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Organization of the
United Nations

Global Forest Resources Assessment 2020

Report

Puerto Rico

Rome, 2020



FAO has been monitoring the world's forests at 5 to 10 year intervals since 1946. The Global Forest Resources Assessments (FRA) are now produced every five years in an attempt to provide a consistent approach to describing the world's forests and how they are changing. The FRA is a country-driven process and the assessments are based on reports prepared by officially nominated National Correspondents. If a report is not available, the FRA Secretariat prepares a desk study using earlier reports, existing information and/or remote sensing based analysis.

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Introduction

Report preparation and contact persons

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Introductory text

Introduction

The information presented in this report is a compilation of 5 cycles (1980, 1990, 2004, 2009, and 2014) of national forest inventories on the islands of the Commonwealth of Puerto Rico. These forest inventories were implemented by the U.S. Forest Service's Forest Inventory and Analysis (FIA) program starting in 1980. Inventory methods and specific objectives have evolved since that first forest inventory which focused on answering questions regarding the island's capacity to produce timber (see Birdsey and Weaver, 1982; Brandeis et al., 2007 for an overview of those changes). But the primary goal has remained the same; assess and monitor the status of the resource and provide that information to all stakeholders. Current inventory methods, first applied during the third forest inventory of 2004 (see Brandeis et al., 2007), were a major change and have been followed though to the current day.

As with the previous forest inventory, forests on mainland Puerto Rico, Vieques and Culebra were sampled and measured (see Brandeis et al., 2007 for details on the sampling design). Mona Island was added with the installation of permanent forest inventory and monitoring plots in 2008. Smaller islands, such as Desecheo, Caja de Muertos, etc. are still not included in the inventory. We continue to use the Holdridge life zones (Holdridge, 1967) as described in detail by Ewel and Whitmore (1973) as broad depictions of forest types and convenient categories for the presentation of the results.

An area must have a minimum of 10% canopy cover of trees, or that had such tree cover previously, and is not undergoing development for a nonforest use to be considered forested by the FIA program. We also require that the forest have a minimum area of 1 acre or be in a strip at least 120 feet wide. More details on how we define forest can be found in Brandeis et al. (2007) and the FIA field manual (U.S. Department of Agriculture Forest Service, 2011). Previously we used a combination of aerial photograph interpretation and classified satellite imagery to estimate forested acreage (Brandeis et al., 2007; Kennaway and Helmer, 2007; Helmer and Ruzyski, 2008). Currently we only use aerial photograph interpretation to assign plots to meaningful strata so that stratified estimation methods can be used to reduce the variance of our estimates and land area stratification estimates based on satellite imagery (see Reams et al., 2005; Scott et al., 2005; and Woudenberg et al., 2010 for more information on the stratified estimation approach used by FIA).

No changes were made to the volume equations and methods described in Brandeis et al. (2007), which are based individual tree measured diameter at breast height (d.b.h.) and total tree height. The manner in which live tree biomass and carbon are estimated have changed from those used for estimation in previous FRA reports. The biomass estimates presented here are derived from Biomass Expansion Factors applied to volume estimates, a methods referred to as the the Component Ratio Method (CRM). Detailed description of the CRM, conversion coefficients and ratios can be found in Smith et al. (2002), Jenkins et al. (2003a, b) and Heath et al. (2008). The CRM-derried dry biomass estimates are multiplied by 0.5 to derive a carbon estimate.

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Smith, J.E., Heath, L.S., Jenkins, J.C., 2002. Forest volume-to-biomass models and estimates of mass for live and standing dead trees in U.S. forests. In: USDA Forest Service, Northeastern Research Station, Newtown Square, PA, p. 57.

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1 Forest extent, characteristics and changes

1a Extent of forest and other wooded land

National data

Data sources

1980	References	<p>Birdsey, R.A., Weaver, P.L., 1982. The forest resources of Puerto Rico. In. USDA Forest Service Southern Forest Experiment Station, New Orleans, Louisiana, p. 56. - for the mainland Puerto Rico forest land area estimate of 283.91 Mha.</p> <p>Brandeis, T.J., Helmer, E.H., Oswalt, S.N., 2007. The Status of Puerto Rico's Forests, 2003. In. USDA Forest Service, Southern Research Station, Asheville, NC, p. 75. - for the Vieques and Culebra forest land area estimate of 27.72 Mha.</p> <p>Brandeis, T. J. and J. A. Turner (2013). Puerto Rico's Forests, 2009. Asheville, NC, U.S. Department of Agriculture Forest Service Southern Research Station: 85. - for the Mona forest land area estimate of 5.21 Mha.</p>
	Methods used	National Forest Inventory
	Additional comments	For this report on those outlying islands which were not inventoried prior to 2004, we will consider forest land area to have been unchanged from 1980 to 2004 and use the first recorded values (2004) for those previous time periods.

1990	References	<p>Franco, P. A., P. L. Weaver, et al. (1997). Forest resources of Puerto Rico, 1990. Asheville, North Carolina, USDA Forest Service Southern Research Station: 45. - for the mainland Puerto Rico forest land area estimate of 292.61 Mha.</p> <p>Brandeis, T.J., Helmer, E.H., Oswalt, S.N., 2007. The Status of Puerto Rico's Forests, 2003. In. USDA Forest Service, Southern Research Station, Asheville, NC, p. 75. - for the Vieques and Culebra forest land area estimate of 27.72 Mha.</p> <p>Brandeis, T. J. and J. A. Turner (2013). Puerto Rico's Forests, 2009. Asheville, NC, U.S. Department of Agriculture Forest Service Southern Research Station: 85. - for the Mona forest land area estimate of 5.21 Mha.</p>
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2009	References	
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		<p>Marcano Vega, Humfredo; Brandeis, Thomas J.; Turner, Jeffery A. 2015. Los bosques de Puerto Rico, 2009. Resour. Bull. SRS–202. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 115 p. - for the Mainland Puerto Rico, Vieques, and Culebra forest land area estimates.</p> <p>Brandeis, T. J. and J. A. Turner (2013). Puerto Rico's Forests, 2009. Asheville, NC, U.S. Department of Agriculture Forest Service Southern Research Station: 85. - for the Mona forest land area estimate of 5.21 Mha.</p>
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Classifications and definitions

1980	National class	Definition
	Forest land	Forest land - Land at least 10-percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent stocked with trees and forest areas adjacent to urban and built-up lands. The minimum area for classification of forest land is 0.4 hectare and 36 meters wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 36 meters wide.

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2004	National class	Definition
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2014	National class	Definition
	Forest land area	Forest land - Land at least 10-percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent stocked with trees and forest areas adjacent to urban and built-up lands. The minimum area for classification of forest land is 0.4 hectare and 36 meters wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 36 meters wide.

Original data and reclassification

1980	Classifications and definitions		FRA classes		
	Class	Area (1000 ha)	Forest	Other wooded land	Other land
	Forest land	311.63	100.00 %	0.00 %	0.00 %
	Total	311.63	311.63	0.00	0.00

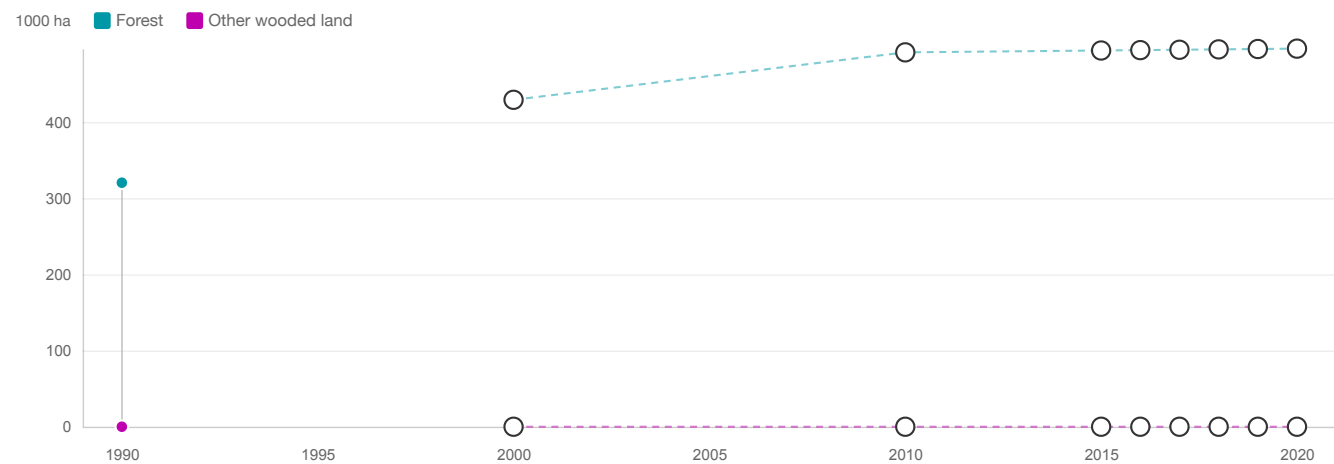
1990	Classifications and definitions		FRA classes		
	Class	Area (1000 ha)	Forest	Other wooded land	Other land
	Forest land	320.33	100.00 %	0.00 %	0.00 %
	Total	320.33	320.33	0.00	0.00

2004	Classifications and definitions		FRA classes		
	Class	Area (1000 ha)	Forest	Other wooded land	Other land
	Forest land	472.68	100.00 %	0.00 %	0.00 %

	Total	472.68	472.68	0.00	0.00
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2009	Classifications and definitions		FRA classes		
	Class	Area (1000 ha)	Forest	Other wooded land	Other land
	Forest land	490.96	100.00 %	0.00 %	0.00 %
	Total	490.96	490.96	0.00	0.00

2014	Classifications and definitions		FRA classes		
	Class	Area (1000 ha)	Forest	Other wooded land	Other land
	Forest land area	493.39	100.00 %	0.00 %	0.00 %
	Total	493.39	493.39	0.00	0.00



FRA categories	Area (1000 ha)								
	1990	2000	2010	2015	2016	2017	2018	2019	2020
Forest (a)	320.33	429.15	491.45	493.88	494.37	494.86	495.35	495.84	496.33
Other wooded land (a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other land (c-a-b)	566.67	457.85	395.55	393.12	392.63	392.14	391.65	391.16	390.67
Total land area (c)	887.00	887.00	887.00	887.00	887.00	887.00	887.00	887.00	887.00

The FAOSTAT land area figure for the year 2015 is used for all reference years

Climatic domain	% of forest area 2015	Override value
Boreal	0.00	
Temperate	0.00	
Sub-tropical	0.00	100.00
Tropical	100.00	0.00

Comments

These current forest land area estimates do not match previous FRA assessment because we are now including the outlying Puerto Rican islands of Vieques, Culebra and Mona. Additionally, the 2014 NFI results showed a change in trend direction, which changed the values for this current reports predictions.

All data cited in these tables come from the U.S. Forest Service Forest Inventory and Analysis program national forest inventory.

Data for inventory year 1980 derived from the publication:

1. Birdsey, R. A., and P. L. Weaver. 1982. The forest resources of Puerto Rico. Resource Bulletin SO-85, USDA Forest Service Southern Forest Experiment Station, New Orleans, Louisiana. pp. 56

Data from the inventory year 1990 derived from the publication:

1. Franco, P. A., P. L. Weaver, and S. Eggen-McIntosh. 1997. Forest resources of Puerto Rico, 1990. Southern Resource Bulletin SRS-22, USDA Forest Service Southern Research Station, Asheville, North Carolina. pp. 45

Data from the inventory year 2004 derived from the following publication and database queries:

1. Brandeis, T. J., E. H. Helmer, and S. N. Oswalt. 2007. The Status of Puerto Rico's Forests, 2003. Resource Bulletin SRS-119, USDA Forest Service Southern Research Station, Asheville, NC. pp. 75.
2. USDA Forest Service, Forest Inventory and Analysis Program, Mon Jun 11 13:13:37 GMT 2018. Forest Inventory EVALIDator web-application Version 1.7.0.01. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: <http://fsxopsx1056.fdc.fs.usda.gov:9001/Evalidator/evaluator.jsp>]

Data for the 2009 inventory year derived from:

1. Marcano Vega, Humfredo; Brandeis, Thomas J.; Turner, Jeffery A. 2015. Los bosques de Puerto Rico, 2009. Resour. Bull. SRS-202. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 115 p.
2. USDA Forest Service, Forest Inventory and Analysis Program, Mon Jun 11 13:13:37 GMT 2018. Forest Inventory EVALIDator web-application Version 1.7.0.01. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: <http://fsxopsx1056.fdc.fs.usda.gov:9001/Evalidator/evaluator.jsp>]

Data for the 2014 inventory year derived from:

1. Marcano-Vega, Humfredo. 2017. Forests of Puerto Rico, 2014. Resource Update FS-12 Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 4 p.
2. USDA Forest Service, Forest Inventory and Analysis Program, Mon Jun 11 13:13:37 GMT 2018. Forest Inventory EVALIDator web-application Version 1.7.0.01. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: <http://fsxopsx1056.fdc.fs.usda.gov:9001/Evalidator/evaluator.jsp>]

The forest inventory of Puerto Rico does not include "Other wooded land" as a separate category. If the other wooded land does not meet the minimum requirements to be categorized as forest it is included in the "Other land" estimates, so although this report shows a zero value, there actually are other wooded lands that are not captured in this data.

About the climatic domains Puerto Rico is generally considered to be subtropical rather than tropical. The Holdridge Life Zones are commonly used there and according to them most of the forested zones are subtropical.

1b Forest characteristics

National data

Data sources

1980	References	<p>Birdsey, R.A., Weaver, P.L., 1982. The forest resources of Puerto Rico. In. USDA Forest Service Southern Forest Experiment Station, New Orleans, Louisiana, p. 56. - for the mainland Puerto Rico forest land area estimate of 283.91 Mha.</p> <p>Brandeis, T.J., Helmer, E.H., Oswalt, S.N., 2007. The Status of Puerto Rico's Forests, 2003. In. USDA Forest Service, Southern Research Station, Asheville, NC, p. 75. - for the Vieques and Culebra forest land area estimate of 27.72 Mha.</p> <p>Brandeis, T. J. and J. A. Turner (2013). Puerto Rico's Forests, 2009. Asheville, NC, U.S. Department of Agriculture Forest Service Southern Research Station: 85. - for the Mona forest land area estimate of 5.21 Mha.</p>
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Classifications and definitions

1980	National class	Definition
	Forest land	Forest land - Land at least 10-percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent stocked with trees and forest areas adjacent to urban and built-up lands. The minimum area for classification of forest land is 0.4 hectare and 36 meters wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 36 meters wide.

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	Class	Area (1000 ha)	Naturally regenerating forest	Plantation forest	Other planted forest
	Forest land	311.63	100.00 %	0.00 %	0.00 %
	Total	311.63	311.63	0.00	0.00

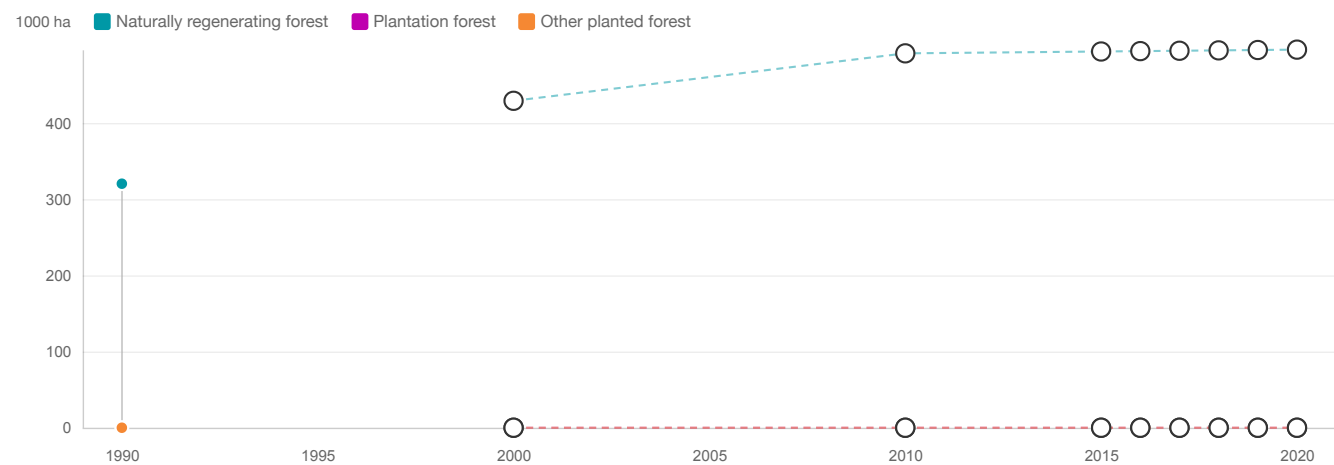
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	1990	2000	2010	2015	2016	2017	2018	2019	2020
Naturally regenerating forest (a)	320.33	429.15	491.45	493.88	494.37	494.86	495.35	495.84	496.33
Planted forest (b)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Plantation forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
...of which introduced species		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other planted forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (a+b)	320.33	429.15	491.45	493.88	494.37	494.86	495.35	495.84	496.33
Total forest area	320.33	429.15	491.45	493.88	494.37	494.86	495.35	495.84	496.33

Comments

1c Primary forest and special forest categories

National Data

Data sources + type of data source eg NFI, etc

While there are areas with bamboos in Puerto Rico, they are not included as tally species in the NFI.

Mangroves are included as trees in the NFI and there are small areas with mangrove forests. The NFI, however, was not intensive enough to capture their limited extent, therefore we do not have estimates of mangrove forest area.

There are not areas of primary forests nor rubber plantations.

National classification and definitions

Forest land - Land at least 10-percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent stocked with trees and forest areas adjacent to urban and built-up lands. The minimum area for classification of forest land is 0.4 hectare and 36 meters wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 36 meters wide.

Original data

Numerator attribute number and description: 0002 Area of forest land, in acres			
FIADEF as the forest land definition.			
Statecd/EVALID(s):			
Puerto Rico 722009			
Puerto Rico 722014			
Puerto Rico 722004			
Page variable=None (based on values from the Current inventory).			
Row variable=EVALID (based on values from the Current inventory).			
Column variable=Forest type group abbr (based on values from the Current inventory).			
Filtering clause(s): and (cond.fortypcd=982)			
Estimate:			
	Forest type group abbr		
EVALID	Total (acres)	TropHw = 982 Mangrove (acres)	Mangrove (thousand ha.)
Total	42,913	42,913	17.37
Puerto Rico (Mainland, Vieques, Culebra) 2004 rscd= 33 evalid= 720401	17,088	17,088	6.92
Puerto Rico (Mainland, Vieques, Culebra) 2009 rscd= 33 evalid= 720901	14,898	14,898	6.03
Puerto Rico (Mainland, Vieques, Culebra) 2014 rscd= 33 evalid= 721401	10,926	10,926	4.42

Analysis and processing of national data

Estimation and forecasting

Estimation and forecasting was done by calculating annual rates of change except for 1990. Mangroves were not measured in the 1990 NFI so no estimates were made for that time period. To estimate 2000 mangrove forest land area, the annual rate of change from 2004-2009 was backcast to 2000. For the 2010 and 2015 estimates, the 2009-2014 annual rate of change was applied. For 2020, the 2015 estimates was carried forward because I am uncertain that mangrove forest area will continue to decline at the currently observed rates in the future.

Thousand hectares						
2000	2004	2009	2010	2014	2015	2020
10.46	6.92	6.03	5.71	4.42	4.10	4.10

Reclassification into FRA 2020 categories

The FIA NFI definition of forest land is compatible with the FRA 2020 forest land categories.

FRA categories	Area (1000 ha)				
	1990	2000	2010	2015	2020
Primary forest	0.00	0.00	0.00	0.00	0.00
Temporarily unstocked and/or recently regenerated					
Bamboos					
Mangroves		10.46	5.71	4.10	4.10
Rubber wood	0.00	0.00	0.00	0.00	0.00

Comments

1d Annual forest expansion, deforestation and net change

National Data

Data sources + type of data source eg NFI, etc

Based on the NFI data, we can say that the vast majority of reforested forest land in Puerto Rico are due to natural regeneration. We cannot, however, assess forest land area losses due to deforestation.

National classification and definitions

-

Original data

-

Analysis and processing of national data

Estimation and forecasting

-

Reclassification into FRA 2020 categories

-

FRA categories	Area (1000 ha/year)			
	1990-2000	2000-2010	2010-2015	2015-2020
Forest expansion (a)				
...of which afforestation				
...of which natural expansion				
Deforestation (b)				
Forest area net change (a-b)	10.88	6.23	0.49	0.49

Comments

1e Annual reforestation

National Data

Data sources + type of data source eg NFI, etc

While there are small areas reforested artificially in Puerto Rico, the NFI sampling has not been sufficiently intensive to capture these plantations. Therefore we will not attempt to estimate annual reforestation.

National classification and definitions

-

Original data

-

Analysis and processing of national data

Estimation and forecasting

-

Reclassification into FRA 2020 categories

-

FRA categories	Area (1000 ha/year)			
	1990-2000	2000-2010	2010-2015	2015-2020
Reforestation				

Comments

1f Other land with tree cover

National Data

Data sources + type of data source eg NFI, etc

These categories of other land with tree cover are not currently included in the NFI.

National classification and definitions

-

Original data

-

Analysis and processing of national data

Estimation and forecasting

-

Reclassification into FRA 2020 categories

-

FRA categories	Area (1000 ha)				
	1990	2000	2010	2015	2020
Palms (a)					
Tree orchards (b)					
Agroforestry (c)					
Trees in urban settings (d)					
Other (specify in comments) (e)					
Total (a+b+c+d+e)	–	–	–	–	–
Other land area	566.67	457.85	395.55	393.12	390.67

Comments

2 Forest growing stock, biomass and carbon

2a Growing stock

National Data

Data sources + type of data source eg NFI, etc

The information found in this database is derived from a national forest inventory (NFI) implemented in Puerto Rico by the U.S. Forest Service Forest Inventory and Analysis (FIA) program. This NFI samples forest land on the islands of Puerto Rico, Vieques, Culebra and Mona, excluding smaller non-forested and/or uninhabited islands and cays which are also part of the island group. The NFI began in Puerto Rico in 1980 and has since remeasured sampling points every 5-10 years. To date, there have been five such periodic inventories in 1980, 1990, 2004, 2009 and 2014, with the 2019 inventory currently underway.

Forest inventory plot data collected include land use and its change, disturbances to the forest, whether stands are naturally or artificially regenerated, forest ownership and information on many other variables. All live and standing dead trees are measured down to a diameter at breast height of 12.5 cm. A sub-sample of plots have additional data collected on soils, floor litter, and down woody materials. Other forest carbon pools such as belowground live tree and understory vegetation are modeled.

All data used to populate this database is publically available through a variety of on-line tools that access the larger FIA database. Links to these tools can be found at: <https://www.fia.fs.fed.us/tools-data/index.php>. Additional documentation from FIA can be found on-line at <https://www.fia.fs.fed.us/library/index.php> or in publications listed below.

Birdsey, R.A., Weaver, P.L., 1982. The forest resources of Puerto Rico. In. USDA Forest Service Southern Forest Experiment Station, New Orleans, Louisiana, p. 56.

Brandeis, T.J., Helmer, E.H., Oswalt, S.N., 2007. The Status of Puerto Rico's Forests, 2003. In. USDA Forest Service, Southern Research Station, Asheville, NC, p. 75.

Brandeis, T. J. and J. A. Turner (2013). Puerto Rico's Forests, 2009. Asheville, NC, U.S. Department of Agriculture Forest Service Southern Research Station: 85.

Franco, P. A., P. L. Weaver, et al. (1997). Forest resources of Puerto Rico, 1990. Asheville, North Carolina, USDA Forest Service Southern Research Station: 45.

Marcano-Vega, Humfredo. 2017. Forests of Puerto Rico, 2014. Resource Update FS–121. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 4 p.

National classification and definitions

Forest land: Land at least 10-percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent stocked with trees and forest areas adjacent to urban and built-up lands. The minimum area for classification of forest land is 0.4 hectare and 36 meters wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 36 meters wide.

Tree: A woody plant usually having one or more erect perennial stems, a stem diameter at breast height of at least 3.0 inches, a more or less definitely formed crown of foliage, and a height of at least 15 feet at maturity.

Net cubic-foot volume. For timber species (trees where the diameter is measured at breast height [DBH]), this is the net volume of wood in the central stem of a sample tree ≥ 12.5 cm in diameter **inside the bark**, from a 30 cm stump to a minimum 10 cm top diameter, or to where the central stem breaks into limbs all of which are < 10 cm in diameter. For woodland species (trees where the diameter is measured at root collar [DRC]), this is the net volume of wood and bark from the DRC measurement point(s) to a 3.5 cm top diameter; includes branches that are at least 2.5 cm in diameter along the length of the branch.

Note again that the above definition and all subsequent volume estimates are for inside the bark, not outside the bark as requested by FRA. We are currently unable to produce outside the bark volume estimates.

Original data

Values for total net merchantable bole volume (inside bark) of live trees in cubic feet on forest land were queried using Evaluator for 1) Mainland Puerto Rico, Vieques and Culebra, and 2) Mona Island. These estimates were then summed and converted to million cubic meters. Cubic feet values were converted to cubic meters using a conversion factor of 0.028317.

Note the trends toward increasing volume density per hectare over time as these secondary forests mature.

Tab 2a. Total Volume (million cubic meters)		
Year	m3	M m3
2004	273,152.91	0.27
2009	404,526.61	0.40
2014	593,120.27	0.59

The volume estimates from the 1990 NFI were limited to timberland, excluding portions of the islands that were not considered to have the potential for commerical production. Therefore estimates have not been made for 1990.

Analysis and processing of national data

Estimation and forecasting

Original data in cubic feet were converted to million cubic meters. Then annual change was calculated.

Tab 2a. Total Volume (million cubic meters)			
Year	m3	M m3	
2004	29,887,317.07	29.89	
2009	35,658,552.80	35.66	
2014	39,432,876.62	39.43	
Annualized change	m3	Mm3	
2004-2014 (10 yr)	954,555.96	0.95	
2004-2009 (5 yr)	1,154,247.15	1.15	
2009-2014 (5 yr)	754,864.76	0.75	
m3 (measured and projected using 5-yr and 10-yr rates of change)			
Year	m3	M m3	
1990	13,727,857.00	13.73	2004-2009 5-yr rate of change
2000	25,270,328.48	25.27	
2004	29,887,317.07	29.89	
2005	30,841,873.02	30.84	2004-2009 5-yr rate of change
2006	31,796,428.98	31.80	
2007	32,750,984.93	32.75	
2008	33,705,540.89	33.71	
2009	35,658,552.80	35.66	
2010	36,812,799.95	36.81	2009-2014 5-yr rate of change
2011	37,967,047.10	37.97	
2012	39,121,294.25	39.12	
2013	40,275,541.39	40.28	
2014	39,432,876.62	39.43	

2015	40,387,432.58	40.39	2004-2014 10-yr rate of change
2016	41,341,988.53	41.34	
2017	42,296,544.49	42.30	
2018	43,251,100.44	43.25	
2019	44,205,656.40	44.21	
2020	45,160,212.35	45.16	

Reclassification into FRA 2020 categories

The FIA NFI definition of forest land is compatible with the FRA 2020 forest land categories.

The FIA NFIs implemented in the United States, its associated Territories and Commonwealths defines growing stock as a subset of all live trees of commercial species that meet minimum merchantability standards. In the Caribbean islands, however, difficulties in applying those guidelines result in our choosing to present all live tree volume as growing stock.

Net cubic foot volume (converted to cubic meters for this report) is calculated inside bark rather than outside bark as per FRA 2020 guidelines. Conversion to outside bark volume is not feasible at this time because the volume equations used in the NFI data processing system produce inside bark volume estimates only.

FRA categories	Growing stock m³/ha (over bark)								
	1990	2000	2010	2015	2016	2017	2018	2019	2020
Naturally regenerating forest	58.88	58.88	74.90	81.78	83.62	85.48	87.31	89.16	90.99
Planted forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
...of which plantation forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
...of which other planted forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forest	58.88	58.88	74.90	81.78	83.62	85.48	87.31	89.16	90.99
Other wooded land									

FRA categories	Total growing stock (million m³ over bark)								
	1990	2000	2010	2015	2016	2017	2018	2019	2020
Naturally regenerating forest	18.86	25.27	36.81	40.39	41.34	42.30	43.25	44.21	45.16
Planted forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
...of which plantation forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
...of which other planted forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forest	18.86	25.27	36.81	40.39	41.34	42.30	43.25	44.21	45.16
Other wooded land									

Comments

There are minor differences between the directly calculated volume density (cubic feet per acre) estimates available from the FIA DB with Evaluator those automatically calculated by the FRA platform. To simplify, I have chosen to leave this table populated with the automatically generated estimates from the FRA platform.

Note that I have assumed the volume density in 2000 to be applicable to 1990 to complete this table. This assumption might not be accurate, particularly for the islands of Vieques, Culebra and Mona for which we have no volume estimates from this time. The NFI indicates increasing volume density over time as the islands' secondary forests mature and continue to accrete volume so these 1990 estimates might be an overestimate.

2b Growing stock composition

National Data

Data sources + type of data source eg NFI, etc

The information found in this database is derived from a national forest inventory (NFI) implemented in Puerto Rico by the U.S. Forest Service Forest Inventory and Analysis (FIA) program. This NFI samples forest land on the islands of Puerto Rico, Vieques, Culebra and Mona, excluding smaller non-forested and/or uninhabited islands and cays which are also part of the island group. The NFI began in Puerto Rico in 1980 and has since remeasured sampling points every 5-10 years. To date, there have been five such periodic inventories in 1980, 1990, 2004, 2009 and 2014, with the 2019 inventory currently underway.

Forest inventory plot data collected include land use and its change, disturbances to the forest, whether stands are naturally or artificially regenerated, forest ownership and information on many other variables. All live and standing dead trees are measured down to a diameter at breast height of 12.5 cm. A sub-sample of plots have additional data collected on soils, floor litter, and down woody materials. Other forest carbon pools such as belowground live tree and understory vegetation are modeled.

All data used to populate this database is publically available through a variety of on-line tools that access the larger FIA database. Links to these tools can be found at: <https://www.fia.fs.fed.us/tools-data/index.php>. Additional documentation from FIA can be found on-line at <https://www.fia.fs.fed.us/library/index.php> or in publications listed below.

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Brandeis, T. J. and J. A. Turner (2013). Puerto Rico's Forests, 2009. Asheville, NC, U.S. Department of Agriculture Forest Service Southern Research Station: 85.

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Marcano-Vega, Humfredo. 2017. Forests of Puerto Rico, 2014. Resource Update FS–121. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 4 p.

National classification and definitions

Forest land: Land at least 10-percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent stocked with trees and forest areas adjacent to urban and built-up lands. The minimum area for classification of forest land is 0.4 hectare and 36 meters wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 36 meters wide.

Tree: A woody plant usually having one or more erect perennial stems, a stem diameter at breast height of at least 8 cm, a more or less definitely formed crown of foliage, and a height of at least 5 meters feet at maturity.

Net cubic-foot volume. For timber species (trees where the diameter is measured at breast height [DBH]), this is the net volume of wood in the central stem of a sample tree ≥ 12.5 cm in diameter **inside the bark**, from a 30 cm stump to a minimum 10 cm top diameter, or to where the central stem breaks into limbs all of which are < 10 cm in diameter. For woodland species (trees where the diameter is measured at root collar [DRC]), this is the net volume of wood and bark from the DRC measurement point(s) to a 3.5 cm top diameter; includes branches that are at least 2.5 cm in diameter along the length of the branch.

Note again that the above definition and all subsequent volume estimates are for inside the bark, not outside the bark as requested by FRA. We are currently unable to produce outside the bark volume estimates.

Original data

Estimates were derived from the FIADB using the Evaluator query tool for the NFI years of 2004, 2009 and 2014; net merchantable volume by species. Original data from the FIA database is below. Species ranking from the 2014 NFI was used.

USDA Forest Service, Forest Inventory and Analysis Program. Forest Inventory EVALIDator web-application Version 1.7.0.01. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: <http://fsxopsx1056.fdc.fs.usda.gov:9001/Evaluator/evaluator.jsp>]

Species	Total	2014	2009	2004
blackbrush wattle	13,418	-	13,418	-
porknut	29,585	-	-	29,585
naked albizia	35,806	-	35,806	-
pride-of-Barbados	20,176	-	-	20,176
Jamaican caper	29,942	-	18,365	11,577
papaya	3,833	-	3,833	-

wild honeytree	13,475	-	-	13,475
galen del monte	17,966	-	9,656	8,310
false chiggergrape	37,723	-	-	37,723
burn nose	5,179	-	5,179	-
royal poinciana	48,602	-	-	48,602
white-mangrove	17,055	-	17,055	-
bulletwood	209,738	-	-	209,738
Nectandra coriacea	14,912	-	-	14,912
aceitillo	6,866	-	6,866	-
palo amargo	3,901	-	3,901	-
mahogany	17,412	-	17,412	-
aceitunilla	160,684	-	-	160,684
Other or unknown live tree	102,842	-	18,177	84,665
Total	44,877,945	20,945,879	14,285,746	9,646,320
Spanish lime	6,932,139	3,457,120	2,161,800	1,313,219
black mampoo	5,764,421	2,330,109	1,971,629	1,462,683
gumbo limbo	4,126,634	1,800,147	1,350,628	975,859
West Indian mahogany	4,704,775	1,627,237	1,592,723	1,484,815
mango	1,231,973	1,231,973	-	-
sweet acacia	1,628,258	1,183,719	322,765	121,774
water mampoo	2,421,395	1,001,550	819,528	600,317
bodywood	2,249,072	933,584	698,987	616,502
spineless wattle	2,076,297	910,629	702,133	463,535
cabbagebark tree	1,882,653	852,273	770,160	260,220
stinkingtoe	548,038	538,353	9,685	-
woman's tongue	781,102	493,689	222,109	65,304
raintree	733,463	367,193	308,801	57,468
tamarind	645,594	336,016	225,256	84,322
puckhout	461,544	297,455	164,089	-
sapodilla	646,265	289,691	356,574	-
Spanish elm	600,852	271,181	210,130	119,542
white cinnamon	771,520	251,803	299,211	220,506

Jamaican nettletree	256,948	233,874	23,074	-
white cedar	487,977	219,386	210,530	58,061
tietongue, pigeon-plum	215,739	215,739	-	-
Florida fiddlewood	389,173	199,138	-	190,035
San Bartolome	328,258	192,533	135,724	-
camito de perro	525,118	191,770	189,233	144,115
Spanish cedar	452,049	184,387	116,995	150,667
gregorywood	273,385	155,242	85,286	32,857
bastard hogberry	278,490	148,255	130,235	-
tall albizia	279,569	109,962	169,607	-
sacky sac bean	354,979	83,044	70,905	201,030
leadwood	273,385	73,523	96,280	103,581
breakbill	102,978	62,968	40,011	-
stinkwood	105,021	59,314	38,686	7,021
Royen's tree cactus	180,949	55,289	48,427	77,233
white pricklyash	134,861	53,575	43,696	37,590
golden shower	62,649	51,165	11,484	-
linguam	108,140	47,799	31,530	28,811
bayrumtree	127,283	44,824	43,572	38,887
bloodwoodtree	41,473	41,473	-	-
guavaberry	130,443	38,708	62,891	28,845
wild guave	62,393	37,796	16,988	7,610
seagrape	67,357	30,185	21,779	15,392
smooth manjack	54,779	28,740	20,549	5,491
wild lime	47,402	27,822	19,580	-
ratapple	24,834	24,834	-	-
spiny fiddlewood	210,125	19,992	190,133	-
Poitea florida	75,332	19,456	49,716	6,161
cucubano de vieques	32,955	18,381	14,574	-
white leadtree	35,870	17,382	18,488	-
marbletree	33,653	14,958	6,080	12,614
bastard redwood	14,897	14,897	-	-

wild cinnamon	24,682	12,456	12,226	-
red rodwood	9,924	9,924	-	-
red stopper	15,414	8,800	6,614	-
bridgotree	42,944	8,595	19,543	14,806
yellow trumpetbush	8,548	8,548	-	-
ratwood	12,860	7,423	5,437	-

Analysis and processing of national data

Estimation and forecasting

Estimation and forecasting was done with the annual change methodology for each species. Species were categorized as native or introduced to Puerto Rico according to the NRCS PLANTS database accessed on September 4, 2018. The top 10 native and top 5 introduced species are presented. Cubic feet volume estimates were converted to cubic meters using a 0.0283168 conversion factor. Values were then expressed in million cubic meters.

The volume estimates for each species from the 2004 NFI were used for the 2000 and 1990 estimates.

Reclassification into FRA 2020 categories

The FIA NFI definition of forest land is compatible with the FRA 2020 forest land categories.

The FIA NFIs implemented in the United States, its associated Territories and Commonwealths defines growing stock as a subset of all live trees of commercial species that meet minimum merchantability standards. In the Caribbean islands, however, difficulties in applying those guidelines result in our choosing to present all live tree volume as growing stock.

Net cubic foot volume (converted to cubic meters for this report) is calculated inside bark rather than outside bark as per FRA 2020 guidelines. Conversion to outside bark volume is not feasible at this time because the volume equations used in the NFI data processing system produce inside bark volume estimates only.

FRA categories	Scientific name	Common name	Growing stock in forest (million m³ over bark)				
			1990	2000	2010	2015	2020
Native tree species							
#1 Ranked in terms of volume	Guarea guidonia	American muskwood		1.89	2.62	3.72	
#2 Ranked in terms of volume	Cecropia schreberiana	pumpwood		1.36	2.65	3.11	
#3 Ranked in terms of volume	Inga vera	river koko		0.51	0.91	1.02	
#4 Ranked in terms of volume	Tabebuia heterophylla	white cedar		0.39	0.73	0.96	
#5 Ranked in terms of volume	Andira inermis	cabbagebark tree		0.97	1.02	0.86	
#6 Ranked in terms of volume	Dacryodes excelsa	candletree		0.49	0.75	0.88	
#7 Ranked in terms of volume	Zanthoxylum martinicense	white pricklyash		0.27	0.53	0.78	
#8 Ranked in terms of volume	Schefflera morototonii	matchwood		0.36	0.61	0.74	
#9 Ranked in terms of volume	Bursera simaruba	gumbo limbo		0.50	0.77	0.69	
#10 Ranked in terms of volume	Inga laurina	sacky sac bean		0.62	0.69	0.70	
Remaining native tree species				7.37	9.12	11.15	
Total volume of native tree species			–	14.73	20.40	24.61	–
Introduced tree species							
#1 Ranked in terms of volume	Spathodea campanulata	African tuliptree		5.77	9.27	7.99	
#2 Ranked in terms of volume	Mangifera indica	mango		1.87	2.29	2.44	

FRA categories	Scientific name	Common name	Growing stock in forest (million m³ over bark)				
			1990	2000	2010	2015	2020
Native tree species							
#3 Ranked in terms of volume	Eucalyptus robusta	swampmahogany		0.72	1.11	1.21	
#4 Ranked in terms of volume	Albizia procera	tall albizia		0.20	0.34	0.42	
#5 Ranked in terms of volume	Syzygium jambos	Syzygium jambos		0.38	0.42	0.39	
Remaining introduced tree species				1.60	2.24	2.81	
Total volume of introduced tree species			–	10.54	15.67	15.26	–
Total growing stock			–	25.27	36.07	39.87	–

Comments

Species rankings are based on results of the 2014 NFI of Puerto Rico. We do not feel it would be appropriate to backforecast the species composition to 1990. We used the 2004 NFI values to represent the year 2000. The island's forests are still undergoing successional changes as they recover from the previous widespread deforestation.

For the FRA year 2000, the NFI 2004 data were used. Similarly, FRA 2005 values are from 2004 NFI, FRA 2010 from the 2009 NFI, and FRA 2015 from the 2014 NFI. For these reasons, the total growing stock presented here differs slightly from the extrapolated totals that appear in table 2a Growing Stock.

2c Biomass stock

National Data

Data sources + type of data source eg NFI, etc

Note - these estimates were made from data collected on mainland Puerto Rico, Vieques and Culebra. Forest carbon pool estimates for dead wood and forest floor were not available for Mona Island at the time of this report, therefore we decided to exclude that island from these calculations.

The information found in this database is derived from a national forest inventory (NFI) implemented in Puerto Rico by the U.S. Forest Service Forest Inventory and Analysis (FIA) program. This NFI samples forest land on the islands of Puerto Rico, Vieques, Culebra and Mona, excluding smaller non-forested and/or uninhabited islands and cays which are also part of the island group. The NFI began in Puerto Rico in 1980 and has since remeasured sampling points every 5-10 years. To date, there have been five such periodic inventories in 1980, 1990, 2004, 2009 and 2014, with the 2019 inventory currently underway.

Forest inventory plot data collected include land use and its change, disturbances to the forest, whether stands are naturally or artificially regenerated, forest ownership and information on many other variables. All live and standing dead trees are measured down to a diameter at breast height of 12.5 cm. A sub-sample of plots have additional data collected on soils, floor litter, and down woody materials. Other forest carbon pools such as belowground live tree and understory vegetation are modeled.

All data used to populate this database is publically available through a variety of on-line tools that access the larger FIA database. Links to these tools can be found at: <https://www.fia.fs.fed.us/tools-data/index.php>. Additional documentation from FIA can be found on-line at <https://www.fia.fs.fed.us/library/index.php> or in publications listed below.

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Marcano-Vega, Humfredo. 2017. Forests of Puerto Rico, 2014. Resource Update FS–121. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 4 p.

National classification and definitions

Forest land: Land at least 10-percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent stocked with trees and forest areas adjacent to urban and built-up lands. The minimum area for classification of forest land is 0.4 hectare and 36 meters wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 36 meters wide.

Tree: A woody plant usually having one or more erect perennial stems, a stem diameter at breast height of at least 7.5 cm, a more or less definitely formed crown of foliage, and a height of at least 5 meters at maturity.

The aboveground weight of live trees (including bark but excluding foliage) reported in dry tons (dry weight). Biomass has four components for most tree species (bole, tops and limbs, saplings, and stump) but is estimated as a single component for woodland species.

1. Bole: Biomass of a tree from 30 cm above the ground to a 10 cm top outside bark or to a point where the central stem breaks into limbs.
2. Tops and limbs: Total biomass of a tree from a 30 cm stump minus the bole.
3. Saplings: Total aboveground biomass of a tree from 2.5 to 12.5 cm in d.b.h.
4. Stump: Biomass of a tree 12.5 cm d.b.h. and larger from the ground to a height of 30 cm.

Woodland species: The oven-dry biomass (pounds) of the aboveground portion of a live or dead woodland species tree (where the species belongs to either of the Western woodland softwoods species group or the Western woodland hardwoods species group), excluding foliage, the tree tip (top of the tree above 4 cm in diameter), and a portion of the stump from ground to diameter at root collar (DRC).

The aboveground weight of live trees (including bark but excluding foliage) reported in dry tons (dry weight). Biomass has four components for most tree species (bole, tops and limbs, saplings, and stump) but is estimated as a single component for woodland species.

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Woodland species: The oven-dry biomass (pounds) of the aboveground portion of a live or dead woodland species tree (where the species belongs to either of the Western woodland softwoods species group or the Western woodland hardwoods species group), excluding foliage, the tree tip (top of the tree above 4 cm in diameter), and a portion of the stump from ground to diameter at root collar (DRC).

Dry biomass of the roots. The oven-dry biomass (pounds) of the belowground portion of a tree, includes coarse roots with a root diameter ≥ 0.25 cm. This is a modeled estimate, calculated on live trees with a diameter of ≥ 2.5 cm and dead trees with a diameter of ≥ 12.5 cm, for both timber and woodland.

The aboveground weight of standing dead trees (including bark but excluding foliage) reported in green tons. Biomass has four components for most tree species (bole, tops and limbs, saplings, and stump) but is estimated as a single component for woodland species.

Coarse Woody Debris (CWD): Pieces or portion of pieces of down dead wood with a minimum small-end diameter of at least 7.5 cm and a length of at least 1 m (excluding decay class 5). CWD pieces must be detached from a bole and/or not be self-supported by a root system with a lean angle more than 45 degrees from vertical.

Original data

Note - these estimates were made from data collected on mainland Puerto Rico, Vieques and Culebra. Forest carbon pool estimates for dead wood and forest floor were not available for Mona Island at the time of this report, therefore we decided to exclude that island from these calculations.

Original data from the FIA database is below. Queries were run in Evalidator for 2004 PR + 2008 Mona; 2009 PR + 2008 Mona; and 2014 PR + 2013 Mona. Total values were then cut and pasted directly from Evalidator into this spreadsheet.

USDA Forest Service, Forest Inventory and Analysis Program. Forest Inventory EVALIDator web-application Version 1.7.0.01. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: <http://fsxopsx1056.fdc.fs.usda.gov:9001/Evalidator/evalidator.jsp>]

Analysis and processing of national data

Estimation and forecasting

Annual rates of change were calculated for the periods of 2004-2009 and 2009-2014 for the three biomass pools.

Reclassification into FRA 2020 categories

Aboveground and belowground biomass pools were sufficiently close in definition between the FIA NFI categories and the FRA 2020 definition to not require reclassification. To present the estimates for the FRA 2002 dead biomass pool, the FIA NFI biomass pools of standing dead trees ("snags") and coarse woody debris were summed.

FRA categories	Forest biomass (tonnes/ha)								
	1990	2000	2010	2015	2016	2017	2018	2019	2020
Above-ground biomass	57.44	57.44	73.16	74.39	75.62	76.85	78.09	79.32	80.55
Below-ground biomass	6.25	6.25	15.50	16.74	17.97	19.20	20.43	21.66	22.90
Dead wood									

Comments

Note - these estimates were made from data collected on mainland Puerto Rico, Vieques and Culebra. Forest carbon pool estimates for dead wood and forest floor were not available for Mona Island at the time of this report, therefore we decided to exclude that island from these calculations.

The values for 2000 were based on subtracting the annual change from 2004 to 2009. These 2000 values were then used again for 1990.

We chose not to report dead wood biomass at this time. We estimate dead wood carbon (table 2d) but do not produce direct dead wood biomass estimates. Approximate values can be estimated by multiplyin carbon dead wood quantities by 2 if desired.

2d Carbon stock

National Data

Data sources + type of data source eg NFI, etc

Note - these estimates were made from data collected on mainland Puerto Rico, Vieques and Culebra. Forest carbon pool estimates for dead wood and forest floor were not available for Mona Island at the time of this report, therefore we decided to exclude that island from these calculations.

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Forest inventory plot data collected include land use and its change, disturbances to the forest, whether stands are naturally or artificially regenerated, forest ownership and information on many other variables. All live and standing dead trees are measured down to a diameter at breast height of 12.5 cm. A sub-sample of plots have additional data collected on soils, floor litter, and down woody materials. Other forest carbon pools such as belowground live tree and understory vegetation are modeled.

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3. Saplings: Total aboveground biomass of a tree from 2.5 to 12.5 cm in d.b.h.
4. Stump: Biomass of a tree 12.5 cm d.b.h. and larger from the ground to a height of 30 cm.

Woodland species: The oven-dry biomass (pounds) of the aboveground portion of a live or dead woodland species tree (where the species belongs to either of the Western woodland softwoods species group or the Western woodland hardwoods species group), excluding foliage, the tree tip (top of the tree above 4 cm in diameter), and a portion of the stump from ground to diameter at root collar (DRC).

The aboveground weight of live trees (including bark but excluding foliage) reported in dry tons (dry weight). Biomass has four components for most tree species (bole, tops and limbs, saplings, and stump) but is estimated as a single component for woodland species.

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The aboveground weight of standing dead trees (including bark but excluding foliage) reported in green tons. Biomass has four components for most tree species (bole, tops and limbs, saplings, and stump) but is estimated as a single component for woodland species.

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Original data

Note - these estimates were made from data collected on mainland Puerto Rico, Vieques and Culebra. Forest carbon pool estimates for dead wood and forest floor were not available for Mona Island at the time of this report, therefore we decided to exclude that island from these calculations.

Original data from the FIA database is below. Queries were run in Evalidator for 2004 PR + 2008 Mona; 2009 PR + 2008 Mona; and 2014 PR + 2013 Mona. Total values were then cut and pasted directly from Evalidator into this spreadsheet.

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Analysis and processing of national data

Estimation and forecasting

Annual rates of change were calculated for the periods of 2004-2009 for the four carbon pools.

Reclassification into FRA 2020 categories

Aboveground and belowground carbon pools were sufficiently close in definition between the FIA NFI categories and the FRA 2020 definition to not require reclassification. To present the estimates for the FRA 2002 dead wood carbon pool, the FIA NFI biomass pools of standing dead trees ("snags") and coarse woody debris were summed. Forest floor carbon estimates are the sum of fine woody debris and litter NFI estimates.

FRA categories	Forest carbon (tonnes/ha)								
	1990	2000	2010	2015	2016	2017	2018	2019	2020
Carbon in above-ground biomass	26.09	26.09	33.28	34.00	34.71	35.43	36.15	36.87	37.59
Carbon in below-ground biomass	5.18	5.18	6.59	7.31	8.03	8.75	9.47	10.19	10.91
Carbon in dead wood	6.89	6.89	3.87	4.59	5.31	6.03	6.75	7.47	8.19
Carbon in litter	14.22	14.22	20.92	21.64	22.35	23.07	23.79	24.51	25.23
Soil carbon									

Soil depth (cm) used for soil carbon estimates	
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Comments

Note - these estimates were made from data collected on mainland Puerto Rico, Vieques and Culebra. Forest carbon pool estimates for dead wood and forest floor were not available for Mona Island at the time of this report, therefore we decided to exclude that island from these calculations.

The values for 2000 were based on subtracting the annual change from 2004 to 2009. These 2000 values were then used again for 1990.

he NFI on Puerto Rico does not currently has soil organic carbon estimates. Rather than use the IPCC default tropical or subtropical values we have chosen to not report on this forest carbon pool.

3 Forest designation and management

3a Designated management objective

National Data

Data sources + type of data source eg NFI, etc

We are currently unable to categorize forests in the Puerto Rico by these categories.

National classification and definitions

-

Original data

-

Analysis and processing of national data

Estimation and forecasting

-

Reclassification into FRA 2020 categories

-

Primary designated management objective

FRA 2020 categories	Forest area (1000 ha)				
	1990	2000	2010	2015	2020
Production (a)					
Protection of soil and water (b)					
Conservation of biodiversity (c)					
Social Services (d)					
Multiple use (e)					
Other (specify in comments) (f)					
None/unknown (g)	320.33	429.15	491.45	493.88	496.33
Total forest area	320.33	429.15	491.45	493.88	496.33

Total area with designated management objective

FRA 2020 categories	Forest area (1000 ha)				
	1990	2000	2010	2015	2020
Production					
Protection of soil and water					
Conservation of biodiversity					
Social Services					
Other (specify in comments)					

Comments

3b Forest area within protected areas and forest area with long-term management plans

National Data

Data sources + type of data source eg NFI, etc

We are currently unable to categorize forests in the Puerto Rico by these categories.

The forest area within protected areas was estimated by FAO using FRA 2020 Geospatial tools and estimates are not based on data from the National Forest Inventory.

National classification and definitions

-

Original data

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Forest area in protected areas (ha)	59,646	59,638	67,332	67,320	67,305	67,266	67,259	67,251	67,244	67,217	67,206	67,206	67,183	67,092	66,975	66,915	66,907	48,689

Analysis and processing of national data

Estimation and forecasting

-

Reclassification into FRA 2020 categories

-

FRA categories	Area (1000 ha)								
	1990	2000	2010	2015	2016	2017	2018	2019	2020
Forest area within protected areas		59.65	67.21	66.92	66.91	48.69			
Forest area with long-term forest management plan									
...of which in protected areas									

Comments

The estimates for forest area within protected areas were derived using FRA 2020 Geospatial tools (combining Hansen tree cover map 2017 and UNEP-WCMC Protected areas map) and they are not based on data coming from the National Forest Inventory.

4 Forest ownership and management rights

4a Forest ownership

National Data

Data sources + type of data source eg NFI, etc

The information found in this database is derived from a national forest inventory (NFI) implemented in Puerto Rico by the U.S. Forest Service Forest Inventory and Analysis (FIA) program. This NFI samples forest land on the islands of Puerto Rico, Vieques, Culebra and Mona, excluding smaller non-forested and/or uninhabited islands and cays which are also part of the island group. The NFI began in Puerto Rico in 1980 and has since remeasured sampling points every 5-10 years. To date, there have been five such periodic inventories in 1980, 1990, 2004, 2009 and 2014, with the 2019 inventory currently underway.

Forest inventory plot data collected include land use and its change, disturbances to the forest, whether stands are naturally or artificially regenerated, forest ownership and information on many other variables. All live and standing dead trees are measured down to a diameter at breast height of 12.5 cm. A sub-sample of plots have additional data collected on soils, floor litter, and down woody materials. Other forest carbon pools such as belowground live tree and understory vegetation are modeled.

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National classification and definitions

Forest land: Land at least 10-percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent stocked with trees and forest areas adjacent to urban and built-up lands. Also included are pinyon-juniper and chaparral areas in the West and afforested areas. The minimum area for classification of forest land is 0.5 hectare and 36 meters wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 36 meters wide.

Original data

Original data from the FIA database is below.

Estimate: With average Mona forest land area added to the public acreage			
	Ownership group - Major		
EVALID	Total	Public	Private
Total	3,561,777	552,370	3,009,406
Puerto Rico (Mainland, Vieques, Culebra) 2004 rscd= 33 evalid= 720401	1,155,137	188,207	966,930
Puerto Rico (Mainland, Vieques, Culebra) 2009 rscd= 33 evalid= 720901	1,200,323	172,901	1,027,422
Puerto Rico (Mainland, Vieques, Culebra) 2014 rscd= 33 evalid= 721401	1,206,316	191,262	1,015,054

USDA Forest Service, Forest Inventory and Analysis Program. Forest Inventory EVALIDator web-application Version 1.7.0.01. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: <http://fsxopsx1056.fdc.fs.usda.gov:9001/Evalidator/evalidator.jsp>]

The average percentage forest land ownership was then applied to the FRA 2020 table 1a, pasted below.

FRA categories	Area (1000 ha)											

	1990	2000	2004	2009	2010	2014	2015	2016	2017	2018	2019	2020
Forest (a)	320.33	429.15	472.68	490.96	491	493.39	493.88	494.37	494.86	495.35	495.84	496.33
Other wooded land (b)	0	0	0	0	0.00	0.00	0.00	0.00	0	0	0	0
Other land (c-a-b)	567	458	414	396	395.55	393.61	393.12	392.63	392.14	391.65	391.16	390.67
Total land area (c)	887	887	887	887	887.00	887.00	887.00	887.00	887	887	887	887

Analysis and processing of national data

Estimation and forecasting

The average percentage of public and private forest land ownership was calculated for the NFI years of 2004, 2009 and 2014.

Percentage of public and private forest land ownership for inventory years 2004, 2009 and 2015					
Inventory year			Percentage		
			Public	Private	
2004			0.1629	0.8371	
2009			0.144	0.856	
2014			0.1586	0.8414	
Average			0.1552	0.8448	

Applying average percentages to forest land area projections					
	1990	2000	2010	2015	2020
Public	49.71	66.59	76.26	76.64	77.02
Private	270.62	362.56	415.19	417.24	419.31
	320.33	429.15	491.45	493.88	496.33

Reclassification into FRA 2020 categories

Reclassification was not necessary.

FRA categories	Forest area (1000 ha)			
	1990	2000	2010	2015
Private ownership (a)	270.62	362.56	415.19	417.24
...of which owned by individuals				
...of which owned by private business entities and institutions				
...of which owned by local, tribal and indigenous communities				
Public ownership (b)	49.71	66.59	76.26	76.64
Unknown/other (specify in comments) (c)	0.00	0.00	0.00	0.00
Total forest area	320.33	429.15	491.45	493.88

Comments

4b Holder of management rights of public forests

National Data

Data sources + type of data source eg NFI, etc

We are currently unable to categorize forests in the Puerto Rico by these categories.

National classification and definitions

-

Original data

-

Analysis and processing of national data

Estimation and forecasting

-

Reclassification into FRA 2020 categories

-

FRA categories	Forest area (1000 ha)			
	1990	2000	2010	2015
Public Administration (a)				
Individuals (b)				
Private business entities and institutions (c)				
Local, tribal and indigenous communities (d)				
Unknown/other (specify in comments) (e)	49.71	66.59	76.26	76.64
Total public ownership	49.71	66.59	76.26	76.64

Comments

5 Forest disturbances

5a Disturbances

National Data

Data sources + type of data source eg NFI, etc

The information found in this database is derived from a national forest inventory (NFI) implemented in Puerto Rico by the U.S. Forest Service Forest Inventory and Analysis (FIA) program. This NFI samples forest land on the islands of Puerto Rico, Vieques, Culebra and Mona, excluding smaller non-forested and/or uninhabited islands and cays which are also part of the island group. The NFI began in Puerto Rico in 1980 and has since remeasured sampling points every 5-10 years. To date, there have been five such periodic inventories in 1980, 1990, 2004, 2009 and 2014, with the 2019 inventory currently underway.

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Franco, P. A., P. L. Weaver, et al. (1997). Forest resources of Puerto Rico, 1990. Asheville, North Carolina, USDA Forest Service Southern Research Station: 45.

Marcano-Vega, Humfredo. 2017. Forests of Puerto Rico, 2014. Resource Update FS–121. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 4 p.

National classification and definitions

Disturbance: A code indicating the kind of disturbance occurring since the last measurement or within the last 5 years for new plots. The area affected by the disturbance must be at least 1 acre in size. A significant level of disturbance (mortality or damage to 25 percent of the trees in the condition) is required.

Original data

-

Analysis and processing of national data

Estimation and forecasting

-

Reclassification into FRA 2020 categories

No reclassification necessary.

FRA categories	Area (1000 ha)																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Insects (a)					0.00					1.92					0.00			
Diseases (b)					0.00					0.00					0.00			
Severe weather events (c)					86.40					4.38					4.08			
Other (specify in comments) (d)					45.21					40.42					32.52			
Total (a+b+c+d)	–	–	–	–	131.61	–	–	–	–	46.72	–	–	–	–	36.60	–	–	–
Total forest area	429.15	–	–	–	472.68	–	–	–	–	490.96	491.45	–	–	–	493.39	493.88	494.37	494.86

Comments

5b Area affected by fire

National Data

Data sources + type of data source eg NFI, etc

While the NFI of Puerto Rico will provide an estimate of average annual hectares disturbed by fire, the sampling scale does not allow for sufficient accuracy.

National classification and definitions

-

Original data

-

Analysis and processing of national data

Estimation and forecasting

-

Reclassification into FRA 2020 categories

-

FRA categories	Area (1000 ha)																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total land area affected by fire																		
...of which on forest																		

Comments

5c Degraded forest

Does your country monitor area of degraded forest		No
If "yes"	What is the national definition of "Degraded forest"?	
	Describe the monitoring process and results	

Comments

6 Forest policy and legislation

6a Policies, Legislation and national platform for stakeholder participation in forest policy

National Data

Data sources + type of data source eg NFI, etc

We are unable to provide these estimates at this time.

National classification and definitions

-

Original data

-

Indicate the existence of	Boolean (Yes/No)	
	National	Sub-national
Policies supporting SFM	Yes	Yes
Legislations and regulations supporting SFM	Yes	Yes
Platform that promotes or allows for stakeholder participation in forest policy development	Yes	Yes
Traceability system(s) for wood products	Yes	No

Comments

For this section, we are answering with policies at the United States of America federal government as National and Commonwealth of Puerto Rico as Sub-national. Policies and legislation exists at broad and specific levels to support sustainable forest management and stakeholder participation in policy development. While there are government and private systems for tracing wood product custody, these are less formalized. I have put that systems exist nationally but are less formalized at the sub-national level, or perhaps better stated for the latter, there is little wood production so little application for chain of custody systems.

6b Area of permanent forest estate

National Data

Data sources + type of data source eg NFI, etc

We are unable to provide these estimates at this time.

National classification and definitions

-

Original data

-

FRA 2020 categories	Forest area (1000 ha)					
	Applicable?	1990	2000	2010	2015	2020
Area of permanent forest estate	Yes					

Comments

There are public lands with permanent forests, but at the moment we cannot quantify them

7 Employment, education and NWFP

7a Employment in forestry and logging

National Data

Data sources + type of data source eg NFI, etc

We are unable to provide these estimates at this time.

National classification and definitions

-

Original data

-

FRA 2020 categories	Full-time equivalents (1000 FTE)											
	1990			2000			2010			2015		
	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male
Employment in forestry and logging												
...of which silviculture and other forestry activities												
...of which logging												
...of which gathering of non wood forest products												
...of which support services to forestry												

Comments

7b Graduation of students in forest-related education

National Data

Data sources + type of data source eg NFI, etc

We are unable to provide these estimates at this time.

National classification and definitions

-

Original data

-

FRA 2020 categories	Number of graduated students											
	1990			2000			2010			2015		
	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male
Doctoral degree												
Master's degree												
Bachelor's degree												
Technician certificate / diploma												
Total												

Comments

7c Non wood forest products removals and value 2015

National Data

Data sources + type of data source eg NFI, etc

We are unable to provide these estimates at this time.

National classification and definitions

-

Original data

-

	Name of NWFP product	Key species	Quantity	Unit	Value (1000 local currency)	NWFP category
#1						
#2						
#3						
#4						
#5						
#6						
#7						
#8						
#9						
#10						
All other plant products						
All other animal products						
Total					-	

Name of currency	
------------------	--

Comments

8 Sustainable Development Goal 15

8a Sustainable Development Goal 15

SDG Indicator 15.1.1 Forest area as proportion of total land area 2015

Indicator	Percent							
	2000	2010	2015	2016	2017	2018	2019	2020
Forest area as proportion of total land area 2015	48.38	55.41	55.68	55.74	55.79	55.85	55.90	55.96

Name of agency responsible	
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SDG Indicator 15.2.1 Progress towards sustainable forest management

Sub-Indicator 1	Percent						
	2000-2010	2010-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
Forest area annual net change rate	1.36	0.10	0.10	0.10	0.10	0.10	0.10

Name of agency responsible	
----------------------------	--

Sub-Indicator 2	Forest biomass (tonnes/ha)							
	2000	2010	2015	2016	2017	2018	2019	2020
Above-ground biomass stock in forest	57.44	73.16	74.39	75.62	76.85	78.09	79.32	80.55

Name of agency responsible	
----------------------------	--

Sub-Indicator 3	Percent (2015 forest area baseline)							
	2000	2010	2015	2016	2017	2018	2019	2020
Proportion of forest area located within legally established protected areas	12.08	13.61	13.55	13.55	9.86	–	–	–

Name of agency responsible	
----------------------------	--

Sub-Indicator 4	Percent (2015 forest area baseline)							
	2000	2010	2015	2016	2017	2018	2019	2020
Proportion of forest area under long-term forest management plan	–	–	–	–	–	–	–	–

Name of agency responsible	
----------------------------	--

Sub-Indicator 5	Forest area (1000 ha)							
	2000	2010	2015	2016	2017	2018	2019	2020
Forest area under independently verified forest management certification schemes	0.00	0.00	0.00	0.00	0.00	0.00	–	–