

Forest Service Research in Virgin Islands National Park

By Peter Weaver

In cooperation with the University of Puerto Rico, Rio Piedras, the U.S. Forest Service began research in the Virgin Islands NP in 1982 with a survey of the park's vegetation (Woodbury and Weaver 1987). All natural and naturalized species of herbs, shrubs, and trees found on St. John and Hassel Islands were identified, and a herbarium was created in the park. A list of species with their relative abundances by vegetation type also was prepared. The flora of St. John contained at least 116 families and 792 species; 66 families and 297 species were enumerated for Hassel Island; 18 species were designated as rare or endangered.

and 6 of these appeared to be new to science. The medicinal uses of many species also were described.

The main vegetation types on both islands were classified and mapped. More than 60 percent of St. John has dry evergreen formations (Table 1). The moist forest formations occupy about 16 percent of the island. In contrast, mangrove, salt flat, and lagoon areas are limited in extent. The remainder of the park is covered with secondary vegetation, pasture, and urban areas. Hassel Island, only about 54.2 ha, is in Charlotte Amalie harbor, and contains mangrove, moist basin forest, dry evergreen thicket, thorn and cactus, coastal hedge/rock pavement, and secondary

scrub comprised of *Acacia*, *Croton*, and *Leucaena*.

Long-term Ecological Studies

Cinnamon Bay encompasses about 1.32 km² in the north-central park of St. John (Fig. 1) and receives about 1300 mm/yr of rainfall. The watershed ranges in elevation from sea level to about 330m in the south-east, only slightly more than 1 km from the shore. The rough topography is characterized by steep slopes and numerous ravines with streambeds devoid of water except after heavy rains. A pronounced soil moisture gradient exists at all elevations from well-drained ridges and upper slopes to the moister lower slopes and ravines.

The response of ecosystems to biotic influences and random events is best assessed through long-term sampling on representative permanent plots. In 1983, the U.S.F.S. initiated the island's first long-term terrestrial research in the Cinnamon Bay watershed. Sixteen permanent 50 x 10 m plots were stratified in groups of three by topographic positions (ridge, slope, and ravine), at elevations of about 60, 120, 180, 210, and 240 m, with the last plot located near the summit. Objectives of the study were to determine species composition, structural characteristics, species-site relationships, and growth rates in the forest (Weaver and Chinea-Rivera 1987). Heights, diameters at breast height, and crown classes were recorded for all trees over 4 cm. Sixty-nine tree species were identified from the 2,698 stems sampled on all plots.

The 10 most common species accounted for 65 percent of the stems and nearly half of the basal area. *Maytenus elliptica* had the greatest density, averaging 428 stems/ha. In contrast, *Torrubia fragrans* averaged 4.9 m²/ha and occurred on 15 plots, giving it the highest basal area and frequency of occurrence, respectively, of any species in the watershed.

Stem density in the Cinnamon Bay watershed is high, with the number of trees averaging 3,370/ha for all of the plots. The highest tree density is found on the summit and the lowest in the ravines. The mean height and diameter for all tallied trees is about 8 m and 9 cm, respectively. Basal area averages about 30 m²/ha. Mean heights and diameters for all stems vary little by topography; however, when only the largest trees in each plot are considered, tree heights and diameters are greatest in the ravines and smallest on the ridges.

A statistical approach (Reciprocal Averaging ordination) was used to detect elevational trends and topographic preferences for 35 species that occurred at least three times in the data set. The major groupings were: ridge species from low to high elevation; cosmopolitan species; ravine species from low to high elevation; slope species; and, transition species from valley to ridges at low elevations. Site information for tree species, especially those considered to be rare or endangered, is useful for locating them in the wild and for vegetative restoration projects.

Tree Growth and Forest Dynamics

All of the Cinnamon Bay plots were re-measured in 1988 (Weaver 1990). At this time, 206 new trees were recorded (representing ingrowth, or stems growing into the minimum diameter class) whereas 161 stems died. This flux in tree numbers yielded an average increase of 12 stems/ha/yr during the 5 year period of measurement.

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Mean annual diameter growth for the 2,538 trees that survived was 0.07 cm/yr. Differences were apparent by crown class with dominant trees averaging 0.10 cm/yr, codominant and intermediate trees 0.08 cm/yr, and suppressed trees 0.06 cm/yr. Basal area increment for all plots averaged 0.26 m²/ha/yr. Only one species, *Rauvolfia nitida*, disappeared from the plots, and no new species were recorded.

Hurricane Assessment and Productivity

On Sept. 18, 1989, Hurricane Hugo passed near St. John, doing considerable damage to the island's forests. In July 1990, all trees in the Cinnamon Bay plots were classified according to damage: uprooted, snapped, or little disturbed. In April 1991, all tags that were damaged or removed by the hurricane were replaced.

In May 1991, seven trees were harvested from approved locations, and leaves, branches, and trunks were oven-dried and weighed separately to yield biomass estimates. Based on data from these trees and 13 trees sampled in the wet limestone forests of north-central Puerto Rico, common equations were developed to predict leaf and woody biomass from stem dimensions (total tree height and diameter). These equations are currently being used in conjunction with the 1983 and 1988 plot measurements to determine biomass accumulation on the 16 plots, and to assess biomass losses attributable to Hurricane Hugo.

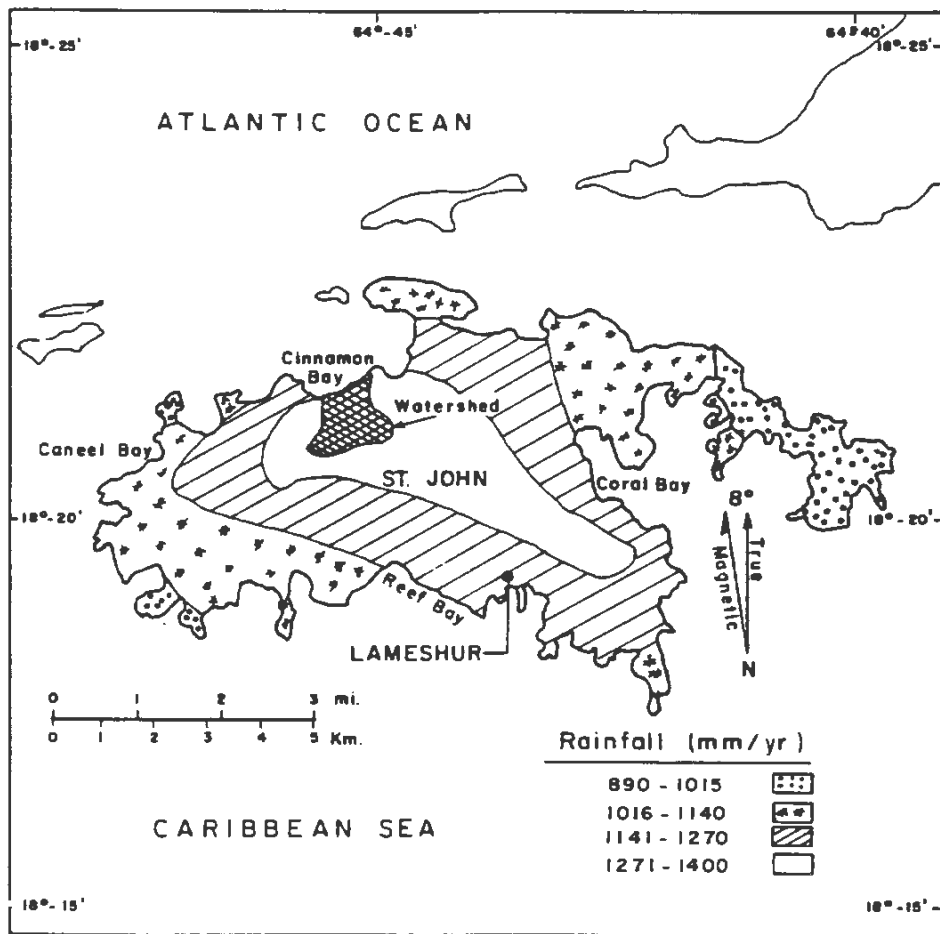


Figure 1. St. John Island and the Cinnamon Bay watershed. Rainfall isotherms are also indicated.

Table 1. Vegetation Types on St. John

• Dry evergreen formations	
– Woodland	33.4%
– Thicket	21.5%
– Thorn and cactus	6.3%
– Coastal hedge/rock pavement	2.1%
• Moist forest formations	
– Upland forest	8.9%
– Gallery forest	3.9%
– Basin forest	3.6%
• Mangrove, salt flat and lagoon areas	2.3%
• Secondary vegetation	13.4%
• Pasture	2.0%
• Urban areas	2.6%
TOTAL	100.0%

Studies of litterfall, loose litter, and herbivory were initiated in February 1992. Data from these studies will be analyzed along with biomass accumulation rates to estimate the productivity of the Cinnamon Bay forest. Monitoring of all permanent plots will occur again in 1993. The 10-year record should provide reliable estimates of incipient changes in forest composition caused by Hurricane Hugo.

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References

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