightly to 32 percent and 22 percent, respectively. These changes in volume component proportions described for secondary forests closely typify the trends observed in timberland as a whole.

Just over one-third of the secondary forest stands supported 50 or more cubic meters of timber volume per hectare, up slightly from 30 percent in 1980. Stands with between 50 and 75 cubic meters per hectare covered over 15 000 hectares, four times the area covered in 1980. The

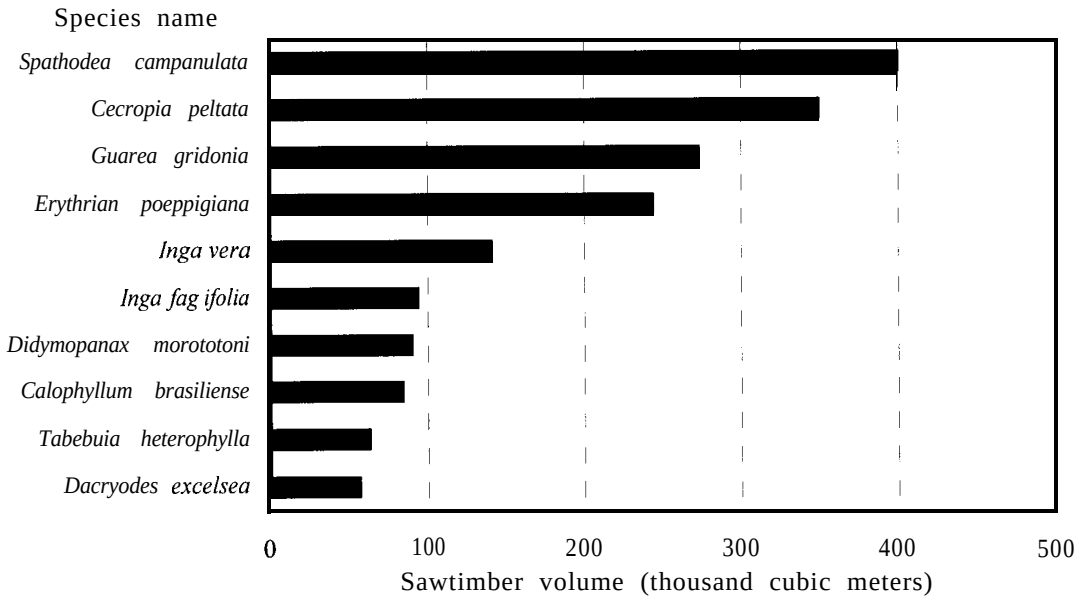


Figure 19-Relative species importance by sawtimber volume,' Puerto Rico timberland, 1990.

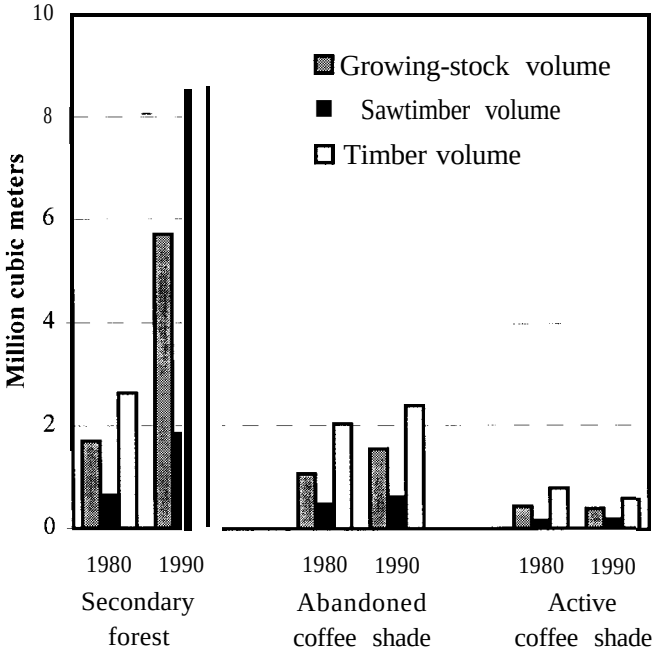


Figure 20—Total growing-stock, sawtimber, and timber volume by forest class, Puerto Rico timberland, 1980 and 1990.

proportion of all secondary forest stands represented by this volume class increased from 6 to 13 percent. The coverage of stands having 100 or more cubic meters of timber volume per hectare increased from 8000 to over 13 000 hectares, although their proportion of all secondary forest stands dropped slightly from 14 to 12 percent. Additions to these two stand-volume classes increased the average timber volume of secondary forests from 44 to 75 cubic meters per hectare.

The character of secondary forests improved during the decade as shown by the greater coverage of stands composed of higher quality trees. Poletimber and sawtimber stands of secondary forests rose from 57 to 74 percent of the total area by 1990. Moreover, the poletimber and sawtimber trees of growing-stock quality in these stands accounted for almost three-fourths of the total basal area and just over three-fourths of the total volume compared to 60 and 68 percent, respectively, in 1980. Such changes indicate that stands in secondary forest stands are experiencing good growth and development, particularly those containing the higher quality trees.

Trends in Coffee Shade Forests

Abandoned coffee shade forest-Stands formerly managed as coffee shade covered an estimated 15 000 fewer hectares in 1990 than in 1980 and supported stands with basal areas ranging from 5 to 30 square meters per hectare. Average basal area of all live trees in these forested areas increased from 14 to 17 square meters per hectare. The only observed decrease in basal area was for sawtimber-size trees, which fell from 6.0 to 4.7 square meters per hectare. The basal area of poletimber and sapling trees increased from 4.9 to 8.7 and 3.0 to 3.5 square meters per hectare, respectively.

Fifty-five percent of the abandoned coffee shade area was composed of stands with an average volume of at least 50 cubic meters per hectare. Only about 700 hectares, however, supported stands with average volumes exceeding 100 cubic meters per hectare. Sawtimber stands

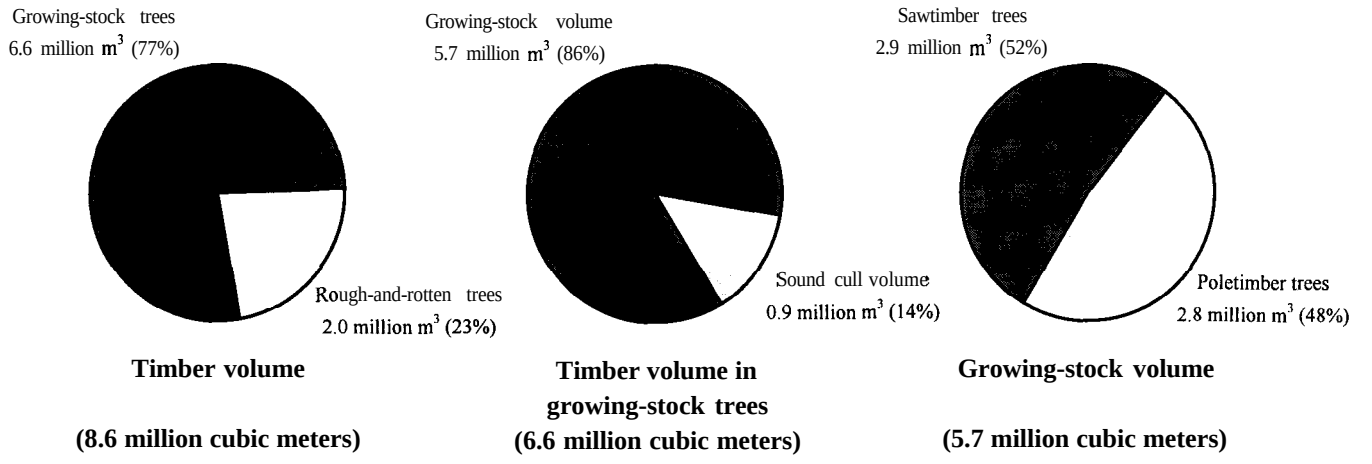


Figure 21—Distribution of components of timber volume (thousand cubic meters) in secondary forests, Puerto Rico timberland, 1990.

carrying 25 to 100 cubic meters per hectare occupied 73 percent of the abandoned coffee shade area. Poletimber stands, covering 90 percent of the remaining abandoned coffee shade area, generally supported <25 cubic meters per hectare.

In both surveys, abandoned coffee shade forests had the highest average volume of timber. The average volumes of growing stock and sawtimber in 1980 were very nearly the same as those found in secondary forests; but by 1990, these too had climbed well above those of secondary forests. Average sawtimber volume in abandoned coffee shade forests reached 26 cubic meters per hectare, 10 cubic meters per hectare more than in secondary forests. Abandoned coffee shade forest in 1990 only had about 350000cubic meters more timber volume than in 1980. However, because of the lower area estimate in 1990, average timber volume of abandoned coffee shade forests almost doubled from 53 to 102 cubic meters per hectare. These changes effected a shift in the ratio of growing-stock volume to timber volume from one-half to two-thirds. The ratio of sawtimber to timber volume remained stable at about one-fourth in this forest class.

Active coffee shade forest-With an **estimated 7000** hectares, active coffee shade forest covered about one-third of the area that it occupied in 1980 and contained the lowest total basal areas of any forest classification. Average basal area of all live trees in these forested areas increased from 10 to 12 square meters per hectare. Total sawtimber basal area decreased to about one-third of the 1980 estimate, closely paralleling the reduction in area of active coffee shade forest. The average basal area per hectare of sawtimber trees, however, remained unchanged from 1980 at 3.5 square meters per hectare. Excluding sapling trees, the total basal area of active coffee shade forest in 1990 averaged 10.2 square meters per hectare, with poletimber and sawtimber trees at 6.7 and 3.5 square meters per hectare, respectively. The average basal area for all size classes in 1980 was also 10.2 square meters per hectare, but this average included saplings. No stands in active coffee shade areas had basal area <5 square meters per hectare or >20 square meters per hectare in 1990.

Active coffee shade forest, as the smallest forest classification sampled, had the lowest total volume of live trees. Sixty percent of the 7000 hectares of active coffee shade forest supported stands having 25 to 50 cubic meters per hectare. Stands comprising the remaining 2800 hectares of active coffee shade forest had volumes between 50 and 100 cubic meters per hectare.

Although active coffee shade supported the lowest total volume, the average timber and growing-stock volumes per hectare in this forest class were very comparable to those found in secondary forests (fig. 18). The total timber volume found in active coffee shade in 1990 was about 574 000 cubic meters. The volume decrease of about 200 000 cubic meters since 1980 did not proportionately parallel the more significant area1 decrease in active coffee shade forest. Consequently, the average timber volume of active coffee shade forests rose substantially from 36 to 82 cubic meters per hectare. Growing-stock volume comprised about two-thirds of that timber volume. Sawtimber volume per hectare more than tripled to 26 cubic meters and accounted for about one-half the average hectare's volume of growing stock. Sawtimber volume, formerly one-fifth of timber volume, represented about one-third of total timber volume on the average hectare in 1990.

Conclusions

Puerto Rico's forest resources are recovering from the land use practices prevalent in the 19th and first half of the 20th centuries. The 1990 survey revealed an increase in forest land, better stocking with larger and higher quality timber trees, and a maturing secondary forest. Area and volume trends, such as the decreased area of sapling-seedling stands and the substantial increase in sawtimber volume, are primarily the result of the absence of management activity and commercial timber harvesting on the island.

The results of the 1990 survey portray Puerto Rico as an example of how once heavily degraded tropical forests can recover to a level of productivity and usefulness. Knowledge of these trends can facilitate the development of management techniques to enhance the value of the timber resource and provide other forest-related benefits for the residents of Puerto Rico.

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Appendix

Survey Methods

1980 Survey

The 1980 survey of Puerto Rico's forest resources was designed to evaluate the production potential of the island's secondary timber resources and to describe their ecological characteristics (Birdsey and Weaver 1982). The 1980 survey also provided baseline information from which changes in forest areas, species compositions, and growth could be assessed in subsequent inventories.

The purpose of the sample design was to partition the island into two major areas: (1) the area with potential for commercial production of timber where an intensive inventory would be conducted, and (2) noncommercial areas where limiting physiographic or economic factors would preclude the commercial production of timber. The noncommercial area encompassed lands designated as critical watersheds, areas with adverse site conditions such as steep slopes or high rainfalls, and areas with higher priority uses such as urban expansion or agriculture. Noncommercial areas were delineated on a 1: 120,000 scale base map but excluded from the ground sample. The remainder of the island, the commercial timber production area, is concentrated in the central highlands. This area was stratified by Life Zone (Subtropical Moist and Subtropical Wet Forests) and soils (deep volcanics, shallow volcanics, granitic, and limestone).

Forest resource statistics were obtained using a systematic sampling method involving forest-nonforest classification of temporary points on aerial photographs and on-the-ground measurements of trees on permanent plots. The sample locations were at the intersections of a 3- by 3-kilometer grid design. There were 978 of these permanent plots on the entire island and 437 in the commercial region. Ground sample locations were first selected on U.S. Geological Survey maps, then transferred to aerial photographs. Initial forest area estimates were derived from interpretation of 10,925 photopoints on black-and-white aerial photographs from the mid-1970's. The photo-interpretation estimates were adjusted based on ground verification at the 437 permanent ground plots. Aerial photographs were also obtained for most of the noncommercial region. Forest cover for the remaining land was estimated using reference material.

Each ground sample location consisted of a cluster of three variable radius subplots spaced 25 meters apart and running along a north-south line. The center of each sample location was the center of the middle subplot in the cluster. This point was established on the ground by running a computed azimuth and distance from a selected starting point. Each sample tree on the variable radius subplot represented 2.5 square meters of basal area per hectare, or 0.83 square meters of basal area per hectare when the subplots were clustered.

Each sample location was classified according to several site characteristics, including the slope and aspect at each of the three subplots. Sample trees smaller than 12.5 centimeters in diameter at breast height (d.b.h.) were tallied on fixed radius plots of approximately 40 square meters around each of the three subplot centers. Sample trees 12.5 centimeters and larger were measured to estimate volume and assessed to determine wood quality.

Volumes were derived from detailed measurements of trees at all sample locations. These measurements included d.b.h., total height, bole length, log length, and two upper stem diameters. Volume of the bole and saw-log portions were computed using the International l/4-inch rule. Regression equations were developed for five species groups and used to estimate branch and fork volumes in the sections above the bole.

1985 Update

The primary objective of the 1985 "midcycle" update (Birdsey and Weaver 1987) was to refine the procedures developed for the 1980 survey in preparation for the 1990 resurvey. Complete color infrared aerial photographic transparencies at a scale of 1:64,000 were acquired for the Commonwealth in 1984 to compensate for the lack of complete coverage in 1980. The increased spectral resolution of the aerial photography allowed for the development of a more detailed forest cover type assessment.

A dot-count method was used to identify 12 forest and 3 nonforest land cover classes on the film transparencies. A 5- by 5-dot grid was centered over each of the 978 permanent sample plot locations. Land-cover class was estimated for each plot location and for each dot, resulting in a total of 22,4 18 photographic interpretations. Most forested locations were identified by 8 of the 12 possible classes. The 3- by 3-kilometer grid sample did not include montane (tabonuco) forest types or plantations also present in Puerto Rico.

1990 Resurvey

All plots in the commercial forest region were remeasured in the spring of 1990. The expanded forest classes used in the 1985 midcycle were used. Only four of these classes were found within the commercial region (table 1) because that area by definition excluded specific forest types such as mangroves and cloud forests found on steep, wet slopes.

Black-and-white 1988-89 aerial photographs at a scale of 1:20,000 were purchased, and a 5- by 5-dot grid was interpreted for each photographic location. There was a total of 10,545 photointerpretations and 430 field-verified sample plot interpretations.

All trees were remeasured using the same methodology established in 1980. Three subplots were measured using variable radius sampling for timber evaluation and fixed radius for regeneration. The basal area factor for the variable radius was 2.5 square meters or 0.83 square meters of basal area per hectare when the subplots were clustered. The minimum d.b.h. for trees on the variable radius plot was 12.5 centimeters.

Regeneration was assessed by tallying all trees between 2.5 and 12.4 centimeters within a 3.6-meter fixed radius plot (about 40 square meters per subplot). Tree variables included form and damage factors that would affect merchantability of timber. Trees were assigned log grades and estimates for both total cull and log cull. Volume computation procedures duplicated those used in 1980.

Reliability of the Data

Two types of errors affect the reliability of the estimates. The first source of error—estimating error-derives from mistakes in measurement, judgment, recording or compiling, and from limitations of the equipment. The SOFIA minimizes estimating error through comprehensive training, supervision, quality-control programs, and emphasis on precision. The second type of error-sampling error-arises from the use of a sample to estimate population parameters and from variability of the items being sampled. This deviation is susceptible to a mathematical evaluation of the probability of error.

The second survey of Puerto Rico again required a special team approach to meet fieldwork requirements for accuracy. In addition to the logistical problems associated with adapting field sampling techniques to a tropical environment, expertise in Puerto Rican dendrology was needed. The approach teamed the most experienced timber cruisers from the SOFIA with dendrologists and botanists from Puerto Rico.

Statistical analysis of the data indicates a sampling error of plus or minus 1.7 percent for the estimate of total timberland and 8.0 percent for the timber-volume estimate. In regular State surveys, sampling errors are estimated for both area and volume using the random sampling formula. The sampling error therefore normally increases as the area or volume under consideration is subdivided according to various strata. Sampling errors for estimates of volume in the Puerto Rico survey are consistent with this approach. A different methodology was used to derive sampling errors for area estimates. Area sampling for the Puerto Rico survey involved pre-stratification of the commercial region into various forest classes, and the proportion represented by each forest class was estimated based on a binomial classification of the photoplots. Because of the different type of area stratification and the assumption of a binomial distribution, sampling errors for areas were estimated by a different method and, thus, do not follow the usual pattern. These errors were estimated using the procedure described by Husch and others (1972) for calculating the variance of adjusted proportions of stratified stand classes.

The following tabulation shows the sampling errors to which the area and volume estimates for secondary forest, abandoned and active coffee shade, and all timberland are liable:

Stratum	Area	Sampling error[1]	Volume	Sampling error[2,3]
	Hectares	*Percent*	*Thousand cubic meters*	*Percent*
Secondary forest	113 558	4.0	8570.1	10.5
Abandoned coffee shade forest	23 365	3.5	2380.2	7.8
Active coffee shade forest	7010	2.4	574.2	21.1
All forest land	143 933	1.7	11524.6	8.0

Definitions

Forest Land Classes

Abandoned coffee shade. Secondary forest land resulting from the abandonment of coffee production under shade trees.

Coffee ***shade.*** A multistory, multicrop system used principally for the production of coffee. An upper story of shade trees is characteristic.

[1] By variance formula for adjusted proportions of a binomially distributed random variable.

*By random sampling formula.

[3] The sampling errors for volume are equal to one standard deviation for the sample data.

Commercial survey region. Area designated as having potential for commercial timber production and where field sampling was carried out. This area remained after the delineation and exclusion of areas with higher priority uses (urban areas, better agricultural land, reserved areas), dry coastal areas, areas with adverse site conditions (extreme slope, excessive rainfall, etc.), and critical watershed areas.

Forest land. Land at least 10 percent stocked[4] 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 one-half hectare, and the minimum width for forest strips is 35 meters. Unimproved roads and trails, streams, and clearings in forest areas are classed as forest if less than 35 meters in width.

Noncommercial forest land. Forest land incapable of yielding crops of industrial wood because of adverse site conditions, forest land withdrawn from timber utilization through statute or administrative regulation, or forest land with higher priority use (except coffee shade).

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.

Secondary forest land. Forest land resulting from the abandonment of cropland or pasture, forest resulting from the regeneration of previously cutover or disturbed forest land, and reclassification of both types of coffee shade.

Timberland. Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization. Forest lands with higher priority uses, yet not specifically withdrawn from timber utilization, are excluded from this class of forest land. These excluded lands were delineated on a base map. Coffee shade is included in this category.

Noncommercial Forest Strata

Alluvial regions. River floodplains with agricultural land use.

Critical watersheds. Upland areas with an average slope >60 percent or rainfall >2500 millimeters per year. These areas require a continuous protective forest cover. Some timber removal would be feasible; however, much of the area is not highly productive.

[4] "Ten percent of "normal" stocking as defined for the Midsouth Forest Survey.

Mangrove and swamp. Coastal wetlands with unique characteristics and values requiring special management considerations.

Metropolitan regions. Regions with primarily urban or residential use.

Subtropical Dry Forest. An ecological Life Zone delineated by a mean annual rainfall of between 600 millimeters and 1000 or 1100 millimeters, and a mean annual biotemperature between about 18 and 24 °C (Holdridge 1967).

Unproductive soils. Soils incapable of yielding crops of industrial wood.

Stand-size Classes

Poletimber stands. Stands with ≥5 square meters per hectare of basal area in sawtimber or poletimber-size trees, and with poletimber basal area exceeding that of sawtimber basal area.

Sapling-seedling stands. Stands with ≥5 square meters per hectare of basal area, with more than one-half of this basal area in saplings or seedlings, or stands with <5 square meters per hectare of basal area, regardless of the size of existing trees.

Sawtimber stands. Stands with ≥5 square meters per hectare of basal area in sawtimber or poletimber-size trees, and with sawtimber basal area at least equal to poletimber basal area.

Timber Classes

Acceptable trees. Trees meeting the specifications for growing stock but not qualifying as desirable trees.

Desirable trees. Growing-stock trees that have no serious defects to limit present or prospective use, are of relatively high vigor, and contain no pathogens that may result in death or serious deterioration before rotation age. These trees would be favored in silvicultural operations.

Growing-stock trees. Sawtimber trees, poletimber trees, saplings and seedlings; that is, all live trees except rough-and-rotten trees, regardless of species.

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

Rough-and-rotten trees. Live trees that are unmerchantable for saw logs now or prospectively because of defect or rot.

Salvable dead trees. Standing or down dead trees that are currently or potentially merchantable.

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

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

Timberland Strata

Deep volcanic soils. Deep soils of the wet volcanic uplands with clayey texture, typically red and acid (Zambrana 1978). The soil depth is generally >50 centimeters.

Granitic soils. Shallow soils of the wet uplands with granitic origin and with a typically sand-clay loam texture (Zambrana 1978).

Limestone soils. Shallow soils over limestone found in the moist coastal hills (Zambrana 1978).

Shallow volcanic soils. Shallow soils of the wet volcanic uplands with clayey texture (Zambrana 1978). The soil depth is generally <50 centimeters.

Subtropical Moist Forest. Forest occurring in an ecological Life Zone delineated by a mean annual rainfall of about 1000 to 2000 millimeters and a mean annual biotemperature between about 18 and 24 °C (Holdridge 1967).

Subtropical Wet Forest. Forest occurring in an ecological Life Zone delineated by a mean annual rainfall of about 2000 to 4000 millimeters and a mean annual biotemperature between about 18 and 24 °C (Holdridge 1967).

Volumes

Volume of growing stock. Volume of sound wood (less cull volume) in the bole and branches of sawtimber and poletimber trees from stump to a minimum lo-centimeter diameter outside bark or to the point past which a l-meter 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 1/4-inch rule.

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 centimeters and larger in d.b.h. from stump to a minimum lo-centimeter diameter outside bark. The minimum length of any section included is 1 meter.

Miscellaneous 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. Tree diameter in centimeters, outside bark, measured at 1.3 meters aboveground.

Diameter class. Each 5-centimeter diameter class extends from 2.5 centimeters below to 2.4 centimeters above the stated midpoint. For example, the 30-centimeter diameter class includes trees 27.5 centimeters through 32.4 centimeters in d.b.h.

Log ***grades.*** A classification of logs based on external characteristics as indicators of quality or value. Logs are graded according to standards used for hardwoods in the Southern United States. Grade 1 logs have very little sweep, crook, cull, or other defects, are the largest, and are suitable for standard lumber. Grade 4 logs need only be 20 centimeters in diameter outside bark at the small end, and are used only for ties and timbers. Grades 2 and 3 are between the two extremes.

CONVERSION FACTORS

Metric to English and English to Metric conversions

1 centimeter = **0.3937** inch	1 inch = 2.54 centimeters
1 meter = 3.281 feet	1 foot = 0.3048 meter
1 kilometer = 0.6214 mile	1 mile = 1.6093 kilometers
1 square meter = 10.7639 square feet	1 square foot = 0.0929 square meter
1 square kilometer = 0.3861 square mile	1 square mile = 2.590 square kilometers
1 hectare = 2.471 acres	1 acre = 0.4047 hectare
1 cubic meter = 35.3145 cubic feet	1 cubic foot = 0.0283 cubic meter
1 square meter per hectare = 4.356 square feet per acre	1 square foot per acre = 0.2296 square meter per hectare
1 cubic meter per hectare = 14.29 cubic feet per acre	1 cubic foot per acre = 0.07 cubic meter per hectare

Metric inventory standards used in the 1990 survey

Item	Metric standard
Prism size	BAF 2.5
Grid spacing	3 kilometers
Cluster point spacing	25 meters
Fixed plot size	40 square meters (r = **3.6** meters)
	15 square meters (r = 2.2 meters)
Breast height	**1.3 meters**
Stump height	**30 centimeters**
Diameter classes	5-centimeter = **2.5 to 7.5 centimeters d.b.h.,**
	lo-centimeter = 7.5 to 12.5 centimeters d.b.h.,
	15-centimeter = 12.5 to 17.5 centimeters d.b.h.,
	20-centimeter = 17.5 to 22.5 centimeters d.b.h., etc.
Tree-size classes	
Sapling	2.5 to 12.5 centimeters d.b.h.
Poletimber (hardwood)	12.5 to 27.5 centimeters d.b.h.
Sawtimber (hardwood)	27.5+ centimeters d.b.h.
Sawtimber (softwood)	22.5+ centimeters d.b.h.
Minimum top diameter, outside bark	
Cubic volume	10 centimeters
Hardwood saw log	22.5 centimeters
Softwood saw log	17.5 centimeters
Sapling	2.5 centimeters
Minimum saw-log diameter, inside bark	
Hardwood	20 centimeters
Softwood	15 centimeters
Minimum length	
Cubic section	1 meter
Saw log	2.5 meters
Sawtimber tree	3.5meter saw log

List of Tree Species Included in Standard Tables

Code number	Species name	Common name
1	***Cyathea arborea*** (L.) J. E. Smith	Helecho gigante, tree-fern
7	***Euterpe globosa*** Gaertn."	Palma de sierra, sierra palm
9	***Roystonea borinquena 0.*** F. Cook	Palma real, royal palm, Puerto Rico
17	***Artocarpus altilis*** (Parkinson) Fosberg	Panapén, pana de pepitas, breadfruit
19	***Castilla elastica*** Cervantes	Caucho, Central American rubber, castilla
20	***Cecropia peltata*** L.	Yagrumo hembra, trumpet-tree
22	*Ficus* ***laevigata*** Vahl[b]	Jagüey blanco, shortleaf fig
33	***Torrubiafrugruns*** (Dum.-Cours.) Standley	Corcho, black mampoo
34	***Magnolia portoricensis*** Bello	Jagtiilla
48	***Ocotea leucoxylon (Sw.)*** Mez	Laurel geo
51	*Persea* ***americana*** Mill.	Aguacate, avocado
61	***Albizia proceru*** (Roxb.) Benth.	Albizia, tall albizia
62	*Inga fagifolia* (L.)	Guamá, "sweetpea"
63	***Inga quatemata*** Poepp. & Endl.	Guamá venezolano
64	*Inga* ***vera*** Willd.	Guaba
74	***Cassia siamea*** Lam.	Casia de Siam, Siamese cassia
76	***Hymenaea courbaril*** L.	Algarrobo, West-Indian-locust, courbaril
81	***Andiru inermis*** (W. Wright) H.B.K.'	Moca, cabbage angelin
84	***Erythrina poeppigiana*** (Walp.) 0. F. Cook	Bucayo gigante, mountain immortelle
86	*Lonchocarpus latifolius* (Willd.) H.B.K.	Retama
87	***Ormosia krugii*** Urban	Palo de matos
99	***Citrus paradisi*** Macfadyen	Toronja, grapefruit
100	***Citrus sinensis*** Osbeck	China, sweet orange
102	***Zunthoxylum martinicense*** (Lam.) DC.	Espino rubial, white-prickle, Martinique
105	***Bursera simaruba*** (L.) Sarg.	Almácigo, turpentine-tree, gumbo-limbo
106	***Dacryodes*** *excelsea* Vahl	Tabonuco
107	***Tetragastris balsamifera (Sw.)*** Kuntze	Masa
108	***Cedrela odorata*** L.	Cedro hembra, Spanish-cedar
109	*Guarea* ***guidonia*** (L.) Sleumer	Guaraguao, American muskwood
114	***Trichilia*** *pallida* ***(Sw.)***	Gaeta
115	***Byrsonima coriacea (Sw.)*** DC.	Maricao
118	***Alchornea*** *latifolia* ***Sw.***	Achiotillo
125	***Hura crepitans*** L.	Molinillo, sandbox, hura
129	***Sapium laurocerasus*** Desf.	Tabaiba
131	*Mangifera indica* L.	Mango
133	***Spondias dulcis*** Parkinson	Jobo de la India, ambarella
134	***Spondias*** *mombin* L.	Jobo, hogplum, yellow mombin
137	***Turpinia paniculata*** Vent.	Sauco cimarrón
138	***Cupania americana*** L.	Guara
143	***Thouinia striata*** Radlk.	Ceboruquillo
144	***Meliosma herbertii*** Rolfe	Aguacatillo
149	*Sloanea* ***berteriana*** Choisy	Motillo
151	***Montezuma speciossima*** Sessé & Moc.	Maga
154	***Ochroma pyramidale*** (Cav.) Urban	Guano, balsa
155	*Quararibœa* ***turbinata (Sw.)*** Poir	Garrocho
156	*Guazuma ulmifolia* Lam.	Guácima, jacocalalu
161	***Calophyllum brasiliense*** Camb.	Maria, Santa-maria
163	***Clusia*** *rosea* Jacq.	Cupey, wild-mammee, copey clusia
164	***Mammea americana*** L.	Mamey, mammee-apple

List of Tree Species Included in Standard Tables (continued)

Code number	Species name	Common name
169	*Casearia arborea* (L. C. Rich.) Urban	Rabo ratón
170	*Cuseuriu decundru* Jacq.	Tostado, wild honey-tree
171	*Cuseuriu guiunensis* (Aubl.) Urban	Palo blanco, wild-coffee
172	*Cuseuriu sylvestris Sw.*	Cafeillo
180	*Buchenuviu cupitutu* (Vahl) Eichl.	Granadillo
181	*Bucidu buceras* L.	Ucar, gregre, oxhorn bucida
184	*Terminalia catappa* L.	Almendra, Indian-almond
187	*Eugeniu aeruginea* DC.	Guasábara
188	*Eugeniu jumbos* L.	Pomarrosa, Rose-apple
192	*Myrciu deflexa* (Poir.) DC.	Cieneguillo
193	*Myrciu splendens (Sw.)* DC.	Hoja menuda
195	*Psidium guajava* L.	Guayaba, common guava
198	*Miconiu prasina (Sw.)* DC.	Camasey
199	*Tetrazygia elueugnoides (Sw.)* DC.	Verdiseco
200	*Dendropunux arboreus* (L.) Decne. & Planch.	Poll0
201	*Didymopunux morototoni* (Aubl.) Decne. & Planch.	Yagrumo macho, matchwood
203	*Rupuneu ferrugineu* (Ruiz & Pav.) Mez	Mantequero
208	*Dipholis salicifolia* (L.) A. DC.	Sanguinaria, wild mespel, willow bustic
209	*Manilkara bidentutu* (A. DC.) Chev.	Ausubo, balata
211	*Micropholis chrysophylloides* Pierre	Caimitillo
212	*Micropholis gurciniuefoliu* Pierre	Caimitillo verde
213	*Pouteriu multiflora* (A.DC.) Eyma	Jácana
221	*Cordiu alliodora* (Ruiz & Pav.) Oken	Capá prieto, capa
224	*Cordiu sulcata* DC.	Moral, white manjack
227	*Cithurexylum fruticosum* L.	Péndula, pasture fiddlewood, Florida
228	*Petitiu domingensis* Jacq.	Capá blanco
230	*Vitex divuricutu Sw.*	Higtierillo, white fiddlewood
234	*Sputhodeu campanulata* Beauv.	Tulipán africano, African tuliptree
236	*Tubebuiu heterophyllu* (DC.) Britton	Roble blanco, "white-cedar"
240	*Coffeu arabica* L.	Cafe, coffee
249	*Terebruriu resinosu* (Vahl) Sprague	Aquilón
260	*Pinus curibueu* Morelet	Pino hodureiio, Caribbean pine
279	*Piper amalago* L.	Higuillo de limón
294	*Ficus stuhlii* Warb. (E)	Jagiiey
330	*Nectundru untillana* Meisn.	Aguacatillo
334	*Nectundru sintenisii* Mez	Laurel amarillo
340	*Phoebe elongutu* (Vahl) Nees	Laurel avispillo
554	*Culyptrunthes pallens* Griseb.	Tapón blanco, pale lidflower
592	*Clidemiu umbrosa (Sw.)* Cogn.	Camasey
612	*Miconiu subcorymbosu* Britton	Camasey
721	*Coffeu dewevrei* Wildem. & T. Dur.	Cafe excelsa, dewevre coffee

[a] Referred to as *Prestoeu montunu* (R. Grah.) Nichols. In 1980 survey.
"Referred to as *Fiscus citrifoliu* Mill. In 1980 survey.
[c] Referred to as *Andïra inermis* (W. Wright) DC. In 1980 survey.

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Table l-Land area by detailed land cover class and survey region, Puerto Rico, 1990

Land cover class	Commercial survey region	Noncommercial survey region"	All regions
		Hectares	
Forest			
Secondary	113 600	83 900	197 500
Abandoned coffee shade	23 400	16 300	9 700
Active coffee shade	7 000	6 800	13 800
Upper mountain	_	2300	2 300
Palm	_	1 800	1 800
Dwarf	--	1 800	1 800
Xeric scrub'	4 200	21 700	25 900
Mangrove	_	4 700	4 700
Total	148 100	139 300	287 400
Nonforest			
Cropland	29 400	60 300	85 000
Pasture	174 100	146 100	312 300
Other	85 000	108 000	205 500
Total	288 500	314 400	602 900
Total land	**436 600**	**453 700**	**890 300**

-- = Dashes indicate the corresponding cell was not sampled.

[a] 1985 estimate.

"Not included in "timberland" in subsequent tables.

Table 2-Land area by survey region and broad land cover class, Puerto Rico, 1980-1990

Survey region and land cover class	Survey year	
	1980	1990
	Hectares	
Commercial survey region		
Forest	130 500	148 100
Nonforest	306 100	288 500
Total	436 600	436 600
Noncommercial survey region"		
Forest	148 200	139 399
Nonforest	305 500	314 400
Total	453 700	453 700
All regions		
Forest	278 700	287 400
Nonforest	611 600	602 900
Total	890 300	890 300

"The noncommercial region was not surveyed; estimates reported are from the 1985 forest area assessment,

Table 3—Area of timberland by Life Zone, soil group, and forest class, Puerto Rico, 1990

Life Zone and soil group	All classes	Forest class: Reversion	Other secondary forest	All secondary forest	Abandoned coffee shade	Active coffee shade
	Hectares					
Subtropical Moist Forest						
Deep volcanic soils	12 928	5 841	4 268	10 110	1416	1402
Shallow volcanic soils	28 938	11 683	15 839	27 522	1 416	0
Granitic soils	12 994	0	12 994	12 994	0	0
Limestone soils	21061	10 709	8 228	18 937	2 124	0
Total	75 921	28 233	41 329	69 563	4 956	1402
Subtropical Wet Forest						
Deep volcanic soils	43 862	1 947	22 147	24 094	14 161	5608
Shallow volcanic soils	5 628	974	1 114	2 088	3 540	0
Granitic soils	16 574	1 947	13 919	15 866	708	0
Limestone soils	1947	1 947	0	1 947	0	0
Total	68 011	6 815	37 180	43 995	18 409	5608
Total, all areas	143 932	35 048	78 509	113 558	23 365	7010

Table 4—Area of timberland by stand-volume class and forest class, Puerto Rico, 1990

Timber volume (m^3 per hectare)	All classes	Forest class: Reversion	Other secondary forest	All secondary forest	Abandoned coffee shade	Active coffee shade
			Hectares			
< 25	61 665	29 207	26 793	56 000	5 664	0
25 to 50	32 666	3 894	19 609	23 504	4 956	4206
50 to 75	25 807	974	14 227	15 201	9 205	1402
75 to 100	9 617	0	5 382	5 382	2 832	1402
> 100	14 178	974	12 496	13 470	708	0
Total	143 933	35 049	78 507	113 557	23 365	7010

Table S-Area of timberland by stand-volume class and soil group, Puerto Rico, 1990

Timber volume (m' per hectare)	Soil group				
	All groups	Deep volcanic	Shallow volcanic	Granitic	Limestone
	Hectares				
< 25	61 665	14 049	21 257	10 981	15 377
25 to 50	32 666	9441	8 789	8 228	6209
50 to 75	25 807	17 019	2 390	6 399	0
75 to 100	9 617	7 486	2 131	0	0
> 100	14 178	8 795	0	3 960	1 423
Total	143 933	56 790	34 567	29 568	23 009

Table 6—Area of timberland by stand-size class and forest class, Puerto Rico, 1990

Stand-size class	Forest class					
	All classes	Reversion	Other secondary forest	All secondary forest	Abandoned coffee shade	Active coffee shade
	Hectares					
Sawtimber	65 930	5 841	37 488	43 329	16 993	5608
Poletimber	47 458	7 789	32 603	40 392	5664	1402
Sapling and seedling	30 544	21 419	8 417	29 836	708	0
Total	143 932	35 049	78 508	113 557	23 365	7010

Table 7-Area of timberland by stand-size class and soil group, Puerto Rico, 1990

Stand-size class	Soil group				
	All groups	Deep volcanic	Shallow volcanic	Granitic	Limestone
	Hectares				
Sawtimber	65 930	30 980	14 872	15 741	4 337
Poletimber	47 458	20 801	8 968	8 893	8 795
Sapling and seedling	30 544	5009	10 725	4 933	9 876
Total	143 932	56 790	34 565	29 567	23 008

Table 8—Area of timberland by stand-age class and forest class, Puerto Rico, 1990

Stand age (years)	All classes	Forest class: Reversion	Other secondary forest	All secondary forest	Abandoned coffee shade	Active coffee shade
			Hectares			
< 30	78 588	35 049	31 559	66 608	6 372	5608
> 30	27 679	0	17 072	17 072	9 205	1402
Mixed ages	5 684	0	4 268	4 268	1416	0
Mature without past age[a]	31 981	0	25 609	25 609	6 372	0
Total	143 932	35 049	78 508	113 557	23 365	7010

[a] Stand age could not be reliably estimated for these stands because past age data were unavailable.

Table 9-Area of timberland by stand-age class and soil group, Puerto Rico, 1990

Stand age (years)	All groups	Soil group: Deep volcanic	Shallow volcanic	Granitic	Limestone
			Hectares		
< 30	78 588	25 564	24 620	13 210	15 193
> 30	27 679	14 180	6 392	2 845	4 262
Mixed ages	5 684	2 131	0	1 423	2 131
Mature without past age[a]	31 981	14 915	3 553	12 090	1 423
Total	143 932	56 790	34 565	29 568	23 009

[a] Stand age could not be reliably estimated for these stands because past age data were unavailable.

Table IO-Area of timberland by basal area class and forest class, Puerto Rico, 1990

Basal area (m^2 per hectare)	All classes	Forest class: Reversion	Other secondary forest	All secondary forest	Abandoned coffee shade	Active coffee shade
			Hectares			
< 5	17000	15 577	1 423	17 000	0	0
5to 10	23 551	8 762	11 263	20 025	2 124	1402
10 to 15	35 238	4 868	18 376	23 244	7 789	4206
15 to 20	30 570	3 894	19 609	23 504	5 664	1402
20 to 25	23 094	974	16 456	17 429	5 664	0
25 to 30	4 970	0	2 845	2 845	2 124	0
30 to 35	5 691	0	5 691	5 691	0	0
> 35	3 819	974	2 845	3 819	0	0
Total	143 933	35 049	78 508	113 557	23 365	7010

Table 11-Area of timberland by basal area class and stand-size class, Puerto Rico, 1990

Basal area (m' per hectare)	Stand-size class: All classes	Sawtimber	Poletimber	Sapling and seedling
	Hectares			
< 5	17 000	0	0	17 000
5 to 10	23 551	9 719	4 463	9 368
10 to 15	35 238	15 568	15 495	4 176
15 to 20	30 570	19 385	11 185	0
20 to 25	23 094	14 866	8 228	0
25 to 30	4 970	3 547	1 423	0
30 to 35	5 691	1 423	4 268	0
> 35	3 819	1 423	2 396	0
Total	143 933	65 931	47 458	30 544

Table 12-Area of stocked timberland by Life Zone, soil group, and slope class, Puerto Rico, 1990

Life Zone and soil group	Percent slope class: All classes	0 to 10	11 to25	26 to 45	> 45
	Hectares				
Subtropical Moist Forest					
Deep volcanic soils	12 928	2 287	1 123	4 164	5 353
Shallow volcanic soils	28 938	3 107	6 325	10 239	9 267
Granitic soils	12 994	474	2 166	3 011	7 343
Limestone soils	21 061	2 614	2 571	4 841	11 036
Total	75 921	8 482	12 185	22 255	32 999
Subtropical Wet Forest					
Deep volcanic soils	43 862	4 007	6 609	12 609	20 637
Shallow volcanic soils	5 628	0	944	1 303	3 381
Granitic soils	16 575	0	1 659	4 380	10 536
Limestone soils	1 947	0	649	1 298	0
Total	68 012	4 007	9 861	19 590	34 554
Total, all areas	143 933	12489	22 046	41 845	67 553

Table 13-Number of live trees by species and diameter class, ranked by basal area plurality, Puerto Rico, 1990"

Species code	Species name	Total basal area (m^2)	All classes	Diameter class (centimeters) 5	10	15	20	25	30	35	40	45	50	55+
				Thousand trees										
234	*Spathodea campanulata* Beauv.	229 543	21 436	12 014	5 529	1 550	929	717	289	195	61	41	54	56
109	***Guarea guidonia*** (L.) Sleumer	229 502	17 569	11 346	2 614	1 463	740	494	297	252	99	94	67	101
64	*Inga vera* Willd.	116731	6 761	3 164	1 397	898	415	370	205	122	99	44	32	14
20	***Cecropia*** *peltata* L.	104 570	3 752	1 232	902	362	419	257	214	170	61	64	41	31
81	***Andira inermis*** (W. Wright) H.B.K.	92 232	10 415	5 667	2 820	1 025	389	311	120	38	14	19	9	3
236	***Tabebuia*** *heterophylla* (DC.) Britton	91 324	11711	7649	1 680	1 487	470	248	64	75	20	8	6	4
188	*Eugenia* ***jambos*** L.	73 453	14 370	11491	1531	677	348	167	81	47	7	15	0	5
62	*Inga fagifolia* (L.)	61 134	3 367	1 371	969	266	315	143	186	34	54	15	6	9
84	*Erythrina* ***poeppigiana*** (Walp.) 0. F. Cook	51 428	996	312	254	0	108	101	47	64	14	19	18	56
131	***Mangifera*** *indica* L.	44451	393	117	0	52	31	20	43	19	10	23	9	64
201	***Didymopanax*** *morototoni* (Aubl.) Decne. & Planch.	43 031	2831	1042	778	472	222	163	103	19	10	12	3	8
7	*Euterpe* ***globosa*** Gaertn.	40 102	1 762	0	117	929	575	130	11	0	0	0	0	0
48	*Ocotea leucoxylon* ***(Sw.)*** Mez	37 708	7 050	5 636	739	203	213	198	24	25	0	12	0	0
9	***Roystonea borinquena 0.*** F. Cook	35 532	674	117	80	44	91	77	89	81	73	21	0	2
171	*Casearia* ***guianensis*** (Aubl.) Urban	33 735	23 753	23 171	552	0	30	0	0	0	0	0	0	0
100	***Citrus sinensis*** Osbeck	28 041	3 576	1 850	867	708	79	72	0	0	0	0	0	0
200	*Dendropanax arboreus* (L.) Decne. & Planch.	24 763	2 693	2 147	58	190	142	78	41	20	0	11	3	3
1	*Cyathea* ***arborea*** (L.) J. E. Smith	23 641	2 237	230	1 405	524	79	0	0	0	6	0	0	0
172	*Casearia sylvestris* ***Sw.***	23 024	15 461	14 941	441	79	0	0	0	0	0	0	0	0
138	***Cupania americana*** L.	22 714	2 876	1344	1 159	220	60	61	18	0	14	0	0	0
592	***Clidemia umbrosa (Sw.) Cogn.***	22 550	9310	8664	458	57	36	49	0	36	9	0	0	0
118	***Alchornea*** *latifolia* ***Sw.***	22 513	1 942	1 262	117	232	224	63	33	0	0	0	3	8
161	***Calophyllum brasiliense*** Camb.	21 980	2 609	2 380	0	53	0	53	50	11	26	14	12	10
224	***Cordia*** *sulcata* DC.	21 457	2 331	1 355	440	244	163	79	24	26	0	0	0	0
163	*Clusia rosea* Jacq.	20 620	1 826	668	779	39	201	126	0	12	0	0	0	0
134	***Spondias*** *mombin* L.	20 134	798	456	0	228	0	48	25	0	9	9	0	22
193	*Myrcia* ***splendens (Sw.)*** DC.	18 016	7 336	6 364	873	64	35	0	0	0	0	0	0	0
334	*Nectandra sintenisii* Mez (E)	17 920	2 458	1 810	350	197	23	24	27	6	5	0	0	17
198	***Miconia*** *prasina* ***(Sw.)*** DC.	17 694	7 994	7200	641	153	0	0	0	0	0	0	0	0
227	*Citharexylum* ***fruticosum*** L.	17 456	2 119	1 224	598	70	120	90	17	0	0	0	0	0
17	*Artocarpus altilis* (Parkinson) Fosberg	17 318	817	478	80	109	56	0	12	31	28	6	7	10
102	*Zanthoxylum* ***martinicense*** (Lam.) DC.	17 304	2 016	1 391	367	108	36	51	34	13	6	7	0	2
22	*Ficus laevigata* Vahl	15 583	390	183	0	78	59	0	8	18	10	22	0	12
249	*Terebraria resinosa* (Vahl) Sprague	15 219	2 728	1 380	1 109	205	33	0	0	0	0	0	0	0
228	*Petitia* domingensis Jacq.	15 147	609	239	0	236	15	0	92	21	0	0	5	0
76	Hymenaea courbaril L.	14 132	449	0	208	74	0	81	35	26	20	0	6	0
221	Cordia *alliodora* (Ruiz & Pav.) Oken	14 033	1 759	1412	116	32	93	56	28	6	11	0	0	5
211	Microphollis chrysophylloides Pierre	12 914	1331	699	350	112	117	0	54	0	0	0	0	0
180	*Buchenavia capitata* (Vahl) Eichl.	12 800	261	0	117	0	56	22	18	13	20	11	0	4
721	*Coffea dewevrei* Wildem. & T. Dur.	12 601	2 812	2 014	622	120	36	21	0	0	0	0	0	0
195	***Psidium guajava*** L.	12 201	9 686	9 436	251	0	0	0	0	0	0	0	0	0
184	Terminalia *catappa* L.	11991	454	319	0	0	44	20	0	12	36	23	0	0
170	*Casearia* decandra Jacq.	11 989	6 385	6231	0	95	39	17	0	0	0	0	0	3

Table 13—**Number of live trees by species and diameter class, ranked by basal area plurality, Puerto Rico, 1990" (continued)**

Species code	Species name	Total basal area (m^2)	All classes	Diameter class (centimeters) 5	10	15	20	25	30	35	40	45	50	55+
				Thousand trees										
199	*Tetrazygia elaeagnoides* (SW.) DC.	11 006	3 857	3 274	429	125	0	29	0	0	0	0	0	0
240	*Coffea arabica* L.	10 901	9 826	9 710	116	0	0	0	0	0	0	0	0	0
87	*Ormosia krugii* Urban	10 756	492	0	117	201	126	49	0	0	0	0	0	0
106	*Dacroyodes excensea* Vahl	10 666	151	0	0	0	62	0	51	12	20	0	6	0
999	Unidentified species	10 562	2 974	2 401	466	47	38	0	18	0	0	4	0	
169	*Casearia arborea* (L. C. Rich.) Urban	10 545	3 942	3641	175	50	77	0	0	0	0	0	0	0
125	*Hura crepitans* L.	10 543	132	0	0	0	55	31	10	8	6	5	0	16
115	*Byrsonima coriacea (Sw.)* DC.	10 228	318	175	0	0	31	47	35	0	19	12	0	0
151	***Montezuma*** *speciossima* Sessé & Moc.	10 017	247	0	117	0	0	85	8	12	18	8	0	0
192	*Myrcia deflexa* (Poir.) DC.	9 650	2 076	1 509	466	73	0	0	15	0	0	0	13	0
156	Guazuma *ulmifolia* Lam.	9 350	404	117	91	136	40	0	0	0	10	7	0	4
149	*Sloanea berteriana* Choisy	9 260	611	233	117	133	71	30	18	0	9	0	0	0
208	***Dipholis*** *salicifolia* (L.) A. DC.	8 813	599	80	233	117	169	0	0	0	0	0	0	0
105	*Burseras imaruba* (L.) Sarg.	8 781	1 013	600	291	0	27	63	18	12	0	0	0	0
33	*Torrubia fragrans* (Dum.-Cours.) Standley	8 578	1 620	1 194	350	74	0	0	0	0	0	0	0	0
213	*Pouteria multiflora* (A. DC.) Eyma	8 274	55	0	0	0	0	0	18	12	14	4	0	5
61	***Albizia*** *procera* (Roxb.) Benth.	7 930	503	159	159	45	106	0	34	0	0	0	0	0
340	***Phoebe*** *elongata* (Vahl) Nees	7 891	790	464	175	62	42	25	10	11	0	0	0	3
108	*Cedrela odorata* L.	7 747	329	115	115	0	66	0	0	0	19	8	0	7
114	***Trichilia*** *pallida* ***Sw.***	7 701	4 895	4 583	313	0	0	0	0	0	0	0	0	0
133	*Spondias dulcis* Parkinson	7 453	134	80	0	0	0	0	0	27	0	16	6	5
143	*Thouinia* ***striata*** Radlk.	7 117	2 138	1 907	159	0	72	0	0	0	0	0	0	0
	Other species (134)	200 205	49 571	42 005	5 358	958	402	338	193	179	62	39	23	22
	Total	2 194 205	308 780	232 253	40 615	15 676	8425	5104	2717	1665	893	593	329	511

"Columns may not add up to totals as a result of rounding numbers.

Table 14—Number of growing-stock trees by species and diameter class, ranked by basal area plurality, Puerto Rico, 1990[a]

Species code	Species name	Total basal area (m^2)	All classes	Diameter class (centimeters) 5	10	15	20	25	30	35	40	45	50	55+
				Thousand trees										
234	*Spathodea campanulata* Beauv.	190 169	14 049	6 239	4 522	1 229	807	641	255	168	61	31	45	49
109	*Guarea* guidonia (L.) Sleumer	123 615	5 909	2 994	662	872	485	375	188	158	33	51	42	48
20	*Cecropia peltata* L.	96 080	2 782	602	669	316	402	257	188	170	61	56	31	31
64	*Inga vera* Willd.	75 438	3 570	1 335	582	765	380	211	111	73	68	16	16	12
236	*Tabebuia heterophylla* (DC.) Britton	72 186	5 786	2 367	1404	1 235	397	226	51	75	20	0	6	4
81	*Andira inermis* (W.Wright) H.B.K.	59 359	4 498	1 547	1 532	789	212	286	92	21	0	19	0	0
84	*Erythrina poeppigiana* (Walp.) 0. F. Cook	44 232	470	116	58	0	31	76	16	64	14	19	18	56
201	*Didymopanax morototoni* (Aubl.) Decne. & Planch.	40 435	2 535	926	661	427	222	163	83	19	10	12	3	8
7	*Euterpe globosa* Gaertn.	38 360	1 555	0	0	838	575	130	11	0	0	0	0	0
62	*Inga fagifolia* (L.)	36 474	1 493	382	472	142	180	105	138	27	36	7	0	3
9	*Roystonea borinquena 0.* F. Cook	35 532	674	117	80	44	91	77	89	81	73	21	0	2
188	Eugenia jambos L.	25 962	6 089	4 629	1 092	128	184	33	16	0	0	8	0	0
40	*Ocotea leucoxylon (Sw.)* Mez	22 172	4 721	3 840	408	203	145	125	0	0	0	0	0	0
1	*Cyathea arborea* (L.) J. E. Smith	20 620	1 840	115	1 199	448	79	0	0	0	0	0	0	0
161	*Calophyllum brasiliense* Camb.	20 534	2 384	2 183	0	53	0	25	50	11	26	14	12	10
118	*Alchornea latifolia Sw.*	20 194	987	323	117	232	224	50	33	0	0	0	0	8
138	*Cupania americana* L.	14 746	1 520	641	598	168	30	61	18	0	5	0	0	0
163	*Clusia rosea* Jacq.	13 937	1 287	472	583	0	121	100	0	12	0	0	0	0
17	*Artocarpus altilis* (Parkinson) Fosberg	13 854	634	319	80	109	56	0	12	24	19	0	7	8
76	*Hymenaea courbaril* L.	13 617	333	0	91	74	0	81	35	26	20	0	6	0
334	*Nectandra sintenisii* (E)	13 177	977	581	117	197	23	24	8	6	5	0	0	17
224	*Cordia sulcata* DC.	12 147	987	567	116	128	70	79	15	12	0	0	0	0
134	*Spondias mombin* L.	12 125	284	183	0	0	0	48	25	0	9	4	0	15
592	*Clidemia umbrosa (Sw.)* Cogn.	11 243	2 785	2 553	58	57	36	49	0	23	9	0	0	0
228	*Petitia domingensis* Jacq.	11 043	556	239	0	236	0	U	72	8	0	0	0	0
249	*Terebraria resinosa* (Vahl) Sprague	10 951	1 606	515	950	141	0	0	0	0	0	0	0	0
106	*Dacryodes excelsea* Vahl	10 666	151	0	0	0	62	0	51	12	20	0	6	0
102	*Zanthoxylum martinicense* (Lam.) DC.	10 649	1 029	779	80	53	36	20	34	13	6	7	0	0
184	*Terminalia catappa* L.	10 592	206	80	0	0	44	20	0	12	27	23	0	0
221	*Cordia alliodora* (Ruiz & Pav.) Oken	10 228	903	590	116	32	93	39	16	6	11	0	0	0
193	*Myrcia splendens (Sw.)* DC.	9 805	3300	2 654	582	64	0	0	0	0	0	0	0	0
200	*Dendropanax arboreus* (L.) Decne. & Planch.	9 515	714	429	58	104	65	29	8	14	0	4	3	1
211	*Micropholis chrysophylloides* Pierre	9 202	1 039	699	117	112	73	0	38	0	0	0	0	0
87	*Ormosia krugii* Urban	8 385	375	0	117	118	92	49	0	0	0	0	0	0
131	*Mangifera indica* L.	8 268	93	0	0	52	0	20	0	5	0	0	3	13
180	*Buchenavia capitata* (Vahl) Eichl.	7 700	103	0	0	0	32	22	18	0	20	11	0	0
22	*Ficus laevigata* Vahl	7 666	82	0	0	0	43	0	8	0	10	15	0	6
171	*Casearia guianensis* (Aubl.) Urban	7 477	6007	5 977	0	0	30	0	0	0	0	0	0	0
208	*Dipholis salicifolia* (L.) A. DC.	7 347	461	0	233	59	169	0	0	0	0	0	0	0
999	Unidentified species	7 247	1431	1 012	350	47	0	0	18	0	0	4	0	0
192	*Myrcia deflexa* (Poir.) DC.	6 837	1 482	1 105	350	0	0	0	15	0	0	0	13	0
74	*Cassia siamea* Lam.	6 756	1644	1 116	478	40	0	0	0	9	0	0	0	0
115	*Byrsonima coriacea (Sw.)* DC.	6 690	258	175	0	0	31	22	0	0	19	12	0	0

Table 14—Number of growing-stock trees by species and diameter class, ranked by basal area plurality, Puerto Rico, 1990[a] (continued)

Species code	Species name	Total basal area (m^2)	All classes	Diameter class (centimeters) 5	10	15	20	25	30	35	40	45	50	55+
				Thousand trees										
151	***Montezuma*** *speciossima* Sessé & Moc.	6 515	105	0	0	0	0	85	0	12	0	8	0	0
108	*Cedrela odorata* L.	6 510	94	0	0	0	66	0	0	0	14	8	0	7
213	***Pouteria*** *multiflora* (A. DC.) Eyma	6 504	33	0	0	0	0	0	8	0	14	4	0	5
100	***Citrus*** *sinensis* Osbeck	6 354	499	175	117	147	39	22	0	0	0	0	0	0
149	*Sloanea berteriana* Choisy	6 260	408	233	0	76	71	0	18	0	9	0	0	0
169	*Casearia arborea* (L. C. Rich.) Urban	5 515	1 657	1 554	0	50	53	0	0	0	0	0	0	0
86	*Lonchocarpus latifolius* (Willd.) H.B.K	5 330	63	0	0	0	0	14	15	25	9	0	0	0
170	*Casearia decandra* Jacq.	5 120	1 294	1 158	0	95	39	0	0	0	0	0	0	3
61	***Albizia*** *procera* (Roxb.) Benth.	5 058	280	80	80	45	52	0	24	0	0	0	0	0
172	*Casearia sylvestris* ***Sw.***	5 024	3 234	3 117	117	0	0	0	0	0	0	0	0	0
721	*Coffea dewevrei* Wildem. & T.Dur.	5 014	1 277	905	290	61	0	21	0	0	0	0	0	0
212	***Micropholis*** *garciniaefolia* Pierre	4 740	65	0	0	0	0	28	0	27	10	0	0	0
129	*Sapium laurocerasus* Desf.	4 650	332	58	117	158	0	0	0	0	0	0	0	0
227	*Citharexylum fruticosum* L.	4 527	381	208	91	0	41	24	17	0	0	0	0	0
340	***Phoebe*** *elongata* (Vahl) Nees	4 282	254	174	0	0	42	25	0	11	0	0	0	3
181	***Bucida*** *buceras* L.	4 160	407	117	233	0	4	24	0	0	0	0	0	0
125	*Hura* ***crepitans*** L.	4 055	74	0	0	0	30	31	10	0	0	0	0	3
198	***Miconia*** *prasina* ***(Sw.)*** DC.	3 954	1 709	1 429	233	47	0	0	0	0	0	0	0	0
133	***Spondias*** *dulcis* Parkinson	3 898	113	80	0	0	0	0	0	27	0	0	6	0
203	***Rapanea ferruginea*** (Ruiz & Pav.) Mez	3 746	1210	1 136	0	60	0	0	0	13	0	0	0	0
105	*Bursera imaruba* (L.) Sarg.	3 568	474	313	117	0	0	26	18	0	0	0	0	0
209	*Manilkara* ***bidentata*** (A. DC.) Chev.	3 555	49	0	0	0	0	0	36	13	0	0	0	0
	Other species (93)	103 959	22 704	18 329	3 044	618	309	226	78	47	20	16	7	17
	Total	1 405 530	126 305	77 467	22 971	10 869	6296	3969	1936	1224	658	370	224	329

[a] Columns may not add up to totals as a result of rounding numbers.

Table 15—Number of life trees on timberland by diameter class and forest class, Puerto Rico, 1990

Diameter class (centimeters)	Forest class					
	All classes	Reversion	Other secondary forest	All secondary forest	Abandoned coffee shade	Active coffee shade
	Hectares					
5	1614	1536	1758	1690	1556	573
10	282	209	348	305	196	197
15	109	58	138	114	91	93
20	59	26	81	64	46	12
25	35	20	43	36	35	31
30	19	7	23	18	24	12
35	12	4	14	11	15	7
40	6	2	7	6	9	4
45	4	1	5	4	7	3
50	2	0	3	2	4	2
55+	4	2	3	3	7	11
Total	2146	1865	2423	2253	1990	945

Table 16a—Basal area and number of live trees per hectare of timberland for selected species, secondary forests, Puerto Rico, 1990[a]

Species code	Species name	Basal area		Number of trees
		m^2/ha	Percent	Hectares
234	*Spafhodea campanulata* Beauv.	1.86	12.4	177
109	*Guarea guidonia* (L.) Sleumer	1.19	7.9	106
236	*Tabebuia heterophylla* (DC.) Britton	.78	5.2	103
81	*Andira inermis* (W. Wright) H.B.K.	.68	4.5	82
20	*Cecropia peltata* L.	.59	3.9	21
188	*Eugenia jambos* L.	.54	3.6	86
64	*Inga vera* Willd.	.46	3.1	26
7	*Euterpe globosa* Gaertn.	.35	2.3	16
62	*Inga fagifolia* (L.)	.34	2.3	18
9	*Roystonea borinquena 0.* F. Cook	.28	1.8	5
171	*Casearia guianensis* (Aubl.) Urban	.28	1.8	196
201	*Didymopanax morototoni* (Aubl.) Decne. & Planch	.28	1.9	16
48	*Ocotea leucoxylon (Sw.)* Mez	.28	1.9	42
84	*Erythrina poeppigiana* (Walp.) 0. F. Cook	.26	1.7	6
131	*Mangifera indica* L.	.19	1.3	3
161	*Calophyllum brasiliense* Camb.	.19	1.3	23
138	*Cupania americana* L.	.19	1.3	25
163	*Clusia rosea* Jacq.	.18	I.2	16
172	*Casearia sylvestris Sw.*	.18	I.2	122
118	*Alchornea latifolia Sw.*	.17	1.1	13
592	*Clidemia umbrosa (Sw.)* Cogn.	.17	1.1	66
1	*Cyathea arborea* (L.) J. E. Smith	.15	1.0	12
193	*Myrcia splendens (Sw.) DC.*	.15	I.0	61
227	*Citharexylum fruticosum* L.	.15	1.0	19
134	*Spondias mombin* L.	.15	1.0	7
17	*Artocarpus altilis* (Parkinson) Fosberg	.14	.9	7
198	*Miconia prasina (Sw.)* DC.	.13	.9	57
249	*Terebraria resinosa* (Vahl) Sprague	.13	.9	24
76	*Hymenaea courbaril* L.	.12	.8	4
100	*Citrus sinensis* Osbeck	.12	.8	13
	Other species (157)	4.36	29.0	876
	Total	15.07	loo.0	2248

'Columns may not add up to totals as a result of rounding numbers

Table 16b—Basal area and number of live trees per hectare of timberland for selected species, abandoned coffee shade, Puerto Rico, 1990"

Species code	Species name	Basal area		Number of trees
		m²/ha	*Percent*	*Hectares*
109	***Guarea guidonia*** (L.) Sleumer	3.51	20.7	225
64	***Inga vera*** Willd.	2.15	12.7	135
20	*Cecropia* ***peltata*** L.	1.34	7.9	57
131	*Mangifera indica* L.	.78	4.6	3
62	*Inga* ***fagifolia*** (L.)	.77	4.6	49
200	***Dendropanax*** *arboreus* (L.) Decne. & Planch.	.71	4.2	59
84	***Erythrina poeppigiana*** (Walp.) O.F. Cook	.63	3.7	13
234	***Spathodea campanulata*** Beauv.	.60	3.5	52
81	***Andira inermis*** (W. Wright) H.B.K.	.53	3.1	44
188	***Eugenia jambos*** L.	.53	3.1	198
201	*Didymopanax morototoni* (Aubl.) Decne. & Planch	.46	2.7	44
224	***Cordia sulcata*** DC.	.37	2.2	45
240	***Coffea*** *arabica* L.	.28	1.6	236
221	***Cordia*** *alliodora* (Ruiz & Pav.) Oken	.26	1.5	29
48	***Ocotea*** *leucoxylon* ***(Sw.)*** Mez	.24	1.4	90
102	*Zanthoxylum* ***martinicense*** (Lam.) DC.	.23	1.4	6
100	***Citrus*** *sinensis* Osbeck	.21	1.2	21
334	*Nectandra* ***sintenisii*** Mez (E)	.21	1.3	25
213	***Pouteria*** *multiflora* (A.DC.) Eyma	.20	1.2	2
721	Coffea *dewevrei* Wildem. & T. Dur.	.19	1.1	52
9	***Roystonea borinquena*** O.F. Cook	.18	1.0	5
134	***Spondias*** *mombin* L.	.15	.9	1
230	*Vitex* ***divaricata Sw.***	.15	.9	6
340	***Phoebe elongata*** (Vahl) Nees	.14	.8	23
198	***Miconia prasina (Sw.)*** DC.	.13	.8	63
	Other species (46)	2.00	11.8	501
	Total	16.94	100.0	1694

"Columns may not add up to totals as a result of rounding numbers.

Table 16c—Basal area and number of live trees per hectare of timberland for selected species, active coffee shade, Puerto Rico, 1990"

Species code	Species name	Basal area		Number of trees
		m^2/ha	Percent	Hectares
64	*Inga vera* Willd.	2.04	16.3	87
109	*Guarea guidonia* (L.) Sleumer	1.70	13.6	43
100	*Citrus sinensis* Osbeck	1.40	11.2	227
84	*Erythrina poeppigiana* (Walp.) 0. F. Cook	1.00	8.0	2
	Cyatheu arborea (L.) J. E. Smith	.99	8.0	125
20	*Cecropia peltata* L.	.83	6.7	11
131	*Mangifera indica* L	.67	5.3	2
62	*Inga fagifolia* (L.)	.63	5.1	23
234	*Spathodea campanulata* Beauv.	.58	4.6	23
22	*Ficus laevigata* Vahl	SO	4.0	2
81	*Andira inermis* (W. Wright) H.B.K.	.33	2.7	4
721	*Coffea dewevrei* Wildem. & T. Dur.	.23	1.8	19
240	*Coffea arabica* L.	.20	1.6	229
51	*Persea americana* Mill	.17	1.3	1
115	*Byrsonima coriacea (Sw.)* DC.	.17	1.3	2
99	*Citrus paradisi* Macfadyen	.17	1.3	3
118	*Alchornea latifolia Sw.*	.17	1.3	5
236	*Tabebuia heterophylla* (DC.) Britton	.17	1.3	2
294	*Ficus stahlii* Warb. (E)	.17	1.3	1
221	*Cordia alliodora* (Ruia & Pav.) Oken	.17	1.3	1
108	*Cedrela odorata* L.	.09	.7	33
592	*Clidemia umbrosa (Sw.)* Cogn.	.05	.4	49
102	*Zanthoxylum martinicense* (Lam.) DC.	.04	.3	16
48	*Ocotea leucoxylon (Sw.)* Mez	.01	.I	16
279	*Piper amalago* L.	.01	.1	16
	Total	12.49	99.6	942

"Columns may not add up to totals as a result of rounding numbers.

Table 17-Basal area of poletimber and sawtimber trees by tree class and forest class, Puerto Rico, 1990

Tree class	Forest class					
	All classes	Reversion	Other secondary forest	All secondary forest	Abandoned coffee shade	Active coffee shade
	Square meters of basal area					
Poletimber-size trees						
Growing stock	**544 257**	**39 738**	**47 926**	**387 665**	**127 398**	**29 195**
Rough-and-rotten	**254 642**	**29 195**	**132 435**	**161 630**	**75 495**	**17 517**
Total	798 899	68 933	480 361	549 295	202 893	46 712
Sawtimber-size trees						
Growing stock	**572 224**	**68 123**	**406 371**	**474 493**	**80 214**	**17 517**
Rough-and-rotten	**197 469**	**27 573**	**132 809**	**160 382**	**30 080**	**7007**
Total	769 693	95 696	539 180	634 875	110 294	24 524
Total, growing stock	I 116481	107 861	754 297	862 158	207 612	46 712
Total, rough-and-rotten	452 Ill	56 768	265 244	322 012	105 575	24 524
Total, poletimber and sawtimber trees	1 568 592	164 629	1 019 541	1 184 170	313 187	71 236

Table 18—Basal area of poletimber and sawtimber trees by tree class, Life Zone, and soil group, Puerto Rico, 1990

Tree class and Life Zone	Soil group				
	groups	All volcanic	Deep volcanic	Shallow Granitic	Limestone
	Square meters of basal area				
Subtropical Moist Forest					
Poletimber-size trees					
Growing stock	222 129	88 539	58 201	43 236	32 153
Rough-and-rotten	102 157	29 112	34 224	24 117	14 704
Total	324 286	117 651	92 425	67 353	46 857
Sawtimber-size trees					
Growing stock	220 117	48 594	54 555	51 847	65 121
Rough-and-rotten	108 312	22 355	35 282	28 501	22 175
Total	328 429	70 949	89 837	80 348	87 296
Total, growing stock	442 246	137 133	112 756	95 084	97 274
Total, rough-and-rotten	210 470	51 466	69 506	52 618	36 879
Total, Subtropical Moist Forest	652 716	188 599	182 262	147 702	134 153
Subtropical Wet Forest					
Poletimber-size trees					
Growing stock	322 128	211 796	27 131	79 146	4 055
Rough-and-rotten	152 485	91 873	20 864	33 259	6 488
Total	474 613	303 669	47 995	112405	10 543
Sawtimber-size trees					
Growing stock	352 107	246 818	20 848	78 764	5 677
Rough-and-rotten	89 157	58 910	12 664	15 961	1 622
Total	441264	305 728	33 512	94 725	7 299
Total, growing stock	674 235	458 614	47 979	157 910	9 732
Total, rough-and-rotten	241 642	150 783	33 528	49 220	8 110
Total, Subtropical Wet Forest	915 877	609 397	81 507	207 130	17 842
Total, Life Zones	1 568 593	797 996	263 769	354 832	151995

Table 19-Volume of timber on timberland by class of timber and forest class, Puerto Rico, **1990**[a]

Class of timber	All classes	Forest class: Reversion	Other secondary forest	All secondary forest	Abandoned coffee shade	Active coffee shade
			Thousand cubic meters			
Growing-stock trees						
Sawtimber trees						
Saw-log portion	2 647.3	154.9	1695.7	1850.6	613.1	183.6
Upper stem	648.3	38.9	419.4	458.3	155.0	35.1
Branches and forks	895.4	51.2	586.4	637.6	225.1	32.1
Sound cull	686.5	38.1	486.2	524.2	142.5	19.7
Total, timber volume	4 817.5	283.0	3187.8	3470.8	1136.3	270.5
Poletimber trees						
Bole volume	2 583.7	321.4	1778.5	2100.0	385.4	98.3
Branches and forks	862.1	15.3	586.1	661.4	170.1	30.6
Sound cull	416.9	14.1	369.2	383.3	29.9	3.1
Total, timber volume	3 862.8	410.8	2733.9	3144.7	585.4	132.7
Total, all growing-stock trees	8 740.2	693.8	592 1 .7	6615.5	1721.7	403.1
Rough-and-rotten trees						
Rough trees						
Bole volume	1 217.2	136.1	705.1	841.3	296.6	19.3
Branches and forks	946.4	144.8	558.4	703.2	184.4	58.1
Sound cull	485.0	53.0	262.8	315.8	145.0	24.1
Total, timber volume	2 648.5	334.0	1526.3	1860.3	626.0	162.2
Rotten trees						
Bole volume	56.0	7.1	34.3	39.3	9.4	7.3
Branches and forks	36.8	2.9	17.1	20.9	15.2	.7
Sound cull	43.0	3.1	29.9	34.1	8.0	.9
Total, timber volume	135.8	13.1	81.3	94.4	32.6	8.9
Total, all rough-and-rotten trees	2 784.3	347.0	1607.6	1954.7	658.6	171.1
Total, all timber	11 524.6	1040.8	7529.3	8570.1	2380.2	574.2

"Columns may not add up to totals as a result of rounding numbers.

Table 20—Volume of timber on timberland by Life Zone, soil group, and tree class, Puerto Rico, 1990"

Life zone and tree class	Soil group: groups	All volcanic	Deep volcanic	Shallow Granitic	Limestone
			Thousand cubic meters		
Subtropical Moist Forest					
Sawtimber trees	1 940.5	781.3	487.2	372.2	299.7
Poletimber trees	1 390.2	298.4	355.7	317.1	418.9
Total, all growing-stock trees	3 330.6	1079.7	842.9	689.4	718.6
Rough trees	1 123.1	276.6	319.0	295.6	231.8
Rotten trees	52.1	21.5	16.0	12.0	2.6
Total, all rough-and-rotten trees	1 175.2	298.1	335.0	307.6	234.5
Total. all timber	4 505.8	1377.8	1178.0	997.0	953.1
Subtropical Wet Forest					
Sawtimber trees	2 937.0	1992.6	221.1	690.7	32.6
Poletimber trees	2 472.6	1778.1	162.1	493.7	38.7
Total. all growing-stock trees	5 409.6	3770.7	383.2	1184.4	71.3
Rough trees	1 525.4	944.5	207.8	303.0	70.2
Rotten trees	83.7	72.6	5.0	6.1	0
Total, all rough-and-rotten trees	I 609.1	1017.1	212.7	309.1	70.2
Total. all timber	7 018.7	4787.8	596.0	1493.5	141.5
Total, all Life Zones	1 l 524.6	6165.6	1773.9	2490.5	1094.5

"Columns may not add up to totals as a result of rounding numbers.

Table 21-Volume of timber on timberland by species and diameter class, Puerto Rico, 1990"

Species code	Species name	All classes	Diameter class (centimeters) 15	20	25	30	35	40	45	50	55+
		Thousand cubic meters									
109	*Guarea guidonia* (L.) Sleumer	1 282.4	123.4	155.7	142.5	161.6	178.9	85.8	109.1	94.2	214.8
234	***Spathodea campanulata*** Beauv.	1 109.4	104.5	167.0	195.5	146.7	140.2	51.2	53.5	79.7	158.4
64	*Inga vera* Willd.	820.6	102.5	109.4	176.6	121.2	104.1	90.2	44.4	42.8	29.4
20	***Cecropia peltata*** L.	812.0	28.9	96.5	129.3	131.5	135.1	77.3	85.8	60.5	67.1
62	*Inga fagifolia* (L.)	398.9	55.4	67.1	42.2	119.6	27.1	55.3	15.5	6.0	10.5
236	***Tabebuia*** *heterophylla* (DC.) Britton	395.0	120.3	65.0	89.3	29.8	51.7	14.7	9.6	7.1	7.7
81	*Andira inermis* (W. Wright) H.B.K.	381.5	84.2	75.3	94.6	54.7	20.1	5.7	30.4	11.5	4.9
84	*Erythrina* ***poeppigiana*** (Walp.) 0. F. Cook	364.4	0	12.5	28.9	18.0	53.2	14.1	23.6	23.4	175.7
9	***Roystonea borinquena 0.*** F. Cook	310.7	1.1	7.8	18.4	64.8	79.6	96.8	35.5	0	6.6
201	***Didymopanax*** *morototoni* (Aubl.) Decne. & Planch	295.7	28.0	39.6	77.1	67.7	18.8	16.0	17.2	8.0	23.2
188	***Eugenia jambos*** L.	291.0	47.0	78.2	69.8	34.7	28.7	5.2	19.4	0	7.9
131	*Mangifera indica* L.	234.8	5.6	2.9	4.7	26.4	16.5	2.7	15.8	21.3	121.4
161	*Calophyllum brasiliense* Camb.	201.3	5.9	0	28.2	45.6	11.6	36.9	25.1	24.3	23.6
48	***Ocotea*** *leucoxylon* (Sw.) Mez	200.7	16.0	37.9	93.4	14.5	26.4	0	12.5	0	0
7	***Euterpe*** *globosa* Gaertn.	189.3	64.5	89.9	33.4	1.4	0	0	0	0	0
118	***Alchornea*** *latifolia* ***Sw.***	146.6	21.8	48.4	27.8	21.6	0	0	0	4.3	22.8
22	*Ficus laevigata* Vahl	144.3	23.6	22.0	0	6.3	16.4	11.8	29.5	0	34.7
76	***Hymenaea courbaril*** L.	141.0	7.2	24.6	20.2	30.8	22.2	19.5	11.9	4.5	0
200	***Dendropanax*** *arboreus* (L.) Decne. & Planch.	133.4	12.1	30.3	24.2	30.0	12.6	0	12.4	3.6	8.2
134	***Spondias*** *mombin* L.	120.4	6.3	0	10.0	16.8	0	12.6	10.9	0	63.9
224	*Cordia sulcata* DC.	110.9	13.5	24.3	31.0	18.3	23.8	0	0	0	0
106	*Dacryodes excelsea* Vahl	110.2	0	19.4	0	37.7	12.4	29.7	0	11.0	0
102	*Zanthoxylum* ***martinicense*** (Lam.) DC.	109.8	11.1	6.8	14.0	36.0	13.9	8.7	12.8	0	6.4
163	***Clusia*** *rosea* Jacq.	109.0	1.8	46.4	50.6	0	10.3	0	0	0	0
334	*Nectandra* ***sintenisii*** Mez (E)	106.4	12.6	7.0	11.6	15.5	6.4	5.8	0	0	47.4
228	***Petitia domingensis*** Jacq.	103.8	21.3	2.4	0	60.6	14.0	0	0	5.5	0
17	***Artocarpus*** *altilis* (Parkinson) Fosberg	102.7	8.3	10.0	0	4.4	22.3	19.9	7.2	6.6	24.0
115	*Byrsonima* ***coriacea (Sw.)*** DC.	101.0	0	7.1	19.8	32.3	0	24.0	17.8	0	0
100	***Citrus*** *sinensis* Osbeck	100.1	57.5	22.0	20.6	0	0	0	0	0	0
138	***Cupania americana*** L.	98.0	17.7	21.4	18.7	10.8	0	29.4	0	0	0
180	***Buchenavia capitata*** (Vahl) Eichl.	97.9	0	20.6	5.7	10.4	6.5	27.4	17.2	0	7.3
184	*Terminalia catappa* L.	87.3	0	7.9	5.9	0	7.5	33.1	32.9	0	0
151	***Montezuma speciossima*** Sessé & Moc.	83.8	0	0	40.5	5.1	9.9	19.5	8.8	0	0
87	***Ormosia krugii*** Urban	81.0	18.5	36.1	25.8	0	0	0	0	0	0
211	***Micropholis*** *chrysophylloides* Pierre	76.2	7.1	29.2	0	29.0	10.9	0	0	0	0
149	*Sloanea* ***berteriana*** Choisy	74.5	11.1	27.9	10.4	10.8	0	14.2	0	0	0
227	***Citharexylum fruticosum*** L.	71.1	5.8	10.8	43.9	10.6	0	0	0	0	0
721	*Coffea dewevrei* Wildem. & T. Dur.	52.5	28.1	13.6	10.8	0	0	0	0	0	0
125	***Hura*** *crepitans* L.	48.5	0	3.7	5.1	2.8	3.5	5.0	4.4	0	24.1
156	Guazuma *ulmifolia* Lam.	47.4	18.0	5.2	0	0	0	12.9	5.1	0	6.2
192	*Myrcia deflexa* (Poir.) DC.	40.7	2.5	0	0	15.5	0	0	0	22.7	0
169	*Casearia arborea* (L. C. Rich) Urban	38.9	14.6	24.3	0	0	0	0	0	0	0
1	***Cyathea*** *arborea* (L.) J. E. Smith	37.8	21.7	16.1	0	0	0	0	0	0	0
193	*Myrcia splendens* ***(Sw.)*** DC.	37.2	5.5	31.7	0	0	0	0	0	0	0
249	*Terebraria resinosa* (Vahl) Sprague	33.8	24.2	9.6	0	0	0	0	0	0	0
170	*Casearia* ***decandra*** Jacq.	30.9	9.3	15.2	1.7	0	0	0	0	0	4.8
199	*Tetrazygia elaeagnoides* ***(Sw.)*** DC.	27.6	19.9	0	7.7	0	0	0	0	0	0
999	Unidentified species	26.8	1.7	6.1	0	12.3	0	0	6.5	0	0
	Other Species (149)	1316.3	172.7	238.8	155.8	193.2	193.7	109.0	83.0	44.6	93.8
	Total	11 524.8	1374.9	1818.7	1831.5	1661.8	1333.9	965.8	757.8	481.6	1200.2

"Columns may not add up to totals as a result of rounding numbers.

Table 22-Volume of growing stock on timberland by species and diameter class, Puerto Rico, 1990[a]

Species code	Species name	All classes	Diameter class (centimeters) 15	20	25	30	35	40	45	50	55+
		Thousand cubic meters									
234	*Spathodea campanulata* Beauv.	964.6	91.2	147.2	180.0	131.5	118.4	49.0	41.6	58.2	134.9
109	*Guarea* ***guidonia*** (L.) Sleumer	762.9	88.3	115.1	98.0	113.0	114.0	31.1	59.1	57.4	86.9
20	***Cecropia*** *peltata* L.	137.3	27.4	83.7	127.1	102.2	134.3	72.2	74.2	52.7	63.5
64	*Inga vera* Willd.	546.7	100.1	102.4	88.2	72.1	62.0	61.5	12.4	22.0	26.0
236	***Tabebuia*** *heterophylla* (DC.) Britton	342.4	100.3	60.9	81.3	24.4	49.5	11.7	0	6.9	7.4
84	*Erythrina* ***poeppigiana*** (Walp.) 0. F. Cook	328.2	0	5.2	22.2	5.9	53.2	14.0	22.9	22.8	170.4
201	***Didymopanax*** *morototoni* (Aubl.) Decne. & Planch	289.1	26.9	39.6	17.1	62.8	18.8	16.0	16.8	8.0	23.2
62	*Inga fagifolia* (L.)	276.3	40.9	46.5	32.6	91.5	19.9	37.2	5.6	0	2.0
81	*Andira inermis* (W. Wright) H.B.K.	272.7	68.0	35.5	83.7	46.2	10.3	0	29.0	0	0
161	*Calophyllum brasiliense* Camb.	175.3	5.9	0	9.8	45.2	11.6	36.9	24.3	22.6	18.9
118	***Alchomea*** *latifolia* ***Sw.***	126.8	21.8	45.0	19.7	21.2	0	0	0	0	19.1
106	*Dacryodes excelsea* Vahl	108.0	0	19.4	0	37.7	12.4	27.5	0	11.0	0
188	***Eugenia*** *jambos* L.	100.8	19.8	46.1	17.4	6.7	0	0	10.7	0	0
76	***Hymenaea*** *courbaril* L.	97.8	6.8	0	20.2	30.3	21.6	15.2	0	3.6	0
48	*Ocotea leucoxylon* ***(Sw.)*** Mez	97.4	16.0	26.7	54.6	0	0	0	0	0	0
334	*Nectandra sintenisii* Mez (E)	89.8	12.6	7.0	11.6	5.2	6.4	5.4	0	0	41.5
224	***Cordia*** *sulcata* DC.	84.1	9.6	16.5	30.8	14.0	13.2	0	0	0	0
134	***Spondias*** *mombin* L.	83.3	0	0	9.0	16.8	0	11.9	5.9	0	39.7
592	***Clidemia*** *umbrosa* ***(Sw.)*** Cogn.	81.2	8.6	6.3	21.5	0	26.3	18.5	0	0	0
102	*Zanthoxylum martinicense* (Lam.) DC.	78.9	2.8	6.4	3.1	34.6	13.5	7.3	11.0	0	0
184	*Terminalia catappa* L.	77.3	0	7.9	5.9	0	6.8	26.1	30.8	0	0
17	*Artocarpus altilis* (Parkinson) Fosberg	75.0	8.3	10.0	0	4.2	17.2	14.7	0	6.6	14.0
22	*Ficus laevigata* Vahl	74.4	0	20.1	0	6.2	0	11.8	18.9	0	17.4
228	*Petitia domingensis* Jacq.	72.1	20.8	0	0	48.9	3.1	0	0	0	0
163	*Clusia rosea* Jacq.	69.6	0	18.8	41.7	0	9.0	0	0	0	0
180	*Buchenavia capitata* (Vahl) Eichl.	67.3	0	8.5	5.1	10.4	0	26.9	16.3	0	0
221	***Cordia*** *alliodora* (Ruiz & Pav.) Oken	65.4	3.5	18.1	15.7	10.2	5.4	12.5	0	0	0
138	*Cupania* ***americana*** L.	63.7	16.0	15.1	18.5	9.6	0	4.5	0	0	0
208	*Dipholis salicifolia* (L.) A. DC.	63.4	23.9	39.5	0	0	0	0	0	0	0
87	*Ormosia krugii* Urban	61.9	14.7	21.6	25.5	0	0	0	0	0	0
149	*Sloanea* ***berteriana*** Choisy	58.8	7.6	27.9	0	10.1	0	13.3	0	0	0
213	*Pouteria multiflora* (A.DC.) Eyma	58.4	0	0	0	4.7	0	17.9	5.2	0	16.7
151	***Montezuma*** *speciossima* Sessé & Moc.	58.0	0	0	40.0	0	9.1	0	8.8	0	0
115	*Byrsonima* ***coriacea*** (Sw.) ***DC.***	55.0	0	7.1	9.3	0	0	22.4	16.2	0	0
86	*Lonchocarpus latifolius* (Willd.) H.B.K.	49.1	0	0	7.2	6.9	26.4	9.1	0	0	0
61	***Albizia*** *procera* (Roxb.) Benth.	46.9	3.7	22.6	0	20.6	0	0	0	0	0
108	*Cedrela odorata* L.	46.3	0	18.9	0	0	0	12.5	4.9	0	10.1
200	*Dendropanax arboreus* (L.) Decne. & Planch.	43.8	4.9	7.8	5.1	6.6	9.0	0	4.2	3.6	2.6
211	*Micropholis chrysophylloides* Pierre	40.4	6.8	18.6	0	14.9	0	0	0	0	0
131	***Mangifera*** *indica* L.	37.1	5.0	0	4.1	0	4.6	0	0	4.1	18.6
192	*Myrcia deflexa* (Poir.) DC.	35.9	0	0	0	14.8	0	0	0	21.1	0
212	***Micropholis*** *garcinaefolia* Pierre	32.5	0	0	6.2	0	15.7	10.6	0	0	0
19	*Castilla elastica* Cervantes	31.0	0	4.2	13.9	12.9	0	0	0	0	0
133	***Spondias*** *dulcis* Parkinson	28.9	0	0	0	0	19.2	0	0	9.1	0
170	*Casearia decandra* Jacq.	28.3	9.3	15.2	0	0	0	0	0	0	3.8
169	*Casearia arborea* (L. C. Rich) Urban	26.6	14.1	12.5	0	0	0	0	0	0	0
721	*Coffea dewevrei* Wildem. & T. Dur.	26.4	16.0	0	10.4	0	0	0	0	0	0
100	Cirrus *sinensis* Osbeck	25.7	12.5	5.1	8.1	0	0	0	0	0	0
	Other species	504.3	83.6	88.7	100.0	99.4	39.7	21.9	21.1	10.3	39.8
	Total	7636.9	939.5	1200.7	1311.9	1141.7	862.9	619.6	439.9	320.6	761.3

"Columns may not add up to totals as a result of rounding numbers.

Table 23-Volume of sawtimber on timberland by species and diameter class, Puerto Rico, 1990”

Species code	Species name	All classes	Diameter class (centimeters) 1 30	35	40	45	50	55+
				Thousand cubic meters				
234	*Spathodea campanulata* Beauv.	399.5	87.5	82.7	35.3	31.6	43.6	106.7
20	*Cecropia peltata* L.	349.4	60.6	91.9	48.7	59.5	34.0	54.7
109	*Guarea guidonia* (L.) Sleumer	272.7	54.4	58.7	17.6	38.6	37.5	65.9
84	*Erythrina poeppigiana* (Walp.) 0. F. Cook	243.3	3.2	33.7	11.2	17.5	19.1	148.2
64	*Inga vera* Willd.	140.5	33.0	33.8	30.0	7.3	14.2	22.2
62	*Inga fagifolia* (L.)	93.6	49.8	13.4	24.6	4.5	0	1.3
201	*Didymopanax morototoni* (Aubl.) Decne & Planch.	89.7	39.3	9.1	9.2	8.4	5.8	18.0
161	*Calophyllum brasiliense* Camb.	83.7	17.2	3.3	21.0	15.2	14.7	12.4
236	*Tabebuia heterophylla* (DC.) Britton	62.5	15.2	29.6	8.5	0	4.3	4.9
106	*Dacryodes excelsea* Vahl	56.2	20.2	9.6	20.0	0	6.4	0
81	*Andira inermis* (W. Wright) H.B.K.	54.5	28.8	4.9	0	20.8	0	0
184	*Terminalia catappa* L.	51.9	0	5.8	17.7	28.3	0	0
134	*Spondias mombin* L.	46.1	6.4	0	6.6	3.7	0	29.4
334	*Nectandra sintenisii* Mez (E)	43.8	3.0	4.8	2.1	0	0	33.8
76	*Hymenaea courbaril* L.	43.7	16.7	14.0	9.3	0	3.6	0
213	*Pouteria multiflora* (A. DC.) Eyma	41.5	2.3	0	9.9	2.8	0	14.6
17	*Artocarpus altilis* (Parkinson) Fosberg	39.4	1.7	10.8	10.3	0	5.5	11.1
180	*Buchenavia capitata* (Vahl) Eichl.	31.8	9.0	0	14.1	8.7	0	0
22	*Ficus laevigata* Vahl	30.4	1.9	0	4.6	11.9	0	12.1
592	*Clidemia umbrosa (Sw.)* Cogn.	27.6	0	15.4	12.2	0	0	0
115	*Byrsonima coriacea (Sw.)* DC.	27.1	0	0	15.8	11.3	0	0
102	*Zanthoxylum martinicense* (Lam.) DC.	27.0	14.2	6.1	2.0	4.7	0	0
228	*Petitia domingensis* Jacq.	22.3	20.6	1.7	0	0	0	0
86	*Lonchocarpus latifolius* (Willd.) H.B.K.	20.0	5.2	11.0	3.8	0	0	0
118	*Alchornea latifolia Sw.*	19.9	9.0	0	0	0	0	10.9
131	*Mangifera indica* L.	18.1	0	1.3	0	0	2.3	14.6
221	*Cordia alliodora* (Ruiz & Pav.) Oken	17.8	5.6	3.1	9.1	0	0	0
108	*Cedrela odorata* L.	17.4	0	0	7.2	3.6	0	6.6
192	*Myrcia deflexa* (Poir.) DC.	17.0	6. I	0	0	0	10.9	0
63	*Inga quaternata* Poepp. & Endl.	15.6	0	0	0	0	0	15.6
224	*Cordia sulcata* DC.	15.1	6.7	8.4	0	0	0	0
260	*Pinus caribaea* Morelet	13.1	0	0	7.5	0	0	0
133	*Spondias dulcis* Parkinson	12.9	0	7.6	0	0	5.3	0
212	*Micropholis garciniaefolia* Pierre	12.6	0	8.1	4.6	0	0	0
19	*Castilla elastica* Cervantes	12.5	12.5	0	0	0	0	0
149	*Sloanea berteriana* Choisy	11.7	5.0	0	6.7	0	0	0
188	*Eugenia jambos* L.	11.5	4.9	0	0	6.5	0	0
209	*Manilkara bidentata* (A. DC.) Chev.	11.4	7.8	3.5	0	0	0	0
200	*Dendropanax arboreus* (L.) Decne. & Planch.	II.3	1.9	3.4	0	2.1	2.0	2.0
340	*Phoebe elongata* (Vahl) Nees	10.4	0	1.8	0	0	0	2.6
144	*Meliosma herbertii* Rolfe	10.3	10.3	0	0	0	0	0
151	*Montezuma speciossima* Sessé & Moc.	10.2	0	2.1	0	8.2	0	0
164	*Mammea americana* L.	9.5	0	0	3.4	0	0	6.2

Table 23-Volume of sawtimber on timberland by species and diameter class, Puerto Rico, 1990" (continued)

Species code	Species name	All classes	Diameter class (centimeters) 30	35	40	45	50	55+
				Thousand cubic meters				
330	*Nectandra antillana* Meisn.	9.2	3.2	0	0	0	6.0	0
211	*Micropholis chrysophylloides* Pierre	7.9	7.9	0	0	0	0	0
999	Unidentified species	7.2	4.1	0	0	3.1	0	0
203	*Rapanea ferruginea* (Ruiz & Pav.) Mez	6.9	0	6.9	0	0	0	0
34	*Magnolia portoricensis* Bello	6.8	0	6.8	0	0	0	0
61	*Albizia procera* (Roxb.) Benth.	5.5	5.5	0	0	0	0	0
155	*Quararibæa turbinata (Sw.)* Poir.	5.2	0	0	0	5.2	0	0
163	*Clusia rosea* Jacq.	5.1	0	5.1	0	0	0	0
138	*Cupania americana* L.	4.4	2.5	0	2.0	0	0	0
230	*Vitex divaricata Sw.*	4.0	0	2.5	1.5	0	0	0
51	*Persea americana* Mill.	3.9	3.9	0	0	0	0	0
107	*Tetragastris balsamifera (Sw.)* Kuntze	3.9	0	0	0	0	0	3.9
227	*Citharexylum fruticosum* L.	3.5	3.5	0	0	0	0	0
125	*Hura crepitans* L.	3.4	1.9	0	0	0	0	1.5
105	*Bursera imaruba* (L.) Sarg.	3.2	3.2	0	0	0	0	0
187	*Eugenia aeruginea* DC.	2.7	0	0	0	2.7	0	0
154	*Ochroma pyramidale* (Cav.) Urban	2.3	2.3	0	0	0	0	0
170	*Casearia decandra* Jacq.	1.6	0	0	0	0	0	1.6
137	*Turpinia paniculata* Vent.	1.5	0	0	1.5	0	0	0
612	*Miconia subcorymbosa* Britton	1.2	0	0	0	0	0	1.2
74	*Cassia siamea* Lam.	.9	0	.9	0	0	0	0
554	*Calyptranthes pallens* Griseb.	.4	0	0	0	0	0	.4
	Total	2647.2	598.0	507.8	378.0	306.2	215.2	602.4

"Columns may not add up to totals as a result of rounding numbers

Table 24—Volume of sawtimber on timberland by species and butt log grade, Puerto Rico, 1990"

Species code	Species name	All classes	Butt log grade* 1	2	3	Volume in ungraded portion
		Thousand cubic meters				
234	*Spathodea campanulata* Beauv.	399.5	9.3	154.6	191.0	44.2
20	*Cecropia peltata* L.	349.4	50.3	165.1	114.1	19.9
109	*Guarea guidonia* (L.) Sleumer	212.1	6.8	52.7	96.5	116.7
84	*Erythrina poeppigiana* (Walp.) 0. F. Cook	243.3	13.7	90.4	58.8	20.4
64	*Inga vera* Willd.	140.5	7.8	32.7	11.2	22.8
62	*Inga fagifolia* (L.) Willd.	93.6	5.2	33.1	50.8	4.5
201	*Didymopanax morototoni* (Aubl.) Decne. & Planch.	89.7	16.4	25.0	48.3	0
161	*Calophyllum brasiliense* Camb.	83.7	0	16.7	62.1	4.9
236	*Tabebuia heterophylla* (DC.) Britton	62.5	0	5.9	36.3	20.3
106	*Dacryodes excelsea* Vahl	56.2	0	28.2	28.0	0
81	*Andira inermis* (W. Wright) H.B.K.	54.5	0	18.4	33.8	2.3
184	*Terminalia catappa* L.	51.9	0	11.3	26.4	14.2
134	*Spondias mombin* L.	46.1	7.9	25.3	12.8	0
334	*Nectandra sintenisii* Mez (E)	43.8	0	30.5	3.0	10.3
	Other species	659.8	8.9	238.8	289.1	123.0
	Total	2641.2	186.3	928.7	1128.2	404.0

"Columns may not add up to totals as a result of rounding numbers.
*Graded by hardwood log grade standards used in the Southern United States.

Table 25—Volume of timber, growing stock, and sawtimber on timberland by stand-size class, Puerto Rico, 1990

Stand-size class	Volume of timber	Volume of growing stock	Volume of sawtimber
	Thousand cubic meters		
Sawtimber	1031.2	4615.1	2060.9
Poletimber	4 244.5	2928.0	572.2
Sapling-seedling	248.9	93.8	14.3
Total	11 524.6	7636.9	2647.4

Table 26—Volume of timber on timberland by Life Zone, soil group, and slope class, Puerto Rico, 1990

Life Zone and soil group	All groups	Percent slope class			
		0 to 10	11 to25	26 to 45	> 45
		Thousand cubic meters			
Subtropical Moist Forest					
Deep volcanic soils	1 377.8	287.1	174.4	487.8	428.5
Shallow volcanic soils	1 178.0	134.5	315.0	361.6	366.8
Granitic soils	977.0	0	144.3	210.4	642.2
Limestone soils	953.1	123.0	163.3	156.4	5 10.5
Total	4 505.9	544.6	797.0	1216.2	1948.0
Subtropical Wet Forest					
Deep volcanic soils	4 787.8	282.6	787.1	1435.0	2283.1
Shallow volcanic soils	596.0	0	88.0	141.8	366.2
Granitic soils	1 493.5	0	224.2	309.4	959.9
Limestone soils	141.5	0	42.9	98.6	0
Total	7 018.8	282.6	1142.2	1984.8	3609.2
Total, all Life Zones	11 524.7	827.2	1939.2	3201 .0	5557.2

Franco, Peter A.; Weaver, Peter L.; Eggen-McIntosh, Susan. 1997. Forest resources of Puerto Rico, 1990. Resour. Bull. SRS-22. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 4.5 p.

The principal findings of the second forest survey of Puerto Rico (1990) and changes that have occurred since the survey was established in 1980 are presented. The forest inventory estimates describe the timber resource found within the potential commercial region designated in the first survey. The timber resource addressed consists primarily of regrown areas on abandoned pastures and cropland, including coffee production areas. The status and trends of the timber resource are presented for the two Life Zones occurring in the commercial region, as well as for various forest classes, which are based on stand history and origin. Topics discussed include forest area, timberland area, basal area, species composition, timber volume, growing-stock volume, and sawtimber volume. Results of the 1990 survey are promising, showing increases in numbers of trees across all diameter classes and substantial increases in volume. These trends offer evidence that Puerto Rico's forests are continuing to recover following a dramatic decline of the late 19th and early 20th centuries.

Keywords: Coffee shade forests, forest area, forest inventory, secondary forests, timber volume, tropical forest management.

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