USDA FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

International Institute of Tropical Forestry General Technical Report IITF-54 January 2022

The Contribution of Nonnative Tree Species to the Structure and Composition of Forests in the Conterminous United States in Comparison with Tropical Islands in the Pacific and Caribbean

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COVER PHOTOS:
CLOCKWISE FROM TOP LEFT: Coconut palm (*Cocos nucifera*). USDA Forest Service photo by James Denny Ward, courtesy of Bugwood.org; Tree of heaven (*Ailanthus altissima*). Courtesy photo by Kevin Potter, North Carolina State University; Silktree (mimosa) (*Albizia julibrissin*). Courtesy photo by Chris Evans, University of Illinois, Bugwood.org; A nonnative African tuliptree (*Spathodea campanulata*) and numerous nonnative peacocksplume trees (Moluccan albizia) (*Falcataria moluccana*) in the Boiling Pots Section of Wailuku River State Park on the Big Island of Hawai'i, near Hilo. The leafless peacocksplume trees had recently been treated with an herbicide. Courtesy photo by Kevin Potter, North Carolina State University.

January 2022

https://doi.org/10.2737/IITF-GTR-54

Published by the Southern Research Station for the International Institute of Tropical Forestry
General Technical Report-IITF-54

Southern Research Station
200 W.T. Weaver Blvd.
Asheville, NC 28804
www.srs.fs.usda.gov

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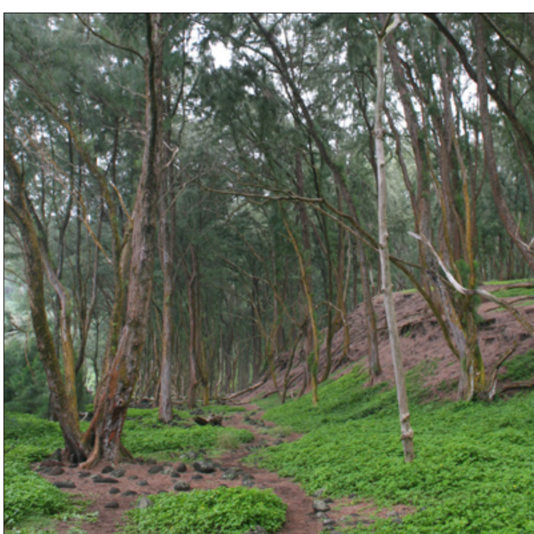

Casuarina spp. in Hawaii. Courtesy photo by Kevin Potter, North Carolina State University.

ABSTRACT

Nonnative tree species have received less scientific attention than nonnative species in general, but when a forest is colonized by a nonnative tree species, the ecological effects can be significant as a change in tree species composition can alter the structural and functional attributes of forest ecosystems. We assess the abundance, geographic distribution, contribution to forest structure (including carbon), and temporal trends of nonnative tree species between the most current inventory and the previous one, ranging from 3 to 15 years earlier, within the conterminous United States (CONUS) and U.S.-affiliated islands in the Caribbean and the Pacific. We used publicly available data from the U.S. Department of Agriculture Forest Service, Forest Inventory and Analysis (FIA) program. Our analysis is by ecological section (ecosection) within ecological provinces of the CONUS and islandwide for Pacific and Caribbean islands. We found that the forest land area with nonnative tree species in the CONUS is 18.8 million acres (7.6 million ha) and is expanding at about 500,000 acres (202 343 ha) per year. The contribution of nonnative tree species in the CONUS to the structural component of forests (basal area and tree density) increased slightly. The mean live aboveground tree carbon of nonnative tree species ranged from 0.39 ton per acre (0.88 Mg/ha) for saplings (small trees with diameter at breast height [dbh] ≥1–<5 inches [≥2.54–<12.7 cm]) to 2.47 tons per acre (5.54 Mg/ha) for all trees (≥1 inch dbh), saplings included. These numbers are equivalent to 19 and 10 percent of the total carbon storage for their respective size classes in the forest plots where they occur, and they slowly increased between previous and current inventories. The contribution of nonnative tree species to the carbon storage of CONUS forests is 92.6 gigapounds (42 Tg) of C or about 0.05 percent of the amount stored in those forests. Nonnative tree species also sequester 1.3 gigapounds (0.6 Tg) of C annually or about 0.5 percent of the carbon sink of CONUS forests. The type and intensity of human activity is generally associated with the presence of nonnative tree species. A similar relationship is at play in Caribbean and Pacific islands and in the mainland forests of the CONUS. Additionally, a greater concentration of human activities in islands makes the nonnative tree species more common there than in the CONUS.

Keywords: Carbon sequestration, carbon sinks, Forest Inventory and Analysis, forest structure, introduced species, novel forests, species invasions, temperate forests, tropical forests.

ACKNOWLEDGMENTS

This work was done in cooperation with the University of Puerto Rico while A.E. Lugo was on special assignment with the Washington Office of the U.S. Department of Agriculture Forest Service, Research and Development staff. We thank Jorge Morales of the Forest Service International Institute of Tropical Forestry for his support with the bibliography. We acknowledge the work of the Forest Inventory and Analysis staff of the Forest Service and their State and nongovernmental organization collaborators, including field technicians, information specialists, scientists, and other professionals that allow our synthesis work based on the data they collected and archived for public use. The manuscript benefited from the support of Grant M. Domke, who contributed to the conceptualization of the approach, and the review by the following colleagues: Alexander Friend, Daniela Yaffar, Benjamin Branoff, Thomas J. Brandeis, Linda Heath, Michael Keller, and Therese Poland. The clarity and consistency of the manuscript was significantly improved by Stephanie Worley Firley, Technical Editor, Forest Service Southern Research Station. This work was supported in part through Cost Share Agreement 18-CS-11330110-033 between the Forest Service Southern Research Station and North Carolina State University.

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LEFT: Scots pine (*Pinus sylvestris*). Courtesy photo by Bill Cook, Michigan State University, Bugwood.org.

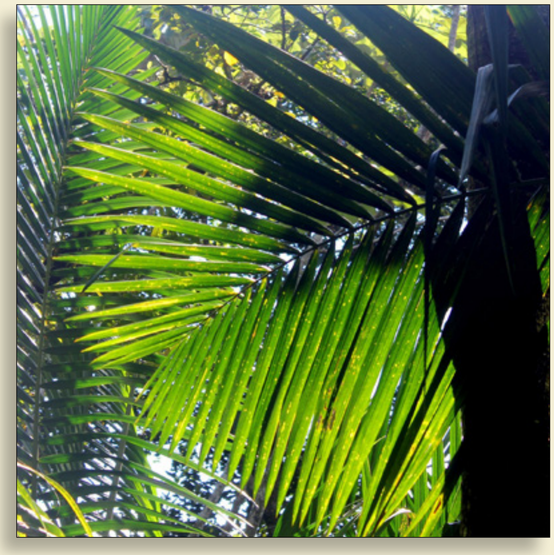
EXECUTIVE SUMMARY

Conservation practitioners face a conundrum when making decisions about interventions with natural processes: Should they challenge these processes or allow them to proceed unimpeded regardless of the consequences? Such is the case with nonnative species, which spread naturally but which many believe cause harm to ecosystems. Science, by helping us understand the consequences of natural phenomena, provides useful knowledge and information that practitioners can use to decide how to approach the conundrum posed by nonnative species. Nonnative tree species have received less scientific attention than nonnative species in general, but when a forest is colonized by a nonnative tree species, the ecological effects can be significant as a change in tree species composition can alter the structural and functional attributes of forest ecosystems.

We assess the abundance, geographic distribution, contribution to forest structure (including carbon), and temporal trends of nonnative tree species between the most current forest inventory and the previous one, ranging from 3 to 15 years earlier, within the conterminous United States (CONUS) and U.S.-affiliated islands in the Caribbean and the Pacific. We used publicly available data from the U.S. Department of Agriculture Forest Service, Forest Inventory and Analysis (FIA) program. Our analysis is by ecological section (ecosection) within ecological provinces of the CONUS and islandwide for Pacific and Caribbean islands.

We found that the forest land area with nonnative tree species in the CONUS is 18.8 million acres (7.6 million ha) and is expanding at about 500,000 acres (202 343 ha) per year. While the area involved is a small fraction (2.8 percent) of the CONUS forest area, forest lands with nonnative tree species are distributed over most (61 percent) of the CONUS forested ecosections.

Nonnative tree species constitute 0.4 percent of the tree species in FIA plots, but they are slowly expanding



LEFT: White leadtree (*Leucaena leucocephala*). USDI National Park Service photo by Dan Clark, courtesy of Bugwood.org;
ABOVE: Sierran palm (*Prestoea acuminata*). Courtesy photo by Whitney Cranshaw, Colorado State University, Bugwood.org.

in the proportion of species per plot. Tropical islands have more species per plot and a larger fraction of nonnative tree species than the CONUS.

Nonnative tree species in insular forests also had greater Importance Values and tended to contribute a higher percentage to tree density and basal area than nonnative tree species in CONUS forests. Nonnative tree species in the CONUS account for 17–22 percent of the tree density and 12–23 percent of the basal area of forest stands where they occur. The contribution of nonnative tree species in the CONUS to the structural component of forests (basal area and tree density) increased slightly between previous and current inventories.

The mean live aboveground tree carbon of nonnative tree species ranged from 0.39 ton per acre (0.88 Mg/ha) for saplings (small trees with diameter at breast height [dbh] ≥1–<5 inches [≥2.54–<12.7 cm]) to 2.47 tons per acre (5.54 Mg/ha) for all trees (≥1 inch dbh), saplings included. These numbers are equivalent to 19 and 10 percent of the total carbon storage for their respective size classes in the forest plots where they occur, and they slowly increased between previous and current inventories. The contribution of nonnative tree species to the carbon storage of CONUS forests is 92.6 gigapounds (42 Tg) of C or about 0.05 percent of the amount stored in those forests. Nonnative tree species also sequester 1.3 gigapounds (0.6 Tg) of C annually or about 0.5 percent of the carbon sink of CONUS forests. The contribution of nonnative tree species to the carbon dynamics of CONUS forests slowly increased. Insular tropical forests exhibit a much greater variability in structure and live aboveground tree carbon attributed to nonnative tree species than CONUS forests, and the range of area-weighted values from these forests fully encompasses that of the less variable CONUS forests.

The type and intensity of human activity is generally associated with the presence of nonnative tree species, and our analysis suggests that a similar relationship is at play in Caribbean and Pacific islands and in the mainland forests of the CONUS. Additionally, a greater concentration of human activities in islands makes the nonnative tree species more common there than in the CONUS. The harshness of temperate climate in some forest locations coupled with less intense human disturbance also limits the success of nonnative tree species in the CONUS. Regardless of geographic location, successful nonnative tree species appear to share similar ecophysiological characteristics associated with fast-growing pioneer species.

More attention is needed on understanding the ecological resistance to colonization, i.e., the invasibility of forests. Equally important is the need to manage ecological resistance for the benefit of practitioners, particularly when deciding when to intervene or when not to intervene with the natural processes that favor nonnative tree species.

INTRODUCTION

A dramatic movement of species across landscapes as a result of climate change and human activities is the new normal for the Anthropocene Epoch. The naturalization of species from historical to novel habitats is an ecological adjustment to the changes in environmental conditions. A consequence of this movement is that the composition and structural parameters of familiar ecosystems change depending on the difference between the functional traits and life history characteristics of the species that prevail and of those that are displaced. Conservationists are faced with a conundrum: either accept in whole or in part natural processes[1] and the changes that those processes entail or opt to maintain conditions prior to new species introductions by resisting change through the expenditure of energy and resources. Change is the outcome of natural processes triggered by climate change and other environmental changes (Botkin 2001). There are strong advocates for either side of the conundrum with no clear consensus of the path to follow. It is up to scientific inquiry to gain understanding of the natural processes and their risks and consequences, and to seek conservation options for a variety of scenarios. The first step to understanding the issue involves acquiring knowledge of the situation and potential consequences.

In this report we summarize new nationwide data from the U.S. Department of Agriculture Forest Service, Forest Inventory and Analysis (FIA) program on the abundance, distribution, and carbon density of nonnative tree species measured by their live aboveground carbon within the conterminous United States (CONUS). Native species are those indigenous to the CONUS; nonnative species were introduced within historical time to the CONUS from other biogeographic regions by anthropogenic or nonanthropogenic forces. With these data, we explore the situation and potential consequences of the naturalization of nonnative tree species. We specifically seek to ascertain their current contribution to the structuring and functioning of forests.

[1] Natural processes as used here refer to the ecesis and naturalization of plant species, regardless of how they were introduced. As humans are part of and inseparable from nature, particularly so in the Anthropocene Epoch, their role in the dispersal of species is also part of natural processes.

To gain further understanding of the role that nonnative tree species can play in the carbon cycle (see box below) and functioning of forests, we add information from Hawaii, Puerto Rico, and other U.S.-affiliated islands in the Caribbean and the Pacific where the FIA program collects comparable inventory data under tropical conditions. Tropical islands offer the opportunity to gain insight into the consequences of processes that develop more slowly in nontropical continental lands. This is particularly true with the study of nonnative species because the presence of these species is usually associated with human activity, which, on a per-unit land area, is more intense in islands than in continental areas. Also, the evolutionary history of island floras, particularly isolated ones, resulted in unique biotic adaptations, small population sizes, and low genetic diversity (Bramwell and Caujapé-Castells 2011), which makes them more vulnerable to environmental change and more illustrative of what can happen to forests when they are colonized by nonnative tree species. Because the FIA program covers both mainland and insular U.S. lands, we have an opportunity to compare the broad latitudinal coverage of information (from tropical to temperate) and gain insight to anticipate issues in parts of the mainland where nonnative tree species are not an issue now. Better understanding of the ecological situation with nonnative tree species will contribute to more effective conservation policies for the management of forests with these species.

Terminology associated with the measurement of carbon in the carbon cycle

As the carbon element cycles in a forest, it can either be described as contained in a component of the forest or in motion as a flux between components of the forest. Measurements of these two states of carbon involve two units, one for each state. When carbon is contained in a forest component, it is measured in units of mass per area such as *tons per acre*. When carbon is moving between components, it is measured in units of mass per area per time such as *tons per acre per year*.

In this study, we measured live aboveground tree carbon both in a contained and flux state. Other studies measure different parameters such as leaves, soil, or roots, which means they use the same units for containment and fluxes, but are reporting values for different forest components. Regardless of the measurements done, the units do not change.

Different authors, addressing different issues or different scales of analysis, use different descriptors for the units of *mass per area* or *mass per area per time*.

When carbon is contained in a forest component, the descriptors for *mass per area* can be biomass, carbon density, carbon mass, carbon storage, or live aboveground live tree carbon as we use in this publication. All these descriptors are synonymous, but they may address a different forest component or groups of components such as leaves, stems, and roots together.

When carbon is moving between components, the descriptors for *mass per area per time* can be tree growth, net uptake flux, net accumulation rate, rate of sequestration, rate of storage, or rate of carbon sink. These descriptors are also synonymous, but they may be used to include different groups or combinations of groups of forest components.

'Sink' can be, and is used by different authors, to describe the carbon stored (units of *mass per area*) or the rate of accumulation or sequestration (units of *mass per area per time*).

This report has three parts. In the first part, we review available literature on the issue of nonnative tree species in the CONUS and FIA results for the Pacific and Caribbean tropical islands, where this issue has received more attention than in the CONUS. In the second part, we compile and report on FIA inventory data for the CONUS to quantitatively describe the contribution of nonnative tree species to forest structure and species composition. We do so geographically and over time to identify regional hot spots and trends between the most current inventory and the previous one, ranging from 3 to 15 years earlier. In the third part, we discuss the results of the analysis and address relevant ecological processes involved. We seek to contrast the ecology of forest stands with a variety of native and nonnative tree species combinations, explore the causes of any differences that we observe, and address the ecological consequences of the dominance of nonnative trees in forest stands. We begin with a review of the FIA program whose results we use in this report.

The Forest Inventory and Analysis Program

The Forest Service FIA program provides continuous inventory data for forests in the United States, including Puerto Rico, the U.S. Virgin Islands, Hawaii, and U.S.-affiliated Pacific Islands (FIA Program Components fact sheet). All FIA sampling is based on plots located on forest land which is defined as "…land that is at least 10 percent canopy cover with trees of any size or formerly having had such tree cover and not currently developed for non-forest use" (Bechtold and Patterson 2005, USDA Forest Service 2019). Generally, to classify as forest, the minimum area is at least 1 acre (0.404686 ha) in size and 120 feet (37 m) in width with specific criteria for forest land near streams, rights-of-way, and shelterbelt strips.

The FIA data are collected using a sample grid of hexagons laid over the U.S. territory with randomized locations for ground plots within the range of influence (i.e., random azimuth and distance) of the center of each hexagon. Individual plots constitute one point per 5,937 acres (2403 ha) of land area sampled by FIA (Reams and others 2005). An FIA plot (fig. 1) consists of a cluster of four subplots with a radius of 24 feet (7.3 m) for a total sampled area of 0.17 acre (0.067 ha; Bechtold and Scott 2005). All trees ≥5 inches (≥12.7 cm) in diameter

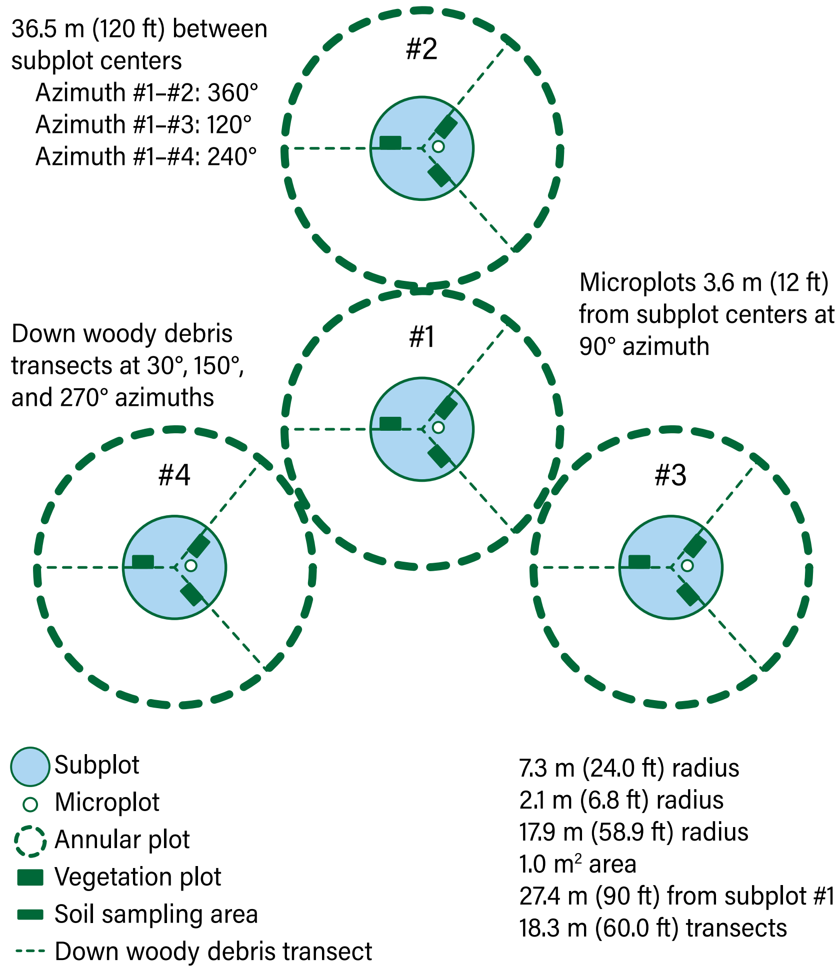


Figure 1—The layout of a Forest Inventory and Analysis plot.

at breast height (dbh) at a height of 4.5 feet (1.37 m), i.e., large trees, are inventoried on the four subplots. All saplings ≥1–<5 inches (≥2.54–<12.7 cm) dbh, i.e., small trees, are inventoried on a microplot with a radius of 6.8 feet (2.1 m) within each subplot. The estimates of tree density, basal area, and live aboveground tree carbon that we report for all trees in FIA plots are based on the sum of the respective values for small and large trees. All inventoried trees and saplings falling within an FIA plot are identified to species and measured. The plots are revisited at 5- to 7-year intervals in the East and 10 years in the West (app. A).

The FIA data include introduced nonnative trees that have naturalized but do not include introduced trees that have not naturalized, except in very rare cases. A naturalized tree species is one that has established populations in the wild without human intervention. Below in this section, and in the next section, we address in more detail the issue of native and nonnative species in relation to FIA and to this study. We exclude data from Alaska and focus attention on the CONUS. For the purpose of this report, and also discussed later, plot data are analyzed in the context of the 190 ecosections mapped by Cleland and others (2007). The map from Cleland and others (2007) depicts a national hierarchical framework of ecological units with 37 provinces, 190 ecosections within provinces (examples of provinces and ecosections with high abundance of nonnative tree species are in app. B), and a variable number of subsections under each ecosection. For U.S.-affiliated islands, we report FIA data aggregated for the whole insular territory of each island and sometimes also aggregate island groups like the Hawaiian Islands or the Puerto Rico archipelago.

Some FIA plots, designated as Phase 2 Plus plots, involve measurements of forest health indicators including select nonnative flora. These plots provide quantitative information about the presence of and cover of a large number of invasive[2] plant species, regardless of plant habit, across the Nation. The nonnative understory plants inventoried by FIA are selected (and called "invasive") because they are considered ecologically and/or economically problematic. There is a subset of nonnative plants which are generally not considered problematic in forests, but these plants are not part of the inventoried list. Stakeholders, on the basis of regional concerns, determine which invasive plant species are monitored by FIA. The categorization of nonnative tree species in this report is based on the list of species used by FIA (see FIA database description and user guide for Phase 2, v 8.02).

Results from FIA Phase 2 Plus plots have been instrumental in describing the degree of nonnative species colonization of forests in the United States. Riitters and Potter (2019), for example, estimated that 51 percent of the forest area in the Eastern United States had invasive understory plants, including shrubs and some trees. This result applies to 1.51 million acres (611 076 ha) of forest land and 74 forest types in that region. In the States of Oregon and Washington, 63 percent of the FIA forest health plots measured in 2001 had at least one or more nonnative[3] species in them (Gray 2009). For the States of California, Oregon, and Washington between 2000 and 2005, Gray (2009) found that the number of nonnative species ranged from 2.7 to 25.3 percent of the total number of species recorded, and they covered from 0.7 to 25.4 percent of the ground with frequencies of plot occurrence that ranged from 1.0 to 35.7 percent (table 13.2 in Gray [2009]). Most of the species recorded in these forest health plots were nontree species. Our focus for this research is on tree species measured by FIA as part of its regular inventory plots, i.e., not on its Phase 2 Plus inventories, which are inclusive of nonnative understory plant species.

[2] The terminology associated with nonnative species is dominated by normative terms such as "invasive," "exotic," "alien," "weeds," or "pests" that influence the objective assessment of these species. Bazzaz (1986) suggested that such anthropomorphic terms be avoided in the ecological literature. We will avoid such terminology, except where necessary to cite documents or organizations.

[3] There is an active debate about assumptions in the field of invasion biology, the definition of native range, and associating nonnative species with invasiveness (e.g., Courchamp and others 2020, Davis and others 2011, Guiaşu and Tindale 2018, Pereyra 2020, Pereyra and Guiaşu 2020, Pereyra and others 2018).

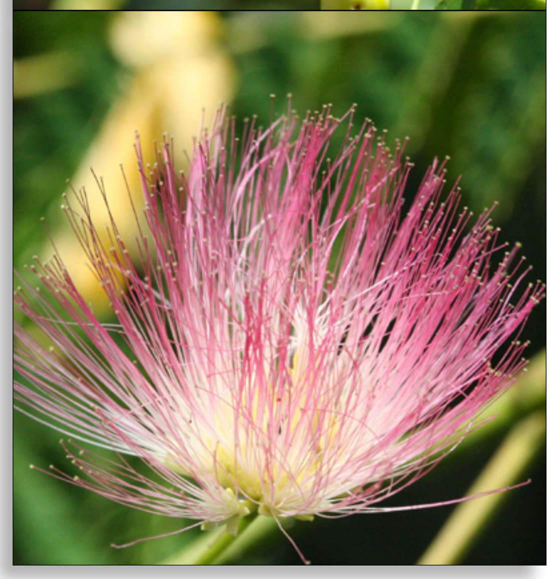
PART 1 LITERATURE REVIEW

Native versus Nonnative Species

Chew (2013) invented the term *anekeitaxonomy* to describe the botany, place, and belonging of plants in relation to human activities. In this scheme, Chew distinguishes between native and nonnative biota, and illustrates the complexity involved in this distinction. This difficulty challenges and limits studies such as the one we undertake here because there are always species whose geographic origin is hard, if not impossible, to elucidate, as is whether the species disperses by nonanthropogenic factors. When humans are involved in the dispersal of a species, time becomes a nontrivial factor to consider. For example, does it make an ecological difference to the designation of a species as nonnative if Polynesians in boats or a different culture using jet planes dispersed it? Clearly, it should not make a difference for the designation as nonnative, unless the geographical or the ecological distance involved makes a difference in the performance of the species being introduced. These nuances and complexities of native plant designations are exemplified by historical case studies across the United States.

In the specific case of the Hawaiian Islands, differences in cultural acceptance of European versus Pacific origins of species introduced to the islands led to the dichotomy of their classification. Potter and others (in review) distinguished species introduced by the Polynesians 1.0 to 1.7 millennia ago from those introduced afterwards by other cultures, based on the classification of Hawaiian plants in Imada (2012). For the United States, Potter and Smith (2012) used the terms "nonindigenous native" for those trees native to North America but outside their historical range within

Tall albizia (*Albizia procera*) in Puerto Rico. USDA Forest Service photo by Ariel E. Lugo.



North America, and "exotic" or "introduced nonnative" for those introduced from outside North America. Nonindigenous native species cause uncertainty to an analysis such as ours because of a lack of clarity about whether they are native to a region. However, not considering them in our analysis does not deter from the generalizations that are possible with current identification of introduced tree species based on the biogeographical understanding—in our case, the list maintained by the FIA program (table 1).

The distinction between what is native and what is not for a given geographical location will become more complicated with climate change because the movement of native flora outside their familiar range is a process that eventually leads to changes in community species composition. For example, Feeley and others (2020) examined millions of records for thousands of species and found evidence of thermophilization (increase in heat-loving plant species) over the recent period of 1970 through 2011 in plant communities of South, Central, and North America. Species were responding to increases in temperature outside their ranges. For future studies like this one, the implications are clear: We will need more effective ways for categorizing species based on their geographic origins and capacity to acclimate to new locations.

The Federal Interagency Committee for the Management of Noxious and Exotic Weeds reported in 1998 that the United States had about 1,365 nonnative 'weed' species. These species are part of the approximately 5,000 nonnative plant species in the United States, which has some 17,000 native plant species (Pimentel and others 2000). According to Pimentel and others (2000), about 138 nonnative tree and shrub species have been introduced into U.S. forests and shrublands. Potter and Smith (2012) were among the first to use national-level data (112,439 plots, 0.17 acre [0.067 ha] each) to display the geographic distribution and abundance of nonnative tree and shrub species by ecological regions of the United States. In doing so, they were responding to the challenge of "Show me the numbers" raised by Crall and others (2006) when referring to the knowledge about nonnative tree species in the United States. We update the original estimate of Potter and Smith (2012).

TOP: Chinaberrytree (*Melia azedarach*). USDA Forest Service photo by Franklin Bonner (retired), courtesy of Bugwood.org;
BOTTOM: Silktree (mimosa) (*Albizia julibrissin*). Courtesy photo by Lesley Ingram, Bugwood.org.

Table 1—Tree species identified as nonnative for the conterminous United States (CONUS) part of this analysis according to the tree list of the Forest Inventory and Analysis (FIA) field manual and the relative set of inventory data (current, previous, or both) where the species is found

Scientific name	Common name(s)	FIA species code	Inventory[a]
Acer platanoides	Norway maple	320	Both
Ailanthus altissima	Tree of heaven, ailanthus	341	Both
Albizia julibrissin	Silktree, mimosa	345	Both
Alnus glutinosa	European alder	355	Both
Castanea mollissima	Chinese chestnut	424	Both
Casuarina glauca	Gray sheoak	856	—
Casuarina lepidophloia	Belah	857	Previous
Casuarina spp.	Sheoak spp.	855	—
Cinnamomum camphora	Camphortree	858	Both
Citrus spp.	Citrus spp.	860	Current
Cocos nucifera	Coconut palm	908	—
Crataegus monogyna	Oneseed hawthorn	508	—
Cupaniopsis anacardioides	Carrotwood	866	—
Elaeagnus angustifolia	Russian olive	997	Both
Eucalyptus camaldulensis	River redgum	512	—
Eucalyptus globulus	Tasmanian bluegum	511	Both
Eucalyptus grandis	Grand eucalyptus	513	Both
Eucalyptus robusta	Swampmahogany	514	—
Eucalyptus spp.	Eucalyptus spp.	510	Previous
Ginkgo biloba	Ginkgo, maidenhair tree	561	Both
Mangifera indica	Mango	885	—
Melaleuca quinquenervia	Punktree	992	Both
Melia azedarach	Chinaberrytree	993	Both
Morus alba	White mulberry	681	Both
Morus nigra	Black mulberry	684	—
Paulownia tomentosa	Princesstree, paulownia, empress tree	712	Both
Persea americana	Avocado	7211	—
Picea abies	Norway spruce	91	Both
Pinus elliottii	Slash pine, Honduras pine	144	—
Pinus nigra	Austrian pine	136	Both
Pinus sylvestris	Scots pine, Scotch pine	130	Both
Populus alba	White poplar, silver poplar	752	Both
Populus nigra	Lombardy poplar	753	Previous
Prunus avium	Sweet cherry	771	Both
Prunus cerasus	Sour cherry	772	Both
Prunus domestica	European plum	773	—
Prunus mahaleb	Mahaleb cherry	774	—
Prunus persica	Peach	764	Previous
Pyrus spp.	Pear spp.	8420	—
Salix alba	White willow	927	Both
Salix × sepulcralis	Weeping willow	929	Both
Schefflera actinophylla	Octopus tree, schefflera	888	—
Sorbus aucuparia	European mountain ash	936	—
Syzygium cumini	Java plum	896	Previous
Tamarindus indica	Tamarind	897	—
Tamarix spp.	Saltcedar	991	Current
Triadica sebifera	Chinese tallow	994	Both
Ulmus pumila	Siberian elm	974	Both
Vernicia fordii	Tungoil tree	995	Both

— = Not found in either set of inventories.

[a] Consult the text and table A.1 for additional information about the previous and current inventories.

Nonnative Trees in the Conterminous United States

There are regions of the United States, such as the western forest region, where nonnative tree species pose little concern (Fiedler and others 2013). Only two nonnative tree species, Norway maple (*Acer platanoides*) and silktree (*Albizia julibrissin*), appeared in the list of species of greatest concern for the coniferous forests of the Western United States. Of about 3.1 million trees recorded by FIA inventories and used by Potter and Smith (2012), 21,338 (0.7 percent) were nonnative, of which 60.7 percent were introduced nonnatives and 39.3 percent were nonindigenous natives. The most abundant nonnative tree was the nonindigenous native Osage-orange (*Maclura pomifera*), which was prevalent throughout the Midwestern States outside its native range of eastern Texas, southeastern Oklahoma, and southwestern Arkansas (Little 1976). Scots pine (*Pinus sylvestris*), found throughout the Great Lake States and the Northeast, was the most common introduced nonnative species in the national assessment of Potter and Smith. Data in Potter and Smith (2012) show a few dominant nonnative tree species, some moderately abundant ones, and a higher number of species with low abundance. Abundance values range from 100 trees per acre (247 trees/ha) to almost zero. Nonnative tree species can persist at a wide range of abundances, which makes it difficult to quantify their importance in the absence of large-scale inventories such as the ones conducted by FIA.

Normally, nonnative tree species are not highlighted in FIA reports, with the notable exception of FIA reports for Puerto Rico (e.g., Marcano Vega 2019). This limitation in the FIA Database affects the availability of national analyses of the status of nonnative tree species in the CONUS, making available analyses regional in nature. For example, the situation with the tree flora of the State of New York is typical of many U.S. States. Leopold (2003) describes 144 native and naturalized tree species in New York. Included in the list are at least 15 tree species that were not present in the first half of the 20th century but which are increasing in abundance in the State. In addition, he mentions that 28 tree species are planted commonly in New York and dozens more could be added but are planted to a lesser degree in the State. In New York, as elsewhere in the United States, the presence of nonnative tree species is dynamic and constantly changing due to the equally dynamic human interference with social-ecological-technological systems. Periodic assessments are needed to maintain an understanding of the state of these forests.

We highlight below studies of two regionally common nonnative tree species because of the relevance of those case studies to an overall understanding of the potential ecological role of nonnative tree species, the cost of their control, and insights into the ecological processes at play.

Peacocksplume (*Moluccan albizia*). Courtesy photo by Kevin Potter, North Carolina State University.

In the Robinson Forest of the University of Kentucky, the nonnative tree of heaven (*Ailanthus altissima*) grows near roadsides and restored mined areas (Fei and others 2009). This region has a long history of anthropogenic disturbances including deforestation for farming and livestock, charcoal production, and mineral, oil, gas, and coal extractions. Rebbeck and others (2016) mapped flowering tree of heaven females using helicopters and found 1,300 colonized areas covering a total of 6,388 acres (2585 ha), or about 4 percent of the inventoried area in the oak-hickory forests of the Appalachian region of southern Ohio. In the Southern region, the Forest Service Southern Research Station FIA program tracks 52 nonnative plant species including tree of heaven, which can occur on up to 30 percent of the plots in the northern montane portion of the region (Miller and Schelhas 2009). Tree of heaven is controlled with herbicides in the Wayne National Forest in Ohio. However, the challenges and high cost of controlling nonnative species in the Great Smoky Mountains National Park in Tennessee and North Carolina, where costs have been quantified, are daunting (Jenkins and Johnson 2009).

A different lens for assessing the success of a nonnative tree species is from the point of view of the degree of invasibility of the habitat, as opposed to focusing only on the capabilities of nonnative species that have proven successful colonizers through the dominance of sites. Ewel (1986) and colleagues addressed habitat invasibility experimentally by introducing millions of seeds of punktree (*Melaleuca quinquenervia*) to undisturbed habitats in south Florida. With 18 percent of its flora (300 species) being naturalized, south Florida behaves as an island due to its environmental, geographic, and historical geological context. The experiments of Ewel (1986) and Myers (1983, 1984) provided insight into the relative roles of the species and the habitat in determining the outcomes of colonization. They showed that the success of punktree in Florida is related to anthropogenic disturbances that open native communities to competition via conditions that favor the nonnative species or by the creation of novel habitats, including novel soils, where nonnative trees have the competitive advantage.

Nonnative Trees in U.S. Tropical Islands in the Pacific and Caribbean

Pacific Islands—Moulton and Pimm (1986) reported that 65 percent of the plant species in Hawaii are nonnative. Kiehn (2011) assembled data to show that the ratio of nonnative to native species in Pacific Islands can range from 0.75 to 1.11. For the Hawaiian Islands, the ratio is 0.91 according to Kiehn, but Imada (2012) found this ratio to be 1.2 (table 2). Unpublished FIA results (Potter and others, in review) show individual islands and sectors of islands with a relatively low fraction of nonnative species as well as islands or sectors of islands with high ratios. The GAP Analysis Program classified Hawaiian forests into 37 classes that were collapsed into native forests, mixed native/alien forests, and alien-dominated forests. Alien-dominated forests were very common in most islands except the Big Island of Hawai'i (Mai 2012). This classification of forest types recognizes the large area covered by nonnative tree species, their dominance in some locations, and their mixing with native species.

Table 2—Number of nonnative and native plant taxa and their ratios by major group in the Hawaiian Islands (Imada 2012)

Plant group	Dicot	Monocot	Gymnosperms	Ferns and lycophytes	Total
Nonnative	1,106	432	19	40	1,597
Native	1,024	151	0	211	1,386
Total	2,130	583	19	251	2,983
Nonnative/native ratio	1.1	2.9	NA	0.2	1.2

Dicot = dicotyledonous; monocot = monocotyledonous.
Ratios are rounded.

Table 3—Summary Forest Inventory and Analysis plot-level statistics on parameters related to nonnative tree species for Hawaiian Islands

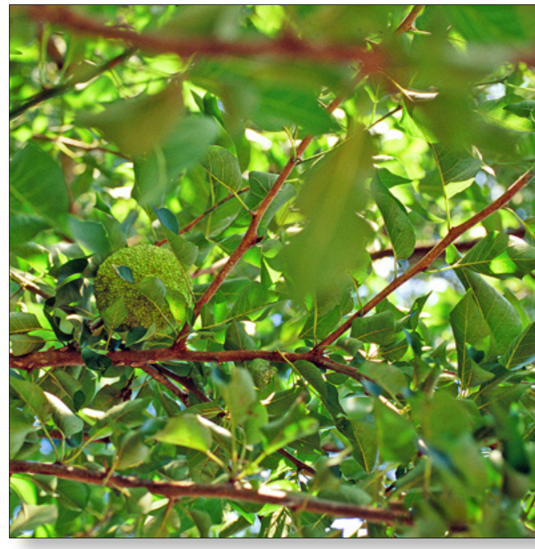
Parameter	All Hawaiian Islands		Big Island of Hawai'i		Other Hawaiian Islands	
	Nonnative ≥5 inches dbh	Nonnative ≥1-<5 inches dbh	Nonnative ≥5 inches dbh	Nonnative ≥1-<5 inches dbh	Nonnative ≥5 inches dbh	Nonnative ≥1-<5 inches dbh
Density *trees per acre* (SE)	33 (4)	500 (78)	25 (5)	337 (81)	57 (9)	985 (181)
Basal area *square feet per acre* (SE)	20 (4)	12 (2)	15 (3)	9 (2)	36 (9)	23 (4)
Live aboveground tree carbon *tons per acre* (SE)	8.2 (1.8)	2.9 (0.5)	7.5 (2.0)	2.3 (0.6)	10.4 (3.7)	4.8 (0.9)
Area of forest[a] *acres*	659,647	619,589	316,690	276,041	342,957	343,548

Summary values for all trees (≥1 inch [2.54 cm] dbh) and the proportion attributed to the nonnative tree species with ≥1 inch dbh by island grouping

Parameter	All Hawaiian Islands	Big Island of Hawai'i	Other Hawaiian Islands
Density *trees per acre* (SE)	980 (80)	885 (82)	1,261 (178)
Density attributed to nonnative trees *percent*	54	41	83
Basal area *square feet per acre* (SE)	98 (6)	106 (7)	77 (10)
Basal area attributed to nonnative trees *percent*	33	22	78
Live aboveground tree carbon *tons per acre* (SE)	29 (2)	32 (3)	19 (4)
Live aboveground tree carbon attributed to nonnative trees *percent*	39	31	78
Forest area *acres*	1,366,947	894,242	472,704

dbh = diameter at breast height; SE = standard error of the mean (n = 238 for all Hawaiian Islands, 178 for the Big Island of Hawai'i, and 60 for other Hawaiian Islands). Values are rounded. 1 acre = 0.4047 ha; 1 square foot = 0.0929 m^2; 1 ton = 0.9072 Mg.

[a] Area containing nonnative tree species of the diameter class in the column heading.



Osage-orange (*Maclura pomifera*). Courtesy photo by John D. Byrd, Mississippi State University, Bugwood.org.

Imada (2012) summarized the proportion of native and nonnative flora in the Hawaiian Islands by major plant taxa (table 2). Only for ferns and lycophytes was the native component more species-rich than the nonnative component. The FIA program in Hawaii inventoried 112 tree species, of which 53 were recorded as nonnatives and 9 introduced by the Polynesians. Using the FIA sampling design, Potter and others (in review) estimated that 29 percent of large trees (≥5 inches [≥12.7 cm] dbh) and 63 percent of saplings or small trees (≥1–<5 inches [≥2.54–<12.7 cm] dbh) in Hawaii are nonnative.

Forest Inventory and Analysis data in table 3 show differences between the Big Island of Hawaiʻi and other Hawaiian Islands in the contribution of nonnative tree species to the structure and live aboveground tree carbon of forest stands. The influence of nonnative tree species in this island chain is greater at lower elevations where human activity has modified the landscape to a greater degree than at the higher elevations typical of the Big Island of Hawaiʻi. However, because of its greater area of forests, the absolute values for Hawaiʻi are larger than for the other Hawaiian Islands. The mean plot area-weighted live aboveground tree carbon for all nonnative trees is 11.1 tons per acre (29.9 Mg/ha), corresponding to 39 percent of the stand total.

We used data from the Pacific Islands to construct carbon-ranked curves for several countries and territories (fig. 2). As the number of tree species in an island increases, the level of dominance of the top-ranked species decreases, and the stand's live aboveground carbon content is portioned among more tree species. Further, as the number of species involved in the ranking decreases, the proportion of a stand's live aboveground carbon in the top-ranked species[4] increases in an exponential decay relationship (fig. 3). Coconut palm (*Cocos nucifera*), a nonnative tree species in the Marshall Islands, is responsible for storing the most aboveground carbon among the 10 islands. Although this species was also the top dominant species in Guam, native tree species occupied the top spot in the other islands, including mangrove apple (*Sonneratia alba*) in the Federated States of Micronesia as a whole and in Pohnpei State, and fig (*Ficus prolixa*) in Kosrae State, Chuuk State, and Northern Mariana Islands. All these species, regardless of geographic origin, are fast-growing species.

Caribbean Islands—The vascular flora of the Caribbean has a nonnative to native ratio of 0.17 for species, 0.35 for genera, and 0.13 for families (table 4). Based on the 2014 FIA forest inventory of Puerto Rico and adjacent islands (table 5), endemic tree species

[4] Species were ranked by their Importance Value, which is an index of dominance for a species or group of species, estimated from the sum of their relative basal area and relative tree density divided by two and expressed in percent. Ecologists use the Importance Value to assess the relative use of available resources (space, nutrients) by species or species groups (Whittaker 1970).

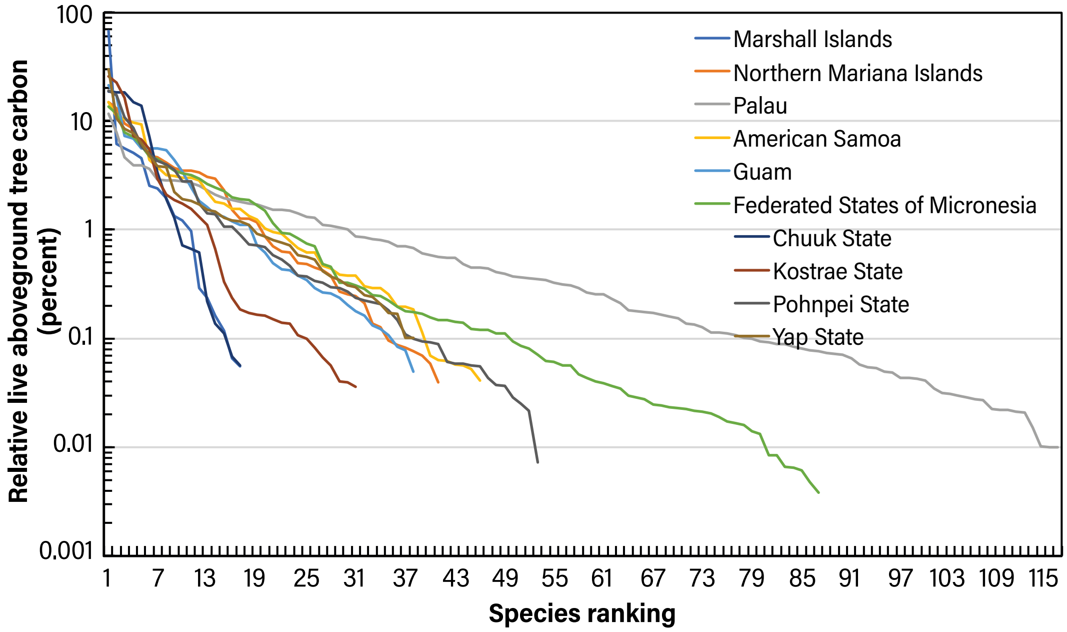


Figure 2—Carbon-ranked curves for tree species in several Pacific Islands. Chuuk State, Kostrae State, Pohnpei State, and Yap State are part of the Federated States of Micronesia and are all included in the curve labeled Micronesia. Data are from Donnegan and others (2004a, 2004b, 2007, 2011a, 2011b, 2011c).

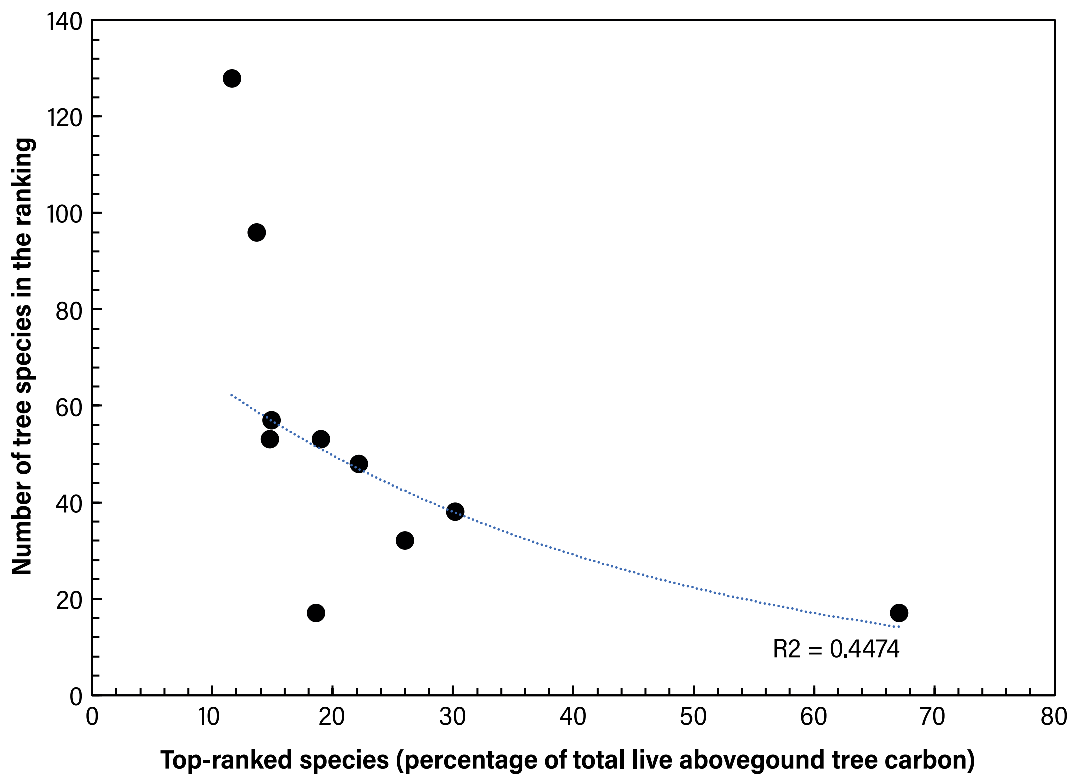


Figure 3—Relationship between number of tree species in Pacific Islands and the proportion of total live aboveground carbon accounted by the most dominant (i.e., top-ranked) tree species based on the Importance Value. The Importance Value is an index based on the relative density and relative basal area of each species in a community.

Table 4—Number of vascular plant taxa by geographic origin and their proportion in the Caribbean Islands (Acevedo Rodríguez and Strong 2008)

Taxon	Native	Nonnative	Nonnative/native ratio
Families	205	26	0.13
Genera	1,447	500	0.35
Species	10,948	1,899	0.17

Ratios are rounded.

Table 5—Contributions of all tree species (endemic, all native [including endemics], naturalized, and all nonnative [including naturalized species]) to stand parameters for the forests of Puerto Rico (Marcano Vega 2019) during the 2014 forest inventory (includes a sampling of 40.62 acres [16.44 ha] using 271 plots in the main island, Culebra, and Vieques)

Parameter for all tree species (≥5 inches [12.7 cm] dbh)	Value	Endemic	All native	Naturalized	All nonnative
		percent			
Number of species	202	10	77	20	22
Number of trees	4,892	2	70	30	30
Basal area	2,533 square feet	1	64	36	36
Importance Value 300[a]	100 percent	2	69	31	31
Importance Value 200[a]	100 percent	2	65	35	35
Live aboveground tree carbon	17.4 million tons	1	62	38	38

dbh = diameter at breast height.

1 square foot = 0.0929 m^2; 1 ton = 0.9072 Mg.

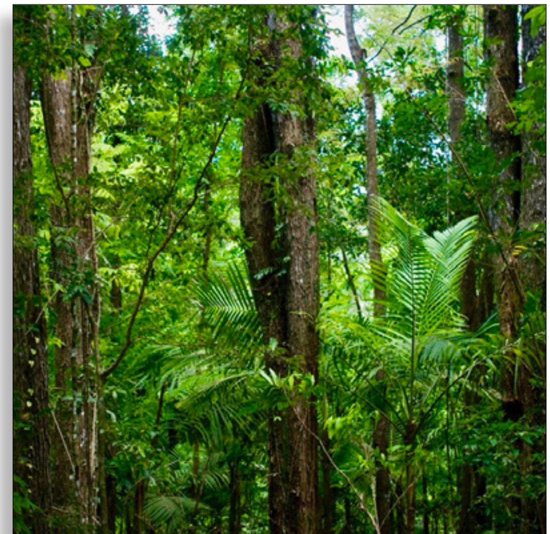
Values are rounded, and two species could not be classified.

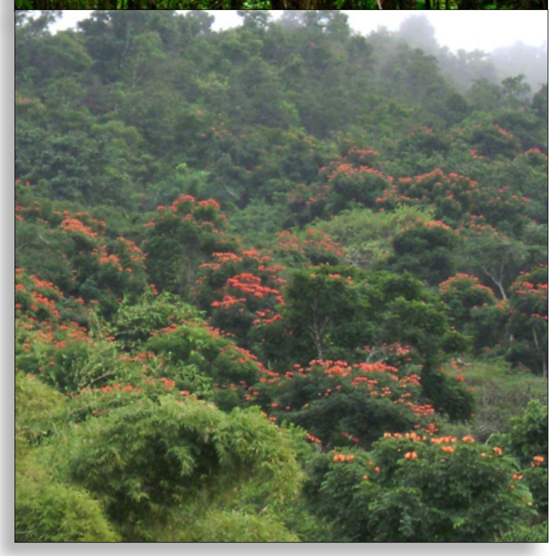
[a] Importance Value 200 is based on relative density and relative basal area, while Importance Value 300 adds the relative frequency of occurrence in measured plots.

represent 10 percent of all the species but only 1 percent of the live aboveground tree carbon. Although nonnative tree species were 22 percent of the tree species in the FIA inventory, they accounted for 38 percent of the live aboveground tree carbon in forests, while native tree species were 77 percent of the species and 62 percent of the live aboveground tree carbon. This means that these species groupings, particularly the naturalized and nonnative species, have a disproportional influence on resource use and processing in insular forests.

The role of nonnative tree species in forests is better defined in a summary of structural parameters for Puerto Rico's forests (table 6). Islandwide, nonnative trees occur in 79 percent of the forest area, account for 21 percent of the tree density, 32 percent of the tree basal area, 39 percent of the forest volume, and 36 percent of the forest aboveground carbon. Also, nonnative tree species account for 20 percent of the forest volume growth and 56 percent of the forest mortality in the island. These rates reflect a high turnover in forest volume.

Comparison of Island Groups—Caribbean and Pacific Islands contrast in age. The age of the large Hawaiian Islands is <5 million years (Vitousek 2004), while the first opportunity for plant colonization of Puerto Rico was in the middle Eocene 49 mil-





lion years ago (Graham 2003). Also, the Pacific Islands, particularly the Hawaiian Islands, are extremely isolated in contrast to the Caribbean Islands, which are well connected to continental masses to their south and northwest. As a result, the flora of the Caribbean is a relatively mature flora, while that of the Pacific is a young flora still experiencing a rapid rate of species change and turnover and dominated mostly by nonnative species as summarized above. However, maturity of the flora does not imply any particular resistance to colonization of nonnative tree species, as nonnative species owe their success to human activities that modify habitats, as is the case of Puerto Rico (Lugo and Helmer 2004).

The FIA inventory found that Puerto Rico has a lower proportion of nonnative tree species relative to its total tree flora than those of the Big Island of Hawai'i (16 versus 25 percent), but these proportions were low for both islands compared to other Hawaiian Islands that reached 64 percent. The structural comparison of forests in Pacific and Caribbean islands shows a wide range of conditions having to do with the age of forests and the level of effects from anthropogenic and nonanthropogenic disturbances on forest stands. However, forests in the Pacific Islands, excluding the Hawaiian Islands, have a much greater structural development when assessed by the wood volume and basal area per unit area than those in Puerto Rico (compare tables 6 and 7). Nonnative trees in Puerto Rico store less aboveground tree carbon than those in all Hawaiian Islands (7 versus 11 tons per acre [16 versus 25 Mg/ha]; compare tables 3 and 6). For the forests as a whole, those in Puerto Rico have less live aboveground tree carbon (20 versus 29 tons per acre [44 versus 64 Mg/ha]) and lower basal area (92 versus 98 square feet per acre [21 versus 23 m^2/ha]) but higher tree density (1,180 versus 980 trees per acre [2,916 versus 2,420 trees/ha]) than forests in Hawaii. The values for Puerto Rico reflect the young age of its forests (Kennaway and Helmer 2007).

TOP: Honduras mahogany (*Swietenia macrophylla*) in Puerto Rico. USDA Forest Service photo by Ariel E. Lugo;
BOTTOM: African tuliptree (*Spathodea campanulata*) in Puerto Rico. USDA Forest Service photo by Ariel E. Lugo.

Table 6—Forest area and structural parameters for the forests of Puerto Rico, including the main island, Culebra, and Vieques, for the 2014 forest inventory and the values attributed to nonnative tree species (Marcano Vega 2019)

Parameter[a]	All tree species	Error[b]	Nonnative tree species		Error[b]
	total	*percent*	*total*	*percent*	*percent*
Tree density *trees per acre*	1,180	4.6	252	21	10.0
Tree basal area *square feet per acre*	92.4	4.2	29.2	32	7.5
Forest volume *cubic feet per acre*	1,143	6.6	443	39	10.6
Forest aboveground carbon *tons per acre*	19.5	5.2	7.0	36	8.8
Aboveground production *tons of C per acre per year*	0.32	6.0	0.06	19	9.8
Aboveground and belowground production *tons of C per acre per year*	0.38	6.0	0.08	20	13.5
Forest volume growth *cubic feet per acre per year*	88.3	16.0	17.7	20	34.3
Forest mortality *cubic feet per acre per year*	63.6	18.6	35.3	56	25.0
Forest area *acres*	1,219,177	3.3	965,504	79	3.7

Values are rounded. 1 acre = 0.4047 ha; 1 square foot = 0.0929 m^2; 1 cubic foot = 0.02832 m^3; 1 ton = 0.9072 Mg.

[a] Estimates of volume are for trees ≥5 inches (12.7 cm) diameter at breast height (dbh) and those of other parameters are for trees ≥1 inch (2.54 cm) dbh. Production values are for live aboveground averaged over a 5-year interval.

[b] Sampling error is at the 68-percent confidence level.

Table 7—Summary statistics of forest tree inventories in the Pacific Islands for trees ≥1 inch (2.54 cm) diameter at breast height (dbh) based on the reported total value divided by the forest area

Island[a]	Forest area	Tree species	Tree density	Basal area	Net volume[b]	Gross volume[b]	Carbon[b]
	acres	*number*	*trees per acre*	*square feet per acre*	*cubic feet per acre*	*cubic feet per acre*	*tons per acre*
Federated States of Micronesia[c]	143,466	96	179	132	3,752	3,788	31.69
Chuuk State	18,134	17	137	98	2,411	2,423	22.56
Kosrae State	26,496	32	166	142	4,357	4,358	36.23
Pohnpei State	81,659	53	208	158	4,582	4,645	36.77
Yap State	6,748	38	123	51	1,026	1,027	25.81
Marshall Islands	23,252	17	168[e]	107	2,457	2,352	18.37
Northern Mariana Islands	75,407	57	100[f]	33	582	463	3.73
Palau 1985	81,574[d]		1,282	136	1,740	—	—
Palau 2003	90,685	128	856[g]	146	2,744	2,956	25.84
American Samoa	43.631	53	277[h]	—	1,517	1,529	12.61
Guam	63,833	48	156[i]	—	922	939	7.84

— = Data not reported.

1 acre = is 0.4047 ha; 1 square foot = 0.0929 m^2; 1 cubic foot = 0.02832 m^3; 1 ton = 0.9072 Mg.

[a] The year of the inventories and reference to results are, respectively: Marshall Islands: 2008, Donnegan and others 2011c; Northern Mariana Islands: 2004, Donnegan and others 2011a; Palau: 2003, Donnegan and others 2007; American Samoa: 2001, Donnegan and others 2004b; Guam: 2002, Donnegan and others 2004a; Federated States of Micronesia: 2006, Donnegan and others 2011b.

[b] Live aboveground tree volume and carbon estimates for trees ≥5 inches (12.7 cm) dbh.

[c] For 2006, tree density for ≥1 inch dbh is 656 trees per acre for all Federated States of Micronesia.

[d] Corresponds to 1976.

[e] Tree density for trees ≥1 inch dbh is 535 trees per acre.

[f] Tree density for trees ≥1 inch dbh is 1,190 trees per acre.

[g] Tree density for trees ≥1 inch dbh is 1,065 trees per acre with a gross volume of 3,334 cubic feet per acre.

[h] Tree density for trees ≥1 inch dbh is 410 trees per acre with a gross volume of 1,657 cubic feet per acre.

[i] Tree density for trees ≥1 inch dbh is 1,203 trees per acre with a gross volume of 1,432 cubic feet per acre.

PART 2 DATA ANALYSIS for the Conterminous United States

Methods

We used the publicly available FIA Datamart of the Forest Service (USDA Forest Service 2020) for the analyses and summaries of nonnative tree species on forest lands of the United States and its territories. The scope of the analysis is forest land, as defined above in the Forest Inventory and Analysis Program section of this report. We explicitly identified lists of nonnative tree species applicable to CONUS, Caribbean, or Pacific forests (e.g., table 1 for the CONUS); these and all other tree species in the data are listed in the FIA Database documentation (Burrill and others 2018). Nativity was determined based on the USDA PLANTS Database (USDA NRCS 2020). Nonindigenous natives were not separately identified for these analyses. We principally characterized three stand-level attributes: tree density (trees per acre [multiply by 2.47105 to obtain trees/ha]), basal area (square feet per acre [multiply by 0.229568 to obtain m^2/ha]), and live aboveground tree carbon, i.e., carbon density (tons per acre [multiply by 2.2417 to obtain Mg/ha]) for trees with ≥1 inch (≥2.54 cm) dbh. To characterize the respective forest ecosystems and provide spatial resolution of these attributes within the large CONUS boundary, we analyzed the data within ecosections (Cleland and others 2007).

Data summaries were developed for each attribute (i.e., tree density, basal area, and carbon density) as ratio estimates following Bechtold and Patterson (2005), which provided per-acre means and sampling error within each domain of interest (e.g., ecosection). The relative size of nonnative trees within a stand was evaluated by classifying the three attributes as saplings or small trees (≥1–<5 inches [≥2.54 and <12.7 cm] dbh), large trees (≥5 inches [≥12.7 cm] dbh), and all trees (≥1 inch [≥2.54 cm] dbh). Data were separately summarized for each ecosection. Additionally, limiting the domain of interest to only those stands with nonnative tree species within each ecosection provided a better characterization of those nonnative species-containing stands. In addition to the summaries by ecosection, we also summarized all of the CONUS (app. A). Appendix A also contains the statistical parameters associated with each of the measured forest attributes.

The data summaries (described above) were based on the most current inventory cycles per State (time 2 [T_2]).[5] An additional set of previous summaries (time 1 [T_1]) was developed with slightly older inventory cycles, with the goal of an approximately 1-year interval. Essentially, this means using a full current inventory cycle as T_2 and pairing this with either the previous cycle (second most recent) in the West or the third most recent in the East to get T_1. Actual intervals can vary, principally due to timing or completeness of remeasurement for some States. When using these two temporal datasets to assess rates of change in parameters, we used the weighted time interval for plots in each ecosection as the interval between measurements to arrive at a rate of change. For example, to assess the rate of change in live aboveground tree carbon, we paired data for T_1 and T_2 for 104 individual ecosections, eliminating all pairings without data for both inventories and conducting the analysis for nonnative trees and all trees. The change in carbon was estimated by: (T_2 - T_1) / weighted time interval between inventories. The resulting number is an annual rate of change over the measuring interval with a positive or negative sign. Negative values indicate a loss of carbon storage over the time interval. The weighted time data for each inventory included in T_2 and T_1 summaries are listed by ecosection in appendix A.

A separate (from above analyses) and informal analysis of numbers of nonnative tree species relative to the total number of tree species on plots within ecosections was based on counts of species in the tally trees of inventory plots within each ecosection. Specifically, the number of nonnative tree species and total number of tree species per plot was calculated. For this analysis, counts were limited to the subset of the permanent inventory plots with a single forest condition, i.e., plots with 100-percent forest cover over the whole plot (see Burrill and others [2018] for details on forest condition and proportions within plots). We estimated the presence of nonnative tree species in ecosections with nonnative tree species in the most current inventory (T_2, with 95 such ecosections) and ignored those without nonnative tree species at T_2.

We also used FIA data from tropical islands in the Caribbean and the Pacific for comparison with the CONUS. The insular data were also collected and analyzed by FIA using the same protocols as for the CONUS when possible (e.g., data for Hawaii were available for only one inventory period). For these comparisons, we used tree basal area and tree density results by species groups (native and nonnative) to estimate their Importance Value. For the CONUS and Hawaiian Islands, we used the mean values of tree density and basal area to estimate Importance Value. For Puerto Rico and the U.S. Virgin Islands, FIA reports the Importance Value by species and groups of species. The Importance Value of a species reflects the species' relative percentage of total aboveground carbon density (fig. 4).

[5] In the case of Puerto Rico, we used data from the sampling cycle (2011 to 2014) before Hurricane María to avoid confounding effects of the event.

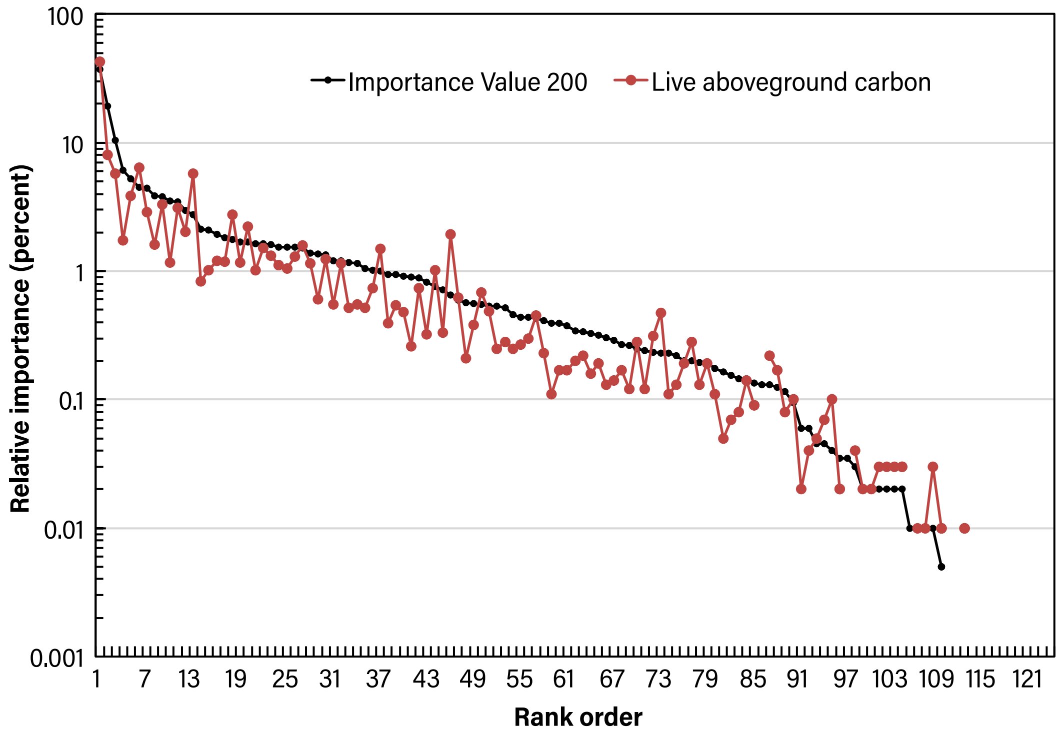


Figure 4—Relative importance (black line) for tropical tree species ranked according to their Importance Value in a wet forest, and the relative contribution of the species to the live aboveground carbon of the forest (red line). The Importance Value 200 means the index is based on relative tree density and relative basal area. Data are from Scatena and Lugo (1995).

Results

The forest area with nonnative tree species in the CONUS is estimated to be in the order of 18.8 million acres (7.6 million ha). This is equivalent to 2.8 percent of the CONUS forest land area (table 8). The area where nonnative tree species are encountered by the FIA inventories has increased by a factor of 1.4 between previous and current inventories, which is equivalent to 5.1 million acres (2.1 million ha). This represents an annual increase of approximately half a million acres (202 343 ha; table 8).

The current total number of tally tree species (native and nonnative) on the FIA inventory plots at the ecosection level in the CONUS has a mode of 5.01 tree species per plot of 0.166 acres (0.067 ha; table 9). That is, after obtaining the average count per plot within each ecosection, the mode of the 95 ecosections that contain nonnative tree species in the CONUS is 5.01 total tree species. The corresponding mode of number of species per plot for nonnative tree species is 0.02 or 0.4 percent of the total tree species. The maximum number of nonnative tree species in a plot is 10.6 percent of the maximum number of all tree species (not shown). The total number of species per plot did not change as shown by a T_2/T_1 ratio of 1.0 for both the median and mode of the total number of tree species per plot. For nonnative tree species, the change in the percentage of total

Table 8—Conterminous U.S. forest area inventoried by ecosection *sensu* Cleland and others (2007), percentage of area with nonnative tree species, and factor of change for the most current (time 2 [T_2]) and a previous (time 1 [T_1]) inventory, which ranged from 3 to 15 years apart

Time of inventory	Parameter	Forest area acres[a] (SE)	Percentage of forest area with nonnative species	Area inventoried T_2/T_1	Area with nonnative species T_2/T_1
Time 2	Total area	682,201,674 (0.215)	2.8	1.0	1.4
	Area with nonnative species	18,822,763 (1.662)			
Time 1	Total area	684,327,292 (0.233)	2.0		
	Area with nonnative species	13,682,178 (2.044)			

Values are rounded. 1 acre = 0.4047 ha.

SE = standard error.

[a] The area of the ecosection was 1,933,300,117 acres in T_2 (SE = 0.123) and 1,933,588,317 in T_1 (SE = 0.128).

Table 9—Conterminous U.S. median and mode number of tree species (total or nonnative) per single condition plots and factor of change for the most current (time 2 [T_2]) and a previous (time 1 [T_1]) inventory, which ranged from 3 to 15 years apart (n = 95, for the mean of the ecosection level of resolution *sensu* Cleland and others [2007])

Parameter	Value	Standard deviation	Standard error
		Time 2	
Total species median	5.43	2.20	0.23
Nonnative species median	0.02	0.14	0.01
Total species mode	5.01	2.65	0.27
Nonnative species mode	0.02	0.14	0.01
		Time 1	
Total species median	5.52	2.22	0.23
Nonnative species median	0.00	0.00	0.00
Total species mode	5.02	2.93	0.30
Nonnative species mode	0.00	0.00	0.00
	T_2/T_1 ratio	**Percent change in nonnative tree species between T_1 and T_2[a]**	
Total species median	1.0	NA	
Total species mode	1.0	NA	
Nonnative species median	—	0.37	
Nonnative species mode	—	0.40	

— = Could not be estimated due to a denominator of zero corresponding to T_1.

Ratios are rounded.

[a] Refers to the difference in the percentage of the corresponding total species count that was nonnative.

tree species between T_1 and T_2 was 0.37 and 0.40 for the median and mode, respectively, and 2.25 for the maximum number of species (not shown). These values suggest a slow increase in the proportion of nonnative tree species in the CONUS (table 9).

The current tree density of nonnative tree species in those plots where at least one nonnative tree species is recorded ranges from 93 to 118 trees per acre (230 to 292 trees/ha) for saplings and all trees ≥1 inch dbh, respectively (table 10). There is a low mean density of nonnative tree species by size class when expressed per acre of the whole ecosection and thousandfold increases when plots without nonnative species present are excluded from the analysis. The actual tree density of nonnative tree species is likely higher because the selected subset includes plots with at least one nonnative species ≥1 inch (≥2.54 cm) dbh. In general, tree density is not changing for all tree species given that their T_2/T_1 ratio is about 1.0. For nonnative tree species, the ratio is >1.0 for all plots and ≤1.0 for the subset of plots with nonnative tree species. Tree densities for all species are higher in the subset of plots that included nonnative tree species. Nonnative trees comprise between 17 and 22 percent of total trees (for large trees and saplings, respectively) in the subset of plots, and their density is stable or slowly increasing.

Similar patterns to those described for tree density were observed for the basal area of nonnative tree species relative to the basal area of all tree species in plots (table 11). The T_2 basal area of nonnative tree species in those plots where at least one nonnative tree species is recorded ranges from 3.27 to 13.82 square feet per acre (0.80 to 3.2 m^2/ha) for saplings only and all trees including saplings, respectively (table 11). The percentage of the basal area of nonnative tree species at T_2 ranged between 12 and 20 percent of stand basal area in plots with at least one nonnative tree species (table 11). The subset of plots where nonnative trees were present had a moderately higher basal area of saplings, and slightly higher basal area of all trees compared to the basal area of all tree sizes in the ecosection as a whole. Table 11 also shows that the basal area ratio of T_2/T_1 was 1.0 for all tree species and >1.0 for nonnative tree species in all plots but not in the subset of plots, where it was ≤1.0. The basal area of trees of all species in the subset of plots, expressed as a percentage of the corresponding basal area of trees in all plots, was in the order of 100 percent (122 percent for saplings) and changed little between T_1 and T_2. However, the basal area of nonnative tree species in the subset of

TOP: Norway maple (*Acer platanoides*). Courtesy photo by Jan Samanek, Phytosanitary Administration, Bugwood.org;
BOTTOM: Coconut palm (*Cocos nucifera*). USDA Forest Service photo, courtesy of Bugwood.org.

plots, expressed as a percentage of their basal area in all plots, was thousandsfold higher and decreased between T_1 and T_2.

In the most current inventory, the live aboveground tree carbon of nonnative trees in the CONUS ranged from 0.39 to 2.47 tons per acre (0.88 to 5.54 Mg/ha) for saplings and all trees, respectively. These values represent (respectively) 19 and 10 percent of the total live aboveground tree carbon storage of the stand (table 12). The live aboveground tree carbon ratio of T_2/T_1 was 1.0 for all tree species. However, for nonnative tree species, the ratio was well above 1.0 for all plots (1.2 to 1.5) but not as high for the subset of plots with nonnative tree species (0.9 to 1.1). While the factor of change between T_1 and T_2 was <1 for saplings, it was >1 for large and all trees in the subset of plots. The live aboveground tree carbon data show a net increase in the influence of nonnative tree species over time. Regardless of species, trees in the subset of plots had higher live aboveground tree carbon storage than trees in all plots with values ranging from 109 to 137 percent higher. That difference was amplified for nonnative tree species, which had thousandsfold more carbon in the subset of plots than in all plots. These differences reflect a greater nonnative tree species influence when plots without nonnative trees are excluded from the analysis.

Table 10—Mean live tree density (TD) for all and nonnative tree species growing in ecosections (*sensu* Cleland and others 2007) of the conterminous United States (all plots) and in a subset of plots where at least one nonnative tree species was recorded by Forest Inventory and Analysis for the most current (time 2 [T_2]) and a previous (time 1 [T_1]) inventory, which ranged from 3 to 15 years apart (app. A)

	Mean live TD			Mean live TD as a percentage of mean live TD of the corresponding tree size in all plots			
				In subset of plots		In nonnatives	
Tree size	T_2	T_1	T_2/T_1	T_2	T_1	T_2	T_1
	trees per acre		*ratio*	*percent*			
	All tree species						
Saplings ≥1–<5 inches dbh (all plots)	383	399	1.0	123	125	0.67	0.55
Large trees ≥5 inches dbh (all plots)	137	138	1.0	108	106	0.52	0.37
All trees ≥1 inch dbh (all plots)	520	537	1.0	119	120	0.63	0.51
Saplings ≥1–<5 inches dbh (subset)	470	499	1.0	NA	NA	19.74	22.02
Large trees ≥5 inches dbh (subset)	148	146	1.0	NA	NA	17.33	17.63
All trees ≥1 inch dbh (subset)	618	646	1.0	NA	NA	19.16	20.90
	Nonnative tree species						
Saplings ≥1–<5 inches dbh (all plots)	2.6	2.2	1.2	3,624	4,995	NA	NA
Large trees ≥5 inches dbh (all plots)	0.7	0.5	1.4	3,613	5,047	NA	NA
All trees ≥1 inch dbh (all plots)	3.3	2.7	1.2	3,622	5,004	NA	NA
Saplings ≥1–<5 inches dbh (subset)	92.8	109.9	0.8	NA	NA	NA	NA
Large trees ≥5 inches dbh (subset)	25.7	25.7	1.0	NA	NA	NA	NA
All trees ≥1 inch dbh (subset)	118.4	135.6	0.9	NA	NA	NA	NA

dbh = diameter at breast height.
Values are rounded. To obtain trees/ha, multiply by 2.471.

Table 11—Mean live tree basal area (BA) for all and nonnative tree species growing in ecosections (*sensu* Cleland and others 2007) of the conterminous United States (all plots) and in a subset of plots where at least one nonnative tree species was recorded by Forest Inventory and Analysis for the most current (time 2 [T_2]) and a previous (time 1 [T_1]) inventory, which ranged from 3 to 15 years apart (app. A)

	Mean live tree BA			Mean live tree BA as a percentage of mean live tree BA of the corresponding tree size in all plots			
				In subset of plots		In nonnatives	
Tree size	T_2	T_1	T_2/T_1	T_2	T_1	T_2	T_1
	square feet per acre		*ratio*	------------------------percent------------------------			
				All tree species			
Saplings ≥1–<5 inches dbh (all plots)	13.05	13.48	1.0	122	124	0.69	0.56
Large trees ≥5 inches dbh (all plots)	82.91	81.62	1.0	101	101	0.35	0.25
All trees ≥1 inch dbh (all plots)	95.96	95.09	1.0	104	104	0.40	0.25
Saplings ≥1–<5 inches dbh (subset)	15.97	16.71	1.0	NA	NA	20.49	22.65
Large trees ≥5 inches dbh (subset)	83.35	82.58	1.0	NA	NA	12.66	12.24
All trees ≥1 inch dbh (subset)	99.32	99.29	1.0	NA	NA	13.91	13.99
				Nonnative tree species			
Saplings ≥1–<5 inches dbh (all plots)	0.090	0.076	1.2	3,636	4,980	NA	NA
Large trees ≥5 inches dbh (all plots)	0.291	0.202	1.4	3,625	5,002	NA	NA
All trees ≥1 inch dbh (all plots)	0.381	0.238	1.9	3,627	5,837	NA	NA
Saplings ≥1–<5 inches dbh (subset)	3.272	3.785	0.9	NA	NA	NA	NA
Large trees ≥5 inches dbh (subset)	10.549	10.105	1.0	NA	NA	NA	NA
All trees ≥1 inch dbh (subset)	13.820	13.891	1.0	NA	NA	NA	NA

dbh = diameter at breast height.
Values are rounded. To obtain m^2/ha, multiply by 0.229568.

Table 12—Mean live aboveground tree carbon (AGTC) for all and nonnative tree species growing in ecosections (*sensu* Cleland and others 2007) of the conterminous United States (all plots) and in a subset of plots where at least one nonnative tree species was recorded by Forest Inventory and Analysis for the most current (time 2 [T_2]) and a previous (time 1 [T_1]) inventory, which ranged from 3 to 15 years apart (app. A)

	Mean live AGTC			Mean live AGTC as a percentage of mean live AGTC of the corresponding tree size in all plots			
				In subset of plots		In nonnatives	
Tree size	T_2	T_1	T_2/T_1	T_2	T_1	T_2	T_1
	tons per acre		*ratio*	------------------------percent------------------------			
				All tree species			
Saplings ≥1–<5 inches dbh (all plots)	1.46	1.52	1.0	137	137	0.74	0.59
Large tees ≥5 inches dbh (all plots)	20.14	19.38	1.0	109	112	0.29	0.19
All trees ≥1 inch dbh (all plots)	21.59	20.89	1.0	111	113	0.32	0.22
Saplings ≥1–<5 inches dbh (subset)	2.0	2.07	1.0	NA	NA	19.70	21.70
Large trees ≥5 inches dbh (subset)	21.94	21.63	1.0	NA	NA	9.47	8.64
All trees ≥1 inch dbh (subset)	23.92	23.70	1.0	NA	NA	10.33	9.78
				Nonnative tree species			
Saplings ≥1–<5 inches dbh (all plots)	0.0109	0.0090	1.2	3,630	4,990	NA	NA
Large trees ≥5 inches dbh (all plots)	0.0573	0.0374	1.5	3,623	5,002	NA	NA
All trees ≥1 inch dbh (all plots)	0.0682	0.0464	1.5	3,625	4,999	NA	NA
Saplings ≥1–<5 inches dbh (subset)	0.3939	0.4491	0.9	NA	NA	NA	NA
Large trees ≥5 inches dbh (subset)	2.0763	1.8682	1.1	NA	NA	NA	NA
All trees ≥1 inch dbh (subset)	2.4702	2.3173	1.1	NA	NA	NA	NA

dbh = diameter at breast height.
Values are rounded. To obtain Mg/ha, multiply by 2.2417.

PART 3 DISCUSSION AND SYNTHESIS

Conterminous United States

Our analysis resulted in the following findings:

- The land area with nonnative tree species is estimated at 18.8 million acres (7.6 million ha) and is expanding in the CONUS at about 500,000 acres (202 343 ha) per year (table 8). Proportionally, the area involved is a small fraction (2.8 percent) of the CONUS forest area, but forests with nonnative tree species are distributed over most (61 percent) of the forested CONUS ecosections (fig. 5).
- Nonnative tree species constitute 0.4 percent of the tree species in FIA plots (table 9). The change in the proportion of nonnative tree species in FIA plots between T_1 and T_2 was 0.4 percent. Nonnative tree species in forests of the CONUS are slowly expanding both in area cover and in the proportion of species per plot.
- Nonnative tree species account for 17–22 percent of the tree density (table 10) and 12–23 percent of the basal area (table 11) of forest stands where they occur. Their contribution to the structural component of forests was stable or slowly increased over the 10-year time period of measurements.
- The Importance Value of nonnative tree species decreased by 1 percent among all trees as a result of reduction in the Importance Value of saplings. Large nonnative trees did not change in their Importance Value over time (table 13).
- The mean live aboveground tree carbon of nonnative tree species ranged from 0.39 ton per acre (0.88 Mg/ha) for saplings to 2.47 tons per acre (5.54 Mg/ha) for all trees, saplings included (table 12). These numbers are equivalent to 19 and 10 percent (respectively) of the total live aboveground tree carbon storage for their respective size classes in the forest plots where they occur. This carbon density is slowly increasing over time.

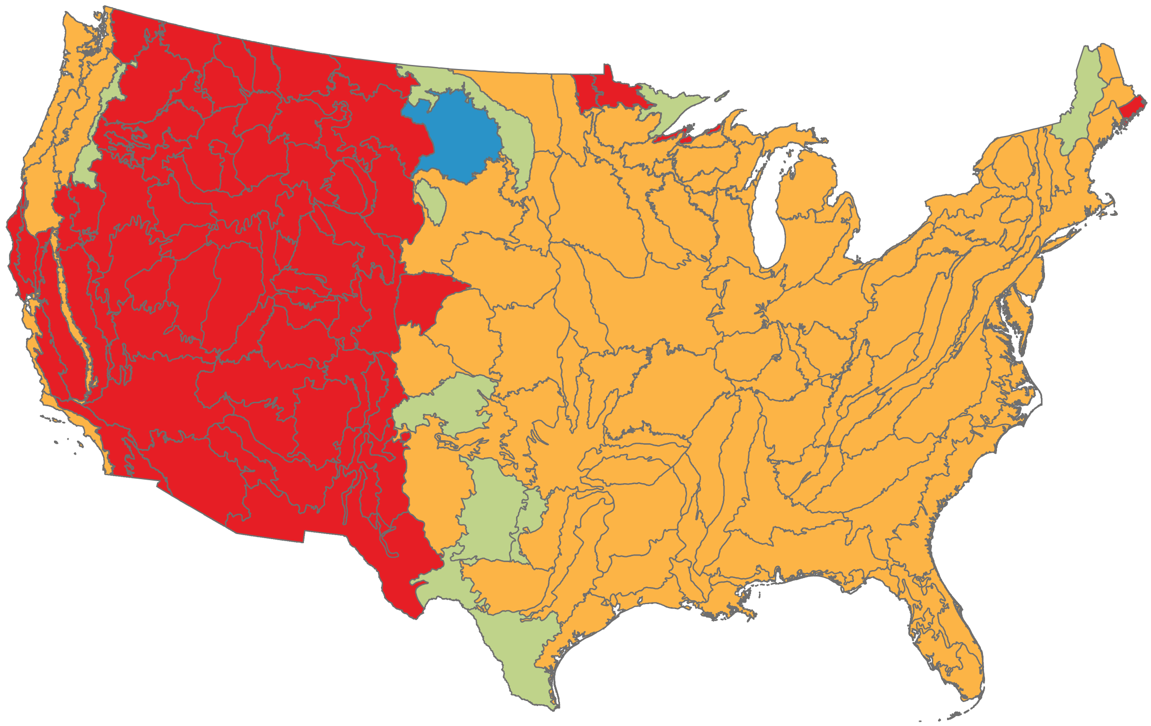


Figure 5—Map of the conterminous United States (CONUS) illustrating the forested ecosections where nonnative trees are found based on species distributions in the previous and current Forest Inventory and Analysis datasets (time 1 [T_1] and time 2 [T_2], respectively). Orange indicates nonnative trees were found in T_1 and T_2, green indicates nonnative trees were found in T_2 only, blue indicates nonnative trees were found in T_1 only, and red indicates nonnative trees were not found in T_1 or T_2. The background lines outline the CONUS ecoregions as mapped by Cleland and others (2007).

Table 13—Importance Value (in percent) of nonnative tree species in the conterminous United States, derived from mean values of tree density and basal area for the subset of plots with nonnative species in tables 10 and 11

Tree size	T_2	T_1
Saplings ≥1–<5 inches dbh	20	22
Large trees ≥5 inches dbh	15	15
All trees ≥1 inch dbh	17	18

- At the local scale (per-acre scale) of analysis, the proportion of total forest carbon content and rate of carbon sequestration of nonnative tree species becomes significant as will be discussed below (compare tables 14–16).
- The contribution of nonnative tree species to the carbon storage of CONUS forests is 92.6 gigapounds (42 Tg) of C (table 17) or about 0.05 percent of the amount stored in those forests. Nonnative tree species sequester 1.3 gigapounds (0.6 Tg) of C annually or about 0.5 percent of the carbon sink of CONUS forests.
- Insular tropical forests exhibit a wide range of variation in their structural parameters and level of live aboveground tree carbon attributed to nonnative tree species. Area-weighted values observed in the CONUS fall within the range measured in insular tropical forests (table 14).

Our results document that nonnative tree species are part of a large-scale, low-intensity ecological process of expansion in progress within the CONUS. At the current time, nonnative tree species constitute a small proportion of CONUS forests as a whole. However, the low average values that we found do not mean that nonnative species lack influence over forest lands in the CONUS. Our results show consistently that they account, on average, for about 20 percent of the structural and possibly functional parameters of the continental forest stands where they occur. Moreover, at local scales, nonnative tree species exert a greater influence on forests (discussed below).

Results for nonnative tree species contrast with nonnative species of other growth forms (Oswalt and others 2015). While nonnative trees have a higher presence in the Eastern United States compared to the Western United States, nontree nonnatives are widespread nationwide, including within western forests (Gray 2009). Similarly, the number of nonnative tree species in the CONUS is low compared to the number of nonnative species of other plant growth forms. In California, where 674 of 6,120 vascular plant species (11 percent) are naturalized, forest regeneration does not appear to be affected by the presence of nonnative species (Mooney and others 1986).

TOP: Brazilian peppertree (*Schinus terebinthifolia*). Courtesy photo by Kevin Potter, North Carolina State University;
BOTTOM: Chinaberrytree (*Melia azedarach*) in the CONUS. Courtesy photo by Kevin Potter, North Carolina State University.

Table 14—Comparison of the mean contribution of nonnative tree species to forests in tropical islands and the conterminous United States (CONUS) from inventory data for trees ≥1 inch (≥2.54 cm) diameter at breast height

Inventory unit	Density	Basal area	Importance Value	Live aboveground carbon	Rate of change in live aboveground carbon[a]
	trees per acre	*square feet per acre*	*percent*	*tons per acre*	*tons of C per acre per year*
Top 10 CONUS[b]	305	55	45	9.4	0.21–0.51
CONUS subplots	95	17	18	2.9	0.03–0.04
Big Island of Hawai'i	362	24	27	9.7	—
Other Hawaiian Islands	1,042	59	70	15.2	—
Kaua'i	—	—	66	—	—
Maui	—	—	58	—	—
O'ahu	—	—	79	—	—
Puerto Rico[c]	252	29	26	7	0.06
Palau	—	—	—	—	—[d]
Global young forests[e]	—	—	—	—	0.03–2.68

— = Data not available.

Values are rounded. 1 acre = 0.4047 ha; 1 square foot = 0.0929 m^2; 1 cubic foot = 0.02832 m^3; 1 ton = 0.9072 Mg.

[a] Rate of change for the CONUS is estimated by using the weighted average for the interval between inventories for each ecosection (8.5 years weighted average for all ecosections).

[b] Top 10 CONUS means the average of parameters for 10 ecosections in the conterminous United States ranked 1 to 10 by aboveground carbon density of nonnative tree species.

[c] For trees ≥5 inches (12.7 cm) diameter at breast height.

[d] Volume growth 1985 to 2003 of 56 cubic feet per acre per year.

[e] Cook-Patton and others (2020).

Table 15—Range of mean live aboveground tree carbon storage in the conterminous United States (Potter and Woodall 2014)

Site productivity[a]	Relative Density[b]	Number of plots[c]	Mean live aboveground tree carbon storage	SD	Mean live aboveground tree carbon storage
			tons per plot		*tons per acre*
Low	Low	14,918	5.6	6.1	33
	Medium	14,562	20.2	12.4	119
	High	4,812	31.0	19.4	182
Medium	Low	10,520	10.4	9.1	61
	Medium	20,242	27.6	12.8	162
	High	6,628	47.0	25.3	277
High	Low	1,757	12.9	16.2	76
	Medium	3,847	33.2	18.3	195
	High	2,038	71.0	49.4	417

SD = standard deviation.

1 acre = 0.4047 ha; 1 cubic foot = 0.02832 m^3; 1 ton = 0.9072 Mg.

[a] Site productivity classes are defined by their volume productivity (cubic feet per acre per year) as follows: low: <50; medium: 50–120; and high: >120. These are estimated from stand density, tree diameter distribution, and species wood density data.

[b] The numerical value of Relative Density classes varies with the region and is estimated as a function of a stand density index and a maximum stand density index.

[c] The individual plot area is 0.17 acre (0.067 ha).

Table 16—Current live aboveground tree carbon and its annual rate of change for all and nonnative trees in conterminous U.S. ecosections that are among the top 10 for one or more of the categories shown in the columns (top 10 values for each column are in bold)

	Nonnative trees		All trees	
Ecosection[a]	Live aboveground tree carbon	Annual change	Live aboveground tree carbon	Annual change
	tons per acre	*tons per acre per year*	*tons per acre*	*tons per acre per year*
211A	**14.3**	**0.51**	20.3	**0.81**
211G	**8.1**	**0.40**	31.5	0.26
212N	**7.8**	**0.44**	24.7	**1.07**
212T	6.3	**0.36**	15.0	-0.86
212Z	**9.8**	0.20	25.3	-0.85
221A	2.8	0.10	**41.2**	0.60
221B	3.7	0.14	**34.8**	**0.83**
221D	2.3	0.01	**40.9**	0.71
222R	1.2	0.06	20.1	**1.06**
223B	**7.4**	0.17	25.3	0.34
232A	2.4	0.10	**40.7**	0.41
232H	1.5	0.06	**34.9**	0.69
242A	**13.2**	0	18.2	0
242B	2.2	-1.88	**35.5**	**2.96**
251A	**8.4**	**0.25**	**34.8**	0.62
251B	3.8	0.10	25.6	**1.12**
261A	3.2	-0.02	**43.4**	**4.18**
331F	**8.9**	**0.34**	14.3	0.52
331I	4.3	**0.50**	4.3	0.50
332B	**7.6**	**0.21**	11.9	0.49
332C	3.8	**0.22**	10.4	-0.59
332F	5.5	**0.24**	14.8	**0.90**
M211C	2.7	-1.31	**38.5**	0.54
M211D	**8.1**	-0.16	28.6	-0.04
M242A	1.0	0.02	**65.4**	-0.38
M242B	0.5	0.05	20.3	**1.73**
M261F	0.0	-0.01	19.1	**2.29**

Values are rounded. 1 acre = 0.4047 ha; 1 ton = 0.9072 Mg.

[a] Appendix B contains the identification of each ecosection, and appendix C lists the ecosections with nonnative tree species.

Table 17—Comparison of carbon (C) storage and uptake fluxes in forests of the conterminous United States (CONUS) and the contribution of nonnative tree species in the CONUS at the CONUS scale and downscaled to local scales

Parameter[a]	All U.S. forests	Nonnative species
Forest area (*acres*)	682 million	18.8 million
Storage (*Tg C*)	89,640	42
Uptake flux in 2015 (*Tg C/year*)	130	0.6
Projected uptake flux by 2050 (*Tg C/year*)	87	NA
Average annual projected uptake flux decline (*Tg C/year*)	1.2	NA
Annual decline per area of forest (*pounds of C per acre per year*)	4.2	NA
Annual net uptake (*pounds of C per acre per year*)	NA	80 to 700

Values are rounded. 1 acre = 0.4047 ha; 1 pound = 454.6 g; 1 ton = 0.9072 Mg.

[a] The national storage and fluxes of C are based on Haight and others (2019) while those for nonnative tree species are based on this study. The mass of C is reported in metric units except the annual mass decline per area and the annual net uptake per area, which are expressed in pounds to compare with stand carbon annual net uptake rates in similar units. All values apply to 2015. Annual net uptake is the range for mean live tree aboveground accumulation for nonnative tree species by ecosection in this study.

Comparison of the Conterminous United States and Tropical Islands

Results from the current (T_2) subset of CONUS plots with nonnative tree species show that on a unit area basis, nonnative tree species have lower tree density and basal area than nonnative tree species in insular forests (table 14). However, the live aboveground tree carbon content is within the range of live aboveground tree carbon in tropical insular forests. The carbon density of nonnative tree species in the CONUS is lower than those in Hawaii and in Puerto Rico. The mean live aboveground tree carbon storage of the top 10 CONUS ecosections is higher than the mean value for Puerto Rico. The CONUS forests have a lower number of tree species per unit area and lower Importance Value of nonnative tree species (15 to 22 percent; table 13) than those of any tropical islands (35 percent for Puerto Rico and 27–79 percent for Hawaiian Islands [tables 5 and 14, respectively]).

Nonnative tree species face a greater ecological challenge colonizing temperate and boreal forests than when colonizing insular tropical forests. The main challenge is climatic. For example, frost—a factor that greatly reduces the species pools available for colonization—does not occur in the tropical lowlands. Colonization is further facilitated in islands because insular native plants tend to be poor competitors when faced with novel disturbances and are more susceptible to displacement by continental species better adapted to such disturbances (Smith 1989). Within tropical islands, moist climates are more favorable to nonnative tree species than dry or wet climates (Francis and Liogier 1991). Thus, one can also

Chinese tallow (*Triadica sebifera*). Courtesy photo by Chris Evans, University of Illinois, Bugwood.org..

expect that in the CONUS, the opportunities for nonnative tree species colonization in dry and wet conditions are also reduced relative to moist sites. As mentioned earlier, tropical islands have a greater human population density than continents and this influences the fraction of nonnative species in the biota, i.e., a greater fraction of nonnative species at higher densities of human populations (Guo and others 2017). As species colonization is associated with human activity, one might expect fewer opportunities for nonnative tree species colonization in the CONUS than in the tropical islands of the Caribbean and Pacific.

Comparatively fewer and sparse human activity legacies in the CONUS favor the continued dominance of native tree species over nonnative ones. Even though this is the case, it is important to continue monitoring the presence of nonnatives in all environments. Rural areas can show elevated numbers of nonnatives due to factors such as port activity, contaminated seed, and ungulate disturbance.

Storage of Live Aboveground Tree Carbon

Potter and Woodall (2014) used FIA data to explore the relationship between tree species richness and live aboveground tree biomass at various scales across the CONUS. In sites of high productivity and high tree stocking, they found no relationship between species richness and live aboveground tree biomass, as few species tended to dominate those sites. However, using phylogenetic clustering of tree species in sites of low productivity, they found a positive role for species biodiversity in the determination of live aboveground tree biomass of stands. We converted the live aboveground tree biomass storage data in Potter and Woodall (2014) to carbon units and compared our results (below) with their snapshot of the range of storage levels of live aboveground tree carbon in the CONUS (table 15). Values (in tons per acre) for CONUS forests range from 33–182 (74–409 Mg/ha) for low productivity sites, to 61–277 (137–620 Mg/ha) for medium productivity sites, and 76–417 (171–936 Mg/ha) for high productivity sites. Site productivity classes were defined by their volume production of <50, 50–120, and >120 cubic feet per acre per year (<3.5, 3.5–8.4, and >8.4 m^3/ha·year) for low, medium, and high productivity sites, respectively.

The mean live aboveground tree carbon storage for nonnative trees was 9.4 tons per acre (21.1 Mg/ha; table 16) among the top 10 ecosections ranked by their live aboveground tree carbon value. This level of carbon storage is 28 percent of the lowest value in table 15, while nonnative trees in Hawaii stored the equivalency of 33 percent. Nonnative tree species in Puerto Rico and the average by ecosections for the CONUS were 18 and 10 percent of the lowest value in table 15, respectively. As with other structural parameters, the carbon storage of nonnative tree species at the national scale is low and ranges widely but can be significant in certain locations. While it is likely that individual forest stands have carbon densities higher than we report for CONUS ecosections, such higher values are of local importance and are diluted at larger geographic scales by the prevalent low Importance Value of nonnative tree species in the CONUS.

Carbon Balance of Forests in the Conterminous United States

Our review of the rate of carbon accumulation of forests with nonnative tree species suggests that low to moderate rates can be attained. For example, the annual volume growth in "exotic softwood forests" reported for northern Wisconsin and western upper Michigan was 90 cubic feet per acre per year (6.3 m^3/ha·year; Janowiak and others 2014). This rate of productivity is in the medium site productivity class values (50–120 cubic feet per acre per year [3.5 to 8.4 m^3/ha·year]) reported for CONUS forests by Potter and Woodall (2014). In comparison, the species-rich forests of Palau accumulated volume at a rate of 56 cubic feet per acre per year (3.9 m^3/ha·year; Donnegan and others 2007). The islandwide average volume growth of nonnative tree species in Puerto Rico (17.7 cubic feet per acre per year [1.24 m^3/ha·year]; table 6), was in the lower limit of the CONUS low site productivity class of Potter and Woodall (2014).

In our study, the average annual rate of live aboveground tree carbon accumulation by nonnative tree species was 0.04 tons per acre per year (SE = 0.02, n = 102; or 0.1 Mg/ha·year; fig. 6) for CONUS ecosections with nonnative tree species and 0.35 tons per acre per year (0.8 Mg/ha·year) for the top 10 most productive ecosections (table 16 and below). A histogram of all the rate-of-change values available to us shows that for all CONUS

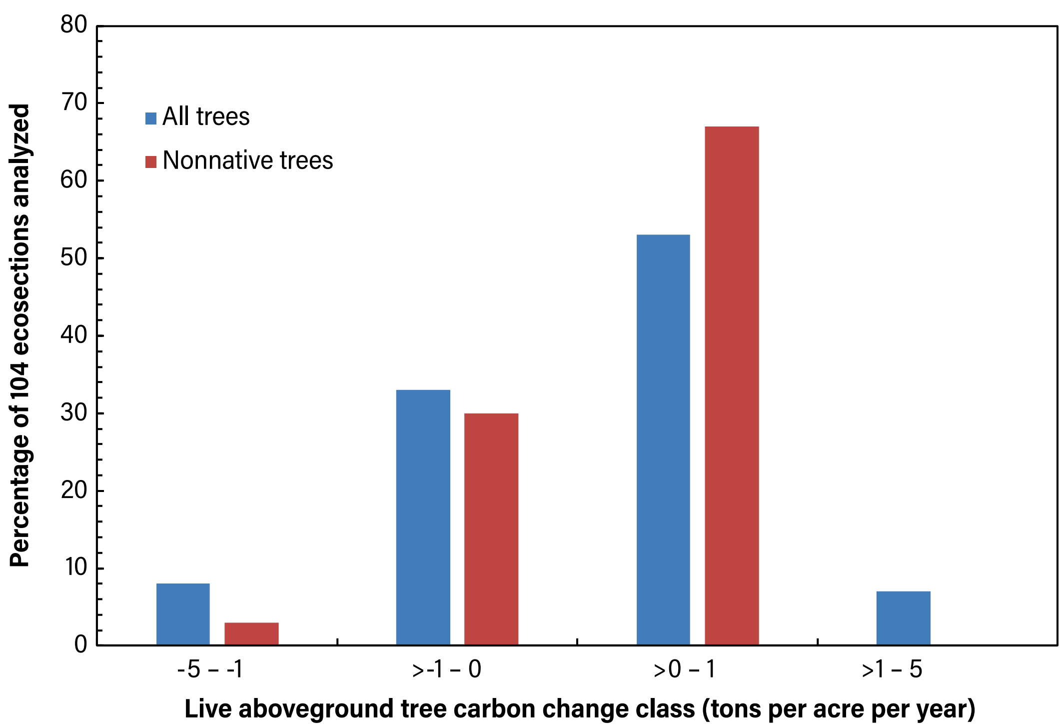


Figure 6—Histogram of the rates of live aboveground tree carbon change of all trees and nonnative trees in the interval between the previous Forest Inventory and Analysis dataset (time 1 [T_1]) and the most current inventory (time 2 [T_2]) for the conterminous United States. The interval between T_1 and T_2 ranged between 3 and 15 years. The analysis included ecosections with nonnative tree species.

trees, the distribution of the rate-of-change data has a wider range of classes than the distribution for the nonnative trees (fig. 6). In almost 70 percent of the ecosections studied, nonnative tree species exhibited a positive carbon balance compared to 53 percent for all trees. The loss of carbon in ecosections can be attributed to many potential causes over the period between inventories, but it is most likely due to nonnative tree mortality, which can affect the balance where nonnative trees are few in number. In spite of the negative values, which lower the average rate of carbon accumulation, nonnative tree species are playing significant roles in the carbon balance of individual stands. However, because of their low abundance, nonnative tree species do not significantly influence the national carbon balance.

Table 16 identifies the top 10 ecosections in the CONUS, ranked individually by the live aboveground tree carbon and its rate of change for all trees and nonnative tree species. The rate of change in live aboveground tree carbon is a measure of the rate of carbon sequestration (positive annual change of live aboveground tree carbon). Some ecosections ranked in the top 10 in more than one of the four categories. 211A (Aroostook Hills and Lowlands Section of the Northeastern Mixed Forest Province), 212N (Northern Minnesota Drift and Lake Plains Section of the Laurentian Mixed Forest Province), and 251A (Red River Valley Section of the Prairie Parkland [Temperate] Province) ranked in the top 10 for three categories each.

The ecosections with the highest nonnative live aboveground tree carbon density (fig. 7A) are clustered in the northern portion of the CONUS, primarily around Pennsylvania and the Dakotas. In order to identify where nonnatives are influential, we identified ecosections where nonnatives have the greatest effect on standing stock or change, and at the same time, avoid the influence of small sample size of some ecosections (figs. 7B and 7C). Those with the highest proportion of total live aboveground tree carbon in nonnative tree species cluster in a south-north corridor from northern Texas to the northern border of the CONUS (fig. 7B). Decreases in the proportion of live aboveground tree carbon attributed to nonnative tree species occur on both the east and west coast at higher latitudes and increases in that proportion attributed to nonnative tree species occur from the central CONUS east and south to central Florida (fig. 7C).

When addressing the storage of carbon for forests of the world, or those of large countries such as the United States, one has to deal with large numbers. For example, the carbon balance of the world is estimated in 10^{15} g (or petagrams [Pg]). For U.S. forests, values are expressed in teragrams (Tg) or 10^{12} g. At the per-acre scale of forests, the values are in megagrams (Mg) or 10^{6} g. The large numbers are aggregates of events occurring at smaller scales with lower orders of magnitude. Therefore, small local numbers, when aggregated over large scales can have an effect on national or global numbers. This is important when evaluating the role of ecosystem components such as nonnative trees, because their aggregate numbers may appear small when first seen, but a different picture emerges at the local level, where they may play a dominant role.

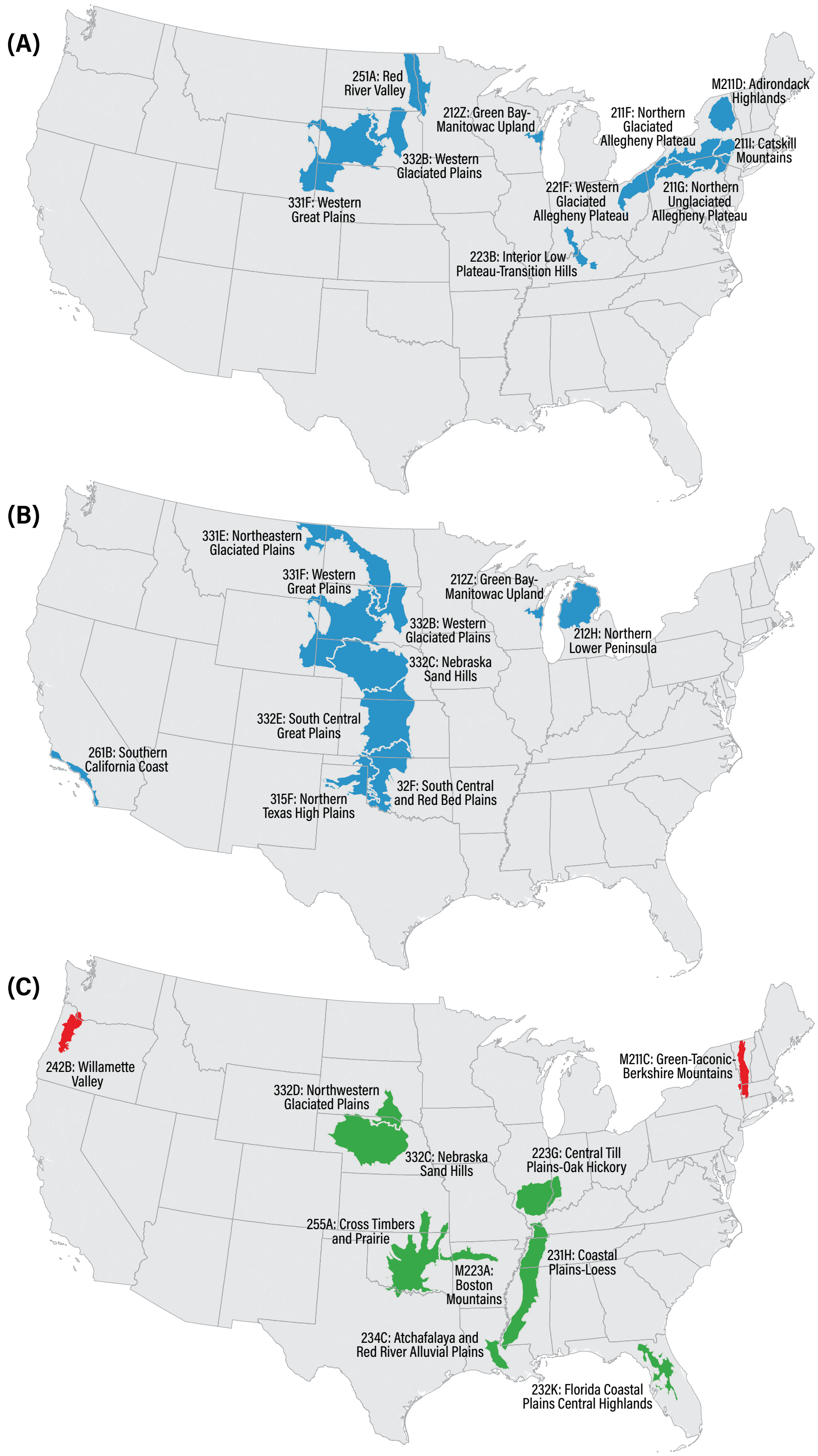


Figure 7—Carbon in nonnative tree species indicating the top 10 ecosections in terms of (A) aboveground carbon density (tons per acre) of nonnative tree species, (B) proportion of total aboveground carbon that is in nonnative species, and (C) by change in the proportion of nonnative carbon (green indicates increase in proportion and red indicates decrease in proportion). The set of ecosections included here is limited to (1) those where nonnative species are identified in the current inventory (see fig. 5), and (2) ecosections with a minimum of 1 percent of forest area with nonnative tree species (to avoid influence of small samples).

Table 17 illustrates aggregated estimates of carbon storages and fluxes of CONUS forests and their projected decline by 2050 due to "the combination and interaction among forest aging, forest disturbance, and land use change" (Haight and others 2019: 15). The projected decline in the carbon sink is 92.6 gigapounds (42 Tg) over 35 years or 2.6 gigapounds of C per year (1.2 Tg/year). When scaled down to the forest stand level, and using the units of this study, the rate of decline is 4.2 pounds of C per acre per year (4.7 kg/ha·year). The mean annual rate of carbon sequestration by nonnative tree species reported earlier was 0.04 tons per acre per year (0.1 Mg/ha·year) for all CONUS ecosections with nonnative tree species and 0.35 tons per acre per year (0.8 Mg/ha·year) for the top 10 ecosections in table 16. These two rates are equivalent to 80 and 700 pounds of C per acre per year (90 and 785 kg/ha·year, respectively). The mean annual carbon sink due to nonnative tree species is >19 times higher than the projected annual decline in the sink function of CONUS forests. Clearly, nonnative tree species can have a nontrivial role in maintaining the carbon sink function of forests in the CONUS. In fact, the proportion of their contribution to the carbon sink of the CONUS is 10 times higher than their contribution to the CONUS carbon stock (0.5 percent versus 0.05 percent, respectively; table 17), suggesting a disproportional contribution to function relative to structure as observed for nonnative trees in Puerto Rico (table 5). However, the reason for raising this point is not to suggest that nonnative species overcome projected reductions in forest productivity over the next 35 years, but to emphasize that small numbers need not be ignored in these types of analyses, particularly when dealing with large land areas. We shift our attention to the causes of the ecological success of nonnative tree species at the local scale.

Ecological Attributes of Nonnative Trees

There are many hypotheses for explaining why some nonnative plant species become so successful (Holzmueller and Jose 2013). One of them addresses the rapid growth and reproduction of these species, including a high capacity to store biomass as was the case of Chinese tallow (*Triadica sebifera* syn. *Sapium sebiferum*) introduced into Georgia in the United States. A 14-year study showed that the genotypes of this species growing in Louisiana and Texas had greater biomass and fewer leaf defenses than genotypes in the native habitat (Siemann and Rogers 2001).

Norway maple (*Acer platanoides*) is an extremely shade-tolerant nonnative tree, naturalized on Mackinac Island in Lake Huron, MI in 1938. By 2003, it occupied about 1,848 acres (748 ha; Webster and Wangen 2009). The species has the capacity to grow under shade or high sunlight conditions, much like a dominant and native tropical palm in Puerto Rico, Sierran palm or palma de sierra (*Prestoea montana*). Norway maple can survive in shade (documented up to 32 years), but overstory individuals grow very rapidly under high sunlight conditions after a canopy gap is formed or due to other canopy disturbance (Webster and others 2005, table 18). Norway maple can surpass other trees in vertical growth and reach the canopy 10 years sooner than the competition. In the understory of urban oak (*Quercus* spp.) forests in the Eastern United States, where Norway maple and the native sugar maple (*Acer saccharum*) grow together, Norway maple uses available resources more effectively than the native maple (Kloeppel and Abrams 1995; table 19).

Table 18—Illustrative exercise with selected attributes of trees of Norway maple (*Acer platanoides*) growing under different conditions (Webster and others 2005)

Attributes[a]	Mean (SE)	Volume growth[b]	Equivalency of volume growth to mass[c]
		cubic feet per year	*pounds per year*
	Open grown (n = 3)		
Age *years*	26 (9)	NA	NA
Height *feet*	38 (10)	NA	NA
Height growth *feet per year*	1.54 (0.23)	NA	NA
Recent mean BA growth *square inches per year*	6.56 (3.95)	0.07	2.8
Cumulative BA growth *square inches per year*	4.54 (2.15)	0.05	2.0
	Co-dominant and dominant (n = 33)		
Age *years*	38.2 (1.7)	NA	NA
Cumulative height *feet*	46.4 (1.3)	NA	NA
Height growth *feet per year*	1.26 (0.06)	NA	NA
Recent mean BA growth *square inches per year*	5.64 (0.62)	0.05	2.0
Cumulative BA growth *square inches per year*	3.29 (0.34)	0.03	1.2
	Intermediate (n = 16)		
Age *years*	29.1 (2.6)	NA	NA
Cumulative height *feet*	31.78 (1.49)	NA	NA
Height growth *feet per year*	1.17 (0.06)	NA	NA
Recent mean BA growth *square inches per year*	1.55 (0.31)	0.01	0.5
Cumulative BA growth *square inches per year*	0.85 (0.15)	0.01	0.3

BA = basal area; SE = standard error.

1 foot = 0.3048 m; 1 cubic foot = 0.02832 m^3; 1 square inch = 6.4516 cm^2; 1 pound = 353.6 g.

[a] Recent growth corresponds to the last 5 years, while cumulative growth corresponds to the whole life interval.

[b] Volume growth is estimated from BA and height growth.

[c] Equivalency of volume growth to pounds-per-year mass was based on a 40.27 pounds-per-cubic-foot conversion (https://wood-database.com).

Table 19—Comparison of ecophysiological attributes of Norway maple (*Acer platanoides*) with sugar maple (*Acer saccharum*)

Attribute	*Acer platanoides*	*Acer saccharum*
Average height growth (*m*)	19.3 (SE = 3.2)	10.0 (SE = 1.7)
Leaf longevity	12 days longer	12 days shorter
Leaf mass/area (*mg/cm²*)	2.67 (SE = 0.03)	2.32 (SE = 0.02)
Leaf thickness	Lower	Higher
Net photosynthesis and light response	Higher C assimilation and N and P use efficiency	Lower
Water use efficiency (*mmol CO_2 /mol H_2O*)	0.88 (SE = 0.12)	0.32 (SE = 0.09)
Osmotic potential	Lower but similar relative water content at zero turgor	Higher

SE = standard error.
Data from Kloeppel and Abrams (1995).
1 foot = 0.3048 m; 1 square inch = 6.4516 cm^2; 1 ounce = 28 350 mg.

From the above, certain ecological traits appear common to most successful nonnative tree species (see box below). Notably important is the capacity to complete the establishment phase of colonization (ecesis) under a variety of conditions associated with disturbance of forests or soils. Most successful nonnative tree species have a pioneer growth strategy ("r" strategy in the scheme of Grime and Pierce 2012), which means they predominate early in succession but are less successful in late stages of succession. This strategy is accompanied by numerous ecophysiological characteristics that allow the species to compete successfully for available resources such as light, nutrients, and space. Also, these nonnative tree species mix and self-organize with native species into novel species assemblages and become part of the network of organisms that regulate biogeochemical cycles. The novel species assemblages include microbial communities and soil organisms critical for recycling of carbon and chemical elements. For example, Jo and others (2018) found that nonnative understory plants in FIA inventory data had increased abundance when associated with arbuscular mycorrhizal dominant forests. The facilitation of nutrient cycling by tree mycorrhiza was implied in this relationship.

Life history characteristics of dominant nonnative tree species[a]

Below is a list of attributes that describe an emerging consensus among ecologists about the ecological life history characteristics of dominant nonnative tree species. Not all dominant nonnative tree species have all the listed attributes, as each species is known for one or more of the characteristics depending on the level of research conducted. For example, in the Big Island of Hawai'i, the wood of eight nonnative tree species has higher nitrogen and phosphorus concentrations than that of four native ones (Mascaro and others 2012). This points to their influence on the stoichiometry of the forest as listed below.

Copious seeding
Successful during ecesis (establishment stage of succession)
- Germination
- Growth (rapid growth)
- Reproduction

Pioneer strategy as opposed to nonpioneer or slow growth strategies
Incorporates into existing or novel food webs
Reinforcing biotic loops with symbionts such as dispersers
Specialized function such as nitrogen fixing
Can influence whole system response through:
- Use or addition of resources
- Control of space
- Stoichiometry
- Food web (including detrital)
- Altering disturbance regimes

[a] Based on reports of individual species in the Literature Cited section.

Ecological Effects of Nonnative Tree Species

Nonnative species can change the conditions under which they grow. Some nonnative species are associated with changes in stand conditions, such as the lower soil pH found in patches of cogongrass (*Imperata cylindrica*) compared with patches of native species without cogongrass (Collins and Jose 2009). Such changes can affect other soil properties and soil organisms, which in turn can drive the ecology of whole forest stands.

In locations such as Hawaii, novel forests with nonnative tree species increase the total species richness by 100 percent, as well as tree species richness and the diversity of dominant species (Mascaro and others 2012). Novel forests in Hawaii significantly differ from historical forests by exhibiting higher aboveground biomass and adding new functional traits, such as nitrogen fixing, to ecosystems (Mascaro and others 2012). One of the main characteristics of nonnative trees that reach high dominance in forests is their rapid growth rate, which translates to a greater rate of carbon accumulation in trees. Rapid growth rate is accompanied by greater use of available forest resources such as space, nutrients, and water. Some nonnative species influence the nitrogen budget through fixation, as is the case of fire tree (*Myrica faya*) in Hawaii (Vitousek and Walker 1989) and other nitrogen-fixing trees and nonnative grasses in Puerto Rico (Cusack and others 2015, Erickson and others 2014, Lugo and Erickson 2017).

The role of nonnative tree species in the stoichiometry of forests can be significant. In an island like Puerto Rico, where 75 percent of the species assemblages identified by FIA were novel (Martinuzzi and others 2013), species composition influenced the chemistry of leaf litter with nonnative species assemblages exhibiting different chemical element concentrations than historical native species assemblages (Erickson and others 2014). Leaf litter from younger and often novel forests had higher phosphorus, iron, and aluminum concentrations and lower carbon concentration and C:P and N:P ratios than those in older historical forests. The lower N:P ratio was due to high nitrogen and even higher phosphorus concentrations. These effects were in addition to significant effects of climate, stand basal area, forest type, and leaf longevity on leaf litter chemistry. Erickson and others (2014) concluded that the current novel landscape has a greater availability of nitrogen and phosphorus than the historical one.

Compared to historical dry forests, novel dry forests in Puerto Rico had higher carbon anomalies, lower calcium and sodium anomalies, and lower C:N anomalies in leaf litter (Lugo and Erickson 2017). Also, at the 2.47-acre (1-ha) scale, novel dry forests had a higher species density than historical dry forests and were dominated by nitrogen-fixing species, which altered the nitrogen input to the litter. In short, dominant nonnative tree species often increase the availability of resources to a community by incorporating resources that were previously not used by native species and by being more effective during ecesis under conditions where historical tree species assemblages could not regenerate.

Why Are Nonnative Tree Species Increasing in Numbers, and What Can Be Done?

The spread of nonnative species is obviously a complex issue because it is grounded in one of the fundamental ecological processes of ecosystems: succession following an environmental disruption. Every situation that one addresses is different and unique, and no single solution is available because of the multitude of potential combinations of disturbance types and intensities with equally diverse ecological states of affected ecosystems. From the outset when scientific attention was given to the issue, Elton (1958) suggested that "ecological resistance" by the community being colonized was the root of the problem and provided an approach for addressing it: "It is this resistance, whether by man or by nature or by man mobilizing nature in his support, that has now to be examined: what it is and how it can be understood and when necessary manipulated and increased when desired" (Elton 1958: 109–110). As pointed out by Orians (1986), this observation of Elton has proven correct since it was formulated, but the scientific effort soon shifted towards the colonizing species and not as much attention was given to the receiving community (but see Ewel 1986, and Guo and others 2015 who devised quantitative criteria to assess the level and degree of invasion).

Norway maple (*Acer platanoides*) in the CONUS. USDA Forest Service photo by Cassandra M. Kurtz.

As we have summarized above, today we have a lot of information about the characteristics of species that lead them to being successful colonizers, but such knowledge, while extremely useful, does not allow us to anticipate which species will become problematic in the future. We also need to understand the conditions that reduce ecological resistance to colonization and reorganize our resources to minimize colonization, where such a strategy is the appropriate one. Clearly, there are other ecological circumstances where high rates of colonization are a desirable outcome (e.g., for land rehabilitation purposes). The cost and risk associated with management actions are critical considerations when making resource decisions that involve the conundrum of either assisting or resisting natural phenomena.

Elton (1958) identified the conditions that lower ecological resistance to colonization, which are associated with human activity and human-induced disturbances to communities of plants and animals. These result in the colonization of cultivated systems, abandoned sites after human use, disturbed and simplified communities, and disturbed habitats on small islands, which he observed were more vulnerable to colonization than those on large continents. This is certainly the experience with nonnative trees in the CONUS and islands of the Caribbean and Pacific as we have discussed.

Empirical data suggest that conditions in the landscape influence the abundance of nonnative tree species. Riitters and others (2018) elegantly demonstrated this through an analysis of 23,039 inventory plots in 13 ecological provinces of the Eastern United States. They analyzed the FIA data using plot distance from a road with adjustments to differences attributed to the province and local scale differences associated with land use, land fragmentation, and productivity. The analysis showed that the landscape context associated with roads was of greater practical value than distance from roads, meaning that road presence is not as important to nonnative species colonization as the conditions around it.

In this section, we asked why nonnative tree species are increasing in numbers and what can be done about it. The response is that the slow increase in nonnative tree species abundance in the CONUS reflects both the greater ecological resistance to colonization of continental forest lands and the slow increase in the human modification of the ecological resistance of its forests. The ecological zones with the highest historical levels of

TOP: Silktree (mimosa) (*Albizia julibrissin*). Courtesy photo by Lesley Ingram, Bugwood.org;
BOTTOM: Norway spruce (*Picea abies*) in the CONUS. USDA Forest Service photo by Cassandra M. Kurtz.

modification, such as the Eastern United States, have the highest presence of nonnative tree species, while those with the least historical levels of modification such as the Western United States, have the least (fig. 5). Iannone and others 2015 found the same pattern for nonnative plants. Climate change, changes in fire regimes, and spreading influence of humans at the wildland-urban interface are bound to increase the opportunities for nonnative tree colonization in the Western United States. A strategy of forest management for ecological resistance to colonization and designed specifically for different ecological zones and types of human disturbances is warranted. We recommend the focus be on forest resilience as opposed to the exclusion or eradication of species by geographic origins.

Elton (1958), whose conservation focus was similar to that of Aldo Leopold's land ethic (Callicott 1999) and consistent with hands-on conservation needed in the Anthropocene Epoch, said it best when he expressed the following:

> …I believe that conservation should mean the keeping or putting in the landscape of the greatest possible ecological variety—in the world, in every continent or island, and so far as practicable in every district. And provided the native species have their place, I see no reason why the reconstitution of communities to make them rich and interesting and stable should not include a careful selection of exotic forms, especially as many of these are in any case going to arrive in due course and occupy some niche (Elton 1958: 155).

The implication of Elton's observation is that we need an informed and flexible approach to the management of landscapes. We need to be able to know when to allow natural processes to proceed and where and when to redirect or reverse them.

TOP: Norway maple (*Acer platanoides*). Courtesy photo by Bill Cook, Michigan State University, Bugwood.org;
BOTTOM: Punktree (melaleuca) (*Melaleuca quinquenervia*). Courtesy photo by Barry Rice, sarracenia.com, Bugwood.org.

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APPENDIX A

This appendix contains tables with summaries of the forest structure data used in this report, and where appropriate, the statistical variation associated with the data. Tables are based on ecoregions within the conterminous United States (CONUS) and contain summaries for current and previous years associated with inventories.

Table A.1—Ecosections and their description; State-level inventories with year contributing to the ecosection summaries for the most current and a previous inventory, which ranged from 3 to 15 years apart; and the mean number of years between the ecosection summaries

Ecosection	Description	Current inventories	Previous inventories	Mean difference[a]
		State(s) and year(s)	*State(s) and year(s)*	*years*
211A	Aroostook Hills and Lowlands	ME 2018	ME 2008	10.0
211B	Maine - New Brunswick Foothills and Lowlands	ME 2018	ME 2008	10.1
211C	Fundy Coastal and Interior	ME 2018	ME 2008	9.9
211D	Central Maine Coastal and Embayment	ME 2018	ME 2008	9.9
211E	St. Lawrence and Champlain Valley	NY 2019, VT 2019	NY 2008, VT 2008	9.8
211F	Northern Glaciated Allegheny Plateau	NY 2019, PA 2018	NY 2008, PA 2008	9.8
211G	Northern Unglaciated Allegheny Plateau	NY 2019, PA 2018	NY 2008, PA 2008	9.2
211I	Catskill Mountains	NY 2019, PA 2018	NY 2008, PA 2008	10.1
211J	Tug Hill Plateau - Mohawk Valley	NY 2019	NY 2008	10.0
212H	Northern Lower Peninsula	MI 2019	MI 2008	10.1
212J	Southern Superior Uplands	MI 2019, WI 2019	MI 2008, WI 2008	10.1
212K	Western Superior Uplands	MN 2019, WI 2019	MN 2008, WI 2008	10.6
212L	Northern Superior Uplands	MI 2019, MN 2019	MI 2008, MN 2008	11.0
212M	Northern Minnesota and Ontario	MN 2019	MN 2008	10.9
212N	Northern Minnesota Drift and Lake Plains	MN 2019	MN 2008	10.9
212Q	North Central Wisconsin Uplands	MN 2019, WI 2019	MN 2008, WI 2008	10.2
212R	Eastern Upper Peninsula	MI 2019	MI 2008	10.2
212S	Northern Upper Peninsula	MI 2019	MI 2008	10.3
212T	Northern Green Bay Lobe	MI 2019, WI 2019	MI 2008, WI 2008	10.0
212X	Northern Highlands	MI 2019, WI 2019	MI 2008, WI 2008	10.0
212Y	Southwest Lake Superior Clay Plain	MI 2019, MN 2019, WI 2019	MI 2008, MN 2008, WI 2008	10.1
212Z	Green Bay - Manitowac Upland	WI 2019	WI 2008	10.0
221A	Lower New England	CT 2018, ME 2018, MA 2018, NH 2019, NJ 2018, NY 2019, PA 2018, RI 2018, VT 2019	CT 2008, ME 2008, MA 2008, NH 2008, NJ 2008, NY 2008, PA 2008, RI 2008, VT 2008	9.2
221B	Hudson Valley	NJ 2018, NY 2019, PA 2018, VT 2019	NJ 2008, NY 2008, PA 2008, VT 2008	10.0

[a] When more than one State is included in an ecosection, the mean difference value is weighted by forest in each State.

(continued)

Table A.1 *(Continued)*

Ecosection	Description	Current inventories	Previous inventories	Mean difference[a]
		State(s) and year(s)	*State(s) and year(s)*	*years*
221D	Northern Appalachian Piedmont	DE 2019, MD 2018, NJ 2018, NY 2019, PA 2018, VA 2018	DE 2008, MD 2008, NJ 2008, NY 2008, PA 2008, VA 2008	9.9
221E	Southern Unglaciated Allegheny Plateau	KY 2017, OH 2018, PA 2018, WV 2018	KY 2008, OH 2008, PA 2008, WV 2008	9
221F	Western Glaciated Allegheny Plateau	NY 2019, OH 2018, PA 2018	NY 2008, OH 2008, PA 2008	9.1
221H	Northern Cumberland Plateau	KY 2017, TN 2017	KY 2008, TN 2008	9.3
221J	Central Ridge and Valley	TN 2017, VA 2018	TN 2008, VA 2008	9.5
222H	Central Till Plains-Beech-Maple	IL 2019, IN 2019, OH 2018	IL 2008, IN 2008, OH 2008	9.3
222I	Erie and Ontario Lake Plain	NY 2019, OH 2018, PA 2018	NY 2008, OH 2008, PA 2008	10.1
222J	South Central Great Lakes	IL 2019, IN 2019, MI 2019, OH 2018	IL 2008, IN 2008, MI 2008, OH 2008	10.1
222K	Southwestern Great Lakes Morainal	IL 2019, IN 2019, WI 2019	IL 2008, IN 2008, WI 2008	10.0
222L	North Central U.S. Driftless and Escarpment	IL 2019, IA 2019, MN 2019, WI 2019	IL 2008, IA 2008, MN 2008, WI 2008	10.1
222M	Minnesota and Northeast Iowa Morainal-Oak Savannah	IA 2019, MN 2019, WI 2019	IA 2008, MN 2008, WI 2008	10.8
222N	Lake Agassiz-Aspen Parklands	MN 2019	MN 2008	10.7
222R	Wisconsin Central Sands	WI 2019	WI 2008	9.8
222U	Lake Whittlesey Glaciolacustrine Plain	IN 2019, MI 2019, OH 2018	IN 2008, MI 2008, OH 2008	9.7
223A	Ozark Highlands	AR 2019, IL 2019, KS 2018, MO 2019, OK 2017	AR 2008, IL 2008, KS 2008, MO 2008, OK 2010	10.1
223B	Interior Low Plateau-Transition Hills	IN 2019, KY 2017	IN 2008, KY 2008	9.5
223D	Interior Low Plateau-Shawnee Hills	IL 2019, IN 2019, KY 2017	IL 2008, IN 2008, KY 2008	9.6
223E	Interior Low Plateau-Highland Rim	AL 2019, KY 2017, TN 2017	AL 2008, KY 2008, TN 2008	9.4
223F	Interior Low Plateau-Bluegrass	IN 2019, KY 2017, OH 2018	IN 2008, KY 2008, OH 2008	9.3
223G	Central Till Plains-Oak Hickory	IL 2019, IN 2019	IL 2008, IN 2008	10.0
231A	Southern Appalachian Piedmont	AL 2019, GA 2018, NC 2019, SC 2018	AL 2008, GA 2008, NC 2010, SC 2008	10.7
231B	Coastal Plains-Middle	AL 2019, GA 2018, MS 2019, TN 2017	AL 2008, GA 2008, MS 2010, TN 2008	10.3
231C	Southern Cumberland Plateau	AL 2019, GA 2018, TN 2017	AL 2008, GA 2008, TN 2008	10.5
231D	Southern Ridge and Valley	AL 2019, GA 2018, TN 2017	AL 2008, GA 2008, TN 2008	10.7
231E	Mid Coastal Plains-Western	AR 2019, LA 2017, OK 2017, TX 2016	AR 2008, LA 2009, OK 2010, TX 2008	10.2
231G	Arkansas Valley	AR 2019, OK 2017	AR 2008, OK 2010	9.9
231H	Coastal Plains-Loess	IL 2019, KY 2017, LA 2017, MS 2019, TN 2017	IL 2008, KY 2008, LA 2009, MS 2010, TN 2008	9.7
231I	Central Appalachian Piedmont	NC 2019, SC 2018, VA 2018	NC 2010, SC 2008, VA 2008	10.6
232A	Northern Atlantic Coastal Plain	DE 2019, MD 2018, NJ 2018, PA 2018, VA 2018	DE 2008, MD 2008, NJ 2008, PA 2008, VA 2008	9.6
232B	Gulf Coastal Plains and Flatwoods	AL 2019, FL 2017, GA 2018, LA 2017, MS 2019	AL 2008, FL 2009, GA 2008, LA 2009, MS 2010	10.3
232C	Atlantic Coastal Flatwoods	FL 2017, GA 2018, NC 2019, SC 2018	FL 2009, GA 2008, NC 2010, SC 2008	10.4
232D	Florida Coastal Lowlands-Gulf	FL 2017	FL 2009	9.5

[a] When more than one State is included in an ecosection, the mean difference value is weighted by forest in each State.

(continued)

Table A.1 *(Continued)*

Ecosection	Description	Current inventories	Previous inventories	Mean difference[a]
		State(s) and year(s)	*State(s) and year(s)*	*years*
232E	Louisiana Coastal Prairie and Marshes	LA 2017, MS 2019, TX 2016	LA 2009, MS 2010, TX 2008	9.2
232F	Coastal Plains and Flatwoods-Western Gulf	LA 2017, TX 2016	LA 2009, TX 2008	9.4
232G	Florida Coastal Lowlands-Atlantic	FL 2017	FL 2009	9.5
232H	Middle Atlantic Coastal Plains and Flatwoods	DE 2019, MD 2018, NC 2019, VA 2018	DE 2008, MD 2008, NC 2010, VA 2008	10.4
232I	Northern Atlantic Coastal Flatwoods	NC 2019, VA 2018	NC 2010, VA 2008	9.9
232J	Southern Atlantic Coastal Plains and Flatwoods	FL 2017, GA 2018, NC 2019, SC 2018	FL 2009, GA 2008, NC 2010, SC 2008	10.6
232K	Florida Coastal Plains Central Highlands	FL 2017	FL 2009	9.9
232L	Gulf Coastal Lowlands	AL 2019, FL 2017, LA 2017, MS 2019	AL 2008, FL 2009, LA 2009, MS 2010	9.8
234A	Southern Mississippi Alluvial Plain	AR 2019, LA 2017, MS 2019	AR 2008, LA 2009, MS 2010	10.1
234C	Atchafalaya and Red River Alluvial Plains	LA 2017	LA 2009	8.8
234D	White and Black River Alluvial Plains	AR 2019, IL 2019, KY 2017, LA 2017, MS 2019, MO 2019, TN 2017	AR 2008, IL 2008, KY 2008, LA 2009, MS 2010, MO 2008, TN 2008	11.2
234E	Arkansas Alluvial Plains	AR 2019, LA 2017	AR 2008, LA 2009	11.5
242A	Puget Trough	OR 2018, WA 2018	OR 2010, WA 2011	6.5
242B	Willamette Valley	OR 2018, WA 2018	OR 2010, WA 2011	6.9
251A	Red River Valley	MN 2019, ND 2019, SD 2019	MN 2008, ND 2008, SD 2008	10.5
251B	North Central Glaciated Plains	IA 2019, MN 2019, ND 2019, SD 2019	IA 2008, MN 2008, ND 2008, SD 2008	10.4
251C	Central Dissected Till Plains	IL 2019, IA 2019, KS 2018, MO 2019, NE 2019, SD 2019	IL 2008, IA 2008, KS 2008, MO 2008, NE 2008, SD 2008	10.1
251D	Central Till Plains and Grand Prairies	IL 2019, IN 2019	IL 2008, IN 2008	10.2
251E	Osage Plains	KS 2018, MO 2019, OK 2017	KS 2008, MO 2008, OK 2010	9.1
251F	Flint Hills	KS 2018, OK 2017	KS 2008, OK 2010	7.6
251H	Nebraska Rolling Hills	KS 2018, NE 2019, SD 2019	KS 2008, NE 2008, SD 2008	9.7
255A	Cross Timbers and Prairie	KS 2018, OK 2017, TX 2016	KS 2008, OK 2010, TX 2008	4.6
255B	Blackland Prairie	TX 2016	TX 2008	6.2
255C	Oak Woods and Prairie	TX 2016	TX 2008	7.1
255D	Central Gulf Prairie and Marshes	TX 2016	TX 2008	6.1
255E	Texas Cross Timbers and Prairie	OK 2017, TX 2016	OK 2010, TX 2008	6.0
261A	Central California Coast	CA 2018	CA 2010	7.4
261B	Southern California Coast	CA 2018	CA 2010	6.5
262A	Great Valley	CA 2018	CA 2010	7.2
263A	Northern California Coast	CA 2018, OR 2018	CA 2010, OR 2010	7.3
313A	Grand Canyon	AZ 2018, CO 2018, NM 2018, UT 2018	AZ 2008, CO 2008, NM 2013, UT 2008	9.1
313B	Navaho Canyonlands	AZ 2018, CO 2018, NM 2018, UT 2018	AZ 2008, CO 2008, NM 2013, UT 2008	4.1

[a] When more than one State is included in an ecosection, the mean difference value is weighted by forest in each State.

(continued)

Table A.1 *(Continued)*

Ecosection	Description	Current inventories	Previous inventories	Mean difference[a]
		State(s) and year(s)	*State(s) and year(s)*	*years*
313C	Tonto Transition	AZ 2018	AZ 2008	8.7
313D	Painted Desert	AZ 2018, NM 2018	AZ 2008, NM 2013	8.6
315A	Pecos Valley	NM 2018, TX 2016	NM 2013, TX 2008	2.9
315B	Texas High Plains	NM 2018, TX 2016	NM 2013, TX 2008	4.9
315C	Rolling Plains	OK 2017, TX 2016	OK 2010, TX 2008	5.9
315D	Edwards Plateau	TX 2016	TX 2008	6.3
315E	Rio Grande Plain	TX 2016	TX 2008	6.6
315F	Northern Texas High Plains	KS 2018, OK 2017, TX 2016	KS 2008, OK 2010, TX 2008	4.8
315G	Eastern Rolling Plains	TX 2016	TX 2008	6.1
315H	Central Rio Grande Intermontane	NM 2018	NM 2013	3.2
321A	Basin and Range	AZ 2018, NM 2018, TX 2016	AZ 2008, NM 2013, TX 2008	5.7
321B	Stockton Plateau	TX 2016	TX 2008	6.0
322A	Mojave Desert	AZ 2018, CA 2018, NV 2018, UT 2018	AZ 2008, CA 2010, NV 2012, UT 2008	7.9
322B	Sonoran Desert	AZ 2018, CA 2018	AZ 2008, CA 2010	8.5
322C	Colorado Desert	AZ 2018, CA 2018	AZ 2008, CA 2010	6.7
331A	Palouse Prairie	ID 2018, OR 2018, WA 2018	ID 2008, OR 2010, WA 2011	7.3
331B	Southern High Plains	CO 2018, KS 2018, NM 2018, OK 2017, TX 2016	CO 2008, KS 2008, NM 2013, OK 2010, TX 2008	3.7
331C	Central High Tablelands	CO 2018, KS 2018, NE 2019	CO 2008, KS 2008, NE 2008	9.8
331D	Northwestern Glaciated Plains	MT 2018	MT 2008	8.4
331E	Northeastern Glaciated Plains	MT 2018, ND 2019, SD 2019	MT 2008, ND 2008, SD 2008	7.3
331F	Western Great Plains	MT 2018, NE 2019, ND 2019, SD 2019, WY 2020	MT 2008, NE 2008, ND 2008, SD 2008, WY 2000	9.4
331G	Powder River Basin	MT 2018, WY 2020	MT 2008, WY 2000	8.3
331H	Central High Plains	CO 2018, NE 2019, WY 2020	CO 2008, NE 2008, WY 2000	7.1
331I	Arkansas Tablelands	CO 2018, KS 2018	CO 2008, KS 2008	8.1
331J	Northern Rio Grande Basin	CO 2018, NM 2018	CO 2008, NM 2013	4.3
331K	North Central Highlands	MT 2018, WY 2020	MT 2008, WY 2000	8.0
331L	Glaciated Northern Grasslands	MT 2018	MT 2008	8.3
331M	Missouri Plateau	MT 2018, ND 2019, SD 2019, WY 2020	MT 2008, ND 2008, SD 2008, WY 2000	9.4
331N	Belt Mountains	MT 2018, WY 2020	MT 2008, WY 2000	7.8
332A	Northeastern Glaciated Plains	ND 2019	ND 2008	10.1
332B	Western Glaciated Plains	ND 2019, SD 2019	ND 2008, SD 2008	10.9
332C	Nebraska Sand Hills	NE 2019, SD 2019	NE 2008, SD 2008	10.1
332D	North Central Great Plains	NE 2019, SD 2019	NE 2008, SD 2008	9.8
332E	South Central Great Plains	KS 2018, NE 2019, OK 2017	KS 2008, NE 2008, OK 2010	9.3
332F	South Central and Red Bed Plains	KS 2018, OK 2017, TX 2016	KS 2008, OK 2010, TX 2008	4.2
341A	Bonneville Basin	NV 2018, UT 2018	NV 2012, UT 2008	9.2
341B	Northern Canyonlands	CO 2018, UT 2018	CO 2008, UT 2008	9.1
341C	Uinta Basin	CO 2018, UT 2018	CO 2008, UT 2008	9.4

[a] When more than one State is included in an ecosection, the mean difference value is weighted by forest in each State.

(continued)

Table A.1 *(Continued)*

Ecosection	Description	Current inventories	Previous inventories	Mean difference[a]
		State(s) and year(s)	*State(s) and year(s)*	*years*
341D	Mono	CA 2018, NV 2018	CA 2010, NV 2012	6.1
341E	Northern Mono	NV 2018	NV 2012	4.4
341F	Southeastern Great Basin	CA 2018, NV 2018, UT 2018	CA 2010, NV 2012, UT 2008	5.9
341G	Northeastern Great Basin	ID 2018, NV 2018	ID 2008, NV 2012	5.4
342A	Bighorn Basin	MT 2018, WY 2020	MT 2008, WY 2000	8.2
342B	Northwestern Basin and Range	CA 2018, NV 2018, OR 2018	CA 2010, NV 2012, OR 2010	7.8
342C	Owyhee Uplands	ID 2018, NV 2018, OR 2018	ID 2008, NV 2012, OR 2010	7.5
342D	Snake River Basalts and Basins	ID 2018, OR 2018, WY 2020	ID 2008, OR 2010, WY 2000	7.8
342E	Bear Lake	ID 2018, UT 2018, WY 2020	ID 2008, UT 2008, WY 2000	9.9
342F	Central Basin and Hills	CO 2018, WY 2020	CO 2008, WY 2000	8.8
342G	Green River Basin	CO 2018, UT 2018, WY 2020	CO 2008, UT 2008, WY 2000	8.5
342H	Blue Mountain Foothills	ID 2018, OR 2018	ID 2008, OR 2010	8.0
342I	Columbia Basin	OR 2018, WA 2018	OR 2010, WA 2011	6.8
342J	Eastern Basin and Range	ID 2018, NV 2018, UT 2018	ID 2008, NV 2012, UT 2008	7.0
411A	Everglades	FL 2017	FL 2009	9.4
M211A	White Mountains	ME 2018, NH 2019, VT 2019	ME 2008, NH 2008, VT 2008	10
M211B	New England Piedmont	MA 2018, NH 2019, VT 2019	MA 2008, NH 2008, VT 2008	9.9
M211C	Green-Taconic-Berkshire Mountains	CT 2018, MA 2018, NY 2019, VT 2019	CT 2008, MA 2008, NY 2008, VT 2008	9.5
M211D	Adirondack Highlands	NY 2019	NY 2008	10.2
M221A	Northern Ridge and Valley	MD 2018, NJ 2018, PA 2018, TN 2017, VA 2018, WV 2018	MD 2008, NJ 2008, PA 2008, TN 2008, VA 2008, WV 2008	10.0
M221B	Allegheny Mountains	MD 2018, PA 2018, VA 2018, WV 2018	MD 2008, PA 2008, VA 2008, WV 2008	8.9
M221C	Northern Cumberland Mountains	KY 2017, TN 2017, VA 2018, WV 2018	KY 2008, TN 2008, VA 2008, WV 2008	9.4
M221D	Blue Ridge Mountains	GA 2018, MD 2018, NC 2019, PA 2018, SC 2018, TN 2017, VA 2018, WV 2018	GA 2008, MD 2008, NC 2010, PA 2008, SC 2008, TN 2008, VA 2008, WV 2008	10.3
M223A	Boston Mountains	AR 2019, OK 2017	AR 2008, OK 2010	11.3
M231A	Ouachita Mountains	AR 2019, OK 2017	AR 2008, OK 2010	9.9
M242A	Oregon and Washington Coast Ranges	OR 2018, WA 2018	OR 2010, WA 2011	6.9
M242B	Western Cascades	OR 2018, WA 2018	OR 2010, WA 2011	7.0
M242C	Eastern Cascades	OR 2018, WA 2018	OR 2010, WA 2011	7.2
M242D	Northern Cascades	WA 2018	WA 2011	6.4
M261A	Klamath Mountains	CA 2018, OR 2018	CA 2010, OR 2010	7.4
M261B	Northern California Coast Ranges	CA 2018	CA 2010	7.2
M261C	Northern California Interior Coast Ranges	CA 2018	CA 2010	8.1
M261D	Southern Cascades	CA 2018, OR 2018	CA 2010, OR 2010	7.6
M261E	Sierra Nevada	CA 2018, NV 2018	CA 2010, NV 2012	7.4
M261F	Sierra Nevada Foothills	CA 2018	CA 2010	7.6
M261G	Modoc Plateau	CA 2018, OR 2018	CA 2010, OR 2010	7.5

[a] When more than one State is included in an ecosection, the mean difference value is weighted by forest in each State.

(continued)

Table A.1 *(Continued)*

Ecosection	Description	Current inventories	Previous inventories	Mean difference[a]
		State(s) and year(s)	*State(s) and year(s)*	*years*
M262A	Central California Coast Ranges	CA 2018	CA 2010	6.9
M262B	Southern California Mountain and Valley	CA 2018	CA 2010	7.0
M313A	White Mountains - San Francisco Peaks - Mongollon Rim	AZ 2018, NM 2018	AZ 2008, NM 2013	5.9
M313B	Sacramento-Monzano Mountains	NM 2018, TX 2016	NM 2013, TX 2008	3.0
M331A	Yellowstone Highlands	ID 2018, MT 2018, WY 2020	ID 2008, MT 2008, WY 2000	8.4
M331B	Bighorn Mountains	MT 2018, WY 2020	MT 2008, WY 2000	8.4
M331D	Overthrust Mountains	ID 2018, UT 2018, WY 2020	ID 2008, UT 2008, WY 2000	9.0
M331E	Uinta Mountains	CO 2018, UT 2018, WY 2020	CO 2008, UT 2008, WY 2000	9.3
M331F	Southern Parks and Rocky Mountain Range	CO 2018, NM 2018	CO 2008, NM 2013	5.4
M331G	South Central Highlands	CO 2018, NM 2018	CO 2008, NM 2013	6.8
M331H	North Central Highlands and Rocky Mountains	CO 2018, WY 2020	CO 2008, WY 2000	8.4
M331I	Northern Parks and Ranges	CO 2018, WY 2020	CO 2008, WY 2000	8.6
M331J	Wind River Mountains	WY 2020	WY 2000	14.9
M332A	Idaho Batholith	ID 2018	ID 2008	7.5
M332B	Northern Rockies and Bitterroot Valley	MT 2018	MT 2008	7.9
M332D	Belt Mountains	MT 2018	MT 2008	7.9
M332E	Beaverhead Mountains	ID 2018, MT 2018	ID 2008, MT 2008	7.7
M332F	Challis Volcanics	ID 2018	ID 2008	7.4
M332G	Blue Mountains	ID 2018, OR 2018, WA 2018	ID 2008, OR 2010, WA 2011	7.5
M333A	Okanogan Highland	ID 2018, WA 2018	ID 2008, WA 2011	6.6
M333B	Flathead Valley	ID 2018, MT 2018	ID 2008, MT 2008	8.0
M333C	Northern Rockies	MT 2018	MT 2008	7.9
M333D	Bitterroot Mountains	ID 2018, MT 2018	ID 2008, MT 2008	7.7
M334A	Black Hills	SD 2019, WY 2020	SD 2008, WY 2000	10.1
M341A	East Great Basin and Mountains	NV 2018, UT 2018	NV 2012, UT 2008	4.8
M341B	Tavaputs Plateau	CO 2018, UT 2018	CO 2008, UT 2008	9.0
M341C	Utah High Plateau	UT 2018	UT 2008	9.4
M341D	West Great Basin and Mountains	NV 2018	NV 2012	4.6

[a] When more than one State is included in an ecosection, the mean difference value is weighted by forest in each State.

Table A.2—Summary data for forest structure (live trees ≥1 inch [2.54 cm] diameter at breast height) on all forest land by ecosection in the most current inventories (see table A.1 for identification of the ecosections)

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
211A	2,027	1,337 (52)	108 (3.1)	16 (0.5)	4.0 (2.8)	0.9 (0.6)	0.1 (0.1)
211B	2,874	1,456 (44)	116 (2.4)	18 (0.4)	2.4 (1.5)	0.1 (0.1)	0.0 (0.0)
211C	1,351	1,413 (64)	116 (3.5)	18 (0.7)	—	—	—
211D	2,642	1,018 (33)	124 (2.3)	25 (0.6)	1.4 (0.7)	0.2 (0.1)	0.0 (0.0)
211E	1,816	664 (22)	103 (3.0)	24 (0.8)	0.6 (0.4)	0.3 (0.2)	0.1 (0.1)
211F	6,161	508 (11)	121 (1.5)	33 (0.5)	5.8 (1.0)	2.5 (0.4)	0.4 (0.1)
211G	4,005	513 (17)	121 (1.8)	37 (0.6)	1.5 (0.7)	0.9 (0.5)	0.2 (0.1)
211I	1,832	558 (21)	132 (2.9)	37 (0.9)	3.3 (1.3)	1.5 (0.6)	0.3 (0.1)
211J	1,330	611 (28)	116 (3.4)	29 (1.0)	4.9 (1.6)	2.6 (0.9)	0.5 (0.2)
212H	7,468	658 (15)	102 (1.4)	21 (0.4)	7.7 (1.7)	1.5 (0.3)	0.3 (0.1)
212J	1,763	805 (27)	121 (2.2)	25 (0.6)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
212K	2,912	745 (19)	83 (1.3)	16 (0.3)	0.4 (0.3)	0.2 (0.1)	0.0 (0.0)
212L	4,944	1,017 (19)	88 (1.2)	14 (0.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
212M	3,421	993 (22)	77 (1.6)	10 (0.2)	—	—	—
212N	5,062	778 (14)	85 (1.0)	15 (0.2)	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)
212Q	1,481	666 (25)	94 (1.9)	21 (0.6)	0.3 (0.2)	0.2 (0.1)	0.0 (0.0)
212R	3,158	925 (28)	109 (2.2)	18 (0.4)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
212S	2,381	757 (27)	111 (2.4)	23 (0.6)	0.4 (0.4)	0.1 (0.1)	0.0 (0.0)
212T	3,440	800 (22)	110 (2.0)	20 (0.4)	1.5 (0.6)	0.3 (0.1)	0.1 (0.0)
212X	5,743	779 (14)	95 (1.0)	19 (0.3)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
212Y	928	901 (40)	103 (2.9)	20 (0.7)	—	—	—
212Z	329	533 (32)	112 (4.6)	25 (1.2)	5.7 (3.8)	1.9 (1.3)	0.3 (0.2)
221A	7,678	513 (10)	126 (1.4)	35 (0.4)	3.3 (0.7)	0.5 (0.1)	0.1 (0.0)
221B	1,560	419 (15)	119 (3.2)	36 (1.0)	7.2 (2.3)	1.2 (0.4)	0.2 (0.1)
221D	2,022	393 (26)	123 (2.8)	40 (1.1)	9.8 (1.6)	2.0 (0.3)	0.4 (0.1)
221E	12,709	464 (7)	102 (0.9)	31 (0.3)	6.8 (0.8)	1.0 (0.1)	0.2 (0.0)
221F	2,718	455 (15)	112 (2.5)	33 (0.9)	4.5 (1.3)	2.3 (0.7)	0.4 (0.1)
221H	5,856	678 (13)	105 (1.2)	30 (0.4)	2.5 (0.7)	0.2 (0.1)	0.0 (0.0)
221J	2,079	592 (22)	99 (2.2)	29 (0.8)	8.7 (2.7)	0.8 (0.2)	0.2 (0.0)
222H	2,136	471 (15)	107 (2.5)	31 (0.9)	7.2 (1.9)	0.9 (0.2)	0.2 (0.0)
222I	2,258	497 (18)	109 (2.8)	31 (0.9)	8.4 (2.2)	2.1 (0.5)	0.4 (0.1)
222J	3,344	423 (12)	100 (2.2)	26 (0.7)	13.4 (2.2)	2.8 (0.4)	0.5 (0.1)
222K	1,721	389 (13)	94 (2.0)	22 (0.6)	6.7 (1.3)	1.3 (0.2)	0.2 (0.0)
222L	3,880	464 (10)	95 (1.3)	23 (0.4)	3.0 (0.5)	0.4 (0.1)	0.1 (0.0)
222M	1,728	477 (16)	96 (2.2)	22 (0.6)	5.6 (1.3)	1.2 (0.3)	0.2 (0.1)
222N	470	778 (47)	66 (3.0)	10 (0.6)	—	—	—

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.2 *(Continued)*

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		------ (sampling error) ------					
		All species			Nonnative species		
222R	1,222	635 (27)	82 (2.1)	17 (0.5)	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)
222U	925	468 (25)	96 (4.0)	25 (1.2)	8.2 (2.0)	1.6 (0.4)	0.3 (0.1)
223A	15,509	561 (6)	92 (0.6)	21 (0.2)	0.8 (0.3)	0.1 (0.0)	0.0 (0.0)
223B	1,621	455 (16)	108 (2.3)	31 (0.8)	0.7 (0.4)	0.3 (0.2)	0.1 (0.1)
223D	3,770	506 (12)	103 (1.5)	28 (0.5)	1.9 (0.5)	0.3 (0.1)	0.1 (0.0)
223E	6,663	567 (11)	102 (1.1)	29 (0.4)	6.2 (0.9)	1.0 (0.1)	0.2 (0.0)
223F	2,540	496 (15)	97 (1.8)	24 (0.6)	2.5 (1.0)	0.2 (0.1)	0.0 (0.0)
223G	1,968	425 (15)	105 (2.3)	27 (0.7)	1.0 (0.3)	0.2 (0.1)	0.0 (0.0)
231A	12,517	718 (11)	104 (1.0)	27 (0.3)	2.9 (0.5)	0.2 (0.0)	0.0 (0.0)
231B	13,706	760 (11)	100 (1.0)	25 (0.3)	2.6 (0.5)	0.2 (0.0)	0.0 (0.0)
231C	3,493	726 (22)	100 (1.7)	26 (0.6)	3.5 (1.1)	0.4 (0.1)	0.1 (0.0)
231D	3,228	729 (24)	96 (1.9)	25 (0.6)	1.5 (1.0)	0.1 (0.1)	0.0 (0.0)
231E	15,255	659 (10)	90 (0.9)	21 (0.3)	3.6 (0.6)	0.2 (0.0)	0.0 (0.0)
231G	2,961	540 (16)	81 (1.7)	18 (0.5)	0.5 (0.4)	0.0 (0.0)	0.0 (0.0)
231H	9,091	676 (13)	106 (1.2)	28 (0.4)	2.0 (0.4)	0.2 (0.0)	0.0 (0.0)
231I	12,281	877 (14)	117 (1.1)	30 (0.4)	4.4 (0.7)	0.4 (0.1)	0.1 (0.0)
232A	1,860	513 (19)	117 (2.4)	31 (0.8)	1.7 (0.7)	0.6 (0.2)	0.1 (0.1)
232B	19,831	599 (8)	87 (0.8)	21 (0.2)	7.0 (0.9)	0.6 (0.1)	0.1 (0.0)
232C	13,533	629 (11)	90 (1.2)	22 (0.3)	2.7 (0.7)	0.2 (0.1)	0.0 (0.0)
232D	2,132	389 (21)	89 (3.5)	19 (0.9)	5.4 (2.5)	0.4 (0.2)	0.1 (0.0)
232E	1,582	681 (32)	102 (3.5)	22 (1.0)	187.5 (20.2)	11.3 (1.2)	1.8 (0.2)
232F	9,970	633 (12)	87 (1.1)	20 (0.3)	32.8 (3.0)	1.6 (0.1)	0.2 (0.0)
232G	2,436	439 (23)	84 (3.0)	17 (0.7)	2.7 (1.5)	0.2 (0.1)	0.0 (0.0)
232H	5,693	850 (21)	124 (1.8)	31 (0.6)	2.2 (0.6)	0.2 (0.1)	0.0 (0.0)
232I	3,388	794 (25)	104 (2.6)	24 (0.8)	0.2 (0.1)	0.0 (0.0)	0.0 (0.0)
232J	13,048	618 (11)	88 (1.1)	21 (0.3)	3.6 (0.6)	0.3 (0.0)	0.1 (0.0)
232K	2,449	434 (17)	85 (2.8)	22 (0.8)	6.1 (2.2)	0.3 (0.1)	0.1 (0.0)
232L	4,648	506 (15)	83 (2.0)	20 (0.6)	15.8 (2.7)	1.0 (0.2)	0.2 (0.0)
234A	2,679	486 (23)	89 (2.7)	23 (0.8)	26.6 (6.3)	2.0 (0.5)	0.4 (0.1)
234C	1,534	533 (29)	103 (3.4)	24 (0.9)	29.0 (6.5)	3.5 (0.7)	0.7 (0.2)
234D	2,758	410 (15)	102 (3.0)	28 (1.0)	1.2 (0.5)	0.2 (0.1)	0.0 (0.0)
234E	1,101	467 (26)	99 (4.1)	26 (1.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
242A	1,983	358 (21)	155 (5.1)	45 (2.0)	0.1 (0.1)	0.2 (0.2)	0.0 (0.0)
242B	1,093	247 (14)	128 (5.9)	41 (2.5)	2.5 (1.0)	0.5 (0.2)	0.1 (0.0)
251A	207	431 (57)	101 (6.3)	21 (1.6)	5.5 (3.4)	2.1 (1.2)	0.5 (0.3)
251B	633	365 (25)	100 (4.5)	23 (1.3)	15.2 (3.9)	3.4 (0.8)	0.8 (0.2)
251C	5,725	382 (8)	93 (1.3)	23 (0.4)	7.6 (1.2)	1.2 (0.2)	0.2 (0.0)
251D	737	377 (21)	112 (4.1)	29 (1.3)	8.8 (2.7)	1.7 (0.5)	0.3 (0.1)

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.2 *(Continued)*

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
251E	1,604	370 (14)	84 (2.4)	20 (0.7)	1.5 (0.7)	0.2 (0.1)	0.0 (0.0)
251F	455	330 (32)	71 (5.2)	15 (1.4)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
251H	758	320 (21)	88 (4.3)	20 (1.1)	12.6 (3.6)	2.6 (0.7)	0.6 (0.2)
255A	5,366	408 (12)	59 (1.2)	11 (0.3)	1.2 (0.4)	0.2 (0.1)	0.0 (0.0)
255B	1,799	466 (25)	57 (2.2)	10 (0.5)	5.6 (2.0)	0.2 (0.1)	0.0 (0.0)
255C	4,385	363 (12)	60 (1.3)	12 (0.3)	1.9 (0.5)	0.2 (0.0)	0.0 (0.0)
255D	1,907	292 (23)	47 (2.3)	8 (0.5)	42.4 (9.0)	3.0 (0.6)	0.5 (0.1)
255E	3,344	351 (15)	58 (2.0)	7 (0.3)	0.9 (0.5)	0.0 (0.0)	0.0 (0.0)
261A	837	345 (48)	165 (11.5)	49 (4.1)	0.0 (0.0)	0.1 (0.1)	0.0 (0.0)
261B	93	186 (102)	57 (11.0)	13 (2.8)	1.2 (1.2)	0.2 (0.2)	0.0 (0.0)
262A	89	176 (94)	56 (11.1)	16 (3.0)	—	—	—
263A	2,706	601 (22)	221 (5.8)	63 (2.6)	—	—	—
313A	6,713	276 (12)	86 (1.6)	7 (0.2)	—	—	—
313B	7,049	342 (12)	81 (1.4)	7 (0.2)	—	—	—
313C	3,330	198 (8)	68 (2.0)	6 (0.3)	—	—	—
313D	1,662	142 (10)	72 (2.8)	5 (0.3)	—	—	—
315A	1,487	77 (9)	27 (2.4)	1 (0.1)	—	—	—
315B	3,070	96 (6)	17 (1.3)	1 (0.1)	0.6 (0.3)	0.1 (0.1)	0.0 (0.0)
315C	9,503	164 (5)	29 (0.7)	2 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
315D	9,728	304 (10)	49 (1.1)	5 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
315E	7,718	216 (9)	29 (0.8)	3 (0.1)	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)
315F	711	147 (25)	23 (2.4)	2 (0.3)	3.0 (1.6)	0.8 (0.4)	0.1 (0.1)
315G	3,382	291 (17)	45 (1.6)	5 (0.2)	0.2 (0.2)	0.0 (0.0)	0.0 (0.0)
315H	392	96 (16)	55 (4.4)	3 (0.4)	—	—	—
321A	8,558	92 (5)	19 (0.7)	1 (0.1)	—	—	—
321B	4,365	198 (10)	23 (0.9)	1 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
322A	2,165	159 (10)	61 (2.7)	4 (0.2)	—	—	—
322B	325	89 (18)	25 (3.2)	2 (0.3)	—	—	—
322C	9	3 (2)	10 (6.6)	1 (0.6)	—	—	—
331A	671	210 (24)	70 (4.5)	15 (1.2)	—	—	—
331B	595	325 (56)	57 (4.1)	4 (0.4)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
331C	22	296 (83)	95 (24.7)	18 (5.8)	29.5 (18.2)	2.1 (1.2)	0.3 (0.2)
331D	88	422 (177)	55 (12.6)	6 (1.5)	—	—	—
331E	67	310 (102)	57 (9.9)	10 (1.9)	0.5 (0.5)	0.1 (0.1)	0.0 (0.0)
331F	787	209 (25)	55 (3.5)	8 (0.6)	4.2 (2.8)	0.7 (0.5)	0.1 (0.1)
331G	1,370	186 (16)	43 (2.7)	5 (0.4)	—	—	—

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.2 *(Continued)*

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
331H	97	120 (29)	50 (9.5)	6 (1.4)	—	—	—
331I	943	381 (50)	83 (4.8)	6 (0.5)	0.7 (0.7)	0.2 (0.2)	0.0 (0.0)
331J	514	240 (36)	59 (4.5)	4 (0.5)	—	—	—
331K	1,796	253 (18)	47 (2.1)	5 (0.3)	—	—	—
331L	21	60 (26)	47 (12.5)	8 (2.6)	—	—	—
331M	529	361 (35)	60 (4.4)	8 (0.9)	—	—	—
331N	299	235 (73)	47 (6.2)	5 (1.0)	—	—	—
332A	267	461 (51)	76 (6.2)	14 (1.5)	2.1 (1.6)	0.8 (0.5)	0.1 (0.1)
332B	39	108 (26)	47 (9.9)	9 (2.0)	36.0 (13.9)	19.2 (7.2)	3.9 (1.5)
332C	442	258 (28)	68 (6.4)	12 (1.6)	3.3 (1.5)	1.5 (0.6)	0.3 (0.2)
332D	280	367 (47)	81 (7.1)	15 (1.6)	2.3 (1.3)	1.1 (0.6)	0.2 (0.1)
332E	591	269 (18)	91 (6.1)	20 (1.5)	16.3 (7.8)	3.9 (1.9)	0.8 (0.4)
332F	1,108	244 (20)	43 (2.8)	6 (0.5)	9.5 (3.0)	2.2 (0.7)	0.4 (0.1)
341A	2,446	257 (22)	84 (3.0)	5 (0.2)	—	—	—
341B	4,594	370 (23)	87 (2.0)	7 (0.3)	—	—	—
341C	306	143 (13)	109 (12.5)	6 (0.7)	—	—	—
341D	1,490	157 (13)	83 (4.1)	7 (0.5)	—	—	—
341E	305	113 (21)	56 (6.4)	3 (0.4)	—	—	—
341F	2,948	261 (13)	77 (2.2)	5 (0.2)	—	—	—
341G	173	494 (99)	58 (7.7)	5 (1.0)	—	—	—
342A	250	172 (21)	77 (7.8)	4 (0.7)	—	—	—
342B	825	126 (21)	43 (2.9)	3 (0.2)	—	—	—
342C	392	142 (18)	55 (5.7)	5 (0.7)	—	—	—
342D	272	476 (68)	70 (6.4)	10 (1.5)	—	—	—
342E	91	291 (93)	99 (19.8)	8 (2.1)	—	—	—
342F	340	193 (28)	58 (6.8)	5 (0.9)	—	—	—
342G	427	163 (34)	106 (10.7)	6 (0.7)	—	—	—
342H	1,972	118 (7)	43 (1.8)	6 (0.4)	—	—	—
342I	438	220 (26)	70 (5.1)	14 (1.3)	—	—	—
342J	749	213 (18)	73 (5.2)	6 (0.6)	—	—	—
411A	1,175	623 (42)	89 (4.8)	14 (0.9)	12.9 (6.1)	0.9 (0.4)	0.2 (0.1)
M211A	9,696	1,432 (29)	115 (1.2)	21 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
M211B	3,228	721 (22)	134 (2.1)	33 (0.6)	0.9 (0.4)	0.4 (0.2)	0.1 (0.0)
M211C	2,940	660 (16)	134 (2.0)	37 (0.6)	0.8 (0.5)	0.2 (0.1)	0.0 (0.0)
M211D	5,446	847 (18)	123 (1.5)	30 (0.4)	2.9 (0.9)	1.0 (0.3)	0.2 (0.1)
M221A	9,967	485 (8)	111 (0.9)	32 (0.4)	6.2 (0.8)	0.9 (0.1)	0.2 (0.0)

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.2 *(Continued)*

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
M221B	5,066	555 (15)	122 (1.5)	36 (0.6)	4.3 (1.3)	0.8 (0.2)	0.1 (0.0)
M221C	6,135	610 (12)	113 (1.3)	33 (0.5)	6.6 (1.0)	0.9 (0.1)	0.2 (0.0)
M221D	8,606	531 (9)	131 (1.1)	38 (0.4)	2.0 (0.3)	0.4 (0.1)	0.1 (0.0)
M223A	3,065	583 (16)	93 (1.4)	23 (0.5)	1.2 (0.5)	0.1 (0.0)	0.0 (0.0)
M231A	5,699	679 (16)	89 (1.3)	19 (0.3)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
M242A	9,426	367 (10)	173 (2.4)	55 (1.0)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
M242B	10,349	428 (8)	188 (2.0)	58 (0.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
M242C	5,557	440 (13)	97 (1.8)	20 (0.5)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
M242D	5,502	467 (16)	148 (3.0)	39 (1.0)	—	—	—
M261A	7,861	443 (11)	148 (2.3)	43 (0.9)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
M261B	2,483	455 (24)	147 (4.8)	44 (2.0)	—	—	—
M261C	640	262 (45)	47 (2.6)	10 (0.7)	—	—	—
M261D	3,813	322 (14)	120 (3.3)	26 (0.9)	—	—	—
M261E	9,843	311 (9)	145 (2.3)	34 (0.7)	—	—	—
M261F	1,941	227 (20)	51 (2.2)	12 (0.6)	0.5 (0.4)	0.0 (0.0)	0.0 (0.0)
M261G	2,924	167 (8)	74 (2.4)	12 (0.5)	—	—	—
M262A	950	133 (12)	60 (3.3)	13 (1.0)	—	—	—
M262B	1,016	228 (35)	59 (4.6)	10 (1.1)	—	—	—
M313A	9,163	264 (7)	82 (1.3)	10 (0.3)	—	—	—
M313B	4,210	278 (13)	72 (1.8)	5 (0.2)	—	—	—
M331A	5,860	500 (21)	76 (2.0)	13 (0.4)	—	—	—
M331B	1,225	505 (37)	105 (4.5)	17 (0.9)	—	—	—
M331D	5,518	515 (19)	84 (2.0)	15 (0.5)	—	—	—
M331E	2,486	424 (22)	93 (3.0)	10 (0.4)	—	—	—
M331F	4,584	568 (23)	103 (2.0)	13 (0.4)	—	—	—
M331G	5,105	423 (14)	98 (2.1)	16 (0.5)	—	—	—
M331H	3,604	569 (25)	100 (2.7)	15 (0.6)	—	—	—
M331I	7,965	498 (13)	91 (1.6)	14 (0.3)	—	—	—
M331J	777	449 (39)	80 (5.3)	11 (0.9)	—	—	—
M332A	8,582	261 (8)	80 (1.8)	18 (0.5)	—	—	—
M332B	3,934	431 (20)	78 (2.3)	14 (0.5)	—	—	—
M332D	3,983	487 (19)	86 (2.1)	12 (0.4)	—	—	—
M332E	3,429	447 (19)	93 (2.4)	15 (0.5)	—	—	—
M332F	1,902	260 (19)	60 (3.2)	10 (0.7)	—	—	—
M332G	6,605	337 (10)	90 (1.3)	19 (0.4)	—	—	—
M333A	5,841	435 (14)	99 (1.8)	22 (0.5)	—	—	—

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Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.2 ***(Continued)***

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
M333B	4,099	519 (22)	101 (2.6)	21 (0.7)	—	—	—
M333C	4,206	542 (23)	91 (2.5)	17 (0.6)	—	—	—
M333D	5,858	453 (14)	122 (2.5)	29 (0.7)	—	—	—
M334A	1,884	326 (17)	67 (1.9)	11 (0.4)	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)
M341A	4,597	272 (8)	94 (2.1)	6 (0.2)	—	—	—
M341B	3,381	321 (17)	92 (2.7)	8 (0.2)	—	—	—
M341C	3,493	530 (26)	92 (2.3)	10 (0.3)	—	—	—
M341D	1,533	205 (13)	75 (2.7)	5 (0.2)	—	—	—
All of CONUS	682,202	520 (1.5)	96 (0.17)	22 (0.05)	3.3 (0.12)	0.38 (0.012)	0.068 (0.0021)

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

Table A.3—Summary data for forest structure on all forest land (live trees ≥1 inch [2.54 cm] diameter at breast height) by ecosection in inventories previous to the most current, which ranged from 3 to 15 years apart (see table A.1 for identification of the ecosections)

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
211A	2,044	1,397 (61)	98 (2.7)	15 (0.5)	4.8 (3.5)	0.7 (0.5)	0.1 (0.1)
211B	2,973	1,406 (43)	102 (2.2)	17 (0.4)	1.0 (0.9)	0.1 (0.1)	0.0 (0.0)
211C	1,325	1,335 (70)	100 (3.2)	16 (0.6)	—	—	—
211D	2,743	1,045 (33)	111 (2.1)	22 (0.5)	0.8 (0.5)	0.1 (0.1)	0.0 (0.0)
211E	1,776	762 (30)	99 (3.1)	22 (0.8)	1.8 (1.3)	0.4 (0.3)	0.1 (0.1)
211F	6,158	575 (12)	116 (1.7)	32 (0.5)	7.9 (1.4)	2.6 (0.5)	0.4 (0.1)
211G	4,067	491 (17)	115 (1.7)	35 (0.6)	1.1 (0.7)	0.5 (0.3)	0.1 (0.1)
211I	1,797	605 (25)	132 (3.2)	37 (1.0)	3.3 (1.5)	1.2 (0.5)	0.2 (0.1)
211J	1,493	663 (27)	120 (3.6)	30 (1.0)	3.8 (1.5)	1.6 (0.6)	0.3 (0.1)
212H	7,414	685 (10)	98 (0.9)	20 (0.2)	5.4 (0.8)	1.0 (0.2)	0.2 (0.0)
212J	1,777	764 (20)	112 (1.8)	23 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
212K	2,775	706 (20)	82 (1.4)	16 (0.3)	0.5 (0.3)	0.1 (0.1)	0.0 (0.0)
212L	4,797	838 (16)	76 (1.2)	12 (0.2)	—	—	—
212M	3,197	920 (23)	70 (1.5)	10 (0.2)	—	—	—
212N	4,987	744 (15)	77 (1.1)	14 (0.2)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
212Q	1,399	663 (24)	87 (2.0)	19 (0.5)	0.7 (0.4)	0.2 (0.1)	0.0 (0.0)
212R	3,136	885 (19)	105 (1.5)	18 (0.3)	0.2 (0.2)	0.0 (0.0)	0.0 (0.0)
212S	2,298	740 (16)	109 (1.6)	23 (0.4)	0.4 (0.2)	0.0 (0.0)	0.0 (0.0)
212T	3,406	803 (17)	103 (1.5)	19 (0.3)	0.9 (0.4)	0.1 (0.1)	0.0 (0.0)
212X	5,741	757 (13)	91 (1.0)	18 (0.3)	0.4 (0.2)	0.1 (0.0)	0.0 (0.0)
212Y	962	883 (37)	93 (2.6)	18 (0.6)	—	—	—
212Z	346	650 (40)	111 (4.8)	24 (1.2)	2.3 (2.5)	0.7 (0.7)	0.1 (0.1)
221A	7,652	550 (11)	119 (1.3)	32 (0.4)	3.1 (0.7)	0.3 (0.1)	0.0 (0.0)
221B	1,606	501 (19)	114 (3.6)	33 (1.1)	6.6 (2.5)	0.7 (0.3)	0.1 (0.0)
221D	2,048	412 (16)	115 (2.5)	36 (1.0)	9.0 (1.8)	1.5 (0.3)	0.3 (0.1)
221E	12,911	491 (7)	96 (0.8)	28 (0.3)	8.9 (1.0)	0.9 (0.1)	0.1 (0.0)
221F	2,952	493 (16)	103 (2.2)	30 (0.8)	4.7 (1.4)	1.8 (0.5)	0.3 (0.1)
221H	5,998	594 (12)	95 (1.2)	27 (0.4)	2.0 (0.6)	0.1 (0.0)	0.0 (0.0)
221J	2,045	547 (20)	93 (2.2)	26 (0.8)	3.7 (1.1)	0.6 (0.2)	0.1 (0.0)
222H	2,081	495 (15)	101 (2.4)	29 (0.9)	6.5 (2.0)	0.7 (0.2)	0.1 (0.0)
222I	2,372	557 (21)	103 (2.9)	28 (0.9)	8.8 (2.8)	1.7 (0.5)	0.3 (0.1)
222J	3,206	513 (10)	99 (1.4)	25 (0.4)	9.0 (1.4)	1.7 (0.3)	0.3 (0.0)
222K	1,623	437 (16)	89 (2.1)	20 (0.6)	7.1 (1.8)	1.0 (0.3)	0.2 (0.0)
222L	3,961	487 (10)	90 (1.3)	21 (0.4)	0.7 (0.2)	0.1 (0.0)	0.0 (0.0)

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.3 *(Continued)*

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
222M	1,591	491 (17)	92 (2.3)	20 (0.6)	1.5 (0.5)	0.3 (0.1)	0.1 (0.0)
222N	415	817 (51)	60 (2.7)	9 (0.5)	—	—	—
222R	1,233	571 (23)	76 (2.0)	15 (0.5)	0.6 (0.3)	0.1 (0.0)	0.0 (0.0)
222U	808	590 (28)	98 (2.9)	25 (1.0)	7.3 (2.6)	1.5 (0.5)	0.3 (0.1)
223A	14,751	620 (7)	92 (0.7)	21 (0.2)	0.6 (0.2)	0.1 (0.0)	0.0 (0.0)
223B	1,599	509 (17)	104 (2.0)	28 (0.7)	1.4 (0.7)	0.4 (0.2)	0.1 (0.0)
223D	3,699	490 (13)	97 (1.5)	26 (0.5)	1.8 (0.5)	0.2 (0.0)	0.0 (0.0)
223E	6,636	561 (10)	96 (1.1)	27 (0.4)	7.9 (1.0)	0.8 (0.1)	0.2 (0.0)
223F	2,551	508 (14)	93 (1.7)	23 (0.6)	2.2 (0.9)	0.2 (0.1)	0.0 (0.0)
223G	1,832	448 (16)	96 (2.3)	24 (0.7)	0.8 (0.4)	0.1 (0.0)	0.0 (0.0)
231A	12,909	784 (12)	94 (0.9)	22 (0.3)	2.4 (0.6)	0.1 (0.0)	0.0 (0.0)
231B	13,655	794 (12)	96 (1.2)	23 (0.4)	1.0 (0.3)	0.1 (0.0)	0.0 (0.0)
231C	3,475	750 (25)	90 (1.7)	22 (0.6)	2.5 (0.8)	0.2 (0.1)	0.0 (0.0)
231D	3,268	739 (27)	89 (1.8)	22 (0.6)	1.6 (1.0)	0.1 (0.1)	0.0 (0.0)
231E	15,157	709 (11)	96 (1.3)	23 (0.4)	1.8 (0.4)	0.1 (0.0)	0.0 (0.0)
231G	3,017	577 (20)	87 (2.4)	18 (0.7)	1.0 (0.5)	0.0 (0.0)	0.0 (0.0)
231H	9,084	730 (14)	108 (1.7)	28 (0.6)	1.9 (0.4)	0.1 (0.0)	0.0 (0.0)
231I	12,180	865 (14)	104 (1.1)	25 (0.3)	4.4 (0.8)	0.3 (0.0)	0.0 (0.0)
232A	1,971	559 (26)	108 (2.7)	28 (0.8)	6.9 (2.4)	0.5 (0.2)	0.1 (0.0)
232B	19,985	655 (9)	90 (1.1)	21 (0.3)	4.4 (0.8)	0.3 (0.0)	0.0 (0.0)
232C	13,761	727 (12)	92 (1.3)	20 (0.3)	2.0 (0.6)	0.2 (0.0)	0.0 (0.0)
232D	2,203	428 (21)	110 (5.6)	23 (1.4)	14.9 (4.8)	0.9 (0.3)	0.1 (0.0)
232E	1,508	645 (33)	121 (6.6)	28 (2.0)	137.6 (17.9)	8.4 (1.0)	1.3 (0.2)
232F	9,949	706 (14)	98 (1.7)	24 (0.6)	25.6 (3.1)	1.1 (0.1)	0.2 (0.0)
232G	2,450	468 (22)	103 (5.1)	22 (1.4)	6.3 (3.0)	0.3 (0.1)	0.0 (0.0)
232H	5,722	849 (20)	109 (1.8)	26 (0.5)	1.5 (0.4)	0.1 (0.0)	0.0 (0.0)
232I	3,351	797 (27)	97 (2.5)	22 (0.7)	0.4 (0.4)	0.0 (0.0)	0.0 (0.0)
232J	13,070	686 (12)	85 (1.1)	19 (0.3)	3.0 (0.6)	0.2 (0.0)	0.0 (0.0)
232K	2,559	537 (23)	114 (5.4)	29 (1.7)	3.8 (1.4)	0.1 (0.1)	0.0 (0.0)
232L	4,642	626 (18)	103 (3.5)	23 (1.0)	14.8 (3.1)	0.8 (0.2)	0.1 (0.0)
234A	2,400	484 (22)	133 (6.0)	37 (1.9)	9.7 (2.8)	0.9 (0.2)	0.2 (0.0)
234C	1,337	591 (30)	156 (8.3)	39 (2.5)	28.8 (8.6)	2.4 (0.7)	0.4 (0.1)
234D	2,532	435 (18)	134 (5.8)	38 (1.9)	0.7 (0.4)	0.1 (0.0)	0.0 (0.0)
234E	1,060	543 (34)	128 (13.3)	34 (3.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
242A	1,991	371 (22)	145 (5.0)	42 (1.9)	0.1 (0.1)	0.2 (0.2)	0.0 (0.0)
242B	1,078	238 (16)	108 (5.8)	35 (2.3)	0.4 (0.3)	0.2 (0.1)	0.0 (0.0)

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.3 *(Continued)*

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
251A	202	536 (103)	84 (6.9)	17 (1.7)	7.2 (4.3)	1.3 (0.8)	0.2 (0.1)
251B	555	447 (37)	99 (5.3)	22 (1.4)	4.7 (2.2)	0.9 (0.4)	0.2 (0.1)
251C	5,606	405 (10)	85 (1.3)	20 (0.4)	1.6 (0.4)	0.3 (0.1)	0.0 (0.0)
251D	817	419 (28)	106 (4.4)	27 (1.3)	0.7 (0.4)	0.4 (0.2)	0.1 (0.0)
251E	1,479	396 (24)	83 (3.1)	19 (0.8)	0.3 (0.2)	0.2 (0.1)	0.0 (0.0)
251F	420	356 (92)	65 (7.1)	13 (1.5)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
251H	759	307 (26)	80 (3.7)	18 (1.0)	6.4 (2.1)	2.1 (0.7)	0.5 (0.1)
255A	5,699	420 (24)	58 (2.5)	10 (0.5)	0.8 (0.3)	0.2 (0.1)	0.0 (0.0)
255B	1,505	487 (37)	63 (3.5)	11 (0.8)	6.8 (4.6)	0.2 (0.2)	0.0 (0.0)
255C	4,492	381 (15)	65 (1.6)	13 (0.4)	1.6 (0.5)	0.1 (0.0)	0.0 (0.0)
255D	1,898	310 (28)	55 (3.5)	10 (0.9)	38.8 (11.0)	2.9 (0.8)	0.4 (0.1)
255E	3,324	343 (22)	57 (2.9)	7 (0.5)	0.6 (0.4)	0.1 (0.1)	0.0 (0.0)
261A	883	360 (48)	154 (10.6)	44 (3.7)	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)
261B	125	137 (39)	67 (9.3)	15 (2.4)	6.8 (7.0)	2.4 (2.4)	0.5 (0.6)
262A	103	166 (96)	51 (10.9)	14 (3.0)	—	—	—
263A	2,752	570 (22)	195 (5.7)	54 (2.6)	—	—	—
313A	6,604	312 (16)	87 (1.8)	8 (0.3)	—	—	—
313B	7,115	365 (15)	81 (1.6)	8 (0.3)	—	—	—
313C	3,336	199 (10)	68 (2.4)	6 (0.3)	—	—	—
313D	1,773	143 (13)	70 (3.1)	5 (0.3)	—	—	—
315A	1,624	76 (9)	25 (2.4)	1 (0.1)	—	—	—
315B	2,965	132 (11)	19 (1.6)	1 (0.1)	0.6 (0.5)	0.0 (0.0)	0.0 (0.0)
315C	9,219	188 (8)	31 (1.0)	2 (0.1)	—	—	—
315D	9,938	296 (13)	47 (1.5)	5 (0.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
315E	8,577	198 (9)	27 (1.0)	3 (0.2)	—	—	—
315F	870	216 (65)	26 (4.3)	3 (0.7)	3.5 (2.2)	2.1 (1.4)	0.3 (0.2)
315G	3,175	286 (22)	47 (2.4)	5 (0.3)	—	—	—
315H	369	112 (21)	57 (5.1)	3 (0.4)	—	—	—
321A	8,593	124 (8)	21 (1.0)	2 (0.1)	—	—	—
321B	4,635	191 (10)	25 (1.3)	1 (0.1)	—	—	—
322A	2,247	155 (10)	59 (2.9)	4 (0.2)	—	—	—
322B	327	77 (14)	25 (3.7)	2 (0.3)	—	—	—
322C	48	17 (11)	8 (1.9)	1 (0.2)	—	—	—
331A	635	241 (38)	71 (6.5)	14 (1.6)	—	—	—
331B	633	343 (86)	57 (6.3)	4 (0.5)	—	—	—
331C	22	166 (51)	82 (14.9)	16 (3.6)	1.7 (1.7)	0.5 (0.5)	0.0 (0.0)

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.3 ***(Continued)***

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
331D	91	494 (168)	80 (17.2)	9 (2.1)	—	—	—
331E	45	72 (32)	26 (10.3)	5 (2.0)	—	—	—
331F	865	227 (23)	59 (3.4)	8 (0.7)	4.0 (2.5)	0.6 (0.4)	0.1 (0.1)
331G	1,470	247 (29)	48 (3.3)	5 (0.5)	—	—	—
331H	81	157 (42)	70 (16.4)	10 (2.7)	—	—	—
331I	875	483 (71)	86 (6.9)	6 (0.6)	1.0 (1.0)	0.0 (0.0)	0.0 (0.0)
331J	521	279 (41)	60 (4.7)	4 (0.5)	—	—	—
331K	1,925	260 (23)	47 (2.8)	5 (0.5)	—	—	—
331L	24	46 (24)	38 (19.8)	6 (3.3)	—	—	—
331M	434	337 (42)	58 (5.0)	8 (1.0)	4.0 (3.3)	0.7 (0.6)	0.1 (0.1)
331N	275	263 (55)	61 (8.2)	6 (1.1)	—	—	—
332A	279	515 (58)	74 (5.7)	13 (1.2)	2.4 (1.9)	0.6 (0.5)	0.1 (0.1)
332B	38	244 (104)	62 (10.9)	12 (2.6)	33.7 (12.1)	14.0 (5.0)	2.5 (0.9)
332C	349	256 (28)	71 (8.6)	14 (2.5)	3.5 (1.6)	1.0 (0.4)	0.2 (0.1)
332D	279	368 (52)	78 (5.7)	14 (1.3)	0.3 (0.2)	0.1 (0.1)	0.0 (0.0)
332E	480	250 (19)	94 (8.0)	21 (2.1)	15.7 (7.9)	3.4 (1.8)	0.7 (0.4)
332F	1,179	243 (42)	44 (5.1)	6 (0.8)	6.2 (3.0)	2.2 (1.0)	0.4 (0.2)
341A	2,446	321 (29)	86 (3.1)	5 (0.2)	—	—	—
341B	4,607	410 (28)	90 (2.4)	7 (0.3)	—	—	—
341C	329	170 (14)	130 (15.0)	7 (0.9)	—	—	—
341D	1,528	179 (15)	84 (4.0)	7 (0.5)	—	—	—
341E	292	128 (24)	59 (6.9)	3 (0.4)	—	—	—
341F	3,002	289 (17)	78 (2.3)	5 (0.2)	—	—	—
341G	180	524 (125)	61 (8.3)	6 (1.0)	—	—	—
342A	347	166 (18)	64 (6.3)	4 (0.6)	—	—	—
342B	966	107 (18)	41 (3.0)	3 (0.2)	—	—	—
342C	393	146 (33)	42 (6.3)	4 (0.7)	—	—	—
342D	223	398 (75)	71 (9.8)	9 (2.2)	—	—	—
342E	88	418 (119)	75 (11.2)	8 (2.0)	—	—	—
342F	380	239 (46)	54 (6.6)	4 (0.8)	—	—	—
342G	573	234 (48)	104 (8.3)	7 (0.7)	—	—	—
342H	2,172	106 (7)	38 (1.8)	5 (0.3)	—	—	—
342I	476	238 (27)	65 (4.8)	12 (1.1)	—	—	—
342J	773	235 (25)	74 (6.3)	6 (1.0)	—	—	—
411A	1,167	674 (50)	95 (5.8)	14 (1.0)	53.3 (18.7)	2.8 (1.0)	0.4 (0.1)
M211A	9,609	1,373 (30)	104 (1.1)	20 (0.3)	—	—	—

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.3 *(Continued)*

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		---------- *(sampling error)* ----------					
		All species			Nonnative species		
M211B	3,375	722 (20)	124 (2.0)	30 (0.6)	1.2 (0.6)	0.3 (0.2)	0.1 (0.0)
M211C	2,954	688 (17)	128 (1.8)	35 (0.6)	0.9 (0.5)	0.5 (0.3)	0.1 (0.1)
M211D	5,457	814 (17)	120 (1.5)	30 (0.5)	3.3 (1.2)	1.0 (0.4)	0.2 (0.1)
M221A	9,631	530 (9)	105 (1.0)	29 (0.3)	5.2 (1.1)	0.6 (0.1)	0.1 (0.0)
M221B	5,074	565 (16)	113 (1.6)	34 (0.6)	3.0 (1.0)	0.7 (0.2)	0.1 (0.0)
M221C	6,015	558 (11)	103 (1.3)	30 (0.5)	5.2 (0.9)	0.4 (0.1)	0.1 (0.0)
M221D	8,565	554 (9)	125 (1.1)	34 (0.4)	3.5 (0.6)	0.4 (0.1)	0.1 (0.0)
M223A	3,090	649 (20)	112 (2.4)	28 (0.7)	0.5 (0.2)	0.0 (0.0)	0.0 (0.0)
M231A	5,601	713 (17)	101 (1.9)	21 (0.5)	0.4 (0.2)	0.0 (0.0)	0.0 (0.0)
M242A	9,483	364 (9)	163 (2.4)	51 (1.0)	0.1 (0.1)	0.0 (0.0)	0.0 (0.0)
M242B	10,327	420 (8)	180 (2.0)	55 (0.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
M242C	5,553	387 (11)	94 (1.8)	20 (0.5)	—	—	—
M242D	5,614	443 (15)	146 (2.8)	38 (1.0)	—	—	—
M261A	8,075	443 (11)	143 (2.2)	41 (0.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
M261B	2,404	433 (23)	138 (4.7)	40 (1.9)	—	—	—
M261C	644	207 (21)	46 (2.7)	10 (0.7)	—	—	—
M261D	3,771	328 (14)	115 (3.2)	24 (0.9)	—	—	—
M261E	9,917	319 (9)	143 (2.2)	33 (0.7)	—	—	—
M261F	2,157	211 (16)	48 (2.0)	12 (0.6)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
M261G	3,174	171 (8)	71 (2.3)	10 (0.4)	—	—	—
M262A	1,067	148 (13)	58 (3.0)	14 (0.9)	—	—	—
M262B	1,232	275 (35)	70 (4.3)	12 (0.9)	—	—	—
M313A	9,172	286 (9)	85 (1.5)	10 (0.3)	—	—	—
M313B	4,149	297 (15)	74 (2.0)	5 (0.2)	—	—	—
M331A	5,956	387 (18)	87 (2.3)	16 (0.5)	—	—	—
M331B	1,149	472 (30)	105 (5.2)	16 (1.1)	—	—	—
M331D	5,631	623 (27)	90 (2.1)	15 (0.5)	—	—	—
M331E	2,424	465 (25)	105 (3.6)	13 (0.5)	—	—	—
M331F	4,467	646 (33)	106 (2.3)	14 (0.4)	—	—	—
M331G	5,210	461 (17)	113 (2.6)	19 (0.6)	—	—	—
M331H	3,535	627 (37)	109 (3.5)	17 (0.8)	—	—	—
M331I	8,011	543 (17)	107 (2.0)	17 (0.4)	—	—	—
M331J	835	407 (29)	104 (5.5)	16 (1.0)	—	—	—
M332A	8,546	308 (12)	94 (2.6)	20 (0.7)	—	—	—
M332B	3,939	440 (23)	92 (3.1)	17 (0.7)	—	—	—
M332D	3,929	539 (29)	105 (3.2)	16 (0.6)	—	—	—

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m^2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.3 ***(Continued)***

Ecosection	Forest area	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	1,000 acres	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
M332E	3,290	503 (29)	109 (3.7)	17 (0.7)	—	—	—
M332F	1,878	316 (27)	78 (4.9)	14 (1.0)	—	—	—
M332G	6,676	302 (10)	86 (1.3)	18 (0.4)	—	—	—
M333A	5,769	438 (16)	95 (2.0)	21 (0.5)	—	—	—
M333B	4,156	515 (27)	96 (3.2)	20 (0.8)	—	—	—
M333C	4,062	555 (26)	99 (3.4)	18 (0.8)	—	—	—
M333D	5,617	442 (19)	114 (3.2)	26 (0.9)	—	—	—
M334A	1,934	318 (17)	73 (2.1)	12 (0.4)	—	—	—
M341A	4,624	281 (9)	94 (2.2)	6 (0.2)	—	—	—
M341B	3,224	347 (19)	96 (3.2)	8 (0.3)	—	—	—
M341C	3,545	582 (29)	95 (2.5)	11 (0.4)	—	—	—
M341D	1,528	209 (14)	75 (2.8)	5 (0.2)	—	—	—
All of CONUS	684,327	537 (1.6)	95 (0.2)	21 (0.06)	2.7 (0.11)	0.28 (0.010)	0.046 (0.0018)

— = No nonnative tree species in the ecosection.

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m²/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

Table A.4—Summary data for forest structure on forest land with nonnative tree species (live trees ≥1 inch [2.54 cm] diameter at breast height) by ecosection in the most current inventories (see table A.1 for identification of the ecosections)

Ecosection	Percentage of forest with nonnative species	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	percent	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		----- (sampling error) -----					
		All species			Nonnative species		
211A	0.78	616 (230)	144 (45.4)	20 (6.0)	511.6 (156.7)	110.1 (35.3)	14.3 (4.4)
211B	0.60	1,074 (283)	80 (20.3)	10 (4.0)	402.0 (111.5)	23.8 (6.8)	2.4 (0.7)
211D	0.98	1,031 (177)	158 (20.8)	31 (4.5)	139.6 (59.9)	19.7 (8.1)	3.5 (1.5)
211E	1.24	459 (104)	108 (27.6)	25 (6.6)	45.3 (25.5)	26.0 (14.2)	5.4 (3.0)
211F	6.22	528 (40)	129 (7.3)	28 (1.9)	93.3 (12.5)	40.6 (5.4)	7.1 (0.9)
211G	2.21	788 (145)	134 (15.4)	32 (3.7)	69.0 (29.3)	42.3 (17.6)	8.1 (3.4)
211I	4.01	650 (69)	109 (16.5)	24 (4.2)	82.6 (22.7)	38.4 (10.3)	6.9 (1.9)
211J	8.85	475 (66)	119 (11.6)	27 (3.0)	54.8 (15.5)	29.0 (8.1)	5.3 (1.5)
212H	3.99	631 (71)	95 (8.1)	17 (1.6)	192.4 (31.9)	38.8 (5.7)	6.6 (1.1)
212J	0.26	1,058 (342)	112 (8.0)	15 (0.7)	33.6 (10.7)	12.4 (4.9)	1.6 (0.5)
212K	0.54	453 (158)	88 (18.1)	18 (4.9)	80.8 (54.0)	30.6 (16.9)	6.7 (4.5)
212L	0.04	500 (4)	120 (24.8)	19 (5.0)	76.0 (24.7)	16.9 (4.0)	2.9 (0.9)
212N	0.06	863 (193)	152 (49.0)	25 (8.9)	123.7 (33.8)	45.1 (13.7)	7.8 (2.1)
212Q	0.92	400 (116)	93 (27.7)	18 (5.3)	32.9 (12.4)	20.5 (7.3)	3.9 (1.5)
212R	0.16	811 (0)	32 (0.0)	6 (0.0)	33.7 (0.0)	5.3 (0.0)	0.6 (0.0)
212S	0.24	188 (0)	31 (0.0)	4 (0.0)	180.2 (0.0)	29.6 (0.0)	3.9 (0.0)
212T	0.88	675 (164)	90 (19.6)	15 (3.7)	170.0 (50.4)	38.8 (11.0)	6.3 (1.9)
212X	0.3	670 (191)	90 (16.3)	18 (3.6)	32.2 (13.5)	15.0 (6.6)	2.6 (1.1)
212Z	2.91	567 (114)	141 (21.5)	25 (6.0)	196.9 (51.8)	66.2 (16.1)	9.8 (2.6)
221A	3.53	418 (42)	136 (8.0)	41 (2.8)	92.2 (17.9)	14.6 (2.8)	2.8 (0.5)
221B	5.84	427 (64)	116 (11.7)	35 (4.5)	123.6 (28.7)	20.1 (4.4)	3.7 (0.9)
221D	17.69	351 (29)	130 (6.6)	41 (2.4)	55.4 (7.4)	11.5 (1.3)	2.3 (0.3)
221E	9.28	519 (25)	96 (2.8)	26 (1.0)	72.8 (7.7)	10.8 (1.2)	1.8 (0.2)
221F	6.34	418 (54)	122 (11.4)	32 (3.5)	70.3 (16.8)	36.6 (8.5)	6.7 (1.6)
221H	2.99	662 (63)	92 (5.3)	24 (1.7)	82.8 (17.3)	7.2 (1.4)	1.4 (0.3)
221J	7.71	658 (91)	96 (7.4)	26 (2.6)	112.7 (29.8)	10.9 (2.5)	2.1 (0.6)
222H	9.79	423 (34)	89 (7.6)	24 (2.4)	73.4 (17.6)	9.4 (2.2)	1.6 (0.4)
222I	12.65	475 (52)	103 (8.6)	26 (2.5)	66.0 (14.9)	16.7 (3.6)	2.9 (0.7)
222J	13.40	442 (30)	93 (6.3)	22 (1.9)	100.2 (13.6)	20.8 (2.7)	3.9 (0.5)
222K	10.45	355 (30)	98 (6.3)	21 (1.7)	64.3 (10.8)	12.0 (1.7)	2.2 (0.4)
222L	5.16	487 (37)	78 (5.0)	17 (1.3)	57.5 (8.3)	8.6 (1.2)	1.7 (0.2)
222M	6.72	432 (60)	109 (8.3)	23 (2.2)	83.2 (15.4)	17.6 (3.1)	3.7 (0.7)
222R	0.42	492 (166)	102 (0.6)	20 (1.5)	13.8 (4.5)	6.5 (1.3)	1.2 (0.4)
222U	11.91	410 (68)	89 (12.0)	23 (4.2)	69.2 (12.2)	13.1 (2.3)	2.4 (0.4)

The restriction to forest land with nonnative species was based on setting the domain of interest to plots with any nonnative species (see Bechtold and Patterson [2005] for more information about these approaches).

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.4 ***(Continued)***

Ecosection	Percentage of forest with nonnative species	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	percent	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
223A	1.05	529 (53)	95 (7.0)	22 (1.8)	76.7 (20.4)	8.2 (1.7)	1.6 (0.4)
223B	1.27	544 (127)	102 (16.1)	25 (5.5)	58.3 (31.6)	26.6 (12.7)	7.4 (4.0)
223D	3.31	490 (48)	97 (8.1)	25 (2.2)	56.0 (13.3)	8.0 (1.6)	1.6 (0.4)
223E	10.10	561 (29)	108 (3.0)	30 (1.2)	61.0 (7.0)	9.6 (1.1)	2.1 (0.2)
223F	3.02	588 (77)	92 (8.5)	20 (2.6)	82.7 (25.7)	8.1 (2.4)	1.4 (0.4)
223G	3.70	353 (53)	95 (12.4)	23 (3.6)	26.9 (6.3)	4.7 (0.9)	0.9 (0.2)
231A	2.55	771 (58)	99 (5.3)	23 (1.7)	113.8 (16.3)	8.7 (1.2)	1.4 (0.2)
231B	2.99	724 (60)	84 (4.8)	19 (1.3)	88.6 (11.8)	6.0 (0.8)	1.0 (0.1)
231C	4.10	867 (162)	101 (8.5)	24 (3.2)	85.1 (22.5)	9.6 (2.1)	1.9 (0.5)
231D	2.08	1,006 (150)	85 (9.6)	19 (3.2)	73.1 (46.1)	6.6 (3.5)	1.3 (0.8)
231E	3.21	768 (47)	83 (5.4)	18 (1.7)	111.4 (15.8)	6.7 (0.8)	1.1 (0.2)
231G	0.38	303 (52)	128 (12.4)	30 (0.3)	130.0 (11.3)	6.4 (0.4)	0.8 (0.1)
231H	2.94	608 (132)	88 (5.6)	23 (2.0)	69.8 (8.6)	5.7 (0.7)	1.1 (0.1)
231I	5.11	807 (48)	120 (4.7)	30 (1.5)	86.4 (12.8)	8.4 (1.0)	1.6 (0.2)
232A	5.68	409 (73)	134 (12.8)	41 (4.7)	30.8 (10.5)	10.6 (2.7)	2.4 (0.8)
232B	5.37	726 (36)	95 (3.2)	22 (0.9)	131.1 (14.1)	10.4 (1.0)	1.9 (0.2)
232C	1.97	817 (87)	118 (7.3)	28 (2.3)	136.9 (30.4)	11.5 (2.3)	2.2 (0.5)
232D	3.74	331 (63)	63 (12.6)	12 (2.7)	144.9 (60.4)	11.7 (4.1)	1.9 (0.8)
232E	51.23	880 (49)	95 (3.8)	19 (1.1)	366.0 (34.1)	22.1 (2.0)	3.4 (0.3)
232F	15.08	854 (36)	94 (2.8)	20 (0.7)	217.7 (16.6)	10.6 (0.8)	1.5 (0.1)
232G	1.35	586 (38)	105 (24.2)	21 (4.9)	199.3 (80.7)	11.1 (4.5)	1.4 (0.6)
232H	2.72	684 (76)	138 (10.2)	35 (3.3)	81.7 (19.7)	8.2 (1.8)	1.5 (0.4)
232I	0.63	1,078 (249)	135 (32.9)	30 (12.5)	36.7 (7.9)	5.8 (1.5)	0.8 (0.2)
232J	3.49	631 (53)	85 (5.2)	20 (1.6)	102.1 (14.1)	8.3 (1.0)	1.5 (0.2)
232K	4.01	503 (93)	90 (12.4)	22 (3.2)	152.5 (51.2)	8.5 (2.6)	1.4 (0.5)
232L	8.15	735 (52)	113 (6.1)	29 (2.1)	193.6 (26.5)	11.8 (1.4)	2.0 (0.3)
234A	9.69	934 (125)	105 (7.2)	21 (1.6)	274.3 (52.2)	20.5 (3.8)	3.8 (0.7)
234C	22.62	648 (74)	89 (5.9)	20 (1.8)	128.2 (24.8)	15.4 (2.5)	3.0 (0.6)
234D	3.03	661 (104)	88 (8.9)	18 (2.0)	40.5 (11.3)	5.9 (1.4)	1.1 (0.3)
234E	0.55	1,197 (0)	74 (0.0)	13 (0.0)	6.0 (0.0)	2.0 (0.0)	0.5 (0.0)
242A	0.31	59 (0)	87 (0.0)	18 (0.0)	45.6 (0.0)	67.6 (0.0)	13.2 (0.0)
242B	4.38	283 (57)	122 (20.2)	36 (9.2)	57.0 (15.6)	11.2 (3.3)	2.2 (0.6)
251A	5.55	394 (53)	152 (26.2)	35 (7.3)	98.3 (50.6)	38.0 (17.0)	8.4 (4.3)
251B	20.04	355 (41)	110 (15.2)	26 (4.3)	75.8 (16.0)	16.8 (3.1)	3.8 (0.8)
251C	8.72	354 (26)	99 (4.8)	23 (1.3)	86.9 (12.1)	13.6 (1.8)	2.6 (0.4)
251D	14.34	336 (46)	106 (12.2)	27 (3.9)	61.1 (16.1)	11.9 (2.8)	2.4 (0.6)

The restriction to forest land with nonnative species was based on setting the domain of interest to plots with any nonnative species (see Bechtold and Patterson [2005] for more information about these approaches).

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.4 *(Continued)*

Ecosection	Percentage of forest with nonnative species	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	percent	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
251E	2.43	420 (85)	61 (12.2)	12 (2.7)	62.3 (24.9)	8.4 (3.4)	1.3 (0.5)
251F	0.80	45 (0)	20 (0.0)	3 (0.0)	11.2 (0.0)	4.9 (0.0)	0.9 (0.0)
251H	10.60	383 (82)	87 (14.0)	19 (3.4)	118.4 (26.0)	24.5 (5.0)	5.8 (1.3)
255A	1.98	371 (63)	60 (9.5)	11 (2.2)	60.1 (16.7)	7.6 (2.0)	0.9 (0.2)
255B	3.11	768 (172)	60 (11.9)	10 (2.8)	181.3 (46.0)	7.7 (2.2)	1.0 (0.3)
255C	2.80	440 (81)	65 (5.9)	13 (1.2)	66.6 (12.1)	6.6 (1.2)	1.0 (0.2)
255D	16.31	540 (82)	65 (5.8)	12 (1.3)	260.0 (44.6)	18.6 (2.9)	2.9 (0.5)
255E	1.05	794 (232)	82 (14.5)	11 (1.4)	89.8 (32.8)	3.4 (1.2)	0.4 (0.1)
261A	1.43	181 (15)	155 (45.3)	43 (16.7)	1.4 (0.3)	6.7 (0.6)	3.2 (0.7)
261B	2.43	49 (0)	10 (0.0)	1 (0.0)	48.9 (0.0)	9.5 (0.0)	1.2 (0.0)
315B	0.82	110 (36)	23 (4.6)	3 (0.6)	72.7 (15.8)	14.3 (1.9)	2.2 (0.5)
315C	0.07	60 (0)	28 (0.0)	3 (0.0)	6.0 (0.0)	1.9 (0.0)	0.2 (0.0)
315D	0.05	508 (0)	18 (0.0)	2 (0.0)	9.3 (0.0)	2.1 (0.0)	0.3 (0.0)
315E	0.25	1,083 (138)	103 (10.9)	20 (4.4)	26.6 (8.4)	6.5 (2.6)	1.0 (0.3)
315F	3.61	474 (226)	57 (20.5)	8 (3.0)	82.1 (26.1)	22.0 (7.1)	3.4 (1.1)
315G	0.26	573 (0)	125 (0.0)	8 (0.0)	75.0 (0.0)	0.6 (0.0)	0.0 (0.0)
321B	0.14	112 (0)	93 (0.0)	22 (0.0)	8.0 (0.0)	1.6 (0.0)	0.3 (0.0)
331B	0.55	12 (0)	2 (0.0)	0 (0.0)	12.0 (0.0)	1.6 (0.0)	0.2 (0.0)
331C	54.01	311 (147)	77 (3.9)	14 (0.8)	54.6 (24.0)	3.8 (1.6)	0.6 (0.3)
331E	2.16	48 (0)	10 (0.0)	2 (0.0)	24.1 (0.0)	5.9 (0.0)	0.9 (0.0)
331F	1.28	347 (271)	80 (28.6)	14 (4.3)	323.0 (187.5)	55.2 (33.6)	8.9 (5.2)
331I	0.68	102 (0)	34 (0.0)	4 (0.0)	102.3 (0.0)	33.8 (0.0)	4.3 (0.0)
332A	4.48	132 (27)	58 (23.7)	11 (5.8)	47.9 (25.6)	17.7 (7.5)	3.1 (1.7)
332B	51.48	145 (24)	61 (7.5)	12 (1.5)	69.9 (19.6)	37.2 (9.7)	7.6 (2.1)
332C	8.98	234 (79)	56 (14.4)	10 (3.0)	36.9 (14.4)	17.0 (5.9)	3.8 (1.5)
332D	8.24	179 (48)	73 (23.8)	12 (4.0)	27.4 (10.2)	13.5 (4.5)	2.7 (1.0)
332E	12.16	411 (63)	98 (14.9)	21 (3.8)	133.7 (54.9)	32.4 (13.4)	6.4 (2.6)
332F	6.90	350 (60)	79 (12.6)	15 (3.2)	138.0 (30.9)	32.3 (6.7)	5.5 (1.2)
411A	5.66	480 (95)	97 (17.3)	19 (3.5)	227.2 (89.2)	16.3 (6.2)	2.7 (1.0)
M211A	0.04	986 (0)	80 (0.0)	14 (0.0)	9.8 (0.0)	3.3 (0.0)	0.5 (0.0)
M211B	1.22	589 (184)	126 (14.9)	30 (3.7)	70.6 (21.5)	31.0 (9.9)	5.3 (1.6)
M211C	1.24	529 (93)	143 (22.1)	38 (7.2)	65.7 (28.4)	15.8 (6.4)	2.7 (1.2)
M211D	2.32	687 (108)	138 (10.2)	29 (2.6)	123.4 (32.6)	44.5 (10.9)	8.1 (2.1)
M221A	8.08	494 (29)	97 (3.0)	26 (1.1)	77.0 (7.8)	11.1 (1.1)	2.1 (0.2)

The restriction to forest land with nonnative species was based on setting the domain of interest to plots with any nonnative species (see Bechtold and Patterson [2005] for more information about these approaches).

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.4 *(Continued)*

Ecosection	Percentage of forest with nonnative species	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	percent	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		---------- *(sampling error)* ----------					
		All species			Nonnative species		
M221B	4.01	794 (106)	103 (7.9)	24 (2.5)	106.3 (28.0)	19.9 (4.9)	3.0 (0.8)
M221C	12.55	638 (34)	98 (3.7)	27 (1.4)	52.3 (6.5)	7.2 (0.8)	1.4 (0.2)
M221D	5.35	532 (34)	115 (4.3)	31 (1.8)	38.1 (5.0)	7.2 (0.9)	1.6 (0.2)
M223A	1.76	721 (105)	71 (9.2)	14 (2.6)	70.0 (18.0)	5.1 (1.3)	0.9 (0.2)
M231A	0.56	659 (136)	74 (16.3)	16 (5.3)	23.6 (6.8)	4.0 (1.0)	0.6 (0.2)
M242A	0.08	496 (0)	203 (0.0)	65 (0.0)	75.0 (0.0)	7.2 (0.0)	1.0 (0.0)
M242B	0.12	398 (243)	83 (24.8)	20 (5.1)	9.0 (3.1)	2.5 (0.6)	0.5 (0.2)
M242C	0.04	439 (0)	64 (0.0)	17 (0.0)	267.4 (0.0)	2.1 (0.0)	0.1 (0.0)
M261A	0.07	2,156 (0)	109 (0.0)	16 (0.0)	8.0 (0.0)	2.0 (0.0)	0.2 (0.0)
M261F	0.57	366 (0)	70 (0.0)	19 (0.0)	88.3 (0.0)	0.5 (0.0)	0.0 (0.0)
M334A	0.17	158 (0)	29 (0.0)	5 (0.0)	24.3 (0.0)	10.2 (0.0)	1.9 (0.0)
All of CONUS	2.76	618 (8.3)	99 (0.8)	24 (0.26)	118 (3.7)	13.8 (0.36)	2.47 (0.067)

The restriction to forest land with nonnative species was based on setting the domain of interest to plots with any nonnative species (see Bechtold and Patterson [2005] for more information about these approaches).

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

Table A.5—Summary data for forest structure on forest land with nonnative tree species (live trees ≥1 inch [2.54 cm] diameter at breast height) by ecosection in inventories previous to the most current, which ranged from 3 to 15 years apart (see table A.1 for identification of the ecosections)

Ecosection	Percentage of forest with nonnative species	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	percent	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
211A	0.78	727 (270)	109 (39.6)	12 (4.4)	617.8 (225.4)	87.8 (31.6)	9.2 (3.4)
211B	0.48	744 (222)	80 (20.8)	10 (2.5)	210.3 (124.7)	30.6 (18.5)	3.3 (2.0)
211D	0.60	753 (351)	111 (32.6)	24 (6.1)	141.1 (59.0)	23.3 (10.8)	3.7 (1.6)
211E	1.72	936 (221)	101 (18.4)	20 (4.1)	105.9 (60.3)	25.0 (13.7)	4.7 (2.7)
211F	5.78	661 (45)	120 (7.8)	26 (1.9)	137.3 (18.5)	44.4 (5.8)	7.5 (1.0)
211G	1.94	589 (108)	125 (16.2)	29 (3.4)	56.8 (31.4)	25.1 (14.1)	4.5 (2.5)
211I	3.27	768 (83)	121 (21.5)	26 (5.6)	101.8 (33.2)	35.8 (11.8)	6.3 (2.0)
211J	6.68	658 (81)	133 (15.9)	30 (4.0)	57.1 (18.3)	24.4 (7.6)	4.3 (1.4)
212H	2.43	558 (48)	94 (6.4)	17 (1.4)	220.6 (24.8)	42.3 (4.4)	6.7 (0.8)
212J	0.23	984 (543)	71 (23.4)	10 (2.7)	8.6 (3.2)	7.2 (2.4)	1.2 (0.5)
212K	0.55	441 (109)	85 (23.9)	15 (5.2)	89.0 (50.0)	24.6 (12.1)	4.8 (2.7)
212N	0.09	642 (196)	75 (5.5)	13 (0.8)	135.6 (100.6)	20.9 (17.1)	3.0 (2.2)
212Q	0.91	295 (82)	79 (29.4)	14 (5.5)	74.5 (22.7)	24.2 (7.2)	4.1 (1.3)
212R	0.12	769 (248)	64 (15.2)	12 (3.0)	189.6 (42.9)	26.4 (6.1)	5.5 (1.2)
212S	0.27	243 (74)	35 (9.5)	6 (1.7)	151.4 (47.0)	18.6 (5.8)	2.7 (0.8)
212T	0.66	728 (91)	119 (14.1)	24 (3.7)	138.8 (44.5)	19.4 (6.4)	2.8 (0.9)
212X	0.34	676 (146)	112 (12.3)	23 (2.6)	103.6 (31.2)	29.4 (10.1)	4.7 (1.4)
212Z	1.21	1,305 (447)	187 (18.9)	34 (5.2)	190.5 (148.1)	53.8 (42.0)	7.7 (6.0)
221A	2.41	504 (67)	120 (9.3)	36 (3.3)	129.0 (25.6)	10.7 (2.0)	1.9 (0.4)
221B	4.41	375 (58)	93 (9.9)	26 (3.5)	150.6 (37.2)	14.8 (4.1)	2.3 (0.6)
221D	13.51	409 (35)	115 (6.2)	34 (2.2)	67.0 (10.7)	11.3 (1.7)	2.2 (0.3)
221E	8.22	586 (27)	93 (2.5)	25 (0.9)	108.3 (10.4)	10.8 (1.0)	1.7 (0.2)
221F	6.23	467 (73)	101 (9.1)	25 (2.8)	75.1 (17.9)	29.4 (6.9)	5.1 (1.2)
221H	1.60	738 (116)	93 (7.7)	24 (2.7)	125.5 (30.0)	5.3 (1.3)	0.8 (0.2)
221J	6.74	528 (69)	93 (8.4)	24 (2.7)	54.2 (13.3)	8.6 (2.1)	1.6 (0.4)
222H	5.95	553 (63)	83 (8.9)	22 (3.2)	109.0 (29.7)	11.9 (3.2)	2.1 (0.6)
222I	8.36	599 (75)	102 (11.7)	25 (3.8)	105.6 (28.6)	20.9 (5.4)	3.7 (1.0)
222J	7.37	521 (32)	93 (5.9)	21 (1.6)	122.4 (16.5)	23.1 (3.0)	3.9 (0.5)
222K	5.13	543 (65)	102 (8.4)	21 (2.5)	137.5 (27.8)	20.3 (3.8)	3.2 (0.6)
222L	0.98	595 (153)	76 (8.7)	17 (2.7)	69.1 (14.8)	9.1 (1.9)	1.3 (0.3)
222M	2.00	430 (97)	96 (13.9)	17 (2.3)	75.9 (23.8)	14.7 (5.1)	2.8 (0.9)
222R	1.12	512 (178)	61 (21.3)	10 (3.4)	54.6 (15.4)	4.9 (1.1)	0.7 (0.2)
222U	7.27	410 (78)	87 (13.8)	22 (4.7)	100.2 (33.0)	20.5 (6.6)	3.5 (1.2)
223A	0.83	489 (60)	96 (7.4)	21 (2.0)	68.5 (19.4)	8.8 (2.4)	1.5 (0.4)

The restriction to forest land with nonnative species was based on setting the domain of interest to plots with any nonnative species (see Bechtold and Patterson [2005] for more information about these approaches).

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.5 *(Continued)*

Ecosection	Percentage of forest with nonnative species	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	percent	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		------- *(sampling error)* -------					
		All species			Nonnative species		
223B	1.64	635 (153)	94 (10.8)	22 (3.4)	87.4 (35.7)	23.1 (8.0)	5.8 (2.4)
223D	2.67	503 (49)	87 (6.4)	21 (2.1)	69.1 (15.1)	6.8 (1.3)	1.2 (0.3)
223E	10.09	637 (32)	101 (2.9)	27 (1.1)	78.0 (7.7)	8.1 (0.8)	1.6 (0.2)
223F	2.85	634 (59)	91 (7.9)	20 (2.6)	77.4 (27.4)	6.6 (2.2)	1.1 (0.4)
223G	3.01	562 (85)	83 (10.2)	18 (2.4)	28.0 (7.5)	2.2 (0.5)	0.4 (0.1)
231A	1.66	739 (88)	95 (7.7)	23 (2.6)	141.8 (34.0)	8.1 (2.0)	1.3 (0.3)
231B	1.71	735 (70)	84 (6.8)	18 (1.8)	59.6 (15.6)	4.6 (1.2)	0.7 (0.2)
231C	2.57	587 (102)	100 (9.7)	25 (3.4)	98.1 (20.7)	9.5 (1.9)	1.8 (0.4)
231D	1.21	832 (91)	77 (21.4)	20 (8.8)	132.1 (67.4)	9.1 (2.8)	2.1 (1.1)
231E	1.74	787 (61)	103 (9.4)	27 (3.3)	102.8 (18.2)	6.3 (1.0)	1.0 (0.2)
231G	0.73	621 (119)	115 (28.8)	29 (8.2)	136.0 (46.8)	3.8 (1.4)	0.4 (0.1)
231H	2.97	683 (67)	119 (9.9)	31 (3.3)	63.3 (9.0)	4.1 (0.6)	0.7 (0.1)
231I	3.78	853 (63)	112 (5.7)	27 (1.8)	115.8 (19.1)	7.5 (1.0)	1.3 (0.2)
232A	5.09	447 (92)	119 (11.4)	37 (4.9)	136.3 (34.1)	9.4 (2.6)	1.5 (0.4)
232B	2.85	779 (61)	99 (5.5)	22 (1.6)	156.2 (25.0)	10.3 (1.5)	1.7 (0.3)
232C	1.20	893 (98)	108 (10.4)	25 (3.2)	163.8 (41.2)	13.6 (3.2)	2.2 (0.6)
232D	5.07	434 (82)	82 (21.3)	18 (6.8)	293.3 (73.1)	18.4 (4.0)	2.9 (0.7)
232E	41.17	826 (51)	96 (6.2)	20 (2.0)	334.2 (37.9)	20.4 (2.1)	3.2 (0.4)
232F	11.16	849 (41)	97 (4.4)	22 (1.3)	229.8 (23.7)	9.6 (1.0)	1.4 (0.1)
232G	2.20	625 (167)	166 (73.5)	42 (21.8)	287.1 (116.2)	13.0 (5.6)	1.9 (0.8)
232H	2.12	817 (108)	117 (8.2)	28 (2.5)	72.2 (14.3)	5.4 (1.0)	0.9 (0.2)
232I	0.31	877 (272)	126 (65.7)	34 (23.9)	133.9 (103.2)	6.3 (4.7)	0.7 (0.6)
232J	2.51	672 (59)	80 (6.1)	17 (1.8)	121.6 (22.2)	9.0 (1.4)	1.5 (0.3)
232K	2.16	527 (102)	116 (25.3)	30 (7.6)	177.8 (46.5)	6.9 (1.8)	1.0 (0.3)
232L	6.18	763 (67)	135 (12.1)	34 (3.8)	240.0 (43.0)	12.3 (2.1)	2.0 (0.4)
234A	6.51	722 (113)	96 (10.0)	23 (3.6)	149.3 (34.3)	13.6 (3.0)	2.5 (0.6)
234C	15.69	684 (61)	129 (15.4)	33 (5.1)	183.4 (46.1)	15.1 (3.5)	2.5 (0.6)
234D	1.55	436 (46)	65 (10.9)	13 (2.1)	47.6 (18.1)	4.1 (1.4)	0.5 (0.2)
234E	0.42	48 (0)	67 (0.0)	20 (0.0)	8.0 (0.0)	2.3 (0.0)	0.4 (0.0)
242A	0.29	59 (0)	87 (0.0)	18 (0.0)	45.7 (0.0)	67.7 (0.0)	13.2 (0.0)
242B	0.16	220 (0)	95 (0.0)	15 (0.0)	220.4 (0.0)	95.1 (0.0)	15.1 (0.0)
251A	4.07	503 (129)	126 (43.4)	28 (11.5)	177.0 (88.3)	31.5 (15.9)	5.8 (2.9)
251B	6.60	426 (115)	77 (20.0)	14 (3.7)	70.9 (29.5)	13.3 (5.0)	2.7 (1.1)
251C	3.42	446 (74)	87 (6.9)	20 (2.0)	45.8 (10.0)	7.4 (1.4)	1.4 (0.3)
251D	3.61	367 (74)	91 (14.8)	21 (3.9)	19.4 (10.0)	10.9 (4.6)	2.5 (1.3)
251E	2.09	250 (51)	91 (20.0)	20 (4.6)	15.9 (4.9)	8.3 (1.8)	1.9 (0.6)
251F	0.58	867 (0)	88 (0.0)	21 (0.0)	15.3 (0.0)	3.5 (0.0)	0.6 (0.0)
251H	11.28	234 (54)	74 (13.8)	16 (3.1)	57.1 (14.8)	18.9 (4.8)	4.0 (1.0)

The restriction to forest land with nonnative species was based on setting the domain of interest to plots with any nonnative species (see Bechtold and Patterson [2005] for more information about these approaches).

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

(continued)

Table A.5 ***(Continued)***

Ecosection	Percentage of forest with nonnative species	Live trees	Live tree basal area	Live aboveground tree carbon	Live trees	Live tree basal area	Live aboveground tree carbon
	percent	*trees per acre*	*square feet per acre*	*tons per acre*	*trees per acre*	*square feet per acre*	*tons per acre*
		(sampling error)					
		All species			Nonnative species		
255A	3.61	368 (45)	88 (18.8)	18 (4.4)	22.1 (3.6)	6.4 (1.9)	0.6 (0.1)
255B	1.00	2,054 (708)	83 (22.0)	10 (2.3)	684.5 (440.7)	24.0 (15.8)	2.9 (1.9)
255C	2.72	488 (72)	64 (12.5)	12 (2.3)	59.8 (16.8)	4.1 (0.9)	0.6 (0.2)
255D	17.10	519 (77)	87 (8.4)	19 (2.5)	227.1 (50.0)	16.9 (3.7)	2.5 (0.6)
255E	1.14	230 (86)	61 (21.9)	10 (5.5)	48.6 (16.5)	6.8 (2.4)	0.5 (0.2)
261A	1.01	104 (0)	53 (4.4)	13 (2.6)	1.9 (1.6)	7.4 (4.9)	3.3 (2.7)
261B	1.68	405 (0)	140 (0.0)	33 (0.0)	405.3 (0.0)	140.2 (0.0)	32.6 (0.0)
315B	0.27	219 (0)	11 (0.0)	1 (0.0)	219.1 (0.0)	11.5 (0.0)	1.3 (0.0)
315D	0.21	208 (121)	31 (14.5)	5 (2.5)	9.0 (0.7)	2.1 (0.1)	0.2 (0.0)
315F	6.47	752 (381)	80 (30.1)	12 (4.4)	53.4 (8.8)	33.0 (5.7)	5.1 (0.8)
331C	6.98	217 (0)	81 (0.0)	15 (0.0)	24.1 (0.0)	7.2 (0.0)	0.6 (0.0)
331F	1.47	301 (218)	58 (18.1)	9 (2.6)	273.6 (154.8)	38.4 (22.1)	5.7 (3.2)
331I	0.17	600 (0)	4 (0.0)	0 (0.0)	599.7 (0.0)	3.6 (0.0)	0.2 (0.0)
331M	2.53	515 (151)	71 (22.3)	12 (3.7)	157.0 (56.7)	27.3 (10.5)	4.8 (1.8)
332A	1.50	306 (22)	110 (24.6)	22 (7.3)	161.8 (8.5)	37.3 (0.4)	7.6 (0.4)
332B	47.97	109 (36)	38 (7.0)	7 (0.8)	70.3 (5.3)	29.1 (2.7)	5.3 (0.4)
332C	12.73	211 (61)	76 (27.3)	16 (7.6)	27.7 (10.0)	8.0 (2.7)	1.6 (0.6)
332D	1.84	267 (35)	113 (7.3)	18 (3.2)	15.3 (6.5)	7.0 (3.0)	1.3 (0.6)
332E	10.64	285 (93)	71 (16.7)	15 (3.5)	147.5 (60.2)	32.1 (13.4)	6.5 (2.7)
332F	7.81	376 (161)	73 (8.4)	11 (1.9)	78.8 (35.3)	28.0 (11.1)	4.6 (2.0)
411A	6.53	1,265 (282)	117 (20.1)	17 (3.4)	816.0 (231.5)	42.6 (11.2)	6.0 (1.7)
M211B	1.05	752 (265)	119 (12.0)	22 (3.0)	118.3 (44.1)	31.0 (12.2)	5.0 (1.9)
M211C	0.61	588 (75)	159 (30.1)	33 (6.9)	143.4 (66.4)	84.3 (39.0)	15.1 (7.0)
M211D	1.88	696 (79)	148 (13.2)	29 (3.1)	173.2 (47.4)	55.6 (14.2)	9.7 (2.7)
M221A	6.28	576 (36)	93 (3.5)	25 (1.2)	82.2 (15.5)	10.2 (1.3)	1.9 (0.4)
M221B	3.12	652 (70)	105 (11.7)	25 (3.1)	96.0 (27.7)	21.2 (6.0)	3.4 (1.0)
M221C	6.77	650 (43)	88 (4.7)	24 (1.7)	77.4 (11.1)	5.8 (0.6)	1.1 (0.2)
M221D	4.53	594 (46)	104 (4.4)	26 (1.7)	76.3 (9.1)	8.1 (1.0)	1.4 (0.2)
M223A	1.23	839 (103)	107 (24.3)	24 (5.9)	41.5 (11.2)	3.7 (1.1)	0.6 (0.2)
M231A	0.61	636 (207)	108 (15.8)	24 (5.2)	71.3 (26.6)	3.9 (1.6)	0.6 (0.2)
M242A	0.11	468 (31)	218 (16.5)	68 (2.9)	63.9 (10.3)	6.4 (0.9)	0.9 (0.1)
M242B	0.06	872 (0)	54 (0.0)	8 (0.0)	6.1 (0.0)	1.2 (0.0)	0.2 (0.0)
M261A	0.02	1,102 (0)	205 (0.0)	47 (0.0)	7.3 (0.0)	1.6 (0.0)	0.2 (0.0)
M261F	0.36	105 (0)	14 (0.0)	2 (0.0)	6.0 (0.0)	1.0 (0.0)	0.1 (0.0)
All of CONUS	2.00	646 (9.7)	99 (1.2)	24 (0.36)	136 (4.9)	13.9 (0.44)	2.32 (0.077)

The restriction to forest land with nonnative species was based on setting the domain of interest to plots with any nonnative species (see Bechtold and Patterson [2005] for more information about these approaches).

Per-acre estimates are ratio estimates. The sampling error in parentheses is at the 68-percent confidence level. Zeros are the result of rounding small numbers. Large means with zero sampling error suggests the estimate is based on a single inventory plot within the ecosection.

For forest area, multiply by 0.404686 to obtain ha; for live trees, multiply by 2.47105 to obtain trees/ha; for live tree basal area, multiply by 0.229568 to obtain m2/ha; for live aboveground tree carbon, multiply by 2.2417 to obtain Mg/ha.

APPENDIX B

Table B.1—Identification of the provinces and ecosections (*sensu* Cleland and others 2007) where nonnative tree species have the highest live aboveground carbon content and fastest annual rate of carbon sequestration (see table 16 for the actual ranking of these ecosections and their level of aboveground tree carbon and annual rate of live aboveground tree carbon change)

Northeastern Mixed Forest Province:
211A - Aroostook Hills and Lowlands Section
211F - Northern Glaciated Allegheny Plateau Section
211G - Northern Unglaciated Allegheny Plateau Section
Laurentian Mixed Forest Province:
212H - Northern Lower Peninsula Section
212N - Northern Minnesota Drift and Lake Plains Section
212T - Northern Green Bay Lobe Section
Eastern Broad Leaf Forest Province:
221A - Lower New England Section
221B - Hudson Valley Section
221D - Northern Appalachian Piedmont Section
Midwest Broad Leaf Forest Province:
222R - Wisconsin Central Sands Section
Outer Coastal Plain Mixed Forest Province:
232A - Northern Atlantic Coastal Plain Section
232G - Florida Coastal Lowlands Atlantic Section
232I - Northern Atlantic Coastal Flatwoods Section
232L - Gulf Coastal Lowlands Section
Pacific Lowland Mixed Forest Province:
242A - Puget Trough Section
242B - Willamette Valley Section
Prairie Parkland (Temperate) Province:
251A - Red River Valley Section
251B - North Central Glaciated Plains Section
California Coastal Chaparral Forest-based Shrub Province:
261A - Central California Coastal Section
261B - Southern California Coastal Section
Great Plains Palouse Dry Steppe Province:
331F - Western Great Plains Section
331I - Arkansas Tahle Lands Section
Great Plains Steppe Province:
332A - Northeastern Glaciated Plains Section
332B - Western Glaciated Plains Section
332C - Nebraska Glaciated Plains Section
332F - South Central and Red Bed Plains Section
Adirondack-New England Mixed Forest Coniferous Forest-Alpine Meadows Province:
M211C - Green-Taconic-Berkshire Mountains Section
M211D - Adirondack Highlands Section
Cascade Mixed Forest-Coniferous Forest-Alpine Meadow Province:
M242A - Oregon and Washington Coastal Ranges Section
M242B - Western Cascades Section
Sierran Steppe-Mixed Forest-Coniferous Forest-Alpine Meadow Province:
M261A - Klamath Mountains Section
M261F - Sierra Nevada Foothills Section

APPENDIX C

Table C.1—Nonnative tree species identified on the current inventory plots by ecosection

Ecosection[a]	Description	Common name(s)	Species code
211A	Aroostook Hills and Lowlands	Norway spruce	91
M211A	White Mountains	Scots pine, Scotch pine	130
211B	Maine - New Brunswick Foothills and Lowlands	Norway spruce	91
M211B	New England Piedmont	Norway spruce	91
M211B	New England Piedmont	Scots pine, Scotch pine	130
M211B	New England Piedmont	Norway maple	320
M211C	Green-Taconic-Berkshire Mountains	Norway spruce	91
M211C	Green-Taconic-Berkshire Mountains	Scots pine, Scotch pine	130
M211C	Green-Taconic-Berkshire Mountains	Norway maple	320
211D	Central Maine Coastal and Embayment	Norway spruce	91
211D	Central Maine Coastal and Embayment	Scots pine, Scotch pine	130
211D	Central Maine Coastal and Embayment	Norway maple	320
M211D	Adirondack Highlands	Norway spruce	91
M211D	Adirondack Highlands	Scots pine, Scotch pine	130
211E	St. Lawrence and Champlain Valley	Scots pine, Scotch pine	130
211F	Northern Glaciated Allegheny Plateau	Norway spruce	91
211F	Northern Glaciated Allegheny Plateau	Scots pine, Scotch pine	130
211F	Northern Glaciated Allegheny Plateau	Tree of heaven, ailanthus	341
211F	Northern Glaciated Allegheny Plateau	Sweet cherry	771
211G	Northern Unglaciated Allegheny Plateau	Norway spruce	91
211G	Northern Unglaciated Allegheny Plateau	Scots pine, Scotch pine	130
211G	Northern Unglaciated Allegheny Plateau	Weeping willow	929
211I	Catskill Mountains	Norway spruce	91
211I	Catskill Mountains	Scots pine, Scotch pine	130
211J	Tug Hill Plateau - Mohawk Valley	Norway spruce	91
211J	Tug Hill Plateau - Mohawk Valley	Scots pine, Scotch pine	130
211J	Tug Hill Plateau - Mohawk Valley	Sweet cherry	771
212H	Northern Lower Peninsula	Norway spruce	91
212H	Northern Lower Peninsula	Scots pine, Scotch pine	130
212H	Northern Lower Peninsula	Austrian pine	136
212H	Northern Lower Peninsula	Siberian elm	974
212J	Southern Superior Uplands	Norway spruce	91
212K	Western Superior Uplands	Norway spruce	91
212K	Western Superior Uplands	Scots pine, Scotch pine	130
212K	Western Superior Uplands	Norway maple	320
212L	Northern Superior Uplands	Scots pine, Scotch pine	130
212L	Northern Superior Uplands	Norway maple	320
212N	Northern Minnesota Drift and Lake Plains	Scots pine, Scotch pine	130
212Q	North Central Wisconsin Uplands	Norway spruce	91
212Q	North Central Wisconsin Uplands	Scots pine, Scotch pine	130
212R	Eastern Upper Peninsula	Scots pine, Scotch pine	130
212S	Northern Upper Peninsula	Scots pine, Scotch pine	130
212T	Northern Green Bay Lobe	Norway spruce	91

[a] Only the ecosections with nonnative species are included.

(continued)

Table C.1 ***(Continued)***

Ecosection[a]	Description	Common name(s)	Species code
212T	Northern Green Bay Lobe	Scots pine, Scotch pine	130
212T	Northern Green Bay Lobe	Siberian elm	974
212X	Northern Highlands	Norway spruce	91
212X	Northern Highlands	Scots pine, Scotch pine	130
212Z	Green Bay - Manitowac Upland	Norway spruce	91
212Z	Green Bay - Manitowac Upland	Scots pine, Scotch pine	130
212Z	Green Bay - Manitowac Upland	Siberian elm	974
221A	Lower New England	Norway spruce	91
221A	Lower New England	Scots pine, Scotch pine	130
221A	Lower New England	Norway maple	320
221A	Lower New England	Tree of heaven, ailanthus	341
221A	Lower New England	White mulberry	681
221A	Lower New England	Sweet cherry	771
221A	Lower New England	White willow	927
221A	Lower New England	Siberian elm	974
M221A	Northern Ridge and Valley	Norway spruce	91
M221A	Northern Ridge and Valley	Scots pine, Scotch pine	130
M221A	Northern Ridge and Valley	Austrian pine	136
M221A	Northern Ridge and Valley	Norway maple	320
M221A	Northern Ridge and Valley	Tree of heaven, ailanthus	341
M221A	Northern Ridge and Valley	Silktree, mimosa	345
M221A	Northern Ridge and Valley	European alder	355
M221A	Northern Ridge and Valley	White mulberry	681
M221A	Northern Ridge and Valley	Princesstree, paulownia, empress tree	712
M221A	Northern Ridge and Valley	Sweet cherry	771
M221A	Northern Ridge and Valley	Siberian elm	974
221B	Hudson Valley	Norway spruce	91
221B	Hudson Valley	Scots pine, Scotch pine	130
221B	Hudson Valley	Norway maple	320
221B	Hudson Valley	Tree of heaven, ailanthus	341
221B	Hudson Valley	White mulberry	681
221B	Hudson Valley	Sweet cherry	771
M221B	Allegheny Mountains	Norway spruce	91
M221B	Allegheny Mountains	Scots pine, Scotch pine	130
M221B	Allegheny Mountains	Austrian pine	136
M221B	Allegheny Mountains	Norway maple	320
M221B	Allegheny Mountains	Tree of heaven, ailanthus	341
M221B	Allegheny Mountains	European alder	355
M221B	Allegheny Mountains	Sweet cherry	771
M221C	Northern Cumberland Mountains	Tree of heaven, ailanthus	341
M221C	Northern Cumberland Mountains	Silktree, mimosa	345
M221C	Northern Cumberland Mountains	European alder	355
M221C	Northern Cumberland Mountains	Chinese chestnut	424
M221C	Northern Cumberland Mountains	Princesstree, paulownia, empress tree	712
M221C	Northern Cumberland Mountains	Sweet cherry	771
221D	Northern Appalachian Piedmont	Norway spruce	91
221D	Northern Appalachian Piedmont	Norway maple	320

[a] Only the ecosections with nonnative species are included.

(continued)

Table C.1 ***(Continued)***

Ecosection[a]	Description	Common name(s)	Species code
221D	Northern Appalachian Piedmont	Tree of heaven, ailanthus	341
221D	Northern Appalachian Piedmont	Silktree, mimosa	345
221D	Northern Appalachian Piedmont	White mulberry	681
221D	Northern Appalachian Piedmont	Princesstree, paulownia, empress tree	712
221D	Northern Appalachian Piedmont	Sweet cherry	771
M221D	Blue Ridge Mountains	Norway maple	320
M221D	Blue Ridge Mountains	Tree of heaven, ailanthus	341
M221D	Blue Ridge Mountains	Silktree, mimosa	345
M221D	Blue Ridge Mountains	White mulberry	681
M221D	Blue Ridge Mountains	Princesstree, paulownia, empress tree	712
M221D	Blue Ridge Mountains	Sweet cherry	771
221E	Southern Unglaciated Allegheny Plateau	Norway spruce	91
221E	Southern Unglaciated Allegheny Plateau	Scots pine, Scotch pine	130
221E	Southern Unglaciated Allegheny Plateau	Norway maple	320
221E	Southern Unglaciated Allegheny Plateau	Tree of heaven, ailanthus	341
221E	Southern Unglaciated Allegheny Plateau	European alder	355
221E	Southern Unglaciated Allegheny Plateau	Chinese chestnut	424
221E	Southern Unglaciated Allegheny Plateau	Ginkgo, maidenhair tree	561
221E	Southern Unglaciated Allegheny Plateau	White mulberry	681
221E	Southern Unglaciated Allegheny Plateau	Princesstree, paulownia, empress tree	712
221E	Southern Unglaciated Allegheny Plateau	Sweet cherry	771
221E	Southern Unglaciated Allegheny Plateau	Siberian elm	974
221F	Western Glaciated Allegheny Plateau	Norway spruce	91
221F	Western Glaciated Allegheny Plateau	Scots pine, Scotch pine	130
221F	Western Glaciated Allegheny Plateau	Austrian pine	136
221F	Western Glaciated Allegheny Plateau	Norway maple	320
221F	Western Glaciated Allegheny Plateau	Tree of heaven, ailanthus	341
221F	Western Glaciated Allegheny Plateau	White mulberry	681
221F	Western Glaciated Allegheny Plateau	Sweet cherry	771
221H	Northern Cumberland Plateau	Tree of heaven, ailanthus	341
221H	Northern Cumberland Plateau	European alder	355
221H	Northern Cumberland Plateau	White mulberry	681
221H	Northern Cumberland Plateau	Princestree, paulownia, empress tree	712
221J	Central Ridge and Valley	Tree of heaven, ailanthus	341
221J	Central Ridge and Valley	Silktree, mimosa	345
221J	Central Ridge and Valley	White mulberry	681
221J	Central Ridge and Valley	Princesstree, paulownia, empress tree	712
222H	Central Till Plains-Beech-Maple	Norway spruce	91
222H	Central Till Plains-Beech-Maple	Scots pine, Scotch pine	130
222H	Central Till Plains-Beech-Maple	Norway maple	320
222H	Central Till Plains-Beech-Maple	Tree of heaven, ailanthus	341
222H	Central Till Plains-Beech-Maple	White mulberry	681
222H	Central Till Plains-Beech-Maple	Sweet cherry	771
222H	Central Till Plains-Beech-Maple	Sour cherry	772
222H	Central Till Plains-Beech-Maple	Siberian elm	974
222I	Erie and Ontario Lake Plain	Norway spruce	91
222I	Erie and Ontario Lake Plain	Scots pine, Scotch pine	130

[a] Only the ecosections with nonnative species are included.

(continued)

Table C.1 ***(Continued)***

Ecosection[a]	Description	Common name(s)	Species code
222I	Erie and Ontario Lake Plain	Norway maple	320
222I	Erie and Ontario Lake Plain	Sweet cherry	771
222I	Erie and Ontario Lake Plain	European mountain-ash	936
222J	South Central Great Lakes	Norway spruce	91
222J	South Central Great Lakes	Scots pine, Scotch pine	130
222J	South Central Great Lakes	Austrian pine	136
222J	South Central Great Lakes	Norway maple	320
222J	South Central Great Lakes	Tree of heaven, ailanthus	341
222J	South Central Great Lakes	White mulberry	681
222J	South Central Great Lakes	Sweet cherry	771
222J	South Central Great Lakes	Sour cherry	772
222J	South Central Great Lakes	White willow	927
222J	South Central Great Lakes	Siberian elm	974
222K	Southwestern Great Lakes Morainal	Norway spruce	91
222K	Southwestern Great Lakes Morainal	Scots pine, Scotch pine	130
222K	Southwestern Great Lakes Morainal	Norway maple	320
222K	Southwestern Great Lakes Morainal	White mulberry	681
222K	Southwestern Great Lakes Morainal	White willow	927
222K	Southwestern Great Lakes Morainal	Siberian elm	974
222K	Southwestern Great Lakes Morainal	Russian-olive	997
222L	North Central U.S. Driftless and Escarpment	Norway spruce	91
222L	North Central U.S. Driftless and Escarpment	Scots pine, Scotch pine	130
222L	North Central U.S. Driftless and Escarpment	Norway maple	320
222L	North Central U.S. Driftless and Escarpment	White mulberry	681
222L	North Central U.S. Driftless and Escarpment	White poplar, silver poplar	752
222L	North Central U.S. Driftless and Escarpment	Siberian elm	974
222M	Minnesota and Northeast Iowa Morainal-Oak Savannah	Norway spruce	91
222M	Minnesota and Northeast Iowa Morainal-Oak Savannah	Scots pine, Scotch pine	130
222M	Minnesota and Northeast Iowa Morainal-Oak Savannah	Austrian pine	136
222M	Minnesota and Northeast Iowa Morainal-Oak Savannah	White mulberry	681
222M	Minnesota and Northeast Iowa Morainal-Oak Savannah	Siberian elm	974
222R	Wisconsin Central Sands	Scots pine, Scotch pine	130
222U	Lake Whittlesey Glaciolacustrine Plain	Norway spruce	91
222U	Lake Whittlesey Glaciolacustrine Plain	Scots pine, Scotch pine	130
222U	Lake Whittlesey Glaciolacustrine Plain	Norway maple	320
222U	Lake Whittlesey Glaciolacustrine Plain	European alder	355
222U	Lake Whittlesey Glaciolacustrine Plain	White mulberry	681
222U	Lake Whittlesey Glaciolacustrine Plain	Sweet cherry	771
222U	Lake Whittlesey Glaciolacustrine Plain	Siberian elm	974
223A	Ozark Highlands	Tree of heaven, ailanthus	341
223A	Ozark Highlands	Silktree, mimosa	345
223A	Ozark Highlands	White mulberry	681
223A	Ozark Highlands	Princesstree, paulownia, empress tree	712
223A	Ozark Highlands	White poplar, silver poplar	752
223A	Ozark Highlands	Siberian elm	974
M223A	Boston Mountains	Tree of heaven, ailanthus	341
M223A	Boston Mountains	Silktree, mimosa	345

[a] Only the ecosections with nonnative species are included.

(continued)

Table C.1 ***(Continued)***

Ecosection[a]	Description	Common name(s)	Species code
M223A	Boston Mountains	Princesstree, paulownia, empress tree	712
223B	Interior Low Plateau-Transition Hills	Norway spruce	91
223B	Interior Low Plateau-Transition Hills	Tree of heaven, ailanthus	341
223B	Interior Low Plateau-Transition Hills	Siberian elm	974
223D	Interior Low Plateau-Shawnee Hills	Scots pine, Scotch pine	130
223D	Interior Low Plateau-Shawnee Hills	Tree of heaven, ailanthus	341
223D	Interior Low Plateau-Shawnee Hills	White mulberry	681
223D	Interior Low Plateau-Shawnee Hills	Princesstree, paulownia, empress tree	712
223E	Interior Low Plateau-Highland Rim	Tree of heaven, ailanthus	341
223E	Interior Low Plateau-Highland Rim	Silktree, mimosa	345
223E	Interior Low Plateau-Highland Rim	Chinese chestnut	424
223E	Interior Low Plateau-Highland Rim	White mulberry	681
223E	Interior Low Plateau-Highland Rim	Princesstree, paulownia, empress tree	712
223F	Interior Low Plateau-Bluegrass	Tree of heaven, ailanthus	341
223F	Interior Low Plateau-Bluegrass	White mulberry	681
223F	Interior Low Plateau-Bluegrass	Princesstree, paulownia, empress tree	712
223G	Central Till Plains-Oak Hickory	Tree of heaven, ailanthus	341
223G	Central Till Plains-Oak Hickory	White mulberry	681
231A	Southern Appalachian Piedmont	Tree of heaven, ailanthus	341
231A	Southern Appalachian Piedmont	Silktree, mimosa	345
231A	Southern Appalachian Piedmont	White mulberry	681
231A	Southern Appalachian Piedmont	Princesstree, paulownia, empress tree	712
231A	Southern Appalachian Piedmont	Chinaberrytree	993
M231A	Ouachita Mountains	Silktree, mimosa	345
M231A	Ouachita Mountains	White mulberry	681
M231A	Ouachita Mountains	Princesstree, paulownia, empress tree	712
M231A	Ouachita Mountains	Chinaberrytree	993
231B	Coastal Plains-Middle	Tree of heaven, ailanthus	341
231B	Coastal Plains-Middle	Silktree, mimosa	345
231B	Coastal Plains-Middle	Chinese chestnut	424
231B	Coastal Plains-Middle	Princesstree, paulownia, empress tree	712
231B	Coastal Plains-Middle	Chinaberrytree	993
231B	Coastal Plains-Middle	Chinese tallow	994
231C	Southern Cumberland Plateau	Tree of heaven, ailanthus	341
231C	Southern Cumberland Plateau	Silktree, mimosa	345
231C	Southern Cumberland Plateau	White mulberry	681
231C	Southern Cumberland Plateau	Princesstree, paulownia, empress tree	712
231C	Southern Cumberland Plateau	Chinaberrytree	993
231D	Southern Ridge and Valley	Silktree, mimosa	345
231D	Southern Ridge and Valley	Princesstree, paulownia, empress tree	712
231D	Southern Ridge and Valley	Chinaberrytree	993
231E	Mid Coastal Plains-Western	Tree of heaven, ailanthus	341
231E	Mid Coastal Plains-Western	Silktree, mimosa	345
231E	Mid Coastal Plains-Western	White mulberry	681
231E	Mid Coastal Plains-Western	Chinaberrytree	993
231E	Mid Coastal Plains-Western	Chinese tallow	994
231G	Arkansas Valley	Tree of heaven, ailanthus	341

[a] Only the ecosections with nonnative species are included.

(continued)

Table C.1 ***(Continued)***

Ecosection[a]	Description	Common name(s)	Species code
231G	Arkansas Valley	White mulberry	681
231H	Coastal Plains-Loess	Tree of heaven, ailanthus	341
231H	Coastal Plains-Loess	Silktree, mimosa	345
231H	Coastal Plains-Loess	Chinese chestnut	424
231H	Coastal Plains-Loess	White mulberry	681
231H	Coastal Plains-Loess	Princesstree, paulownia, empress tree	712
231H	Coastal Plains-Loess	Chinaberrytree	993
231H	Coastal Plains-Loess	Chinese tallow	994
231I	Central Appalachian Piedmont	Norway spruce	91
231I	Central Appalachian Piedmont	Tree of heaven, ailanthus	341
231I	Central Appalachian Piedmont	Silktree, mimosa	345
231I	Central Appalachian Piedmont	White mulberry	681
231I	Central Appalachian Piedmont	Princesstree, paulownia, empress tree	712
231I	Central Appalachian Piedmont	Sweet cherry	771
231I	Central Appalachian Piedmont	Siberian elm	974
231I	Central Appalachian Piedmont	Chinaberrytree	993
232A	Northern Atlantic Coastal Plain	Norway spruce	91
232A	Northern Atlantic Coastal Plain	Scots pine, Scotch pine	130
232A	Northern Atlantic Coastal Plain	Austrian pine	136
232A	Northern Atlantic Coastal Plain	Norway maple	320
232A	Northern Atlantic Coastal Plain	Tree of heaven, ailanthus	341
232A	Northern Atlantic Coastal Plain	White mulberry	681
232A	Northern Atlantic Coastal Plain	Princesstree, paulownia, empress tree	712
232A	Northern Atlantic Coastal Plain	Sweet cherry	771
232A	Northern Atlantic Coastal Plain	White willow	927
232B	Gulf Coastal Plains and Flatwoods	Silktree, mimosa	345
232B	Gulf Coastal Plains and Flatwoods	White mulberry	681
232B	Gulf Coastal Plains and Flatwoods	Camphortree	858
232B	Gulf Coastal Plains and Flatwoods	Chinaberrytree	993
232B	Gulf Coastal Plains and Flatwoods	Chinese tallow	994
232B	Gulf Coastal Plains and Flatwoods	Tungoil tree	995
232C	Atlantic Coastal Flatwoods	Silktree, mimosa	345
232C	Atlantic Coastal Flatwoods	Camphortree	858
232C	Atlantic Coastal Flatwoods	Chinaberrytree	993
232C	Atlantic Coastal Flatwoods	Chinese tallow	994
232D	Florida Coastal Lowlands-Gulf	Grand eucalyptus	513
232D	Florida Coastal Lowlands-Gulf	Camphortree	858
232D	Florida Coastal Lowlands-Gulf	Citrus spp.	860
232D	Florida Coastal Lowlands-Gulf	Melaleuca	992
232D	Florida Coastal Lowlands-Gulf	Chinaberrytree	993
232D	Florida Coastal Lowlands-Gulf	Chinese tallow	994
232E	Louisiana Coastal Prairie and Marshes	Camphortree	858
232E	Louisiana Coastal Prairie and Marshes	Chinese tallow	994
232E	Louisiana Coastal Prairie and Marshes	Tungoil tree	995
232F	Coastal Plains and Flatwoods-Western Gulf	Silktree, mimosa	345
232F	Coastal Plains and Flatwoods-Western Gulf	Weeping willow	929
232F	Coastal Plains and Flatwoods-Western Gulf	Chinaberrytree	993

[a] Only the ecosections with nonnative species are included.

(continued)

Table C.1 ***(Continued)***

Ecosection[a]	Description	Common name(s)	Species code
232F	Coastal Plains and Flatwoods-Western Gulf	Chinese tallow	994
232F	Coastal Plains and Flatwoods-Western Gulf	Tungoil tree	995
232G	Florida Coastal Lowlands-Atlantic	Silktree, mimosa	345
232G	Florida Coastal Lowlands-Atlantic	Belah	857
232G	Florida Coastal Lowlands-Atlantic	Camphortree	858
232G	Florida Coastal Lowlands-Atlantic	Citrus spp.	860
232G	Florida Coastal Lowlands-Atlantic	Melaleuca	992
232G	Florida Coastal Lowlands-Atlantic	Chinese tallow	994
232H	Middle Atlantic Coastal Plains and Flatwoods	Norway maple	320
232H	Middle Atlantic Coastal Plains and Flatwoods	Tree of heaven, ailanthus	341
232H	Middle Atlantic Coastal Plains and Flatwoods	Silktree, mimosa	345
232H	Middle Atlantic Coastal Plains and Flatwoods	White mulberry	681
232H	Middle Atlantic Coastal Plains and Flatwoods	Princesstree, paulownia, empress tree	712
232H	Middle Atlantic Coastal Plains and Flatwoods	White willow	927
232H	Middle Atlantic Coastal Plains and Flatwoods	Weeping willow	929
232H	Middle Atlantic Coastal Plains and Flatwoods	Siberian elm	974
232H	Middle Atlantic Coastal Plains and Flatwoods	Chinaberrytree	993
232I	Northern Atlantic Coastal Flatwoods	Tree of heaven, ailanthus	341
232I	Northern Atlantic Coastal Flatwoods	Silktree, mimosa	345
232I	Northern Atlantic Coastal Flatwoods	White willow	927
232I	Northern Atlantic Coastal Flatwoods	Chinaberrytree	993
232J	Southern Atlantic Coastal Plains and Flatwoods	Tree of heaven, ailanthus	341
232J	Southern Atlantic Coastal Plains and Flatwoods	Silktree, mimosa	345
232J	Southern Atlantic Coastal Plains and Flatwoods	White mulberry	681
232J	Southern Atlantic Coastal Plains and Flatwoods	Peach	764
232J	Southern Atlantic Coastal Plains and Flatwoods	Sweet cherry	771
232J	Southern Atlantic Coastal Plains and Flatwoods	Chinaberrytree	993
232J	Southern Atlantic Coastal Plains and Flatwoods	Chinese tallow	994
232K	Florida Coastal Plains Central Highlands	Silktree, mimosa	345
232K	Florida Coastal Plains Central Highlands	Camphortree	858
232K	Florida Coastal Plains Central Highlands	Citrus spp.	860
232K	Florida Coastal Plains Central Highlands	Chinaberrytree	993
232K	Florida Coastal Plains Central Highlands	Chinese tallow	994
232K	Florida Coastal Plains Central Highlands	Tungoil tree	995
232L	Gulf Coastal Lowlands	Silktree, mimosa	345
232L	Gulf Coastal Lowlands	Chinaberrytree	993
232L	Gulf Coastal Lowlands	Chinese tallow	994
232L	Gulf Coastal Lowlands	Tungoil tree	995
234A	Southern Mississippi Alluvial Plain	Silktree, mimosa	345
234A	Southern Mississippi Alluvial Plain	Chinaberrytree	993
234A	Southern Mississippi Alluvial Plain	Chinese tallow	994
234C	Atchafalaya and Red River Alluvial Plains	Chinaberrytree	993
234C	Atchafalaya and Red River Alluvial Plains	Chinese tallow	994
234D	White and Black River Alluvial Plains	Tree of heaven, ailanthus	341
234D	White and Black River Alluvial Plains	Silktree, mimosa	345
234D	White and Black River Alluvial Plains	White mulberry	681
234D	White and Black River Alluvial Plains	Princesstree, paulownia, empress tree	712

[a] Only the ecosections with nonnative species are included.

(continued)

Table C.1 ***(Continued)***

Ecosection[a]	Description	Common name(s)	Species code
234D	White and Black River Alluvial Plains	Chinaberrytree	993
234E	Arkansas Alluvial Plains	Chinaberrytree	993
242A	Puget Trough	White willow	927
M242A	Oregon and Washington Coast Ranges	Tree of heaven, ailanthus	341
242B	Willamette Valley	Scots pine, Scotch pine	130
242B	Willamette Valley	Sweet cherry	771
M242B	Western Cascades	Norway maple	320
M242B	Western Cascades	Sweet cherry	771
251A	Red River Valley	Siberian elm	974
251A	Red River Valley	Russian-olive	997
251B	North Central Glaciated Plains	Scots pine, Scotch pine	130
251B	North Central Glaciated Plains	Tree of heaven, ailanthus	341
251B	North Central Glaciated Plains	White mulberry	681
251B	North Central Glaciated Plains	White willow	927
251B	North Central Glaciated Plains	Siberian elm	974
251C	Central Dissected Till Plains	Scots pine, Scotch pine	130
251C	Central Dissected Till Plains	Tree of heaven, ailanthus	341
251C	Central Dissected Till Plains	White mulberry	681
251C	Central Dissected Till Plains	Siberian elm	974
251C	Central Dissected Till Plains	Russian-olive	997
251D	Central Till Plains and Grand Prairies	Scots pine, Scotch pine	130
251D	Central Till Plains and Grand Prairies	White mulberry	681
251D	Central Till Plains and Grand Prairies	Siberian elm	974
251E	Osage Plains	White mulberry	681
251E	Osage Plains	Siberian elm	974
251F	Flint Hills	Siberian elm	974
251H	Nebraska Rolling Hills	Scots pine, Scotch pine	130
251H	Nebraska Rolling Hills	Austrian pine	136
251H	Nebraska Rolling Hills	Siberian elm	974
255A	Cross Timbers and Prairie	Scots pine, Scotch pine	130
255A	Cross Timbers and Prairie	Silktree, mimosa	345
255A	Cross Timbers and Prairie	White mulberry	681
255A	Cross Timbers and Prairie	Siberian elm	974
255B	Blackland Prairie	Chinaberrytree	993
255C	Oak Woods and Prairie	Silktree, mimosa	345
255C	Oak Woods and Prairie	Chinaberrytree	993
255C	Oak Woods and Prairie	Chinese tallow	994
255D	Central Gulf Prairie and Marshes	Chinaberrytree	993
255D	Central Gulf Prairie and Marshes	Chinese tallow	994
255E	Texas Cross Timbers and Prairie	Silktree, mimosa	345
255E	Texas Cross Timbers and Prairie	Chinaberrytree	993
261A	Central California Coast	Tasmanian bluegum	511
M261A	Klamath Mountains	Scots pine, Scotch pine	130
261B	Southern California Coast	Tasmanian bluegum	511
M261F	Sierra Nevada Foothills	Tree of heaven, ailanthus	341
315B	Texas High Plains	White mulberry	681
315B	Texas High Plains	Siberian elm	974

[a] Only the ecosections with nonnative species are included.

(continued)

Table C.1 ***(Continued)***

Ecosection[a]	Description	Common name(s)	Species code
315C	Rolling Plains	Chinaberrytree	993
315D	Edwards Plateau	Chinaberrytree	993
315E	Rio Grande Plain	Chinaberrytree	993
315E	Rio Grande Plain	Chinese tallow	994
315F	Northern Texas High Plains	Tree of heaven, ailanthus	341
315F	Northern Texas High Plains	White mulberry	681
315F	Northern Texas High Plains	Princesstree, paulownia, empress tree	712
315F	Northern Texas High Plains	Siberian elm	974
315F	Northern Texas High Plains	Russian-olive	997
315G	Eastern Rolling Plains	Norway spruce	91
321B	Stockton Plateau	Chinaberrytree	993
331B	Southern High Plains	Saltcedar	991
331C	Central High Tablelands	Russian-olive	997
331E	Northeastern Glaciated Plains	Russian-olive	997
331F	Western Great Plains	Siberian elm	974
331F	Western Great Plains	Russian-olive	997
331I	Arkansas Tablelands	Siberian elm	974
332A	Northeastern Glaciated Plains	Scots pine, Scotch pine	130
332A	Northeastern Glaciated Plains	Siberian elm	974
332B	Western Glaciated Plains	Siberian elm	974
332C	Nebraska Sand Hills	Scots pine, Scotch pine	130
332C	Nebraska Sand Hills	Siberian elm	974
332C	Nebraska Sand Hills	Russian-olive	997
332D	North Central Great Plains	Scots pine, Scotch pine	130
332D	North Central Great Plains	Siberian elm	974
332E	South Central Great Plains	Austrian pine	136
332E	South Central Great Plains	Tree of heaven, ailanthus	341
332E	South Central Great Plains	Siberian elm	974
332E	South Central Great Plains	Russian-olive	997
332F	South Central and Red Bed Plains	White mulberry	681
332F	South Central and Red Bed Plains	Siberian elm	974
M334A	Black Hills	Siberian elm	974
411A	Everglades	Citrus spp.	860
411A	Everglades	Melaleuca	992

[a] Only the ecosections with nonnative species are included.

Lugo, Ariel E.; Smith, James E.; Potter, Kevin M.; Marcano Vega, Humfredo; Kurtz, Cassandra M. 2022. The contribution of nonnative tree species to the structure and composition of forests in the conterminous United States in comparison with tropical islands in the Pacific and Caribbean. Gen. Tech. Rep. IITF-54. Río Piedras, PR: U.S. Department of Agriculture Forest Service, International Institute of Tropical Forestry. 81 p. https://doi.org/10.2737/IITF-GTR-54.

Nonnative tree species have received less scientific attention than nonnative species in general, but when a forest is colonized by a nonnative tree species, the ecological effects can be significant as a change in tree species composition can alter the structural and functional attributes of forest ecosystems. We assess the abundance, geographic distribution, contribution to forest structure (including carbon), and temporal trends of nonnative tree species between the most current inventory and the previous one, ranging from 3 to 15 years earlier, within the conterminous United States (CONUS) and U.S.-affiliated islands in the Caribbean and the Pacific. We used publicly available data from the U.S. Department of Agriculture Forest Service, Forest Inventory and Analysis (FIA) program. Our analysis is by ecological section (ecosection) within ecological provinces of the CONUS and islandwide for Pacific and Caribbean islands. We found that the forest land area with nonnative tree species in the CONUS is 18.8 million acres (7.6 million ha) and is expanding at about 500,000 acres (202 343 ha) per year. The contribution of nonnative tree species in the CONUS to the structural component of forests (basal area and tree density) increased slightly. The mean live aboveground tree carbon of nonnative tree species ranged from 0.39 ton per acre (0.88 Mg/ha) for saplings (small trees with diameter at breast height [dbh] ≥1–<5 inches [≥2.54–<12.7 cm]) to 2.47 tons per acre (5.54 Mg/ha) for all trees (≥1 inch dbh), saplings included. These numbers are equivalent to 19 and 10 percent of the total carbon storage for their respective size classes in the forest plots where they occur, and they slowly increased between previous and current inventories. The contribution of nonnative tree species to the carbon storage of CONUS forests is 92.6 gigapounds (42 Tg) of C or about 0.05 percent of the amount stored in those forests. Nonnative tree species also sequester 1.3 gigapounds (0.6 Tg) of C annually or about 0.5 percent of the carbon sink of CONUS forests. The type and intensity of human activity is generally associated with the presence of nonnative tree species. A similar relationship is at play in Caribbean and Pacific islands and in the mainland forests of the CONUS. Additionally, a greater concentration of human activities in islands makes the nonnative tree species more common there than in the CONUS.

Keywords: Carbon sequestration, carbon sinks, Forest Inventory and Analysis, forest structure, introduced species, novel forests, species invasions, temperate forests, tropical forests.