The Status of
U.S. Virgin Islands'
Forests, 2004

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United States
Department of
Agriculture

Forest Service

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Front cover: top left, subtropical moist forest is the most developed and biologically diverse forest type in the U.S. Virgin Islands *(photo by Tom Brandeis)*; top right, Trunk Bay in the Virgin Islands National Park, St. John, U.S. Virgin Islands *(photo by Angie Rowe)*; bottom, Lignum-vitae *(Guajacum officinale L.)*, a highly valued native tree, has been greatly reduced throughout the U.S. Virgin Islands (photo by Tom Brandeis). Back cover: top left, former agricultural land on St. Croix reverts to forest in the absence of development *(photo by Tom Brandeis)*; top right, subtropical moist forest; bottom, the Caribbean Basin is one of the world's biodiversity hotspots *(photo by Tom Brandeis)*.

The flamboyant tree [*Delonix regia* (Bojer ex Hook.) Raf.] is a widely propagated introduced species in the U.S. Virgin Islands. *(photo by Tom Brandeis)*

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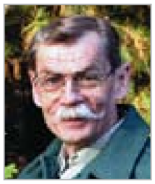
Healthy, well-developed forests protect both terrestrial and marine environments. (photo by Tom Brandeis)

Welcome...

Louis E. Petersen, Jr.

Ariel E. Lugo



Peter J. Roussopoulos

This Resource Bulletin contains the results of the first-ever forest inventory conducted by the USDA Forest Service for the United States Virgin Islands. The VI Department of Agriculture and its Forestry Division are looking forward to seeing the results of this forest inventory as we believe the information contained herein will be extremely useful to us as we plan forestry programs for the future. We are especially happy to note that this forest inventory is the result of on-the-ground work and includes the three major islands of St. Croix, St. John, and St. Thomas. We are also pleased to see that this forest inventory includes all types of forested lands in the Territory and provides a clear picture of the biodiversity of Virgin Islands forests.

As we enter a new era of rapid climatic change, resource inventories such as this one become increasingly important tools for informing policy and advancing understanding of how ecosystems and species adapt to changes in environmental conditions. This is particularly important in the Caribbean, where natural disasters such as hurricanes, droughts, and earthquakes interact with high population densities and intense human activities. Thus, the Caribbean provides an example on a small scale of how global climate change impacts both human populations and the ecosystems upon which they depend. We are lucky to have the information in this forest inventory as we plan for the future.

The VI Department of Agriculture is pleased to see this forest inventory, and we look forward to future collaborations with the Southern Research Station. The users of this Resource Bulletin will find in it the best information available on the current status of our Territorial forests. We trust users will be as pleased as we are to have this information available on our tropical forests.

Louis E. Petersen Jr.

Louis E. Petersen, Jr.
Commissioner of Agriculture,
The Virgin Islands of the
United States Department of Agriculture

Ariel E. Lugo

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Director, International Institute of
Tropical Forestry

Peter J. Roussopoulos

Peter J. Roussopoulos
Director, Southern Research Station

About Forest Inventory and Analysis Inventory Reports

The Southern Research Station's Forest Inventory and Analysis (FIA) Research Work Unit and cooperating State forestry agencies now conduct annual forest inventories of the 13 Southern States (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia), the Commonwealth of Puerto Rico, and the U.S. Virgin Islands.

The primary objective of these inventories is to develop the resource information needed to formulate sound forest policies and programs. This is done by gathering and analyzing data about forest resources including, but not limited to, forest area, forest ownership, forest type, stand structure, timber volume, growth, removals, and management activity. In addition, new assessments that address issues of ecosystem health have been added. These include information about ozone-induced injury, down woody material, soils, lichens, and tree crown condition. The information presented is applicable at the State and unit level; it furnishes the background for intensive studies of critical situations but is not designed to reflect conditions at very small scales.

More information is available in the publication "Forest Service Resource Inventories: An Overview" (U.S. Department of Agriculture Forest Service 1992). More detailed information about new sampling methodologies employed in annual FIA inventories can be found in the report "The Enhanced Forest Inventory and Analysis Program—National Sampling Design and Estimation Procedures" (Bechtold and Scott 2005).

Data tables included in FIA reports are designed to provide a comprehensive array of forest resource estimates, but additional data can be obtained for those who require more specialized information. FIA data for the majority of States in the United States can be accessed at http://www.ncrs2.fs.fed.us/4801/FIADB/index.htm.

Additional information about any aspect of this or other FIA surveys may be obtained from:

Forest Inventory and Analysis
  Research Work Unit
U.S. Department of Agriculture
  Forest Service
Southern Research Station
4700 Old Kingston Pike
Knoxville, TN 37919
Telephone: 865-862-2000
William G. Burkman
Program Manager

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The biologically diverse secondary forests of the U.S Virgin Islands are a mix of native and introduced species. *(photo by Tom Brandeis)*

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Construction on the islands, such as that seen here in the Salt River Bay, St. Croix, must be done carefully so that soil erosion that can damage marine ecosystems is controlled. *(photo by Tom Brandeis)*

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Gallery moist forests found along intermittent stream channels are some of the best developed forests in the U.S. Virgin Islands. *(photo by Tom Brandeis)*

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Forest Land and Its Change over Time

- Forest covers 21 237 ha of the U.S. Virgin Islands, 61 percent of the total land area. St. John had the highest percentage of forest land (92 percent), followed by St. Thomas (74 percent), and St. Croix (50 percent).

- There are 12 533 ha of forest in the subtropical dry forest life zone, which occurs at lower elevations. At higher elevations, there are 8704 ha of forest in the subtropical moist forest life zone.

- Forest land decreased 7 percent, or 1671 ha, from 1994 to 2004. Most notably, St. Croix lost 986 ha (11 percent) of subtropical dry forest and St. Thomas lost 307 ha (13 percent) of subtropical dry forest.

Forest Structure and Development

- The forest of the U.S. Virgin Islands consists of very young stands, reflecting past and present land use and disturbances. Eighty percent of the forest inventoried was stands mostly made up of saplings and seedlings. Twenty percent of the forest found was in stands where small diameter (12.5- to 22.4-cm d.b.h.) trees predominated.

- Areas recently colonized by forest vegetation were only found on St. Croix. The survey did not find evidence of significant recent forest recolonization of former agricultural land on St. John or St. Thomas.

U.S. Virgin Islanders face the challenge of balancing development and forest conservation. *(photo by Tom Brandeis)*

- Most of the forest found was relatively young and undeveloped. On St. Croix and St. Thomas, there were few (3 percent and 8 percent, respectively) stands considered to be mature secondary forest based on the number and size of trees present. St. John had a higher percentage of mature forest (20 percent).

Species Composition

- The forest inventory sampled 105 tree species, 46 species as trees with d.b.h. ≥ 12.5 cm. Fifty-nine species were found only as saplings or seedlings (d.b.h. < 12.5 cm).

- Of the species present as trees with d.b.h. ≥ 12.5 cm, black mampoo [*Guapira fragrans* (Dum.-Cours.) Little]) had the highest importance value, followed by gumbo limbo [*Bursera simaruba* (L.) Sarg.]), and genip (*Melicoccus bijugatus* Jacq.).

- Ninety-five tree species were found as saplings or seedlings (d.b.h. ≤ 12.4 cm). Of these, tan tan [*Leucaena leucocephala* (Lam.) de Wit)] had the highest importance value.

Forest Health Indicators

- There were few indications of stressed trees or widespread pest and disease problems. Only 3.8 percent of live trees had some type of damage or disease. The most common disease was fungal infection (2.4 percent of live trees), as indicated by the presence of external fungal fruiting bodies or signs of advanced decay.

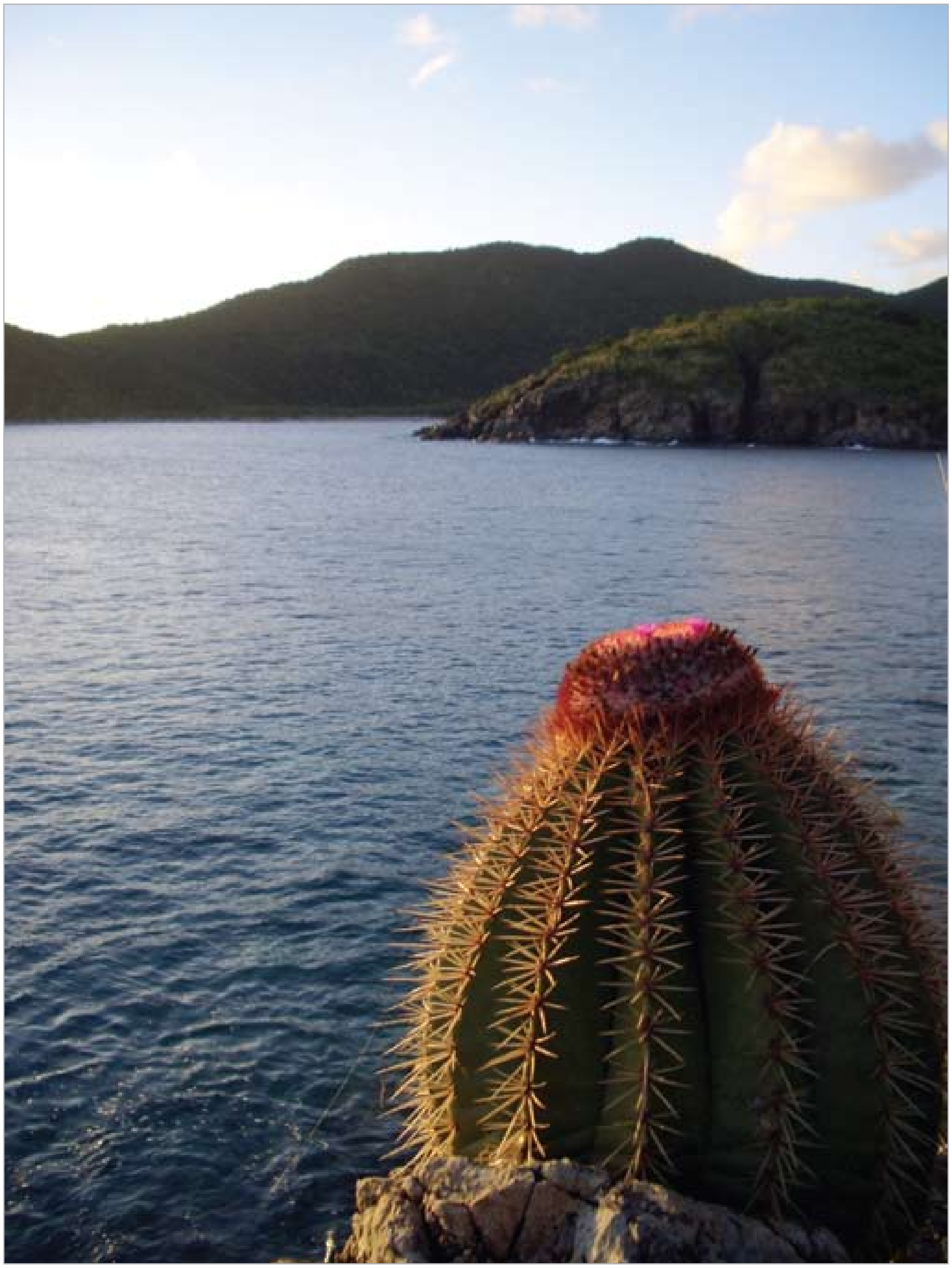
- Only 1.5 percent of trees showed indications of crown dieback. Sixty-three percent of the trees with crown dieback showed losses of 15 percent of the crown or less.

- Amounts of down woody material (DWM), forest floor duff, and forest floor litter increased from dry to wetter forest life zones. Subtropical dry and moist forests had comparable amounts of fine woody materials on the forest floor (1-hour fuels). Larger (1,000-hour) fuels were more abundant in subtropical moist forest.

- The U.S. Virgin Islands' forests lack the largest sized (diameter ≥ 45 cm) pieces of DWM on the forest floor, perhaps because they are in an early successional stage and have few large trees.

- The majority of carbon sequestered by forests on the U.S. Virgin Islands is found in live trees. The proportion of carbon in the forest floor and fine woody debris is substantial, however. Relatively little carbon is stored in coarse woody debris and standing dead trees.

Down woody materials are important to wildlife, carbon sequestration, and nutrient cycling. *(photo by Tom Brandeis)*



Turk's cap cactus [*Melocactus intortus* (P. Mill.) Urban]. *(photo by Sonja Oswalt)*

The U.S. Virgin Islands, an unincorporated territory of the United States, consists of St. Croix, St. John, St. Thomas, and numerous smaller islands centered on the geographic coordinates 18°20′ N. by 64°50′ W. (fig. 1). With Puerto Rico to the west and the British Virgin Islands to the east and north, the U.S. Virgin Islands lie at the eastern extreme of the Greater Antilles. Puerto Rico, St. Thomas, St. John, and the British Virgin Islands are all part of the Puerto Rico Bank, an area of relatively shallow water, and were connected until rising sea levels at the end of the last ice age separated the islands about 8,000 years ago (Rankin 2002, Wiley and Vilella 1998). The much deeper waters of the Virgin Islands Basin, in places > 2500 m deep, may have always kept St. Croix separate from her sister islands to the north (Rankin 2002, Wiley and Vilella 1998).

St. Croix is the largest of the U.S. Virgin Islands, having a total area of 219 km^2 (34 km long by 9.6 km wide). The elevation of its highest point, the summit of Mount Eagle, is 355 m. St. John, the smallest of the three main islands, has a total area of 53 km^2 (roughly 13 km wide), and the elevation of its highest point, the summit of Bordeaux Mountain, is 392 m. St. Thomas has an area of 90 km^2 (19 km long by 5 km wide). The highest point in St. Thomas—and the highest in the U.S. Virgin Islands—is the summit of Crown Mountain, which rises to a height of 474 m. The combined total land area of these islands (362 km^2)

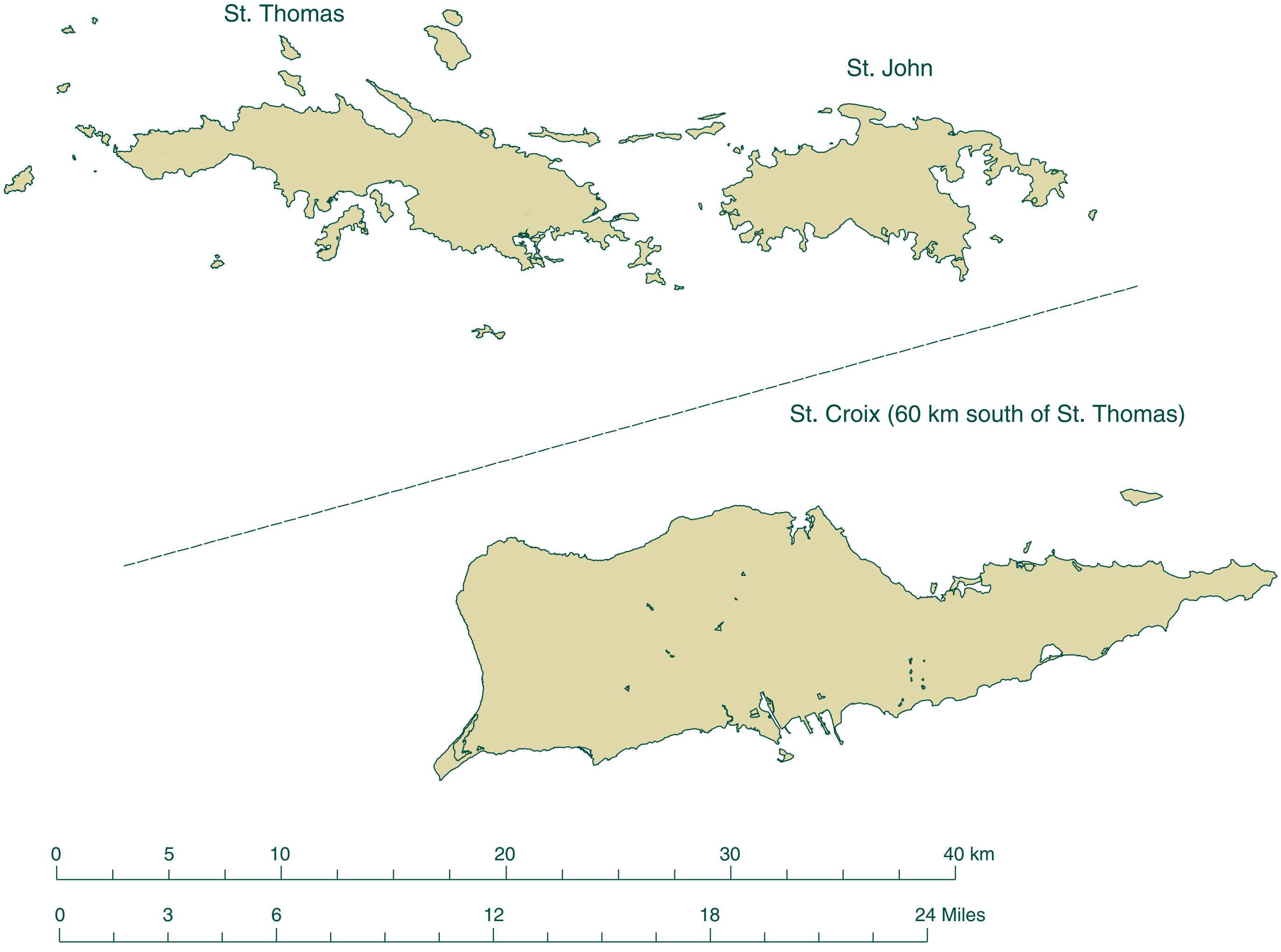


Figure 1—The U.S. Virgin Islands.

is roughly twice the size of Washington, DC (Central Intelligence Agency 2007). The U.S. Virgin Islands are volcanic in origin and have clayey, finely textured soils derived from volcanic materials (Rankin 2002, Rivera and others 1970). There are also significant areas of limestone-derived, caliche soils, particularly on St. Croix (Rankin 2002, Rivera and others 1970).

Although the U.S. Virgin Islands lie south of the Tropic of Cancer, the cooling effect of the Atlantic Ocean to the north and Caribbean Sea and easterly trade winds throughout the year produce a subtropical climate with temperatures that average 25 °C in winter and 28 °C in the summer (Ewel and Whitmore 1973, Wiley and Vilella 1998). The U.S. Virgin Islands are generally drier than the rest of the Greater Antilles due to their lower elevations (Wiley and Vilella 1998). Annual rainfall in the U.S. Virgin Islands averages 1400 mm and occurs mostly during July through October (Wiley and Vilella 1998). Because there are few mountains and the majority of the land is at lower elevations, air temperatures are not greatly affected by orographic/adiabatic cooling. In the few high-elevation areas, moisture-laden trade winds are forced up mountainsides, water vapor condenses, clouds form, and rainfall can result leading to significant differences in vegetation. Summer and early fall is hurricane season. Hurricanes are an important factor in the formation and dynamics of forests on many Caribbean islands (Weaver 1994, 1998a, 1998b). In the past 20 years, four major hurricanes have passed through the U.S. Virgin Islands—Hugo in 1989, Luis and Marilyn in 1995, and Lenny in 1999.

Widespread land clearance for plantation agriculture, particularly sugarcane production, deforested much of the U.S. Virgin Islands. *(photo by Tom Brandeis)*

History of Human Occupation and Its Impacts on the Forest

Taino, Arawak, and Carib peoples occupied the islands prior to their discovery by Christopher Columbus in 1493. These indigenous Caribbean people relied on the island forests for fruit, building materials, and fuel. It is thought that the islands were 90 percent forested before European colonization (Haagensen 1995 as cited in The Nature Conservancy 2003). What little is known about the precolonization forests of the Virgin Islands comes from anecdotal descriptions by early European settlers and reports on the presence and quantity of valuable timber trees. St. Croix in particular is cited as having valuable timberland and timber trees, particularly the species fustic [*Pictetia aculeata* (Vahl) Urban], lignum vitae (*Guaiacum officinale* L.), cigar box cedar (*Cedrela odorata* L.), ironwood (*Krugiodendron ferreum*), and mastic (*Mastichodendron foetidissimum*) (The Nature Conservancy 2003, Weaver 2006). At this time we can only speculate about the forests that once covered the Virgin

Islands based on nontechnical descriptions furnished by residents and travelers, and on the secondary forests found on the islands today.

The islands underwent a chaotic period of early colonization in which control of the islands alternated among several European nations, trading companies, and private interests until the islands were finally sold to the Danish by the French in 1733. Organized, widespread land clearance for plantation agriculture, especially sugarcane and cotton production, then began in earnest and plantation owners prospered until the 1830s (Rogozinski 2000). The progress of agricultural development on St. Croix, where the generally flatter terrain was more appropriate for the extensive agriculture practiced by European colonists, is well described by Weaver (2006). Both St. Thomas and St. John were also eventually cleared of almost all their forest cover for agricultural plantations during this time. Agriculture on the islands became less economically viable with a decline in sugar prices and the increase in production costs that resulted from the emancipation of slaves in the 1830s and 1840s (Rogozinski 2000). Steeper terrain that was more difficult to farm was gradually abandoned. St. John was the first island to see the general abandonment of agriculture around 1848, starting the period of forest recovery on all three islands. By the time the U.S. Virgin Islands were acquired from Denmark by the United States in 1917, an estimated 90 percent of St. Croix had been cleared for agriculture and logged for valuable timber (Ward and others 2000). Somberg (1976) estimated forest cover to be 45.1 percent over all three of the islands in 1976.

Since acquisition of the islands by the United States, the islands have followed similar but not identical economic paths. Agricultural abandonment has proceeded on St. John and St. Thomas and is largely complete, but small-scale farming and ranching still play a small but significant role in St. Croix's economy, where sugarcane export remained viable through the 1950s (Rogozinski 2000).

Livestock raising on St. Croix is on the decline and the abandoned agricultural land is reverting to forest where not developed. *(photo by Tom Brandeis)*

Starting in the 1950s, tourism has been promoted as an economic option for the islands (Weaver 2006). There were fewer than 50,000 visitors each year in the 1950s (Rogozinski 2000). Now tourism accounts for 80 percent of gross domestic product, with the islands hosting more than 2 million visitors each year (Central Intelligence Agency 2007). Estimated tourist expenditures in 1995 were over $800 million, while the U.S. Virgin Islands government had an annual operating budget of about $500 million that same year (U.S. Department of the Interior 2006). Each island's involvement in the tourist industry is different, with some benefiting more than others. St. Thomas' large cruise ship docking facilities and duty-free shopping attract the lion's share of visitors to the U.S. Virgin Islands each year. Many of these same cruise ship passengers make the day trip to visit the beaches and forests of the Virgin Islands National Park, which was established on St. John in 1956. St. Croix has benefited much less from the tourist industry and has seen a decline in visitors since repeated hurricanes from 1989 to 1999 damaged much of that island's tourist infrastructure (Weaver 2006). Increased prosperity, growing populations, and a tourism-based economy has put new and increasing pressure on forest land on all islands, a pressure that was identified 30 years ago by Somberg (1976). Young forest that began to grow on abandoned agricultural land is now being cleared for residential and commercial developments, as well as tourism-related development such as resorts and golf courses.

Development, such as this construction in Cinnamon Bay, St. John, is the principal cause of forest loss in the U.S. Virgin Islands. (photo by Tom Brandeis)

The baobab tree (*Adansonia digitata* L.) at Estate Grove Place, St. Croix, connects Virgin Islanders to their African spiritual and cultural roots and their colonial history. *(photo by Tom Brandeis)*

Essentially all forests on the islands are secondary; that is, these forests have regrown or are recovering in the wake of human and climatic disturbance. Some forests on St. John on the summit of Bordeaux Mountain and in some larger ravines around the islands were less disturbed by human activities and are at a later stage of successional development today (Woodbury and Weaver 1987). Steep hillsides that were farmed have undergone soil erosion (Woodbury and Weaver 1987) that will likely reduce plant productivity and the rate of forest succession, and alter the course of forest succession.

Additionally, the forests have been colonized extensively by introduced species, many of which were brought to the islands during the colonial period for agricultural purposes. These species are now naturalized and form a substantial, permanent part of the Virgin Islands' recovering forests. Feral introduced animals such as burros, goats, and white-tailed deer are also having an unknown impact on forest regeneration. The response of the new forest associations to frequent disturbance by hurricanes is unknown. The long-term effects that these species and community additions will have on the islands' native flora and fauna, as

Feral animals, such as these burros on St. John, while they may be appealing to visitors and residents, damage the forests they inhabit. *(photo by Sonja Oswalt)*

well as on the forests' ability to provide valuable ecosystem services to Virgin Islanders, are still unknown. Despite the forest damage, the widespread changes, and the relatively early stages of recovery, the forests of the U.S. Virgin Islands still play vital ecological, economic, and cultural roles.

Forest Products in the U.S. Virgin Islands

While materials for arts, crafts, and buildings could be drawn from over 500 native and introduced tree species (The Nature Conservancy 2003), a survey of forest products in the U.S. Virgin Islands showed the production of 188,500 board feet of lumber and a gross income of $600,400, an amount that represents < 10 percent of the islands' wood consumption (Pierce and Hultgren 1997). Thirty years ago, commercial forestry was not viewed as economically feasible (Somberg 1976), and at this time there is no reason to believe this situation has changed. Locally harvested forest products do have a role in the economy and culture of the U.S. Virgin Islands. Forest products are used in arts and crafts, botanicals and medicinals, and charcoal-making. Wooden arts and crafts are produced primarily for the tourist trade, particularly cruise ship passengers. Clocks, bead jewelry, bowls, spoons, and a variety of items are made not only from locally grown wood but also from other forest products such as bamboo, tree seeds, and palm fronds. But even with local artisans producing objects from local wood, most of the wood arts and crafts being sold in shops are imported from the Dominican Republic, Haiti, Indonesia, or South America. The harvest of botanicals and medicinal herbs from the forest for use in cooking, making "bush teas," and traditional herbal remedies accounts for a relatively small percentage of the income derived from forest products. Despite a relatively low economic value, these products have a long history in the islands and are an important component of Virgin Islands' culture and an expression of appreciation for the forest. A very small-scale charcoal industry on St. Croix provides for local consumption using tan tan and cassia (*Cassia siamea*) (Pierce and Hultgren 1997).

There is potential for increasing the use of locally grown forest products to supply the local woodworking industry, whose shops specialize in furniture construction and repair, cabinetry, millwork and doors, woodcarving, and wooden boat construction and repair (Pierce and Hultgren 1997). The species most used in the woodworking industries are species that grow on the islands, and include West Indian mahogany [*Swietenia mahagoni* (L.) Jacq.)], hybrids with Honduran mahogany (*Swietenia mahagoni* Jacq. x *S. macrophylla* King.), saman [*Samanea saman* (Jacq.) Merr.], tibet [*Albizia lebbeck* (L.) Benth.], gregre (*Bucida buceras* L.), Spanish cedar, and lignum vitae (Pierce and Hultgren 1997).

But, in general, the larger the woodworking operation, the less it relies on locally grown lumber because of the lack of consistent supplies (Pierce and Hultgren 1997). In 1997 there were 13 sawmills in the U.S. Virgin Islands, either chainsaw mills or small, portable bandsaw mills, mostly owned by local woodworkers to meet their own needs, with the sale of extra milled lumber providing additional income (Pierce and Hultgren 1997). Almost all production is mahogany, saman, and tibet reported to have come from cutting associated with road improvement projects and the salvaging of hurricane damaged trees (Pierce and Hultgren 1997). These mills are idle most of the time and produce little income for their owners due to the lack of trees to mill.

Forests' Role in Soil and Water Conservation

Although U.S. Virgin Islands' forests yield only minor quantities of marketable commodities, they support important elements of the Virgin Islands economy and society indirectly. The forest's role in watershed protection is critically important on all Caribbean islands. Forest cover reduces surface runoff and increases infiltration to the water table, speeding aquifer recharge. There are no freshwater lakes or ponds in the U.S. Virgin Islands to draw upon for water, and there are few nonephemeral streams; most streams are only small rivulets during the dry season (The Nature Conservancy 2003). Drinking water is obtained from rainfall trapped in cisterns and a few wells in rural areas, and desalinization plants in urban areas. In 1985 an estimated 80 percent of water used came from surface water supplies, and 20 percent from ground-water supplies (Weaver 1996). Forest cover loss and increased pressure on ground-water supplies from a growing population have caused some wells to go dry, while some smaller streams and springs that appear on historical maps no longer exist and others have become ephemeral, only having water after heavy rains (Weaver 1996).

Terrestrial and marine ecosystems are intimately connected in the Caribbean. The benefits of healthy forest cover extend well offshore to marine habitats such as coral reefs that benefit from the protection from soil erosion and sedimentation associated with deforestation. The risk of soil erosion is particularly high on the islands where there is a combination of steep slopes, highly erodable soils with moderately fine textures, and often torrential rainfall events. Sedimentation due to runoff from coastal development is cited as the most important threat to Virgin Islands coral reefs (Rogers 1998). Researchers have documented significant decreases in coral growth associated with upland development and road construction in and around the Virgin Islands National Park (Rogers 1998). Mangrove forests in particular stabilize the coastline, filtering out sediments that would otherwise cloud the waters and be deposited onto coral reefs. Their labyrinthine networks of prop roots provide nursery habitat for colorful Caribbean reef

Terrestrial and marine ecosystems are intimately connected in the Caribbean. (photo by Sonja Oswalt).

Uncontrolled soil erosion resulting from construction damages both terrestrial and marine ecosystems. *(photo by Tom Brandeis)*

fish that are important to local fisheries and the tourism industry. Mangrove forests also provide unique snorkeling and kayaking experiences that attract ecotourists.

U.S. Virgin Islands Forests as Biological Refuges

The Caribbean Basin is seen as one of the world's biodiversity hotspots due to the large numbers of endemic species found there (Myers and others 2000). The International Union for Conservation of Nature Red List of Threatened Species lists 315 threatened and endangered terrestrial species for the U.S. Virgin Islands (International Union for Conservation of Nature and Natural Resources 2006). The Insular Caribbean islands are described as the "most important (and sometimes exclusive) wintering ground" for many declining species of warblers, including the Cape May Warbler (*Dendroica tigrina*), Black-throated Blue Warbler (*D. caerulescens*), and Prairie Warbler (*D. discolor*) (Birdlife International 2004). These species face continuing pressures on their wintering grounds. Habitat destruction, fragmentation, and invasive species are primary threats to the outstanding avian diversity of the Caribbean. Thus, intact island forests provide invaluable habitat for resident birds and Neotropical migrant songbirds (Askins and Ewert 1991). The Forest Service Southern Research Station, in conjunction with the U.S. Fish and Wildlife Service, International Institute of Tropical Forestry, University of Florida, and National Park Service are now conducting a multiyear study on St. John to explore habitat use of subtropical dry and moist forest by both resident and Neotropical migrant songbirds. Surveys conducted in 2005 indicated that 47 indigenous bird species, including 17 species of Neotropical migrants, were present. Initial analyses suggest that many Neotropical migrants may prefer the island's subtropical moist forests, a finding supported by earlier observations on both St. John and on other, similar islands (Askins and Ewert 1991, Wunderle and Waide 1993).

Inventory and Reporting Objectives

The 2004 forest inventory of the U.S. Virgin Islands completed by the Forest Service's FIA program had the following objectives.

- Estimate the status of and change in forest land on St. Croix, St. John, and St. Thomas for the period 1994 to 2004.

- Provide estimates of the numbers of trees, their size distributions, quantity of merchantable wood, and amount of carbon stored in their biomass.

- Assess and monitor stand age class structure to see how forests are recovering from past land clearance, recent hurricanes, and continuing human pressures.

- Contribute to a broader understanding of the species composition, regeneration trends, successional processes, and dynamics between native and introduced species in highly disturbed island landscapes.

- Assess tree crown health by looking for damage due to pests and pathogens, breakage by hurricanes, or factors that might cause losses of tree vigor.

- Monitor quantities of DWM because they are important carbon sinks, wildlife habitat, and forest fire fuels.

The Caribbean Basin is one of the world's biodiversity hotspots. *(photo by Tom Brandeis)*

Study Area and Its Forest Associations

We present the forest inventory results stratified according to the two Holdridge forested life zones found in the U.S. Virgin Islands. The Holdridge life zone model broadly defines ecological life zones using mean annual precipitation and mean annual bio-temperature (Ewel and Whitmore 1973). Holdridge life zone associations are commonly used in the U.S. Virgin Islands and neighboring Puerto Rico, facilitating comparison to other studies. More detailed classifications of Virgin Islands' forests exist, most notably Thomas and Devine (2005). However, these classifications subdivide forest vegetation into categories that are too small in area for use in this forest inventory because too few sampling points would fall into each category to allow for an adequate estimation of forest characteristics.

The forested life zones found on the U.S. Virgin Islands are subtropical dry forest and subtropical moist forest (Ewel and Whitmore 1973, Birdsey and Weaver 1982) (fig. 2). Subtropical dry forest conditions predominate at lower elevations on all three islands, and subtropical moist forest is found at higher elevations where the orographic cooling of moisture carried on the trade winds provides increased precipitation.

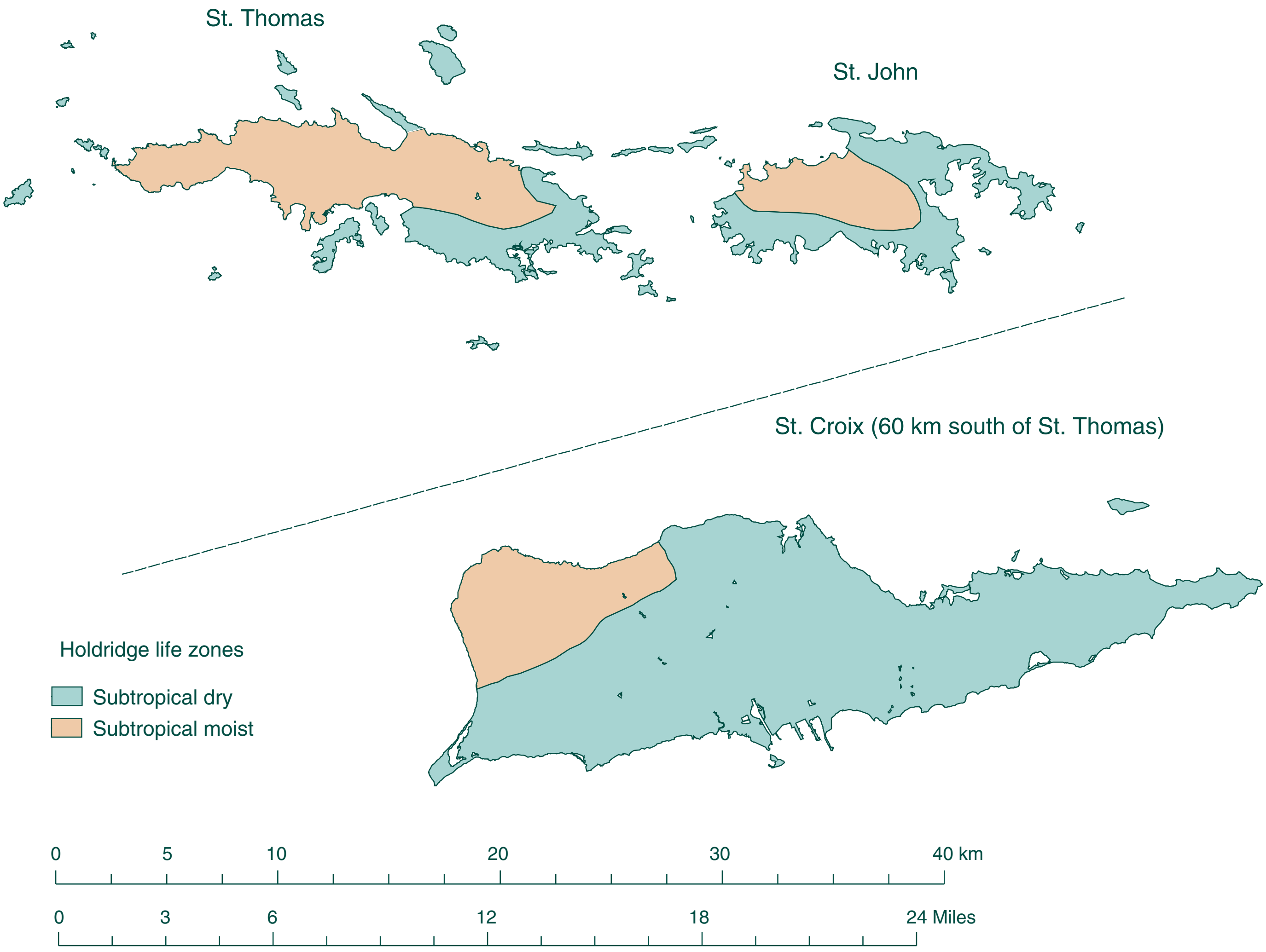


Figure 2—Holdridge life zones of the islands of the U.S. Virgin Islands.

Birdsey and Weaver (1982) and Ewel and Whitmore (1973) give excellent descriptions of these forest associations as found on Puerto Rico, and these descriptions are also broadly applicable to the vegetation of the U.S. Virgin Islands. The glossary of terms in this report also contains brief descriptions of each forested life zone. The species composition described for each forested life zone in the glossary and the following sections is greatly simplified, citing only the most commonly found representative species and is not meant to be an exhaustive description.

Subtropical dry forest—Subtropical dry forest is found at elevations below 300 m, where annual precipitation totals 600 to 1100 mm (Ewel and Whitmore 1973, Acevedo Rodriquez 1996, Gibney and others 2000, Thomas and Devine 2005). The dry forest canopy usually does not exceed 15 to 20 m in height, consisting of sparse tree crowns that are often deciduous and commonly have small succulent or leathery leaves (Woodbury and Weaver 1987, Acevedo Rodriquez 1996, Gibney and others 2000, Thomas and Devine 2005). Some of the native tree species that

The understory vegetation of Caribbean subtropical dry forest commonly consists of grasses, thorny legumes, and cacti. *(photo by Tom Brandeis)*

are common in subtropical dry forest in the U.S. Virgin Islands are gumbo limbo [*Bursera simaruba* (L.) Sarg.], torch wood (*Amyris elemifera* L.), Jamaican caper (*Capparis cynophallophora* L.), black manjack (*Cordia rickseckeri* Millsp.), water mampoo (*Pisonia subcordata* Sw.), lignum vitae, white frangipani (*Plumeria alba* L.), and fustic. The lower, understory vegetation of the Caribbean subtropical dry forest commonly consists of grasses, thorny legumes, and cacti.

Subtropical dry forests on the flatter lowlands were extensively cleared for agriculture, particularly sugarcane production and livestock grazing, although the cleared land was only marginally productive even with irrigation. Large-scale agricultural activities have ceased on St. Thomas and St. John, and very nearly so on St. Croix. While small-scale, dispersed farming, livestock grazing, and charcoal cutting continue, much of the land formerly used for agriculture has been allowed to naturally revert to forest. In some parts of the islands these regenerating forests are prone to wildfires that decrease their stature and allow for the development of persistent shrublands dominated by introduced species and grasses (Wiley and Vilella 1998). The more heavily disturbed dry forest areas have numerous, smaller-stemmed tan tan, mesquite [*Prosopis juliflora* (Sw.) DC.], stink kasha (*Acacia macracantha* Humb. & Bonpl.), and casha [*Acacia farnesiana* (L.) Willd.] individuals.

Subtropical moist forest—The boundary between subtropical dry forest and subtropical moist forest is usually indistinct, with forest structure changing gradually along moisture and elevation gradients, and complicated by the highly-dissected terrain interacting with prevailing trade winds. As a result, the islands' subtropical dry and moist forests have many species in common. Subtropical moist forests are found in areas with 1100 to 2200 mm of annual precipitation, with a 2 to 4 month dry period (Gibney and others 2000, Thomas and Devine 2005). These rainfall levels occur at higher elevations on all three islands, where the hills and mountains intercept moisture carried on the trade winds. Subtropical moist forest is found on the summits and upper north-facing slopes, in riparian galleries, and along basins and lowland areas where there are sufficient amounts of freshwater runoff to support it (Woodbury and Weaver 1987, Acevedo Rodriquez 1996, Gibney and others 2000, Thomas and Devine 2005).

Subtropical moist forests have been heavily impacted by most of the same human activities that have degraded the subtropical dry forests. Greater precipitation allows greater productivity, so these areas were used for agriculture where the terrain permitted, as in northwestern St. Croix. The forests growing on these uplands are especially important to the islands' water supplies, stabilizing the soils in these higher rainfall areas and intercepting cloud-borne moisture.

Subtropical moist forests are more structurally developed and complex than subtropical dry forests and can have canopy heights up to 30 m (Acevedo Rodriquez 1996, Gibney and others 2000). Most of the species are evergreen, but there are

Subtropical moist forest is found on the summits, riparian galleries, and lowland areas where there is sufficient freshwater to support it. *(photo by Tom Brandeis)*

also drought deciduous species (Woodbury and Weaver 1987, Gibney and others 2000). Some of the many natural indicator species of subtropical moist forest in the U.S. Virgin Islands include dog almond [*Andira inermis* (W. Wright) Kunth ex DC.], black mampoo [*Guapira fragrans* (Dum.-Cours.) Little], yellow mombin (*Spondias mombin* L.), gre gre, sandbox tree (*Hura crepitans* L.), kapoktree [*Ceiba pentandra* (L.) Gaertn.], cigar box cedar, bayrumtree (*Pimenta racemosa* var. racemosa), royal palm (*Roystonea borinquena* O.F. Cook) (on St. Croix only), stinkingtoe (*Hymanaea courbaril* L.), pumpwood (*Cecropia schreberiana* Miq.), and white cedar [*Tabebuia heterophylla* (DC.) Britt.]. While subtropical moist forests have some of the same introduced species found in subtropical dry forest, tamarind (*Tamarindus indica* L.) and genip (*Melicoccus bijugatus* Jacq.) are also commonly found.

Mangroves—Coastal and brackish estuarine forests are very important ecologically and economically. Common species include red mangrove (*Rhizophora mangle* L.), white mangrove [*Laguncularia racemosa* (L.) Gaertn. f.], black mangrove [*Avicennia germinans* (L.) L.], and buttonwood

(*Conocarpus erectus* L.). These forests fringe the coastlines, providing vital habitat and refuges for numerous terrestrial and marine organisms. Their role as fish and marine invertebrate nurseries helps support fishing and aquatic-based tourism, activities vital to the islands' economies. Unfortunately, these forests are so restricted in their distribution and occur in such narrow bands along the coast that none of the systematic sampling points fell in mangrove forest. This should not reflect on the importance of these forests and efforts are being made to better assess mangrove forests in the forest inventory.

Woodlands and shrublands—FIA considers woodlands to be sparse forests with 5 to 10 percent canopy cover of woodland tree species. Other common woodland definitions specify a minimum cover of 25 percent (Gibney and others 2000, Thomas and Devine 2005). For the definition of forest, the FIA program uses 10 percent, which would include as forest what some authorities categorize as woodland. Most of the species found in woodlands are the same ones found in forests, but are present in smaller numbers. Usually, woodland areas have developed in response to persistent human disturbances, and they are sometimes maintained naturally by wildfires. Shrublands have woody species that do not reach heights over 5 m, and are therefore categorized by the FIA program as shrubs in the Caribbean and are not surveyed.

Mangrove forests stabilize coastlines, filter sediments, serve as nurseries for reef fish, and provide important wintering habitat for Neotropical migrant birds. (photo by Tom Brandeis)

Forest Land Estimation

The FIA program inventories forests using a three phase system. The first phase is forest land estimation. The second phase is installation and measurement of permanent forest inventory and monitoring plots, and the third phase is the collection of additional data for forest health monitoring (FHM). All three forest inventory phases are based on a computer generated hexagonal grid that provides an unbiased, systematic sampling framework. For detailed information about the FIA sampling design, see Reams and others 2005.

In the first phase of the inventory, forest land was estimated by photointerpreters using aerial photographs. The sampling points that were classified as forest or nonforest by photointerpreters were generated by computer using a hexagonal sampling grid that gave a sampling point every 67 ha. This sampling grid produced 516 photointerpretation points over St. Croix, St. John, and St. Thomas. Photointerpreters projected these points onto orthorectified color digital aerial photos (digital orthophoto quarter quadrangles - DOQQs) that were taken in 1994 and in 2004. They then categorized the sampling points as forested or not forested according to the definition of forest land used by the FIA program in the Caribbean for both time periods.

The FIA program defines forest land as having at least 10 percent stocking of forest trees, or that has had such tree cover and is not undergoing development for a nonforest use. Stocking refers to the degree of occupancy of land by trees, measured by basal area or the number of trees in a stand and spacing in the stand, compared with a minimum standard, depending on tree size, required to fully utilize the growth potential of the land. In the Caribbean, the FIA program considers 10 percent stocking of mature trees to occur at 10 percent canopy coverage. Stocking guidelines change with tree size, however, so an area is also considered forest if it has 10 percent stocking in tree seedlings, which is equivalent to 1,500 seedlings/ha. By using stocking as a guideline for defining forest, the FIA program will classify an area as forested that might not be considered forest under other, more common definitions that are based on the canopy coverage of mature trees alone because the FIA program's definition of forest takes into account all stages of forest development. An area must not only meet minimum stocking requirements to be defined as forest, it must also meet minimum area requirements. The minimum area for classification as forest land is 0.4 ha. Roadside, streamside, and shelterbelt strips of trees must be at least 37 m wide to qualify as forest land. Grazed woodlands, reverting fields, and pastures that are not actively maintained are also included as forest land if the above size requirements are met.

Once photointerpreters classified sampling points as forested or not forested, each sampling point was assigned to a forest life zone using the map of Holdridge life zones for the U.S. Virgin Islands and Puerto Rico produced by Ewel and Whitmore (1973) and digitized by the U.S. Geological Survey Caribbean Division and Southern Research Station's FIA program (fig. 2). This allowed us to obtain forest area estimates for subtropical dry and subtropical moist forest. The area covered in mangrove forest could not be accurately estimated using the FIA program's forest area estimation methods, however, because too few of the systematically placed sampling points fell in the narrow bands of mangrove forest that fringe the coastlines.

Field Data Collection

On mainland St. Croix and St. Thomas, field crews visited 6 out of every 36 of the photointerpretation points, or 1 point every 400 ha. The point visited in the field was at the center of the 36 photointerpretation points, and was visited whether it was forested or not, whatever type of forest might be there, and whoever owned the land. On St. John, 12 out of every 36 of the photointerpretation points were visited by field crews, so there was one plot every 200 ha (see McCollum 2001, and Brandeis 2003 for details on this procedure) (table A.1).

Field crews visited the sampling points in the U.S. Virgin Islands during July through November, 2004. Plots were located using aerial photographs, maps, and Global Positioning System (GPS) receivers. Where the field crew found vegetation that met the FIA program's requirements for categorization as forest land, permanent plots were installed and measured regardless of ownership, intended use, or any restrictive management policy. Sampling points falling in nonforest land were located and briefly described without any further data collection. Field crews installed a standard FIA subplot cluster (fig. 3) at sampling points falling on forest

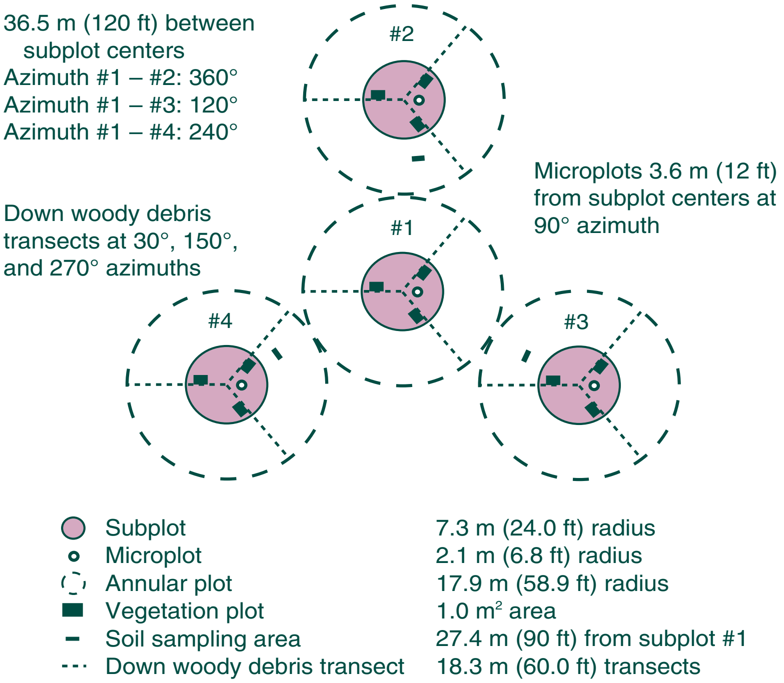


Figure 3—Forest inventory and health monitoring plot layout.

U.S. Forest Service personnel take detailed measurements on permanent forest inventory and monitoring plots across the U.S. Virgin Islands. *(photo by Tom Brandeis)*

land. Each of the cluster's 4 subplots has a radius of 7.3 m, which gave a total sampled area of 0.067 ha (see Bechtold and Scott 2005 for further details on plot layout). All trees within the subplots with a diameter at breast height (d.b.h., measured at 1.37 m) ≥ 12.5 cm were identified and measured. Field crews identified and measured all saplings with a d.b.h. ≥ 2.5 cm within a 2.1 m radius microplot nested within each subplot. They also identified and counted all seedlings with a height > 30 cm within the microplot.

Field crews assessed forest ecosystem health by making additional FHM measurements at one out of every six forest inventory plot locations on St. Croix and St. Thomas, and at every plot location on St. John (table A.1). Because the sampling was systematic, the numbers of FHM plot locations on St. Croix and St. Thomas do not equal exactly one out of every six inventory plots because some potential plot locations were in water. In the end, there was only one FHM plot on St. Thomas.

The forest health indicators measured included tree crown condition, forest floor litter, and DWM. Tree crown condition indicates tree vigor and stress, and it allows us to monitor both tree damage resulting from hurricanes and subsequent tree recovery. The amount of DWM helps analysts determine forest fire risks and, when combined with the vegetation structure data, it can be used in assessing wildlife habitat.

Detailed information about plot location, installation, monumentation, site descriptions, tree measurement, tree damage description, and other data collected at each forested plot can be found in the FIA Southern Research Station Field Guide, Field Procedures for Puerto Rico and the Virgin Islands (Forest Service 2002), and descriptions of FHM by FIA can be found in Smith and Conkling (2005). The sampling protocols and analysis procedures for estimating the amounts of DWM can be found in Woodall and Williams (2005).

Analytical and Statistical Techniques

Merchantable stem volume estimation— To estimate stem volume in trees with d.b.h. ≥ 12.5 cm for the current inventory, species-specific volume equations developed by Brandeis and others (2005) were used for the following species: dog almond, pumpwood (*C. schreberiana*), Cordia spp., sweet pea (*Inga laurina*), river koko (*Inga vera*), mango (*Mangifera. indica* L.), Ocotea spp., yuquilla (*S. morototonii*), and white cedar. A general equation was used for all other species except palms and tree ferns, which were excluded from volume estimates (Brandeis and others 2005). All equations shared the same model form and used d.b.h. and total tree height (H_T)

$$V_{stem} = e^{b_0 + b_1(\ln D_{BH}) + b_2(\ln H_T) + b_3(D_{BH})}$$

where

V_{stem} = merchantable stem volume in m^3

Additionally, volume equations developed by Brandeis and others (2006a) were used to estimate merchantable stem volume for mixed species in Puerto Rican dry forest, and the species gregre and gumbo limbo. These equations had the following model form

$$V_{stem} = a + b^* D_{bh}^2 H_T$$

where

V_{stem} = merchantable stem volume in m^3

Aboveground live tree biomass estimation—Aboveground biomass (AGB) was calculated for all living trees with d.b.h. ≥ 2.5 cm with the equations compiled from the scientific literature or developed by the FIA Program (table A.2). Locally developed biomass equations were used wherever possible, and equations developed from international datasets were used when equations from the Caribbean could not be found. With few exceptions, species-specific AGB equations are not available for Caribbean. Rather, AGB equations have been developed for forest types and life zones. The digitized map of the island's Holdridge life zones was used to assign each inventory sampling point to one of the two life zones previously described, and the classification was confirmed by field crews and examination of the data so that the appropriate equation could be used to estimate AGB.

Note that all of the biomass equations estimate total tree AGB in oven-dry kg from ground level to the tip of the tree, including stem, branch, and foliage. Belowground biomass (BGB) was derived using the equation in Cairns and others (1997) for estimating tree BGB for tropical forests

Inventory field work enables us to estimate how much wood and carbon are present in the forest. (photo by Tom Brandeis)

(table A.2) from the per-ha AGB estimate (the derivation of which is described in the next section). Estimates of aboveground and belowground biomass per ha were summed for a total live tree biomass estimate. Total tree biomass was multiplied by 0.5 for an estimate of carbon sequestered in each tree (Nabuurs and others 2003).

Per-hectare estimation—Once each individual tree's attributes were calculated, for example, each tree's merchantable stem volume, per-ha values were derived for all the strata of interest using the "ratio of means" methodology described in Zarnoch and Bechtold (2000) and the SURVEYMEANS procedure in SAS (SAS Institute 2001). Estimates of these parameters for the different d.b.h. classes were derived indirectly by first calculating the percentage of each parameter found in each d.b.h. class, for example, the percentage of total basal area found in trees in the 30-cm d.b.h. class, and multiplying that percentage by the total value for the parameter.

Population estimates presented here for U.S. Virgin Islands' forests are the product of mean per-ha estimates (derived from forest inventory plot data) and the forest area in the strata of interest (derived from photointerpretation), each of which have their own variance estimates. The standard error for their product was calculated using the formula for variance of the product of two independent variables,

$$SE_{XY} = \sqrt{\left(X^2\ Var_Y\right) + \left(Y^2\ Var_X\right)}$$

where

X and Y are the mean values being multiplied together, and

Var_Y and Var_X are their respective variance estimates

Species composition and relative importance value—Species nomenclature is based on the U.S. Department of Agriculture, Natural Resources Conservation Service PLANTS database (U.S. Department of Agriculture, Natural Resources Conservation Service 2006), with supplemental reference to Little and Wadsworth (1989) and Little and others (1974). Molina and Alemañy (1997) was used as an additional reference to determine which tree species were native or introduced to the U.S. Virgin Islands.

An importance value (IV) was calculated for each species so that the importance of the various species could be compared. IVs were calculated by taking the average of relative dominance (each species' basal area divided by the total basal area), relative density (each species' trees per ha divided by total trees per ha), and relative frequency (number of plots where the species occurred divided by total number of plots), multiplied by 100 (Curtis and McIntosh 1951, pages 87-88 in Whittaker 1975, and pages 15-16 in McCune and Grace 2002, Whittaker 1975). Species IV was calculated for all species found to be present and represented by trees having stems with d.b.h. ≥ 12.5 cm.

Forest Land and Its Change over Time

We estimate overall forest land on the three U.S. Virgin Islands at 61.3 percent (fig. 4, table A.3). St. Croix was the least forested of the three islands with only 49.5 percent forest land, while St. John (91.6 percent forested) and St. Thomas (73.7 percent forested) were more forested (fig. 5). Subtropical dry forest was the most prevalent forest life zone on the islands, occupying 7655 ha on St. Croix, 2828 ha on St. John, and 2049 ha on St. Thomas (table A.3). There was less subtropical moist forest on St. Croix and St. John (2964 and 1824 ha,

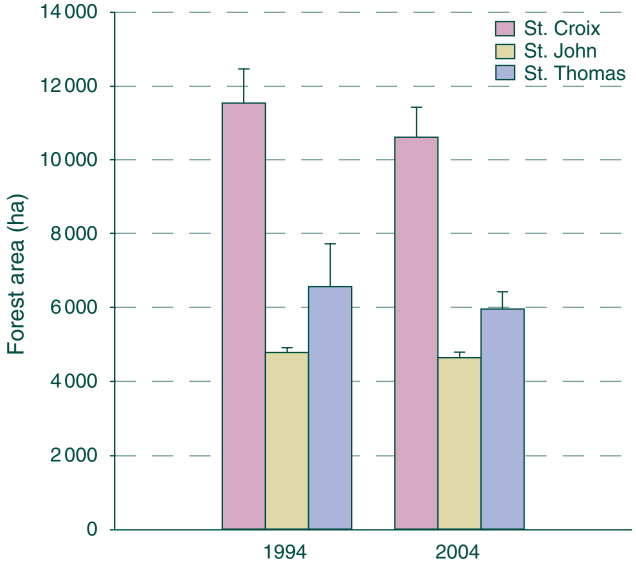


Figure 5—Forest land for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, in 1994 and 2004, with standard error of the estimate.

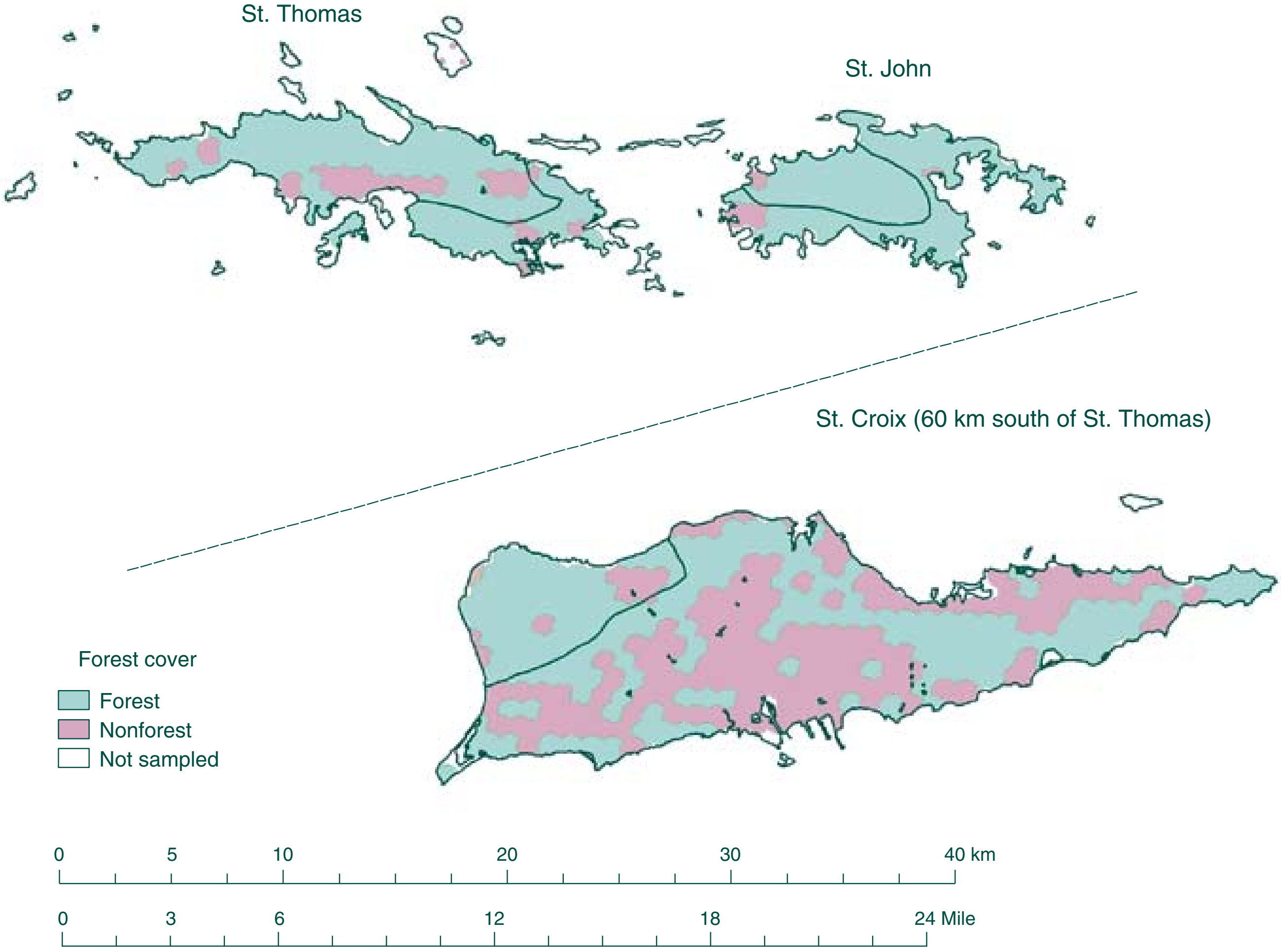


Figure 4—Forest cover on the U.S. Virgin Islands based on the 2004 Forest Service forest inventory.

respectively) than subtropical dry forest. St. Thomas had more subtropical moist forest (3916 ha) than subtropical dry forest.

Out of all the forested conditions recorded by field crews, 6 percent of the total on all islands were natural forest reversions, areas that had been recently colonized by trees. All of these reversions were on St. Croix (fig. 6), and all were in subtropical dry forest (fig. 7).

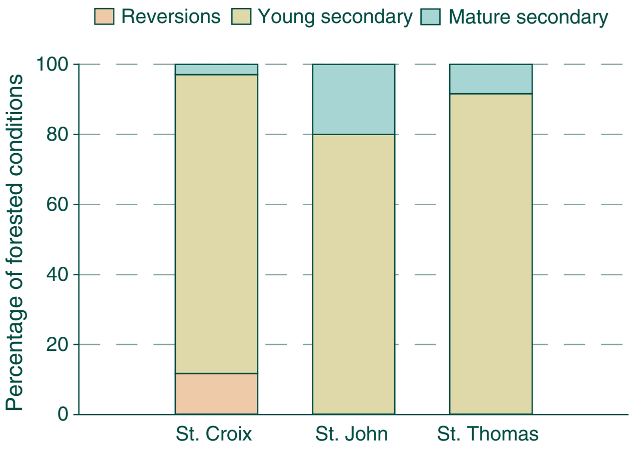


Figure 6—Reversions, young secondary, and mature secondary stands by island for the U.S. Virgin Islands, 2004.

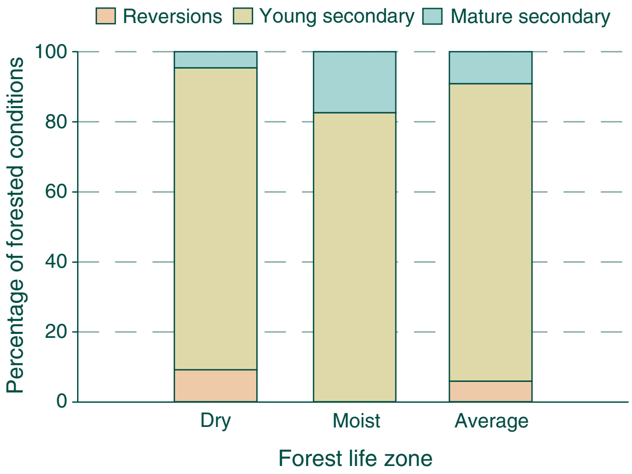


Figure 7—Percentage of forest conditions that were categorized as reversions, young secondary, and mature secondary stands by forest life zone, for the U.S. Virgin Islands, 2004.

Despite these reversions, there has been a notable loss of forest land on all three islands over the past 10 years, particularly in the subtropical dry forest life zone on St. Croix and St. Thomas. In the case of St. Thomas, 13 percent of the subtropical dry forest and 7.1 percent of the moist forest present in 1994 had been lost by 2004, a loss of 609 ha of forest. Overall, there was a 9.3-percent decrease in forest land on St. Thomas. There was an 8-percent decrease on St. Croix (a loss of 918 ha of forest), and a 3-percent decrease in forest land on St. John (a loss of 145 ha of forest).

Forest Structure and Development

Forest was found at 66 of the 113 sampling points on St. Croix, St. John, and St. Thomas (table A.1). Forty-three sampling points were in subtropical dry forests and 23 in subtropical moist forests. Again, no plots fell in mangrove forest, so no results for that forest type are presented.

Most of the forest found was relatively young and not highly developed structurally, based on the size of the predominant trees in the stand and subjective assessment by an experienced field crew (figs. 6 and 7). Eighty percent of the stands were in the sapling-seedling class (stands at least 10 percent stocked with live trees with d.b.h. < 12.5 cm, and that have more than one-half of their total stocking in saplings and seedlings).

The landscape of the U.S. Virgin Islands is a dynamic mosaic of forest, agricultural, and developed land. *(photo by Tom Brandeis)*

Much of the forest of the U.S. Virgin Islands consists of saplings and small trees, reflecting past and present land use and disturbances. *(photo by Tom Brandeis)*

The field crews categorized 3 percent of stands on St. Croix and 8 percent of stands on St. Thomas as mature secondary forest based on the number and size of trees present in the stand. The subtropical moist forest life zone on St. John had a higher percentage of mature forest (20 percent). Still, only 20 percent of the stands surveyed were small diameter stands (stands at least 10 percent stocked with live trees, of which one-half or more of total stocking is trees with d.b.h. from 12.5 to 22.4 cm), indicating that even the forest categorized by field crews as mature consists of relatively small trees.

We estimated that about 90.9 million trees with d.b.h. ≥ 2.5 cm are found in the forests of the U.S. Virgin Islands (table A.4). As further indication of the recovering nature of the forests, the majority of these trees are small. About 81 percent have a d.b.h. < 15 cm (table A.5), and only 1.2 percent of trees measured had a d.b.h. ≥ 40 cm. We estimated that there was 247 682 m^2 of live tree basal area (tables A.6 and A.7) and 130 614 m^3 of merchantable stem volume in living trees (tables A.8 and A.9) in these forests. Live trees were estimated to contain about 899 997 Mg of AGB (tables A.10 and A.11) or 1 118 627 Mg of total live tree biomass (table A.12). On average, there were 4,573 trees (fig. 8), 12.9 m^2 of basal area (fig. 9), 17.7 m^3 of merchantable stem volume (fig. 10), (but only 4.8 m^3 in growing-stock trees), and 47.6 Mg of AGB (fig. 11) in 1 ha of Virgin Islands forest.

We also calculated the number and volume of the subset of live trees classified as growing stock according to the FIA definitions (see glossary), using the same forest life zone and diameter class categories used for all live trees (tables A.13 and A.14). There is only 82 015 m^3 of merchantable stem volume (tables A.15 and A.16) in trees classified as growing stock because there are few trees that meet growing-stock requirements. Forty-one percent of growing-stock volume was concentrated in two species, gumbo limbo and black mampoo (table A.17).

Species Composition

The forest inventory recorded 105 tree species, including 46 species that were present as trees with d.b.h. ≥ 12.5 cm (for the complete species list see appendix B). Fifty-nine species were found only as saplings or seedlings. Black mampoo was

Figure 8—Mean stem density by forest life zone for the U.S. Virgin Islands, 2004.

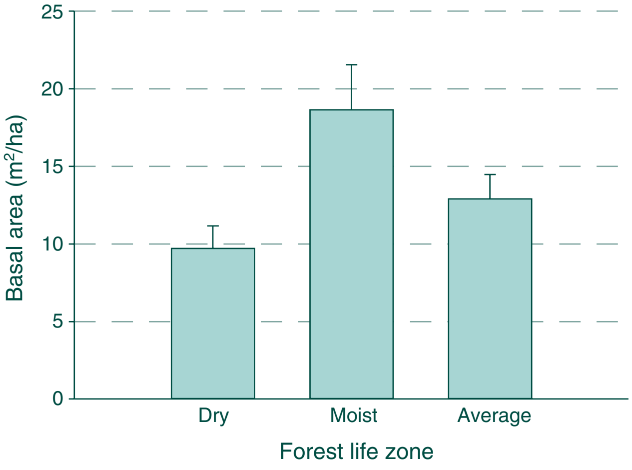


Figure 9—Mean basal area by forest life zone for the U.S. Virgin Islands, 2004.

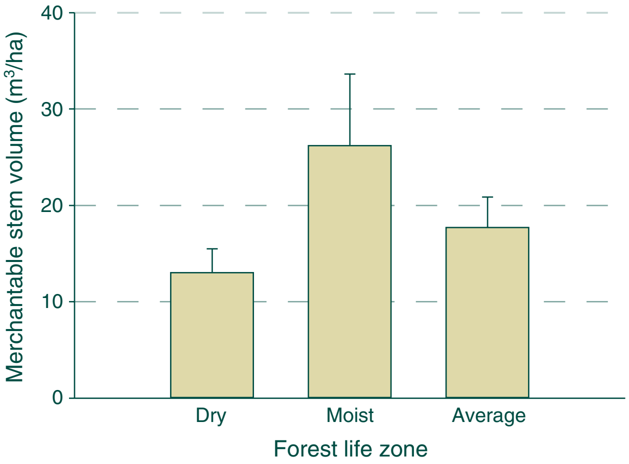


Figure 10—Mean merchantable stem volume by forest life zone for the U.S. Virgin Islands, 2004.

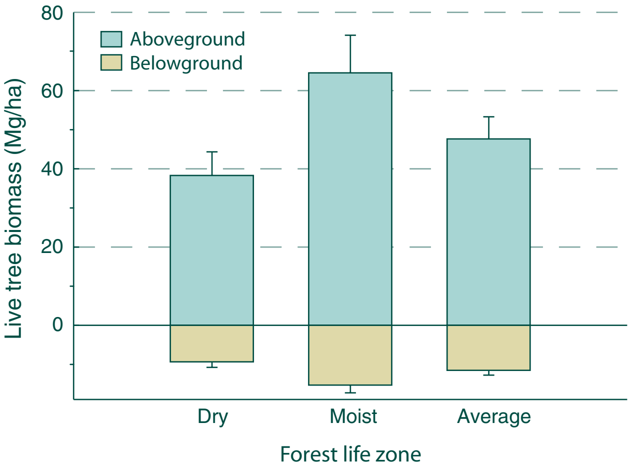


Figure 11—Mean per-hectare aboveground and belowground biomass with standard error of the mean, by forest life zone, for the U.S. Virgin Islands, 2004.

the most important species (in terms of IV) of trees with d.b.h. ≥ 12.5 cm, followed by gumbo limbo and the introduced species genip (table A.18). However, among saplings (2.5 ≤ d.b.h. ≤ 12.4) and seedlings (d.b.h. < 2.5 cm, height ≥ 30 cm), tan tan was by far the most important species found (table A.19), followed by black mampoo. While one species, tan tan, was found in great numbers on many inventory plots, saplings and seedlings of a total of 95 species (83 native and 12 introduced) were found. Subtropical moist forest had slightly greater species richness (74 species found) than subtropical dry forest (71 species found) (tables A.20 and A.21), even though it covers a smaller area (8704 ha of moist forest vs. 12 533 ha of subtropical dry forest) (table A.3).

Disturbed and abandoned areas are quickly colonized by species like tan tan (*Leucaena leucocephala* [Lam.] de Wit). *(photo by Tom Brandeis)*

Forest Health Indicators

We caution readers to keep in mind that the FHM sample sizes were small and unequally distributed across the 3 islands (7 of the FHM sampling points fell on forested land on St. Croix, 20 fell on St. John, and only 1 fell on forest in St. Thomas) when interpreting the forest health results reported here.

Tree damage, disease, and crown condition—There were few indications of stressed trees or widespread pest and disease problems. Only 3.8 percent of live trees had some type of damage or disease. Of those trees with damage or disease, the most common disease was fungal infection, as indicated by the presence of external fungal fruiting bodies or signs of advanced decay (fig. 12).

Only 1.5 percent of trees showed indications of crown dieback, and when it did occur it was minor more often than not. More than one-half of the trees with crown dieback showed losses of 15 percent of the crown or less. No one species had a higher incidence or severity of crown dieback. As this is FIA's first attempt to describe tree crown condition in the U.S. Virgin Islands, the values reported here can only be used as baseline information for comparison with future results. Mean compacted and uncompacted crown ratio, by crown class, appears in figure 13. Crown density, epiphyte and vine density, and crown transparency mean values appear in figure 14.

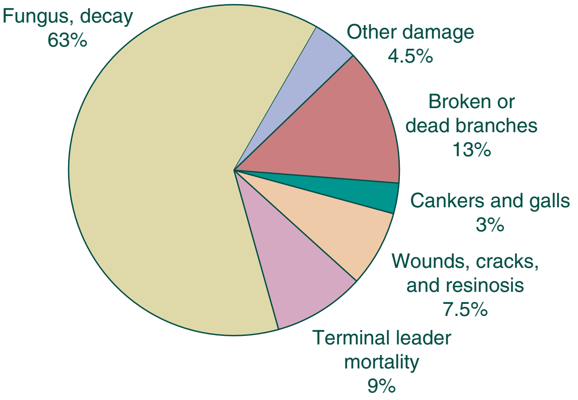


Figure 12—Types and frequencies of damaged or diseased trees in the U.S. Virgin Islands, 2004 (note that these percentages are for trees where damage or disease was observed, and that only 3.8 percent of all the trees measured had any damage or disease).

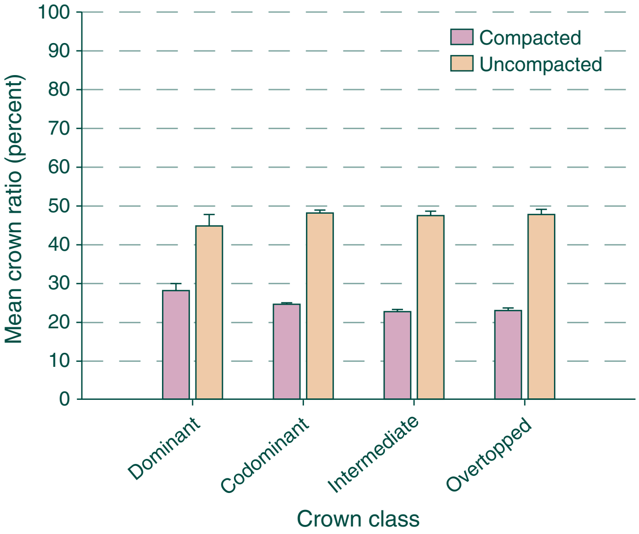


Figure 13—Mean compacted and uncompacted crown ratios with standard error of the mean, by crown class, for the U.S. Virgin Islands, 2004.

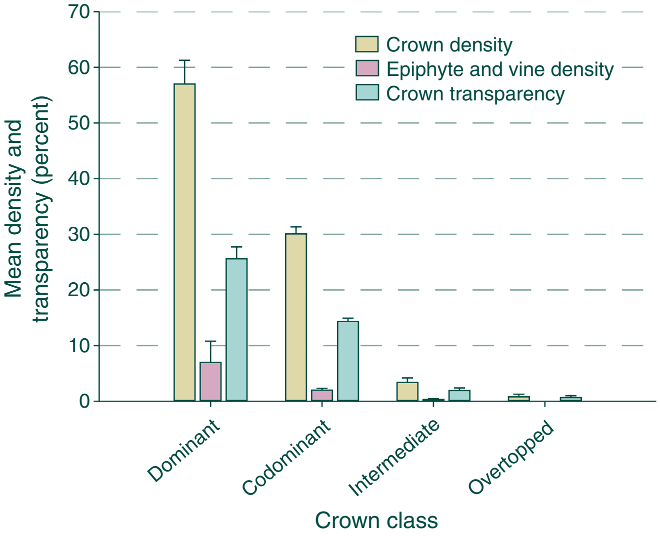


Figure 14—Mean crown density, epiphyte and vine density, and crown transparency with standard error of the mean, by crown class, for the U.S. Virgin Islands, 2004.

Down woody material, forest floor litter, and forest fire fuels—Amounts of DWM, forest floor duff, and forest floor litter appeared to be greater in subtropical moist forest than in subtropical dry forest (table A.22). Subtropical dry and moist forests had comparable amounts of fine woody materials on the forest floor (1-hour fuels) (table A.23). Subtropical moist forests appeared to have greater amounts of larger forest fire fuels than subtropical dry forests. Fuel loads for the largest size class of fuels (1,000-hour fuels) were higher in subtropical moist forest than in subtropical dry forest. Most of the DWM found in the forests consisted of small-diameter (8 to 20 cm) pieces of wood (table A.22). The Virgin Islands' forests lack large pieces (> 20 cm diameter) of DWM on the forest floor, owing to the rarity of large trees in the forests. Additionally, FIA sampling methods result in random samples of stands varying widely in size, structure, and composition. Any feature meeting the FIA definition of "forest" is included in the sample, so that the sample includes both highly disturbed and managed forests, such as edges, backyards, and resort grounds, as well as mature forests. Therefore, landscape-scale variations in land use history, aspect, slope, and exposure to prevailing winds complicate data analysis, making it harder to interpret averages of observed values.

Carbon sequestered in trees, down woody material, and forest floor—Mean carbon in DWM and forest floor is presented in table A.24. An average of 82 percent (across all islands and life zones) of the carbon sequestered by forests on the Virgin Islands is found in live trees (table A.25). Carbon sequestered in fine woody debris and the forest floor accounts for 16 percent of the total forest carbon across all islands and life zones, while only 2 percent is stored in coarse woody debris and standing dead trees with d.b.h. ≥ 12.5 cm (table A.25). Forest soil carbon was not addressed in this work. Other studies (Brown and Lugo 1982, Delaney and others 1997, Silver and others 2004) have indicated that the contribution of soil organic carbon to total carbon stocks is high relative to the contribution of carbon in DWM, particularly in subtropical moist life zones. Soil carbon estimates are needed to better quantify total carbon stocks on Caribbean landscapes.

Down woody materials are important carbon sinks, wildlife habitat, and forest fire fuels. *(photo by Angie Rowe)*

Forest Area Estimates and Change over Time

FIA's estimate of the amount of forest on the islands may seem high to those who have seen estimates from other sources, largely because FIA uses a utilitarian, forestry oriented definition of forest. For example, Thomas and Devine (2005), using a Rapid Ecological Assessment (REA) done in 2001 by the University of the Virgin Islands Conservation Data Center and The Nature Conservancy (Virgin Islands Conservation Data Center 2001), estimated overall forest cover to be only 30 percent using aerial photographs taken from 1994 to 2000. Brandeis and Cochran (in press) compare forest area estimates from the FIA Program, which made use of the 1994 aerial photographs, with the area estimate of the REA (Virgin Islands Conservation Data Center 2001). Brandeis and Cochran (in press) found that the FIA criterion for forest (10 percent stocking) included areas of recent forest reversions and shrublands (with 10 to 25 percent canopy coverage) that were not considered to be forest under the REA forest definition (area having at least 25 percent coverage of tree species). If areas defined as shrublands by the REA were included, the REA estimate would increase to 60 percent, which is comparable to FIA's estimate of 66 percent (Brandeis and Cochran, in press).

The lower limits of canopy cover and stocking that differentiate forest from shrubland are especially important in the Caribbean. Island forests are often naturally short statured, partly as a result of regular hurricane disturbance. Subtropical dry forests are prevalent in much of the islands, and these forests naturally tend to have more open canopies and more multistemmed trees (Ewel and Whitmore 1973). The long history of land clearing and recent agricultural abandonment has left the islands with essentially nothing but young, secondary stands that are still developing, even on St. John (Woodbury and Weaver 1987). Also, many areas are being kept in a young seral state by repeated wildfires and grazing.

Another difference between the findings of this forest inventory and general perceptions about the forest of the U.S. Virgin Islands has to do with the amount of subtropical moist forest on St. Thomas. The Holdridge life zone map (Ewel and Whitmore 1973) used in this work served as the basis for area calculation and as a stratification tool. Subsequent ground truthing of the map has revealed some inconsistencies, especially at lower

Subtropical moist forest is the most developed and biologically diverse forest type in the U.S. Virgin Islands. *(photo by Tom Brandeis)* elevations on St. Thomas, which may result in an overestimation of subtropical moist forest.

The decrease in forest cover in the U.S. Virgin Islands over the period 1994 to 2004 shows that past gains in forest cover resulting from the reversion of abandoned agricultural land have been surpassed by the loss of forest to development. This has not been the case in neighboring Puerto Rico, where forest cover continues to increase (Birdsey and Weaver 1987; Brandeis and others, in press; Franco and others 1997). While studies aimed specifically at identifying the land uses that replaced forest are needed before we can have definitive answers, we can hypothesize that the expansion of urban areas, dispersed housing developments for the islands' increasing population, and expansion of the tourism infrastructure have all contributed to forest loss during this period.

Forest Structure and Development

Recolonization of abandoned agricultural land appears to have run its course on St. John and St. Thomas, but continues on parts of St. Croix. The forests that have naturally regenerated on these former croplands are not well developed because they are relatively young, and in some areas, because of continued disturbance by grazing and wildfire. Eighty percent of the forest stands inventoried consisted of saplings and seedlings. Twenty percent of the forest consisted mostly of small diameter (12.5 to 22.4 cm d.b.h.) trees. Merchantable stem volume (17.7 m^3/ha) is relatively low because each of the numerous small trees has very little merchantable volume. Very little, if any, of the forest measured in this inventory was considered to have reached a mature state. The overall lack of large pieces of DWM on the forest floor across the three islands, and the presence of few standing dead trees with d.b.h. ≥ 12.5 cm, also reflect the overall early successional state and the rarity of larger mature trees in forests of the Virgin Islands.

Findings of this inventory can be compared with those of a few published studies. Weaver and Chinea (1987), reporting results of a long-term study on St. John, found an average of 3,372 trees/ha and 30.4 m^2 of basal area/ha in trees with d.b.h. ≥ 4.1 cm along a gradient from lower elevation subtropical dry forest to higher elevation subtropical moist forest in the Cinnamon Bay watershed. In another study, stem densities at two 1-ha permanent plots installed in subtropical dry forest on St. John were 3,239 trees/ha (basal area 23.7 m^2/ha) and 5,656 trees/ha (basal area 21.8 m^2/ha) for stems with d.b.h. ≥ 2.5 cm (Ray and others 1998), values that are comparable to those found in this inventory.

Outside of St. John, we are limited to a forest inventory of Estate Little Princess done in subtropical dry forest of northwest St. Croix. This inventory found an average of 17,354 trees with d.b.h. ≥ 2 cm/ha, and an average basal area of 15.7 m^2/ha (Adam and Ryan 2003). Even taking into account the measurement of trees slightly smaller in diameter than those measured in the FIA inventory, the secondary forest of Estate Little Princess has a much greater stem density than the average subtropical dry forest found over all three Virgin Islands by the FIA Program (4,078 trees/ha) and higher average basal area (9.7 m^2/ha). The prevalence of smaller stemmed tan tan on Estate Little Princess might explain the much higher stem density and basal area found there.

The FIA Program's results presented here have tended to show fewer trees per ha than other published studies. This is due to the systematic unbiased sampling used by FIA and the program's definition of forest. First, permanent plots are installed where indicated by the computer-generated sampling grid, regardless of the forest conditions there. This means marginal, degraded, and partially forested sites that meet the FIA definition of forest, but might not be chosen by researchers as study sites, are included in the sample. For example, the FIA sample includes areas where vegetation is in the process of reverting to forest. This vegetation would not meet the needs of a research project that conducts preferential sampling with the goal of describing more mature forest characteristics.

Species Composition

The number of tree species found by the forest inventory demonstrates the diversity of Caribbean forests. It is notable that the two most important tree species represented by individuals with d.b.h. ≥ 12.5 cm are natives (black mampoo and gumbo limbo), but the next most important tree is an introduced species, genip. Tables A.18, A.20, and A.21 do not reflect tan tan's importance because this species was rarely found with a d.b.h. ≥ 12.5 cm. In the sapling-size class (2.5 ≤ d.b.h. ≤ 12.4) and as seedlings (d.b.h. < 2.5 cm, height ≥ 30 cm), tan tan was the most important species encountered (table A.19). Tan tan's prevalence in the islands' forests has been well documented (Adam and Ryan 2003, Ray and Brown 1995, Ray and others 1998), and its role in colonizing abandoned agricultural land, and persisting there through continued human disturbance, is obvious throughout the islands.

At this time, we can only speculate about the long-term impacts of early successional species like tan tan on Virgin Islands' forests. These nitrogen-fixing colonizers are often growing on badly degraded sites where the soils no longer support native vegetation. It is unclear whether they facilitate the eventual secondary succession of native tree species and the formation of new forest communities as has been seen in Puerto Rico (Lugo 2004, Lugo and Brandeis 2005, Lugo and Helmer 2004) or if these colonizers prevent the establishment of other vegetation. Our forest inventory results show that many native tree species are regenerating in the secondary forests of the U.S. Virgin Islands. Only continued, long-term monitoring will answer our questions about secondary forest succession on the islands. Fifty-nine of the one hundred and five species (57 percent) recorded in the forest inventory were found only as saplings and seedlings; that is, there were no trees of those species with d.b.h. > 12.4 cm. The lack of larger individuals in so many species is another indication of the youth of the recovering forests on the islands. Perhaps over time these species also will reach maturity and increase diversity in the forest overstory. Also, at this time we can only speculate as to whether these forests, often dominated by pioneer species, will show the same resiliency to periodic hurricane disturbance demonstrated by Caribbean forest made up mostly of native species (Foster and others 1999, McDowell 2001, Reilly 1998, Weaver 1998a).

Forest Health Indicators

Although the FHM conducted by the FIA Program is not of sufficient intensity spatially or temporally to capture some fast-moving threats such as the introduction of exotic pests and disease, continued monitoring over time will alert us to long-term, large-scale changes in forest health, such as those caused by extended periods of drought.

The measurements of DWM and tree crowns presented in this report are from a single short measurement period between severe hurricanes. Future hurricanes will sometimes hit the islands hard enough to damage the forest significantly. FIA will monitor carbon and biomass dynamics in U.S. Virgin Islands' forests to assess the ability of trees and forests of various kinds to recover from hurricane damage.

References

Acevedo R.P. 1996. Flora of St. John, U.S. Virgin Islands. Memoirs of the New York Botanical Garden. 78: 1-581.

Adam, M.C.; Ryan, C. 2003. Evaluation of Estate Little Princess forest ecosystem: assessment of restoration needs. Unpublished report by The Nature Conservancy, Urban and Community Forest Program, Christiansted, St. Croix. 26 p.

Askins, R.A.; Ewert, D.N. 1991. Impact of Hurricane Hugo on bird populations on St. John, U.S. Virgin Islands. Biotropica. 23: 481-487.

Bechtold, W.A.; Scott, C.T. 2005. The forest inventory and analysis plot design. In: Bechtold, W.A.; Patterson, P.L., eds. The enhanced forest inventory and analysis program—national sampling design and estimation procedures. Gen. Tech. Rep. SRS–80. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station: 27-42.

Birdlife International. 2004. The insular Caribbean: a biodiversity conservation priority. http://www.birdlife.net/print.html. [Date accessed: October 20, 2006].

Birdsey, R.A.; Weaver, P.L. 1982. The forest resources of Puerto Rico. Resour. Bull. SO–85. New Orleans: U.S. Department of Agriculture Forest Service, Southern Forest Experiment Station. 59 p.

Birdsey, R.A.; Weaver, P.L. 1987. Forest area trends in Puerto Rico. Res. Note SO–331. New Orleans: U.S. Department of Agriculture Forest Service, Southern Forest Experiment Station. 5 p.

Brandeis, T.J. 2003. Puerto Rico's forest inventory: adapting the forest inventory and analysis program to a Caribbean island. Journal of Forestry. 101: 8-13.

Brandeis, T.J.; Cochran, J.K. [In press]. Defining forest and its implications for estimating forest area in the Virgin Islands. In: Zimmerman, T.W., ed. Proceedings of the 9th annual Caribbean urban and community forestry conference. St. Croix, U.S. Virgin Islands: University of the Virgin Islands Cooperative Extension Service.

Brandeis, T.J.; Delaney, M.B.; Parresol, R.; Royer, L. 2006. Development of equations for predicting Puerto Rican subtropical dry forest biomass and volume. Forest Ecology and Management. 233: 133-142.

Brandeis, T.J.; Helmer, E.H.; Oswalt, S.N. [In press]. The status of Puerto Rico's forests, 2003. Resour. Bull. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station.

Brandeis, T.J.; Kuegler, O.; Knowe, S.A. 2005. Equations for merchantable volume for subtropical moist and wet forests of Puerto Rico. Res. Pap. SRS–39. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 15 p.

Brown, S. 1997. Estimating biomass and biomass change in tropical forests: a primer. FAO Forestry Pap. 134. Rome: Food and Agriculture Organization of the United Nations. [Number of pages unknown].

Brown, S.L.; Lugo. A.E. 1982. The storage and production of organic matter in tropical forests and their role in the global carbon cycle. Biotropica. 14: 161-187.

Cairns, M.A.; Brown, S.; Helmer, E.H.; Baumgardner, G.A. 1997. Root biomass allocation in the world's upland forests. Oecologia. 111: 1-11.

References

Central Intelligence Agency. 2007. The world factbook 2007: Virgin Islands. http://www.cia.gov/cia/publications/factbook/geos/vq.html. [Date accessed: February 9].

Cintrón, G.; Schaeffer-Novelli, Y. 1984. Características y desarrollo estructural de los manglares de Norte y Sur América. Ciencia Interamericana. 25: 4-15. In Spanish.

Curtis, J.T.; McIntosh, R.P. 1951. An upland forest continuum in the prairie-forest border region of Wisconsin. Ecology. 32: 476-498.

Delaney, M.; Brown, S.; Lugo, A.E. [and others]. 1997. The distribution of organic carbon in major components of forests located in five life zones of Venezuela. Journal of Tropical Ecology. 13: 697-708.

Ewel, J.J.; Whitmore, J.L. 1973. The ecological life zones of Puerto Rico and the U.S. Virgin Islands. Res. Pap. ITF–18. Río Piedras, PR: U.S. Department of Agriculture Forest Service, Institute of Tropical Forestry. 72 p.

Foster, D.R.; Fluet, M.; Boose, E.R. 1999. Human or natural disturbance: landscape-scale dynamics of the tropical forests of Puerto Rico. Ecological Applications. 9: 555-572.

Franco, P.A.; Weaver, P.L.; Eggen-McIntosh, S. 1997. Forest resources of Puerto Rico, 1990. Resour. Bull. SRS–22. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 45 p.

Frangi, J.L.; Lugo, A.E. 1985. Ecosystem dynamics of a subtropical floodplain forest. Ecological Monographs. 55: 351-369.

Fromard, F.; Puig, H.; Mougin, E. [and others]. 1998. Structure, above-ground biomass and dynamics of mangrove ecosystems: new data from French Guiana. Oecologia. 115: 39-53.

Gibney, E.; O'Reilly, T.T.; Devine, B. 2000. U.S. Virgin Islands vegetation community classification system. The Virgin Islands data atlas series. St. Thomas: The Nature Conservancy and Virgin Islands Conservation Data Center. 10 p. http://cdc.uvi.edu/reaweb/vegbody.html. [Date accessed: December 22, 2006].

Haagensen, R. 1995. Description of the islands of St. Croix in America in the West Indies. St. Thomas, U.S. Virgin Islands: Virgin Islands Humanities Council. [Number of pages unknown]. [Translated to English by A.R. Highfield].

International Union for Conservation of Nature and Natural Resources. 2006. IUCN red list of threatened species. http://www.iucnredlist.org. [Date accessed: June 15].

Little, E.L.; Wadsworth, F.H. 1989. Common trees of Puerto Rico and the Virgin Islands. 2d ed. Washington, DC: U.S. Department of Agriculture Forest Service. 556 p.

Little, E.L.; Woodbury, R.O.; Wadsworth, F.H. 1974. Trees of Puerto Rico and the Virgin Islands. Agric. Handb. 449. Washington, DC: U.S. Department of Agriculture Forest Service. 1,024 p.

Lugo, A.E. 2004. The outcome of alien tree invasions in Puerto Rico. Frontiers in Ecology and the Environment. 2: 265-273.

Lugo, A.E.; Brandeis, T.J. 2005. A new mix of alien and native species coexists in Puerto Rico's landscapes. In: Burslem, D.F.R.P.; Pinard, M.A.; Hartley, S.E., eds. Biotic interactions in the tropics: their role in the maintenance of species diversity. Cambridge, UK: Cambridge University Press: 484-509. Chapter 20.

Lugo, A.E.; Helmer, E.H. 2004. Emerging forests on abandoned land: Puerto Rico's new forests. Forest Ecology and Management. 190: 145-161.

McCollum, J. 2001. Honeycombing the icosahedron and icosahedroning the sphere. In: Reams, G.A.; McRoberts, R.E.; Van Deusen, P.C., eds. Proceedings of the second annual forest and inventory symposium. Gen. Tech. Rep. SRS–47. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station: 25-31.

McCune, B.; Grace, J.B. 2002. Analysis of ecological communities. Gleneden Beach, OR: MjM Software Design: 56-16.

McDowell, W.H. 2001. Hurricanes, people, and riparian zones: controls on nutrient losses from forested Caribbean watersheds. Forest Ecology and Management. 154: 443-451.

Molina, S.; Alemañy, S. 1997. Species codes for the trees of Puerto Rico and the U.S. Virgin Islands. Gen. Tech. Rep. SO–122. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 67 p.

Myers, N.; Mittermeier, R.A.; Mittermeier, C.G. [and others]. 2000. Biodiversity hotspots for conservation priorities. Nature. 403: 853-858.

Nabuurs, G.J.; Ravindranath, N.H.; Paustian, K. [and others]. 2003. LUCF sector good practice guidance. In: Penman, J.; Gytarsky, M.; Hiraishi, T. [and others], eds. Good practice guidance for land use, land-use change, and forestry. Hayama, Kanagawa, Japan: IPCC National Greenhouse Gas Inventories Program, Technical Support Unit: 3.1-3.95. Chapter 3.

Pierce, S.; Hultgren, P., eds. 1997. Forest products of the U.S. Virgin Islands. An overview of trends in forest products use. St. Croix, U.S. Virgin Islands: Virgin Islands Resource Conservation and Development Council. 31 p.

Rankin, D.W. 2002. Geology of St. John, U.S. Virgin Islands. U.S. Geological Survey Prof. Pap. 1631. Reston, VA: U.S. Department of the Interior, U.S. Geological Survey. 36 p.

Ray, G.J.; Brown. B. 1995. The structure of five successional stands in a subtropical dry forest, St. John, U.S. Virgin Islands. Caribbean Journal of Science. 31: 212-222.

Ray, G.J.; Dallmeier, F.; Comiskey, J.A. 1998. The structure of two subtropical dry forest communities on the island of St. John, U.S. Virgin Islands. In: Dallmeier, F.; Comiskey, J.A., eds. Forest biodiversity in North, Central and South America, and the Caribbean. Washington, DC: Parthenon Publishing Group: 367-384.

Reams, G.A.; Smith, W.D.; Hansen, M.H. [and others]. 2005. The forest inventory and analysis sampling frame. In: Bechtold, W.A.; Patterson, P.L., eds. The enhanced forest inventory and analysis program—national sampling design and estimation procedures. Gen. Tech. Rep. SRS–80. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station: 11-26.

Reilly, A.E. 1998. Hurricane Hugo: winds of change...or not? Forest dynamics on St. John, U.S. Virgin Islands, 1986-1991. In: Dallmeier, F.; Comiskey, J.A., eds. Forest biodiversity in North, Central and South America, and the Caribbean. Washington, DC: Parthenon Publishing Group: 349-365.

Rivera, L.H.; Frederick, W.D.; Farris, C. [and others]. 1970. Soil survey of the Virgin Islands of the United States. Washington, DC: U.S. Department of Agriculture, Soil Conservation Service. [Number of pages unknown].

Rogers, C.S. 1998. Coral reefs of the U.S. Virgin Islands. In: Mac, M.J.; Opler, P.A.; Puckett Haecker, C.E. [and others], eds. Status and trends of the nation's biological resources. Reston, VA: U.S. Department of the Interior, U.S. Geological Survey. 10 p.

Rogozinski, J. 2000. A brief history of the Caribbean—from the Arawak and Carib to the present. Revised. New York: Penguin Group. [Number of pages unknown].

SAS Institute Inc. 2001. SURVEYMEANS procedure. Version 8.02. Cary, NC: SAS Institute Inc. [Number of pages unknown].

Silver, W.L.; Kueppers, L.M.; Lugo, A.E. [and others]. 2004. Carbon sequestration and plant community dynamics following reforestation of tropical pasture. Ecological Applications. 14: 1115-1127.

Smith, W.D.; Conkling, B.L. 2005. Analyzing forest health data. Gen. Tech. Rep. SRS–77. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 33 p.

Somberg, S.I. 1976. Virgin Islands forestry research: a problem analysis. Rep. 9. St. Croix, U.S. Virgin Islands: College of the Virgin Islands, Virgin Islands Agricultural Experiment Station. 14 p.

The Nature Conservancy. 2003. Forest legacy for the U.S. Virgin Islands: an assessment of need. Report prepared for the Virgin Islands Department of Agriculture, St. Thomas, U.S. Virgin Islands. Arlington, VA: The Nature Conservancy. 54 p.

Thomas, T.; Devine, B. 2005. Island peak to coral reef, a field guide to the plant and marine communities of the Virgin Islands. U.S. Virgin Islands: University of the Virgin Islands. 214 p.

U.S. Department of Agriculture Forest Service. 1992. Forest service resource inventories: an overview. Washington, DC. 39 p.

U.S. Department of Agriculture Forest Service. 2002. Field procedures for Puerto Rico and the Virgin Islands. Supplement C to SRS Regional Manual 1.56. http://srsfia2.fs.fed.us/data_acquisition/manual.shtml. [Date accessed: August 31].

U.S. Department of Agriculture, Natural Resources Conservation Service. 2006. The PLANTS database. http://plants.usda.gov. [Data accessed: June 15].

U.S. Department of the Interior. 2006. Virgin Islands. Washington, DC: The Department of the Interior, Office of Insular Affairs. http://www.doi.gov/oia/Islandpages/vipage.htm. [Date accessed: October 3].

Virgin Islands Conservation Data Center. 2001. U.S. Virgin Islands rapid ecological assessment: vegetation community classification GIS maps for St. Croix, St. John, and St. Thomas. St. Thomas, U.S. Virgin Islands: University of the Virgin Islands, Eastern Caribbean Center, and The Nature Conservancy.

References

Ward, S.; Rodriguez, A.; Morgan, R. 2000. Estate Thomas Experimental Forest: past, present and future. In: Zimmerman, T.W., ed. Proceedings of the 5th annual Caribbean urban forestry conference. St. Croix, U.S. Virgin Islands: University of the Virgin Islands, Cooperative Extension Service: 105-114.

Weaver, P.L. 1994. Effects of Hurricane Hugo on trees in the Cinnamon Bay watershed, St. John, U.S. Virgin Islands. Caribbean Journal of Science. 30: 255-261.

Weaver, P.L. 1996. Regional forest research committee report to the seventh American forest congress: Puerto Rico and the U.S. Virgin Island Region. Río Piedras, PR: U.S. Department of Agriculture Forest Service, International Institute of Tropical Forestry. 16 p.

Weaver, P.L. 1998a. The effects of environmental gradients on hurricane impact in Cinnamon Bay watershed, St. John, U.S. Virgin Islands. In: Dallmeier, F.; Comiskey, J.A., eds. Forest biodiversity in North, Central and South America, and the Caribbean. Washington, DC: Parthenon Publishing Group: 333-348.

Weaver, P.L. 1998b. Hurricane effects and long-term recovery in a subtropical rain forest. In: Dallmeier, F.; Comiskey, J.A., eds. Forest biodiversity in North, Central and South America and the Caribbean—research and monitoring. Washington, DC: Parthenon Publishing Group: 249-270. Chapter 13.

Weaver, P.L. 2006. Estate Thomas Experimental Forest, St. Croix, U.S. Virgin Islands: research history and potential. Gen. Tech. Rep. IITF–30. San Juan, PR: U.S. Department of Agriculture Forest Service, International Institute of Tropical Forestry.

Weaver, P.L.; Chinea, J.D. 1987. A phytosociological study of Cinnamon Bay watershed, St. John, U.S. Virgin Islands. Caribbean Journal of Science. 23: 318-336.

Whittaker, R.H. 1975. Communities and ecosystems 2d ed. New York: Macmillan Publishing Co.: 87-88.

Wiley, J.W.; Vilella, F.J. 1998. Caribbean Islands. In: Mac, M.J.; Opler, P.A.; Puckett Haecker, C.E.; Doran, P.D., eds. Status and trends of the nation's biological resources. Reston, VA: U.S. Department of the Interior, U.S. Geological Survey: 337-343.

Woodall, C.; Williams, M.S. 2005. Sampling protocol, estimation, and analysis procedures for down woody materials indicator of the FIA Program. Gen. Tech. Rep. NC–256. St. Paul, MN: U.S. Department of Agriculture Forest Service, North Central Research Station. 47 p.

Woodbury, R.O.; Weaver, P. L. 1987. The vegetation of St. John and Hassel Island, U.S. Virgin Islands. Res./Resour. Manage. Rep. SER–83. Atlanta: U.S. Department of the Interior, National Park Service. 103 p.

Wunderle, J.M.; Waide, R.B. 1993. Distribution of overwintering nearctic migrants in the Bahamas and Greater Antilles. The Condor. 95: 904-933.

Zarnoch, S.J.; Bechtold, W.A. 2000. Estimating mapped-plot forest attributes with ratios of means. Canadian Journal of Forest Research. 30: 688-697.

Aboveground biomass and carbon. Total oven-dry biomass in kg of all live aboveground tree parts, including stem, stump, branches, bark, seeds, and foliage, as estimated from regression equations that predict aboveground biomass from individual tree d.b.h. and total height measurements. Carbon is calculated by multiplying estimated total biomass of all trees with d.b.h. ≥2.5 cm by a factor of 0.5.

Basal area. The area in m^2 of the cross section at breast height of a single tree or of all the trees in a stand, usually expressed in m^2/ha.

Belowground biomass and carbon. Total oven-dry biomass in kg of all live belowground tree parts, as estimated using a regression equation that models the relationship between aboveground biomass and belowground biomass (Cairns and others 1997). Carbon is calculated by multiplying biomass by a factor of 0.5. Estimated for all trees with d.b.h. ≥2.5 cm.

Bole. That portion of a tree between a 30-cm high stump and a 10-cm top d.o.b. in trees 12.5 cm d.b.h. and larger.

Census water. Streams, sloughs, estuaries, canals, and other moving bodies of water 200 m wide and greater, and lakes, reservoirs, ponds, and other permanent bodies of water 1.8 ha in area and greater.

Coarse woody debris. Down pieces of wood with a minimum small-end diameter of at least 8 cm and a length of at least 0.9 m (excluding decay class 5). Coarse woody material pieces must be detached from a bole and/or not be self-supported by a root system, and must have a lean angle of more than 45 degrees from vertical. These pieces of down wood comprise the 1,000+ fuel-hour class, also.

Commercial species. Tree species currently or potentially suitable for industrial wood products.

Condition class. The combination of discrete landscape and forest attributes that identify, define, and stratify the area associated with a plot. Examples of such attributes include condition status, forest type, stand origin, stand size, owner group, reserve status, and stand density.

Crown class. Rating of tree crowns in relation to the sunlight received and proximity of neighboring trees.

Open grown. Trees with crowns that received full light from above and from all sides throughout most of their life, and especially during their early developmental period.

Dominant. Trees with crown extending above the general level of the crown cover and receiving full direct light from above and some from the sides. These trees are taller than the average trees in the stand and their crowns are well developed, but they can be somewhat crowded on the sides.

Codominant. Trees with crowns at the general level of the crown canopy. Crowns receive full light from above but little direct sunlight from their sides. Usually they have medium-sized crowns and are somewhat crowded on their sides. In stagnated stands, codominant trees have small-sized crowns and are crowded on the sides.

Intermediate. Trees that are shorter than dominants and codominants, but have a crown that extends into the canopy of codominant and dominant trees. They receive little direct light from above and none from the sides. As a result, intermediates usually have small crowns and are very crowded from the sides.

Overtopped. Trees with crowns entirely below the general level of the crown canopy that receive no direct sunlight either from above or the sides.

Crown density. The amount of crown stem, branches, twigs, shoots, buds, foliage, and reproductive structures that block light penetration through the visible crown. Dead branches and dead tops are part of the crown. Live and dead branches below the live crown base are excluded. Broken or missing tops are visually reconstructed when forming this crown outline by comparing this crown outline with those of adjacent healthy trees of the same species and d.b.h.

Crown dieback. This is recent mortality of branches with fine twigs, which begins at the terminal portion of a branch and proceeds toward the trunk. Dieback is only considered when it occurs in the upper and outer portions of the tree. When whole branches are dead in the upper crown, without obvious signs of damage such as breaks or animal injury, assume that the branches died from the terminal portion of the branch. Dead branches in the lower portion of the live crown are assumed to have died from competition and shading. Dead branches in the lower live crown are not considered as part of crown dieback, unless there is continuous dieback from the upper and outer crown down to those branches.

Crown ratio, compacted. Percentage determined by dividing the live crown length by the total live tree height, where live crown length is determined by field crew by ocularly transferring lower live branches to fill in large holes in the upper portion of the tree until a full, even crown is visualized.

Crown ratio, uncompacted. Percentage determined by dividing the live crown length by the total live tree height, where live crown length is the distance between live crown top and lowest live foliage.

D.b.h. Tree diameter in cm (outside bark) at breast height (1.37 m aboveground).

Decay class. Rating of individual coarse woody material according to a five-class decay scale defined by the texture, structural integrity, and appearance of pieces. Scale ranges from freshly fallen trees (decay class 1) to completely decomposed cubical rot heaps (decay class 5).

Diameter class. A classification of trees based on tree d.b.h. For example, the 20-cm class includes trees 15.0 through 24.9 cm d.b.h.

D.o.b. (diameter outside bark). Stem diameter including bark.

Down woody material. Woody pieces of trees and shrubs that have been uprooted (roots no longer support growth) or severed from their root system, are not self-supporting, and are lying on the ground.

Duff. A soil layer dominated by organic material derived from the decomposition of plant and animal litter and deposited on either an organic or a mineral surface. This layer is distinguished from the litter layer in that the original organic material has undergone sufficient decomposition that the source of this material, e.g., individual plant parts, can no longer be identified.

Epiphyte and vine density. Additional crown density percentage comprised of epiphytic plants and vines in the tree crown.

Fine woody debris. Down pieces of wood with a diameter ≤ 8 cm, not including foliage or bark fragments. These pieces of down wood comprise the medium (0.7 to 8 cm diameter) and small fuel-hour classes (0 to 0.6 cm diameter), also.

Foliage transparency. The amount of skylight visible through microholes in the live portion of the crown, i.e. where you see foliage, normal or damaged, or remnants of its recent presence. Recently defoliated branches are included in foliage transparency measurements. Macroholes are excluded unless they are the result of recent defoliation. Dieback and dead branches are always excluded from the estimate. Foliage transparency is different from crown density because it emphasizes foliage and ignores stems, branches, fruits, and holes in the crown.

Forest fire fuels. Accumulated mass of coarse and fine down woody debris above the top of the duff layer (excluding live shrubs and herbs). Forest fire fuel-hour classes are further defined by the approximate amount of time it takes for moisture conditions to fluctuate. Larger coarse woody debris takes longer to dry out than smaller fine woody pieces.

Diameter *cm*	Down woody material class name	Fuel-hour class
0.0–0.6	Small-fine woody debris	1
0.7–2.4	Medium-fine woody debris	10
2.5–7.5	Large-fine woody debris	100
7.6+	Coarse woody debris	1,000+

Forest floor. The entire thickness of organic material overlying the mineral soil, consisting of the litter and the duff (humus).

Forest land. In the Caribbean, land where forest trees of any size provide at least 10 percent canopy coverage, or land formerly having such tree cover and not currently developed for a nonforest use. Only areas at least 0.4 ha in size may be classified as forest land. Roadside, streamside, and shelterbelt strips of trees must have a crown width of at least 37 m to qualify as forest land. Grazed woodlands, reverting fields, and pastures that are not actively maintained are also included as forest land if the above size requirements are met.

Forest life zone. A classification of forest land based on life zone and forest type.

Subtropical dry forest. Found in areas with 600 to 1100 mm of annual precipitation. Some of the native tree species that are common in subtropical dry forest in the U.S. Virgin Islands are gumbo limbo [*Bursera simaruba* (L.) Sarg.], torchwood (*Amyris elemifera* L.), Jamaican caper (*Capparis cynophallophora* L.), black manjack (*Cordia rickseckeri* Millsp.), water mampoo (*Pisonia subcordata* Sw.), lignum vitae (*Guaiacum officinale* L.), white frangipani (*Plumeria alba* L.), and fustic [*Pictetia aculeata* (Vahl) Urban]. The more heavily disturbed dry forest areas have numerous, smaller stemmed tan tan [*Leucaena leucocephala* (Lam.) deWit], *Prosopis juliflora* (Sw.) DC., stink kasha (*Acacia macracantha* Humb. & Bonpl.), and casha [*Acacia farnesiana* (L.) Willd.] individuals.

Subtropical moist forest. Found in areas with 1000 to 2200 mm of annual precipitation. Some of the many natural indicator species of subtropical moist forest in the U.S. Virgin Islands include the dog almond [*Andira inermis* (W. Wright) Kunth ex DC.], black mampoo [*Guapira fragrans* (Dum.-Cours.) Little], yellow mombin (*Spondias mombin* L.), gregre (*Bucida buceras* L.), sandbox tree (*Hura crepitans* L.), kapoktree [*Ceiba pentandra* (L.) Gaertn.], cigar box cedar (*Cedrela odorata* L.), bayrumtree (*Pimenta racemosa* var. *racemosa*), royal palm (*Roystonea borinquena* O.F. Cook) (on St. Croix only), stinkingtoe (*Hymanaea courbaril* L.), pumpwood (*Cecropia schreberiana* Miq.), and white cedar [*Tabebuia heterophylla* (DC.) Britt.]. While subtropical moist forests have some of the same introduced species found in subtropical dry forest, tamarind (*Tamarindus indica* L.) and genip (*Melicoccus bijugatus* Jacq.) are also commonly found.

Mangrove forest. Mangrove forests comprised of *Rhizophora mangle* L., *Avicennia nitidia* Jacq., *Laguncularia racemosa* (L.) Gaertn. f., and *Conocarpus erectus* L. are found along the coastlines and estuaries.

Nonstocked stands. Stands with < 10 percent stocking or canopy coverage of live trees.

Forested tract size. The area of forest within the contiguous tract containing each FIA sample plot.

Fuel bed. Accumulated mass of all down woody material components above the top of the duff layer (excluding live shrubs and herbs).

Growing-stock trees. Living trees of commercial species classified as sawtimber, poletimber, saplings, and seedlings. For a tree to be considered growing stock, one-third or more of the gross volume in its saw-log section must meet grade, soundness, and size requirements for commercial logs, or the tree must have the potential to meet these requirements if it is poletimber size with 12.5 cm ≤ d.b.h. ≤ 27.5 cm.

Growing-stock volume. The m^3 volume of sound wood in growing-stock trees at least 12.5 cm d.b.h. from a 30-cm stump to a minimum 10-cm top d.o.b. of the central stem.

Land area. The area of dry land and land temporarily or partly covered by water, such as marshes, swamps, and river floodplains (omitting tidal flats below mean high tide), streams, sloughs, estuaries, and canals < 61 m wide, and lakes, reservoirs, and ponds < 1.8 ha in area.

Life zone. The Holdridge life zone model defines ecological life zones using mean annual precipitation and mean annual biotemperature. The forested life zones found on the U.S. Virgin Islands are subtropical dry forest, subtropical moist forest, subtropical wet forest, subtropical rain forest, subtropical lower montane wet forest, and subtropical lower montane rain forest.

Litter. Undecomposed or only partially decomposed organic material that can be readily identified, e.g., plant leaves, twigs, etc.

Live trees. All living trees. All size classes, all tree classes, and both commercial and noncommercial species are included.

Measurement quality objective (MQO). A data user's estimate of the precision, bias, and completeness of data necessary to satisfy a prescribed application, e.g., Resource Planning Act, assessments by State foresters, forest planning, forest health analyses. Describes the acceptable tolerance for each data element. MQOs consist of two parts: (1) a statement of the tolerance and (2) a percentage of time when the collected data are required to be within tolerance. MQOs can only be assigned where standard methods of sampling or field measurements exist, or where experience has established upper or lower bounds on precision or bias. MQOs can be set for measured data elements, observed data elements, and derived data elements.

Merchantable stem volume. The m^3 volume of sound wood in live trees at least 12.5 cm d.b.h. from a stump height of 30 cm to a minimum 10-cm top d.o.b. of the central stem, estimated by applying regression equations that use d.b.h. and total tree height to individual trees. Merchantable stem volume is not estimated for palms and tree ferns.

Mineral soil. A soil consisting predominantly of products derived from the weathering of rocks, e.g., sands, silts, and clays.

Noncommercial species. Tree species typically of small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonforest land. Land that has never supported forests, and formerly forested land where timber production is precluded by development for other uses.

Nonstocked stands. Stands < 10 percent stocked with live trees.

Other forest land. Forest land other than timberland and productive reserved forest land. It includes available and reserved forest land which is incapable of producing annually 1.4 m^3/ha of industrial wood under natural conditions, because of adverse site conditions such as sterile soils, dry climate, poor drainage, high elevation, steepness, or rockiness.

Ownership. The property owned by one ownership unit, including all parcels of land in the United States.

National forest land. Federal land that has been legally designated as national forests or purchase units, and other land under the administration of the Forest Service, including experimental areas and Bankhead-Jones Title III land.

Forest industry land. Land owned by companies or individuals operating primary wood-using plants.

Nonindustrial private forest land. Privately owned land that is not forest industry land.

Corporate. Owned by corporations, including incorporated farm ownerships.

Individual. All lands owned by individuals, including farm operators.

Other public. An ownership class that includes all public lands except national forests.

Miscellaneous Federal land. Federal land other than national forests.

State, county, and municipal land. Land owned by States, counties, and local public agencies or municipalities or land leased to these governmental units for 50 years or more.

Phase 1 (P1). FIA activities related to remote sensing, the primary purpose of which is to label plots and obtain stratum weights for population estimates.

Phase 2 (P2). FIA activities conducted on the network of ground plots. The primary purpose is to obtain field data that enable classification and summarization of area, tree, and other attributes associated with forest land uses.

Phase 3 (P3). A subset of phase 2 plots where additional attributes related to forest health are measured.

Poletimber-size trees. Softwoods 12.5 to 22.6 cm d.b.h. and hardwoods 12.5 to 27.5 cm d.b.h.

Reversion. Land that was in a nonforest condition and is in the process of reverting to forest land.

Rotten trees. Live trees of commercial species not containing at least one 3.7-m saw log, or two noncontiguous saw logs, each 2.4 m in length or longer, now or prospectively, primarily because of rot or missing sections, and with less than one-third of the gross board-foot tree volume in sound material.

Rough trees. Live trees of commercial species not containing at least one 3.7-m saw log, or two noncontiguous saw logs, each 2.4 m in length or longer, now or prospectively, primarily because of roughness, poor form, or splits and cracks, and with less than one-third of the gross m^3 tree volume in sound material; and live trees of noncommercial species.

Saplings. Live trees 2.5 to 12.4 cm d.b.h.

Saw log. A log meeting minimum standards of diameter, length, and defect, including logs at least 2.4 m long, sound and straight, with a minimum diameter inside bark of 15 cm for softwoods or 20 cm for hardwoods.

Saw-log portion. The part of the bole of sawtimber trees between a stump height of 30 cm and the saw-log top.

Seedlings. Hardwood trees $<$2.5 cm d.b.h. and $>$30 cm tall, and softwood trees $<$ 2.5 cm d.b.h. and $>$15 cm tall.

Standard error of the estimate. The standard error of the estimates presented here was calculated using the formula for variance of the product of two independent variables, where X and Y are the mean values being multiplied together, and Var_Y and Var_X are their respective variance estimates.

$$SE_{XY} = \sqrt{\left(X^2\, Var_Y\right) + \left(Y^2\, Var_X\right)}$$

Standard error of the mean. The standard error of the mean is as follows, where s is the sample standard deviation and N is the sample size.

$$SE_Y = {}^{s}\!/\!\sqrt{N}$$

Stand-size class. A classification of forest land based on the diameter class distribution of live trees in the stand.

Nonstocked stands. Stands having $<$10 percent stocking or $<$ 10 percent canopy coverage with live trees.

Sapling-seedling stands. Stands that are at least 10 percent stocked with live trees with a d.b.h. $\leq$12.5 cm and in which saplings and seedlings account for more than one-half of total stocking.

Small diameter stands. Stands at least 10 percent stocked with live trees and in which trees with d.b.h. from 12.5 to 22.4 cm account for at least one-half of total stocking.

Medium diameter stands. Stands at least 10 percent stocked with live trees and in which trees with d.b.h. from 22.5 to 49.9 cm account for at least one-half of total stocking.

Large diameter stands. Stands at least 10 percent stocked with live trees and in which trees with d.b.h. $\geq$50 cm account for at least one-half of total stocking.

Stocking. The degree of occupancy of land by trees, measured by basal area or the number of trees in a stand and spacing in the stand, compared with a minimum standard, depending on tree size, required to fully utilize the growth potential of the land. FIA classifies land in the Caribbean as stocked if that land has at least 10 percent canopy coverage by forest trees of any size.

Density of trees and basal area per ha required for full stocking

D.b.h. class (cm)	Trees per hectare	Basal area (m²) per hectare
Seedlings	1,500	—
5	1,400	—
10	1,150	—
15	850	15.0
20	600	18.8
25	400	19.6
30	300	21.2
35	250	21.6
40	200	22.6
45	150	23.8
50	130	25.5

— = not applicable.

Timberland. Forest land capable of producing at least 1.4 m^3 of industrial wood/ha/year and not withdrawn from timber utilization.

Timber products. Roundwood products and byproducts.

Transect diameter. Diameter of coarse woody pieces at the point of intersection with sampling planes.

Tree. Woody plant having at maturity one erect perennial stem or trunk at least 7.6 cm d.b.h., a more or less definitely formed crown of foliage, and a height of at least 4 m.

Upper-stem portion. The part of the main stem or fork of sawtimber trees above the saw-log top to a minimum top diameter of 10 cm outside bark or to the point where the main stem or fork breaks into limbs.

Volume of live trees. The m^3 volume of sound wood in live trees at least 12.5 cm d.b.h. from a stump height of 30 cm to a minimum 10-cm top d.o.b. of the central stem.

Volume of saw-log portion of sawtimber trees. The m^3 volume of sound wood in the saw-log portion of sawtimber trees. Volume is the net result after deductions for rot, sweep, and other defects that affect use for lumber.

Fustic [*Pictetia aculeata* (Vahl) Urban] is found in the subtropical dry forest of the U.S. Virgin Islands. *(photo by Tom Brandeis)*

Table A.1—Number of forest inventory and forest health monitoring sampling points[a] on St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, by forest life zone and forested status in 2004

		Forest inventory		Forest health monitoring		
Survey unit	Forest life zone[b]	Forested[c]	Nonforest	Forested	Nonforest	Total
		number				
St. Croix	Subtropical dry	21	18	6	4	49
	Subtropical moist	6	1	1	0	8
	Unit subtotal	27	19	7	4	57
St. John	Subtropical dry	0	0	12	7	19
	Subtropical moist	0	0	8	1	9
	Unit subtotal	0	0	20	8	28
St. Thomas	Subtropical dry	4	5	0	0	9
	Subtropical moist	7	11	1	0	19
	Unit subtotal	11	16	1	0	28
All units	All life zones	38	35	28	12	113

[a] FIA uses a systematic network of ground plots to collect field data on forest area, trees, and other attributes associated with forest land uses.

[b] Forest life zone is a classification of forest land based on Holdridge life zone and forest type.

[c] To be classified as forest land by FIA, land in the Caribbean must have at least 10 percent canopy coverage of forest trees of any size, or must be land that formerly had such tree cover and is not currently developed for a nonforest use. The minimum area for classification as forest land is 0.4 ha. Roadside, streamside, and shelterbelt strips of trees must have a crown width of at least 36 m to qualify as forest land. Grazed woodlands, reverting fields, and pastures that are not actively maintained are also included as forest land if the above size requirements are met.

Table A.2—Equations used to predict aboveground[a] and belowground[b] oven-dry biomass in the U.S. Virgin Islands

Forest life zone or species	Equation	Source
Subtropical moist forest	$AGB = e^{(-1.71904 + 0.78214 * \ln D_{bh}^{2} H_T)}$	Brandeis and others (2006)
Subtropical dry forest	$AGB = e^{(-1.94371 + 0.84134 * \ln D_{bh}^{2})}$	Brandeis and others (2006)
Bucida buceras, all forest-type groups	$AGB = e^{(-1.76887 + 0.86389 * \ln D_{bh}^{2})}$	Brandeis and others (2006)
Prestoea montana, all forest-type groups	$AGB = 10.0 + 6.4 * H_T$	Frangi and Lugo (1985), Brown (1997)
Rhizophora mangle, mangrove	$AGB = [125.957 * (D_{bh}^{2} H_T{}^{0.8557})] / 1000$	Cintrón and Schaeffer-Novelli (1984)
Laguncularia racemosa, mangrove	$AGB = [70.0513 * (D_{bh}^{2} H_T{}^{0.9084})] / 1000$	Cintrón and Schaeffer-Novelli (1984)
Avicennia germinans, mangrove	$AGB = 0.14 * (D_{bh}^{2.4})$	Fromard and others (1998)
Belowground biomass, all forest types	$BGB = e^{(-1.0587 + 0.8836 \ln AGB)}$	Cairns and others (1997)

AGB = oven-dry aboveground biomass in kilograms; D_{bh} = diameter in centimeters at 1.37 m; H_T = total tree height in meters; BGB = oven-dry belowground biomass in kilograms.

[a] Oven-dry biomass, of all live aboveground tree parts, including stem, stump, branches, bark, seeds, and foliage, as estimated from regression equations that predict aboveground biomass from individual tree d.b.h. and total height measurements.

[b] Oven-dry biomass of all live belowground tree parts is estimated from a regression equation modeling the relationship between aboveground biomass and belowground biomass (Cairns and others 1997).

Table A.3—Total land area and forest[a] area by forest life zone for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, 1994 and 2004, with forest cover change

Survey unit and forest life zone	Total land area	1994			2004			Forest change 1994-2004	
		Forest area	Standard error	Forest cover	Forest area	Standard error	Forest cover	Change	Change in remaining forest
	- - - - - - - - - - *ha* - - - - - - - - - -			*%*	- - - - - - *ha* - - - - - -		*%*	*ha*	*%*[b]
St. Croix									
Subtropical dry	18 020	8 642	737	48.0	7 655	653	42.5	- 986	-11.4
Subtropical moist	3 447	2 895	528	84.0	2 964	—	86.0	69	2.4
All life zones	21 466	11 537	925	53.7	10 619	811	49.5	- 918	-8.0
St. John									
Subtropical dry	3 191	2 973	113	93.2	2 828	107	88.6	- 145	-4.9
Subtropical moist	1 889	1 824	—	96.6	1 824	—	96.6	0	0
All life zones	5 080	4 797	128	94.4	4 652	150	91.6	- 145	-3.0
St. Thomas									
Subtropical dry	2 869	2 357	690	82.1	2 049	170	71.4	- 307	-13.0
Subtropical moist	5 222	4 218	769	80.8	3 916	638	75.0	- 301	-7.1
All life zones	8 091	6 574	1 031	81.3	5 966	816	73.7	- 609	-9.3
All islands									
Subtropical dry	24 080	13 972	826	58.0	12 533	765	52.0	-1 439	-10.3
Subtropical moist	10 558	8 937	867	84.6	8 704	767	82.4	- 232	-2.6
All life zones	34 637	22 908	1 161	66.1	21 237	467	61.3	-1 671	-7.3

— = not estimated due to insufficient sample.

[a] To be classified as forest land by FIA, land in the Caribbean must have at least 10 percent canopy coverage of forest trees of any size, or must be land that formerly had such tree cover and is not currently developed for a nonforest use. The minimum area for classification as forest land is 0.4 ha. Roadside, streamside, and shelterbelt strips of trees must have a crown width of at least 36 m to qualify as forest land. Grazed woodlands, reverting fields, and pastures that are not actively maintained are also included as forest land if the above size requirements are met.

[b] This percentage represents the change in forested area, not total land area, between 1994 and 2004. For example, by 2004, St. Croix had lost 8.0 percent of the forest found there in 1994.

Table A.4—Number of live trees with d.b.h. ≥ 2.5 cm by forest life zone for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, with standard error of the estimate

			Forest life zone			
	All life zones		Subtropical dry		Subtropical moist	
Survey unit	Live trees	Standard error	Live trees	Standard error	Live trees	Standard error
	number					
St. Croix	43,410,869	6,020,464	29,958,116	5,088,430	13,452,753	—
St. John	26,765,031	2,372,091	14,516,258	1,477,149	12,248,773	—
St. Thomas	20,749,685	6,885,593	2,065,131	1,265,477	18,684,554	5,559,664
All units	90,925,585	8,858,440	46,539,505	6,102,902	44,386,080	6,426,290

— = not estimated due to insufficient sample.

Table A.5—Number of live trees with d.b.h. ≥ 2.5 cm by forest life zone and diameter class for the U.S. Virgin Islands

		Diameter class (*cm at breast height*)						
Forest life zone	All classes	0–10	10	20	30	40	50	60+
	number							
Subtropical dry	46,539,505	27,062,404	12,968,422	5,285,243	734,062	342,562	97,875	48,937
Subtropical moist	44,386,080	21,353,010	12,302,369	8,346,100	1,734,255	270,977	108,391	270,977
All life zones	90,925,585	48,415,414	25,270,790	13,631,344	2,468,316	613,539	206,266	319,915

Table A.6—Basal area[a] of live trees with d.b.h. ≥ 2.5 cm by forest life zone for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, with standard error of the estimate

			Forest life zone			
	All life zones		Subtropical dry		Subtropical moist	
Survey unit	Basal area	Standard error	Basal area	Standard error	Basal area	Standard error
	m^2					
St. Croix	92 469	19 006	53 432	10 875	39 036	—
St. John	94 726	14 016	46 186	8 084	48 539	—
St. Thomas	60 487	19 466	6 599	6 233	53 889	14 076
All units	247 682	36 237	106 218	19 629	141 464	29 085

[a] Basal area is the area in square meters of the cross section at breast height of a single tree or of all the trees in a stand, usually expressed in square meters per hectare.

Table A.7—Basal area[a] of live trees with d.b.h. ≥ 2.5 cm by forest life zone and diameter class for the U.S. Virgin Islands

Forest life zone	All classes	Diameter class (*cm at breast height*)						
		0–10	10	20	30	40	50	60+
	m²							
Subtropical dry	106 218	7 325	24 774	41 253	13 381	10 966	4 628	3 892
Subtropical moist	141 464	4 864	21 447	52 025	23 892	7 479	4 749	27 008
All life zones	247 682	12 189	46 220	93 278	37 273	18 445	9 377	30 899

[a] Basal area is the area in square meters of the cross section at breast height of a single tree or of all the trees in a stand, usually expressed in square meters per hectare.

Table A.8—Merchantable stem volume,[a] inside bark, of live trees with d.b.h. ≥ 12.5 cm by forest life zone for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, with standard error of the estimate

			Forest life zone			
	All life zones		Subtropical dry		Subtropical moist	
Survey unit	Stem volume	Standard error	Stem volume	Standard error	Stem volume	Standard error
	m³					
St. Croix	50 843	33 460	19 750	20 437	31 093	—
St. John	40 336	32 580	12 756	12 980	27 580	—
St. Thomas	39 435	28 920	26 354	26 438	13 080	16 236
All units	130 614	70 103	58 860	32 516	71 754	67 473

— = not estimated due to insufficient sample.

[a] Volume of live trees is the cubic-meter volume of sound wood in live trees at least 12.5 cm d.b.h. from a 30-cm stump height to a minimum 10-cm top d.o.b. of the central stem.

Table A.9—Merchantable stem volume,[a] inside bark, of live trees with d.b.h. ≥ 12.5 cm by forest life zone and diameter class for the U.S. Virgin Islands

Forest life zone	All classes	Diameter class (*cm at breast height*)					
		10[b]	20	30	40	50	60+
	m³						
Subtropical dry	58 860	11 631	26 872	7 360	7 502	3 256	2 240
Subtropical moist	71 754	6 021	26 846	16 882	4 564	3 223	14 218
All life zones	130 614	17 652	53 718	24 242	12 066	6 479	16 457

[a] Volume of live trees is the cubic-meter volume of sound wood in live trees at least 12.5 cm d.b.h. from a 30-cm stump height to a minimum 10-cm top d.o.b. of the central stem.

[b] Note that the 10-cm d.b.h. class is truncated at 12.5 cm.

Table A.10—Aboveground biomass[a] of live trees with d.b.h. ≥ 2.5 cm, by forest life zone for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, with standard error of the estimate

			Forest life zone			
	All life zones		Subtropical dry		Subtropical moist	
Survey unit	Biomass	Standard error	Biomass	Standard error	Biomass	Standard error
	- *Mg* -					
St. Croix	336 663	64 523	203 548	45 256	133 115	—
St. John	357 996	50 875	186 895	33 375	171 100	—
St. Thomas	205 338	68 133	26 088	25 564	179 250	45 826
All units	899 997	130 393	416 531	81 386	483 465	97 237

— = not estimated due to insufficient sample.

[a] Oven-dry biomass of all live aboveground tree parts, including stem, stump, branches, bark, seeds, and foliage, as estimated from regression equations that predict aboveground biomass from individual tree d.b.h. and total height measurements.

Table A.11—Aboveground biomass[a] of live trees with d.b.h. ≥ 2.5 cm by forest life zone and diameter class for the U.S. Virgin Islands

		Diameter class (*cm at breast height*)						
Forest life zone	All classes	0–10	10	20	30	40	50	60+
	- *Mg* -							
Subtropical dry	416 531	41 237	116 584	150 402	42 428	40 264	15 436	10 180
Subtropical moist	483 465	29 918	90 274	182 463	84 295	20 333	13 108	63 075
All life zones	899 997	71 154	206 858	332 865	126 723	60 597	28 544	73 255

[a] Oven-dry biomass of all live aboveground tree parts, including stem, stump, branches, bark, seeds, and foliage, as estimated from regression equations that predict aboveground biomass from individual tree d.b.h. and total height measurements.

Table A.12—Total biomass[a] of live trees with d.b.h. ≥ 2.5 cm by forest life zone for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, with standard error of the estimate

			Forest life zone			
	All life zones		Subtropical dry		Subtropical moist	
Survey unit	Biomass	Standard error	Biomass	Standard error	Biomass	Standard error
	- *Mg* -					
St. Croix	421 243	79 207	255 909	56 159	165 334	—
St. John	442 480	61 644	231 724	40 757	210 756	—
St. Thomas	254 903	84 470	31 477	30 625	223 426	57 141
All units	1 118 627	150 430	519 111	100 230	599 516	118 411

— = not estimated due to insufficient sample.

[a] Total biomass is the sum of aboveground biomass and belowground biomass. Oven-dry biomass of all live belowground tree parts is estimated from a regression equation modeling the relationship between aboveground biomass and belowground biomass (Cairns and others 1997).

Table A.13—Number of growing-stock[a] trees by forest life zone for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, with standard error of the estimate

			Forest life zone			
	All life zones		Subtropical dry		Subtropical moist	
Survey unit	Growing-stock trees	Standard error	Growing-stock trees	Standard error	Growing-stock trees	Standard error
	- *number* -					
St. Croix	236,551	133,002	16,382	12,099	220,169	—
St. John	1,406,831	470,474	644,687	272,143	762,144	—
St. Thomas	528,399	336,102	36,314	38,828	492,085	304,611
All units	2,171,781	861,720	697,382	444,485	1,474,398	785,663

— = not estimated due to insufficient sample.

[a] Growing-stock trees are living trees of commercial species classified as sawtimber, poletimber, saplings, and seedlings. For a tree to be considered growing stock, one-third or more of the gross volume in its saw-log section must meet grade, soundness, and size requirements for commercial logs, or the tree must have the potential to meet these requirements if it is poletimber size with 12.5 cm ≤ d.b.h. ≤ 27.5 cm. Commercial species are tree species currently or potentially suitable for industrial wood products.

Table A.14—Number of growing-stock[a] trees by forest life zone and diameter class for the U.S. Virgin Islands

Forest life zone	All classes	Diameter class (*cm at breast height*) 0–10	10	20	30	40	50	60+
	number							
Subtropical dry	697,382	17,009	272,149	272,149	102,056	34,019	0	0
Subtropical moist	1,474,398	184,300	353,241	721,841	184,300	0	15,358	15,358
All life zones	2,171,781	201,309	625,391	993,990	286,356	34,019	15,358	15,358

[a] Growing-stock trees are living trees of commercial species classified as sawtimber, poletimber, saplings, and seedlings. For a tree to be considered growing stock, one-third or more of the gross volume in its saw-log section must meet grade, soundness, and size requirements for commercial logs, or the tree must have the potential to meet these requirements if it is poletimber size with 12.5 cm ≤ d.b.h. ≤ 27.5 cm. Commercial species are tree species currently or potentially suitable for industrial wood products.

Table A.15—Merchantable stem volume,[a] inside bark, of growing stock by forest life zone for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, with standard error of the estimate

			Forest life zone			
	All life zones		Subtropical dry		Subtropical moist	
Survey unit	Stem volume	Standard error	Stem volume	Standard error	Stem volume	Standard error
	m^3					
St. Croix	16 247	9 195	1 990	1 616	14 257	—
St. John	49 233	19 605	16 800	6 987	32 432	—
St. Thomas	16 535	9 744	8 115	8 674	8 420	6 071
All units	82 015	34 568	26 906	11 425	55 110	36 205

— = not estimated due to insufficient sample.

[a] Volume of growing-stock trees is the volume of sound wood in live trees at least 12.5 cm d.b.h. from a 30-cm stump height to a minimum 10-cm top d.o.b. of the central stem.

Table A.16—Merchantable stem volume,[a] inside bark, of growing-stock trees by forest life zone and diameter class for the U.S. Virgin Islands

Forest life zone	All classes	Diameter class (*cm at breast height*) 10	20	30	40	50	60+
	m^3						
Subtropical dry	26 906	2 279	11 261	7 764	5 602	0	0
Subtropical moist	55 110	3 544	19 994	19 441	0	4 816	7 315
All life zones	82 015	5 823	31 255	27 205	5 602	4 816	7 315

[a] Volume of growing-stock trees is the volume of sound wood in live trees at least 12.5 cm d.b.h. from a 30-cm stump height to a minimum 10-cm top d.o.b. of the central stem.

Table A.17—Growing-stock composition found by the 2004 forest inventory of the U.S. Virgin Islands, ranked by mean volume

Rank	Scientific name	U.S. Virgin Islands common name	Plants— common name	Volume
				m³/ha
1	*Bursera simaruba* (L.) Sarg.	Gumbo limbo, turpentine tree, tourist tree	Gumbo limbo	1.08
2	*Guapira fragrans* (Dum.-Cours.) Little	Mampoo, black mampoo	Black mampoo	0.90
3	*Manilkara bidentata* (A. DC.) Chev.	Bulletwood, mastwood	Bulletwood	0.43
4	*Coccoloba venosa* L.	Geigertree, bay almond	False chiggergrape	0.38
5	*Acacia muricata* (L.) Willd.	Amaret, wild tamarind, spineless acacia	Spineless wattle	0.34
6	*Cordia alliodora* (Ruiz & Pavón) Oken	Manjack, copper, capa, onion cordia	Spanish elm	0.33
7	*Melicoccus bijugatus* Jacq.	Kenip, genip, ginep	Spanish lime	0.23
8	*Maytenus laevigata* (Vahl) Griseb. ex Eggers	—	White cinnamon	0.22
9	*Andira inermis* (W. Wright) Kunth ex DC.	Dog almond, hog turd, false mahogany	Cabbagebark tree	0.19
10	*Inga laurina* (Sw.) Willd.	Sweet pea	Sacky sac bean	0.18
11	*Citharexylum fruticosum* L.	Geigertree, bay almond	Florida fiddlewood	0.10
12	*Tabebuia heterophylla* (DC.) Britt.	Pink cedar, white cedar, pink poui	White cedar	0.09
13	*Pimenta racemosa* var. racemosa	Bay rum, cinnamon	Bayrumtree	0.08
14	*Bourreria succulenta* Jacq.	Pigeonberry, chink	Bodywood	0.07
15	*Myrciaria floribunda* (West ex Willd.) Berg	Guavaberry	Guavaberry	0.04
16	*Eugenia rhombea* Krug & Urban	Spiceberry, crumberry	Red stopper	0.03
17	*Ocotea coriacea* (Sw.) Britt.	Pepper cilliment, laurel	Lancewood	0.03
18	*Casearia decandra* Jacq.	Geigertree, bay almond	Wild honeytree	0.03
19	*Krugiodendron ferreum* (Vahl) Urban	Ironwood, black ironwood, ebonytree	Leadwood	0.02
20	*Chionanthus compactus* Sw.	—	Bridgotree	0.02
21	*Cordia laevigata* Lam.	Bastard capa, manjack, smooth manjack	Smooth manjack	0.01
	Total			4.79

— = no common name.

Table A.18—Relative dominance, relative density, relative frequency, importance value,[a] and origin [whether native (N) or introduced (I) to the islands] of tree species with d.b.h. ≥ 12.5 cm found by the 2004 forest inventory of the U.S. Virgin Islands

Rank	Scientific name	U.S. Virgin Islands common name	Relative dominance	Relative density	Relative frequency	IV	Species origin
1	*Guapira fragrans* (Dum.-Cours.) Little	Mampoo, black mampoo	17.45	15.57	12.21	15.08	N
2	*Bursera simaruba* (L.) Sarg.	Gumbo limbo, turpentine tree, tourist tree	10.74	10.87	10.47	10.69	N
3	*Melicoccus bijugatus* Jacq.	Kenip, genip, ginep	11.33	9.81	6.98	9.37	I
4	*Bourreria succulenta* Jacq.	Pigeonberry, chink	7.01	10.45	7.56	8.34	N
5	*Acacia muricata* (L.) Willd.	Amaret, wild tamarind, spineless acacia	6.26	9.38	4.65	6.76	N
6	*Pisonia subcordata* Sw.	Water mampoo, loblolly	6.60	6.40	4.65	5.88	N
7	*Swietenia mahagoni* (L.) Jacq.	West Indian mahogany, small leaf mahogany, mahogany	11.42	2.13	2.33	5.29	I
8	*Maytenus laevigata* (Vahl) Griseb. ex Eggers	—	3.45	6.18	5.23	4.96	N
9	*Citharexylum fruticosum* L.	Geigertree, bay almond	1.78	2.77	3.49	2.68	N
10	*Andira inermis* (W. Wright) Kunth ex DC.	Dog almond, hog turd, false mahogany	2.71	2.13	2.33	2.39	N
11	*Cordia alliodora* (Ruiz & Pavón) Oken	Manjack, copper, capa, onion cordia	1.73	2.35	2.91	2.33	N
12	*Inga laurina* (Sw.) Willd.	Sweet pea	1.66	2.13	2.33	2.04	N
13	*Krugiodendron ferreum* (Vahl) Urban	Ironwood, black ironwood, ebonytree	1.24	1.92	2.33	1.83	N
14	*Acacia farnesiana* (L.) Willd.	Amaret, wild tamarind, spineless acacia	0.80	1.07	2.33	1.40	I
15	*Chrysophyllum pauciflorum* Lam.	Geiger tree, bay almond	1.63	1.28	1.16	1.36	N
16	*Pilosocereus royenii* (L.) Byles & Rowley	Organ pipe cactus, pipe organ cactus, diddledoo, cactus	1.38	1.49	1.16	1.34	N
17	*Tabebuia heterophylla* (DC.) Britt.	Pink cedar, white cedar, pink poui	0.66	1.28	1.74	1.23	N
18	*Tamarindus indica* L.	Tamarind, taman	0.72	1.07	1.16	0.98	I
19	*Albizia lebbeck* (L.) Benth.	Mother-in-law tongue, tibet, woman's tongue	0.66	1.07	1.16	0.96	I
20	*Capparis indica* (L.) Druce	Geigertree, bay almond	0.39	0.64	1.74	0.92	N
21	*Unknown*	—	0.74	0.85	1.16	0.92	Unk.
22	*Bucida buceras* L.	Gregre, gris gris, black olive	0.24	0.64	1.74	0.87	N
23	*Manilkara bidentata* (A. DC.) Chev.	Bulletwood, mastwood	1.79	0.21	0.58	0.86	N
24	*Cedrela odorata* L.	Geigertree, bay almond	1.65	0.21	0.58	0.81	N
25	*Zanthoxylum martinicense* (Lam.) DC.	White prickle	0.46	0.64	1.16	0.75	N
26	*Samanea saman* (Jacq.) Merr.	Raintree, saman, licorice	0.40	0.64	1.16	0.73	I
27	*Myrciaria floribunda* (West ex Willd.) Berg	Guavaberry	0.37	0.64	1.16	0.72	N
28	*Pimenta racemosa* var. racemosa	Bay rum, cinnamon	0.46	0.43	1.16	0.68	N
29	*Ocotea coriacea* (Sw.) Britt.	Pepper cilliment, laurel	0.24	0.43	1.16	0.61	N
30	*Chionanthus compactus* Sw.	—	0.20	0.43	1.16	0.60	N
31	*Cassine xylocarpa* Vent. var. attenuata (A. Rich.) Kuntze	Geigertree, bay almond	0.18	0.43	1.16	0.59	N
32	*Guettarda scabra* (L.) Vent.	Greenheart, velvet seed	0.15	0.43	1.16	0.58	N
33	*Symplocos micrantha* Krug & Urban	—	0.79	0.21	0.58	0.53	N
34	*Coccoloba uvifera* (L.) L.	Geigertree, bay almond	0.29	0.64	0.58	0.50	N
35	*Delonix regia* (Bojer ex Hook.) Raf.	Flamboyant	0.36	0.43	0.58	0.46	I
36	*Casearia decandra* Jacq.	Geigertree, bay almond	0.22	0.43	0.58	0.41	N
37	*Coccoloba venosa* L.	Geigertree, bay almond	0.30	0.21	0.58	0.37	N
38	*Eugenia rhombea* Krug & Urban	Spiceberry, crumberry	0.27	0.21	0.58	0.36	N
39	*Caesalpinia pulcherrima* (L.) Sw.	Geigertree, bay almond	0.24	0.21	0.58	0.34	I
40	*Acacia macracantha* Humb. & Bonpl. ex Willd.	Amaret, wild tamarind, spineless acacia	0.21	0.21	0.58	0.33	N
41	*Capparis cynophallophora* L.	Geigertree, bay almond	0.20	0.21	0.58	0.33	N
42	*Cestrum laurifolium* L'Hér.	Geigertree, bay almond	0.12	0.21	0.58	0.31	N
43	*Sabinea florida* (Vahl) DC.	Wattapama	0.12	0.21	0.58	0.31	N
44	*Piscidia carthagenensis* Jacq.	Fish poison, jamaican dogwood	0.11	0.21	0.58	0.30	N
45	*Cordia laevigata* Lam.	Bastard capa, manjack, smooth manjack	0.10	0.21	0.58	0.30	N
46	*Plumeria alba* L.	White frangipani, wild frangipani, frangipani, milkbush	0.10	0.21	0.58	0.30	N
47	*Pictetia aculeata* (Vahl) Urban	Fustic	0.09	0.21	0.58	0.30	N
	Total		100.00	100.00	100.00	100.00	

— = no common name.

[a] Importance value (IV) for each species was calculated by taking the average of relative dominance (each species' basal area divided by the total basal area), relative density (each species' trees per hectare divided by total trees per hectare), and relative frequency (number of plots where the species occurred divided by total number of plots), multiplied by 100.

Table A.19—Importance value[a] and origin [whether native (N) or introduced (I) to the islands] of tree saplings (2.5 cm ≤ d.b.h. ≤ 12.4 cm) and seedlings (height ≥ 30 cm) found by the 2004 forest inventory of the U.S. Virgin Islands

Rank	Scientific name	U.S. Virgin Islands common name	Sapling IV	Seedling IV	Origin
1	*Leucaena leucocephala* (Lam.) de Wit	Tan tan, wild tamarind, wild taman	18.61	10.94	N
2	*Guapira fragrans* (Dum.-Cours.) Little	Mampoo, black mampoo	5.41	5.71	N
3	*Bourreria succulenta* Jacq.	Pigeonberry, chink	5.39	2.62	N
4	*Trema micranthum* (L.) Blume	Jamaican nettletree	4.65	0.94	N
5	*Acacia muricata* (L.) Willd.	Amaret, wild tamarind, spineless acacia	4.47	1.74	N
6	*Maytenus laevigata* (Vahl) Griseb. ex Eggers	White cinnamon	3.61	1.35	N
7	*Eugenia monticola* (Sw.) DC.	Skunk cherry, black cherry, bunchberry	3.27	4.65	N
8	*Acacia farnesiana* (L.) Willd.	Casha, kasha, sweet acacia	2.83	2.87	N
9	*Bucida buceras* L.	Gregre, gris gris, black olive	2.81	3.30	N
10	*Myrciaria floribunda* (West ex Willd.) Berg	Guavaberry	2.73	2.02	N
11	*Citharexylum fruticosum* L.	Fiddlewood, pasture fiddle	2.67	0.75	N
12	*Guettarda scabra* (L.) Vent.	Greenheart, velvet seed	2.54	0.67	N
13	*Capparis baducca* L.	Caper, cat bean, rat bean	1.78	3.73	N
14	*Bursera simaruba* (L.) Sarg.	Gumbo limbo, turpentine tree, tourist tree	1.65	1.32	N
15	*Capparis cynophallophora* L.	Jamaican caper, black caper, black willie, black witty, liguam	1.60	1.37	N
16	*Tecoma stans* (L.) Juss. ex Kunth	Ginger thomas, yellow cedar	1.49	2.46	N
17	*Eugenia cordata* (Sw.) DC.	Lathberry	1.44	2.00	N
18	*Capparis indica* (L.) Druce	Liguam, caper tree, white caper	1.42	3.35	N
19	*Adelia ricinella* L.	Adelia, wild lime	1.30	0.67	N
20	*Eugenia rhombea* Krug & Urban	Spiceberry, crumberry	1.29	1.95	N
21	*Ocotea coriacea* (Sw.) Britt.	Pepper cilliment, laurel	1.29	1.47	N
22	*Coccoloba uvifera* (L.) L.	Seagrape, grape tree	1.26	0.48	N
23	*Chionanthus compactus* Sw.	Bridgotree	1.12	0.60	N
24	*Sabinea florida* (Vahl) DC.	Wattapama	1.05	1.11	N
25	*Coccothrinax alta* (O.F. Cook) Becc.	Tyre, teyer, silver or broom palm	1.01	2.12	N
26	*Krugiodendron ferreum* (Vahl) Urban	Ironwood, black ironwood, ebonytree	1.00	1.20	N
27	*Melicoccus bijugatus* Jacq.	Kenip, genip, ginep	0.98	2.02	I
28	*Pisonia subcordata* Sw.	Water mampoo, loblolly	0.95	0.00	N
29	*Capparis hastata* Jacq.	Caper tree, broadleaf caper	0.94	0.58	N
30	*Tabebuia heterophylla* (DC.) Britt.	Pink cedar, white cedar, pink poui	0.94	0.53	N
31	*Amyris elemifera* L.	Torchwood, candlewood	0.91	1.35	N
32	*Ardisia obovata* Desv. ex Hamilton	False mamey, breakbill	0.90	0.70	N
33	*Albizia lebbeck* (L.) Benth.	Mother-in-law tongue, tibet, woman’s tongue	0.89	0.75	I
34	*Faramea occidentalis* (L.) A. Rich.	Wild coffee, false coffee	0.85	1.16	N
35	*Casearia guianensis* (Aubl.) Urban	Wild coffee	0.75	1.28	N
36	*Pilosocereus royenii* (L.) Byles & Rowley	Organ pipe cactus, pipe organ cactus, diddledoo, cactus	0.73	1.57	N
37	*Croton astroites* Ait.	Marang, maran bush	0.69	2.24	N
38	*Swietenia mahagoni* (L.) Jacq.	West Indian mahogany, small leaf mahogany, mahogany	0.65	1.01	I
39	*Eugenia ligustrina* (Sw.) Willd.	Birchberry, crumberry	0.64	3.28	N
40	*Chrysophyllum pauciflorum* Lam.	Palmet, wild mesple	0.60	0.26	N
41	*Randia aculeata* L.	Inkberry, Christmas tree	0.57	2.79	N
42	*Ficus citrifolia* P. Mill.	Wild fig, strangler fig, short leaf fig, spotted leaf fig	0.54	0.00	N
43	*Cassine xylocarpa* Vent. var. *attenuata* (A. Rich.) Kuntze	Marble tree, nothing nut, false nutmeg	0.51	0.87	N
44	*Eugenia biflora* (L.) DC.	Rodwood	0.44	2.07	N
45	*Pithecellobium dulce* (Roxb.) Benth.	Monkeypod, bread and cheese, blackbead	0.42	0.00	I
46	*Eugenia pseudopsidium* Jacq.	Bastard guava, false guava, Christmas cherry	0.41	0.58	N
47	*Guettarda odorata* (Jacq.) Lam.	Blackberry	0.41	0.17	N
48	*Rondeletia pilosa* Sw.	Downy rondeletia, wild rondeletia	0.39	0.80	N
49	*Cordia alliodora* (Ruiz & Pavón) Oken	Manjack, copper, capa, onion cordia	0.37	0.12	N
50	*Colubrina arborescens* (P. Mill.) Sarg.	False maubi	0.36	0.12	N
51	*Erythroxylum rotundifolium* Lunan	Brisslet	0.34	0.17	N

continued

Table A.19—Importance value[a] and origin [whether native (N) or introduced (I) to the islands] of tree saplings (2.5 cm ≤ d.b.h. ≤ 12.4 cm) and seedlings (height ≥ 30 cm) found by the 2004 forest inventory of the U.S. Virgin Islands (continued)

Rank	Scientific name	U.S. Virgin Islands common name	Sapling IV	Seedling IV	Origin
52	*Rauvolfia nitida* Jacq.	Milkbush, bitter ash, bitterbush	0.33	0.24	N
53	*Coccoloba microstachya* Willd.	Uverillo	0.33	0.12	N
54	*Comocladia dodonaea* (L.) Urban	Christmas tree	0.32	0.67	N
55	*Tamarindus indica* L.	Tamarind, taman	0.31	0.00	I
56	*Pithecellobium unguis-cati* (L.) Benth.	Cat’s claw, bread and cheese, blackbead	0.29	0.24	N
57	*Erithalis fruticosa* L.	Blacktorch	0.29	0.14	N
58	*Triphasia trifolia* (Burm. f.) P. Wilson	Sweet lime, limeberry	0.27	2.27	I
59	*Exostema caribaeum* (Jacq.) J.A. Schultes	Yellow torch, black torch, princewood	0.24	0.19	N
60	*Henriettea squamulosum* (Cogn.) Judd	Jusillo	0.24	0.00	N
61	*Casearia decandra* Jacq.	Wild cherry	0.23	0.12	N
62	*Piscidia carthagenensis* Jacq.	Fish poison, jamaican dogwood	0.22	0.41	N
63	*Tetrazygia elaeagnoides* (Sw.) DC.	Krekre	0.21	0.00	N
64	*Trichilia hirta* L.	Broom wood, broomstick	0.20	0.26	N
65	*Croton rigidus* (Muell.-Arg.) Britt.	Marang, maran bush, yellow maran	0.19	0.70	N
66	*Pictetia aculeata* (Vahl) Urban	Fustic	0.19	0.00	N
67	*Annona squamosa* L.	Sugar apple	0.18	0.19	N
68	*Euphorbia petiolaris* Sims	Black manchineel, manchineel berry	0.17	0.60	N
69	*Schaefferia frutescens* Jacq.	Yellow boxwood, Florida boxwood	0.17	0.79	N
70	*Capparis flexuosa* (L.) L.	Flexible caper, bottle wiss, dog or limber caper	0.14	1.30	N
71	*Gymnanthes lucida* Sw.	Crabwood, goatwood, oysterwood	0.14	0.00	N
72	*Myrospermum frutescens* Jacq.	Cercipo	0.14	0.00	N
73	*Chionanthus domingensis* Lam.	White rosewood	0.14	0.12	N
74	*Chrysobalanus icaco* L.	Coco plum, fat pork	0.14	0.00	N
75	*Zanthoxylum monophyllum* (Lam.) P. Wilson	Yellow prickle	0.14	0.12	N
76	*Samyda dodecandra* Jacq.	Guayabilla	0.13	0.77	N
77	*Savia sessiliflora* (Sw.) Willd.	Milktree	0.13	0.00	N
78	*Casearia sylvestris* Sw.	Crackopen	0.13	0.19	N
79	*Licaria parvifolia* (Lam.) Kosterm.	Puerto Rico cinnamon	0.13	0.00	N
80	*Plumeria alba* L.	White frangipani, wild frangipani, frangipani, milkbush	0.13	0.82	N
81	*Crossopetalum rhacoma* Crantz	Maidenberry	0.13	0.24	N
82	*Swinglea glutinosa* (Blanco) Merr.	Glutinous swinglea	0.13	0.00	I
83	*Adenanthera pavonina* L.	Coral bead, jumbee bead, jumbie bead	0.00	0.12	I
84	*Cestrum laurifolium* L’Hér.	Wild cestrum	0.00	0.70	N
85	*Cordia sebestena* L.	Geigertree, bay almond	0.00	0.29	I
86	*Cunninghamia lanceolata* (Lamb.) Hook.	Chinese fir	0.00	0.14	I
87	*Guazuma ulmifolia* Lam.	Jackass calalu	0.00	0.12	N
88	*Haematoxylum campechianum* L.	Logwood, logwood casha	0.00	0.14	I
89	*Inga laurina* (Sw.) Willd.	Sweet pea	0.00	0.12	N
90	*Jatropha multifida* L.	Coralbush	0.00	0.19	I
91	*Neea buxifolia* (Hook. f.) Heimerl	Boxwood	0.00	0.84	N
92	*Parathesis crenulata* (Vent.) Hook. f.	Scratchthroat	0.00	0.22	N
93	*Pimenta racemosa* var. racemosa	Bay rum, cinnamon	0.00	0.29	N
94	*Sideroxylon salicifolium* (L.) Lam.	Break bill	0.00	0.14	N
95	Unknown	—	0.00	0.36	—
	Total		100.00	100.00	

[a] Importance value (IV) for saplings was calculated by taking the average of relative dominance (each species’ basal area divided by the total basal area), relative density (each species’ trees per hectare divided by total trees per hectare), and relative frequency (number of plots where the species occurred divided by total number of plots), multiplied by 100. Seedling IV is based on only relative density and relative frequency.

Table A.20—Relative dominance, relative density, relative frequency, importance value,[a] and origin [whether native (N) or introduced (I) to the islands] of tree species with d.b.h. ≥ 12.5 cm found by the 2004 forest inventory in the subtropical dry forest life zone of the U.S. Virgin Islands

Rank	Scientific name	U.S. Virgin Islands common name	Plants—common name	Relative dominance	Relative density	Relative frequency	IV	Species origin
1	*Bursera simaruba* (L.) Sarg.	Gumbo limbo, turpentine tree, tourist tree	Gumbo limbo	21.55	19.10	13.10	17.91	N
2	*Guapira fragrans* (Dum.-Cours.) Little	Mampoo, black mampoo	Black mampoo	11.75	10.55	11.90	11.40	N
3	*Melicoccus bijugatus* Jacq.	Kenip, genip, ginep	Spanish lime	13.57	9.05	8.33	10.32	I
4	*Bourreria succulenta* Jacq.	Pigeonberry, chink	Bodywood	9.45	11.56	8.33	9.78	N
5	*Pisonia subcordata* Sw.	Water mampoo, loblolly	Water mampoo	8.02	7.54	7.14	7.57	N
6	*Maytenus laevigata* (Vahl) Griseb. ex Eggers	—	White cinnamon	4.04	6.53	7.14	5.91	N
7	*Acacia muricata* (L.) Willd.	Amaret, wild tamarind, spineless acacia	Spineless wattle	2.99	5.03	4.76	4.26	N
8	*Swietenia mahagoni* (L.) Jacq.	West Indian mahogany, small leaf mahogany, mahogany	West Indian mahogany	6.05	2.51	2.38	3.65	I
9	*Citharexylum fruticosum* L.	Geigertree, bay almond	Florida fiddlewood	3.10	4.02	3.57	3.56	N
10	*Pilosocereus royenii* (L.) Byles & Rowley	Organ pipe cactus, pipe organ cactus, diddledoo, cactus	Royen's tree cactus	3.68	3.52	2.38	3.19	N
11	*Acacia farnesiana* (L.) Willd.	Amaret, wild tamarind, spineless acacia	Sweet acacia	2.13	2.51	4.76	3.14	N
12	*Krugiodendron ferreum* (Vahl) Urban	Ironwood, black ironwood, ebonytree	Leadwood	2.10	3.52	3.57	3.06	N
13	*Tamarindus indica* L.	Tamarind, taman	Tamarind	1.91	2.51	2.38	2.27	I
14	*Cordia alliodora* (Ruiz & Pavón) Oken	Manjack, copper, capa, onion cordia	Spanish elm	0.85	1.51	2.38	1.58	N
15	*Albizia lebbeck* (L.) Benth.	Mother-in-law tongue, tibet, woman's tongue	Woman's tongue	1.25	2.01	1.19	1.48	I
16	*Capparis indica* (L.) Druce	Geigertree, bay almond	Linguam	0.62	1.01	2.38	1.33	N
17	*Bucida buceras* L.	Gregre, gris gris, black olive	Gregorywood	0.42	1.01	2.38	1.27	N
18	*Symplocos micrantha* Krug & Urban	—	Aceitunilla	2.10	0.50	1.19	1.26	N
19	*Coccoloba uvifera* (L.) L.	Geigertree, bay almond	Seagrape	0.78	1.51	1.19	1.16	N
20	*Delonix regia* (Bojer ex Hook.) Raf.	Flamboyant	Royal poinciana	0.96	1.01	1.19	1.05	I
21	*Caesalpinia pulcherrima* (L.) Sw.	Geigertree, bay almond	Pride-of-Barbados	0.63	0.50	1.19	0.77	I
22	*Acacia macracantha* Humb. & Bonpl. ex Willd.	Amaret, wild tamarind, spineless acacia	Porknut	0.55	0.50	1.19	0.75	N
23	*Myrciaria floribunda* (West ex Willd.) Berg	Guavaberry	Guavaberry	0.40	0.50	1.19	0.70	N
24	*Inga laurina* (Sw.) Willd.	Sweet pea	Sacky sac bean	0.33	0.50	1.19	0.67	N
25	*Piscidia carthagenensis* Jacq.	Fish poison, jamaican dogwood	Stinkwood	0.29	0.50	1.19	0.66	N
26	*Cassine xylocarpa* Vent. var. *attenuata* (A. Rich.) Kuntze	Geigertree, bay almond	Marbletree	0.26	0.50	1.19	0.65	N
27	*Samanea saman* (Jacq.) Merr.	Raintree, saman, licorice	Raintree	0.24	0.50	1.19	0.64	I
	Total			100.00	100.00	100.00	100.00	

— = no common name.

[a] Importance value (IV) for each species was calculated by taking the average of relative dominance (each species' basal area divided by the total basal area), relative density (each species' trees per hectare divided by total trees per hectare and relative frequency (number of plots where the species occurred divided by total number of plots), multiplied by 100.

Table A.21—Relative dominance, relative density, relative frequency, importance value,[a] and origin [whether native (N) or introduced (I) to the islands] of tree species with d.b.h. ≥ 12.5 cm found by the 2004 forest inventory in the subtropical moist forest life zone of the U.S. Virgin Islands

Rank	Scientific name	U.S. Virgin Islands common name	Plants—common name	Relative dominance	Relative density	Relative frequency	IV	Species origin
1	*Guapira fragrans* (Dum.-Cours.) Little	Mampoo, black mampoo	Black mampoo	20.87	19.26	12.50	17.54	N
2	*Melicoccus bijugatus* Jacq.	Kenip, genip, ginep	Spanish lime	9.99	10.37	5.68	8.68	I
3	*Acacia muricata* (L.) Willd.	Amaret, wild tamarind, spineless acacia	Spineless wattle	8.22	12.59	4.55	8.45	N
4	*Bourreria succulenta* Jacq.	Pigeonberry, chink	Bodywood	5.55	9.63	6.82	7.33	N
5	*Swietenia mahagoni* (L.) Jacq.	West Indian mahogany, small leaf mahogany, mahogany	West Indian mahogany	14.64	1.85	2.27	6.25	I
6	*Bursera simaruba* (L.) Sarg.	Gumbo limbo, turpentine tree, tourist tree	Gumbo limbo	4.25	4.81	7.95	5.67	N
7	*Pisonia subcordata* Sw.	Water mampoo, loblolly	Water mampoo	5.74	5.56	2.27	4.52	N
8	*Andira inermis* (W. Wright) Kunth ex DC.	Dog almond, hog turd, false mahogany	Cabbagebark tree	4.34	3.70	4.55	4.20	N
9	*Maytenus laevigata* (Vahl) Griseb. ex Eggers	—	White cinnamon	3.10	5.93	3.41	4.14	N
10	*Inga laurina* (Sw.) Willd.	Sweet pea	Sacky sac bean	2.46	3.33	3.41	3.07	N
11	*Cordia alliodora* (Ruiz & Pavón) Oken	Manjack, copper, capa, onion cordia	Spanish elm	2.26	2.96	3.41	2.88	N
12	*Chrysophyllum pauciflorum* Lam.	Geigertree, bay almond	Camito de perro	2.61	2.22	2.27	2.37	N
13	*Tabebuia heterophylla* (DC.) Britt.	Pink cedar, white cedar, pink poui	White cedar	1.05	2.22	3.41	2.23	N
14	*Citharexylum fruticosum* L.	Geigertree, bay almond	Florida fiddlewood	0.98	1.85	3.41	2.08	N
15	Unknown	Sweet lime, limeberry	Unknown	1.18	1.48	2.27	1.64	Unk.
16	*Manilkara bidentata* (A. DC.) Chev.	Bulletwood, mastwood	Bulletwood	2.86	0.37	1.14	1.45	N
17	*Cedrela odorata* L.	Geigertree, bay almond	Spanish cedar	2.64	0.37	1.14	1.38	N
18	*Zanthoxylum martinicense* (Lam.) DC.	White prickle	White pricklyash	0.74	1.11	2.27	1.37	N
19	*Pimenta racemosa* var. racemosa	Bay rum, cinnamon	Bayrumtree	0.73	0.74	2.27	1.25	N
20	*Ocotea coriacea* (Sw.) Britt.	Pepper cilliment, laurel	Lancewood	0.38	0.74	2.27	1.13	N
21	*Chionanthus compactus* Sw.	—	Bridgotree	0.32	0.74	2.27	1.11	N
22	*Guettarda scabra* (L.) Vent.	Greenheart, velvet seed	Wild guava	0.24	0.74	2.27	1.08	N
23	*Krugiodendron ferreum* (Vahl) Urban	Ironwood, black ironwood, ebonytree	Leadwood	0.73	0.74	1.14	0.87	N
24	*Samanea saman* (Jacq.) Merr.	Raintree, saman, licorice	Raintree	0.49	0.74	1.14	0.79	I
25	*Casearia decandra* Jacq.	Geigertree, bay almond	Wild honeytree	0.35	0.74	1.14	0.74	N
26	*Myrciaria floribunda* (West ex Willd.) Berg	Guavaberry	Guavaberry	0.35	0.74	1.14	0.74	N
27	*Coccoloba venosa* L.	Geigertree, bay almond	False chiggergrape	0.49	0.37	1.14	0.66	N
28	*Eugenia rhombea* Krug & Urban	Spiceberry, crumberry	Red stopper	0.44	0.37	1.14	0.65	N
29	*Capparis cynophallophora* L.	Geigertree, bay almond	Jamaican caper	0.33	0.37	1.14	0.61	N
30	*Albizia lebbeck* (L.) Benth.	Mother-in-law tongue, tibet, woman's tongue	Woman's tongue	0.31	0.37	1.14	0.60	I
31	*Capparis indica* (L.) Druce	Geigertree, bay almond	Linguam	0.25	0.37	1.14	0.59	N
32	*Cestrum laurifolium* L'Hér.	Geigertree, bay almond	Galen del monte	0.20	0.37	1.14	0.57	N
33	*Sabinea florida* (Vahl) DC.	Wattapama	Wattapama	0.20	0.37	1.14	0.57	N
34	*Cordia laevigata* Lam.	Bastard capa, manjack, smooth manjack	Smooth manjack	0.16	0.37	1.14	0.56	N
35	*Plumeria alba* L.	White frangipani, wild frangipani, frangipani, milkbush	Nosegaytree	0.16	0.37	1.14	0.56	N
36	*Pictetia aculeata* (Vahl) Urban	Fustic	Fustic	0.15	0.37	1.14	0.55	N
37	*Bucida buceras* L.	Gregre, gris gris, black olive	Gregorywood	0.13	0.37	1.14	0.55	N
38	*Cassine xylocarpa* Vent. var. *attenuata* (A. Rich.) Kuntze	Geigertree, bay almond	Marbletree	0.13	0.37	1.14	0.54	N
	Total			100.00	100.00	100.00	100.00	

— = no common name; Unk. = unknown.

[a] Importance value (IV) for each species was calculated by taking the average of relative dominance (each species' basal area divided by the total basal area), relative density (each species' trees per hectare divided by total trees per hectare), and relative frequency (number of plots where the species occurred divided by total number of plots), multiplied by 100.

Table A.22—Mean pieces of down woody material[a] by forest life zone, size class,[b] and decay class[c] for the U.S. Virgin Islands

Forest life zone	Size class (*cm*)				Decay class				
	8–20	20–33	33–45	≥ 45	1	2	3	4	5
	number/ha								
Subtropical dry	160	0	0	0	0	0	150	10	0
Subtropical moist	309	4	0	0	9	32	210	63	0
Mean	213	2	0	0	3	12	171	29	0

[a] Down woody material is a term used to collectively describe attributes estimated by the down woody materials indicator. A majority of the indicator's components are down and dead forest materials, fine woody material, coarse woody material, duff, litter, slash, live and dead herb and shrubs, and fuel bed depths.

[b] Diameter (centimeters) where down woody material crossed the transect.

[c] Decay class is a rating of individual coarse woody material according to a 5-class decay scale defined by the texture, structural integrity, and appearance of pieces. Scale ranges from freshly fallen trees (decay class 1) to completely decomposed cubical rot heaps (decay class 5).

Table A.23—Mean forest fire fuels by forest life zone and fuel type[a] for the U.S. Virgin Islands, with standard error of the mean

Forest life zone	1–hour		10–hour		100–hour		1,000–hour		Duff		Litter		Total all fuels	
	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error
	Mg/ha													
Subtropical dry	0.51	0.11	1.65	0.41	1.15	0.28	0.37	0.15	2.40	1.34	1.34	0.62	10.14	1.69
Subtropical moist	0.52	0.07	2.09	0.42	1.86	0.59	2.09	0.47	0.80	0.58	4.66	0.79	12.02	1.16
Mean	0.52	0.07	1.81	0.30	1.40	0.28	0.99	0.25	1.83	0.89	4.26	0.48	10.81	1.16

[a] Fuel-hour classes are defined by the amount of time it takes for moisture conditions to fluctuate. Larger coarse woody material takes longer to dry out than smaller fine woody pieces (small = 1–hour; medium = 10–hour; large = 100–hour; coarse woody material = 1,000–hour).

Table A.24—Mean carbon[a] in down woody materials and forest floor by forest life zone for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, with standard error of the mean

		FWD[b]		CWD[c]		FF[d]		Total carbon	
Survey unit	Forest life zone	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error
		Mg/ha							
St. Croix	Subtropical dry	1.18	0.68	0.07	0.07	3.03	1.08	4.28	1.64
	Subtropical moist	1.45	0.00	1.18	0.00	2.25	0.00	4.88	0.00
	All life zones	1.22	1.39	0.23	0.17	2.92	0.92	4.37	1.39
St. John	Subtropical dry	1.93	0.23	0.25	0.11	5.90	1.01	8.99	1.21
	Subtropical moist	2.33	0.47	1.13	0.30	5.53	0.60	8.08	0.99
	All life zones	2.09	0.23	0.60	1.62	5.75	0.64	8.44	0.75
St. Thomas	Subtropical dry	—	—	—	—	—	—	—	—
	Subtropical moist	2.50	0.00	0.40	0.00	3.72	0.00	6.62	0.00
All units	All life zones	2.50	0.00	0.40	0.00	3.72	0.00	6.62	0.00

— = not estimated due to insufficient sample; FWD = fine woody debris; CWD = coarse woody debris; FF = forest floor.

[a] Carbon is calculated by multiplying biomass by a factor of 0.5. Estimated for all trees with d.b.h. ≥ 2.5 cm.

[b] Fine woody debris is down pieces of wood with a diameter ≤ 8.0 cm, not including foliage or bark fragments.

[c] Coarse woody debris is down pieces of wood with a minimum small-end diameter of at least 8 cm and a length of at least 0.9 m (excluding decay class 5). Coarse woody material pieces must be detached from a bole and/or not be self-supported by a root system, and must have a lean angle > 45 degrees from vertical.

[d] Forest floor is the layer of fallen leaves, needles, twigs, fruits, and dead herbaceous material found on the ground. Forest floor includes the litter layer and the duff layer of decomposing organic material found just above mineral soil.

Table A.25—Carbon in live trees with d.b.h. ≥ 2.5 cm, standing dead trees, fine woody debris, coarse woody debris, and forest floor by forest life zone for St. Croix, St. John, and St. Thomas, U.S. Virgin Islands, with standard error of the estimate

				Forest life zone			
		All life zones		Subtropical dry		Subtropical moist	
Survey unit		Carbon	Standard error	Carbon	Standard error	Carbon	Standard error
		- - - - - - - - - - - -	- - - - - - - - - - - -	- - - - - - - - - - - - *Mg*	- - - - - - - - - - - -	- - - - - - - - - - - -	- - - - - - - - - - - -
St. Croix	Live trees	184 403	32 261	101 736	22 627	82 667	—
	Standing dead trees	383	960	383	85	0	—
	FWD	13 331	14 794	9 033	6 092	4 298	—
	CWD	4 033	1 815	536	—	3 498	—
	Forest floor	29 864	10 052	23 195	—	6 669	—
	Unit subtotal	232 014	15 180	134 882	12 861	97 132	—
St. John	Live trees	221 226	25 460	115 848	20 365	105 378	—
	Standing dead trees	1 987	655	509	396	1 478	—
	FWD	9 709	1 115	5 459	683	4 250	—
	CWD	2 768	7 537	707	312	2 061	—
	Forest floor	26 774	3 099	16 687	2 926	10 087	—
	Unit subtotal	262 464	3 711	139 210	2 307	123 254	—
St. Thomas	Live trees	127 471	34 065	15 739	15 323	111 733	28 557
	Standing dead trees	940	786	—	—	940	153
	FWD	9 791	2 041	NS	NS	9 791	1 594
	CWD	1 567	327	NS	NS	1 567	255
	Forest floor	14 569	3 037	NS	NS	14 569	2 373
	Unit subtotal	154 337	5 404	15 739	15 326	138 598	4 222
All units	Total	648 815		289 831		358 984	

— = not estimated due to insufficient sample; FWD = fine woody debris; CWD = coarse woody debris; NS = not sampled because there were no forest health monitoring plots in subtropical dry forest on St. Thomas.

Appendix B—Species List

List of all tree[a] species found in the 2004 forest inventory of the U.S. Virgin Islands, with number of individuals recorded, family, and origin [whether native (N) or introduced (I) to the islands]

No.	Scientific name	U.S. Virgin Islands common name	Plants—common name	No.	Family	Origin
1	*Acacia farnesiana* (L.) Willd.	Casha, kasha, sweet acacia	Sweet acacia	156	Fabaceae	N
2	*A. macracantha* Humb. & Bonpl. ex Willd.	Stink kasha, stink casha, steel acacia	Porknut	1	Fabaceae	N
3	*A. muricata* (L.) Willd.	Amaret, wild tamarind, spineless acacia	Spineless wattle	196	Fabaceae	N
4	*Adelia ricinella* L.	Adelia, wild lime	Wild lime	40	Euphorbiaceae	N
5	*Adenanthera pavonina* L.	Coral bead, jumbee bead, jumbie bead	Red beadtree	1	Fabaceae	I
6	*Albizia lebbeck* (L.) Benth.	Mother-in-law tongue, tibet, woman's tongue	Woman's tongue	32	Fabaceae	I
7	*Amyris elemifera* L.	Torchwood, candlewood	Sea torchwood	38	Rutaceae	N
8	*Andira inermis* (W. Wright) Kunth ex DC.	Dog almond, hog turd, false mahogany	Cabbagebark tree	10	Fabaceae	N
9	*Annona squamosa* L.	Sugar apple	Sugar apple	8	Annonaceae	N
10	*Ardisia obovata* Desv. ex Hamilton	False mamey, breakbill	Guadeloupe marlberry	37	Myrsinaceae	N
11	*Bourreria succulenta* Jacq.	Pigeonberry, chink	Bodywood	194	Boraginaceae	N
12	*Bucida buceras* L.	Gregre, gris gris, black olive	Gregorywood	142	Combretaceae	N
13	*Bursera simaruba* (L.) Sarg.	Gumbo limbo, turpentine tree, tourist tree	Gumbo limbo	96	Burseraceae	N
14	*Caesalpinia pulcherrima* (L.) Sw.	Pride-of-Barbados, divi divi	Pride-of-Barbados	1	Fabaceae	I
15	*Capparis baducca* L.	Caper, cat bean, rat bean	Caper	151	Capparaceae	N
16	*C. cynophallophora* L.	Jamaican caper, black caper, black willie, black witty, liguam	Jamaican caper	48	Capparaceae	N
17	*C. flexuosa* (L.) L.	Flexible caper, bottle wiss, dog or limber caper	Falseteeth	24	Capparaceae	N
18	*C. hastata* Jacq.	Caper tree, broadleaf caper	Broadleaf caper	24	Capparaceae	N
19	*C. indica* (L.) Druce	Liguam, caper tree, white caper	Linguam	70	Capparaceae	N
20	*Casearia decandra* Jacq.	Wild cherry	Wild honeytree	9	Flacourtiaceae	N
21	*C. guianensis* (Aubl.) Urban	Wild coffee	Guyanese wild coffee	37	Flacourtiaceae	N
22	*C. sylvestris* Sw.	—	Crackopen	6	Flacourtiaceae	N
23	*Cassine xylocarpa* Vent. var. *attenuata* (A. Rich.) Kuntze	Marble tree, nothing nut, false nutmeg	Marbletree	32	Celastraceae	N
24	*Cedrela odorata* L.	Cigar box cedar, West Indies cedar, red cedar, acajou	Spanish cedar	1	Meliaceae	N
25	*Cestrum laurifolium* L'Hér.	Wild cestrum	Galen del monte	10	Solanaceae	N
26	*Chionanthus compactus* Sw.	—	Bridgotree	31	Oleaceae	N
27	*C. domingensis* Lam.	—	White rosewood	3	Oleaceae	N
28	*Chrysobalanus icaco* L.	Coco plum, fat pork	Icaco coco plum	2	Chrysobalanaceae	N
29	*Chrysophyllum pauciflorum* Lam.	Palmet, wild mesple	Camito de perro	21	Sapotaceae	N
30	*Citharexylum fruticosum* L.	Fiddlewood, pasture fiddle	Florida fiddlewood	80	Verbenaceae	N
31	*Coccoloba microstachya* Willd.	Uverillo	Puckhout	9	Polygonaceae	N
32	*C. uvifera* (L.) L.	Seagrape, grape tree	Seagrape	63	Polygonaceae	N
33	*C. venosa* L.	Cherry grape, chiggery grape, chicory grape, false grape	False chiggergrape	1	Polygonaceae	N
34	*Coccothrinax alta* (O.F. Cook) Becc.	Tyre, teyer, silver or broom palm	Puerto Rico silver palm	66	Arecaceae	N
35	*Colubrina arborescens* (P. Mill.) Sarg.	False maubi	Greenheart	7	Rhamnaceae	N
36	*Comocladia dodonaea* (L.) Urban	Christmas tree	Poison ash	14	Anacardiaceae	N
37	*Cordia alliodora* (Ruiz & Pavón) Oken	Manjack, copper, capa, onion cordia	Spanish elm	18	Boraginaceae	N
38	*C. laevigata* Lam.	Bastard capa, manjack, smooth manjack	Smooth manjack	1	Boraginaceae	N
39	*C. sebestena* L.	Geigertree, bay almond	Largeleaf geigertree	4	Boraginaceae	I
40	*Crossopetalum rhacoma* Crantz	—	Maidenberry	4	Celastraceae	N
41	*Croton astroites* Ait.	Marang, maran bush	Wild marrow	75	Euphorbiaceae	N
42	*Croton rigidus* (Muell.-Arg.) Britt.	Marang, maran bush, yellow maran	Yellow balsam	13	Euphorbiaceae	N
43	*Cunninghamia lanceolata* (Lamb.) Hook.	—	Chinese fir	2	Cupressaceae	I

continued

List of all tree[a] species found in the 2004 forest inventory of the U.S. Virgin Islands, with number of individuals recorded, family, and origin [whether native (N) or introduced (I) to the islands] (continued)

No.	Scientific name	U.S. Virgin Islands common name	Plants—common name	No.	Family	Origin
44	*Delonix regia* (Bojer ex Hook.) Raf.	Flamboyant	Royal poinciana	2	Fabaceae	I
45	*Erithalis fruticosa* L.	Blacktorch	Blacktorch	12	Rubiaceae	N
46	*Erythroxylum rotundifolium* Lunan	Brisslet	Ratwood	11	Erythroxylaceae	N
47	*Eugenia biflora* (L.) DC.	Rodwood	Blackrodwood	44	Myrtaceae	N
48	*E. cordata* (Sw.) DC.	—	Lathberry	87	Myrtaceae	N
49	*E. ligustrina* (Sw.) Willd.	Birchberry, crumberry	Privet stopper	88	Myrtaceae	N
50	*E. monticola* (Sw.) DC.	Skunk cherry, black cherry, bunchberry	Birdcherry	201	Myrtaceae	N
51	*E. pseudopsidium* Jacq.	Bastard guava, false guava, Christmas cherry	Christmas cherry	14	Myrtaceae	N
52	*E. rhombea* Krug & Urban	Spiceberry, crumberry	Red stopper	66	Myrtaceae	N
53	*Euphorbia petiolaris* Sims	Black manchineel, manchineel berry	Manchineel berry	13	Euphorbiaceae	N
54	*Exostema caribaeum* (Jacq.) J.A. Schultes	Yellow torch, black torch, princewood	Caribbean princewood	12	Rubiaceae	N
55	*Faramea occidentalis* (L.) A. Rich.	Wild coffee, false coffee	False coffee	64	Rubiaceae	N
56	*Ficus citrifolia* P. Mill.	Wild fig, strangler fig, short leaf fig, spotted leaf fig	Wild banyantree	8	Moraceae	N
57	*Guapira fragrans* (Dum.-Cours.) Little	Mampoo, black mampoo	Black mampoo	296	Nyctaginaceae	N
58	*Guazuma ulmifolia* Lam.	Jackass calalu	Bastardcedar	1	Sterculiaceae	N
59	*Guettarda odorata* (Jacq.) Lam.	Blackberry	Cucubano de vieques	13	Rubiaceae	N
60	*G. scabra* (L.) Vent.	Greenheart, velvet seed	Wild guava	104	Rubiaceae	N
61	*Gymnanthes lucida* Sw.	Crabwood, goatwood, oysterwood	Oysterwood	2	Euphorbiaceae	N
62	*Haematoxylum campechianum* L.	Logwood, logwood casha	Bloodwoodtree	2	Fabaceae	I
63	*Henriettea squamulosum* (Cogn.) Judd	—	Jusillo	2	Melastomataceae	N
64	*Inga laurina* (Sw.) Willd.	Sweet pea	Sacky sac bean	11	Fabaceae	N
65	*Jatropha multifida* L.	—	Coralbush	4	Euphorbiaceae	I
66	*Krugiodendron ferreum* (Vahl) Urban	Ironwood, black ironwood, ebonytree	Leadwood	41	Rhamnaceae	N
67	*Leucaena leucocephala* (Lam.) de Wit	Tan tan, wild tamarind, wild taman	White leadtree	1,004	Fabaceae	N
68	*Licaria parvifolia* (Lam.) Kosterm.	—	Puerto rico cinnamon	2	Lauraceae	N
69	*Manilkara bidentata* (A. DC.) Chev.	Bulletwood, mastwood	Bulletwood	1	Sapotaceae	N
70	*Maytenus laevigata* (Vahl) Griseb. ex Eggers	—	White cinnamon	137	Celastraceae	N
71	*Melicoccus bijugatus* Jacq.	Kenip, genip, ginep	Spanish lime	104	Sapindaceae	I
72	*Myrciaria floribunda* (West ex Willd.) Berg	Guavaberry	Guavaberry	109	Myrtaceae	N
73	*Myrospermum frutescens* Jacq.	—	Cercipo	2	Fabaceae	N
74	*Neea buxifolia* (Hook. f.) Heimerl	Boxwood	Saltwood	19	Nyctaginaceae	N
75	*Ocotea coriacea* (Sw.) Britt.	Pepper cilliment, laurel	Lancewood	69	Lauraceae	N
76	*Parathesis crenulata* (Vent.) Hook. f.	—	Scratchthroat	5	Myrsinaceae	N
77	*Pictetia aculeata* (Vahl) Urban	Fustic	Fustic	3	Fabaceae	N
78	*Pilosocereus royenii* (L.) Byles & Rowley	Organ pipe cactus, pipe organ cactus, diddledoo, cactus	Royen's tree cactus	52	Cactaceae	N
79	*Pimenta racemosa* var. racemosa	Bay rum, cinnamon	Bayrumtree	6	Myrtaceae	N
80	*Piscidia carthagenensis* Jacq.	Fish poison, jamaican dogwood	Stinkwood	10	Fabaceae	N
81	*Pisonia subcordata* Sw.	Water mampoo, loblolly	Water mampoo	40	Nyctaginaceae	N
82	*Pithecellobium dulce* (Roxb.) Benth.	Monkeypod, bread and cheese, blackbead	Monkeypod	16	Fabaceae	I
83	*P. unguis-cati* (L.) Benth.	Cat's claw, bread and cheese, blackbead	Catclaw blackbead	12	Fabaceae	N
84	*Plumeria alba* L.	White frangipani, wild frangipani, frangipani, milkbush	Nosegaytree	13	Apocynaceae	N
85	*Randia aculeata* L.	Inkberry, Christmas tree	White indigoberry	78	Rubiaceae	N
86	*Rauvolfia nitida* Jacq.	Milkbush, bitter ash, bitterbush	Palo amargo	8	Apocynaceae	N
87	*Rondeletia pilosa* Sw.	Downy rondeletia, wild rondeletia	Cordobancillo peludo	29	Rubiaceae	N
88	*Sabinea florida* (Vahl) DC.	Wattapama	Wattapama	43	Fabaceae	N

continued

List of all tree[a] species found in the 2004 forest inventory of the U.S. Virgin Islands, with number of individuals recorded, family, and origin [whether native (N) or introduced (I) to the islands] (continued)

No.	Scientific name	U.S. Virgin Islands common name	Plants—common name	No.	Family	Origin
89	*Samanea saman* (Jacq.) Merr.	Raintree, saman, licorice	Raintree	3	Fabaceae	I
90	*Samyda dodecandra* Jacq.	—	Guayabilla	10	Meliaceae	N
91	*Savia sessiliflora* (Sw.) Willd.	—	Milktree	2	Euphorbiaceae	N
92	*Schaefferia frutescens* Jacq.	Yellow boxwood, florida boxwood	Amansa guapo	13	Celastraceae	N
93	*Sideroxylon salicifolium* (L.) Lam.	Break bill	White bully	2	Sapotaceae	N
94	*Swietenia mahagoni* (L.) Jacq.	West Indian mahogany, small leaf mahogany, mahogany	West indian mahogany	50	Meliaceae	I
95	*Swinglea glutinosa* (Blanco) Merr.	—	Glutinous swinglea	2	Rutaceae	I
96	*Symplocos micrantha* Krug & Urban	—	Aceitunilla	1	Symplocaceae	I
97	*Tabebuia heterophylla* (DC.) Britt.	Pink cedar, white cedar, pink poui	White cedar	30	Bignoniaceae	N
98	*Tamarindus indica* L.	Tamarind, taman	Tamarind	9	Fabaceae	I
99	*Tecoma stans* (L.) Juss. ex Kunth	Ginger thomas, yellow cedar	Yellow trumpetbush	102	Bignoniaceae	N
100	*Tetrazygia elaeagnoides* (Sw.) DC.	Krekre	Krekre	4	Melastomataceae	N
101	*Trema micranthum* (L.) Blume	—	Jamaican nettletree	187	Ulmaceae	N
102	*Trichilia hirta* L.	Broom wood, broomstick	Broomstick	7	Meliaceae	N
103	*Triphasia trifolia* (Burm. f.) P. Wilson	Sweet lime, limeberry	Limeberry	66	Rutaceae	I
104	*Zanthoxylum martinicense* (Lam.) DC.	White prickle	White pricklyash	3	Rutaceae	N
105	*Z. monophyllum* (Lam.) P. Wilson	Yellow prickle	Yellow prickle	3	Rutaceae	N

— = no common name.

[a] A tree is defined by FIA as a woody plant having one erect perennial stem or trunk at least 7.6 cm d.b.h., a more or less definitely formed crown of foliage, and a height of at least 4 m (at maturity). This species list includes all trees, saplings, and seedlings found.

Brandeis, Thomas J.; Oswalt, Sonja N. 2007. The status of U.S. Virgin Islands' forests, 2004. Resour. Bull. SRS–122. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 61 p.

Forest covers 21 237 ha of the U.S. Virgin Islands, 61 percent of the total land area. St. John had the highest percentage of forest cover (92 percent), followed by St. Thomas (74 percent), and St. Croix (50 percent). Forest cover has decreased 7 percent from 1994 to 2004, a loss of 1671 ha of forest. Most notably, St. Croix lost 986 ha (11 percent) of subtropical dry forest and St. Thomas lost 307 ha (13 percent) of subtropical dry forest. The forest of the U.S. Virgin Islands consists of very young, undeveloped stands, reflecting past and present land use and disturbances. Eighty percent of the forest inventoried was in stands mostly made up of saplings and seedlings (d.b.h. < 12.5 cm). The remaining 20 percent of the forest was dominated by stands composed of small diameter (12.5- to 22.4-cm d.b.h.) trees.

The inventory sampled 105 tree species, 47 species as trees with d.b.h. ≥ 12.5 cm. Sixty species were found only as saplings or seedlings. Among the species present as trees with d.b.h. ≥ 12.5 cm, black mampoo [*Guapira fragrans* (Dum.-Cours.) Little]) had the highest importance value, followed by gumbo limbo [*Bursera simaruba* (L.) Sarg.]) and genip (*Melicoccus bijugatus* Jacq.). Ninety-five tree species were found as saplings or seedlings (d.b.h. ≤ 12.4 cm), and of these, tan tan [*Leucaena leucocephala* (Lam.) de Wit)] had the highest important value.

There were few indications of stressed trees or widespread pest and disease problems. Only 3.8 percent of live trees had some type of damage or disease. Amounts of down woody material (DWM), forest floor duff, and forest floor litter increased as the forest environment became more humid, but overall the U.S. Virgin Islands' forests lack large pieces of DWM on the forest floor, perhaps because they are in an early successional stage and have few large trees.

Keywords: Caribbean, FIA, forest health, forest inventory, tropical forest, U.S. Virgin Islands, secondary forest.

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U.S. Virgin Islands: During the 17th century, the archipelago was divided into two territorial units, one English and the other Danish. Sugarcane, produced by slave labor, drove the islands' economy during the 18th and early 19th centuries. In 1917, the United States purchased the Danish portion, which had been in economic decline since the abolition of slavery in 1848.

Capital City: Charlotte Amalie

Location: Caribbean, islands between the Caribbean Sea and the North Atlantic Ocean, east of Puerto Rico. Latitude 18.20 N; Longitude 64.50 W

Origin of Commonwealth's Name: Christopher Columbus named the islands Santa Ursula y las Once Mil Vírgenes (shortened to Las Vírgenes), after St. Ursula and her 11,000 virgins.

Population: 108,448 (July 2007 est.)

Geography Note: Important location along the Anegada Passage, a key shipping lane for the Panama Canal; St. Thomas has one of the best natural deepwater harbors in the Caribbean.

Largest City: Charlotte Amalie (2000 U.S. Census found a population of 18,914)

Highest Point: Crown Mountain, 475 m (1,558.40 feet)

Lowest Point: Sea level, Caribbean Sea 0 m

Coastline: 188 km (116.82 miles)

Maritime Claims:
- Territorial sea: 12 nautical miles
- Exclusive economic zone: 200 nautical miles

Constitution: Revised Organic Act of July 22, 1954

Bird: Yellow breast (*Coereba flaveola*) was designated as the official bird of the Virgin Islands by the Virgin Islands legislature in 1970.

Industry: Includes tourism, petroleum refining, watch assembly, rum distilling, construction, pharmaceuticals, textiles, and electronics.

Agriculture: Includes fruit, vegetables, sorghum, and senepol cattle.

Natural Resources: Sun, sand, sea, and surf

Flag: White, with a modified U.S. coat of arms in the center between the large blue initials V and I; the coat of arms shows a yellow eagle holding an olive branch in one talon and three arrows in the other with a superimposed shield of vertical red and white stripes below a blue panel.

Trees: No official tree

Song: Virgin Islands march

Flower: Yellow elder (*Tecoma stans*)

Motto: United in pride and hope

Information courtesy of www.cia.gov/library/publications/the-world-factbook; www.rareflora.com/tecomastan.htm and www.usna.usda.gov/gardens/collections/statetreeflower.

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