


AMERICAN TROPICAL FORESTS
OF THE CARIBBEAN
COUNTRIES
by
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Introduction

The tropical forests with nearly one half of the total forest area of the world cannot be considered as not being an important and vital factor to civilization and the economic life of the large industrial nations of the temperate zone. With the rapid depletion of the domestic timber supply of the nations consuming large amounts of wood products, by exploitation, fire, disease, and insects; this almost untouched timber supply of unknown quantity and composition in the tropics will become more and more important. The forests of the Caribbean states, being in a close transportation radius of the United States, and with friendly diplomatic relations, are worthy of much consideration by all people in the United States; especially those in the forestry profession.

The purpose of this paper is to condense and assemble much of the available material on the forests of the Caribbean region for education on this extensive and almost virgin natural resource lying at our Southern gateway and within protection of our fleet for commercial freedom. The intention is to stimulate a wider interest in, and a broader understanding of the forest types, problems, and the magnitude of available tropical forests to the United States. No detailed description of woods or identification material will be presented, as there are many excellent references available, and such material would largely be repetition.

The area covered by the Caribbean region refers mainly to those countries either islands within or continental land bordering the Caribbean Sea. The general outline lies principally between the equator and 20° north latitude; and roughly between 65° and 95° longitude west from the Greenwich line. The islands of the West Indies, Central American countries, and a belt along the Northern coastline of South American countries are included. The main countries involved are:

- Puerto Rico (Porto Rico)
- Haiti
- Santo Domingo
- Cuba
- Jamaica
- Guatemala
- Honduras
- San Salvador
- Nicaragua
- Costa Rica
- Panama
- Southern Mexico
- Northern Colombia and Venezuela
- Minor Islands

Because of the similarity in the forests of these countries, they will be treated mainly as a group with special cases and types being referred to where there is a justification.

Of the total forest area of about 231,241,500 acres, much of it lies in the states of Venezuela and Colombia with an included forested area of approximately 100,000,000 acres. The portion of Mexico included, Honduras, Nicaragua, and Guatemala have a forest area of 120,000,000 acres. All other states mentioned contain approximately 10,000,000 acres (see Table I). (7) Most of the forested regions are of rather even topography, much of it being close to sea level, although some peaks in Venezuela and Colombia reach a height of 20,000 feet. Accessibility of the forests is seriously hampered by the almost universal swamps and jungle like character of the vegetation.(1) It is usually considered that only slightly over one-fifth to one-fourth of the area is commercially accessible for timber operations.(2)

Tropical soils have been classified by geologists according to their minerological origin into three broad classes, namely: clayey, limey, and sandy soils. Clayey soils are very rich in available mineral constituents, will absorb immense quantities of water, but are generally poorly aeriated. They must contain at least 50 per cent clay to be classified as clayey soils. Limey soils must contain 10% lime which nearly always occurs in some form of a carbonate; they are usually shallow with a good open texture, and very fertile. These limey soils are well adapted to agricultural crops if sufficient moisture is received and they are deep enough to be successfully cul-

TABLE I
Forest Areas
of the
Caribbean Region

Country	Acres in Forest	% of area forested
British Honduras	3,825,000	75.0
Costa Rica	9,000,000	75.2
Guatemala	20,000,000	65.0
Honduras	23,700,000	80.0
Nicaragua	22,400,000	70.7
Panama	12,400,000	60.0
Salvador	925,000	17.8
Mexico (portion)	10,000,000	25.0
Cuba	13,000,000	46.0
Haiti	4,250,000	60.0
Puerto Rico	441,500	20.1
Santo Domingo	9,500,000	77.0
Venezuela and Colombia (portion)	100,000,000	----
Other Islands	<u>1,800,000</u>	20.0 (ave.)

Total Forest Area-231,241,500 acres

(Condensed from reference No. 7)

tivated. Soils consisting of 75 per cent silica in the form of disintegrated sand are classed as sandy. They are the fertile soils of the tropics and give up and absorb water and heat rapidly. Much shifting and blowing make these sandy soils a serious problem in some sections.(3)

The forests of these tropical countries previous to the invasion of fire and agriculture were very dense and much more extensive than at the present time. The two following quotations adequately describe primitive forest conditions:

Robert Davie, a member of Captain Amais Preston's crew of 1595, wrote the following on the "Yland of Dominica":

"This is a goodly land and sometime high land, but al overgrown with woods so thick that no man could pass for his life."(1)

From Captain Nathaniel Uring, deputy governor of St. Lucia island in about 1695, we get the following:

"It is full of trees, among which are great quantities of good timber, fit for building houses and windmills."(1)

With this almost unbelievable dense forest as a challenge, the invasion of white men follows somewhat on the lines of other countries now exploited and populated. Transient agriculturists cleared land here and there in more accessible areas that did not have soil capable of supporting agricultural crops for more than two or three years. Much timber was felled and burned, the land was used by these farmers for a few years and then was aban-

done and another piece of likely ground would be cleared with more waste and destruction. This clearing for migratory agriculture has wasted more timber in the tropics than any other agency.(1)

Fire has regularly caused destruction to many thousands of acres. During the drought season in the dry forest type (discussed later in this paper), a traveler or casual observer might easily believe that the entire country side was on fire or would soon be completely burned due to the great number and size of the fires. The highly selective system of cutting practiced for mahogany, Spanish cedar, and rosewood has much reduced the value of many stands. The cutting has been so close for these valuable species that no reserve is left for future stands, and therefore the forest is composed only of trees that at the present time are unimportant commercially.(1)

Because of the ease of transportation along streams, the more clearing for agriculture in alluvial sites, and the need for lumber in semi-settled communities, these areas were becoming rapidly denuded. Some of the early officials of Santo Domingo foresaw the damage to watersheds and reserve water supply that these unwise cutting practices were causing and enacted laws in 1874 prohibiting destruction of trees near springs and at the head of streams. These early laws were not enforced to any degree due to the lack of technical administrators and

governmental funds and power. In many of these Caribbean countries in early times and even at the present, "paper forestry laws" may be found. They exist only in statute books and follow the general principle of cut-a-tree-plant-a-tree; e. g., plant 2 to 5 mahogany, Spanish cedar, and rosewood for every tree of one of these species cut in Cuba.(1)

Composition of the Forests

The tropical forests are made up of both conifers and hardwoods contrary to the common belief that they are nearly all hardwood stands. These two major classes are represented by area as follows in the Caribbean countries:

Coniferous types-- 28,000,000 acres

Hardwood types-- 203,241,500 acres

Coniferous Forests:

Mexico, Honduras, Nicaragua, Guatemala, Santo Domingo, and Costa Rica are the only countries that are represented by more than one million acres of coniferous forests. Honduras being the only country with a percentage of more than one-half its forest area being coniferous.(7) (See Table II)

The coniferous species present are:

Pinus caribaea
" *occidentalis*
" *montezuma*

Juniperus spp.

Abies spp.

It is rare cases that all of these species are found in the same stand, as a rule they occur in mixture with other broadleaf shrubs and tropical trees. Other species of pine than those listed occur in Mexico and to a limited extent in Central American countries but are very much scattered.

In Honduras, Guatemala, Nicaragua, and Costa Rica, the pine stands are found on coarse grit and quartz sands on inland coastal plains to a large extent.(4) High inaccessible areas on sites too infertile and dry to support hardwoods are generally forested with conifers throughout the Caribbean region.(1) The usual associated species with the pine are:

Quercus spp.

Yaha*

Craboo

Calabash and Palmetto on moist inland sandy sites

Coniferous forests of the tropics occupy those sites that for some reason will not support broadleaf species as is the case in the temperate zone. However on the extremely dry sites only species that have special adaptations for the conditions can exist and these species are not coniferous.(4)

Hardwood Forests:

The tropical hardwoods are very much more varied

*A complete list of common and technical names of species mentioned in this report may be found in the appendix.

TABLE II
Character of the Forests
Divisions of
Area

Country	% of area Coniferous	% of area Hardwoods
British Honduras	44.6	55.4
Costa Rica	15.0	85.0
Guatemala	10.0	90.0
Honduras	59.1	40.9
Nicaragua	27.5	72.5
Panama	----	100.0
Mexico (entire country) (Temperate hardwoods--33.7%)	47.2	19.1
Cuba	5.0	95.0
Haiti	4.7	95.3
Puerto Rico	----	100.0
Santo Domingo	14.2	85.8
Other Islands	----	100.0
Colombia & Venezuela	----	100.0

From reference No. 7

in composition and type than the coniferous forests and should be classified more specifically. The outline below illustrates a satisfactory division of types for discussion purposes:

Rain Forests

Swamp
Intermediate

Deciduous Forests

Dry Forests

There is a savannah type occurring between the swamp and intermediate sub-types but it is non-forested. Sedges and other Cyperaceous plants compose the major cover.

The rain forests are the most important in respect to area and economic value. In this type mahogany, Spanish cedar, satinwood, rosewood and most of the well known tropical hardwoods grow. These trees are evergreen and usually grow the year around, often making fifteen or twenty feet of height growth in a single year. The canopy is very dense and many storied allowing very little if any light to reach the wild tangle of underbrush and lianas that mat together between the densely spaced tree boles. The swamp area is characterized by white, black, and red mangrove which is about 12 feet high on the average. These swamp forests are called "Tidal Levee Forests" locally, and it is a term that well defines their location. The soil is deep and fertile, but the cover present is limited by the high salinity reaction. Brackish tidal lagoons, swamps, and slow moving streams make a net work

General Position of Types
In Relation to the
Coast Lines

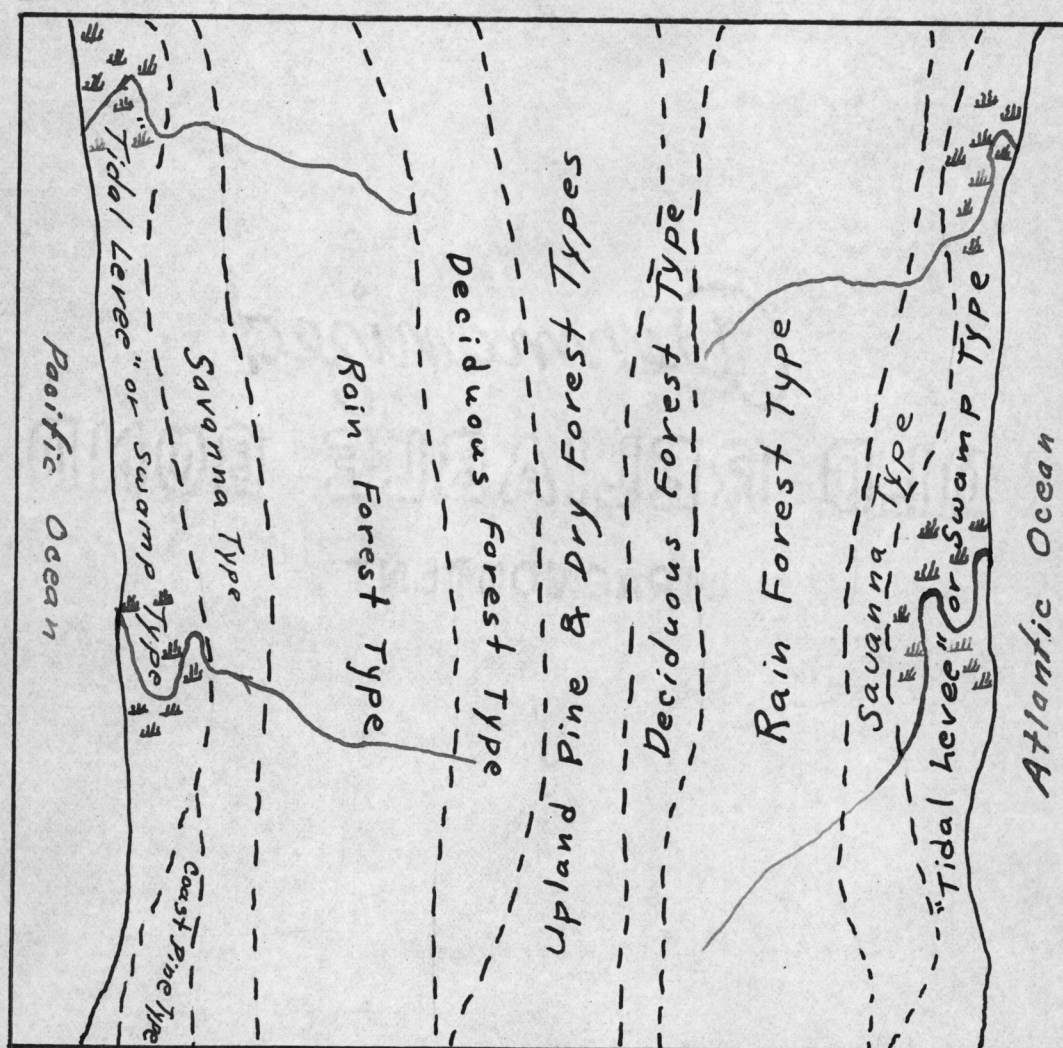


Figure 1

thru this type.

The intermediate type gets its name from the place it occupies in the forest canopy, a majority of them being somewhat in the under canopy rather than the dominant position at and near maturity. Mahogany, cypress, rosewood, Spanish cedar, pimento, and banak are the predominating species due to their high economic value rather than on the basis of the proportion of the canopy occupied. The soils of the type are the best forest soils of the tropics, being deep, high in organic matter, friable, and well aeriated. The extremely humid atmosphere and almost continual rains are a very important influencing factor on the productivity of these sites.

The deciduous hardwood forests occur in regions where there is a decided wet and dry season in contrast to the rain forests. The trees shed their leaves during the dry season thereby giving the name of the type. These forests of tropical America correspond to the "monsoon" forests of the East (India) which are widely known commercially for their economic importance. Many of the trees attain immense size and are known to commerce mainly by the following names: purpleheart, greenheart, wallabas, logwood, cocobolo, and quebracho (axe-breaker). The mahoganies, and Spanish cedar are found intermingled to a considerable extent.(1) The soils are fertile, friable, easily tilled, and excellent for agriculture; because of this man has destroyed much

timber in clearing in this type. Because of heavier populations due to agriculture and the dry season, fire takes a much heavier toll here than in the rain forests.

The dry forest type occurs in nearly all of the Caribbean countries in lee of mountains, and many other areas that for some climatic and meteorological reasons do not get much precipitation. The trees are smaller in stature, more branched, more gnarled, and not as vigorous as in the deciduous and rain forests. Botanists refer to this type as "thorn forests" and they are very well justified in doing so. As an adaptability for protection against biotic enemies, many of the species are literally a mass of thorns and are very well guarded to animals.(1) Excepting the giant ceiba, the outstanding exception, the species have a peculiar quality of being extremely hard and heavy. *Lignumvitae* is the only commercially recognized species on the foreign markets that occurs in this type. The soils are low in fertility, rocky, and are in very poor condition as a result of severe desiccation from the winds and tropical heat. The occasional rains are very heavy and because of the almost entire absence of ground cover, the soils are seriously pounded and eroded by each storm. Moisture is the limiting factor in this type rather than light as in other tropical hardwood types. The stands are usually open with few lower plants and shrubs filling out the cover. Adaptations to conserve moisture in

trees are very well exemplified in this type. Some trees remain leafless through the entire year excepting a very short period during the rain season when they bud out with leaves and flowers. Several species coat their leaves, twigs, branches, and bole with a wax to prevent evaporation into the very dry and hot atmosphere. Others extend their primary roots to almost unbelievable depths in search of an adequate water supply, similar to our indigenous mesquite in the United States.

Excluding Venezuela, Colombia, and Mexico which are not truly typical representatives of the other Caribbean states, the relative percentage of forest area occupied by each type is:

Pine	2%	
Rain Forests	45%	
Deciduous Forests	35%	
Dry Forests	18%	(includes some of the coniferous forests)
	<u>100%</u>	

Economic Aspects

Approximately fifty tropical species have entered successfully into foreign trade with varying amounts of trade volume. Probably twelve of these are widely recognized commercially, the remainder being used as substitutes for recognized woods under the same trade names but with lower value ratings. The more important species will be discussed individually and Table III will give a resume of the remainder.

Mahogany is probably the one tropical hardwood that is known to all classes of people and is known as the most important tropical wood of the world. In 1928, 63,325 M. bd. ft. were exported to the United States by Caribbean countries. It belongs to the family Meliaceae and the genus Swietenia. Several species grow in the tropics, the most important as to quantity produced is probably S. macrophylla. (4) The wood is reddish brown in color, highly figured, medium texture, and very durable. It occurs in commercial quantities in all countries of the region, with wood from Santo Domingo being considered the highest quality and wood from Cuba second.(1) Principle uses are furniture, cabinet work, etc., being used almost entirely in the form of very thin veneers.

Spanish cedar (*Cedrela mexicana*) also belongs to the Meliaceae family, but in contrast to mahogany has a soft, light in weight, aromatic, durable, medium textured, pinkish brown wood.(1) It ranks second to mahogany in the amount exported to the United States (6,964 M bd. ft. in 1928) and is classed as the most generally useful tree of the American tropics. Nicaragua leads at the present time in exports of Spanish Cedar, but it occurs in commercial amounts in the entire region. It should hold its place well because of its adaptability to reforestation. The principle use is for high grade cigar boxes, but has quite an amount of domestic use for furniture, general carpentry, interior trim, and to some extent construction.(4)

Damaged

OLD RELIABLE BOND

Lignumvitae (*Guaiacum officinale*) belongs to the family Zygophyllaceae. It has an extremely hard and heavy wood that is oily and waxy, fine textured, and of an oliveaceous color. It is found in the dry forest type wherever it occurs, in limited quantities.(1) Its properties make it adaptable for use on propeller shafts on ships as bearings, bearings in water turbines, saw guides in saw-mills, bowling balls, and numerous other specialty uses.(8)

Cocobolo (*Dalbergia* spp.) belongs to the Leguminosae family. It has a hard, heavy, variable red colored, very durable, fine textured wood. Its vernacular name is "nambar". Its main use is for handles in the cutlery industry, about three-fourths of the total production is utilized by that industry. Its rich color, durability, and hardness make it very desirable for this use. The remaining one-fourth is utilized for various decorative uses. It occurs in the least accessible interior uplands along the Pacific Coast side of Panama, Costa Rica, and Nicaragua. The sapwood is hewn off before the logs leave the woods in order to reduce the weight in transportation since only the heartwood is valuable, it is a great saving to remove the sapwood. The natives find that cutting the trees is very laborious, so they resort to burning down the trees. This is possible because of the high resinous content of the lower portion of these trees. There are many very difficult problems in getting cocobolo out to the coast, it is so heavy that it will not float down the numerous streams and therefore they must be

packed overland. It is very slow and usually very disgusting in results as well as expensive.(6)

Rosewood (*Dalbergia retusa*) belongs to the family of Leguminosae and resembles the cocobolo tree in most respects excepting that the wood is coarse grained instead of fine. The wood is purple to brown in color and hard. British Honduras is the major exporting state. Its principle uses are for musical instruments as the xylophone and marimba, and cabinet work.(1) (7)

Another species belonging to the Leguminosae family is logwood (*Haematoxylon campechianum*). It was the original dyewood taken from the Western Hemisphere, and the income derived from this was responsible in a large part for the establishment of Honduras and the Guianas. At the present time it is the only vegetable dye that has not entirely given over to anilin dyes, however it has suffered a heavy decrease in exports in recent years. The wood has a bright red color, a fine grain, and is very dense. It occurs mainly in the deciduous forests. The trees are cut into three foot lengths and floated to the coast.(4)

West Indian Boxwood (*Caesaria praecox*) belongs to the family Flacourtiaceae. It is found mainly in Cuba, Colombia, and Venezuela. The wood is extremely fine grained, hard, heavy, and of a pale yellow color. It is found in the dry and deciduous forests. It is used for scientific instruments, shuttlestock, and furniture

to a limited extent.(4) (1)

In the Rhizophoraceae family, there is Red mangrove (*Rhizophora mangle*), it is found in the swamp forest in all of the countries and to some extent in the high rain forests. It is used for tanin, charcoal, and domestically for ties, posts, and general construction.(4)

Balsa (*Ochroma limonensis*), belonging to the family Bombacaceae, is an extremely light, corky wood that is very low in durability, and has a coarse texture. Being very light it is well adapted to airplane building and due to its buoyance is used to quite an extent in life boat construction. The refrigerator industry consumes quite an amount of this wood for insulation.

In the Palmaceae family an economic species is the cohune palm (*Attalea Cohune*). It is used for paper in the domestic industry but is not exported.(5)

Greenheart (*Nectandra rodioei*) belonging to the Lauraceae family, and is found in rain forests of the Guianas and Eastern Venezuela. It is very abundant, and is valuable for dock construction, marine piling, and ship building as it is immune to the toredo. It is a very hard and heavy wood of an olive green color.(1)

Snakewood (*Piratinera guianensis*) also with principle stands in the rain forests of the Guianas belongs to the Moraceae family. It is very expensive and a scarce wood being used for canes, whipstocks, umbrella handles, etc. Its growth form of long and slender stems make it well

adapted to these uses.(5)

Cashew (*Anacardium occidentale*) furnishes the cashew nut of commerce. Similarly pimento (*Pimento officinalis*) provides allspice.(4)

The total value of exported Caribbean forest products in 1930 was close to 80,000 M bd. ft. A substantial amount of this came to the United States for the specialty uses.

At the present time it is not economically feasible to put very much money into tropical forests. Very few of the species have been recognized commercially and a very large investment would probably result in bankruptcy for a private operator, and a deficit followed by a revolution for governmental regimes.(8)

Foreign markets are good for the wood products exported at the present mainly because they are special use goods and do not compete seriously with domestic goods of the importing nations. To bring the tropical forests into mass lumber production would entail a market problem which would probably result in tariff barriers from countries with native wood supplies. However due to cheap labor, etc. the development of large lumber plants in the Caribbean regions would put out lumber products at a lower price because of the lower costs of production. Competition to sell to countries importing large amounts of lumber would be keen and prices would ultimately be lowered on the average in the world market.

TABLE III
Minor Economic Species

Technical Name	Common Name	Use
<i>Acacia glomerosa</i>	White tamarind	Furniture
<i>Achra zapota</i>	Sapodilla	Chicle Gum Construction
<i>Anona glabra</i>	Bobwood	Bottle Stoppers
<i>Andira inermis</i>	Cabbage bark	Rolling Stock
<i>Aspidosperma meglacarpum</i>	My Lady	Ties, framing
<i>Astronium graveolens</i>	Palo Mulato	Furniture
<i>Belotia campbellii</i>	Moho	Box shooks drawers
<i>Bixa orellana</i>	Atta	Foodstuff dye
<i>Calphyllum brasiliensis</i>	Santa Maria	Gen. construction
<i>Castilla elastica</i>	Wild Rubber	Rubber substitute
<i>Chlorophora tinctoria</i>	Fustic	Dyewood
<i>Cordia alliodora</i>	Salmwood	Furniture
<i>Cordia dodecandra</i>	Siricote	Furniture
<i>Drypetes Brownii</i>	Bull hoof	Flooring
<i>Enterolobium cyclocarpum</i>	Tubroos	Veneers
<i>Lonchocarpus castilloi</i>	Black cabbage bark	Auto spokes
<i>Metropium brownei</i>	Black poison wood	Counter tops
<i>Nectandra</i> spp.	Laurel	Furniture
<i>Pinus caribaea</i>	Pine	Turpentine
<i>Pithecolobium arboreum</i>	Black tamarind	Furniture
<i>Podocarpus guatemalensis</i>	Cypress	Cheap furniture
<i>Pseudoemedia</i> spp.	Cherry	Carpentry
<i>Schizolobium parachybum</i>	Quamwood	Paper pulp
<i>Seetia panamensis</i>	Billy Webb	Coach building
<i>Symphoria globulifera</i>	Waika Chewstick	Vat timbers
<i>Tabeluia pentophylla</i>	Mayflower	Cabinet work
<i>Terminalia hayesii</i>	Nargusta	Veneer
<i>Virola merendonis</i>	Banak	Cedar uses
<i>Vochysia hondurensis</i>	Yemeri	Furniture
<i>Zanthoxylon kellermanii</i>	Prickly yellow	Carpentry

(Reference No. 4)

Silvicultural Aspects

Silvicultural systems should be recognized in the Caribbean region in the near future if, as expected, an increase in exploitation will come in a few years. At the present time the annual growth exceeds or equals the annual cut in all the countries except Puerto Rico, Cuba, Jamaica, Mexico, and Guatemala.(7) It would appear, after casual observation, that under such condition there is no cause to become alarmed concerning the tropical American forests, but this growth has been calculated on the basis of all species rather than on the basis of those economically valuable and being cut in large quantities. Conditions are actually serious. A highly intensified economic selection system of cutting mahogany, cocobolo, Spanish cedar, rosewood, etc. has resulted in a high grading of the forests to a place where these above listed valuable species are almost extinct in any region that is at all accessible. Until sufficient timber shortage is felt to force the markets to accept certain abundant tropical hardwoods in place of the accustomed temperate species, some provisions for the maintenance and improvement of stands of the now commercially recognized species must be made.

Most of the countries have from time to time passed forest conservation laws as the need for such action was recognized. But as mentioned before they exist only in the statute books because of the lack of trained adminis-

trators, funds, and political pressures. In British Honduras, British Guiana and islands controlled by the British Empire, rather satisfactory forestry departments are organized along British forestry lines. Puerto Rico is the only country with its forest problems being handled by the United States Forest Service. Nicaragua has a rapidly improving forestry set up, whose personnel are United States trained and naturally are putting American forestry into practice.

The status of forest land ownership, excepting Cuba, Puerto Rico, Salvador, and Honduras, is mostly publicly owned and controlled. This is a distinct advantage in one sense of the word in getting unified forest practices initiated and into actual practice. While not having very many private owners to deal with, the character of most Central American and Insular governments offers the foresters a very serious barrier. The predominance of revolutions, and changing of governments every few years, months, or even weeks brings out changing policies with new leaders. This makes a hard job for the forester for he must be continually campaigning with new regimes to get recognition and authorizations for a forest program.

Cutting practices are varied with little if any basic science or uniformity. Where economic species are in pure stands, almost complete denudation results from clear cutting, and in other places a widely selective cutting is made leaving a good forest canopy but seriously

lowered in value by the removal of good species. Logging is by hand (e. g., cocobolo packed out in small pieces), by oxen, by small hand pushed rail carts, and by driving down the streams in cases where the wood is light enough to float. In few if any cases are heavy, destructive logging machinery used. Labor is cheap and unskilled, doing the work in a way to expend the smallest amount of energy possible, illustrated by the way the extremely hard quebracho and cocobolo trees are burned down.

Growth is exceptionally rapid on desirable sites for most of the tropical species, therefore making it possible to have investments in forest areas and get a reasonably rapid turnover from capital invested. Logwood, extensively used commercially can be successfully logged on a 15 year rotation, and this species is no outstanding example but rather a good representative species. At the present time there are rather extensive areas of second growth polak, and Spanish cedar in the rain forest type reclaiming areas that have been cleared either for agriculture or by fires in the past. The big problem in all tropical forests is to get back a stand of the commercially valuable species in the accessible regions.

Enemies of the forests are many, and can well be classified under the following heads: diseases, insects, animals, and climbing plants (lianas). Under diseases, the outstanding destroyers are the root-fungi group: Fomes pappianus attacking the acacias, is the most destructive. Wood rots, twig diseases, cankers, and leaf

diseases all take a heavy toll in the tropical forests. Genera in the orders Lepidoptera, Coleoptera, and Orthoptera cause the majority of insect losses. A few species in the two orders Neuroptera and Hemiptera cause considerable damage.

Rodents may easily be classed as the most destructive enemies of tropical forests excepting man and fire. Rats, which are usually present in plague numbers, cause the most serious damage, often eating the bark off of all young trees for four or five inches above the ground over large acreages. Deer and domestic animals that feed on browse do much damage by excessive defoliation of palatable species in the younger age groups. Wild pigs destroy many seedlings entirely by rooting them out and harm the roots of older trees sufficiently to cause them to either die or stagnate in growth. However by rooting these wild pigs also help by preparing seed beds. Lianas are destructive by entwining trees together and causing several trees to fall when an old, dead, mature one falls. Often times the trunks are so tightly entwined that food and water movements up and down the trunk are stopped. These vines also give competition for light which is the limiting factor on density in the rain forests.(3)

Very little has been done to control insect, disease, or animal damage largely due to the lack of information and funds. A few advancements have been made within the last decade along experimental lines and there are a few

cases of practical application at the present time. Most of these applications of protective measures deal with limiting domestic livestock grazing. Fire protection has been started in Guatemala, Nicaragua, British Honduras, The Guianas, Colombia, Venezuela, Salvador, Panama, Cuba (to a limited extent), and Puerto Rico. Fire laws provide for penalties both for accidental and intentional starting of fires in the majority of the listed countries. The practice of burning down trees is unlawful in a few countries. Funds for protection are obtained by revenue from selling public timbers or by export taxes on wood products, which averages from one to four dollars per thousand board feet in the countries using this system.

Salavador has probably the most effective forest laws of the entirely independent countries. One of the most efficient systems is the requirement that all land owners with an ownership of forty-five hectares (111 acres) or more must establish and successfully maintain woodlots of reasonable size providing the soils will produce trees. Another reasonably successful law in the "Arbor Day", which require all adults to plant at least one tree of value a year and to care for it throughout the first few years to be certain that the tree or trees become established. Guatemala has made it unlawful to cut trees and not remove them from the forest or otherwise utilize them; the penalty being a tax on all logs left in the woods at the

same rate as exported timbers.(10)

British Honduras operates under the following forest policy:(4)

- "1. To improve the present condition of the forests and logging methods so that the cost of exploiting the forest will gradually become smaller and smaller to make competition in the world markets easier.
- "2. To concentrate gradually the growth of mahogany in favorably situated areas, to increase its stock and also the output.
- "3. To find a market for some of the useful secondary species.
- "4. To improve communications thru more systematic exploitation instead of the present hand to mouth system, which leaves no permanent mark of progress in this country."

Puerto Rico is probably the favored nation in consideration of funds available. An annual appropriation of thirty thousand dollars (\$30,000) is provided by the United States.(10) In 1937 \$13,887 of Clarke-McNary funds were granted to Puerto Rico for planting of deforested areas. Fire protection is carried on thru cooperation with the United States government.(9)

Conclusion

The future use of tropical hardwoods depends largely on the demand for additional timber supplies from the large wood consuming nations, attempts on the part of tropical countries to get recognition for the abundant secondary species, and the success of such research organizations working on tropical forestry as: The Tropical Plant Research Foundation, Yale School of Forestry, the Conservator of Forestry in England, and the

United States Forest Service. The outstanding limiting factors to the development of these forests are the lack of funds for research by the individual countries, and the lack of resourcefulness and aggressiveness of the people in most of the countries. Up to 1925 Cuba and Haiti regarded their forests with no concern as something to exploit and not to be troubled with in the sense of conservation for future use.

Nicaragua has little agricultural income or from industry to depend on for a national income. Income from its forests are recognized as being very important to the country, and will be increasingly so in the future. Panama with its strategic position in reference to the Panama canal has an outlet to both Atlantic and Pacific markets with an especially good potential market in Chile's mining industries. Forests are recognized as one of the most valuable resources in that country. Guatemala, Honduras, Costa Rica, San Salvador, and Santo Domingo are rapidly becoming aware that forest products are undoubtedly going to play an important part in their future foreign trade.

A final impression of these tropical forests is their future potential timber supply for the world powers, especially those of the Western Hemisphere. We in the United States have seen the lumber frontier move from one section of the country to another until it has spanned the continent, and a virgin timber supply in close

proximity has vital interest. Although substitutes and managed forests should adequately take care of our needs, an emergency available timber supply should be worthy of some consideration, and the only close supply to the United States and under protection of its fleet is the forests of the Caribbean countries.

Foresters are challenged by the expanse of forests under practically no management in this region to promote forestry to the various governments. All people in the United States and Canada should at least get a general idea of the vastness of these forests by some reading, and a reasonable amount of familiarity with the names of the now commercially important species and of some of the more outstanding secondary species. Where else besides the tropics can one find tracts of timber of unknown size and without true data on composition? Although exploited in a few areas, tropical forests may truly be considered the storehouse of the world's supply of wood products.

---APPENDIX---

Tropical Species

Common and Technical Names

Common Name	Technical Name
Acacia	Numerous genera and species
Acoma	Sideroxylon mastichodendron
Ahuachuate	Not classified
Agave	Several genera and species
Albarco	Cariniana pyriformis
Algarrobo	Prosopis juliflora
	Hymenaea courbaril
Almacigo	Bursera simoaruba
Angelino	Homalium spp.
Apamate	Tecoma pentaphylla
Atta	Bixa orellana
Bacu	Cariniana pyriformis
Balata	Mimusops globosa
Balso	Ochroma spp.
Balsamo	Myroxylon toluiferum
Banak	Viola merendonis
Barbasco	Ichthyomethis spp.
Bayahonda	Prosopis juliflora
Bitterwood	(a widely used name)
Black Mangrove	Avicennia nitida
Bobwood	Anona glabra
Bois blanc	Phyllostylon brasiliensis
Bois chene	Catalpa longissima
Bois de campeche	Haematoxylon campechianum
Boie de fer	Colubrina ferruginosa
	Sideroxylon spp.
	Genipa americana
Bois de lance	Oxandra lanceolata
Bois d'orme	Guazuma ulmifolia
Brazilwood	Caesalpinia echinata
Bulletwood	Mimusops globosa
Buttonwood	Conocarpus erecta
Black Cabbage Bark	Lonchocarpus castilloi
Black Poison Wood	Metropium brownei
Black Tamarind	Pithecolobium arboreum
Cabbage Bark	Andira inermis
Calabash	Crescentia cyjete
Cadelon	Rhizophora mangle
Caracaro	Enterodobium cyclocarpum
Carbonero	Capparis spp.
Casuarina	Several genera
Cashew	Anacardium occidentale
Cativo	Prioria copaifera
Cedro dulce	Cedrela spp.
Cedro espinoso	Bombacopsis fendleri

Table IV (con't.)

Common Name	Technical Name
Ceiba pentandra	Bombacopsis fendleri
Cherry	Pseudoemia spp.
Chestnut	Castanea spp.
Cocobolo	Dalbergia spp.
Cohune palm	Attalea cohune
Colombian mahogany	Cariniana pyriformis
Craboo	Byrsonima crassiflora
Crabwood	Carapa guianensis
Curarire	Tecoma spp.
Cypress	Podocarpus guatemalensis
Dagame	Calycophyllum candidissimum
Dividivi	Casalsalpinia coriaria
Ebano	Casalsalpinia granadillo
Espave	Anacardium rhinocarpus
Eucalyptus	Eucalyptus spp.
Eugenia	Eugenia spp.
Fig	Inga spp.
Fustic	Chlorophora tinctoria
Galba	Calophyllum calaba
Gateado	Sweitenia spp.
	Astronium graveolens
	Coccoloba uvifera
	Piratinera guianensis
Gommier	Bursera simaruba
Greenheart	Nectandra rodioei
Grenadillo	Caesalpinia granadillo
Guama	Angra
Guanacaste	Enterolobium cyclocarpum
Guayacan	Guaiacum officinale
Guayule	Vauquelinia corymbosa
Hog plum	Ximenia spp.
	Metopium spp.
	Spondias spp.
	(Variably applied locally)
Ironwood	Eperua jenmani
Ituri Wallaba	Hura crepitans
Jabillo	Lucuma spp.
Jacana	Spondias spp.
Jobo	Juniperus spp.
Juniper	Lecythis spp.
Kakaralli	Unclassified
Kakarwa	Myristica macrophylla
Kirikawa	Avicennia nitida
Kurida	Oxandra lanceolata
Lancewood	Piratinera guianensis
Letterwood	Guaiacum officinale
Lignumvitae	Liquidambar styraciflua
Liquidambar	Haematoxylon campechianum
Logwood	Sweitenia mahogani
Mahogany	" macrophylla

Table IV (con't.)

Common Name	Technical Name
Majagua	Heliocarpus spp.
	Hampea spp.
Mayflower	Tabeluia pentophylla
Manicole	Euterpe spp.
Manni	Symphonia globulifera
Maria	Calophyllum calaba
Mata palo	Ficus
Moho	Belotia campbellii
Mora	Dimorphandra mora
	Chlorophora tinctoria
Morabukea	Dimorphandra gonggrijpii
My Lady	Aspidosperma megalocarpan
Nargusta	Terminalia hayesii
Oak	Quercus spp.
Oyamel	Abies spp.
Palo Blanco	Several genera
Palo Verde	Gymnanthes lucida
Partridge Wood	Caesalpina granadillo
Pimento	Pimento officinalis
Pine	Pinus spp.
Pochote	Bombax spp.
	Ceiba pentandra
Possumwood	Hura repitans
Poui	Tecoma spp.
Prickly Yellow	Zanthoxylon kellermanii
Primavera	Tabebuia donnell-smithii
Purpleheart	Peltogyne spp.
Quamwood	Schizolobium parachybum
Quebracho blanco	Aspidosperma quebracho-blanco
Quebracho colorad	Schinopsis spp.
Red Mangrove	Rhizophora mangle
Redwood	(old name for mahogany)
Roble	(used for oak, catalpa, etc.)
Ronron	Astronium spp.
Rosewood	Dalbergia spp.
Salmwood	Cordia alliodora
Sabino	Magnolia splendens
Saman	Enterolobium saman
Santa Maria	Calophyllum calaba
Sapodilla	Achra zapota
Sapote	" "
Saqui-saqui	Bombacopsis spp.
Satinwood	Zanthoxylum flavum
Siricote	Drypetes brownii
Souari	Caryocar tomentosum
Spanish Cedar	Cedrela mexicana
Tabonuco	Dacryodes excelsa
Tea	Amyris balsamifera
Teak	(Several genera)

Table IV (con't.)

Common Name	Technical Name
Tempisque	<i>Sideroxylon mastichodendron</i>
Tolu	<i>Myroxylon toluiferum</i>
Tonka Bean	<i>Dipteryx odorata</i>
Trompillo	<i>Guarea</i> spp.
Tubroos	<i>Enterolobium cyclocarpum</i>
Ucar	<i>Terminalia buceras</i>
Venezuelan boxwood	<i>Casearia praecox</i>
Vera	<i>Bulnesia arborea</i>
Wallaba	<i>Eperua falcata</i>
Wild Rubber	<i>Castilla elastica</i>
West Indian Boxwood	<i>Caesaria praecox</i>
West Indian Locust	<i>Hymenaea courbaril</i>
White Mangrove	<i>Launcularia racemosa</i>
Waika Chewstick	<i>Symphoria globulifera</i>
Yaha	<i>Curatella americana</i>
Yemeri	<i>Vochysia hondurensis</i>
References used: (1) (4) (7)	

REFERENCES CITED

1. Gill, Tom
"Tropical Forests of the Caribbean"
Tropical Plant Research Foundation
1931
2. Haman and Wood
"The Forests of British Guiana"
Tropical Woods No. 15, Sept. 1, 1928
3. Broun, A. F.
"Silviculture in the Tropics"
MacMillan and Co. Limited
1914
4. Standley, P. C. & Record, S. J.
"The Forests and Flora of British Honduras"
Field Museum of Natural History, Publication #350
Botanical Series vol. 12
5. Record, S. J.
"Timbers of Tropical America"
Yale University Press
1924
6. Record, S. J. & Garratt, G. A.
"Cocobolo"
Yale University, School of Forestry
Bulletin #8 1923
7. Zon and Sparhawk
"Forest Resources of the World"
Volume I
McGraw Hill Book Co.
1923
8. Austin, O. P.
"Commercial Puerto Rico"
U. S. Bureau of Statistics
1907
9. "Lumber and Timber Information"
National Lumber Manufacturers Association
1938
10. Zon and Sparhawk
"Forest Resources of the World"
Volume II
McGraw Hill Book Co.
1923