



FORESTS OF Puerto Rico, 2014

This resource update provides a short overview of the status of forest resources in Puerto Rico (Mainland, Culebra, and Vieques) based on the fifth forest inventory funded and conducted by the U.S. Forest Service, Forest Inventory and Analysis (FIA) program of the Southern Research Station and by the International Institute of Tropical Forestry. Data estimates are based on field data collected using the FIA annualized sample design for the measurement years 2011-2014 with comparisons made to data collected in 2006-2009 and 2001-2004. The sample plot population presented here for Puerto Rico consists of 480 plots, collected across a period of 4 years (about 120 plots, or about 25 percent of the data per year). The data used in this publication were accessed from the FIA Database at <http://fia.fs.fed.us/tools-data/> on September 2016.

For methods used for forest area estimation and field data collection see Brandeis and others 2007.

Overview

Forest cover on Puerto Rico (Mainland, Culebra, Vieques) has remained stable since 2009 because the small change of 0.5 percent in forest cover is encompassed within the estimated sampling error (table 1). The number of live trees with diameter at breast height (d.b.h.) ≥ 1.0 inch on forest land also held steady at 1.42 billion trees in 2014. Net volume and aboveground biomass of live trees with d.b.h. ≥ 5.0 inches increased 133.3 million cubic feet (10.6 percent) and 3,532.8 thousand tons (9.1 percent) respectively. Average annual net growth increased to 43.2 million cubic feet per year, while average annual removals increased to 4.5 million cubic feet. Average annual mortality held steady at 32.7 million cubic feet since 2009 (table 1). These estimates reveal a positive growth-to-removals ratio and a net total gain of 193.5 million cubic feet over the entire 5-year period.

Table 1—Puerto Rico forest statistics, change between 2009 and 2014

Forest statistics	2009 Estimate	Sampling error percent	2014 Estimate	Sampling error percent	Change since 2009
Forest land					
Area (thousand acres)	1,200.3	3.27	1,206.3	3.34	6.0
Number of live trees ≥ 1 inch d.b.h. (million trees)	1,442.2	5.65	1,421.5	5.62	-20.7
Net volume live trees ≥ 5 inches d.b.h. (million cubic feet)	1,257.0	7.93	1,390.3	6.95	133.3
Live trees aboveground biomass (thousand oven-dry tons)	38,806.3	6.51	42,339.1	5.78	3532.8
Net growth live trees ≥ 5 inches d.b.h. (million cubic feet per year)	34.4	21.70	43.2	15.80	8.8
Annual removals of live trees ≥ 5 inches d.b.h. (million cubic feet per year)	0.1	84.86	4.5	58.40	4.4
Annual mortality of live trees ≥ 5 inches d.b.h. (million cubic feet per year)	31.9	16.04	32.7	18.61	0.8
Timberland					
Area (thousand acres)	886.3	5.0	881.8	5.04	-4.6
Number of live trees ≥ 1 inch d.b.h. (million trees)	994.5	7.0	961.1	7.07	-33.5
Net volume live trees ≥ 5 inches d.b.h. (million cubic feet)	1,044.1	9.2	1,128.0	8.04	83.9
Live trees aboveground biomass (thousand oven-dry tons)	31,504.5	8.0	33,593.4	7.13	2,088.9
Net growth live trees ≥ 5 inches d.b.h. (million cubic feet per year)	33.4	20.9	33.4	19.33	0.0
Annual removals of live trees ≥ 5 inches d.b.h. (million cubic feet per year)	0.1	83.9	4.3	61.20	4.1
Annual mortality of live trees ≥ 5 inches d.b.h. (million cubic feet per year)	25.5	18.0	29.8	20.39	4.4



Forest Area

Puerto Rico is an archipelago comprising the islands of Puerto Rico, Culebra, and Vieques, among other smaller islands with forests typically described using the Holdridge life zone classification system (fig. 1).

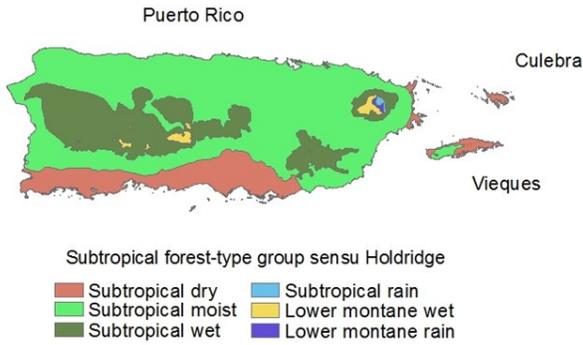


Figure 1—Forest survey units by forest-type group in Puerto Rico.

From a phase characterized by a high rate of forest cover increase on mainland Puerto Rico, shown by the inventories from 1980 to 2004 (31.3 percent to 52.8 percent), the island has transitioned now to a phase of forest cover steadiness since 2004 (fig. 2). The total forested land estimated for mainland Puerto Rico was 1,127,417 acres in 2004, 1,168,292 acres in 2009 and 1,172,439 acres in 2014. Although these values seem to illustrate a pattern of slight increase, it is more appropriate to state that forest cover on mainland Puerto Rico has remained stable because such small changes are encompassed within sampling errors (fig. 2).

The percent forest cover on mainland Puerto Rico was 54.7 percent in 2009 and 54.8 percent in 2014 (fig. 3). Total forest cover on Vieques was estimated at 77.1 percent in

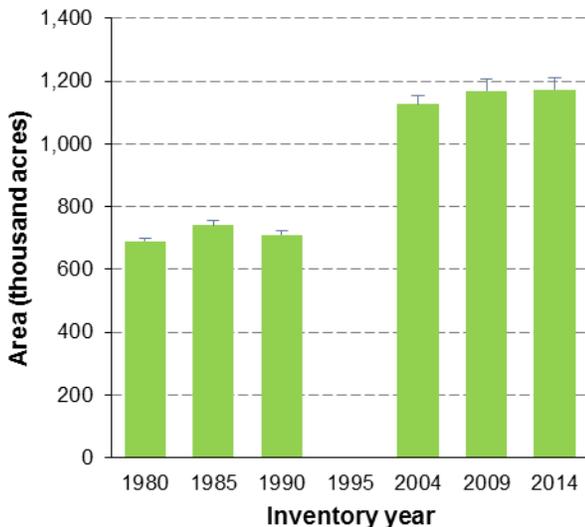


Figure 2—Forest area with sampling errors for mainland Puerto Rico, 1980-2014.

2004, 74.4 percent in 2009, and 79.1 percent in 2014, while on Culebra it was 94.6 percent in 2004, 90.2 percent in 2009, and 91.1 percent in 2014 (fig. 3). As in the case of mainland Puerto Rico, these small fluctuations illustrate a relatively stable phase regarding total forest cover on Vieques and Culebra when sampling errors are considered.

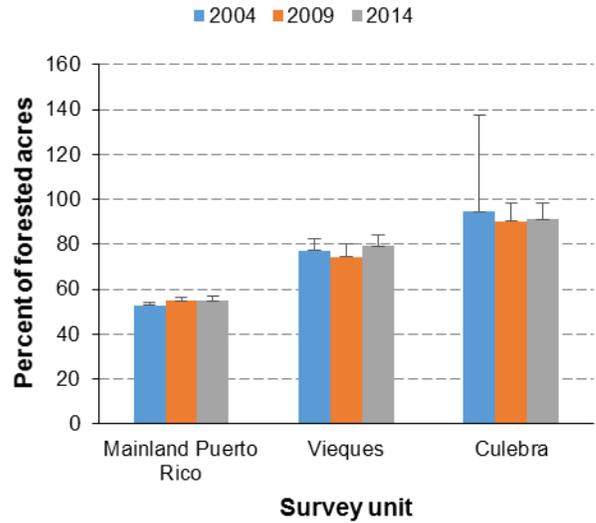


Figure 3—Percent of forested acres with sampling errors by survey unit, Puerto Rico, 2004-2014.

Forest area in 2004, 2009, and 2014 by forest type group shows an increase in the case of subtropical dry forest life zone to 211.8 thousand acres (fig. 4).

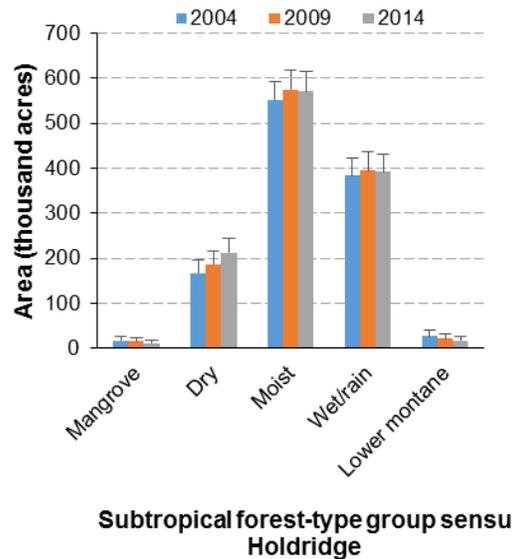


Figure 4—Forest area with sampling errors by forest-type group, Puerto Rico, 2004-2014.

Volume, Biomass, and Trends

Estimated values of net volume in 2014 show 5 million cubic feet of wood in mangrove forest, 76.1 million in dry forest, 643.2 million in moist forest, 637.6 in wet/rain forest, and 28.4 million in lower montane forest (fig. 5).

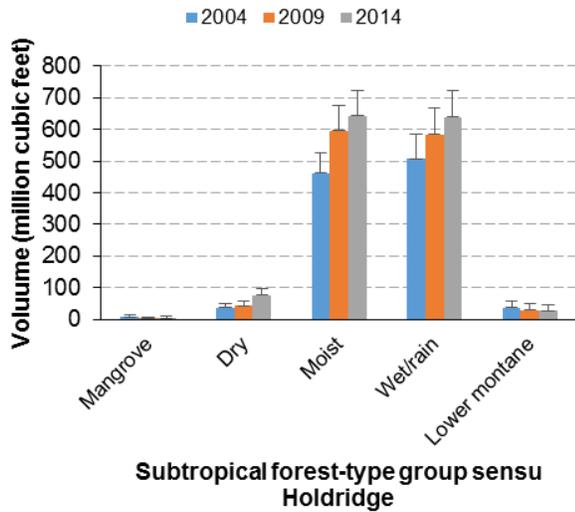


Figure 5—Net volume of live stems ≥ 5 inches d.b.h., with sampling errors, on forest land by forest-type group and inventory year, Puerto Rico, 2004-2014.

Estimated values of biomass in 2014 show 0.2 million tons of aboveground biomass stored in mangrove forest, 3.3 million in dry forest, 20.1 million in moist forest, 17.9 million in wet/rain forest, and 0.8 million tons in lower montane forest (fig. 6).

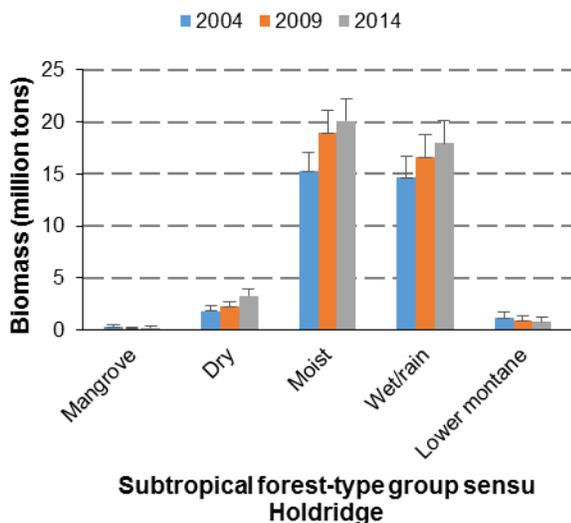


Figure 6—Aboveground biomass of live stems ≥ 1 inch d.b.h., with sampling errors, by forest-type group and inventory year, Puerto Rico, 2004-2014.

Trees within dominant forest types show a trend of increase in total net volume and total aboveground biomass, suggesting a tendency towards more mature stages of development within secondary forests (figs. 5, 6).

A total of 349 species of live trees were recorded on the inventory plots measured from 2011-2014. Both native and introduced species cohabit in the forests of Puerto Rico (table 2). The introduced African tulip tree (*Spathodea campanulata*), and natives *Guarea guidonia* and *Cecropia schreberiana* account for the highest biomass storage.

Table 2—Number of stems and aboveground biomass of live trees ≥1.0 inch d.b.h. of the top 10 species for biomass on forest land, Puerto Rico, 2014.

Scientific name	Number of stems million trees	Aboveground biomass thousand tons
<i>Spathodea campanulata</i>	90.0	7,524.4
<i>Guarea guidonia</i>	94.2	3,641.2
<i>Cecropia schreberiana</i>	10.8	2,280.9
<i>Mangifera indica</i>	5.1	1,953.8
<i>Tabebuia heterophylla</i>	39.3	1,025.8
<i>Inga vera</i>	11.4	986.1
<i>Andira inermis</i>	21.7	921.9
<i>Zanthoxylum martinicense</i>	6.5	708.8
<i>Inga laurina</i>	7.7	625.3
<i>Schefflera morototonii</i>	4.8	523.7

Changes in tree volume were explored by re-measuring trees from the 2006-2009 inventory on forested plots, which allows the estimation of net annual growth on all-live trees, the average annual mortality, and the average annual net removals. Mortality relative to total growth per acre shows different dynamics according to forested-type group (fig. 7). While mortality represented 11 percent of the changes in the volume of re-measured trees in the dry forest, it represented a 95 percent in the lower montane forest.

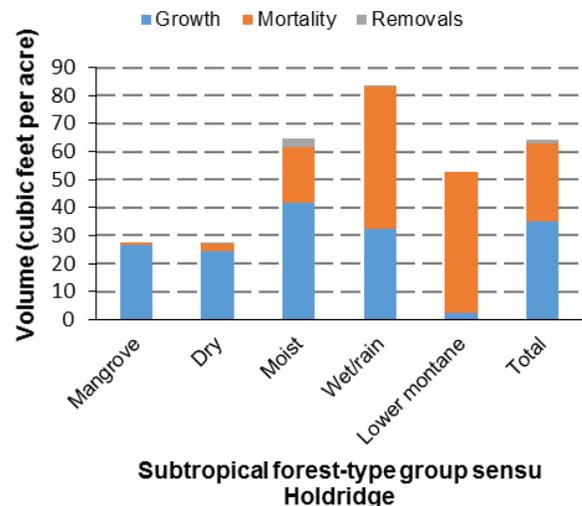


Figure 7—Annual growth, mortality, and removals by forested-type group, Puerto Rico, 2011-2014.

Puerto Rico's Non-timber Forest Products

Species used by the craft sector and fruit trees offer opportunities for the sustainable management of non-timber forest products in private land. Estimated values show that 84 percent of forests in Puerto Rico are privately owned and that species used by artisans have generally increased in volume (fig. 8).

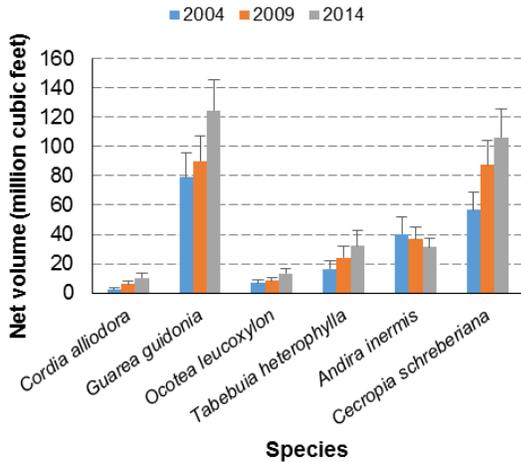


Figure 8—Net volume with sampling errors of live stems ≥ 5 inches d.b.h. of some of the wood species used by the Puerto Rican craft sector, Puerto Rico, 2004-2014.

Nevertheless, a parallel increase is observed in the volume considered as rough cull primarily due to poor tree form (fig. 9). By current FIA methods, only stems with at least one solid 12-foot section or two solid 8-foot sections (now or prospectively) comply with minimum merchantability standards and are classified as growing-stock (Brandeis and others 2007). In contrast, solid 3.3-foot sections are recommended by artisans to make string instruments such as the Puerto Rican cuatro (Rivera 2016).

Fruit trees within the secondary forests of Puerto Rico are an imprint of its' past agricultural economy and broaden opportunities for the promotion of agroforestry systems and guarantee of ecosystem services under an insular environment. As an example, the mango tree population figures as the fourth species of highest biomass with a total of 5.1 million stems in 2014 (table 2, fig. 10).

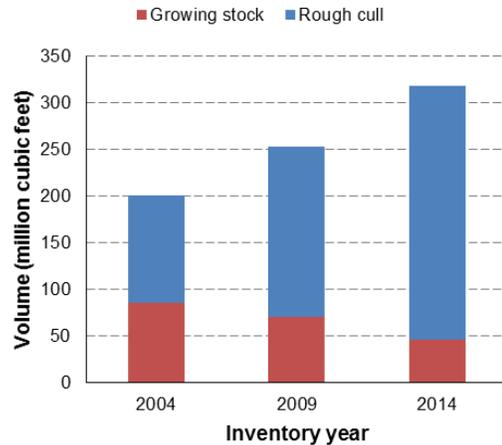


Figure 9—Net volume of live stems ≥ 5 inches d.b.h. by inventory year and tree class, Puerto Rico, 2004-2014.

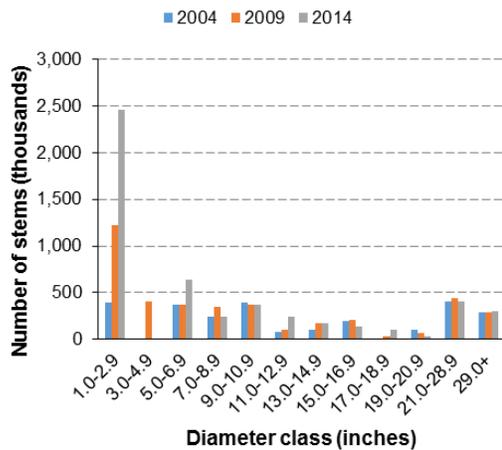


Figure 10—Number of stems of mango (*Mangifera indica*) by diameter class, Puerto Rico, 2004-2014.

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