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Legal, Institutional, and Economic Indicators of Forest Conservation and Sustainable Management in the United States: Analyzing Criterion 7 of the Montréal Process Criteria and Indicators Framework



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Kathleen A. McGinley is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926; and **Frederick W. Cubbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008. This work was performed under USDA Forest Service Cooperative Agreement 13-CA-11120101-006.

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Kathleen A. McGinley and Frederick W. Cubbage, Technical Editors

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Abstract

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This report examines the nation's legal, institutional, and economic capacity to promote forest conservation and sustainable resource management through a set of 10 indicators associated with criterion 7 of the Montréal Process criteria and indicators framework. Specifically, we considered (1) legislation and policies, (2) cross-sectoral coordination, (3) taxation and incentives, (4) property rights and land tenure, (5) law enforcement, (6) programs and services, (7) research and technology, (8) partnerships, (9) public participation and conflict resolution, and (10) monitoring and reporting as they relate to forests and their sustainability. The report is based on extensive research, assessment, and synthesis of information from a variety of sources. Data are presented quantitatively and qualitatively. There is a range of public laws that govern public lands, which dictate their management and public involvement in various detailed approaches. Federal and state laws protect wildlife and endangered species on all public and private lands and foster various levels of forest practices regulation or best management practices to protect water quality, air quality, and other public goods. Federal and state laws also provide for technical and financial assistance, research, education, and planning on private forest lands, but do not prescribe specific actions or standards.

Many newer market based mechanisms, including forest certification, wetland banks, payments for environmental services, and conservation easements increasingly are used to implement sustainable forest management (SFM) across the country. There is increasing development of cross-sectoral policies and programs that link related policy networks, purposes, and desired outcomes at all levels. Critical partnerships affecting forests are evolving around cross-boundary issues, such as climate change, land use, and water conservation. Nevertheless, analytical challenges remain in addressing issues that cross ecological, social, political, legal, and other boundaries. In addition, SFM remains difficult in practice owing to competitive land uses and diverse social objectives, particularly in places where incentives for SFM are low and pressures for development or agriculture are high.

Keywords: Sustainable forest management, forest policy, forest institution, forest law, forest instrument, criteria and indicators, Montréal Process.

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Chapter 1: Introduction

Kathleen A. McGinley and Frederick W. Cubbage¹

Background

The United Nations Conference on the Environment and Development (UNCED), held in Río de Janeiro in 1992, brought together the largest gathering of world leaders in history, including 117 heads of state and representatives of 178 nations, in pursuit of paths to sustainable development that include socioeconomic advances alongside environmental protections (Halpern 1992). Five major policy instruments were signed at UNCED. These instruments included two formal treaties with binding agreements on all parties: (1) a Framework Convention on Climate Change, and (2) a Framework Convention on Biological Diversity; and three nonbinding agreements: (1) the Río Declaration (a statement of principles on sustainable development), (2) Agenda 21 (an action plan for achieving those principles), and (3) a Statement of Forest Principles (goals and objectives associated with sustaining the world's forests) (UNCED 1992).

Although no binding agreement on forests was reached in Río, the Statement of Forest Principles and Agenda 21 chapter 11, “Combating Deforestation,” pledged parties to sustain existing forests, rehabilitate degraded and deforested lands, improve forest utilization, and enhance forest-related human capacities. Both documents highlighted the need for “criteria, norms and definitions for systematic observations and assessment of forest resources” and catalyzed efforts to develop criteria and indicators (C&I) of forest sustainability at international to local levels (UNCED 1992).² More recently, the “Non-Legally Binding Instrument on Forests” adopted by the United Nations General Assembly in 2007 reinforced support for development and use of C&I frameworks for measuring, monitoring, and reporting on forest sustainability at various levels of governance (UN 2007).

In this report, we use C&I to collect, organize, and assess information related to the policies, institutions, and economic measures that influence forests and their management in the United States. This work is part of the larger U.S. initiative to measure, monitor, and report on forest sustainability at the national level using the

We use criteria and indicators to collect, organize, and assess information related to the policies, institutions, and economic measures that influence forests and their management in the United States.

¹ **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926; and **Frederick W. Cubbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008.

² “Criteria” define the essential elements against which sustainability is assessed, reflecting publicly held values framed as goals or standards. “Indicators” are aspects or parameters of a criterion that can be measured quantitatively or qualitatively and tracked over time (Montréal Process 2015).

Montréal Process criteria and indicators (MPC&I) for conservation and management of temperate and boreal forests. This work specifically contributes to the forthcoming *National Report on Sustainable Forests—2020*, and, more broadly, aims to provide critical information for understanding the political, institutional, and economic framework on forests and their management in the United States.

Forest C&I Initiatives

The International Tropical Timber Organization (ITTO) was a pioneer in the development of C&I, producing its first framework of C&I for tropical forests prior to UNCED in 1992 (Castañeda 2000). By the mid-1990s, multiple efforts were underway to develop C&I for forests of specific regions and for specific forest types. Eventually, nearly 150 countries participated in at least one of nine international processes to develop, implement, and use C&I for forest sustainability (Castañeda 2000). In addition to the ITTO C&I initiative, the most active processes have been the Pan European Forest Process, the Lepaterique Process for Central America, the Tarapoto Process for the Amazon Basin, the African Timber Organization initiative for humid Africa, and the Montréal Process for temperate and boreal forests. The Pan European and Montréal processes have made the most progress in establishing permanent secretariats, convening regular meetings, and reporting on C&I every 5 years or so (Grainger 2012). Overall, the impacts of these various initiatives have been mixed, with some significant progress in C&I developments for several forest regions and types; comparatively less progress in their national-level uptake, institutionalization, and regular reporting; and quite limited measurable impacts on forest sustainability and related policies (Grainger 2012, Poore 2003, Wijewardana 2008).

The Montréal Process

Following agreements made at UNCED in 1992, an international seminar of experts on the sustainable development of boreal and temperate forests was held in Montréal, Canada, in 1993 (Montréal Process 2014). This and subsequent meetings, collectively referred to as the Montréal Process, focused on the development of guidelines for measuring and tracking progress toward forest sustainability at the national level. In 1995, participating countries signed the Santiago Declaration, agreeing on a comprehensive framework of C&I for assessing and reporting on the conservation and sustainable management of temperate and boreal forests. Normative assessments of forest sustainability by decisionmakers and other stakeholders are facilitated by the information gathered and generated through this framework. As it currently stands, the MPC&I framework consists of seven criteria, which characterize the essential ecological, economic, and social components of SFM and

54 indicators, which provide a means for their measurement (table 1.1). Over time, the Montréal Process indicators have been revised based on experiences with their implementation, their effectiveness in measuring forest sustainability, and evolving international priorities to measure and monitor forests, but the seven Montréal Process criteria have been maintained as originally crafted (Montréal Process 2015).

Table 1.1—Montréal Process Criteria

Criterion (number of indicators)
C1. Conservation of biological diversity (9)
C2. Maintenance of the productive capacity of forest ecosystems (5)
C3. Maintenance of forest ecosystem health and vitality (2)
C4. Conservation and maintenance of soil and water resources (5)
C5. Maintenance of forest contributions to global carbon cycles (3)
C6. Maintenance and enhancement of socioeconomic benefits from forests to meet the needs of societies (20)
C7. Legal, institutional, and economic framework for forest conservation and sustainable management (10)

Today, 12 countries participate voluntarily in the Montréal Process: Argentina, Australia, Canada, Chile, China, Japan, Mexico, New Zealand, the Republic of Korea, Russia, the United States, and Uruguay. Together, they account for 45 percent of world trade in wood and wood products, about half the world’s population, and about 60 percent of the world’s forest area (Montréal Process 2015). The United States has been an active member of the Montréal Process since its inception and has made a political and institutional commitment to use the framework to track progress in forest sustainability at national and subnational levels (USDA FS 2011). It has reported on the MPC&I three times since 1997, with a fourth assessment report planned for release in 2020 (USDA FS 1997, 2004, 2011). Most member countries have used the MPC&I at least twice to assess the status of and trends in their nation’s forests.

Montréal Process criterion 7—

In 2009, member countries agreed on revisions to the indicators associated with criterion 7. These revisions reduced the original subset from 20 to 10 indicators, maintaining some of the original indicators (e.g., 7.3.a, 7.3.b), modifying or combining several (e.g., 7.1.a, 7.2.a, 7.4.b), and adding two new indicators on forest-related partnerships and cross-sectoral policy and program coordination (i.e., 7.1.b, 7.5.a) (table 1.2). Specifically, these 10 indicators focus on (1) forest-related legislation,

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Table 1.2— Current and original indicators under Montréal Process criterion 7 (C7): legal, institutional, and economic framework for forest conservation and sustainable management

Current C7 indicator (Montréal Process 2015)	Original C7 indicators (Montréal Process 2006)
Indicator 7.1.a: Legislation and policies supporting the sustainable management of forests.	Very similar to the original indicators 7.1.b: Extent to which the legal and policy framework provides for periodic forest-related planning, assessment, and policy review; 7.1.d: Extent to which the legal and policy framework encourages best practice codes for forest management; 7.1.e: Extent to which the legal and policy framework provides for the management of forests to conserve a range of values.
Indicator 7.1.b: Cross-sectoral policy and program coordination	New to the MPC&I ^a framework and has not been measured or reported in previous reporting cycles.
Indicator 7.2.a: Taxation and other economic strategies that affect the sustainable management of forests.	Comprises the original indicators 7.3.a and 7.3.b, which address the extent to which economic policies and measures support the conservation and sustainable management of forests, including investment, taxation, and trade policies.
Indicator 7.3.a: Clarity and security of land and resource tenure and property rights	Very similar to the original indicator 7.1.a: Extent to which the legal and policy framework clarifies property rights, provides for land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides means of resolving property disputes by due process.
Indicator 7.3.b: Enforcement of laws related to forests	Very similar to the original indicator 7.2.e: Extent to which the institutional framework has capacity to enforce laws, regulations, and guidelines.
Indicator 7.4.a: Programs, services, and other resources supporting the sustainable management of forests	Closely related to the original indicators 7.2.c: Extent to which the institutional framework has the capacity to develop and maintain human resource skills across relevant disciplines; and 7.2.d: Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management.
Indicator 7.4.b: Development and application of research and technologies for the sustainable management of forests	Closely related to the original indicators 7.5.a–e; which address the capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services.
Indicator 7.5.a: Partnerships to support the sustainable management of forests	New to the MPC&I framework and has not been measured or reported in previous reporting cycles.
Indicator 7.5.b: Public participation and conflict resolution in forest-related decisionmaking	Closely related to original indicators 7.1.c: Extent to which the legal and policy framework provides opportunities for public participation in public policy and decisionmaking related to forests and public access to information; and 7.2.a: extent to which the institutional framework has the capacity to provide for public involvement activities. The additional focus on processes that reduce or resolve conflict amongst forest stakeholders is new to the MPC&I framework.
Indicator 7.5.c: Monitoring, assessment, and reporting on progress toward sustainable management of forests	Related to indicators 7.57–7.64 that address the capacity to measure and monitor changes in the conservation and sustainable development of forests and the capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services.

^a MPC&I = Montréal Process and indicators.

(2) cross-sectoral coordination, (3) taxation and incentives, (4) land tenure, (5) law enforcement, (6) institutions and personnel, (7) research and technology, (8) partnerships, (9) public participation and conflict resolution, and (10) monitoring and reporting (Montréal Process 2015).

Considered as a whole, the revisions to the criterion 7 indicators now provide a framework for examining the overall legal, institutional, economic, and policy framework for forests at national and subnational levels that is considerably more concise, streamlined, and measurable than the original subset of criterion 7 indicators. This revised set of indicators identifies information that is essential for understanding the enabling conditions for or impediments to sustainable forest management and for formulating or revising related policies and programs.

Measurement Approach

This report encompasses a comprehensive assessment of the criterion 7 indicators for the United States, which contributes to the broader effort led by the U.S. Department of Agriculture (USDA) Forest Service to regularly measure, monitor, and report on forests in the United States using the MPC&I and provides key information for assessing the state of and trends in forest governance at national and subnational levels in the United States.

We developed multiple metrics for measuring each of the 10 criterion 7 indicators at national and subnational levels and determined related sources of data (table 1.3). The Montréal Process Technical Advisory Committee provides technical notes on the application of the MPC&I to assist forest practitioners in collecting relevant data and reporting on the revised framework, and to aid policymakers, stakeholders, and the general public “understand the scope and application of C&I” (Montréal Process 2014). We used these technical notes as a primary reference to identify quantitative and qualitative metrics for each indicator and supplemented them with additional relevant metrics to enhance indicator measurement and reporting. Then, we identified data sources at national and subnational levels and collected and analyzed the data according to the indicator objectives.

As an example, the first indicator under criterion 7 addresses legislation and policies supporting the sustainable management of forests. In the United States, although there are thousands of national, state, and local laws and regulations that affect forests, there is no specific national source for data on forest-related legislation and policies. Through legal, organizational, and literature review, we identified, reviewed, and assessed the major federal laws that directly and indirectly affect sustainable forest management on public and private lands, reviewed and

Table 1.3— Montréal Process criterion 7 indicators and examples of metrics for their measurement

C7 indicators	Metrics examples
7.1.a Legislation and policies supporting sustainable forest management (SFM)	Number and description of national, subnational forest legislation and policies International forest, environmental agreements/processes participation
7.1.b Cross-sectoral policy and program coordination	Number and description of interagency arrangements Description of horizontal, vertical coordination
7.2.a Taxation and other economic strategies that affect forests	Description and funding of subsidies, incentives, taxes, etc. Area of forest land benefitting from economic strategies
7.3.a Clarity and security of land and resource tenure and property rights	Number and area of forest by property rights/tenure
7.3.b Enforcement of laws related to forests	Description of forest-related law enforcement processes and systems Number of forest-related prosecutions, convictions, and law enforcement officers per acre per agency
7.4.a Programs, services, and other resources supporting SFM	Description of public and private institutions involved in SFM Number of registered foresters Number of universities with accredited forestry curriculum
7.4.b Development and application of research and technologies for SFM	Number of full-time employee equivalents in forest science and research and development
7.5.a Partnerships to support SFM	Number, type, funding, and area covered by public-public, public-private, and international partnerships
7.5.b Public participation and conflict resolution in forest-related decisionmaking	Description and number of public consultation—processes, disputes, and public advisory bodies
7.5.c Monitoring, assessment, and reporting on progress toward SFM	Frequency, completeness, and currency of forest assessment by Montréal Process criteria

Source: Montréal Process 2014.

This report identifies a wide range of data types and sources for assessing forest laws, policies, economic instruments, and other governance factors.

summarized state and local forest legislation, and documented key references and websites for federal, state, and local laws. In the chapters that follow, we discuss each indicator, describing the specific metrics and methods used for its measurement, and the related results and findings.

Although some indicator metrics were associated with regularly collected or existing datasets, most indicators required primary or secondary data collection for this assessment. Gaps in data availability were found at all levels, particularly at the subnational level. Even when information was available, there were some challenges in aggregating data vertically as well as across geographies, organizations, and sectors. Ultimately, the identification of a wide range of data types and sources for assessing forest laws, policies, economic instruments, and other governance factors is an important outcome of this report.

Major Findings and Conclusions

Overall, federal and state laws govern the public lands of the United States, which contain about one-third of the nation's forest area. They dictate management and public involvement in various detailed approaches. Federal and state laws call for the protection of wildlife and endangered species on all public and private lands and include various levels of forest practices regulation or best management practices to protect water quality, air quality, and other public goods. Federal and state laws also provide for technical and financial assistance, research, education, and planning on private forest lands, but do not prescribe specific actions or standards for them.

Many newer market-based mechanisms, including forest certification, wetland banks, payments for environmental services, and conservation easements for implementing sustainable forest management, are increasing throughout the United States. And, there is increasing development of cross-sectoral policies and programs that link related policy networks, purposes, and desired outcomes across jurisdictions and administrative levels. Partnerships affecting forests are evolving around cross-boundary issues, such as climate change, land use, and water conservation. However, challenges remain in advancing forest sustainability in the United States, particularly where incentives for sustainable forest management are low and pressures for development and agriculture are high.

The Montréal Process criterion 7 sets out a fairly robust and inclusive assessment of forest-related legislation, policies, processes, and economic instruments toward a comprehensive measure of forest governance arrangements in the United States. With this revised set of indicators, we were able to identify and collect a considerable amount of data for assessing various characteristics of forest governance at multiple levels. Applying the criterion 7 indicators, this report provides a thorough overview of the status of forest policy institutions in the United States and serves as a benchmark for comparisons with other countries and future trends. Limits and gaps do remain, particularly in terms of the lack of regularly collected data on many aspects of forest policy, institutions, and economic measures at national and more importantly subnational levels. Furthermore, though multilateral agreements like the Montréal Process help identify common forest goals, develop metrics, and report individual country status, they by no means enforce specific forest practices or ensure good forest governance. Future assessments should build on this report and the data sources identified to continue to describe, assess, and track trends in forest governance in the United States.

Partnerships affecting forests are evolving around cross-boundary issues, such as climate change, land use, and water conservation.

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Chapter 2: Legislation and Policies Supporting the Sustainable Management of Forests (Indicator 45)

Frederick W. Cubbage, Kathleen A. McGinley, and Jay O’Laughlin¹

Indicator Background and Rationale

Legislation and policies designed to conserve and improve forest functions and values are a prerequisite to achieving sustainable forest management (Montréal Process 2015). Forests at all levels (stand, landscape, local, regional, national, global) require the application of forest practices that are capable of ensuring sustained use, management, and protection of important social, economic, and ecological values. Markets efficiently provide many goods and services, but government intervention may be required for the equitable allocation and management of ecosystem services and public goods, and to redress market failures. Indicator 45 provides information on legislation and policies, including regulations and programs that govern and guide forest management, operations, and use.

Measurement Approach

There are thousands of national, state, and local laws and regulations that affect forests. Indicator 45 is measured primarily through descriptive means. We list the major federal laws that could affect sustainable forest management on public and private lands, either directly or indirectly, but do not “quantify” them in terms of their number or impacts per se. Selected principal federal laws that directly affect forest management are discussed, as well as the related state laws that are used to implement the federal laws. Key references and websites for both federal and state laws are included.

The data for this indicator are largely from federal and state agency policy literature, available from the federal government or state websites. These policies and data are generally current, summarizing the status of the federal programs. These are complemented by literature on program evaluation and implementation of federal programs. The information on state forestry programs and policies can be obtained, in part, from state and forestry sector association sources on the Internet but is difficult to find consistently, let alone keep current and summarize succinctly

There are thousands of national, state, and local laws and regulations that affect forests.

¹ **Frederick W. Cubbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008; **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926; and **Jay O’Laughlin** is a professor emeritus and director emeritus, Policy Analysis Group, University of Idaho, College of Natural Resources, 7950 SE Osprey Street, Hobe Sound, FL 33455.

for 50 states. Ellefson et al. (2005) provided a previous review for the 2005 criterion 7 report, which is updated here, and expanded with new topics and new literature to match this new criterion 7, indicator 47 on legislation and policies. We also used Cubbage et al. (1993, 2017), which provided more extensive reviews of natural resource policies. A large amount of current Web and literature sources, which are cited here, also were used to compile this summary.

Status and Trends

No single national forest management law governs all public and private lands in the United States, or even all the public federal lands in the United States. There are three types of federal laws that affect forest land management: (1) statutes passed by the U.S. Congress and signed by the president, (2) administrative law—often referred to as regulations—that executive branch agencies promulgate to implement the statutes as directed by Congress, and (3) case law—also called common law—made via court decisions when judges rule on challenges affirming that agencies are not properly implementing statutory mandates. A wide variety of international, federal, state, and local forest policies exist to improve sustainable forest management and protection, as well as evolving nongovernmental market systems such as forest certification and corporate responsibility efforts. At the federal level, each agency has its own forest management policies and regulations, state public lands have separate management policies, and private forest lands are governed by relevant state policies but are not directly regulated in many states. National and subnational policies and laws that affect forest management and protection in the United States, such as environmental laws, are so abundant that summarizing them all succinctly is challenging. Broad overviews are possible here, and some details are illustrated in cited documents.

For reference, the United States has about 766 million ac of forest land (Oswalt et al. 2014). There are 321 million ac (42 percent) of public forest land and 445 million ac of private forest land (58 percent). Private noncorporate owners hold 39 percent (298 million ac) of the nation's forest land, and private corporate owners hold 19 percent (147 million ac) (Oswalt et al. 2014). Accordingly, there is a complex web of laws and policies that govern public and private forest lands, and there are significant differences in the laws among states. Federal lands have specific laws creating protected areas and planning laws for determining what the appropriate mix of forest uses should be; private lands are guided by the owners' objectives for their lands, with federal and state environmental laws acting as constraints; and state and local lands have various institutional arrangements and policies.

Laws and other policy tools related to forestry may include specific substantive rules, or require general processes that agencies or landowners must follow, and thus can be characterized as being process or substantive in nature. Process refers to procedures that must be followed before an action can be taken (e.g., an environmental analysis); substantive policies require specific actions and practices (e.g., leaving streamside buffers). In addition, there are a variety of laws and policy tools that prescribe specific practices, provide incentives, and provide research, educational, and technical assistance for private forest landowners. This spectrum of laws and various approaches to their implementation provides comprehensive coverage for sustainable forest management practices at the federal, state, and local levels (Cubbage et al. 2007, 2012; McGinley et al. 2012). However, sustainable forest management is neither defined nor required by these laws.

Federal Land Management and Planning Laws

As noted, no single national forest policy governs all public and private forest lands in the United States nor does any single policy govern all federal public forest lands. Several significant “organic acts” provide management discretion and authority for federal lands assigned by Congress to different federal agencies, and those broad statutory laws are all implemented by many separate regulations (i.e., rules for implementing statutes) and agency policies. Four agencies are responsible for managing more than 95 percent of the federal lands (Gorte et al. 2012), and Congress has provided each with its own organic act that provides management authority and guidance (table 2.1) in accordance with the different missions for lands assigned to them (box 2.1).

The Forest Service (FS), an agency in the U.S. Department of Agriculture, administers the largest total area of federal forest lands. The Multiple-Use Sustained-Yield Act of 1960 requires the Forest Service to provide sustained outputs and multiple uses on its 193 million ac of lands in the National Forest System, 145 million ac of which are classified as forest land, and the remaining area as rangelands/grasslands or other land types. The National Forest Management Act (NFMA) of 1976 defines a planning process for determining what mix of multiple uses and sustained outputs each planning unit is to provide. The Forest Service 2012 “planning rule” codifies regulations for implementing the NFMA.

The other three large federal land management agencies are in the U.S. Department of the Interior: the National Park Service (NPS), Fish and Wildlife Service (FWS), and Bureau of Land Management (BLM). The NPS is charged with protecting natural and cultural features and providing opportunities for public enjoyment of those resources. The FWS is responsible for managing national wildlife refuges

No single national forest policy governs all public and private forest lands in the United States nor does any single policy govern all federal public forest lands.

Table 2.1—Major U.S. federal natural resource agency land areas and organic acts, 2010

Federal department/agency	Land area	Organic act for management authority
	<i>Acres (hectares)</i>	
U.S. Department of the Interior:		
Bureau of Land Management	247,859,076 (101 166 970)	Federal Land Policy and Management Act of 1976
Fish and Wildlife Service	88,948,699 (36 305 591)	National Wildlife Refuge System Administration Act of 1966; National Wildlife Refuge System Improvement Act of 1997
National Park Service	79,691,484 (32 257 136)	National Park Service Act of 1916
U.S. Department of Agriculture:		
Forest Service	192,880,840 (79 726 873)	National Forest Management Act of 1976
U.S. Department of Defense:		
Natural Resources and Environment	19,421,540 (7927 159)	
Army Corps of Engineers Civil Works/Recreation	12,000,000 (4 897 959)	
Total, all federal land	628,801,639 (256 653 730)	
All land, United States	2,263,230,000 (923 767 347)	
All forest land, United States	748,923,000 (305 682 857)	

Agency land area source: Gorte et al. 2012.

By the late 1990s, all federal land management agencies had adopted the principles of ecosystem management.

and also carries out the regulatory functions of managing populations of migratory birds and conserving imperiled species, on private as well as public lands. The BLM has 38 million ac of forest land out of its 248 million total ac, which encompass most of the most public rangeland in the Western States.

Despite some differences in their missions, by the late 1990s, all federal land management agencies had adopted the principles of ecosystem management, which focuses on sustaining ecosystems to meet both ecological and human needs for present and future generations (Meffe et al. 2002). Although there is no statutory requirement for the agencies to adopt ecosystem management, “the central components of ecosystem management have undoubtedly made their way onto the federal lands (including) adaptive management, collaboration, and restoration... all (of which) figure more prominently in federal land politics and planning” (Nie 2013). However, ecosystem management implementation by the agencies, even in its more modern forms, has become increasingly problematic, because, according to Nie (2013) “the legal and institutional challenges to practicing a more ecosystem-based approach to planning are still in place.”

The NPS and the FWS limit or prohibit timber harvesting on most lands assigned to them, and even the FS and BLM have substantial limits on logging on

Box 2.1

Mission Statements of Major Federal Land Management Agencies in the United States

Forest Service:

“Sustain the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of present and future generations.”

Bureau of Land Management:

“Sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.”

National Park Service:

“Conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.”

Fish and Wildlife Service:

“Working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.”

their lands through strict planning rules and regulations, as well as requirements for environmental impact statements on “major” land management projects. The National Wilderness System, encompassing 109 million ac across several federal agency jurisdictions, provides strict limitations on resource use to protect wilderness values. The National Trails System and the National Scenic Rivers System also provide strict protection for lands near specifically designated trails and rivers.

The NFMA provided some general principles under which national forests were to be managed but avoided specific prescriptive language regarding silvicultural methods. The act did, however, mandate that clearcuts be generally limited to no more than 40 ac. Further, it stated that timber rotations should be based on the criterion of maximum mean annual increment—a biological measurement that calls for longer rotations than economic criteria. More importantly, the NFMA mandated that national forest plans be developed for each forest, integrating all multiple uses. The plans were to be prepared by interdisciplinary teams of specialists in forestry, wildlife, recreation, social sciences, and other relevant disciplines. NFMA also initiated procedures and rules for widespread public input, public review, and appeal

The National Forest Management Act mandated that national forest plans be developed for each forest, integrating all multiple uses.

of the plan. National forest plans also are subject to National Environmental Policy Act (NEPA) requirements, as described below.

The 2012 Forest Service planning rule and its directives are a procedural policy designed to provide a framework for making and revising land management plans for each Forest Service national forest and grassland. Every national must prepare and follow a forest management plan written under the guidelines enumerated in the planning rule. Each plan must identify alternative management actions for maintaining plant, animal, and ecosystem diversity and resilience; meet the requirements of the Multiple-Use Sustained-Yield Act (timber, wildlife, grazing, water, and recreation) and the Wilderness Act; account for ecosystem services; protect water and watersheds; and promote socioeconomic sustainability (USDA FS 2015a, 2015c). The revised rule requires the development of these land management plans with public input and taking in account landscape-level context, using the best available science and incorporating local knowledge. The planning process is integrated within a three-part cycle of conditions assessment, plan revision and amendment, and monitoring as conditions change (Sherman 2012).

Salient components and issues with national forest planning include public participation, collaboration, biodiversity requirements, inventory and monitoring, operational forest management problems, forest planning methods, public values, operations research, rural development, and much more. This breadth of issues and components for the NFMA, which is just one component of all the lands and laws in the United States, cannot be definitive regarding the status of sustainable forest management laws and legislation in the country, but must abstract the general principles regarding the subject. Specifically, in regard to the NFMA and national forest planning, 729 challenges against the Forest Service were filed in federal court from 1989 to 2002. Of these cases, the Forest Service won 58 percent, lost 21 percent, and settled 18 percent (Keele et al. 2006). Legal challenges associated with national forest planning are discussed in more detail in chapter 10.

The FS is not the only federal agency that has mandated planning requirements. The other three major land management agencies also conduct land and resource management planning. The BLM has explicit guidelines expressed in the Federal Land Planning and Management Act of 1976 that are somewhat similar to NFMA planning requirements. The NPS and the FWS have narrower missions than the FS and BLM and thus less complex planning requirements. For instance, neither agency is required to consider the full range of commercial development with which the FS and BLM must contend, but both still face conflicts between resource preservation and developed uses such as recreation, hunting, and fishing opportunities.

Federal Environmental Laws

In addition to the federal land systems created by Congress, the organic acts assigning them to different agencies, and the planning laws they must follow, numerous federal environmental laws affect all public and private lands in the United States. These laws were enacted or amended following the advent of modern environmental legislation in 1969. These are not specifically forestry laws, but all may have some impact on sustainable forest management on public and private forests, as well on other land uses in the country. Table 2.2 summarizes the laws chronologically. We drew from Cubbage et al. (1993, 2017) to summarize these laws as they related to sustainable forest management.

Table 2.2—Major federal environmental laws and major amendments, 1969–2015

Legislation	Year(s) enacted and amended	Current implementing agency	Focus
National Environmental Policy Act PL 91-190	1969	All federal agencies	Requires environmental assessments and impact analyses for major federal projects
Resources Recovery Act PL 91-512	1970	EPA	Solid waste management and disposal
Clean Air Amendments PL 91-604	1970 1977 1990	EPA	Point source and vehicle air quality standard and emission limits, state implementation plans; later added more listed pollutants and cap-and-trade to control acid rain
Federal Water Pollution Control Act Amendments (Clean Water Act) PL 92-500	1972 1977 1987	EPA	National water quality goals, control of point and nonpoint source pollution, wetlands protection, state planning and assistance
Federal Environmental Pesticide Act PL 92-516	1972 1996	EPA	Registration of all pesticides, licensed applicators, reasonable risk standards
Marine Mammal Protection Act PL 92-532	1972	EPA	Regulated dumping of wastes into ocean and coastal waters
Coastal Zone Management Act PL 92-583	1972	DOC	Federal guidelines and grants to states for planning
Endangered Species Act PL 93-205	1973	DOI FWS / DOC NMFS	Listing and protection of threatened and endangered species
Safe Drinking Water Act PL 93-523	1974 1986 1996	EPA	Drinking water standards; state programs to protect underground water supplies
Magnuson-Stevens Fishery Conservation and Management Act PL 94-265	1976 1996 2006	DOC	Goals for protecting ocean fishes, quotas to protect fisheries, advisory councils, scientific committees
Toxic Substances Control Act PL 94-469	1976	EPA	Testing and ban of dangerous chemicals, prohibited PCBs
Resource Conservation and Recovery Act PL 94-580	1976 1984	EPA	Hazardous waste treatment, storage, and transportation, recycling

Table 2.2—Major federal environmental laws and major amendments, 1969–2015 (continued)

Legislation	Year(s) enacted and amended	Current implementing agency	Focus
Surface Mining and Control Act PL 95-87	1977	DOI	Environmental controls on strip mining, limits on key lands, land restoration
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); PL 96-510	1980 1986 1990	EPA	Hazardous waste, dump site cleanup, “Superfund,” cleanup liability
Nuclear Waste Policy Act PL 100-203	1982 1987	DOE	Plans for permanent disposal of high-level nuclear waste
Global Climate Protection Act PL 100-204	1988	State Department	Federal strategy for responding to climate change threat
Ocean Dumping Act PL 100-688	1988	EPA	Control of ocean dumping sources and permit requirements
Oil Pollution Act of 1990 PL 101-380	1990	DOT and DOC	Oil spill cleanup and costs
Energy Policy Act PL 102-486	1992 2005	DOE	Domestic, nuclear, and renewable energy, subsidies, environmental regulation exemptions
Omnibus Water Act PL 102-575	1992	DOI	Western water projects, allocation, and rights, wildlife protection
Small Business Liability Relief and Brownfields Revitalization Act PL 107-118	2002	EPA	Amended CERCLA for revitalization of old industrial sites
Paleontological Resources Preservation Act PL 111-011	2009	All federal agencies	Protect paleontological resources on federal lands, require permits for collecting paleontological resources

DOC = Department of Commerce; DOC NMFS = Department of Commerce, National Marine Fisheries Service;; DOE = Department of Energy; DOI FWS = Department of the Interior Fish and Wildlife Service; DOT = Department of Transportation; EPA = Environmental Protection Agency; PCBs = polychlorinated biphenyls.

Source: Adapted from Cubbage 2020, Vig and Kraft 2003.

NEPA affects all major federal actions and expenditures as well as land management activities on federal lands, thus extending the reach of the law to activities such as state highway construction across federal lands and housing developments that use federal funds. The Endangered Species Act (ESA) of 1973 protects listed threatened and endangered fauna on all lands, and listed flora on federal lands. The Federal Water Pollution Control Act Amendments of 1972, now most commonly referred to the Clean Water Act or CWA, governs water quality protection throughout all public and private lands in the Nation. Overall, the major federal environmental laws have various impacts on federal, state, and private landowners who use the lands for forest, range, agricultural, and urban uses. Note the distinction between land ownership, and land use/cover; any combination of ownership and land use may exist, and different laws and policies may affect different landowners or land uses somewhat differently. A summary of the key federal laws and their state implementation components follows.

National Environmental Policy Act of 1969—

NEPA requires environmental impact analyses and statements for proposed “major” federal agency actions with the potential to have environmental impacts. NEPA is process law, not an act that requires substantive practices or a specific action, and is a strong policy instrument to ensure that environmental protection is considered by federal agencies in project development (Anderson 2010); i.e., the agencies must take a “hard look” as they are planning to take actions. NEPA is administered by the Council on Environmental Quality, which was established specifically to administer the law and is under the president’s direct control. Many states have similar state environmental policy acts as well, as listed later in the state policy section.

Although NEPA requires consideration and detailed analysis of “major” federal actions, how “major” actions are defined and interpreted is the subject of considerable contention, and many court cases. NEPA authorizes public lawsuits to enforce the law, which have been a standard strategy for many groups trying to halt or ameliorate what they consider to be environmentally adverse federal actions. Although NEPA is directed only at federal actions, its broad mandates and the external effects of federal actions can affect state, local, private, and even international development activities (Caldwell 1999). The overall process for NEPA analysis is depicted in figure 2.1.

The National Environmental Policy Act requires environmental impact analyses and statements for proposed “major” federal agency actions.

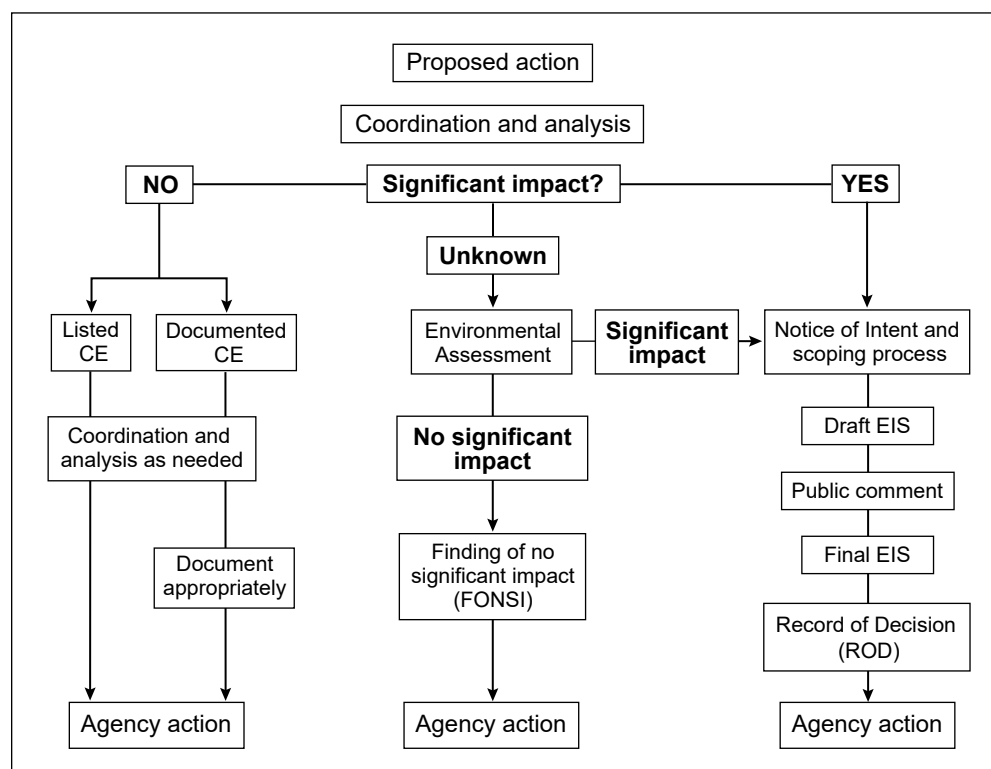


Figure 2.1—National Environmental Policy Act decision process (Cubbage et al. 2017).
CE = categorical exclusion, EIS = environmental impact statement.

For small projects, with known and minimal impacts, a categorical exclusion (CE) from a detailed NEPA analysis may be granted. If the potential impacts of a project or action are unknown, an environmental assessment (EA) is required, which entails a relatively full scoping of the issue, including environmental analyses and public input and review. If the EA determines that there will be no significant impacts, the agency will issue a “finding of no significant impacts” (FONSI). If the potential impacts of an action are found to be significant in the EA, a full, detailed, environmental impact assessment (EIS) is required, which includes identification of specific listed reasonable alternatives to achieve the project goal; detailed analyses of environmental impacts for each of those alternatives; and formal public review and comment procedures.

Citizen lawsuits to enforce NEPA are provided for explicitly, and federal agencies may be sued for failure to perform an EA/EIS, or for performing a deficient EA/EIS. NEPA requires consultation with other federal and state agencies, open and well-documented public input processes, release of draft EIS documents in the *Federal Register*, and agency responses before the final alternative is selected. NEPA does not require that the alternative with the least environmental impact be chosen, but it does require clear and reasonable justification for the preferred alternative that ultimately is chosen.

The Endangered Species Act is intended to protect significantly imperiled species and the ecosystems upon which they depend, on public and private lands.

Endangered Species Act of 1973—

The ESA is intended to protect significantly imperiled species and the ecosystems upon which they depend, on public and private lands. The ESA creates three main processes: (1) the identification and designation of species and their critical habitat through “listing” (the process of identifying species to put on either the endangered or threatened species lists), (2) protection of those species and their critical habitat, and (3) recovery of the species to the point at which ESA protection is no longer necessary. As of December 2019, 679 animal species and 943 plant species found in the United States and its protectorates were listed as endangered or threatened under the ESA.

The presence of a threatened or endangered species on federal lands drastically affects management by making protection of the species the dominant use to which all others must be adjusted. Protection provisions in the ESA have provided courts with grounds to enjoin proposed dams, roads, hunting regulations, and timber harvesting plans. For example, the northern spotted owl (*Strix occidentalis caurina*) controversy in the Pacific Northwest and litigation involving the protection of the red-cockaded woodpecker (*Leuconotopicus borealis*) in the Southeast challenged traditional timber management practices in national forests, training on military installations, and development on private lands (Cubbage et al. 2017).

Listing is important because it triggers the major provisions of the ESA, which are to “conserve” listed species (defined in the ESA as any action that contributes to the recovery of the species); prohibit actions that may cause “jeopardy” (on federal lands only), destruction, or adverse modification of “critical habitat” (defined in the ESA as habitat essential for the recovery of the species); and prohibit “taking” (defined in the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species).

Species may be listed as endangered or threatened. The distinction between listing a species as “endangered” and “threatened” is subtle [ESA section 3]: An endangered species is “...any species which is in danger of extinction throughout all or any significant portion of its range.” A threatened species is “...likely to become an endangered species within the foreseeable future.” As a practical matter, the difference is that a threatened species may be “taken” under certain circumstances that would promote conservation and are defined in an approved habitat conservation plan [ESA section 10]; an endangered species may not be “taken” except under very limited and explicit circumstances, such as for American Indian cultural traditions.

Two federal agencies and their cabinet officers have the authority to list species: the FWS under the Secretary of the Interior, and, in the case of salmon, other anadromous fish, and most marine species, the National Marine Fisheries Service (NMFS) under the Secretary of Commerce. Listing determinations must be made “...solely on the basis of the best scientific and commercial data available to him after conducting a review of the status of the species and after taking into account those efforts, if any, being made by any state or foreign nation... to protect such species” [ESA section 4(b)(1)(A)]. Note that petitions to list a species may be initiated by individuals or by the two agencies; almost all petitions are filed by individuals or by wildlife or conservation nongovernmental organizations (NGOs). These NGO petitions have often taken the form of lawsuits mandating action for reviews of listing by the FWS or NMFS.

Once a species has been listed, section 7 prohibits “jeopardy” and gives all federal agencies an affirmative duty to “conserve” the species, which means do whatever they can to see that the species will be delisted sometime in the future when it has met quantified goals specified in a section 4 recovery plan. Part of the section 7 mandate is to protect listed species. This involves several things, all intended to promote the conservation of listed species. A federal agency may not act (i.e., do anything) unless it ensures that such action will neither jeopardize a species nor adversely affect the designated critical habitat of the species (ESA section 7(a)(2)). Agencies planning actions in an area used by an ESA-protected species must consult with either the FWS or NMFS.

Species may be listed as endangered or threatened.

Section 9 of the ESA applies to all lands and involves several prohibited actions. First, trade in endangered species is prohibited without a permit, grantable only in a few narrow situations. Second, no person may “take” an endangered species, and “taking” is defined very broadly: “The term ‘take’ means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” [ESA section 3(19)]. Furthermore, the FWS defined “harm” to include “an act which actually kills or injures wildlife [including] significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering” [50 C.F.R. section 17.3 (1986)]. In essence, this regulatory definition applies to all habitat, not just critical habitat. Third, with few exceptions (e.g., traditional use by indigenous peoples), possession of endangered species, their parts, and their products is prohibited.

Section 10 describes exceptions to the “take” prohibition. Specifically prohibited acts can be allowed if (1) harm to a species is an “incidental take” (not the purpose of) an activity or (2) are needed to enhance survival of a species, and (3) an adequate “habitat conservation plan” (HCP) is provided. The plan must describe impacts, describe how they will be minimized and mitigated (e.g., creating or donating habitat elsewhere), demonstrate adequate funding is available to carry out the plan, and demonstrate the taking will not appreciably increase chances of extinction for the species.

Two implementation rules in the 1990s were designed to settle disputes over impacts of ESA on private lands and led to the rapid expansion of the HCP program. First, the “no surprises” rule guaranteed landowners that once an HCP was approved, the government could not later demand stricter rules based on new information, new scientific knowledge, or changes in the condition of the species. Second, the “safe harbor” rule encourages voluntary efforts by landowners to manage their lands to support listed species. Despite some opposition by conservation scientists, the HCPs, no surprises, and safe harbor policy tools provided landowners with regulatory stability and reasonable amounts of continued commercial production, and muted critics who want to eliminate the ESA altogether (Klyza and Sousa 2008).

Clean Water Act—

The Federal Water Pollution Control Act (FWPCA) Amendments of 1972 and its amendments in 1977 and 1987—now termed the Clean Water Act (CWA)—are intended to restore and maintain the chemical, physical, and biological integrity of the waters of the United States. As originally codified, the statute was to eliminate the discharge of point sources of pollutants into navigable waters so they would be fishable and swimmable. The law also prohibits degradation of existing water quality levels (termed “non-degradation”). The CWA and its amendments and

subsequent regulations have the most widespread impacts of all environmental laws on public and private agricultural, forest, urban, and mining activities.

The 1972 law distinguished between point sources and nonpoint sources of pollution. Point source pollution is any discrete conveyance such as a pipe, ditch, or other identifiable source with a distinct origin. The definition of nonpoint source pollution has evolved to mean pollution originating from a widespread land area, such as agricultural, silvicultural, mining, or construction activities. Also, in 1972, the Nixon administration created the Environmental Protection Agency (EPA) and assigned to it the responsibility for implementing the CWA.

The key sections of the CWA affecting forest management, agriculture, ranching, and urban development are covered below. Sections 208 and 319 deal with nonpoint source pollution; section 404 for wetlands dredge and fill permits, and section 402 for industrial point sources; sections 303 and 305—mandating a list of waters not meeting standards intended to support designated beneficial uses of a waterbody; and section 303(d)—the total maximum daily loads, or maximum pollutant allowed in a water body without violating water quality standards; such standards may be a quantitative numeric limit or, as in the case of sediment, qualitative.

Sections 208 and 319, nonpoint source pollution—The CWA regulations provide criteria for determining nonpoint sources of pollution: (1) pollution induced by natural processes such as precipitation, seepage, percolation and runoff; (2) pollution not traceable to any discrete or identifiable facility; and (3) discharged pollutants that are better controlled through the use of best management practices (BMPs). Sections 208 and 319 of the CWA mandate state planning to control nonpoint source pollution from mining, development, agricultural, and silvicultural activities. Section 319 of the CWA requires each state to prepare detailed water quality management plans that identify bodies of water that are not in compliance with water quality standards because of nonpoint source pollution. States are required to identify categories and individual nonpoint sources that violate water quality, and to describe control mechanisms. States could devise either mandatory or voluntary programs to control nonpoint source pollution, including BMPs to mitigate impacts, which are discussed more in the state forestry law section.

Most forestry sources of pollution under the CWA are nonpoint in nature, but specific regulations identify those silvicultural activities that constitute section 402 point sources of pollution, including (1) rock crushing, (2) gravel washing, (3) log sorting, and (4) log storage facilities. A legal challenge to the CWA in Oregon in the 2010s maintained that forest roads were also point sources and would thus require a section 402 stormwater permit. That case was elevated to the U.S. Supreme Court (*Decker v. Northwest Environmental Defense Center*, 568 U.S.

Sections 208 and 319 of the Clean Water Act mandate state planning to control nonpoint source pollution from mining, development, agricultural, and silvicultural activities.

(2013)). The court held that the CWA exempts the logging road storm water runoff from section 402 permits because the runoff was not associated with industrial activity. Roads were used for the transport of raw materials; they were not used for the manufacturing, processing, or storage of those materials. The court deferred to the EPA's interpretation that the permit requirement extends only to traditional industrial sites, such as factories, and that the use of BMPs to control the mostly nonpoint source pollution was adequate. Therefore, runoff ditches and channels did not constitute point sources that require permits under the act (Oyez 2015). Furthermore, a small but very significant CWA amendment contained in the 2014 Farm Bill specifically exempted forest roads from consideration as point sources of pollution.

Section 404, wetland modification—Section 404 of the 1972 FWPCA mandated that the U.S. Army Corps of Engineers (COE) develop regulations governing permits and their jurisdiction in wetland areas, and allowed a broad definition of wetlands based on vegetation, soils, and hydrology (Stine 1983). Because wetlands are areas that are periodically or continuously inundated by water, they fall along a transitional zone between permanently wet aquatic ecosystems and dry terrestrial ecosystems. From one end to the other, this zone differs considerably in the associated hydrologic conditions and area. Consequently, wetland boundaries are not easily identified. A definition that is both practical and legally precise and that accurately reflects ecological reality has engendered debate for decades. Wetlands are defined in statutory law as

...those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (CWA section 404).

The EPA (2015a) describes the coverage of section 404:

Section 404 of the Clean Water Act (CWA) establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Activities in waters of the United States regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and mining projects. Section 404 requires a permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from Section 404 regulation (e.g., certain farming and forestry activities).

Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands.

The basic premise of the program is that no discharge of dredged or fill material may be permitted if (1) a practicable alternative exists that is less damaging to the aquatic environment or (2) the nation's waters would be significantly degraded. In other words, when you apply for a permit, you must first show that steps have been taken to avoid impacts to wetlands, streams and other aquatic resources; that potential impacts have been minimized; and that compensation will be provided for all remaining unavoidable impacts.

After considerable public debate about wetlands, three distinguishing features delineating their extent were defined and described in the official 1987 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands*: (1) wetland hydrology (water at or near the surface for some part of the growing season); (2) hydric soils (seasonally wet or saturated); and (3) hydrophytic vegetation (plants adapted for life in saturated soil) were all required for an area to be classed as a wetland. These definitions have been extremely controversial as they determine whether private land is subject to federal regulation; specifically, it determines whether wet areas are “permissible”—i.e., whether the area needs a federal section 404 permit before the owner can modify the area by dredging or filling it. The rules for determining a permissible federal wetland are specific, at least on paper, but still require considerable COE interpretation and discretion on the ground to determine whether permits will be required in a particular area.

There are many debates about what activities are subject to or exempt from section 404 permit requirements, and whether such permits would be granted if required. This is related to the definition of “Waters of the United States” (WOTUS) in addition to issues with clearing land for farming, timber harvesting in wetland areas, (e.g., swamp logging), and development issues in general. In 2015, EPA (2015b) released a new definition of WOTUS, including wetlands, which met with strong opposition from farm and forestry groups as an expansion of the scope of EPA and COE regulatory authority. Several groups and states filed lawsuits to stop implementation of the new rule. Then, in 2017, the 2015 WOTUS regulations were annulled and reverted to the 1987 guidelines. The lawsuits and implementation were still pending as of 2019. The eventual final definition will determine the degree to which varying dry land and wetland rural lands, even on private lands, are subject to CWA section 319 or section 404 regulations.

Wetlands mitigation and banking—No net loss of wetlands became the official federal policy in 1990, and since then, wetlands mitigation and banking became crucial. Wetlands mitigation is the creation, enhancement, or restoration of a wetlands area. It can also refer to preserving wetlands, or leaving them alone. Offsite wetlands mitigation has become accepted as a means to allow development in wetlands to occur without a net loss of wetland acreage.

Wetlands mitigation and banking has become crucial.

Mitigation banking is the concept of compensating for wetland alterations by acquiring or improving land “off-site.” Banking can take many forms: (1) acquiring, protecting, and managing large areas of wetlands as a “bank” against which credits can be withdrawn in exchange for altering wetlands elsewhere; (2) enhancing and restoring degraded or former wetlands in exchange for credits to alter other wetlands; and (3) establishing a bank account into which cash is contributed for wetland acquisitions in exchange for permits to alter wetlands. Mitigation banking advantages include (1) large wetland areas (the banks) will benefit from protection, (2) banking encourages up-front mitigation (i.e., mitigation before development), and (3) increasing ease of monitoring by decreasing the number of sites to monitor.

Criticisms of mitigation banking include (1) bank lands may not be managed carefully and may not provide the wetland functions they are intended to replace; (2) scientific methodologies for quantifying wetland functions are presently crude and imprecise; (3) long-term ownership of bank lands may not be possible, leading to destruction of the lands by subsequent landowners; (4) it may not be ecologically sensible to replace wetlands lost in one geographic zone with wetlands in another (i.e., different states or physiogeographical regions); and (5) mitigated bank lands could be expensive to manage and monitor.

Clean Air Act—

The federal Clean Air Act (CAA) Amendments of 1970 and later amendments in 1977 required planning by each state to maintain air quality standards, with EPA providing administrative oversight and coordination of regional and state planning efforts. The 1970 act requires setting national primary and secondary air quality standards to protect public health. Per the 1970 law and as amended since, the CAA is intended to reduce outdoor, or ambient, concentrations of air pollutants that cause smog, haze, acid rain, and other problems; reduce emissions of toxic air pollutants that may cause cancer or other serious health effects; and phase out production and use of chemicals that destroy stratospheric ozone. Pollutants may come from stationary sources (like chemical plants, gas stations, and power plants) and mobile sources (like cars, trucks, and planes). Following its creation in 1972, the EPA became responsible for CAA implementation, and states were to develop plans to meet air quality standards, subject to EPA approval (U.S. Legal 2015).

Prescribed burning for agriculture and forest management is an important issue under the Clean Air Act.

Prescribed burning for agriculture and forest management is an important issue under the CAA. Most states have adopted regulations for controlling open burning in exurban areas. These laws have been prompted in part by the federal air quality law and partially by local issues. States often require burning permits to prevent

smoke from settling on highways, raising the potential for traffic accidents. These laws may also be used to achieve ambient air quality standards. All particulate matter smaller than 10 μm (called PM 10 particulates) are considered to be a concern for human health because their small size makes them hard to trap in the nose and throat. They can easily be swept into the small air passages of the lungs, where they may irritate tissues. Particulate matter smaller than 2.5 μm (called PM 2.5 particulates) may even pass through the lungs and into the blood stream. Small particulates are thought to play a role in lung damage, respiratory illness, cardiovascular disease, and premature death.

In 2006, the EPA strengthened standards for particulate matter, setting a maximum limit on particulate concentrations. Open burning of vegetation can result in the release of a variety of air pollutants including aerosols of organic acids and hydrocarbons, in addition to particulate matter of various sizes. If air quality in a given region is already approaching the standard for particulate matter, prescribed burning could cause that region to exceed the daily limits. Because prescribed burning can be scheduled, permits in areas at risk of being classified “non-attainment” can be restricted on “bad air quality days” to avoid violating air quality standards. Uncontrolled, accidental, or natural wildfires may significantly decrease air quality across large areas because of the smoke they produce. During wildfires, nearby air quality monitoring stations are effectively switched off—the data are not included in daily emissions counts and do not affect whether the area is “in attainment.” This is because wildfires are not considered to be intentional. However, prescribed fires are always subject to air quality standards, so their use must be planned carefully to keep the smoke they produce at acceptable levels (Monroe et al. 2013).

Federal pesticide and herbicide control—

Another major area of environmental protection measures has evolved under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1947 and its substantial amendments contained in the 1972 Federal Environmental Pesticide Control Act (FEPCA). The 1972 amendments authorized federal control over the application of pesticides, with the EPA in charge of pesticide regulation. In 1975, the act was amended to (1) require the EPA to advise the Secretary of Agriculture before taking action with respect to a pesticide, (2) provide the Department of Agriculture with specific authority to comment on pesticide regulations, and (3) require the EPA to assess the economic impact of any action proposed or taken against a pesticide. The 1975 amendments thus ensured some coordination among the EPA, Department of Agriculture, and relevant user groups (Dana and Fairfax 1980).

A 1978 amendment to FIFRA influenced the availability of minor uses such as forest tree nurseries, seed orchards, and greenhouses. The act required the EPA

The Federal Environmental Pesticide Control Act authorized federal control over the application of pesticides, with the EPA in charge of pesticide regulation.

to issue simplified regulations for registration of all chemicals and to define minor uses (such as forestry uses of agriculture chemicals) in a flexible manner. FIFRA also authorizes the responsible state enforcement agencies to impose greater regulations on the sale or use of any pesticide that has been registered with the EPA. For this reason, the requirements for certification differ to some degree among the states. In addition to the requirements for commercial forestry herbicide applications (i.e., where payment for application is involved), some states also require a business license for the company that performs the applications. Also, several states require special licenses for public or government agency work.

Other federal environmental laws—

As indicated in table 2.2, more than a dozen other federal laws affect sustainable forest management in some fashion. Recall that forests comprise about one-third of the total land area in the country, and that public lands comprise one-third of all land, much of which is forested. Thus any federal laws that affect public or private land will apply to forests as part of the U.S. land base. Details on the specifics of these laws and regulations can be obtained from the Code of Federal Regulations, from the relevant agency websites, and from various refereed and popular literature.

State Forest Policies

Most states have legislation that governs the management of state-owned forest lands, state forestry laws for private lands, and state environmental laws that usually, but not always, are linked to implementation of federal environmental laws. Ellefson and Hibbard (2005b) identified the number of states that employed regulatory approaches and programs to protect water quality (26 states); promote reforestation (14); regulate timber harvesting practices (17); protect forests from wildfire, insects, and disease (27); protect wildlife and endangered species (20), and enhance recreation and aesthetic qualities (8). States also use voluntary guidelines and BMPs, educational programs, technical assistance, and tax or financial incentives (see other criterion 7 indicators) to protect these forest functions and values. And although these voluntary guidelines may not be optional, they are often backed by specific general regulations to ensure that water quality is protected. There also is a plethora of county, local, municipal and city regulations related to tree protection, forest retention, roads, logging, and timber transport.

A review of state forestry laws by the Defenders of Wildlife (2000) found:

...at least 105 state forest management laws which can be categorized into nine basic types of regulatory legislation: forest management laws, policy and purpose laws, powers and duties laws or administrative legislation, land

acquisition laws, private landowner laws regulating privately owned forest areas, educational and forest research laws, timber laws regulating the cutting, harvesting and conservation of timber on state lands, prescribed burning and fire prevention laws, and disease and insect control laws. Sixty-six of these laws deal with forest land management, legislative policy, and the purposes, powers, and duties of state forestry agencies. Twenty-three of these laws concern timber resource regulation and harvesting, forestry education and research, and prescribed burning laws or laws permitting periodic burning of forest areas to promote new growth. The remainder of these laws relate to acquisition of state forest lands, regulation of privately owned forest lands, and prevention of diseases and insect infestations.”

State forest planning and environmental laws—

State governments have engaged in some form of forest planning activity since the early 1980s. These plans range from the development of comprehensive statewide forest resource plans to the preparation of plans required by forest practice regulatory programs, and from broad water quality plans that influence forests to plans for forest-based rural economic development (Ellefson and Hibbard 2005b).

State government planning activities focused on forests differ greatly in scope and magnitude. States may undertake different planning approaches (issue driven, goal driven, iterative planning) and pursue different goals, objectives, and strategies. Some states develop broad strategic plans that consist of a vision, objectives, and operational plans, whereas others tend to focus on the specifics of land use and management, especially state-owned forest land. Some state forest plans are prepared for private forest planning and private owners to allow for them to participate in cost-share programs, property tax relief programs, easement programs, or a state’s forest practice regulatory program. A few states use planning to control land development and growth management. Some activities are not allowed within designated forest areas, and some states limit conversion of forests to nonforest uses (Ellefson and Hibbard 2005b).

Ellefson and Hibbard (2005b) also list 17 states that have broad authority to perform EISs, either through specific environmental policy acts or general statutes. In addition, nine states had limited requirements for environmental assessments for lands such as wetlands or power plants. Ma et al. (2009) reviewed state environmental policies in detail as well and identified 37 states with formal environmental review requirements, which range widely in terms of the scope of related policies and procedures.

BMPs are specific practices or actions used to reduce or control impacts to water bodies from nonpoint sources of pollution.

Best management practices—

Forestry BMPs generally encompass conservation practices that help protect soil, water, and other forest resources and may be implemented through educational programs, voluntary guidelines, technical assistance, tax incentives, fiscal incentives, or regulatory approaches. BMPs are specific practices or actions used to reduce or control impacts to water bodies from nonpoint sources of pollution, most commonly by reducing the loading of pollutants from such sources into storm water and waterways. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants to water bodies (USDA FS 2015b).

At least 16 federal laws require development and application of best forest practice standards, ranging from the federal agency organic acts, to clean air and water acts, to coastal zone and endangered species, to occupational health and safety legislation. Three of these laws apply directly to federal land; nine apply to all forest land in the country; and 13 require indirect state action for best practice code development (Ellefson and Hibbard 2005a). In 2014, the Forest Service released proposed specific rules for a national forestry BMP program on Forest Service lands to improve management of water quality consistently with the CWA and state water quality programs (USDA FS 2015b). These rules integrated individual state and Forest Service regional BMPs under one umbrella to facilitate an agencywide BMP monitoring program and provide general, nonprescriptive BMPs for the broad range of activities that occur on National Forest System lands.

BMPs may be prescriptive and mandatory, as required in the state forest practice laws of all the states on the west coast and many in the Northeast, may require that forest managers and loggers follow specific processes, such as in the West and Virginia; or may be performance- or outcome-based, ensuring that water quality is protected, such as in North Carolina (McGinley et al. 2012). BMPs may cover a variety of practices, such as timber harvest, road construction, fire management, site preparation and planting, and insect and disease protection. They also may identify natural resources that are to be protected, such as water quality, air quality, wildlife, endangered species, or visual impacts. Local governments also implement BMPs for private forest lands, along with other land use controls on development, agriculture, or mining.

Ellefson et al. (2005) stated that more than 25 states have regulatory forestry BMPs to protect water quality and to protect landowners from wildfire, insects, and diseases. At least 45 states have educational and technical assistance programs for BMPs about water quality, timber harvesting methods, and protecting wildlife and endangered species; and more than 40 states have such programs to enhance rec-

recreation and aesthetic qualities. Schilling et al. (2009) and Ice et al. (2010) reported that all 50 states have some type of voluntary or regulatory forestry BMPs, and estimated the average national average BMP implementation rate to be 89 percent. Based on their best estimates from data in the top 16 timber-producing states, which provided 81 percent of U.S. timber removals, they estimated that BMP compliance is greater than 90 percent.

Even states that do not have legally required BMPs often have water quality laws intended to control surface erosion into water bodies, and methods to enforce BMP compliance. These include site inspections of logging operations, consultation with loggers in violation of voluntary standards, negotiated but required onsite remediation of violations, or prosecution under the separate water quality laws for failure to remediate if requested. Local governments can also identify BMPs for private forest lands, along with other land use controls on development, agriculture, or mining. Compliance with BMPs and all applicable federal and state laws also is required as part of the standards of all three major forest certification standards in the United States—the Sustainable Forestry Initiative (SFI), Forest Stewardship Council (FSC), and American Tree Farm System (ATFS) (Ice et al. 2010).

With an increased focus on the use of biomass for energy in the United States, several states have developed biomass harvesting guidelines (BHG) that identify BMPs. Forest biomass (e.g., small stems and large down woody debris) manipulation is related to soil productivity, water quality, and forest biodiversity, and its complete removal can negatively affect forest conditions. Therefore, guidelines for sustainable biomass harvesting increasingly are being developed and adopted at various levels of government and in the private sector. Five states enacted BHGs between 2007 and 2011, and several other states recently had BHGs under consideration (Fielding et al. 2012). Many of the Northeast and North Central states already have or are evaluating BHGs, and all the forest certification standards have many recommended practices that also cover biomass harvesting guidelines. More than 30 BHG forest practices are covered by state or forest certification standards, including woody debris, dead wood, silviculture, soils, water quality/riparian, wildlife/biodiversity, and other subjects (NEFA 2012).

Forest Certification

Forest certification is a private market-based sustainable forest management tool introduced in 1993 that is designed to measure, monitor, and improve economic, environmental, and social components of forestry. Forest certification has been termed a non-state market-driven governance mechanism (Cashore et al. 2004), indicating its market-based orientation, rather than government intervention. Lister

Compliance with BMPs is required as part of the standards of all three major forest certification standards in the United States.

(2011) extended this view, terming forest certification as co-governance, noting that while the private sector serves as the program administrator, there are many ways in which government is involved including educating, promoting, and funding certification; participating in certification as a government agency; and requiring use of certified forest products or green building design and construction, such as Leadership in Energy and Environmental Design (LEED).

Forest certification developed as a response to the lack of binding international forestry accords at the United Nations Commission on Environment and Sustainable Development in 1992 (Humphreys 2006). Environmental nongovernmental organizations, social and community organizations, and some private sector firms responded with the development of the global Forest Stewardship Council (FSC) in 1993, which was followed shortly thereafter by many individual country certification programs, such as the Sustainable Forestry Initiative (SFI) in the United States and Canada in 1995. The European forest certification programs were integrated into the Pan-European Forest Certification program (PEFC) in 1999, serving as an umbrella program linking individual European country programs. In the mid-2000s, PEFC expanded its reach beyond Europe by endorsing individual country programs throughout much of the rest of the world and ultimately maintaining the acronym but changing its name to the Programme for Endorsement of Forest Certification. During the same period, FSC expanded throughout most of the world as well, retaining a core set of 10 principles that guide the development of all individual country standards (Humphreys 2006).

As of mid-2018, 1.048 billion ac of forest were certified worldwide by the FSC and PEFC, including areas with single and dual certification but not double counting areas certified under both systems (UNECE/FAO 2019). The global area of certified forest in mid-2018 decreased by about 17.3 million ac from the previous reporting period (mid-2017), with much of the decrease attributed to declines in Australia's certified forest area (UNECE/FAO 2019).

The three U.S. forest certification systems include the Sustainable Forestry Initiative, American Tree Farm System, and Forest Stewardship Council-US.

The three U.S. forest certification systems include the Sustainable Forestry Initiative (SFI), American Tree Farm System (ATFS), and FSC-US. Both SFI and ATFS are endorsed by PEFC, the former including 63 million certified ac and the latter including 18 million certified ac in the United States as of mid-2019 (PEFC 2019, SFI 2019). The FSC-US program included 35 million certified ac in the United States in 2019 (FSC 2019). Some areas in the United States have been “dual certified” to more than one system, such that simply adding the certified area of the three systems would result in double counting some areas. In 2017, approximately 21.8 million ac of forest were dual certified by PEFC and FSC, such that about 13 percent of the nation's total forest area (749 million ac) was certified (Alvarez 2018).

Both SFI and FSC programs also certify the forest products supply chain from the “stump” or harvest site to the manufactured consumer product point of sale (or “chain of custody”), which together covers approximately one-third of all round-wood production in the United States.

The development and implementation of voluntary environmental program standards and audits by the private sector, including forest certification, is sometimes referred to as “soft law.” Soft law may well have a level of rigor that exceeds binding legal instruments or “hard law,” by requiring compliance with hard laws as a baseline for the voluntary programs, by setting standards that exceed those laws, and by ensuring compliance with system standards through annual audits by external third-party professionals. Where budgets and other constraints limit public agencies from monitoring and enforcement, certification and other voluntary environmental programs can provide a means for ratcheting up environmental standards and enhancing compliance (Cashore and Newson 2004).

International Policy Instruments

International policy and law addresses environmental and development issues, including forests. As of 2019, the United States had signed 35 international environmental treaties and was a participating member or party to another 127 international agreements (ENTRI 2019). This includes 65 agreements about the sea, 63 about waste and hazardous substances, 39 about wild species and ecosystems, 33 about fisheries, 28 about air and atmosphere, and 7 about forestry. The United States also has utilized bilateral and regional trade agreements to influence transnational policy and incorporate increasingly rigorous environmental requirements (Jinnah 2011). For example, the 2009 U.S.-Peru trade promotion agreement was the first bilateral agreement to go beyond requiring accepted environmental procedures by including a prescriptive annex of enhanced forest governance stipulations.

Although both a presidential signature and congressional ratification are required for legally binding multilateral environmental and trade agreements, much of U.S. international environmental engagement stems from voluntary processes and initiatives and bilateral aid programs, or are derived from U.S. leadership in international organizations (table 2.3). For instance, the United States is a member or an observer to all major international forest-related instruments, initiatives, and institutions; though it has elected not to ratify some agreements, such as the Convention on Biological Diversity and the Kyoto Protocol to the Framework Convention on Climate Change, and reversed course on others, including the Paris accord on climate change. U.S. involvement on many international environmental issues typically is a collaborative process among many U.S. agencies and representative scientists,

The United States had signed 35 international environmental treaties and was a participating member or party to another 127 international agreements.

Table 2.3—Major international forest-related instruments, initiatives, and institutions in which the United States participates

Legally binding instruments	Voluntary partnerships/initiatives	Institutional membership
United Nations (UN) Framework Convention on Climate Change	Montréal Process on Criteria and Indicators	UN Forum on Forests
UN Convention on International Trade in Endangered Species	Group on Earth Observations	Food and Agriculture Organization of the United Nations
UN Convention on Combatting Desertification	Global Partnership on Forest Landscape Restoration	Intergovernmental Panel on Climate Change
UN Convention on Biological Diversity—observer status	Forest Legality Alliance	UN Economic Commission for Europe’s Committee for Forestry and Forest Industry
Free Trade Agreements (environmental chapters/annexes)	Tropical Forest Alliance 2020	Global Environmental Facility
International Tropical Timber Agreement	Global Bioenergy Partnership	International Union of Forest Research Organizations
Ramsar Convention on Wetlands		International Union for the Conservation of Nature
Convention for the Protection of Migratory Birds		World Bank
		Asian-Pacific Economic Cooperation Expert Group on Illegal Logging and Associated Trade
		Center for International Forest Research

development practitioners, trade representatives, and foreign policy specialists.

In the early 2000s, growing concerns over illegal logging worldwide, and particularly in the tropics, prompted amendments to the Lacey Act of 1900, which prohibits the trade in wildlife, fish, and plants taken, possessed, transported, or sold illegally. In 2008, the Lacey Act was amended to include a broader range of plants and their products, specifically prohibiting U.S. commerce in illegally taken or traded timber products originating from anywhere in the world. The 2008 amendment also required U.S. importers and manufacturers to declare the legal source of imported wood and wood products, and addressed similar concerns for domestic sources. Violators of the Lacey Act, as amended, are subject to civil and criminal penalties, even if they did not know that they were dealing with an illegally harvested product, because the onus for verifying the legality of imported products is on the importer or trader. The 2008 amendment to the Lacey Act was the world’s first ban on trade in illegally sourced wood products.

Conclusions

The U.S. legislation and policies supporting the sustainable management of forests have evolved slowly over a century or more, and during the past three decades in particular. The United States has an extensive set of substantive and process laws that provide detailed regulations and planning for federal forestry, and considerable guidance to private forest management through broader environmental laws such as the ESA, CWA, and CAA. The laws governing federal forest management and protection include detailed agency organic acts and subsequent planning rules, and broad environmental laws requiring environmental impact statements and compliance with specific substantive actions. Laws that affect forest management and protection on private forest lands include direct regulation of forest practices or administrative processes, financial incentives and public research, professional and landowner education, and technical assistance.

In recent years, changes in administrative law, or the rules and regulations for implementing statutes, are the norm, rather than dramatic changes in statutory laws. Most of the federal forestry and environmental laws were enacted in the 1970s but have seen a series of changes in their subsequent rules and regulations. The laws are reviewed periodically, but on an ad hoc basis, not as a regular schedule. Sometimes case law decisions trigger such reviews and revisions. For private lands, state agencies implement most laws, ranging from strict state forest practice regulations in the West and burning laws in most states, to BMP implementation in all states. The forestry BMPs are voluntary in most states in the East but are monitored closely with periodic BMP evaluation surveys. Private landowners also must comply with or meet specific state water quality standards, which add strength to the voluntary BMPs. In the West, for example, all states have forestry BMPs, 11 of which have been developed or revised since 2000 (CWSF 2007, Ice et al. 2010), and most are required by rigorous state forest practice acts as well.

Throughout the United States, there is an ongoing evolution of BMPs, especially at the state level, resulting in increasingly sophisticated and detailed guidelines for reducing forestry impacts on water bodies and other resources, resulting in increased protection to forest streams, lakes, wetlands, and other systems. Biomass harvesting guidelines also have been adopted by many states and are being considered by others. The Forest Service has promulgated preliminary national BMP standards for control of water pollution on national forest lands, which are under review as of 2018.

Forest landowners also must comply with strict protections for any endangered or threatened species on their land, which had substantial impacts on logging on federal lands beginning in the 1990s and continuing today. Although some of these protections also affect private lands, landowners may develop habitat conservation plans or other agreements with the FWS to protect threatened or endangered species and retain some forest management flexibility.

Forest certification systems have continued to expand since their introduction in 1993, and each such system has revised its standards several times since then. The standards have continually become more rigorous, with greater levels of performance required for biodiversity and wildlife protection, community and stakeholder consultation, public reporting, and forest management practices. These systems are one type of voluntary environmental programs and corporate social responsibility efforts, which have become common for many business sectors.

Binding and nonbinding international agreements have probably increased their impact on U.S. forest management and protection the most in the 2000s. Reflecting an increasingly strong stance against illegal logging, at home and abroad, the Lacey Act of 1900 was amended in 2008. The act initially prohibited trade in wildlife, fish, and plants that have been illegally taken, possessed, transported or sold, and as amended prohibits U.S. commerce of illegally taken or traded timber products from anywhere in the world, requiring U.S. forest products manufacturers to track and verify the legality of imported timber, and at least address similar concerns for domestic sources. Other international agreements such as Convention on International Trade of Endangered Species also affect forestry to some extent, as do agreements on migratory birds and climate change.

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Appendix 2.1: Key Websites

Forest Service:

- National Forest Management Act: <http://www.fs.fed.us/emc/nfma/includes/NFMA1976.pdf>
- Health Forest Initiative: <http://www.fs.fed.us/projects/hfi/field-guide/web/toc.php>
- The Forest Planning Rule: <http://www.fs.usda.gov/planningrule>
- 2012 Planning Rule Final Directives <http://www.fs.usda.gov/detail/planningrule/home/?cid=stelprd3828310>

Federal Organic Acts:

- The Federal Land Policy and Management Act of 1976 as amended: <https://www.blm.gov/or/regulations/files/FLPMA.pdf>
- National Park Service: <http://www.nps.gov/grba/parkmgmt/organic-act-of-1916.htm>
- U.S. Fish and Wildlife Service: http://www.fws.gov/refuges/policiesandbudget/HR1420_index.html
- National Association of State Foresters: <http://www.stateforesters.org/>
- Council on Environmental Quality: <http://www.whitehouse.gov/administration/eop/ceq>
- National Environmental Policy Act: <https://ceq.doe.gov/index.html>
- U.S. Fish and Wildlife Service Endangered Species Act: <http://www.fws.gov/endangered/laws-policies/>

Certification home pages:

- Sustainable Forestry Initiative: <http://www.sfiprogram.org/>
- Forest Stewardship Council: <https://us.fsc.org/>
- American Tree Farm System: <https://www.treefarmssystem.org/>

Chapter 3: Cross-Sectoral Policy and Program Coordination (Indicator 46)

Kathleen A. McGinley and Frederick W. Cabbage¹

Indicator Background and Rationale

Forests are affected by a broad range of biophysical, economic, and social influences, many of which originate beyond the forest community in other sectors such as agriculture, housing, water, energy, and transportation. Urban development and other nonforest land uses can significantly affect forests and the goods and services that they provide. Indicator 46 is intended to assess the extent to which policies and programs are coordinated across forest and nonforest sectors to support forest sustainability (Montréal Process 2014). It is an important component of sustainability assessments as cross-sector coordination of policies and programs can facilitate shared goals, strategies, and instruments and lead to comprehensive solutions to complex problems affecting forests and their sustainability.

Measurement Approach

Building from theory and studies on cross-sectoral policy and program development and integration (Dube and Schmithusen 2003, Shannon and Schmidt 2002, Tikkanen et al. 2002), we identified critical issues and sectors affecting and interacting with forests in the United States. Then, we conducted Internet research (e.g., canvassing of government and civil society websites) and archival data review (e.g., analysis of organizational documentation including budgets, and refereed and grey literature) to determine and describe existing and emerging policies and programs that address the key issues through a cross-sectoral approach. We considered horizontal, vertical, and multidirectional coordination and activities among agencies and organizations across forest and nonforest sectors. Also, we identified major legal statutes requiring cross-sectoral coordination of planning and other activities affecting forests. The reported results represent a comprehensive cross section of key policies and programs that influence forests and the forest sector at different levels in the United States.

We identified critical issues and sectors affecting and interacting with forests in the United States.

¹ **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926; **Frederick W. Cabbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008.

Status and Trends

Forests are influenced by an expanding array of forces that stretch far beyond the forest sector. Complex issues such as water consumption, open space preservation, and biodiversity protection frequently intersect with forests, crossing ecological, economic, social, political, administrative, and legal boundaries (fig. 3.1). Traditionally, forest issues have been dealt with in a relatively autonomous policy sector in the United States (e.g., federal- and state-level forestry agencies). However, there is increasing emphasis on the development of cross-sectoral policies and programs that link related policy networks, purposes, and desired outcomes, many of which focus on a landscape-scale perspective (Meidinger 1999, Shannon and Schmidt 2002).

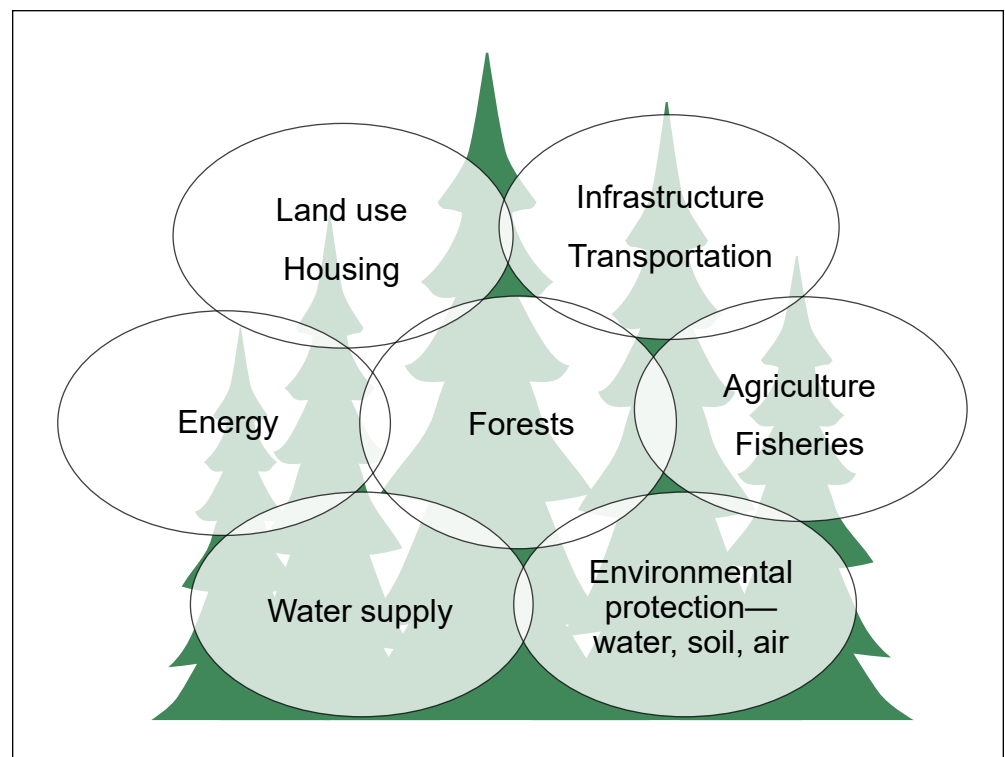


Figure 3.1—Key policy sectors interacting with forests in the United States (Adapted from Schmithusen 2003).

Land Use

Land cover in the United States reflects a dynamic pattern of land use that is influenced by multiple sectors and shifts over space and time. In theory, land is devoted to the use that provides the greatest value to its owner(s) (Freyfogle 2003, Hardin 1968, Nagubadi and Zhang 2007). However, land use choice often involves

complex interactions between multiple factors that include characteristics of the land and the landowner, and the economic, social, and policy context in which the choice is made. Forest land use in the United States is subject to influence from competing and at times misaligned sectors, such as urban development, agriculture, and energy. Yet, in some cases, diverse sectors demonstrate increasing compatibility, particularly when land use choices are structured in strategic, informed, and collaborative ways (USDA FS 2006).

Forests cover 33 percent (766 million ac) of the United States, active cropland covers an additional 19 percent (361 million ac), and developed land covers another 6 percent (113 million ac) (Oswalt et al. 2019, USDA 2013). Developed land is a comparatively small fraction of the total land area, yet the acreage of developed land has steadily increased since 1982, while lands used for growing food and forage crops have declined. And, although the total area of forest in the United States has remained fairly stable in recent decades, forest expansion mostly in the nation's interior on abandoned lands and following decades of fire suppression primarily is offset by forest losses to urban sprawl and development throughout the country and especially in the coastal regions of the East and West (Oswalt et al. 2019).

Between 1982 and 2007, most of the rural land that was converted to development in the United States included more than 11 million ac of cropland, 12 million ac of pasture and rangeland, and 16 million ac of forest land (USDA 2009). By the 1990s, conversion of forest land to developed uses had reached 1 million ac per year. An additional 23 million ac of forest land in net (i.e., accounting for reforestation on agricultural and other lands) is projected to be lost to development by 2050 (Alig et al. 2003). Ultimately, shifts between agriculture and forest and the ongoing loss of both to development reflect the importance of policies beyond the forest sector in influencing forest extent, health, and composition.

Urban and housing development in the United States is regulated primarily by local governments through traditional land use controls such as zoning and performance standards, while the nature of the zoning regime may be determined or limited by state or national planning authorities or through enabling legislation. Although in theory these types of measures may provide for natural resource protection, in practice they have not been sufficient to fully protect forests and other natural resources. For example, despite zoning and performance standards, housing density on and around private forest land is increasing in every region of the United States and is projected to continue to increase in most regions through 2030 at least (Stein et al. 2005, White et al. 2009). Some 44.2 million ac (11 percent) of private forest land in the coterminous United States are expected to see dramatic increases in housing density from rural to exurban or urban by 2030 (fig. 3.2). Additionally,

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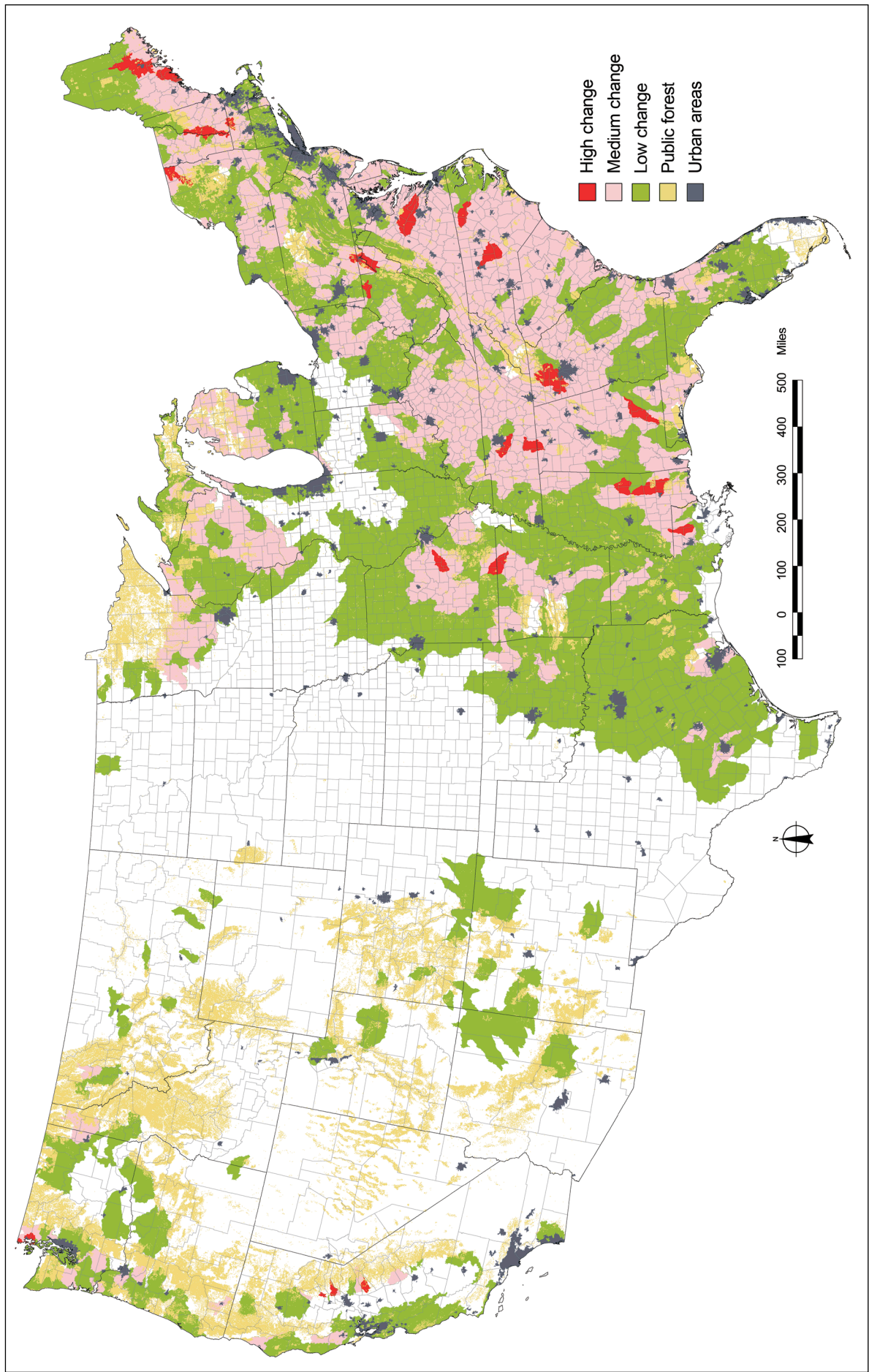


Figure 3.2—Watersheds in which housing density is projected to increase on private forests by 2030 (Stein et al. 2005).

nearly 22 million ac (about 8 percent) of rural lands located within 10 mi of national forests and grasslands are projected to undergo increases in housing development by 2030 as well (Stein et al. 2007). Given the consequent impacts on ecological, economic, and social services associated with these shifts in land use, cross-sectoral and intergovernmental policies and programs that support the conservation of forests and other open spaces within the context of sustainable or “smart” development have emerged as important tools for managing urban and suburban growth.

Sustainable development and smart growth—

At the local level, “sustainable development” often incorporates a strategy by which communities seek to balance environmental protection, economic development, and social objectives, meeting present needs without compromising the quality of life for future generations (Johnson et al. 2002). “Smart growth” encompasses a development philosophy that aims to be environmentally sensitive, economically viable, community-oriented, and sustainable. It is an approach to land use planning that typically promotes compact, transit-oriented urban communities toward more compact, mixed-use development within existing urban areas and discourages dispersed, automobile-dependent development at the urban fringe (Johnson et al. 2002).

Smart growth and sustainable development initiatives at local to national levels have been increasing across the United States since the early 1990s. Today, most states and local governments have some form of sustainable development or smart growth policy, on paper at least (USEPA 2016). Intergovernmental and cross-sectoral initiatives focused on sustainable development or smart growth also are increasingly common. For example, the Smart Growth Network, founded in 1996, focuses on the development of new approaches to growth that simultaneously expand the economy, protect the environment, and enhance community vitality (Smart Growth Network 2016). Network partners span public, private, and civil society actors, including the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA) Forest Service, environmental groups; historic preservation organizations; professional societies; developers; real estate interests; and local, state, and other federal government entities.

Sustainable development and smart-growth initiatives appear to be making progress, in some areas of the country (Ingram et al. 2009, USEPA 2012). In an EPA (2012) study on residential construction trends in America’s metropolitan regions, a “fundamental shift” was detected in the real estate market toward denser development and suburban-urban migration from 2000 to 2009. In 26 of the nation’s 50 largest metropolitan areas (population of 1 million or more), the share of residential construction taking place in central cities more than doubled during this period.

Cross-sectoral and intergovernmental policies and programs that support the conservation of forests and other open spaces within the context of sustainable or “smart” development have emerged as important tools for managing urban and suburban growth.

Smart growth policy performance is most effective when a variety of regulatory controls, market incentives, institutional policies, and cross-sectoral and intergovernmental initiatives are used.

According to the study, this trend was strongest in the metropolitan areas with the strictest regional land use policies, such as Portland, Oregon, but many metropolitan areas known for sprawl, such as Chicago, Illinois, and Los Angeles, California, saw similar increases in the redevelopment of their urban core. Nevertheless, only four metropolitan regions demonstrated greater infill construction (i.e., new houses constructed on vacant, underused lots interspersed among older, existing properties, or major refurbishing or reuse of existing homes or buildings) than new home construction during the study period, while the other 205 metropolitan regions were still growing outward faster than they were growing inward when measured on a per-housing unit basis (USEPA 2012). Generally, smart growth policy performance is most effective when a variety of regulatory controls, market incentives, institutional policies, and cross-sectoral and intergovernmental initiatives are used (Ingram et al. 2009, USEPA 2012).

Wildland-urban interface and wildfires—

Although some people are choosing to repopulate revitalized urban areas (e.g., Ingram et al. 2009, USEPA 2012), many people continue to move out of the cities and into previously open spaces (Radeloff et al. 2005, Stein et al. 2005, White et al. 2009). More than one-third of all houses in the United States are now considered to be located within the wildland-urban interface (WUI), where houses, structures, and other forms of human development meet or intermingle with undeveloped natural areas (Radeloff et al. 2005). As the WUI expands nationwide, there are multiple implications for forest and other natural resource uses and conservation, including the increasing number and extent of extreme wildfires across the country in recent history. As the number and extent of wildfires increase, so do the risks to responders and citizens, damages and losses to homes and property, fiscal costs, and other threats to communities and landscapes within the WUI and beyond.

Some zoning rules and sustainable development and smart growth policies seek to limit growth in the WUI, though their impacts have been limited to date. Other initiatives focus on mitigating and responding to massive wildfires, particularly where people live (e.g., in the WUI). For example, the National Cohesive Wildland Fire Management Strategy was developed through a collaborative process with active cross-sectoral involvement of all levels of government and nongovernment organizations, as well as the scientific community and the public, to comprehensively address wildland fire management across all lands in the United States (USDI and USDA 2014). The strategy seeks to “safely and effectively extinguish fire when needed; use fire where allowable; manage natural resources; and as a nation, to live with wildland fire” (USDI and USDA 2014). It is not prescriptive in determining which options to apply locally or regionally, but includes a set of guidelines

intended to provide basic direction when planning activities. Broadly defined to address national challenges, these guidelines can be tailored to meet local and regional needs.

Land acquisition—

Financial mechanisms across a range of sectors aim to contribute to sustainable land use and development by providing support for the acquisition of forested areas and other open spaces. For example, municipal bonds are created to fund land purchases or the transfer of development rights through conservation easements. Between 1988 and 2014, voters in 37 states supported more than \$72 billion in funding for forests and other open space acquisition or protection through 1,855 approved local ballot measures (Trust for Public Land 2015). For example, Boulder County in Colorado has approved multiple municipal bonds since the early 1990s that have allowed for the purchase of or development rights to more than 100,000 ac of forests and other natural areas (Boulder Country 2016). Additionally, in the Highlands Region of New Jersey, recent bond measures totaled more than \$400 million for open space conservation as part of the Highlands Regional Master Plan, which identifies priority conservation and agricultural lands to aid the protection of critical open space and related environmental resources and services (State of New Jersey 2010).

At the federal level, the Land and Water Conservation Fund (LWCF), created by Congress in 1964, provides funds to federal, state, and local governments to acquire land, water and conservation easements in critical areas identified by the U.S. Department of the Interior National Park Service, Fish and Wildlife Service, and Bureau of Land Management and the U.S. Department of Agriculture Forest Service. Congress appropriates up to \$900 million a year for the acquisition of these key areas and finances the fund mostly from offshore drilling fees (USDA FS 2016). Since its inception, the LWCF has distributed more than \$9 billion to purchase or acquire conservation easements on more than 7 million ac of wild and scenic rivers, wilderness, scenic and recreation areas, scenic trails, and other natural areas—including 1.5 million ac of land and water within or adjacent to existing national forests and grasslands (USDA FS 2016).

The Forest Legacy Program (FLP) is another federal government initiative, administered by the Forest Service in partnership with states and other politically affiliated jurisdiction (e.g., U.S. territory, Commonwealth) agencies to promote the conservation protection of forests on private lands through acquisitions or conservation easements. As of January 2018, FLP funds had been used to conserve nearly 2.7 million ac of forest land in 53 states and territories. These 53 states and territories had used FLP funds to purchase or protect more than 2.58 million ac of forests across the United States, including in Alaska, Hawaii, and Puerto Rico

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(USDA FS 2018). Lands are protected through conservation easements (65 percent of FLP projects, 82 percent of total acreage) and fee-simple purchases (35 percent of FLP projects, 18 percent of total acreage). Lands or conservation easements are held by state agencies or other unit of government. Additionally, land trusts and other conservation organizations play a critical role in the FLP by working with landowners, identifying projects, helping to secure cost share, and facilitating the execution of projects (USDA FS 2015). Finally, conservation easements and land donations also may receive federal and state income tax deductions in compensation for deeding development rights to conservation or government organizations.

Water

Water is one of the most important resources associated with forests. Issues related to water supply and demand have spurred the development of cross-sectoral and intergovernmental policies and programs across the country for decades. These types of policies and programs increasingly focus on forest protection as an important component of water supply strategies, given that two-thirds of the country's fresh water originates from forested watersheds (Ernst et al. 2004). Moreover, Ernst et al. (2004) estimated that, on average, a 10 percent increase in forest cover corresponds with a 20 percent reduction in water treatment costs for an associated community.

Numerous intergovernmental and cross-sectoral initiatives at federal, state, and local levels promote sustainable water use and conservation of water supplies and sources. For example, the EPA Healthy Watershed Initiative includes assessment and management approaches that encourage states, local governments, watershed organizations, and others to adopt a strategic, systems approach to watershed conservation. The initiative is intended to protect healthy watersheds and prevent impacts to aquatic ecosystems (and, thus, water quality impairments) from land use changes and other perturbations (e.g., invasive species) (USEPA 2016a).

The Urban Waters Federal Partnership, established in April of 2013 and including 11 federal entities and a wide range of state and local agencies and nongovernmental organizations (NGOs), is another example of an interorganizational initiative. This partnership takes a landscape-scale approach to water conservation, encompassing “upstream forests to downstream faucets” and focuses specifically on revitalizing urban waters and the communities that surround them (USEPA 2016b). Additionally, the LWCF, described above, along with other federal programs, provide various fiscal resources for water conservation in forested watersheds.

Private sector organizations that rely on fresh water supply and directly or indirectly affect forested watersheds also are increasingly engaging in conservation programs and other initiatives with government and other stakeholders. They do so

not only to reduce business and reputational risks but also to increase the long-term positive impacts of private sector development (Jenkins and Kate 2006). For example, in 2007, The Coca-Cola CompanyTM launched its Water Stewardship Program to “increase efficiency, improve conservation” and address criticisms of extensive water use worldwide (The Coca-Cola Company 2013). Through this and other initiatives, Coca-Cola² has set out to become “water-neutral” by 2020 through water-use reduction, wastewater recycling, and local water resource replenishment. In 2012, it established a partnership with the USDA, agreeing to “return” more than 26 million gal of water to the National Forest System through multiple measures, including watershed restoration in areas that have been damaged or altered by development, wildfire, and agriculture (Inez Ward 2014).

Energy

Forests have long served as a source of fuel, and as energy demands and costs have increased in the United States and around the world, policies and programs promoting renewable energy sources and uses have grown, as have efficiencies in their production and processing. Between 2004 and 2013, energy from biomass, including biofuels, wood, and residues, rose by more than 62 percent in the United States and now comprises about 2 percent of the total energy consumed in the United States (USDOE EIA 2014). Global demands for biofuel, for example from European renewable energy portfolio standards, also are driving increasing wood-based biofuel production in the United States, particularly for wood pellets from the Southeast.

The Federal Renewable Electricity Production Tax Credit (REPTC), originally enacted in 1992 and renewed and expanded numerous times, including through the American Recovery and Reinvestment Act of 2009 (H.R. 1 Div. B, section 1101 & 1102) and most recently in the Bipartisan Budget Act of 2018 (H.R. 1892, sec. 40409), and other related policy developments, have stimulated emerging markets in the United States for wood-based energy sources (USDOE EIA 2014). The REPTC combines mandates with subsidies to promote increased use of liquid bio-fuels for domestic transport, requiring a gradual increase in their supply by 2022 (i.e., required supply set at 9 billion gal in 2008 and rising to 36 billion gal in 2022; the cellulosic biofuel incentive increased to \$1.04 per gallon; the corn ethanol subsidy decreased from \$0.51 to \$0.45 per gallon) (Sedjo and Sohngen 2009). Multisector initiatives promoting increased production and use of renewable energy have been expanding as well. For instance, 25x’25 is a cross-sectoral initiative that includes agricultural, forestry, environmental, conservation, and other organiza-

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² The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

tions and businesses focused on securing 25 percent of the nation's energy needs from renewable sources by the year 2025 (25x'25 2016).

Through their studies of national bioenergy production capacity, the U.S. Department of Energy (DOE) (USDOE 2016), along with the Oak Ridge National Laboratory, identify a broad range of biomass resources that could be accessed to double or perhaps triple current levels of biomass use in the United States for bioenergy, potentially producing approximately 1.0 to 1.5 billion tons of biomass annually for energy and co-products. However, bringing this potential production to reality relies on “a mix of economic factors, such as markets, investment, and innovation” that is not yet present in the United States (USDOE 2016). The DOE 2016 Billion Ton Report estimated annual gross potential of all forest biomass supply (including residues) to be about 21 to 116 million dry tons from 2017 to 2040 for both private and federal lands for the baseline scenario, which is modeled on a moderate growth in housing starts, plantation intensity, paper, and foreign demand, with low growth in biomass for energy. For the 2016 report, only timberland (not all forest land) is included in the analysis, excluding all protected, reserved, and unroaded forest land. High-value sawtimber harvest for bioenergy is also excluded, as it is economically inaccessible. It is also assumed that no forest land losses occurred during the modeling time period, and there are no land cover changes. Nevertheless, increased demands for biomass energy production are expected to affect forest and other land uses, but in ways that are not yet completely understood.

Climate Change

Although there is not complete certainty about the extent and timing of climate change and its effects across the landscape, forests and other natural and developed systems already are being affected by climate variability and changing disturbance regimes, and these effects are expected to continue to change over the next 100 years (Vose et al. 2012). Numerous initiatives and partnerships involving civil society, the private sector, and government have developed to address climate change and its projected effects, many of which directly or indirectly focus on forests and many of which increasingly have been developed across forest and nonforest sectors.

At the federal level, for example, the U.S. Global Change Research Program (USGCRP) was established by presidential initiative in 1989 and mandated by Congress in the Global Change Research Act of 1990 to “assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change” (USGCRP 2016). The program comprises a confederation of the research divisions of 13 federal departments and agencies that conduct research related to global change, reporting every 4 years on the state of climate science and on the effects and implications of changing climatic conditions in the United States. The most recent Climate Science Report was released in 2017 and the Fourth

National Climate Assessment in 2018 (USGCRP 2017, 2018). Other federal-level efforts to address climate change have included the U.S. Department of the Interior (USDI) National Climate Adaptation Science Center (formerly named the National Climate Change and Wildlife Science Center) established by Congress in 2008, along with eight regional climate adaptation science centers (formerly named climate science centers) to provide scientific information and tools to help natural and cultural resource managers respond to the impacts of climate change (USDI GS 2016).

Federal Statutes Promoting Cross-Sectoral Coordination

In general, the federal government encourages or requires the development of cross- and multisector plans to address the intersecting effects among forests and water, air, wildlife, and other resources through a number of statutes that require the coordination of land management plans within related sectors (table 3.1). For example, the Cooperative Forestry Assistance Act of 1978 encourages lead forestry agencies of state governments to develop plans that focus on statewide forest resource conditions and trends within the context of the broader environmental, social, and economic system.

More recently, the Food, Conservation, and Energy Act of 2008 (also referred to as the 2008 U.S. Farm Bill) required states and territories to develop forest

The federal government encourages or requires the development of cross- and multisector plans to address the intersecting effects among forests and water, air, wildlife, and other resources through a number of statutes that require the coordination of land management plans within related sectors.

Table 3.1—Key legal statutes that directly or indirectly affect forests and that require coordination of planning and other activities with related sectors

Statute addressed	Land ownership category
Multiple-Use Sustained Yield Act of 1960	Federal
National Wildlife Refuge System Administration Act of 1966	Federal
Wild and Scenic Rivers Act of 1968	All
National Trails System Act of 1968	All
National Environmental Policy Act of 1969	Federal
Coastal Zone Management Act of 1972	All
Federal Land Policy and Management Act of 1976	Federal
Soil and Water Conservation Act of 1977	Private
Cooperative Forestry Assistance Act of 1978	All
Forest and Rangeland Renewable Resources Research Act of 1978	All
National Forest Management Act of 1978	All
Renewable Resources Extension Act of 1978	All
Clean Water Act of 1987	All
Government Performance and Results Act of 1993	All
Healthy Forests Restoration Act of 2003	All
Food, Conservation, and Energy Act of 2008	All
Agriculture Improvement Act of 2018	All

Source: Updated from Ellefson et al. 2005.

action plans that assess forest conditions and trends on public and private lands and provide strategies to address forest threats and improve forest health across all land ownerships and policy sectors. These plans are intended to provide practical, long-term plans for investing state, federal, and other resources where they can be most effective in achieving national conservation goals. In 2010, the USDA developed an “all-lands approach” to forests and a broader concept of open-space conservation that focuses on wild and working lands that cross ownership boundaries across the landscape. More specifically, the 2012 National Forest Land Management Planning Rule directs national forests to work across forest boundaries in a collaborative, adaptive, “all-lands” approach to forest assessment, planning, management, and monitoring.

Conclusions

Forests are affected by a wide variety of physical, economic, and social influences, many of which originate beyond the forest sector. Urban development and other nonforest land use decisions and actions have had significant impacts on forests and their uses throughout the United States. Policies and programs with coordinated aims, strategies, and instruments across multiple sectors are expanding across the country at local to national levels. Continued development and implementation of these types of initiatives can produce comprehensive solutions to complex problems threatening forests and their sustainability.

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Appendix 3.1: Key Websites

25x25: <http://www.25x25.org/>

Land and Water Conservation Fund: <http://www.fs.fed.us/land/staff/LWCF/about.shtml>

National Cohesive Wildland Fire Management Strategy: <http://www.forests-andrangelands.gov/strategy/>

Partnership for Sustainable Communities:
<https://www.epa.gov/smartgrowth/partnership-sustainable-communities-five-years-learning-communities-and-coordinating>

Smart Growth Online: <http://www.smartgrowth.org/>

Trust for Public Lands Land Vote Database: <https://tpl.quickbase.com/db/bbqna2qct?a=dbpage&pageID=8>

Urban Waters Federal Partnership: <http://www.urbanwaters.gov/>

USDA Forest Service Forests on the Edge: <http://www.fs.fed.us/openspace/fote/>

U.S. Department of the Interior (USDI) Climate Adaptation Science Centers:
<https://www.usgs.gov/land-resources/climate-adaptation-science-centers/about>

U.S. Environmental Protection Agency Healthy Watershed Initiative:
<http://water.epa.gov/polwaste/nps/watershed/index.cfm>

U.S. Global Change Research Program: <http://www.globalchange.gov/>

USDI Fish and Wildlife Service Landscape Conservation Cooperatives:
<http://lccnetwork.org/>

Chapter 4: Taxation and Other Economic Strategies That Affect the Sustainable Management of Forests (Indicator 47)

Frederick W. Cubbage, Kathleen A. McGinley, and Tiera Arbogast¹

Indicator Background and Rationale

The sustainability of forests and the many benefits they are capable of providing requires high levels of sustained investment in their management and protection. Management decisions and investments are driven by several national macroeconomic factors and government policies, including product or service costs and prices, capital costs, management efficiency, forest land productivity, and government interventions including tax and incentive policies and associated technical assistance. Government policies and strategies on investment, taxation, and trade may influence both forest management and the level of long-term investment in forestry. Taxes and incentives affect sustainable forest management, both as a cost of forestry business or to favor certain activities and sectors, and as tools to encourage forest production and conservation.

Indicator 47 focuses on public policies that influence management of timber and commodities on private forest lands. It does not examine nontimber forest products or payments for ecosystem services, or forest products trade, which are examined under Montréal Process Criterion 6: Maintenance and Enhancement of Long-Term Multiple Socioeconomic Benefits to Meet the Need of Societies. Nor does this indicator address public forests, which receive direct government appropriations and are managed by government agencies, as discussed in detail here in chapter 2, indicator 45. Nevertheless, most federal and state programs for forest management and protection bridge all forest goods and services, so the overall funding and policies for forests are examined in this indicator.

Measurement Approach

Descriptive data on both federal and state incentives and taxes that affect sustainable forest management of private forest lands were collected from agency and organizational websites, documentation, and budgets. Forest policies at both

¹ **Frederick W. Cubbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008; **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926; and **Tiera Arbogast** is a planning and environmental coordinator, U.S. Department of the Interior, Bureau of Land Management, Ely District Office, 702 North Industrial Way, Ely, NV 89301.

government levels are dynamic, so we present a snapshot in time of these and trends where detectable. Dozens of natural resource policies affect forests, even at the federal level, for forest, agricultural, and urban lands. There are also many different public policies in each state, which also are difficult to track.

Key websites on forestry financial incentives and taxation policies exist at the federal and state levels (listed in the appendix). Periodic Forest Service National Woodland Owner surveys also provide important information for this indicator. These organizations and websites provide an introduction to the main relevant incentives for federal agricultural and forestry programs, and key state incentives. Most are updated periodically and provide a mechanism to identify laws and agencies that can be contacted to survey the status of current policies. These websites, literature and summaries of the principal programs, and a review of the literature on evaluation of forestry programs provided the background for this indicator. We also draw from a review by Cabbage et al. (2017) on this subject, which synthesized much of the information that we expand on here.

State financial assistance programs were obtained from the “Financial Incentive Programs for Non-Industrial Private Forest Owners” website (Greene et al. 2010). Summaries of programs were obtained through administering agency websites, in which most had a basic summary of the program goals and eligibility criteria. State funding data were collected by direct contacts with forestry agency personnel, either by e-mail or telephone.

Status and Trends

The United States has a variety of investment and taxation policies that favor long-term forest resource investments.

The United States has a variety of investment and taxation policies that favor long-term forest resource investments, provide consistent market-based incentives and signals, and provide some payments for provision of environmental and nonmarket values. These policies and approaches include direct conservation incentive payments through the federal Farm Bill or other agencies, state programs, or from other private sources; incentives and subsidies in the form of federal and state income tax benefits; favorable treatment of timber and wildlife habitat in state and local property taxes; and deductions for donating land or its development rights in perpetual conservation easements.

Forests cover 766 million ac of land in the United States and comprise 33 percent of the land area in the United States, as well as 33 percent of the land area in the lower 48 states. Privately owned forests comprise 58 percent of the forests in the entire United States, and 63 percent of the forests in the conterminous United States. (Oswalt et al. 2014). Private owners generally hold fee simple land rights that allow them exclusive, but not absolute rights. Their forest management and protection is influenced by markets as well as by public policies of regulation, education, incentives, and protection. Public assistance for natural resource conservation by individuals on private lands is an objective of government and nongovernmental organizations

(NGOs), ranging from international and national to state and local scales. Thousands of financial and technical assistance programs and cooperative programs provide economic incentives for the sustainable use, conservation, and protection of forest resources, including land, forests, water, fish and wildlife, and rangelands.

Economic incentives use a mix of financial payments, usually coupled with technical assistance, to stimulate voluntary enrollment in programs that encourage natural resource management or protection. Government may influence environmental protection, conservation, and land management by direct payments and programs at the federal level (e.g., the Conservation Reserve Program in the Farm Bill administered by the U.S. Department of Agriculture), through international organizations and policies (e.g., United Nations Forum and Forests), through federal and state partnerships (e.g., the Conservation Reserve Program), through state programs (e.g., the Forest Resource Development Program in Mississippi), or local programs (e.g., the Atlanta Free Yard Tree Program). Environmental NGOs also may provide incentives, cooperate with government organizations and private landowners, or own and manage land for conservation purposes. The types of economic assistance provided by these different organizations ranges from direct financial payments and tax deductions or credits to education and technical assistance and no-cost management plans or materials such as seedlings.

Important differences exist between tax approaches and financial incentive approaches in implementing natural resource policies. Financial incentive payments usually are accompanied by technical assistance, monitoring, evaluation, annual reports, and some field checks to ensure that practices are implemented correctly and maintained—providing rigor but also carrying government restrictions. In addition, they must be repaid, or at least are terminated, if an agreed practice or process is not adhered to. The federal Farm Bill financial incentives also have “cross-compliance” requirements, which require owners to have a conservation plan and which prohibit the draining of swamps or tilling of highly erodible lands without an approved conservation plan. Noncompliance may result in owners losing their incentive payment, as well as their crop subsidy or insurance payments.

Income tax benefits enacted and implemented through the Internal Revenue Service (IRS) code also are available for forests. Generally, there are no government cross-compliance requirements or extensive monitoring attached to income tax benefits—individuals do not need to comply with specific practices other than, say, buying a house or an electric car, making charitable gifts, planting trees, or fulfilling the broad purpose of the tax benefit. Somewhat differently, state and local property taxes on rural land that may be applied to forests usually do have some requirements to keep the land in the designated rural use for a fixed number of years. If such stipulations are violated, landowners must pay back the tax reductions, usually with some modest interest penalty.

Economic incentives use a mix of financial payments and tax benefits, usually coupled with technical assistance, to stimulate natural resource management or protection.

Government payments encourage more conservation than markets will provide—either a greater area being conserved or better quality programs.

Financial Incentives

Economic policy instruments include direct financial payments and indirect tax benefits, which we will address in separate sections for clarity. Direct payments may be termed financial incentives, subsidies, or simply government payments. Essentially these payments are made to encourage some type of environmental conservation, environmental protection, or commodity production practice through general tax or other government revenues or grants and appropriations. They provide individuals or organizations with cash reimbursements for performing practices they might not perform otherwise without incentives. In recent years, federal payments have focused largely on conservation and environmental practices, while states have a mix of production and conservation incentive programs.

Government payments might encourage more conservation than markets will provide—either a greater area being conserved or better quality programs. These payments lower the costs of conservation or production or provide new funds to pay for activities that would not occur without the government intervention. The payments for many conservation programs will often include a full or partial cost reimbursement to establish the practice—e.g., tree planting or fencing—and an annual payment for a fixed period of time—e.g., 10 to 30 years. Many federal and state incentive programs also promote forest investments in timber, conservation, or environmental activities. The periodic federal Farm Bill has included increasing provisions for tree planting, crop retirement, and environmental land use programs in each of its authorizations and appropriations since the 1960s.

Market-based policy tools also address timber production, ecosystem goods and services production, and environmental protection for sustainable forest management. These specifically include market-based programs such as forest certification for sustainable forest management, wetlands banks for wetland functions and values, cap-and-trade for carbon storage and endangered species protection, conservation easements for fixed-term or permanent protection from development, and even outright purchase of forest lands by NGOs or government agencies. In addition, conservation easements and donations may receive federal and state income tax deductions in compensation for deeding development rights to conservation or government organizations.

Federal financial incentives—

Federal assistance programs provide federal funding to state or local governments, federally recognized Indian tribes, territories of the United States, domestic public, quasi-public, and private profit and nonprofit organizations and institutions, specialized groups, and individuals for health and human services, public and private lands,

fish and wildlife, energy, law and justice, education, disaster assistance, and farms and forests to name just a few (USGSA 2019). This assistance or benefits include the:

... transfer of money, property, services, or anything of value, the principal purpose of which is to accomplish a public purpose of support or stimulation authorized by Federal statute. Assistance includes, but is not limited to grants, loans, loan guarantees, scholarships, mortgage loans, insurance, and other types of financial assistance, including cooperative agreements; property, technical assistance, counseling, statistical, and other expert information; and service activities of regulatory agencies. It does not include the provision of conventional public information services. (USGSA 2019: i)

For decades, periodic legislation on agriculture (aka the Farm Bill) has provided the largest single federal source of funding for private land conservation in the United States, including numerous federal programs that directly or indirectly support forests and their uses (Straka et al. 2007). These programs provide conservation incentives for forests and wildlife and include the Forest Stewardship Program, which provides forest landowner assistance for resource management plans that incorporate multiresource stewardship principles; the Forest Legacy Program, which protects environmentally important private forest lands via conservation easements; the Healthy Forest Reserve Program, which helps landowners restore, enhance, and protect forest land resources on private lands through easements and financial assistance, and the Environmental Quality Incentive Program, which promotes agricultural production, including forestry, and environmental quality as compatible goals (<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/farmbill/>).

The Agricultural Act of 2014 (aka 2014 Farm Bill) consolidated 23 existing conservation programs into 13, aggregating individual farm and natural resource programs under three broad umbrella programs: (1) Environmental Quality Incentive Program, (2) Regional Conservation Partnership Program, and (3) Agricultural Conservation Easement Program (USDA NRCS 2014). For example, the Wetlands Reserve Program, Grasslands Reserve Program, and Farm and Ranch Land Protection Program were consolidated into the Agricultural Conservation Easement Program. This reorganization was largely maintained in the Agriculture Improvement Act of 2018 (aka 2018 Farm Bill), which specifies several provisions to provide financial and technical assistance to forest landowners primarily through: the Cooperative Forestry Assistance Act, the Forest and Rangeland Renewable Resources Research Act, and the Healthy Forests Restoration Act. Table 4.1 summarizes the principal federal financial assistance programs that can be directed to

The Farm Bill has provided the largest single federal source of funding for private land conservation in the United States.

Table 4.1—Federal programs providing financial and technical assistance to private landowners and interests in forests and related resources by program, agency, resource focus, funding obligations, fiscal year, and assistance type, 2014 and 2018/2019

	Funding obligations					
Program name	Agency	Resource focus	Administration	Payments	Fiscal year	Assistance type
----- Dollars -----						
Agricultural Conservation Easement Program ^a	USDA NRCS	Agricultural lands and wetlands	115,046,000 86,792,000	262,931,000 250,637,000	2014 2018	Cooperative agreement
Wetland Reserve Program ^b	USDA NRCS	Wetlands	16,244,000 —	2,832,000 —	2014 2018	Cooperative agreement
Grassland Reserve Program ^b	USDA NRCS	Grazing lands	553,000 1,461,000	273,000 1,000	2014 2018	Direct payment
Farms and Ranch Lands Protection Program ^b	USDA NRCS	Agricultural lands and soils	1,672,000 2,693,000	145,000 1,000	2014 2018	Direct payment
Environmental Quality Incentive Program ^b	USDA NRCS	Soil and water	368,285,000 463,599,000	981,715,000 1,395,449,000	2014 2018	Direct payment
Wildlife Habitat Incentives Program ^b	USDA NRCS	Wildlife	2,543,000 5,327,000	194,000 73,000	2014 2018	Direct payment
Regional Conservation Partnership Program ^a	USDA NRCS	Soil, water, and wildlife	21,142,000 30,950,000	74,538,000 41,903,000	2014 2018	Cooperative agreement
Agricultural Water Enhancement Program ^b	USDA NRCS	Soil and water	10,740,000 1,227,000	44,518,000 20,000	2014 2018	Direct payment
Chesapeake Bay Watershed Protection Program	USDA NRCS	Soil and water	5,556,000 1,392,000	7,107,000 438,000	2014 2018	Direct payment
Conservation Stewardship Program	USDA NRCS	Agricultural lands, soil and water	116,071,000 247,941,000	962,871,000 949,353,000	2014 2018	Cooperative agreement
Healthy Forests Reserve Program	USDA NRCS	Forest, wildlife and carbon	957,000 1,016,000	5,491,000 6,684,000	2014 2019	Direct payment
Agricultural Management Assistance	USDA NRCS	Soil and water	1,439,000 749,000	5,021,000 3,473,000	2014 2018	Direct payment
Emergency Watershed Protection Program	USDA NRCS	Watersheds	85,653,500 22,295,839	29,248,300 181,198,198	2014 2018	Discretionary grant
Conservation Reserve Program	USDA FSA	Soil, water, and wildlife	— —	2,202,222,640 1,953,982,000	2014 2018	Direct payment
Emergency Conservation Program	USDA FSA	Soil and water	— —	70,000,000 176,461,000	2014 2018	Direct payment
Emergency Forest Restoration Program	USDA FSA	Forest land	— —	3,759,819 12,725,000	2014 2018	Cost share
Forest Legacy Program	FS	Forest land	— —	50,965,000 62,268,593	2014 2018	Project grant
Forest Stewardship Program	FS	Forest land	— —	7,596,808 9,082,072	2014 2018	Project grant
Community Forest and Open Space Program ^a	FS	Forest land	— —	1,683,000 4,410,000	2014 2018	Project grant
Collaborative Forest Restoration Program	FS	Forest land	— —	4,747,847 2,901,000	2014 2018	Project grant

— = no funds; USDA = U.S. Department of Agriculture; NRCS = National Resources Conservation Service; FSA = Farm Service Agency; FS = Forest Service.

^a New programs.

^b Programs repealed and being phased out.

Source: Executive Office of the President 2014 and USGSA 2019.

forests and benefit private landowners and their funding levels in FY 2014 and FY 2018. Forest-specific programs include the Collaborative Forest Restoration Program, Community Forest and Open Space Program, Emergency Forest Restoration Program, Forest Legacy Program, Forest Stewardship Program, and Healthy Forest Reserve Program, which together accounted for more than \$99 million in obligated funding for forests in FY 2018.

Revenues from forest-based environmental services in the United States include a significant portion from the programs cited above and in table 4.1 (Mercer et al. 2010). Federal programs with a conservation focus in 2012 included the Wetlands Reserve Program, Wildlife Habitat Incentives Program, Conservation Security Program, CRP, and Emergency Watershed Protection Program, which encompass production and other forest conservation measures such as habitat improvement, water quality improvement, and carbon sequestration, along with other federal, state, private sector, and civil society transactions associated with environmental services from forests in the United States. Altogether, these governmental and nongovernmental programs and payments totaled slightly more than \$2 billion in 2012 (fig. 4.1).²

These governmental and nongovernmental programs and payments totaled slightly more than \$2 billion in 2012.

² Mercer, E. [N.d.]. Indicator 6.27. Revenue from forest-based environmental services. In: Robertson, G., ed. National report on sustainable forests–2020 (forthcoming). U.S. Department of Agriculture, Forest Service.

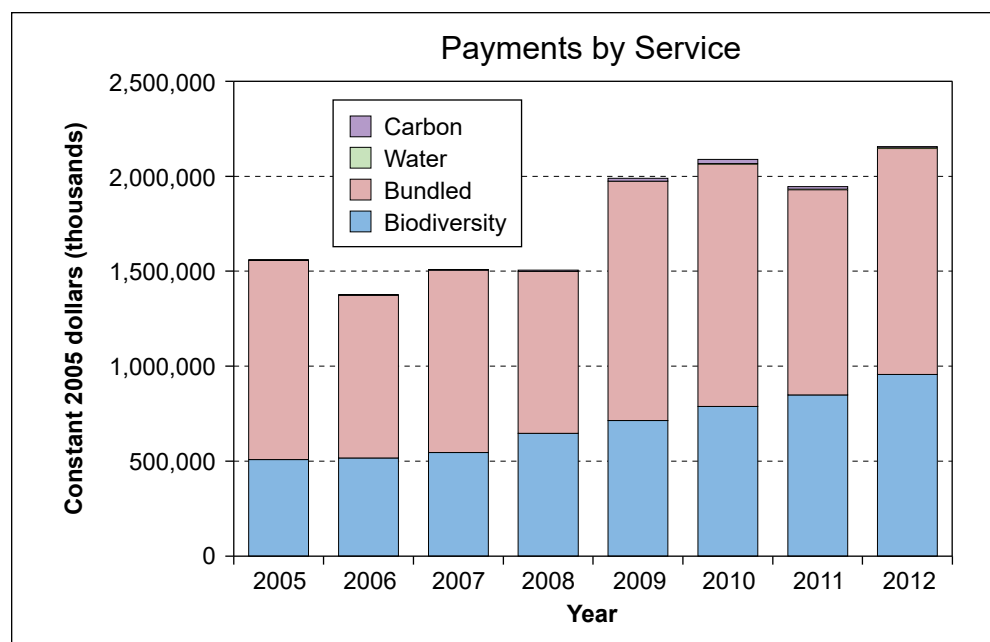


Figure 4.1—Indicator 6.27: Payments for ecosystem services, fiscal years 2005–2012 (Mercer et al. 2014). Note: Amounts reflect constant 2005 U.S. dollars; they are not adjusted to current dollars.

Many state and local programs also provide incentives and technical assistance to landowners.

State financial incentives—

In addition to the extensive federal cost-share programs, many state and local programs provide incentives and technical assistance to landowners. All 50 states provide some type of cost-share or grant or loan assistance for forest landowners through federal or state funding sources. Almost every state includes property tax incentives for forests and at least 29 states offer state-funded forest conservation or promotion programs. States administer programs through natural resource departments, forestry services, fish and wildlife services, and other relative departments (Kilgore et al. 2018). In 46 states, private organizations or such NGOs as the American Tree Farm System had specific types of assistance for nonindustrial private landowners as well. In addition, state agencies, including the relevant Soil and Water Conservation Districts, forestry and wildlife agencies, and natural resource departments, often provide technical assistance for the federal funded programs.

Cost-share assistance is another type of incentive, often used to establish a practice, with annual payments disbursed typically for a period of 10 to 30 years after establishment. Cost-share and grant or loan assistance may be delivered in the form of reimbursements or payments prior to performing management actions. Seventeen states provide some type of cost-share assistance of grant funding for forestry practices, totaling about \$11 million per year (table 4.2). These focus more on timber production or forest health than on broad conservation purposes. In total, these annual budgets range from less than \$100,000 in a few states—Alabama, Delaware, Oklahoma, and Missouri—to from \$500,000 to \$2 million in others—Louisiana, North Carolina and South Carolina, Mississippi, Oregon, Virginia, and Wisconsin. Most of these are funded by general state appropriations, a timber harvest yield or severance tax, or a combination of both.

Evidence suggests that federal financial incentive programs have helped promote sustainable forestry throughout the United States, but gaps persist between user needs and programmatic direction (see, for example, Buffum et al 2014, Kilgore et al. 2007). For example, although many programs largely focus on cost-share approaches, “research has repeatedly shown that technical assistance, cost sharing, and putting family forest owners in direct contact with forester or other natural resource professionals are among the program approaches that are most preferred by owners and the most effective in leading them to apply sustainable forest management practices on their land” (Kilgore et al. 2007: 185).

State agencies provide the bulk of the forestry technical assistance on-the-ground, but often are restricted by limited or stagnant human and financial resources at the state-level. State budget constraints have limited funding for many forestry programs at multiple levels. For example, Alabama’s Agricultural and Conservation

Table 4.2—Funding allocations from state financial incentives programs for forest market commodities in the United States, fiscal year (FY) 2014

State programs	Program type	FY 2014	Funding source(s)
<i>Dollars</i>			
California Forest Improvement Program	Cost-share	24,153,000	Greenhouse Gas Reduction Fund
Delaware Forestry Cost-Share Program	Cost-share	3,257	Delaware Forest Service/U.S. Department of Agriculture (USDA)
Florida Rural and Family Lands Protection Program	Easement	5,000,000	Florida Forest Service, Private Silviculture Operation
Illinois Forestry Development Act Program	Cost-share	75,413	Illinois Forestry Development Fund
Iowa Resource Enhancement and Protection Program (FY 2012)	Cost-share	1,200,000	Iowa Environment First Fund, natural resources license plate sales
Louisiana Forest Productivity Program (FY 2013)	Cost-share	1,800,000	Severance tax
Maryland Woodland Incentive Program	Cost-share	100,000	Woodlands Incentive Fund
Mississippi Forest Resource Development Program	Cost-share	2,000,000	Mississippi Forestry Community Timber Severance Tax
Missouri Forest Resource Development Program	Cost-share	1,258	Missouri Department of Natural Resources, Park, Soils, and Water Sales Tax
North Carolina Forest Development Program	Cost-share	1,746,000	Legislative Appropriations, Forest Product Assessments
Oklahoma Forest Resource Development Program	Cost-share	22,720	Oklahoma Forestry Cost-Share Fund
Oregon Forest Resource Trust (FY 2012)	Grant/loan	1,500,000	Forest Resource Trust (initial deposit by Klamath Cogeneration Project)
South Carolina Forest Renewal Program	Cost-share	815,838	Roundwood tax, state appropriations
Virginia Pine Bark Beetle Prevention Program	Cost share	200,000	Virginia Department of Forestry
Virginia Reforestation of Timberlands	Cost share	1,600,000	Commonwealth of Virginia's General Fund
Washington Eastern Washington Forest Landowner Cost-Share Program	Cost share	1,849,000	USDA Forest Service
Wisconsin County Forest Acreage Share Payments (FY 2013)	Grant/loan	711,634	Wisconsin Forestry Fund

Development Commission (ACDC) Program, established in 1986, had not been funded from FY 2012 through FY 2019, owing to budget cuts across all state agencies in recent years. Similarly, North Carolina stopped contributing the state share to its ACDC program in FY 2009. Programs such as Oklahoma Forest Resource Development Program provide payments for several management actions, but as of FY 2011 Oklahoma had provided assistance only through southern pine beetle prevention and invasives control, instead of the full suite of practices authorized through

Timber tax benefits offset the long growing cycles for trees and the substantial upfront costs for tree planting and forest management.

the program. Additionally, states may offer funding for practices directly relevant to forest market commodities, but with limited outreach and education, some sources of funding often go unused or are not requested. Budget constraints and allocation preferences may be less of a concern for state allocations funded by federal sources, such as the Forest Stewardship Program and the Healthy Forest Reserve Program, which have suffered fewer budget cutbacks in the federal Farm Bill to date.

Income Taxes

Federal and state income tax policies for timber production generally treat income from timber as long-term capital gains, similar to stocks, which are taxed at a lower rate than for other sources of income such as wages and salaries. Forest landowners rely on timber tax benefits to offset the long growing cycles for trees and the substantial upfront costs for tree planting and forest management, including forest health protection and the payment of property taxes and interest. These provisions also help compensate landowners for nonmarket environmental services that they provide to society and enable them to better protect against natural disturbances such as fire, pests, and disease, which are largely uninsurable. Federal estate taxes, however, are much more likely to apply to timberland owners than most other taxpayers, owing to relatively large land holdings and land values.

A range of tax incentives or tax reductions affect forest land, either generally as they affects all taxpayers, or specifically for timber, conservation, and rural land uses. These include preferential timber taxes, increased inheritance tax limits, preferential use value taxation, and favorable business taxation (National Timber Tax Website 2014). Income tax or property exemptions or reductions are a preferred way for reducing costs and increasing profits. Federal income tax coverage for long-term investments, such as stocks and bonds or timber, is treated favorably on the premise that investment in the United States is worthwhile and that the lower capital gains rate—mostly at 15 percent as of 2014—will help achieve that objective.

Federal income tax rates—

Forestry investments have received various federal tax deductions for timber growing since the capital gains tax rate for timber was first enacted in 1944. Reforestation tax incentives also provided credits for reforestation investments for many years, but these credits have now been eliminated and replaced with deductions as described below. These rates change periodically and were reduced by varying amounts in the Tax Cuts and Jobs Act of 2017. For tax year 2018, the marginal tax rates for individuals and for two married persons filing jointly are listed in table 4.3. These brackets are increased approximately at the rate of inflation each year to avoid “bracket creep”—higher taxes resulting only from inflation.

Table 4.3—Federal income tax rates for filing year 2018 tax returns

Marginal tax on income	Single person tax bracket	Married filing jointly tax bracket
<i>Percent</i>	<i>Dollars</i>	
1	0–9,520	0–19,050
12	9,526–38,700	19,051–77,400
22	38,701–82,500	77,401–165,000
24	82,501–157,500	165,001–315,000
32	157,501–200,000	315,001–400,000
35	200,001–500,000	400,001–600,000
37	500,000+	600,001+

Source: Erb 2018.

For 2018, the marginal tax rate for all taxable income (i.e., after allowable deductions have been made) was 10 percent for the first \$9,520 for individuals and for the first \$19,050 for married couples. Any portion of income beyond that and up to \$38,700 for individuals and \$77,400 for couples was taxed at 12 percent. From there, any portion of income beyond the second tax bracket and up to \$82,500 for individuals and \$165,000 for couples was taxed at 22 percent, and so on. There also were intermediate tax rates of 24 percent, 32 percent, and 35 percent for levels of income ranging up to \$500,000 for individuals and \$600,000 for married couples. Thus only the highest income levels paid the maximum rate of 37 percent, and even that was only for income exceeding \$500,000 for individuals or \$600,000 for couples (Erb 2018).

Federal tax policy was modified by reforms in 2013 and in 2017. The 2013 revision increased income tax rates for high income earners, which were dropped in 2017. There also was an increase in capital gains federal tax rates for 2013 from the 15 percent tax rate for the higher two tax brackets. These capital gains rates remained the same after the 2017 reform. The estate tax was essentially reduced in 2017, however, by increasing the minimum amount excluded from taxation. In addition, income received from pass-through organizations, such as real estate or some small businesses, would be taxed at a lower 20 percent rate compared to the higher income tax bracket rates, but the fine points and conditions vary too much to describe the full details here.

Deductions from income are “worth” the value of the marginal tax rate times the value of the deduction. For example, an \$8,000 mortgage interest deduction for married persons with an annual income of \$100,000 would be worth \$2,000 in actual tax savings (the 25 percent marginal rate times \$8,000). On the other hand, an \$8,000 energy tax credit would be worth the total \$8,000 off 1 year’s tax bill.

Thus credits are worth a full dollar reduction in taxes per dollar of credit, while deductions were worth only the marginal tax percentage rate times the stated dollar amount of tax deduction.

Forest land and federal timber taxes—

Private forest landowners are affected by many tax provisions via the federal tax code. Most of these provisions are directed toward a range of costs associated with forest land property: purchase of forest land and the values attributed to land, timber, and other property improvements; expenses subsequent to forest management activities; and equipment and land improvement depreciation (Ellefson et. al 2005). Federal woodland income tax is collected by the IRS under three woodland tax classifications: personal property, investment property, and business property. The main difference between each classification is intent of use; woodland use can range from ownership without specific investment purposes to active or passive business-level investment purposes. Investment property receives more favorable tax treatment and can deduct many expenses on an annual basis against income—like a business—while passive investors usually must capitalize their business expenses and deduct them when timber is thinned or at the end of a forest rotation (table 4.4).

Among the large number of tax provisions relevant for forest landowners, there are three specifically designed to encourage investment in forest management: capital gains treatment of timber, reforestation amortization and deductions, and operating expense and carrying charges deductions (Ellefson et. al 2005, USDA FS 2013), as described below.

- **Capital gains treatment of timber.** Capital gains treatment can provide an important incentive for noncorporate forest landowners, as long-term capital gains are taxed at a lower rate than ordinary income. In addition to a lower tax rate, capital gains treatment allows an unlimited use of capital losses to offset capital gains; if being taxed at the ordinary income rate,

Three key provisions to encourage investment in forest management: capital gains treatment of timber, reforestation amortization and deductions, and operating expense and carrying charges deductions.

Table 4.4—Federal noncorporate income tax rates for woodland property in the United States, fiscal year 2015

Personal property; passive investors	Investment property	Business property
Gains from sale taxed as capital gains (Gross Sale Proceeds-adjusted basis-selling expenses).	Taxed as long (L) or short (S) term capital gains. Short-term gains are taxed at ordinary income tax rate.	Sale of standing timber (ST) taxed as long-term capital gains. Sale of cut timber (CT) taxed as ordinary income unless election for capital gains is made.
Minimum: 0%	Minimum: (L) 0%, (S) 10%	Minimum: (ST) 0%, (CT) 10%
Maximum: 20%	Maximum: (L) 20%, (S) 39.6%	Maximum: (ST) 20%, (CT) 39.6%

Source: Adams 2015, USDA FS 2011.

there is a \$3,000 limit for this type of offset. Last, timber holdings considered as business property are subject to self-employment tax on ordinary income from the business, but this tax is exempt under conditions of capital gains treatment (USDA FS 2013). Capital gains treatment varies depending upon property classification and other factors such as ownership length and type of timber sold.

- **Reforestation amortization and deductions.** Prior to October 23, 2004, tax provisions provided a 10 percent investment tax credit for reforestation costs. This provision was replaced with one that provides up to \$10,000 of immediate deductions per qualified timber property for reforestation or afforestation expenditures. This tax deduction excludes trusts. In addition to deductions, qualified reforestation costs that are incurred in excess of those immediately deducted can be amortized or deducted over a set time period up to 8 tax years. Trusts are not excluded from amortization; instead, they are qualified to amortize all eligible costs including all under the \$10,000 limit set for other qualified timber property.
- **Operating expense and carrying charges deductions.** Expenses associated with day-to-day management of forest land can be large and accompanied also by regularly incurred and recurring expenses. Operating expenses are defined as those normally incurred by management activity, which can include fees for consulting foresters, cost of timber management activities, travel directly relevant to income gain on the property, and more. Carrying charges include property taxes, interest, or possible insurance payments. Operating expenses and carrying charges that are “ordinary and necessary” expenses for management of forest land may be fully or partially deducted each year as incurred. This deduction remains possible even without income generation, so long as timber growing activity is intended for profit and the expenditures are directly related to income potential. Deduction extent is dependent upon classification as it relates to ownership and operation of the forest property.

In addition to the above tax incentives specifically in place for forest landowners, it is often possible for those receiving cost-share payments from federal and state programs to exclude those payments from their gross income claim. Generally, government cost-share payments must be claimed for taxes, but forest and other landowners are excluded from the requirement if they are receiving payments from government conservation, reclamation, or restoration programs that meet specific requirements. Many federal and state government programs meet these requirements, including the Conservation Reserve Program, Longleaf Pine Initiative,

North Carolina Forestry Development Program, Virginia Reforestation of Timberlands Program, Mississippi Forest Resource Development Program, and several other programs listed above in the section on state fiscal incentive programs.

Active farm and forest businesses—which file on an IRS Schedule F (Farm) or Schedule C (Business)—also are permitted to deduct all their expenses each year against their income, thus reducing profits in each year that they occur. This tax treatment is allowed only for active investors and owners who are in the “trade or business.” For owners who actively manage forest land, this is preferred over waiting many years after the expense was incurred until timber can be harvested. Passive investors, who own forest land for general purposes or recreation, and earn most of their income from other sources, must carry forward their forest management costs as their timber cost basis, and deduct such costs at the time they might harvest timber, in proportion to the amount of timber removed.

Under the Reforestation Tax Incentives, forest owners can receive an accelerated tax deduction for reforestation and planting over an 8-year period.

Under the Reforestation Tax Incentives, forest owners can receive an accelerated tax deduction for reforestation and planting over an 8-year period, rather than waiting for the end of a harvest rotation to apply the deduction as a cost of business. They may deduct reforestation incentives from their taxes, regardless of whether they are active or passive investors. Forest owners may deduct up to \$10,000 of reforestation expenses immediately in the tax year in which they occurred, and deduct any expenses of more than \$10,000 in an 8-year schedule, with 1/14 of the excess costs in the same first year, 1/7 for the next 6 years, and 1/14 in the eighth year. These deductions then reduce the reforestation tax basis to zero. Thus all timber sale profits are taxed at the capital gains rate, as there are timber basis (costs) left. Owners also may deduct costs of equipment, qualifying cost-share payments, or the value of a gift of land for conservation purposes from their forest land taxes (Greene et al. 2014a, National Timber Tax Website 2014).

Timber income is treated as capital gains treatment of timber income, and filed on a Form T, for timber. Timber investors and landowners may deduct their casualty losses from weather disaster, theft, or condemnation from their federal income taxes, albeit only at the small basis value, not at the standing timber value. Timber income is currently taxed at a long-term capital gains rate of 15 percent for noncorporate forest landowners and for real estate investment trusts (REITs), such as Rayonier and Weyerhaeuser. This rate is less than the highest marginal tax rates for individuals of 35 percent to 39.6 percent, or for industrial C Corporation owners. Adverse impacts to earnings from the higher C Corporations tax rate contributed to the sale of forest products firm timberland to timber investment management organizations (TIMOs) and REITs; by 2014, there were no major vertically integrated forest products firms left in the United States.

Forest landowners and society rely on these timber tax benefits to offset the long growing cycles for trees and the substantial upfront costs for tree planting and forest management, including forest health protection and the payment of property taxes and interest. These provisions also help compensate landowners for nonmarket environmental services that they provide to society and enable them to better protect against natural disturbances such as fire, insects, and disease, which are largely uninsurable (Tenny 2014).

Federal estate taxes—

Inheritance taxes generally are imposed to generate income for federal and state government and to level the playing field so that excessive wealth is not accumulated in one family. Estate tax planning is important for sustainable management of forests, as highly valued forest land can impose significant tax burdens on the inheritor. Estate taxes may force landowners to harvest timber prematurely or even sell the property to pay the taxes, especially when coupled with division of family assets among heirs.

Several revisions have been made to federal estate tax provisions, including in years 1997, 2001, 2012, and 2017. The 2017 maximum federal gift and estate tax rate is 40 percent, which has decreased from the 55 and 50 percent rates of 2001 and 2002, respectively. The 2015 estate tax exemption is \$5.34 million, which has increased significantly from the lower value of \$675,000 in 2001. Federal estate tax rates continue to decline as exemption amounts increase, and the impact of federal estate tax is usually greater than state-level estate or inheritance taxes (Butler et al. 2012). There also is a complete marital deduction, whether passed through lifetime gifts or at death (Greene et al. 2013). The final 2017 Tax Cuts and Jobs Act approximately doubled the amount of the exclusion for the federal 40 percent estate tax starting in the 2018 tax year. The new law exempts about \$11 million for individuals and \$22 million for couples (the exact amount depends on the inflation adjustment), but only until 2026, when the thresholds will revert to the preceding thresholds (Steverman 2017). Some states, however, still may have significant inheritance taxes with much lower limits.

Greene et al. (2014a, b) identified 10 federal estate tax provisions beneficial to family forest owners, which include general provisions, targeted provisions, and advanced provisions. General provisions include (1) effective exemption for estates, (2) annual exclusion for gifts, (3) use of a will, (4) step-up in basis, (5) effective exemption for gifts, (6) the marital deduction, and (7) disclaimer. Targeted provisions include special use valuation and exclusion for land in a conservation easement. Last, the advanced provision includes the use of trusts. These provisions are explained by Green et al. (2014) as follows:

**Estate tax planning
is important
for sustainable
management of forests.**

Effective exemption for estates—Estates can qualify for exemption, which is a credit against the estate tax that can partially or fully shield estates from the tax.

Annual exclusion for gifts—Individuals can make gifts to as many recipients as chosen and avoid the effective exemption for gifts amount, so long as gifts do not exceed the annual exclusion amount.

Use of a will—A will allows individuals to distribute their estate amongst family members, ensure continuity of the family enterprise, and minimize tax and probate costs.

Step-up in basis—The basis for an inherited asset is its fair market value on the valuation date, which generally results in a “step-up” from basis in the decedent’s hands.

Effective exemption for gifts—Exemption for gifts is a credit against the gift tax, which partially or fully shields gifts over the annual exclusion from tax.

Marital deduction—The value of all property passed from one spouse to another, either through lifetime gifts or at death, qualifies for unlimited deduction.

Disclaimer—A beneficiary’s refusal to accept property passing to them, either through will or state law, will result in property passing to the next eligible beneficiary.

Special use valuation—An executor can value assets used for farming, forest land, and a business at their value in use for estate tax purposes instead of at their fair market value.

Conservation easement—An executor can exclude a calculated part of the land value in a qualified conservation easement from the taxable value of an estate.

Use of trusts—Property title can be transferred from an individual to the trustee to manage according to terms of the trust; the property can be removed from the donor’s estate only with an irrevocable lifetime trust.

Conservation easements—

A relatively new state and federal income tax benefit for land conservation has been the deductibility of the value of land or conservation easements. Conservation easements provide another avenue for tax deductions in the United States. In 2012,

the federal tax code allowed for a tax deduction of up to 50 percent of an easement owner's annual adjusted gross income (or 100 percent for land that has derived more than half of an owners income) for the qualified donation of a conservation easement (Butler et al. 2012). Unused amounts of the deduction can be carried forward for up to 15 years. This approach is used by at least 10 states (USDA FS 2006), and was included as a federal tax benefit beginning in 2006. This conservation deduction or tax credit treatment has helped lead to major land and development right gifts in many states.

Essentially, deductions for easements allow taxpayers to deduct from their income taxes a portion of the value of their gift of land for conservation. The gift value could be the entire value of the property if it were donated to a qualified conservation organization such as the Conservation Fund, the government, or a university. It also could be the value of the conservation easement if the landowner kept the property but donated the development rights to the qualified organization. This would be calculated as the full market price minus the restricted-use price, and has the potential to generate quite substantial federal tax deductions, as well as state deductions where allowed (Land Trust Alliance 2015a, 2015b).

The conservation easement tax deduction rules have varied but were set at a fixed rate in new federal legislation in 2015. The Land Trust Alliance (2016) described the new benefits:

If a conservation easement is voluntarily donated to a land trust or government agency, and if it benefits the public by permanently protecting important conservation resources, it can qualify as a charitable tax deduction on the donor's federal income tax return. [The new law] increases the benefits to landowners by:

- Raising the deduction a donor can take for donating a conservation easement to 50 percent, from 30 percent, of his or her annual income;
- Extending the carry-forward period for a donor to take a tax deduction for a conservation agreement to 15 years from 5 years; and
- Allowing qualifying farmers and ranchers to deduct up to 100 percent of their income, increased from 50 percent.

State income tax—

State income tax treatments usually follow the federal rules for determining the adjusted gross income, deductions, and credits, with various exceptions that occur

in each state. State income tax systems differ significantly in structure, rates, deductions, and exemptions, including nine states with no income tax on wages and eight with flat income taxes. California and Hawaii have the highest marginal tax rates, at 13.3 percent and 11 percent on annual incomes over \$1 million and \$200,000, respectively. No other states have tax rates that exceed 10 percent (Tax Foundation 2015).

All but seven states have an income tax along with the federal income tax (table 4.5). States with no income tax include Alaska, Florida, Nevada, South Dakota, Texas, Washington, and Wyoming. Some states follow a flat tax provision; these states include Colorado, Illinois, Indiana, Massachusetts, Michigan, and North Carolina. Also, two states, Tennessee and New Hampshire, do not have a wage tax, but instead apply taxes only to dividend and interest. The overall highest maximum marginal income tax rate provision is in California at 13.3 percent, while the overall lowest minimum marginal tax rate provision is in Oklahoma at 0.5 percent. Some states rely on sales taxes, lotteries, excise taxes, or inheritance taxes for a large share of their revenues.

State estate tax—

As of 2015, 15 states and the District of Columbia have estate tax provisions; the states include Connecticut, Delaware, Hawaii, Illinois, Maine, Maryland, Massachusetts, Minnesota, New Jersey, New York, Oregon, Rhode Island, Tennessee, Vermont, and Washington. The 2015 exemption amounts among states range from \$675,000 to \$5.43 million. Six states have inheritance taxes: Iowa, Kentucky, Maryland, Nebraska, New Jersey, and Pennsylvania (Tax Foundation 2014). Figure 4.2 provides information on estate and inheritance tax rates and exemptions in 2014.

Property taxes—

Hickman (2007) provided a seminal review of property taxes, which are the most important source of revenue for most local units of government. Property taxes, or “ad valorem” taxes, are levied on the fair market value of the highest and best use of tangible, real property, such as land, timber, livestock, crops, or vehicles. Forest land property taxes were controversial historically owing to two issues: parcel bias and time bias. Empirical parcel bias studies showed that lower value properties such as forest lands were typically being overassessed relative to those of higher value, placing a greater tax burden on forest owners, whose land was proportionately less profitable, making them the least able to meet their tax obligations. In addition, forests were penalized by a time bias because:

Property taxes are levied on the fair market value of the highest and best use of tangible, real property, such as land, timber, livestock, crops, or vehicles.

Table 4.5—State and District of Columbia income taxes, 2014

State	Maximum marginal tax rate	Minimum marginal tax rate	State	Maximum marginal tax rate	Minimum marginal tax rate
<i>Percent</i>			<i>Percent</i>		
Alabama	5	2	Missouri	6	1.50
Alaska			Montana	6.90	1
Arizona	4.54	2.59	Nebraska	6.84	2.46
Arkansas	7	1	Nevada		
California	13.30	1	New Hampshire	5	5
Colorado	4.63	4.63	New Jersey	8.97	1.40
Connecticut	6.70	3	New Mexico	4.90	1.70
Delaware	6.60	2.20	New York	8.82	4
District of Columbia	8.95	4	North Carolina	5.80	5.80
Florida			North Dakota	3.99	1.51
Georgia	6	1	Ohio	5.39	0.54
Hawaii	11	1.40	Oklahoma	5.25	0.50
Idaho	7.40	1.60	Oregon	9.90	5
Illinois	5	5	Pennsylvania	3.70	3.70
Indiana	3.40	3.40	Rhode Island	5.99	3.75
Iowa	8.98	0.36	South Carolina	7	0
Kansas	4.90	2.70	South Dakota		
Kentucky	6	2	Tennessee	6	6
Louisiana	6	2	Texas		
Maine	7.95	6.50	Utah	5	5
Maryland	5.75	2	Vermont	8.95	3.55
Massachusetts	5.25	5.25	Virginia	5.75	2
Michigan	4.25	4.25	Washington		
Minnesota	9.85	5.35	West Virginia	6.50	3
Mississippi	5	3	Wisconsin	7.65	4

= not applicable; no state income tax.

Source: Tax-Rates.org 2014.

...most forest properties produce incomes only periodically, a growing forest crop—unlike other agricultural crops that mature and are harvested in a single year—isn't taxed just once, but many times. This was seen as inequitable, and the problem was compounded by the fact that in concept the amount of the tax would rise from year-to-year as the value of the trees increased because of physical growth. The implication was not only that the tax wasn't neutral regarding the allocation of resources, but that it actually operated so as to encourage forest exploitation—i.e., so as to induce forest

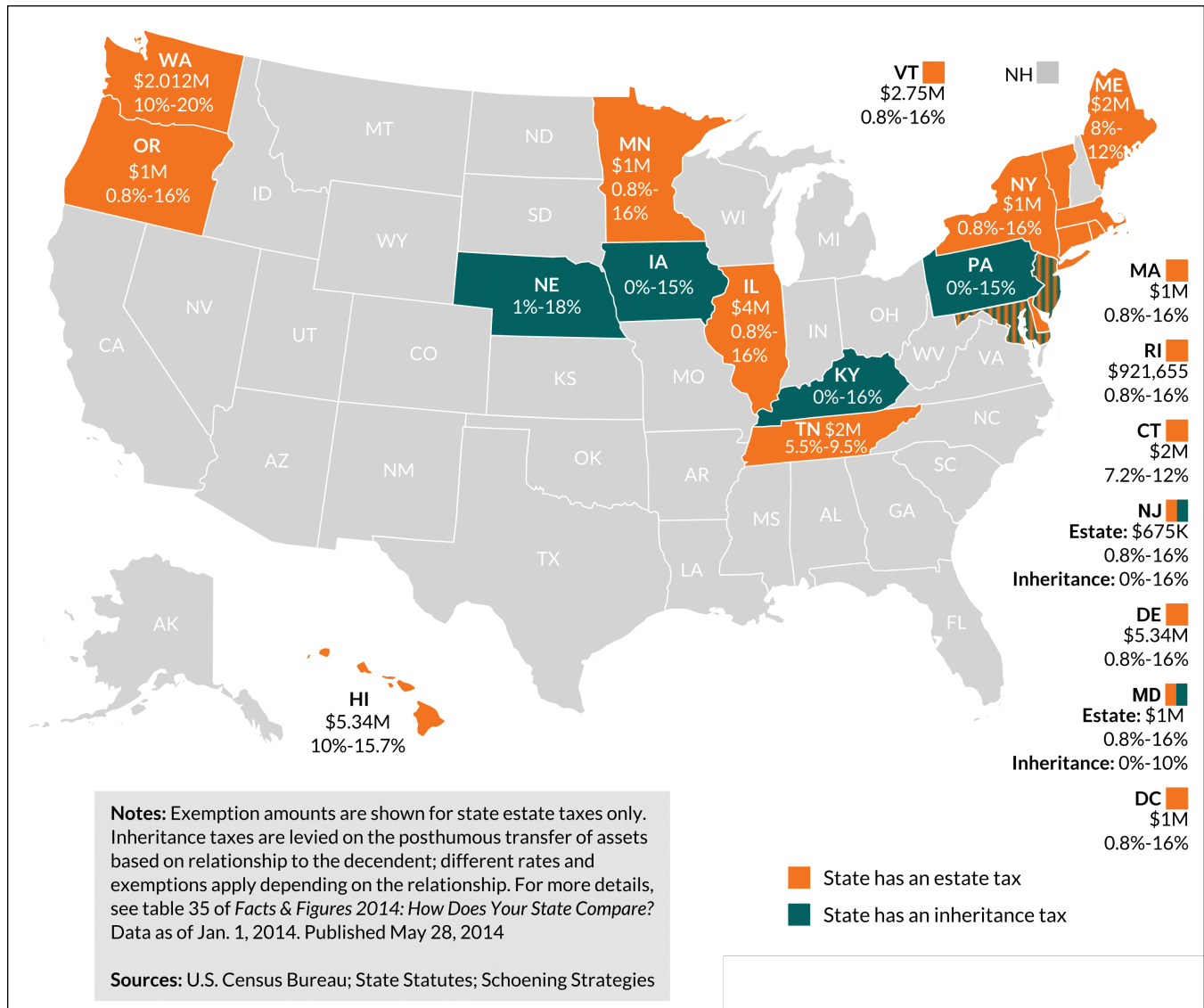


Figure 4.2—Inheritance and estate tax rates and exemptions in 2014 (Tax Foundation 2014).

owners to reduce stocking levels, shorten rotation lengths, move marginal forest lands into other uses, and even forfeit their lands when taxes became higher than productive values. (Hickman 2006, p. 6).

In addition, agricultural crops and livestock are rarely taxed as property, whereas timber typically has been taxed as such. Slowly increasing urban development in the 1960s led to fears that forest and other rural lands would be forced into conversion by higher taxes alone, because urban land values (and unmodified taxes) could be 10 to 100 times higher than forest uses.

These issues have led to a variety of special tax treatments for forest and agriculture land to (1) make them more equitable among similar classes of owners,

(2) prevent premature liquidation of older timber, (3) and prevent forced conversion to higher and better (more developed) land uses. These property tax benefits include exemptions, rebates, yield taxes, modified assessment rates, or modified assessment property tax laws, as described by Hickman (2007), and updated and summarized in table 4.6.

- **Exemption laws.** Provide that forest land or timber are to be removed from the property tax rolls, either permanently or for some specified number of years. A timber exemption could apply to all standing timber, or it could be limited to planted stands, immature stands, particular tree species, or trees retained for specific purposes such as windbreaks.
- **Rebate laws.** Provide that landowners who engage in some approved activity, such as tree planting, may subsequently apply for abatement of a portion of the taxes levied on the value of their land, timber, or both. The rebate may be given in the form of a direct cash payment or as a reduction from the total amount of taxes owed.
- **Yield tax laws.** Provide for a conceptual separation of land and timber values. Land values normally remain subject to the annual property tax, although sometimes in modified form. Timber values go untaxed until the time of harvest. At this juncture, a gross income tax, equal to some percentage of the stumpage value of the products cut, is imposed.
- **Modified rate laws.** Provide that forest land and timber are to be assessed like other forms of property, but that a different tax rate, lower than otherwise applicable, is to be used in computing the tax.
- **Modified assessment laws.** Provide that forest properties are to be valued differently than other forms of property. If fair market value in highest and best use is retained as the basic valuation standard, forest assessments may be frozen or calculated using a reduced assessment ratio. Alternatively, fair market value may be abandoned in favor of another valuation standard such as current use value.

As of 2007, all but four states had some type of modified assessment law providing favorable tax treatment of forest land, and even those four without such laws had some other type of forest landowners tax relief (Hickman 2007).

Kilgore et al. (2018) examined state preferential property tax programs for sustainable forest management in the United States in 2015 and identified 58 property tax programs, including at least one program per state, enrolling nearly 210 million acres of forest land nationwide through a range of preferential taxes promoting ecosystem services from private forest land. Preferential property tax laws help redress the problems of parcel bias, time bias, and highest and best use conversion issue.

Property tax benefits include exemptions, rebates, yield taxes, modified assessment rates, or modified assessment property tax laws.

Table 4.6—Forest property taxation systems in the United States, 2017

State	Exemption	Rebate	Yield tax	Modified rate	Modified assessment		
					Forests	Agriculture	Severance tax
Alabama	✓		✓		✓	✓	✓
Alaska	✓					✓	✓
Arizona	✓				✓	✓	✓
Arkansas					✓	✓	✓
California			✓		✓	✓	
Colorado	✓				✓	✓	
Connecticut			✓		✓	✓	
Delaware	✓				✓	✓	
Florida					✓	✓	
Georgia					✓	✓	✓
Hawaii					✓	✓	
Idaho			✓		✓		
Illinois					✓	✓	✓
Indiana					✓		
Iowa	✓				✓	✓	
Kansas						✓	
Kentucky					✓	✓	
Louisiana			✓		✓	✓	
Maine					✓	✓	✓
Maryland					✓		
Massachusetts			✓		✓	✓	✓
Michigan			✓			✓	
Minnesota		✓			✓	✓	
Mississippi					✓	✓	
Missouri			✓		✓	✓	✓
Montana	✓				✓	✓	
Nebraska	✓					✓	✓
Nevada					✓		
New Hampshire			✓		✓		
New Jersey					✓	✓	
New Mexico					✓		✓
New York			✓		✓	✓	
North Carolina	✓				✓	✓	✓
North Dakota				✓	✓	✓	
Ohio				✓	✓	✓	
Oklahoma					✓		

Table 4.6—Forest property taxation systems in the United States, 2017 (continued)

State	Exemption	Rebate	Yield tax	Modified rate	Modified assessment		
					Forests	Agriculture	Severance tax
Oregon		✓	✓		✓	✓	✓
Pennsylvania					✓		
Rhode Island	✓				✓	✓	
South Carolina					✓	✓	✓
South Dakota					✓		
Tennessee	✓				✓	✓	
Texas					✓	✓	
Utah					✓	✓	
Vermont					✓	✓	
Virginia					✓		✓
Washington			✓		✓	✓	
West Virginia					✓	✓	✓
Wisconsin			✓	✓	✓	✓	
Wyoming					✓	✓	
Totals	11	2	13	3	47	40	14

Nevertheless, none is perfect. Forest landowners still may face tax rates of \$10 to \$50 per acre per year, which is as much as or more than the value of the annual growth rate of timber. And the restrictions and covenants to participate in some tax relief programs also can be strict, which may deter enrollment. On the other hand, weak covenants and penalties for dropping out of tax-favored programs may prevent these programs from actually protecting land from conversion when enrollees drop out and sell their forest land for development or other uses without penalty. In these cases, taxpayers in general, and other forest landowners in particular, subsidize other owners' deferred development actions for little to no real benefit, underscoring the need for a balance between favorable tax treatment and ensuring long-term conservation.

The National Timber Tax Website (2014) provides a slightly different summary of state property taxes dividing state property tax laws into classes:

- **Ad valorem property tax** (current use): A tax, duty, or fee that varies based on the value of the products, services, or property on which it is levied (41 states).
- **Flat property tax:** Under this system, the same amount of money per acre is collected on any acre of timberland regardless of its value (11 states).
- **Yield tax:** This is a tax on the value of the harvested timber. The tax is collected after the timber is harvested (11 states).

- **Severance tax:** This is a flat tax on a specific unit of volume harvested (i.e., board feet, cubic feet, cords, tonnage, etc.). The tax is collected after the timber is harvested (12 states).
- **Exemption:** No tax (4 states).

Modified assessments are the most pervasive property tax treatments for broad-based forest and agriculture tax benefits. In theory, all states have an ad valorem tax unless there is a complete exemption, and some of those have current use assessment.

The National Woodland Owner Survey (<http://www.fia.fs.fed.us/nwos/>) provides evaluations of the impacts and landowner opinions about the property tax programs. The survey finds that state preferential tax programs had primary assistance goals for forestry (52 percent), open space protection (37 percent), agriculture preservation (7 percent), or wildlife habitat (4 percent). They had a wide range of minimum acreage required to enroll, and some had maximum acreages that could enroll in them as well, or limited enrollment to family farms and forests, excluding industrial owners. Some required a farm or forest management plan, most had a specified duration of enrollment, and almost all had some payback penalty for withdrawing from the program (Butler et al. 2010).

Forest land still may be taxed at rates that are high compared to its potential to generate timber or other revenue.

Various other types of state tax programs affecting farms and forests include timber harvest taxes, state-level income taxes, preferential treatment for capital gains from timber or land sales, forestry or land conservation income tax credits, state estate or inheritance taxes, and estate tax special valuation. In recent years, these programs have made substantial reductions in property taxes for most states in the country (fig. 4.3). Despite these preferential tax programs, forest land still may be taxed at rates that are high compared to its potential to generate timber or other revenue, which places pressure on forest landowners to convert their land to other uses. Overall, state preferential property tax administrators reported anywhere from over 75 percent to below 25 percent participation in their programs, which does not include forest landowners ineligible to participate (Butler et al. 2012).

Greene et al. (2013) summarized similar tax effects on southern forest owners, and the effects of federal taxes on U.S. family owners. This suite of related studies and articles summarized taxes affecting forestry in the United States, interviewed forest landowners and tax administrators, and assessed tax effects. Tax policies per se were not found to be triggering premature timber harvests or timberland sales. However, many tax programs and benefits—including federal reforestation tax incentives and cost-share payments, and preferential use assessments for county property taxes—were complex, poorly understood, and underutilized, thus failing to fully attain their intended aims.

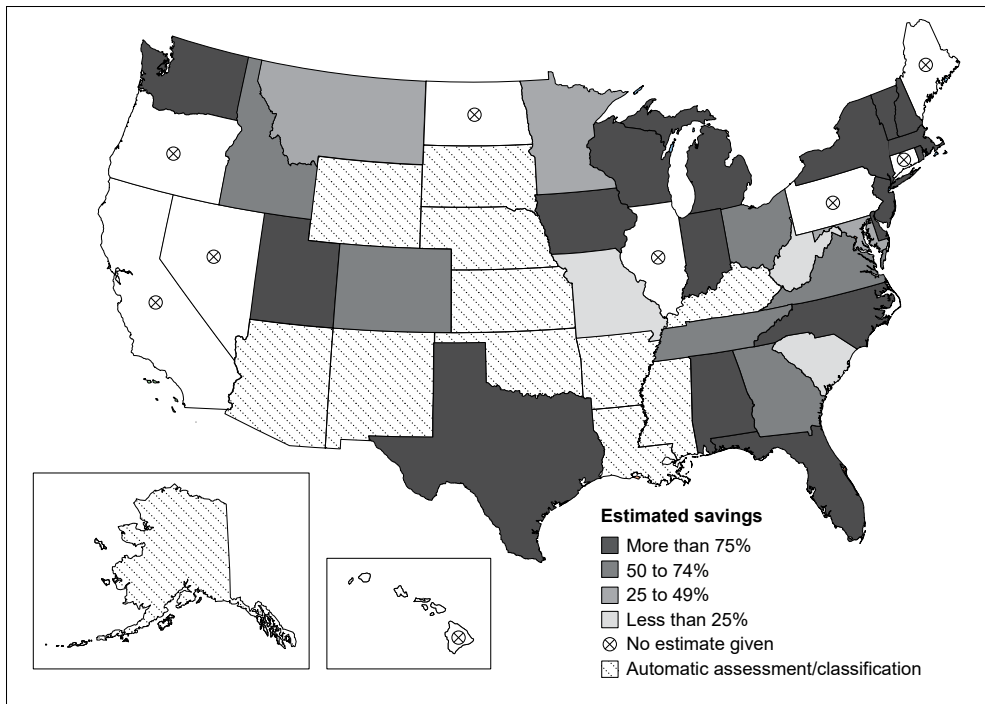


Figure 4.3—Reduction in annual property tax burdens for forest owners enrolled in preferential property tax programs as reported by program administrators (Butler et al. 2012).

Owners of family forests and other working lands are many times more likely than U.S. taxpayers in general to incur the federal estate tax. Of the forest estates that owe estate tax, 40 percent sell timber or land to pay part or all of the tax, with the net effect that roughly one-quarter of the acres sold end up being converted to other uses. Financial incentive programs are generally successful in promoting sustainable practices among the family forest owners who participate in them, but funding levels and owner confusion about the requirements to apply for and participate in the programs limit their impacts (Greene et al. 2013).

Conclusions

There are hundreds to thousands of federal, state, and local incentives and reduced tax benefits for forest land and commodities, and the associated nontimber and ecosystem services that they provide. Although a specific enumeration of all the laws and policies at the federal, state, and local level is not possible, the broad picture of policies is clear, and some trends can be suggested. Similarly, there are no definitive studies of the impacts of all these forest policies on private landowners, but there are some evaluations made by the National Woodland Owners Surveys and national research that provide thorough insights into federal state tax and incentive coverage and use.

Many tax and incentive policies influence the management of private forest lands.

The websites listed at the end of this chapter on timber taxes, forestry incentives, the Farm Bill and federal assistance programs, and the woodland owners survey have substantially increased our ability to track federal, and to a lesser extent, state tax and financial assistance to private forest landowners. It is unclear how often the tax and incentive websites are updated, and the property tax site does not provide current use assessment data per se. However, these sites provide good starting points for more detailed contacts and analyses providing that they are maintained and dates of revisions and persons to contact for more information are documented.

Many tax and incentive policies influence the management of private forest lands. The 2014 federal Farm Bill authorized \$46 billion for conservation programs, many of which provide conservation incentives for forest lands. An approximate estimate would suggest that federal financial incentives for forest conservation programs amounts to about \$2 billion per year, or up to one-third of the annual Farm Bill payments for conservation, but only about 5 percent of total farm payments including commodity programs and crop insurance. States also have forestry incentive programs that focus more on timber production, with some conservation programs for forests. These programs amounted to about \$11 million in FY 2014, but some states have stopped providing legislative funding for their programs in recent years.

Federal timber taxation provides various operating cost and carrying charge deductions for forest landowners who are classed as being in the trade or business or active investors. All forest landowners can receive capital gains treatment for their timber income since 1947, although recently this has been subject to revocation owing to federal budget issues. Small owners may be able to deduct up to \$10,000 of reforestation expenses each year from their federal income taxes and take accelerated depreciation of up to \$10,000 more over an 8-year period.

Property taxes are the most important factors affecting forest land management and retention at the state and local level. Most states have some type of favorable use value property tax treatment, which protects forests from conversion to more developed uses as a means to offset otherwise high annual property taxes. These property tax benefits include exemptions, rebates, yield taxes, modified assessment rates, or modified assessment property tax laws.

Several recent changes affect U.S. tax and incentives for sustainable forest management. Federal policy was modified by tax reforms in 2013, which basically increased general income taxes for high-income earners and increased the effective capital gains tax rate for all high-income individuals, including forest landowners. This was reversed more substantially in 2017. The estate tax was revised in 2013

and in 2017, raising the minimum tax level, or possibly by eliminating estate taxes entirely, which should help family forest landowners retain their property across generations. State forest property taxes continue to fund state and local services and have increased in many jurisdictions as the demand for services rises rapidly. The 2014 Farm Bill consolidated 23 conservation programs into 13 and provided \$57 billion in conservation funding for 5 years, which included \$6 billion in conservation spending cuts compared to the previous 5-year bill. The national timber tax website and new financial incentives website listed above help keep much better track of these changes, along with the periodic data reported in the national woodland owner surveys.

In sum, there is a wealth of federal, state, and local programs to encourage forest retention, management, and protection. These are perhaps under more threat now than in the past owing to budget pressures for all governments, but very few have been rescinded or eliminated to date. The U.S. Farm Bill was reauthorized in 2014 with slightly reduced but still quite large conservation programs, and most states and localities are still encouraging forest land retention through favorable property tax policies. Tracking the status of these national and state laws under this indicator will now provide an improved means to estimate trends in sustainable forest management on private lands in the United States.

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Appendix 4.1: Key Websites

- National Timber Tax: www.timbertax.org
- Forestry Incentives Programs: <http://www.srs.fs.usda.gov/econ/data/forestincentives/>
- Farm Bill: <http://www.usda.gov/wps/portal/usda/usdahome?navid=farmbill>
- U.S. Department of Agriculture Natural Resources Conservation Service: <http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/>
- USDA Forest Service Forest Inventory and Analysis National Woodland Owner Survey: <http://www.fia.fs.fed.us/nwos/>
- USDA Forest Service NWOS Table Maker: <http://apps.fs.fed.us/nwos/tablemaker.jsp>
- U.S. General Services Administration Federal Assistance: https://www.cfda.gov/downloads/CFDA_2014.pdf

Chapter 5: Clarity and Security of Land and Resource Tenure and Property Rights

Frederick W. Cubbage and Kathleen A. McGinley¹

Indicator Background and Rationale

Stable property rights and the assurance that those rights will be protected, or disputed through due process, are essential for sustainable forest management (Montréal Process 2014). Clear title to forest land identifies rights and responsibilities under the law with respect to land and resources, while due process ensures that these rights can be protected or disputed. Lack of clear ownership or due process may hinder the active engagement of stakeholders in the sustainable management of forests or leave forests vulnerable to illegal or unsustainable use. This indicator is intended to provide information on land, forest and resource tenure, laws, and rights.

Stable property rights are essential for sustainable forest management.

Measurement Approach

We report quantitative and qualitative information on forest land tenure and property rights. We also discuss key theoretical frames for understanding forest ownership and rights in the United States. A large amount of data on forests in the United States is collected by the Forest Service Forest Inventory and Analysis (FIA) program, including information on forest land ownership, which we summarize below. Definitions of land ownership used by FIA and others have evolved in recent decades with changes in land ownership arrangements such that differences in the literature and datasets on private land ownership statistics may differ. We discuss these differences and reconcile them in our discussion, to the extent possible. Data on land tenure and rights and changes in ownership are more disparate but were collected from key sources and discussed descriptively in this chapter.

Status and Trends

Forest land ownership classes and terminology have evolved from traditional classes of public, industrial, and nonindustrial forest land to more detailed breakdowns of public, private corporate, and private noncorporate. Although primary landowners generally fall into one of these three classes, each class also has subclasses that have changed over time. In addition, ownership is rarely absolute. For example, owners may own most of the rights to the land and its aboveground

¹ **Frederick W. Cubbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008; **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926.

resources, but may not have rights to the belowground resources or may sell their rights to development through conservation easements. Property rights theory has evolved with these changes, which we discuss along with the status and trends in forest ownership and tenure in the sections below.

Forest Ownership Classes

In the United States, property may be owned by any public or private organization, ranging from individual private property owners and corporations to local governments and American Indian tribes. Approximately 65 percent of **all** land in the United States is owned privately, and 35 percent by various government sectors, including 28 percent federal and 7 percent state and local governments (Oswalt et al. 2014). Of the 766 million ac of forest land in the United States, the private sector owns 445 million ac (58 percent), and the public sector owns 321 million ac (42 percent) (Oswalt et al. 2014) (table 5.1, fig. 5.1). Private noncorporate owners

Table 5.1—U.S. forest land by ownership class, 2012

Owner class/land class	United States	North	South	West
<i>Million acres</i>				
All owners:	766	176	245	346
Timberland	521	167	210	144
Reserved forest	74	7	4	63
Other forest	187	17	31	139
National forest:	145	12	13	120
Timberland	98	10	12	75
Reserved forest	27	1	1	24
Other forest	20	0	0	20
Other public:	176	35	20	122
Timberland	63	29	15	19
Reserved forest	47	5	3	39
Other forest	67	0	2	65
Private corporate:	147	29	65	53
Timberland	111	29	61	21
Reserved forest	0	—	0	0
Other forest	36	0	4	32
Private noncorporate:	298	100	147	51
Timberland	249	99	121	28
Reserved forest	0	0	0	0
Other forest	48	1	25	22

— = no data.

Source: Oswalt and Smith 2014.

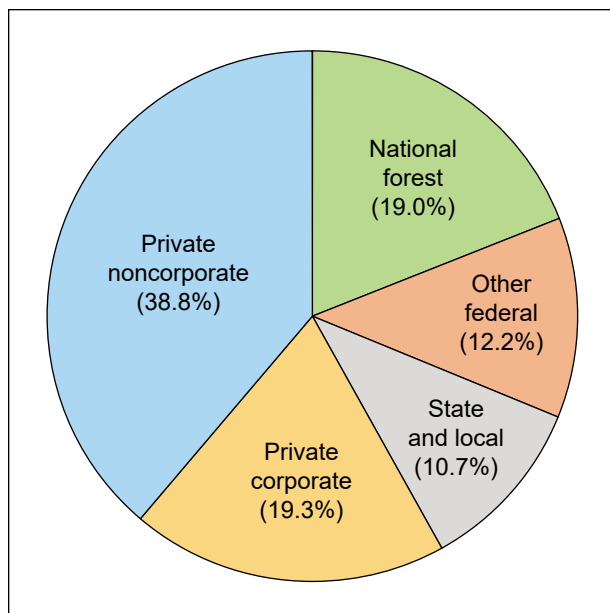


Figure 5.1—Forest land in the United States by owner class, 2012 (total: 766 million ac of forest land) (Oswalt et al. 2014).

(e.g., individuals, families) hold 39 percent (298 million ac) of the nation's forest land, and private corporate owners hold 19 percent (147 million ac) (Oswalt et al. 2014) (fig. 5.2).

Publicly held forest land in the United States is administered by a range of agencies. The U.S. Forest Service administers 19 percent of the total forest area in the United States, the Bureau of Land Management administers 5 percent, and other federal agencies administer another 7 percent; states own and administer 9 percent, and county and municipal governments own and administer 2 percent (Oswalt et al. 2014). Federal reservation lands held in trust for or owned by American Indians may be controlled by separate treaties, tribal laws, and regulations for management, sale, and acquisition, but still are subject to federal environmental restrictions or laws. Tribal forest lands exceed 18 million ac across 24 states on 305 forested Indian reservations (Indian Forest Management Assessment Team 2013).

Forest ownership types differ considerably by region of the country (table 5.1). Federal and some corporate lands predominate in the West. The Lake States have a diverse mix of public and private lands, including the most state and local government owners. The South and Northeast are mostly private land—family forest owners and corporate holdings, with some state land in the Northeast.

Property Rights Theory

Property rights govern the ability of forest and other landowners to acquire, manage, use, and dispose of their land and its products and services. These rights are exclusive but rarely absolute. Property and tenure rights are determined by the government and may be changed at the behest of government with due process that

Property rights govern the ability of forest and other landowners to acquire, manage, use, and dispose of their land and its products and services.

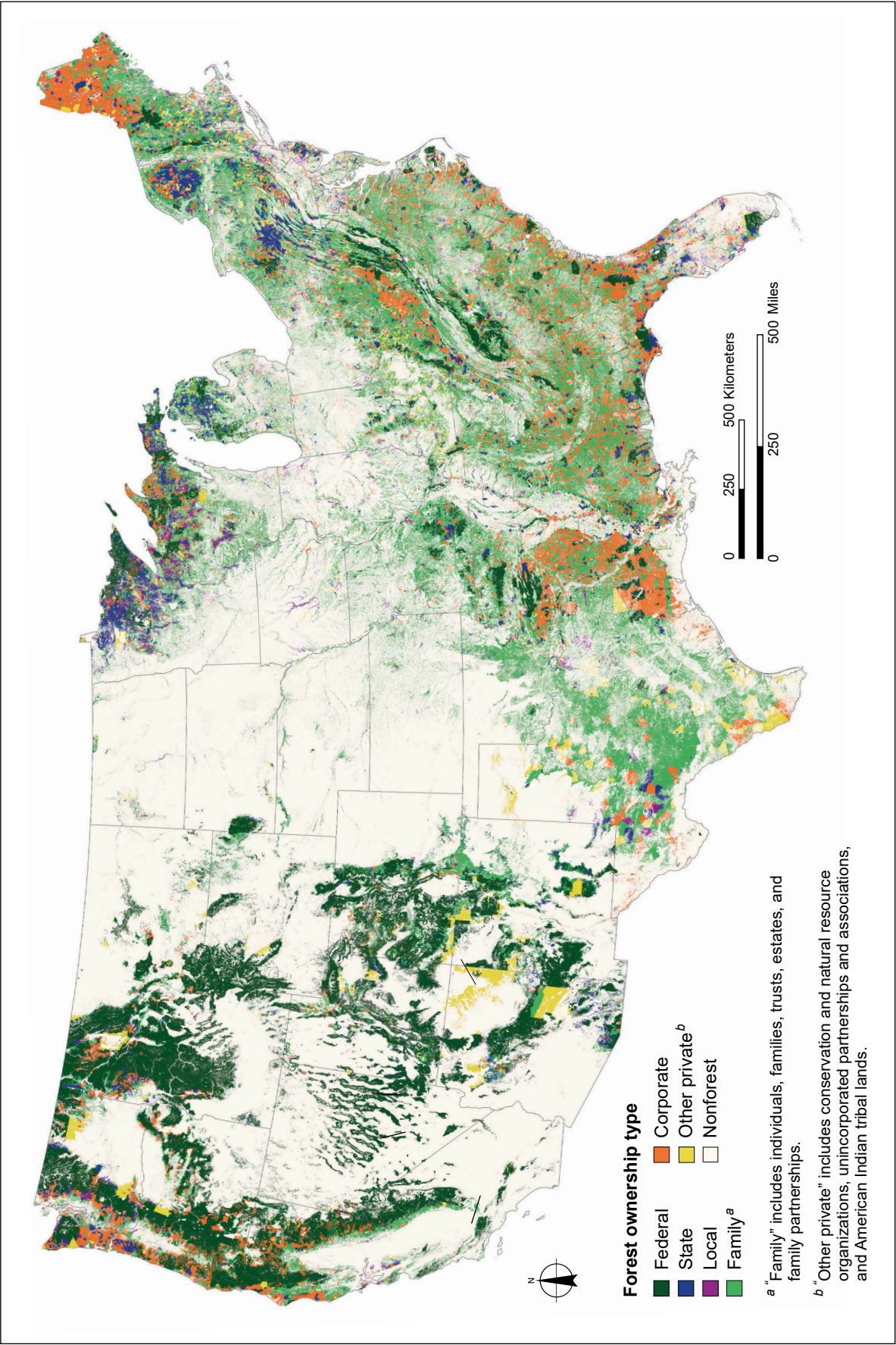


Figure 5.2—Distribution of forest ownership types in the United States.

includes the interests of the community and the landowner. Landowners' tenure and property rights are generally circumscribed by limits on externalities, such as preventing soil and water pollution, or on usufructuary requirements to leave land in good condition for future generations, such as seed tree or tree planting requirements. Broader landowner and zoning restrictions also have been made to provide for wildlife habitat protection, recreation access, or cumulative landscape effects, although these occur mostly in more urban and developed areas.

Theory on property rights helps to parse out nuances and understand their connections to and impacts on natural resource conservation. Schlager and Ostrom (1992) and Ostrom and Hess (2007) summarized the types of land use and protection rights that various users might have (table 5.2). Ownership categories (i.e., owner, proprietor, claimant, authorized user, viewer) can be applied to land as well as to the products and services that the land provides. According to their classification, an **owner** of property or products and services essentially can do as they wish with their property, as long as it does not violate any laws or regulations that protect other owners, society, or future owners from environmental damage or loss of land productivity. A **proprietor**—one who is leasing the land—can use, manage, harvest, and exclude others, but may not sell their land rights. **Claimants** have rights only up to management, **authorized users** only up to access and withdrawal, and **viewers** may access land, but may not withdraw products from it.

There are many different products and services associated with the rights to land, and they may be and are often owned separately. Rights to manage and protect forests may be separate from rights to exploit minerals or extract oil or water, and often are subjugated to more valuable uses, on both public and private lands. The rights to land and its uses differ among private and public owners. Private owners may possess all rights from access to alienation in exclusion of any other potential rights holder. Public owners may also hold all these rights, but users of those public lands almost always hold smaller bundles of rights to the same land base.

Table 5.2—Bundles of rights associated with land users

Level of rights /title	Owner	Proprietor	Claimant	Authorized user	Entrant/ viewer
Access	✓	✓	✓	✓	✓
Withdrawal	✓	✓	✓	✓	
Management	✓	✓	✓		
Exclusion	✓	✓			
Alienation/sale	✓				

Source: Ostrom and Hess 2007, Schlager and Ostrom 1992.

Contemporary U.S. forest ownership examples illustrate the different bundles of rights outlined by Schlager and Ostrom (1992) and Ostrom and Hess (2007) that are associated with forest land use. Traditional forest landowners may grow and harvest timber and nontimber forest products at will, within existing environmental laws. Many farm owners lease their lands to proprietors for annual crop or livestock production at fixed rental rates or cost share of the crop/livestock proceeds. Some forest owners, particularly in the U.S. South, have leased timberland to vertically integrated forest products firms in the past. In these cases, the landowner may sell the land, but the timber or crop rights remain with the proprietor, at least for the agreed time period. U.S. examples of claimants may apply on some public lands, such as for ski resorts, although they cannot remove timber or other resources, but may enjoy recreation values. Authorized users could include hunters and anglers, on privately or publicly owned land, as well as persons collecting or even growing nontimber forest products such as medicinal plants, florals, or edible wild plants. Recreationists such as hikers, kayakers, birdwatchers, campers, and motorists on scenic roads on private and public lands are examples of entrants and viewers.

Property Rights and Tenure Arrangements in the United States

Holding clear and absolute title to land is provided and protected by law in the United States. Administrative services to track land titles and ownership are usually provided by various local, county, or parish governments. Titles may be complete or partial, depending on the bundle of rights that are conveyed with a piece of property. Specific prescriptive laws govern the use and transfer of land, legal processes of contracts and torts govern how land rights are exercised or exchanged, and courts can resolve disputes when they arise. The 5th and 14th Amendments to the U.S. Constitution protect the rights of private landowners from the taking of private property without due compensation. These amendments have rarely been involved in direct application to limits of forest regulations of private landowner actions in legal challenges but do provide significant checks on excessive government regulation. Government may change the bundle of rights included in different ownership classes but may not do so arbitrarily or single out any specific class or group of owners for unfair burdens (Freyfogle 2001).

Most privately owned land in the United States historically has been held through fee simple ownership.

Most privately owned land in the United States historically has been held through fee simple ownership, which encompasses the most complete bundle of rights possible for land (Barlowe et al. 2013, Cubbage et al. 2017). As described by Barlowe et al. (2013):

[Fee simple owners] have the right to possess, use, and within reason exploit, abuse, and even destroy their land resources. They can sell land with or without deed restrictions that affect its future use. They can give it away, trade it for other things, or devise it in any of a number of ways to heirs. They can lease use rights to others; mortgage their property or permit liens to be established against it; subdivide their holdings or grant easements for particular uses; enter into contractual arrangements involving its development, use, or disposition and exercise these rights, as long as they have not disposed of them to the exclusion of all other persons.

Fee simple ownership is one of the broadest and most complete concepts of property ownership yet developed. Yet it must be recognized that the fee simple owner holds exclusive, not absolute, rights. Ownership rights are always limited and conditioned by the overall interests of society administered by the state. Because of their public nature four important sticks are never included in the fee simple bundle of rights. These include the public rights of regulation, taxation, taking for public use, and escheat (p. 251).

Fee simple rights to possess, use, sell, lease, mortgage, subdivide, and sell easements in the United States are clear. So are the rights of the state to tax land and its uses, to control land use, and to take land for public use (eminent domain). The ownership rights “to devise” property ensures that one can pass the land on to one’s heirs or other designated beneficiaries. If one has no beneficiaries, the state has the right of **escheat** to reclaim the land as state property.

Traditionally, forest ownership in the United States included all rights associated with the forested land, both above- and belowground. Notable exceptions to this generalization have long existed for mineral rights, such as oil, gas, and coal, which could be sold separately from the land rights to the forests, and in fact often hold superior claims; with due compensation, the forest can be cleared against owners’ wishes to mine coal or drill for oil or gas. Complete ownership of all property rights was common for commodity production of timber and even nontimber forest products through the 20th century. However, since the late 1990s, increasing attention has been given to the separation of property rights to protect or pay for environmental services from forests and other natural areas. Most of this attention has focused on the sale of development rights through conservation easements and other such types of arrangements, so as to ensure that the land will remain in its natural state for a determined length of time or in perpetuity.

Conservation easements typically set aside part of the land to protect it from development or to encourage a conservation use.

Conservation easements typically set aside part of the land to protect it from development or to encourage a conservation use, either for a fixed period in a contract or permanently by a restriction in the title to the land. These usually involve protecting natural ecosystems or removing land from production, agriculture, or development. Easements may allow only passive uses such as recreation and hunting or may permit more active uses such as timber management. In return for the conservation contracts or easements, owners receive financial payments for environmental services. A large number of Farm Bill programs are implemented as conservation contracts for a fixed period (see chapter 4 for detailed discussion of Farm Bill programs). A wide variety of land trusts and state conservation programs also buy permanent easements to protect forest and farm land in perpetuity. Organizations like The Nature Conservancy and Conservation International buy land outright, and either maintain and manage it for natural and ecosystem values, or transfer it to other long-term conservation owners and managers.

Who Owns Forest Land in the United States?

As noted above, 58 percent (445 million ac) of forest land in the United States is privately owned, and 42 percent (321 million ac) is publicly owned (Oswalt et al. 2014). In the following sections, we describe detailed status of and trends in these ownership classes.

More than 10 million individual and family forest landowners own 39 percent of total forest land in the United States.

Private landowners—

As reported by Oswalt and Smith (2014), more than 10 million individual and family forest landowners own 39 percent of total forest land in the United States, representing a diverse group of people who have many reasons for owning forest land. Most of this family-owned forest is used for the aesthetics that forests provide, as habitat for wildlife, and as part of a family legacy. Research indicates that just 8 percent of the individuals and families who own U.S. forest land have a written management plan, but this represents 24 percent of the total forest land held by this ownership class (Oswalt and Smith 2014).

Although 61 percent of private forest landowners own fewer than 10 ac of forest land, most (67 percent) private forest land is in holdings of at least 100 ac, and 22 percent is in holdings of at least 10,000 ac and is owned by less than 1 percent of owners—primarily corporations or investment organizations and primarily managed for commercial purposes (Oswalt et al. 2014). Private forests provide more than 90 percent of the nation's wood and paper products. By contrast, national forests provide less than 2 percent of our wood and paper products today. In general, private forests are more productive than comparable publicly owned forests. Private forests tend to be located on higher quality sites and have annual growth potentials that are, on average, 17 percent greater than the growth potential on public forests.

Further, private forests are achieving 56 percent of their potential annual growth compared with only 28 percent for public forests (Oswalt et al. 2014).

Timber investment management organizations and real estate investment trusts (TIMOs and REITs)—

Since the late 1990s, there has been a significant shift in corporate forest ownership to TIMOs and REITs. As indicated by their name, TIMOs are management companies that usually buy and hold timberland on behalf of other investors such as insurance companies, pension funds, wealthy individuals, foreign interests, or others. Conversely, REITs are publicly traded forest land owning companies usually spun off from the major vertically integrated forest products companies (VIFPCs) that restructured themselves to legally separate forest land ownership and management from their manufacturing facilities (Hickman 2007).

By 2014, all the major U.S. VIFPCs had sold their lands to TIMOs or reincorporated as REITs. In fact, by about 2010, the 30 largest TIMOs and REITs had acquired approximately 57 million ac of forest land (Forisk Consulting 2014, Harris et al. 2013, Zhang et al. 2012), virtually all of it from former VIFPCs (table 5.3). These TIMOs and REITs comprise slightly more than half of the total corporate class area of 111 million ac and maintain timber production, hunting, or other commercial uses as their main landowning objectives. Diverse other corporations own the balance of corporate forest lands, ranging from railroads, power companies, retailers, incorporated private farms and forest-limited liability companies (LLCs), among others. These other corporate owners' landowning objectives may be very diverse as well, but timber production seldom is their primary objective.

The distinctions between REITs and TIMOs also are significant in terms of land ownership rights. REITs are publicly owned and traded forest products real estate companies. TIMOs on the other hand are usually management companies that buy the land on behalf of other investors in individual or pooled funds. The TIMO sector is very dynamic, with frequent ownership changes occurring as investors acquire and sell forest land. There are fewer forest landowner REITs than TIMOs, but one major acquisition in 2015 changed that landscape when Weyerhaeuser merged with Plum Creek Timber Company, making Weyerhaeuser the largest private forest landowner in the United States at that time with more than 13 million ac of forest land.

The recent trend in VIFPCs selling formerly industrial forest lands to TIMOs and conversions to REITs is described by some, including Hickman (2007) and Zhang et al. (2012), as the largest reformation of forest land ownership in modern U.S. history. Many VIFPCs sold their lands because of relatively poor corporate financial performance, limits to timberland price appreciation owing to standard accounting principles, opportunities to cash out on significantly appreciated land

TIMOs buy and hold timberland on behalf of other investors. REITs are publicly traded forest land owning companies.

Table 5.3—Top 20 owners and managers of private timberland in the United States, 2015

Firm/organization type	Timberland
	<i>Acres</i>
Plum Creek Public REIT (purchased by Weyerhaeuser in 2015)	6,800,000
Weyerhaeuser Public REIT (industrial before 2010)	5,800,000
Forestland Group TIMO	3,400,000
Campbell Group TIMO	3,040,000
Hancock Timber Resource Group TIMO	2,948,000
Resource Management Service TIMO	2,600,000
Forest Capital Partners TIMO	2,500,000
Rayonier Public REIT	2,100,000
GMO Renewable Resources TIMO	2,100,000
Forest Investment Associates TIMO	2,000,000
Sierra Pacific Industries REIT (industrial)	1,900,000
Molpus Woodlands Group TIMO	1,800,000
Potlatch Public REIT	1,600,000
Wagner Forest Management TIMO	1,400,000
J.D. Irving Private REIT	1,200,000
BTGPactual (Formerly RMK) Timberland Group TIMO	1,100,000
Seven Islands Land Management TIMO	1,000,000
Timbervest LLC TIMO	825,000
Prentiss & Carlisle TIMO	800,000
MeadWestvaco Industrial (purchased by Plum Creek and other buyers in 2014)	730,000

REIT = real estate investment trusts, TIMO = timber investment management organization.

Source: Zhang et al. 2012, updated.

values, declining incentives to own and produce their own wood supply, and prohibitive federal tax treatment for C-Corporations. REITs tend to be restructured VIFPCs, such as Plum Creek (Plum Creek and Georgia Pacific lands), Weyerhaeuser, Rayonier, and Potlatch, and were motivated by passage of the Real Estate Investment Trust Simplification Act (REITSA) of 1997; more favorable tax treatment and enhanced after-tax investment returns; and a desire to ensure that timberlands were fairly valued in financial markets—i.e., to “monetize” timberlands. On the other hand, TIMOs and their institutional investors were motivated by passage of the Employee Retirement Income Security Act (ERISA) of 1974, and increased recognition within the financial community of the advantages of timberland investments, including favorable forest land investment returns and inflation protection.

Conservation payments and land trusts—

Government, civil society, and the private sector increasingly cooperate to protect private forest land, rangeland, and agricultural land in the United States. Together,

they have developed a broadening set of instruments to protect lands threatened by conversion to development or otherwise important to conservation by buying private land outright, buying permanent or temporary rights to prevent development, or by providing payments for environmental services. Interested parties negotiate prices, swaps, and loans for land and its products and services, and these agreements are recorded as simple contracts for a fixed time period, or as permanent conditions on property titles, liens, or other legally binding instruments that affect the land title.

Conservation easements are one such mechanism by which land and at least some of its associated bundle of rights is “set aside” to protect the land from future conversion or development. Conservation easements may allow only passive uses such as recreation and hunting or may permit more active uses such as timber management. Depending on the terms, a landowner with a conservation easement may be able to sell the land or pass it on to heirs, but future owners of the property are bound by the restrictions of the easement agreement (Land Trust Alliance 2016).

When a landowner enters into a conservation easement agreement, she or he gives away some of the rights associated with the land in exchange for compensation, technical support, or other resources for land conservation. For example, a donating landowner can retain the right to grow crops on a parcel while, at the same time, relinquishing the right to build additional structures or to allow recreation on the donated parcel. Conservation easements differ greatly in the compensation associated with them, with the highest easement values typically found on tracts of open space under high development pressure.

In some jurisdictions, placing an easement on one’s land also may result in property tax savings for the landowner (Land Trust Alliance 2016). Forest owners who donate land or gift it at reduced land values may deduct these gifts from state taxes in about 20 states, and also may receive a deduction in their federal income taxes. Essentially, the landowner receives a tax deduction for the difference between the full market value of their land and the amount of development rights that they give up by donating that land. These tax benefits can be substantial and may increase the interest and land contributions from present owners, particularly those interested in conservation.

The federal tax deduction for land conservation gifts was increased substantially in 2015 and made permanent rather than requiring periodic renewal as previously. The Land Trust Alliance (2016) described the new benefits:

If a conservation easement is voluntarily donated to a land trust or government agency, and if it benefits the public by permanently protecting important conservation resources, it can qualify as a charitable tax deduction on the donor’s federal income tax return. [The new law] increases the benefits to landowners by:

- Raising the deduction a donor can take for donating a conservation easement to 50 percent from 30 percent, of his or her annual income;
- Extending the carry-forward period for a donor to take a tax deduction for a conservation agreement to 15 years from 5 years; and
- Allowing qualifying farmers and ranchers to deduct up to 100 percent of their income, increased from 50 percent.

Land trusts are another type of agreement in which one party agrees to hold the title or ownership of a piece of property for the benefit of another party (note: a land trust may also refer to an organization holding, stewarding, or assisting with the acquisition of conservation easements or other types of land acquisitions). Although conservation easements usually require that protected land be kept in its undeveloped natural state forever, and may have various other use restrictions, land trusts cover a broader range of land uses, including protection for critical natural habitat, as well as land offering recreational, agricultural, and other conservation values (Land Trust Alliance 2016). As of 2015, 56 million ac of land in the United States were conserved by local, state, and national land trusts, having increased by more than 9 million ac since 2010 (Land Trust Alliance 2016).

A large number of programs listed under the Farm Bill and described in chapter 4 are implemented as conservation contracts for a fixed time period or in perpetuity. Fixed-time-period contracts include most of the 10-year contracts under the Conservation Reserve Program, which is authorized to make payments for up to 32 million ac of farm or forest land, and has funded about 2 million ac of planted forests. Farm Bill programs also involve permanent conservation easements, including in the Healthy Forests Protection Program, Farmland Protection Program, Environmental Quality Incentives Program, and Forest Legacy Program (see also chapter 4).

Other types of payments may be made to compensate or incentivize landowners for forest environmental services. These payments may be made directly by the government; voluntary payments from businesses, individuals, and nongovernment organizations; and payments in compliance with government regulations, such as the Clean Water Act or the Endangered Species Act. Total revenues for landowners from these types of payments for environmental services were \$1.5 billion in 2005 and reach more than \$2 billion by 2012 (Mercer, n.d.).² This included \$366 million from government sources (19 percent), such as the Conservation Reserve Program; and \$1.5 billion from nongovernmental sources, including payments for wetlands mitiga-

² Mercer, E. [n.d.]. Indicator 6.27. Revenue from forest-based environmental services. In: Robertson, G., ed. National report on sustainable forests–2020 (forthcoming). U.S. Department of Agriculture, Forest Service.

tion (\$727 million), hunting leases (\$410 million), conservation easements (\$315 million), conservation banks (\$34 million) and wildlife viewing (\$34 million) (fig. 4.1).

Public lands—

The federal government owns most of the public forest lands in the West, and state and county governments own most of the public lands in the East. Of all public forest acres, 75 percent are in the West. Most protected forests are in public ownership, whereas most production forests are in private ownership (Oswalt and Smith 2014). Public forests are managed for a broad diversity of uses and values, including multiple uses of outdoor recreation, range, timber, wildlife and fish, and water typical of the U.S. Forest Service. Timber production on federal public lands is far less than their proportional land area or timber volumes would suggest, but state and county lands in the North Central region and Northeast are active timber producers and other commodity producers, such as natural gas in Pennsylvania.

Federal reservation lands held in trust for or owned by Americans Indians may be controlled by separate treaties, tribal laws and regulations for management, sale, and acquisition, but still are subject to federal environmental restrictions or laws and are considered public lands. Tribal forest lands encompass 18 million ac on 305 Indian reservations located in 24 states. These lands are held in trust by the U.S. government and encompass a unique mix of forests and peoples but are subject to many of the same threats as other forest ownerships in the United States, including wildfire, insects, disease, development, climate change, fewer markets, and urbanization (Indian Forest Management Assessment Team 2013). Overall, timber activities on tribal forest lands have declined in the last decade, but they continue to provide jobs, income, and other benefits to tribal communities (Indian Forest Management Assessment Team 2013).

Conclusions

U.S. forest ownership has changed markedly in the past three decades, and tenure rights have evolved as well. Public land area has remained relatively constant for decades, although some state and local initiatives have purchased land for conservation purposes. National forests cover 145 million ac, or 19 percent of the U.S. total. Other federal, state, and local government lands total 176 million ac (23 percent). In the private sector, many VIFPCs sold their lands to TIMOs or converted their ownership into independent RIETS from the 1980s to present, which together now hold about 57 million ac (7 percent) of U.S. forest land. Other private corporate owners hold about 7 percent.

Private noncorporate owners—family forest owners—are the largest single class of forest landowner, with 298 million ac (39 percent) of the total forest land in

Of all public forest acres in the United States, 75 percent are in the West.

the United States. Coupled with all private corporate owners (11.8 percent), private owners hold 58 percent of U.S. forest land (Oswalt et al. 2014).

The objectives of public and private owners in the United States differ widely, as do the goods and services that they produce. Most private owners hold fee simple tenure rights to their land but may not hold the rights to all the parts, goods, or services of a tract. Underground mineral rights may be sold to other owners; water rights differ between the Eastern and Western states; and a variety of conservation use rights are being sold on private land. Public land usually is managed for multiple-use purposes, and federal land in particular uses ecosystem management and public participation to produce a broad range of environmental services. State lands still produce a range of goods and services but often have specific timber production objectives in order to produce income for states or communities.

Division of the complete bundle of land use rights is expanding in the United States, particularly in terms of the separation of land ownership and tenure rights for development and conservation. Fee simple ownership was standard in the United States for nearly 200 years, except perhaps for separation of mineral and water rights from land rights. However, in the late 20th century, a movement to promote and protect natural environments led to the purchase of land for conservation, and the occasional separation of development rights and conservation rights through conservation easements and other mechanisms to protect rural forest and agricultural land from development.

Modern conservation easements and land trusts may conserve entire properties outright or at least purchase the associated development rights. Government organizations and nongovernment organizations have been active in purchasing these forest lands or partial use rights for conservation use. These sales of rights, such as via programs in the Farm Bill or to land trusts, have increased substantially since the early 2000s. These purchases of development rights to retain forest and agricultural lands have occurred through short-term conservation contracts of 10 to 30 years, or permanent conservation easements with registered development restrictions as part of the land title.

Land trusts protect about 47 million ac of land in the United States. Government also is continuing to buy moderate amounts of forest lands for public ownership and conservation. Favorable tax treatment at the state and federal levels, which allow the deduction of the value of conservation gifts, has been credited with increasing sales or gifts of land. This tax treatment has been eliminated in some states, but the federal tax deduction for making conservation easements was extended substantially in 2015, which should result in continued increases in this type of land conservation in the future.

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Appendix 5.1: Key Websites

Forest Inventory and Analysis (FIA): <http://www.fia.fs.fed.us/>

FIA library: <http://www.fia.fs.fed.us/library/>

FIA national reports: <http://www.fia.fs.fed.us/program-features/rpa/default.asp>

FIA forest facts: <http://www.fia.fs.fed.us/library/brochures/default.asp>

FIA 2014 national report: http://www.srs.fs.usda.gov/pubs/gtr/gtr_wo091.pdf

FIA ownership summary: <http://www.fia.fs.fed.us/nwos/>

FIA maps: <http://www.fia.fs.fed.us/library/maps/>

Land trusts: <http://www.landtrustalliance.org/>

Chapter 6: Enforcement of Laws Related to Forests (Indicator 49)

Kathleen A. McGinley and Frederick W. Cubbage¹

Indicator Background and Rationale

Although market forces allocate many forest resources and services in the United States, laws, regulations, and guidelines generally are required to promote and protect accepted standards of forest sustainability, such as environmental protection, tenure rights, and aesthetic values. Compliance with forest-related rules may be promoted through persuasive means, such as fiscal incentives and technical assistance. However, full conformity with the legal framework often requires some form of enforcement as well, such as oversight and monitoring of compliance and prosecution and penalization for noncompliance. Indicator 49 is intended to provide information on the extent to which forest-related laws and regulations are followed and enforced throughout the country (Montréal Process 2015). It is an important aspect in sustainability assessments as effective law enforcement can deter activities that adversely affect forests and their sustainability (e.g., illegal logging, endangered species damage/destruction).

Measurement Approach

We used quantitative and qualitative data on forest law compliance, infractions, and enforcement to measure this indicator. We collected data related to land area and law enforcement personnel, programs, and budgets from federal land management agency websites and databases and through direct consultation with key program officers. Law enforcement program managers with federal land management agencies provided critical data on forest-related crimes, prosecutions, and penalties, which we summarize and present here. Additionally, we reviewed refereed and grey literature to document and describe the enforcement of forest-related laws at federal, state, and local levels.

Extensive quantitative and qualitative data related to this indicator were available at the federal level; however, access to similar data at the state and local level was highly dispersed and more difficult to obtain, particularly as there is no database or dataset addressing forest law enforcement at the subnational level. Furthermore, although data on forest-related crimes were available at the federal level, explanatory or causal factors for detectable trends were not readily available.

Compliance with forest-related rules may be promoted through persuasive means, such as fiscal incentives and technical assistance. However, full conformity with the legal framework often requires some form of enforcement as well, such as oversight and monitoring of compliance and prosecution and penalization for noncompliance.

¹ **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926. **Frederick W. Cubbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008.

Enforcement actions include inspections, investigations, fines, and other penalties to deter violations and noncompliance with sustainability mandates.

Status and Trends

Laws and other policy directives requiring enforcement actions relevant to sustaining forest conditions are extensive in the United States (see chapter 2). They exist at national and subnational levels and address environmental conditions (air, water, hazardous waste); wildlife and fisheries (harvest limits, species preservation, subsistence hunting); timber resources and extraction (harvest limits, road construction, health and safety); and special features protection (sensitive or fragile areas, archeological sites), among many other factors and activities. Enforcement actions include inspections, investigations, fines, and other penalties to deter violations and noncompliance with sustainability mandates. In addition, education, technical assistance, fiscal incentives, and other approaches are used to promote the uptake and adoption of actions and conditions considered essential for forest sustainability (see chapters 4, 7, and 9). Ultimately, the mere existence of authority to impose fines or seek court-imposed prison terms can significantly influence behavior regarding the adoption of forest sustainability standards, as can technical assistance, tax breaks, education, and outreach (Ellefson et al. 2005).

Federal Land

Numerous laws and related rules and regulations include enforcement mechanisms for federal forest land, including the National Forest Management Act of 1976, the Endangered Species Act of 1973, the Archeological Resources Protection Act of 1979, the Clean Water Act of 1987, the Clean Air Act of 1990, and the Paleontological Resources Preservation Act of 2009. There are numerous policy directives specific to timber theft and fraud that address the illegal destruction, removal, and transport of timber from federal lands (e.g., 18 USC § 1852); the destruction of timber on public land and Indian reservations (e.g., 18 USC § 1853); and general theft of public money, property, or records (e.g., 18 USC § 641).

Federal agencies with forest and natural resource management and protection mandates have broad authority and significant institutional capacity to enforce forest-related laws, regulations, and guidelines. In particular, these agencies include the Department of the Interior Bureau of Land Management (BLM), National Park Service (NPS), and Fish and Wildlife Service (FWS), and the U.S. Department of Agriculture Forest Service (FS). In fiscal year (FY) 2010, these four agencies had established law enforcement programs with combined budgets that exceeded \$470 million and more than 4,000 law enforcement personnel (table 6.1).

Although forest and natural resource law enforcement budgets and personnel are quite high relative to those of most countries, one federal law enforcement officer may be responsible for patrolling vast areas of federal land, which can

Table 6.1—Land area, number of units, number of visitors, enforcement personnel, and enforcement budget for key federal land management agencies in the United States, 2010

Agency ^a	Total land area	Units	Total annual visitors	Law enforcement personnel	Law enforcement budget	Area per person	Budget per acre
	<i>Million acres</i>	<i>Number</i>	<i>Millions</i>	<i>Number</i>	<i>Million dollars</i>	<i>Thousand acres</i>	<i>Dollars</i>
BLM	245	417	57	303	28.5	808.6	0.12
NPS ^b	84	401	279	3,097	232.7	27.1	2.77
USFWS	150	561	40	326	65.8	460.1	0.44
FS ^c	193	174	173	766	145.1	252.0	0.75
Total	672	1,553	549	4,492	472.1	149.6	0.70

^a BLM = Bureau of Land Management; NPS = National Park Service; USFWS = U.S. Fish and Wildlife Service; FS = Forest Service.

^b Total land area and land units include national parks, monuments, battlefields, military parks, historical parks, historic sites, lakeshores, seashores, recreation areas, scenic rivers and trails, and the White House. More than half of law enforcement budget is directed toward resource protection against vandalism and for archeological safeguards. Total wilderness area of the NPS is about 44 million ac.

^c As of 2008, \$23.0 million was added each year to FS Law Enforcement and Investigation's budget for cost pool expenses, such that the operational budget was not significantly greater than the fiscal year 2007 budget of \$110.7 million.

Sources: USDA FS 2014, USDI BLM 2013, USDI FWS 2013, USDI NPS 2012.

augment the challenges in detecting and investigating forest offenses and crimes.

For example, the total area overseen by the BLM averaged more than 800,000 ac per law enforcement officer in FY 2012 (USDI BLM 2013). In some locations, such as Alaska, an individual officer's area of responsibility can exceed 25 million ac (USDI BLM 2013).

The NPS has the most enforcement personnel per area, at one officer per 27,000 ac. Forest Service enforcement personnel covered about 250,000 ac per person on average, and FWS personnel more than 450,000 ac per person (table 6.1). For comparison, note that as computed in chapter 7 for the entire United States, the average area of forest covered per forester was about 19,000 ac; 7,500 ac per forest resource professional or 75 ac per landowner. Enforcement budgets averaged \$0.70 per ac and were as little as \$0.12 per acre for BLM and up to \$2.77 for NPS. To augment enforcement resources, federal land management agencies increasingly work in partnership with other federal, state, local, and tribal governments and nongovernmental partners to monitor and even enforce forest laws, rules, and regulations through interagency enforcement activities, joint investigations, public education, community outreach campaigns, and other initiatives.

Reflecting their multiple-use missions, federal land management agency law enforcement programs focus on a broad range of rules and regulations including those related to timber, mineral, cultural, and other resource trespass and theft; arson and human-induced fire; unlawful use of roads and lands; harm or destruction of threatened and endangered species; and occupational safety and health. In

FY 2012, a recorded 7,982 forest-related enforcement actions (i.e., “written warning, citation, criminal complaint, arrest, grand jury indictment, or administrative/civil remedy”) occurred on BLM lands (247 million ac), up just slightly from FY 2010 but by more than 2,000 enforcement actions since FY 2008 (USDI BLM 2013). Overall, on BLM lands from FY 2008 to FY 2012, there was an increase in enforcement actions related to off-highway vehicles (OHVs); the production, sale, or distribution of illegal drugs and other substances; and arson and human-caused fire (fig. 6.1). Data and information on the causal variables associated with these shifts were not available at the time of this report.

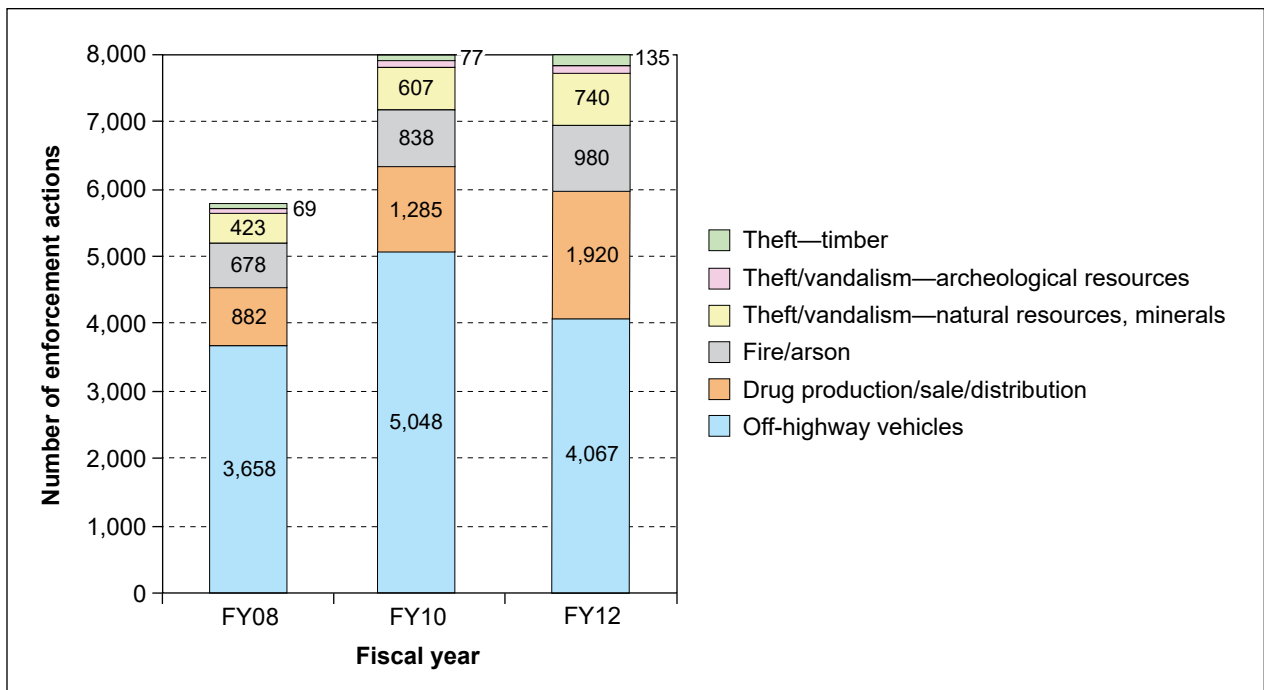


Figure 6.1—Number of forest-related enforcement actions on Bureau of Land Management lands, select fiscal years, 2008–2012 (data source: USDI BLM 2014).

In the National Forest System (NFS) (193 million ac), there were 14,124 forest-related violations (i.e., documented violation of regulation **with** a citation or fine), and an additional 33,525 forest-related incidents (i.e., documented violation of regulation **without** citation or fine) in FY 2013 (fig. 6.2) (USDA FS 2014). The majority of these violations and incidents were associated with the illegal or unauthorized use of or activities on forest roads and trails (encompassing offenses ranging from parking violations to unauthorized timber transport), illegal/unauthorized use of or activity with OHVs, and arson and human-caused fires. The overall number of forest-related

law enforcement violations on NFS lands generally decreased from FY 2005 to FY 2013, with the exception of timber-theft and fire-related violations, which increased slightly during this time period. Timber theft violations in particular ranged from localized theft of fuel wood and other forest products, to harvest permit violations, through to complex illegal logging cases that span large areas, timeframes, and multiple jurisdictions (USDA FS 2014). Information on causal or explanatory factors for these trends were not readily available at the time of this report.

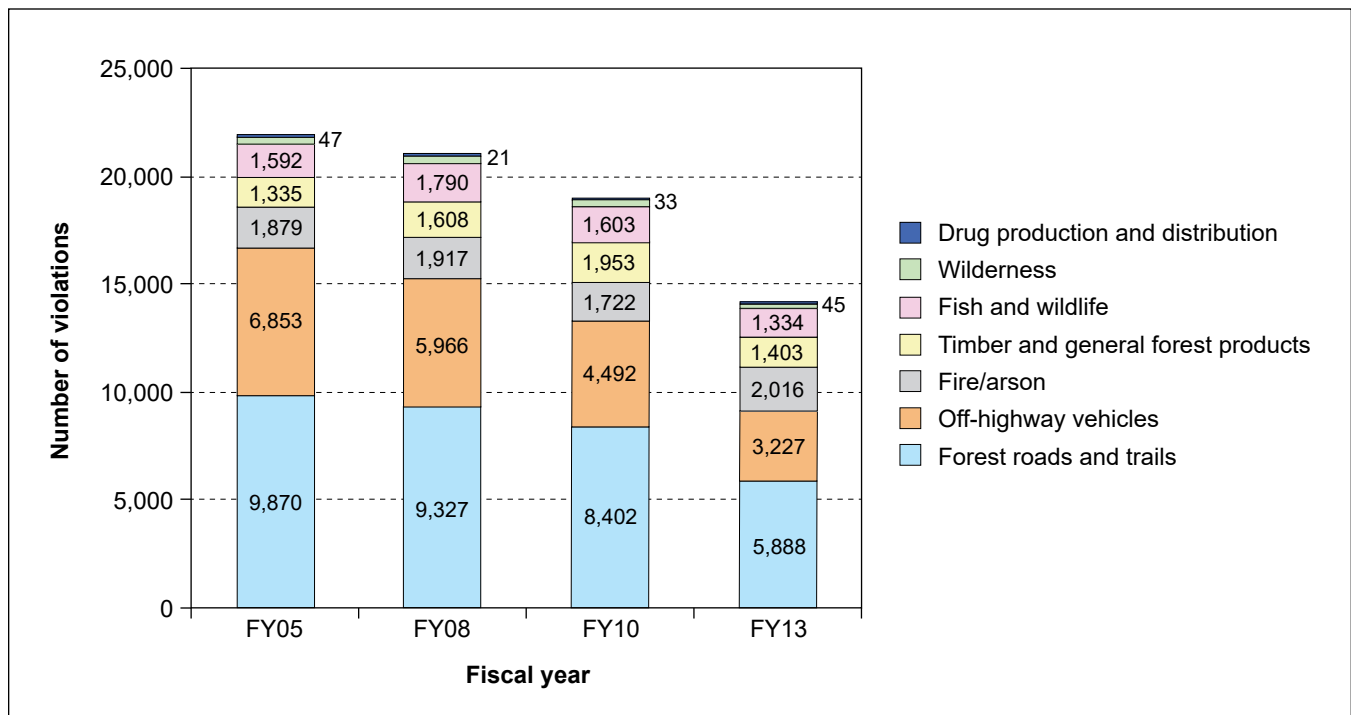


Figure 6.2—Number of forest-related violations on National Forest System lands, select fiscal years, 2005–2013 (data source: USDA FS 2014).

International Laws and Enforcement

The United States also participates in international efforts to ensure the legality and protection of forest resources and products, many of which have enforcement requirements. For example, the United States is a participating country in the legally binding Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the United Nations Convention on Combatting Desertification (UNCCD), International Tropical Timber Agreement (ITTA), Ramsar Convention on Wetlands, the Convention for the Protection of Migratory Birds, and numerous free trade agreements with environmental chapters or annexes. Additionally, several health and safety-related rules and regulations in the United States

include phyto-sanitary requirements with enforcement measures to protect against the introduction and spread of nonnative pests and diseases.

CITES is a legally binding international agreement intended to ensure that international trade in specimens of wild animals and plants does not threaten their survival (CITES 2015). The agreement was signed in 1973 by 80 countries, including the United States. By the late 2000s, CITES had become one of the most widely accepted global conservation agreements in existence with 179 countries or nations as signatory parties (CITES 2015). In 2016, about 5,600 species of animals and 30,000 species of plants worldwide were listed under one of three appendixes to CITES.² The FWS is responsible for enforcing the provisions of CITES in the United States and works with multiple partners, including federal and state agencies, industry groups, and conservation organizations, to carry out its authorities. In 2012, the FWS seized 187,148 CITES specimens (including live wildlife, parts, and products) and about 27 tons of commodities made from CITES species (USDI FWS 2016). Seizures increased in 2014 to 282 tons of CITES specimens and about 96 tons of commodities made from CITES species (USFWS 2016).

The U.S. government takes further action to enforce the legality of imported wildlife, plants, and wood products, particularly as stipulated by the U.S. Lacey Act and its amendments. The original wildlife and plant provisions stipulated under the Lacey Act have been in force for more than a century. Enacted in 1900, the act's original focus was on the control of illegal hunting, trapping, and trade of wildlife. Later, amendments extended its mandate to include concern for plants. However, it was not until a 2008 amendment through the Farm Bill that its scope expanded significantly to include illegally obtained plants and products made thereof. This amendment makes it unlawful to import, export, sell, acquire, or purchase fish, wildlife, or select plants (including timber products) in the United States that have been illegally taken, possessed, transported, or sold from their point of origin (USDA APHIS 2016). Supported by a diverse coalition of actors that included the timber industry as well as environmentalists, the 2008 Lacey Act Amendment (LAA) produced the world's first ban on trade in illegally sourced timber

The 2008 Lacey Act Amendment (LAA) produced the world's first ban on trade in illegally sourced timber and related products and has since been used as a model by others, including the European Union, Australia, and China.

² Species listed in CITES appendix I are demonstrably affected by trade and threatened with extinction, their commercial trade is illegal under CITES agreements, and export and import permits are required to move a specimen on this list for any other reason. Appendix II species are identified as those which may become threatened with extinction if their trade is not restrained and therefore require a CITES-regulated export permit for commerce. Appendix III species are listed when one nation asks other CITES nations for help in controlling trade, but which may not necessarily be threatened by current trade levels (CITES 2016).

and related products and has since been used as a model by others, including the European Union, Australia, and China.

The 2008 LAA requires importers and traders to exercise “due care” in their handling of plants and plant products, including an import declaration that includes the scientific name, volume, value, and country of origin of all plants and plant products, excepting certain scientific specimens and food crops (USDA APHIS 2016). The LAA also establishes penalties for noncompliance, including forfeiture of goods and vessels, fines, and imprisonment. Violators may be prosecuted for knowingly importing illegal timber and timber products, or even when they did so unknowingly but should have known what they were so doing. Implementation challenges associated with global timber tracking necessary for compliance with LAA have triggered some new opposition to the amendment’s mandates, but most groups still agree that it has contributed to forest protection by requiring importers to identify the source of imported wood, leading to more sustainable supply chains and discouraging illegal logging globally (see, for example, Lawson and McFaul 2010, Prestemon 2015).

The FWS is responsible for oversight and enforcement functions associated with the Lacey Act and its amendments. In FY 2012, the FWS conducted 2,474 investigations involving the Lacey Act (including plant and animal imports) compared to just over 1,500 investigations involving the Lacey Act (pre-amendment) in 2000 (USDI FWS 2013). A few highly publicized cases involving violations of the LAA have included the Gibson Guitar Company, which ended in July 2012 with a criminal enforcement agreement in which the firm accepted responsibility for knowingly importing banned timber species from Madagascar and India and agreed to pay \$600,000 in penalties and fines but avoided a criminal prosecution (USDA APHIS 2016). Another high-profile case involved Lumber Liquidators Inc., a major hardwood flooring retailer in the United States that pleaded guilty to knowingly importing illegally sourced hardwood from Russia. On 17 October 2015, Lumber Liquidators agreed to pay more than \$13 million in fines and penalties and accepted a 5-year probationary period during which it must put into place a Lacey Act Compliance Plan. This case represents the first felony conviction and largest fine at that time under the Lacey Act (USDOJ 2015).

States, Local Government, and the Private Sector

At the state level, nearly all states have forest and water quality laws that authorize enforcement of actions intended to enhance forest sustainability on public and private lands. These laws cover issues like fire control, timber trespass, forest practices, forest health, and roads. Most states have institutional resources and capacity

to oversee forest-related laws, regulations, and guidelines (NASF 2017). In 2016, about \$33 million (~1 percent) of state expenditures totaling \$3.025 billion were spent directly on forest practices oversight and enforcement, another \$305 million (10 percent) were spent on education and outreach related to sustainable forestry practices (NASF 2018). Nevertheless, most state forest agency budgets and personnel numbers have been stagnant or in decline in recent years, while key clients and issues continue to expand (NASF 2017).

The Clean Water Act (CWA) regulates forestry as a nonpoint source of pollution and indicates that best management practices (BMPs) are a viable and effective means for addressing this type of diffused pollution source. As codified in the 2014 U.S. Agricultural Act (P.L. 113-79; aka the Farm Bill), forestry activities (e.g., harvesting, logging roads) are exempt from the permitting requirements associated with runoff discharge when conducted in accordance with state-approved BMPs or standard industry practice. All states have some form of science-based forestry BMPs (NASF 2015). These guidelines are generally designed to protect water and soil resources in terms of quality and quantity and can be adapted to local and regional forest types and management contexts.

State-level forestry BMPs are disseminated and enforced through multiple mechanisms. Eleven states (22 percent) regulate forestry BMP implementation through their forest practices laws or related legislation (NASF 2015). Twenty states (40 percent) use a strictly voluntary approach to BMP compliance (e.g., through technical assistance, education, fiscal incentives, etc.) (NASF 2015). Nineteen states (38 percent) use a “quasi-regulatory” approach in which state law specifies a desired outcome (e.g., maintaining water quality) and provides voluntary BMPs but does not prescribe a specific method for achieving the desired outcome (NASF 2015). Each of these three approaches has been found to be equally effective in terms of engendering compliance, such that differences in implementation rates are not associated with differences in enforcement approach (NASF 2015). Overall, “forestry agencies report that logger training/certification programs have proven to be a key element in strengthening the acceptance, adoption, and use of forestry BMPs,” regardless of enforcement approach (NASF 2015).

Regional and national data demonstrate generally high and increasing levels of BMP implementation across the United States. This upward trend is associated with “federal and state legislation, regulation, and extension; certification programs; and public pressure” in support of forestry BMPs and guidelines (Ice et al. 2010). In 2013, the average implementation rates of forestry BMPs nationwide was

Regional and national data demonstrate generally high and increasing levels of BMP implementation across the United States.

estimated at 91 percent. Regionally, Pacific Coast states had slightly higher implementation rates (93.5 percent) than those in the Rocky Mountain region and the Southern region (92 percent), which were slightly higher than the Northern region (87 percent) (NASF 2015).³ Ultimately, even where implementation and compliance with BMPs is high, their effectiveness is dependent in large part upon their content and the range of forest practices and the associated impacts they address (McGinley et al. 2012).

Local governments also have laws, rules, and guidelines that focus on forest sustainability and protection, though enforcement approaches and capacity have not been cataloged or assessed. Additionally, the private sector increasingly complies with voluntary guidelines for sustainable forest management, such as forest certification standards, that often go beyond the requirements at federal, state, and local levels. Forest certification is recognized by the National Association of State Foresters (NASF 2015) and others (see, for example, Ice et al. 2010) as making positive impacts on forestry in the United States, including the implementation of related BMPs. As noted in chapter 2, as of mid-2018, three forest certification systems had certified approximately 13 percent of the nation's total forest area, 63 million ac certified by the Sustainable Forestry Initiative (SFI), 18 million ac certified by the American Tree Farm System (ATFS) and 25 million ac certified by FSC-US, some of which has dual certification and which is not double counted in the total reported here and in chapter 2. (FSC 2019, PEFC 2019, SFI 2019).

Conclusions

A broad range of laws and other policy directives require enforcement actions relevant to forests and their sustainability at all levels in the United States. At the federal level, there is fairly substantial total capacity to enforce forest-related rules and regulations, although this still seems modest on a person-per-acre or dollar-per-acre basis, and is much smaller than the entire effort provided by forest resource professionals for all other land management activities, as calculated in chapter 7. Some types of forest infractions and crimes, such as arson, illegal drug production and distribution, and the use of OHVs are on the rise. At the state level, guidelines on forestry BMPs are a key component of forest oversight and protection, whether implemented through regulatory, voluntary, or mixed-policy approaches. Local forestry laws and ordinances also require enforcement, but information on capacity and outcomes is limited.

³ Regions are defined by the USDA Forest Service Resources Planning Act assessment as depicted at: <http://www.fs.fed.us/research/rpa/regions.php>.

As forest-related rules and regulations increase while budgets and personnel levels stagnate or decline, there is an increasing need for coordination and clarification of roles and responsibilities at all levels of government and forest ownership in the United States. Ultimately, the effectiveness of forest regulations requires some level of oversight, enforcement, and penalties for noncompliance, but also benefits from education and outreach, technical assistance, and fiscal incentives.

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Appendix 6.1: Key Websites

U.S. Forest Service Law Enforcement and Investigations: <http://www.fs.fed.us/lei/>

U.S. Bureau of Land Management Law Enforcement: <https://www.blm.gov/programs/public-safety-and-fire/law-enforcement>

U.S. Fish and Wildlife Service Office of Law Enforcement: <http://www.fws.gov/le/index.html>

U.S. Fish and Wildlife Service International Affairs Convention on International Trade in Endangered Species and Wild Fauna and Flora: <http://www.fws.gov/international/cites/>

Chapter 7: Programs, Services, and Other Resources Supporting Sustainable Management of Forests (Indicator 50)

Frederick W. Cubbage and Kathleen A. McGinley¹

Indicator Background and Rationale

Sustainable forest management requires well-trained people and sound public and private institutions to provide knowledge and skills to manage forests (Montréal Process 2014). The human capital required for sustainable forest management includes professionals in academia including scientists, educators, and extension workers; government and nongovernmental organizations; and the private sector with knowledge in the natural and social sciences. Infrastructure to access and manage forests—buildings, roads, utilities, and physical capital—also is important. Human, social, and physical capital facilitates implementation and advancement of rural development, urban green spaces, and sustainable forest management. Indicator 50 is intended to capture information on the human, social, and physical capital supporting forests, including the capacity of both government and private organizations to deliver programs and services, to maintain and develop infrastructure, and to access the financial and human resources necessary to support the sustainable management of forests.

Measurement Approach

Indicator 50 is measured through quantitative and qualitative information. The number and trends in forestry education and professional foresters (i.e., human capital), and forestry institutions and infrastructure (i.e., physical capital) can be used as metrics of programs and services supporting sustainable forest management (Montréal Process 2014). There are no long-term consistent data series that measure human or physical capital in forest resources in the United States, but some relevant sources are available from professional organizations and the largest forestry employers. Various useful data series and program summaries were obtained from professional organizations, the Forest Service, and the National Association of State Foresters.

¹ **Frederick W. Cubbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008. **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926.

In particular, the U.S. Forest Service provides general information on human and physical capital dedicated to their various programs. Professional societies track membership, certifications, and continuing education. The National Association of University Forest Resources Programs (NAUFRP) also maintains some data, but not a consistent time series. Previously, the U.S. Department of Agriculture collected data on forest and natural resource programs enrollment, but has since ceased. Also, no known data source exists that measures or reports on the physical infrastructure for sustainable forest management. Consequently, this indicator had only partial and infrequent data available for this report.

Status and Trends

Forestry Education

Most forestry college-level education and training in the United States are conducted by land grant universities or community colleges as well as two private university-accredited graduate forestry programs. The Society of American Foresters (SAF) accredits forestry programs. As of 2017, there were 53 accredited or candidate baccalaureate or master's degree programs in the United States. Several programs have multiple options, some with bachelor of science and master's degrees, and several with some degree programs accredited under natural resources and environmental management or urban forestry in addition to forestry. There also were 21 accredited and 3 candidate forest technology degree programs at 24 institutions in 2017 (Redelsheimer 2017).

As of 2009, there were more than 12,000 total undergraduate students majoring in natural resources and the environment. This included about 2,800 forestry students.

Sharik et al. (2015) summarized natural resource program enrollment trends across 31 major NAUFRP forestry and natural resource programs from 1980 to 2009, as well as a larger dataset of 67 institutions from 2005 to 2012. Based on the longer dataset (with fewer schools), as of 2009, there were more than 12,000 total undergraduate students majoring in natural resources and the environment. This included about 2,800 forestry students in the United States, 4,400 natural resources and environment students, 2,800 fisheries and wildlife students, 600 wood products students, and 1,000 outdoor recreation students (Sharik et al. 2015) (fig. 7.1). Since the late 1990s, there have been increasing numbers of students in wildlife and natural resource programs, but declining enrollment in forest management.

The larger dataset of 67 NAUFRP university natural resource enrollments indicates that there were almost twice as many undergraduate natural resources and the environment students, with about 27,000 in total as of 2012. This included about 4,000 undergraduate forestry majors; 7,500 in fisheries and wildlife, 5,000 in natural resource conservation and management, and 8,000 in environmental science undergraduate programs (Sharik et al. 2015).

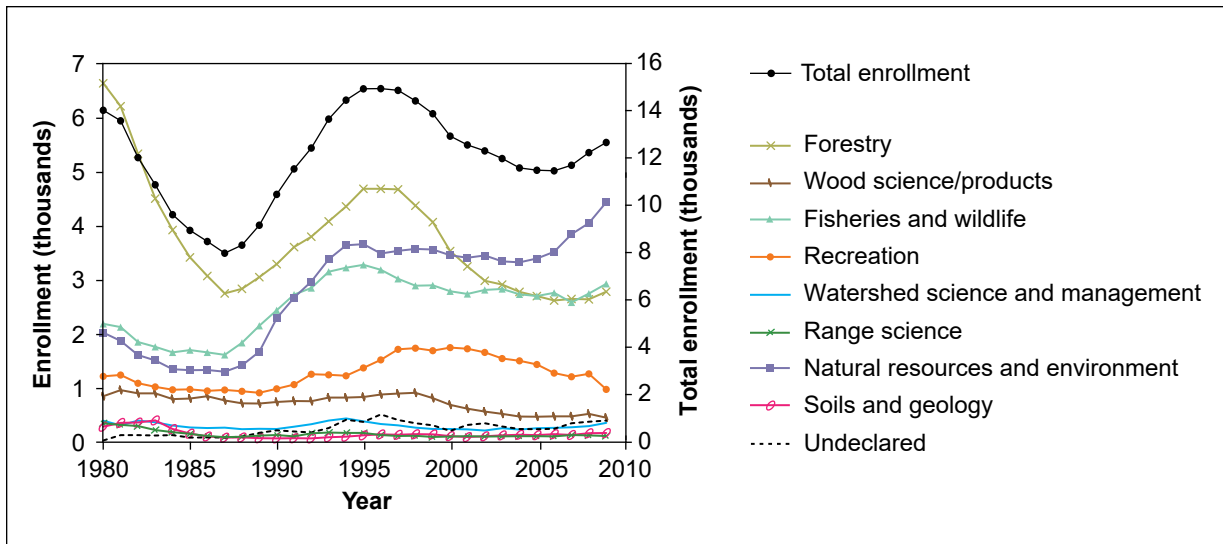


Figure 7.1—Undergraduate enrollment in natural resource programs by field of study at 31 National Association of University Forest Resources Programs institutions in the United States, 1980–2009 (Source: Sharik et al. 2015).

Most of the 53 SAF-accredited university programs also provide continuing professional education for foresters and offer programs for forest landowners, other professionals, and the public as well. In addition, there are a variety of natural resource, wildlife, and environmental science programs that provide varying levels of forest resource management skills across a wide range of university education programs.

Natural Resource Professionals

Membership in SAF and the Association of Consulting Foresters (ACF) is open to forestry and forest-related professionals, as well as to students in the case of SAF. As of 2014, SAF and ACF included more than 10,000 and 650 members, respectively (table 7.1). Although a complete tally of professional foresters and forest resource managers who manage federal, state, local, and private lands in the United States is not readily available, partial statistics of the number of foresters who work for federal or state agencies, or who are members of SAF present a snapshot of forest resource professionals working in the United States at a given point in time. A large share of wildlife professionals also manage forest habitat; the Wildlife Society has about 7,500 professional members. Other natural resources professionals, fisheries biologists, and environmental scientists also contribute to forest resources management, as suggested by the preceding natural resources education summaries, and by the fact that forests comprise about one-third of the nation's land.

A certified forester program is offered by SAF, which had about 2,000 certified or candidate certified foresters as of 2017, including forestry consultants (25

Table 7.1—Forestry employment and professional memberships for select organizations

Type/region/ organization	USDA Forest Service	State forestry agencies	Cooperative extension	Society of American Foresters	Association of Consulting Foresters
	<i>Number of employees in 2014</i>		<i>Number of FTEs in 2013</i>	<i>Number of members in 2014</i>	
Status:					
Permanent	29,500	16,281		—	—
Seasonal	15,000	9,549		—	—
Total	44,500	25,830	248	10,099	651
Region:					
North and D.C.	—	—	89	3,411	162
South	—	—	106	3,466	394
Mountain	—	—	15	1,166	23
Pacific Coast, Alaska, Hawaii	—	—	39	2,056	72

— = no data; USDA = U.S. Department of Agriculture, D.C. = District of Columbia.

Sources: Hoffman 2014, National Association of State Foresters 2015, Sagor et al. 2014, USDA FS 2014, White 2014.

percent), private industry (24 percent), state and local government (19 percent), federal government (9 percent), college/university (7 percent), retired (7 percent), and other (9 percent) individuals (Murgia 2017). There also were about 1,300 certified wildlife biologists and 350 associate wildlife biologists certified by the Wildlife Society, many of whom were involved in forest-related fields. Both designations have the same educational requirements, but certified wildlife biologist certification requires 5 years of professional wildlife experience (Murphy 2017).

Sixteen states have statutes with a mix of required or voluntary forester licensing and registration laws, which include 12 with mandatory licensing or registration (Alabama, Arkansas, California, Connecticut, Georgia, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, South Carolina, and Vermont). Four have voluntary registration (Michigan, North Carolina, Oklahoma, and West Virginia); Texas has a voluntary accredited forester program (Watson 2017).

The Forest Service is the largest employer of forestry-affiliated personnel in the United States, with approximately 29,500 permanent employees and more than 15,000 temporary employees. The most common occupations are forestry technician (about 7,000 employees) and forester (about 4,000) (USDA FS 2014). Additionally, 711 research scientists and their associated technical staff work for the agency. Most agency employees are located on the national forests, but a large number of employees also work on college campuses, at research laboratories, or in office buildings in urban to rural settings.

All states have some form of forestry agency or department or professional staff. These state organizations employed a total of 26,747 persons in 2016, up from 25,830 persons in 2014. State personnel included 7,780 foresters (29 percent), 4,901 technical persons (19 percent), 2,492 other professionals (9 percent), 1,408 administrative and clerical staff (5 percent), and 10,166 seasonal workers (38 percent). The largest share of seasonal state forestry employees—more than 7,000—work in fire control and fire prevention (NASF 2017).

University programs employed more than 1,200 forestry professors in 2014 (see chapter 8). Cooperative extension program personnel (about 250) also provide education and outreach to private forest landowners, state and local forest landowners, and urban residents in every state except Nevada (Sagar et al. 2014). The greatest number of extensionists worked in the South, followed by the North and West. There were more than 20 broad subjects for which extension personnel developed programs, with forest health and invasive species, intergenerational land transfer, effects of climate change on forests, geographical information systems, nontimber forest products, and urban forestry having the greatest number of programs (Sagar et al. 2014).

Infrastructure

Because the infrastructure that supports sustainable forestry in the United States is so large, varied, and broadly distributed, only a basic descriptive assessment is feasible in this report. Federal and state governments own public lands, develop and maintain infrastructure, and teach or perform research. For example, the Forest Service maintains 14,077 recreation sites, 42,085 buildings, 143,346 mi of trails, and 374,883 mi of roads across 193 million ac of national forests and grasslands (USDA FS 2009). Private-sector firms and forest owners manage forests or forest product manufacturing facilities. Altogether, they generally develop and maintain adequate physical infrastructure to support the supply of extant forest products and services and forest management activities across the country.

Some informational and educational mechanisms are required by law, including technical assistance and research to provide adequate facilities and forest infrastructure such as roads, firebreaks, firefighting gear, and harvesting equipment. Often such infrastructure is required in terms of the process for developing adequate capacity for forestry activities. Owing to more frequent and larger forest fires, the budget for national forests has been increasingly dedicated to firefighting, and the fire budget now exceeds the national forest management budget. States also have retrenched many of their forestry programs because of firefighting costs.

**There are about
40,000 forest resource
professionals in the
United States.**

Private-sector firms develop physical infrastructure and institutional capacity through private market, free enterprise efforts. They develop internal firm or trade association rules, processes, or outcome guidelines as necessary, with either voluntary compliance or self-regulation, including through forest certification. Their ultimate success in developing efficient infrastructure is measured by market performance and profits in the long run. Direct government subsidies have seldom been employed in developing private forestry infrastructure, but many parts of the federal tax code related to accelerated depreciation, tax deductions, and tax credits promote investments and manufacturing plants and facilities and in-woods equipment.

Conclusions

Overall forestry capacity in the United States is substantial but has declined somewhat in recent years. Forestry program undergraduate enrollments at 31 major traditional forestry programs was about 3,000 as of 2009; about the same number of wildlife students; and more than 4,000 natural resources and environment students, for a total of about 13,000 at that time. At present, most universities have merged their forestry departments into broader natural resources colleges or added other disciplines to the forestry program to expand its purview. Other universities and programs have added environmental programs, as well as new forestry and natural resources degrees. This is reflected by a larger undergraduate enrollment of about 27,000 natural resource and environmental programs at 67 NAUFRP universities in 2012.

Membership in professional forestry associations has decreased somewhat. There still is a large number of field foresters and natural resource professionals, university professors and staff, research, and outreach personnel, totaling approximately 40,000 or more professionals across all public and private employers. There are even more professionals when the broader field of natural resources and fisheries and wildlife management are included, and likely vastly more if all environmental sciences are considered.

Overall resources at federal and state levels dedicated to forests have shifted toward firefighting and prevention owing to more frequent large forest fires. This shift has certainly enhanced firefighting capacity but adversely affected funding for forest management, education, insect and disease, recreation, wildlife, maintenance, and ongoing operations. Finally, infrastructure to support sustainable forest management is significant, vast, and widespread across public and private sectors. Nevertheless, related statistics and trends regarding infrastructure are difficult to track.

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Appendix 7.1: Key Websites

Society of American Foresters (SAF) home page: <https://www.eforester.org/main>

SAF Certified Forester: https://www.eforester.org/Main/Certification_Education/Main/Certification/Professional_Dev_Home.aspx?hkey=47860dc0-26fb-4187-b2ce-e1e8b65b5f6b

Association of Consulting Foresters: <http://www.acf-foresters.org/default.aspx>

National Association of University Forest Resource Programs:

<http://naufrp.forest.mtu.edu/>

<http://www.naufrp.org/>

National Association of State Foresters (NASF): <http://www.stateforesters.org/>

Chapter 8: Development and Application of Research and Technologies for the Sustainable Management of Forests (Indicator 51)

Frederick W. Cubbage and Kathleen A. McGinley¹

Indicator Background and Rationale

Research and development provide the scientific basis for adaptive management of forests. Science improves our understanding of forest ecology and social and economic dynamics and is fundamental to ensuring that we can meet society's goals for forest ecosystems. Indicator 51 provides information on the capacity to develop and incorporate new science, research, and technologies into forest management. Continuous improvement in the depth and extent of forest-related knowledge and its application facilitates advances in the protection and sustainable management of forests (Montréal Process 2014).

Indicator 51 provides information on the capacity to develop and incorporate new science, research, and technologies into forest management.

Measurement Approach

The Montréal Process Technical Advisory Committee notes on indicator measurement state that useful data may include the number of full-time equivalents (FTEs) in forest-science-related research and development by discipline; the number of operational laboratories, research stations, experimental forests, and long-term research/monitoring sites; and the number of peer-reviewed papers published annually by discipline or research area. Other information may highlight the area and percentage of forests monitored using remote sensing, area logged using state-of-the-art harvesting techniques (e.g., reduced impact logging equipment), and the extent to which other technologies are being applied and the scale of their impact on forest management.

We measured this indicator mostly through quantitative information on the number of FTEs in forest-science-related research and development by discipline and the number of operational laboratories, research stations, experimental forests, and long-term research/monitoring sites dedicated to forest research. We also produced summaries of research programs and budgets from administering agency websites and direct correspondence with agency or organization personnel.

To determine the number of full-time scientists in government and academia, we collected data from the major organizations conducting forest research in the

¹ **Frederick W. Cubbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008; and **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926.

We canvassed professors at accredited forestry programs, as well as scientists in Forest Service Research and Development.

United States. We canvassed professors at accredited forestry programs, as well as scientists in Forest Service Research and Development. Data on other support staff or technicians in these organizations were available for the Forest Service, but not for universities. Data were collected from organizational or agency websites; calls to individual organizations were made if any necessary information was unavailable on the Internet.

We canvassed U.S. forestry schools and programs, as well as Forest Service research station websites, to gather data on research, teaching, and outreach for full-time scientists and employees as of 2016. To provide a clear, replicable dataset for this and future efforts, only full-time Ph.D. research scientists or senior research staff in the Forest Service (excludes technicians or other nonscientist research staff), and full-time university tenure track and nontenure track professors (excludes instructors, emeritus, or adjuncts) were tallied in the 2016 survey. The findings were compared with the 2002 National Research Council (NRC) report on “National Capacity in Forestry Research.” The 2002 data may have included some mix of Ph.D., graduate degrees, and technical staff, so the 2002 and 2016 results are not exactly comparable, but still useful. Similar to the 2002 data, we categorized the 2016 professors, researchers, and scientific employees according to SFM criteria based on their primary research activities as described below.

In the past decade or so, forestry programs in many universities have been folded into natural resource and environmental programs and colleges, which makes separating “forestry” research from broader research categories more difficult than in the past. To address these changes, we (1) used the list of accredited forestry programs from the Society of American Foresters (SAF) for the 2014 population of forestry universities ($n = 45$), which corresponded most closely with the prior 2002 NRC report; (2) included all forestry, wildlife, and solid wood products faculty listed in the “forestry” programs and schools and related departments; (3) included similar faculty with “forestry” as their primary research or teaching role in broader colleges and schools; but (4) did not count faculty in areas such as geology, geography, pulp and paper science, or parks and recreation that had no direct forestry research, or were housed in a separate department from the forestry program.

Once the list of professors and scientists was completed, we classified these individuals in line with the Montréal Process criteria to determine their distribution across a broad range of forest science topics. The research team developed a classification protocol for coding scientists and professors by SFM criteria (table 8.1). We coded the data with assistance from two graduate students and checked other available data for the Forest Service scientists. Scientists and professors also were coded in relation to their location per major regions outlined by the Forest Service (fig. 8.1).²

² Regions are defined by the USDA Forest Service Resources Planning Act assessment as depicted at: <http://www.fs.fed.us/research/rpa/regions.php>.

Table 8.1—Fields of study for classifying scientists and professors among Montréal Process criteria

Montréal Process Criterion	Scientist/professor classification criteria—fields of study
Criterion 1—Biological diversity	Genetics, biology, ecology, silviculture, physiology, wildlife, geography
Criterion 2—Productive capacity	Forest management, biometrics, geographical information system, modeling and inventory, quantitative silviculture, forestry
Criterion 3—Ecosystem health	Climate change, entomology, pathology, fire, meteorology, ecosystem health
Criterion 4—Soil and water	Hydrology and soils
Criterion 5—Carbon cycles	Carbon pools and fluxes
Criterion 6—Socioeconomics	Social needs, perceptions, and values of forest resources, urban forestry, economics, production and consumption of wood resources
Criterion 7—Policy, laws, institutional framework	Forest and natural resource policy and planning, economics, stakeholder involvement and coordination, collaboration, property rights, governance

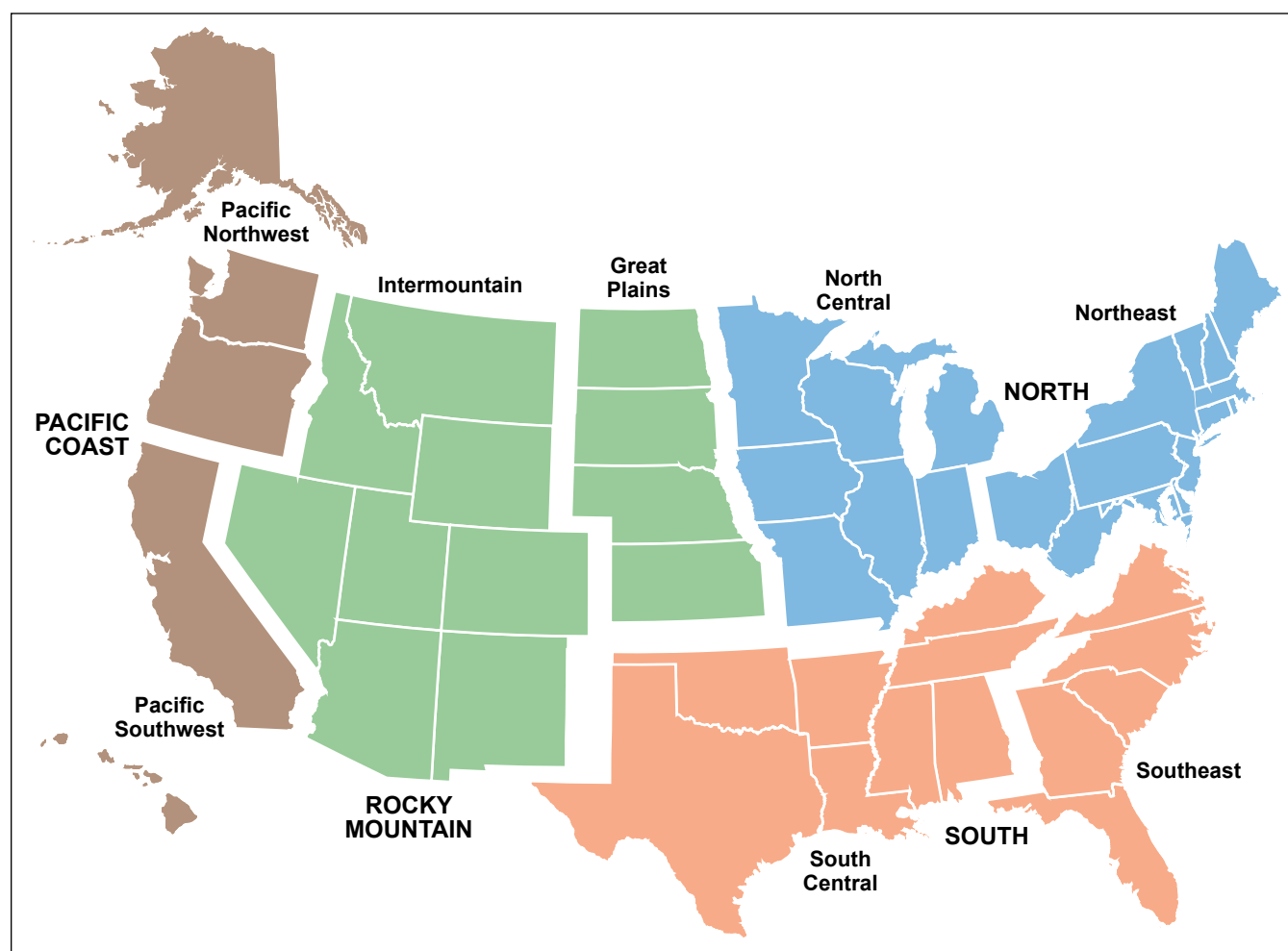


Figure 8.1—Major subregions and regions of the United States (Smith et al. 2009)

Total tallies of scientists and professors and tallies by criterion were compared with the 2002 NRC report on “National Capacity in Forestry Research,” which conducted a primary survey of all sectors. The NRC report included all FTEs and a breakdown of scientists and professors by research, teaching, and extension activities. Our approach was more restricted, including only persons listed as scientists for the Forest Service or professors for the universities and summarizing total scientist years by criterion. Thus, the fiscal year (FY) 2016 data may slightly underestimate the total research capacity compared to that measured in 2002 by NRC (2002). Nevertheless, the datasets are comparable at the aggregated level, and the current definition used in this report is more easily replicated and reliable, which will facilitate future measurements and comparisons.

Status and Trends

In the United States, federal, state, and university forest research and development efforts are authorized by government programs and laws, which prescribe research programs to provide scientific information for forest resource management and protection. The federal government, universities, state forestry and natural resource agencies, environmental nongovernmental organizations, forest products industry, and large forest landowning firms perform SFM research and development. This research improves scientific understanding of forest ecosystem characteristics and functions, as well as social and economic processes.

Research Capacity by Montréal Process Criterion and Research Sector

Table 8.2 summarizes the data collected for university professors and Forest Service scientists for 2016 and 2002. Per the 2002 NRC data, the Forest Service research program had 701 scientist-years of personnel, with about 500 research scientists, and a budget of \$241 million in FY 2002. Universities had 1,361 scientists in 2002. At that time, faculty functions were identified as 44 percent teaching, 42 percent research, and 14 percent extension. More recent aggregate data reported by the Forest Service Washington office indicates that the agency employed 618 full-time research scientists in 2002 compared to 500 in 2016, although this differs some from the NRC literature and our direct tallies reported here.

We identified 540 full-time scientists in the Forest Service in 2016.

Based on our criteria, we identified 540 full-time scientists (i.e., permanent employees) in the Forest Service in 2016, as listed by regional research stations and the Washington office on their websites. This number is slightly higher than the total reported by the Washington office, likely owing in part to slight differences in categories of scientists. In addition, there were approximately 2,000 technical and

Table 8.2—U.S. forestry scientists and professors by sector, function, and sustainable forest management (SFM) criterion, 2002 and 2016

Sector/SFM criterion	1: Biological diversity	2: Productive capacity	3: Ecosystem health	4: Soil and water	5: Carbon cycles	6: Socio- economics	7: Legal, policy	Total
<i>Number (percent)</i>								
2016:								
University	453 (37)	141 (12)	119 (10)	113 (9)	8 (1)	352 (29)	38 (3)	1,225 (100)
Forest Service	159 (29)	49 (9)	160 (30)	41 (8)	6 (1)	115 (21)	10 (2)	540 (100)
Private	—	—	—	—	—	—	—	—
Total	612 (35)	190 (11)	279 (16)	154 (9)	14 (1)	468 (26)	48 (3)	1,764 (100)
2002:								
University	318 (23)	221 (16)	128 (9)	186 (14)	77 (6)	293 (22)	138 (10)	1,361 (100)
Forest Service	122 (17)	161 (23)	166 (24)	92 (13)	43 (6)	90 (13)	27 (4)	701 (100)
University and Forest Service	440 (21)	382 (19)	294 (14)	278 (13)	120 (6)	383 (19)	165 (8)	2,062 (100)
Private	10 (8)	75 (60)	5 (4)	22 (17)	3 (2)	10 (8)	0	124 (100)
Total	450 (21)	457 (21)	299 (14)	300 (14)	123 (6)	393 (18)	165 (8)	2,187 (100)

— = no data.

Source: 2002 Data—NRC 2002; 2016 data—data from individual university and U.S. Forest Service websites and lists of professors and scientists.

support staff in Research and Development throughout the agency. Overall, Forest Service Ph.D. research capacity has decreased from the 701 scientist-years tallied in 2002, and significantly since the mid-1980s when scientists numbered near 1,000. In real terms, research budgets also have declined. The Forest and Rangeland Research budget was \$291 million in FY 2016, a nominal increase of \$50 million from the FY 2002 amount of \$241 million. However, adjusted for inflation, FY 2016 appropriations would equal about \$217 million in 2002 dollars, which was a 10 percent decrease from 2002 in real terms.

In 2016, accredited forestry programs listed more than twice as many professors as there were scientists in the Forest Service, but their activities spanned research, teaching, and extension. This included 1,224 persons with Ph.D. degrees or titles of assistant professor, associate professor, or professor, which were classed into one of the seven SFM criteria listed above. This was a decrease of 137 professors, or 10 percent, from the 1,361 professors in 2002. Based on the 2002 proportions, the 2016 tally would include about 540 research FTEs, 540 teaching FTEs, and 150 extension FTEs. For comparison, Sagor et al. (2014) estimated that forestry extension programs in the United States employed 249 FTE state specialists, educators, and support staff.

Forestry schools and programs included 1,224 persons with Ph.D. degrees or titles of assistant professor, associate professor, or professor.

In 2014, private sector forestry research funding was reported as \$70 million by the Sustainable Forestry Initiative participants, which was down from the 2002 total of \$72 million and worth only \$53 million in real 2002 dollars after discounting for inflation. The private sector research personnel capacity was uncertain, but not likely to be more than 100 persons.

For all forestry research personnel, the distribution among SFM criteria indicate that criterion 1, biological diversity, encompassed by far the largest amount of scientific effort in 2016, with 612 scientists and professors, or 35 percent of all scientists in total. This could be attributed to the focus on biology, ecology, biodiversity, and wildlife for forestry research. Socioeconomics was second with 468 scientists and professors, or 26 percent of the total. Yet, that criterion was not uniform, with a large split that included forest products and economics research versus human dimensions, urban forestry, and recreation. Ecosystem health had the third largest contingent of scientists with 279 (17 percent). Productive capacity had 11 percent; and soil and water had 9 percent of all scientists and professors, while legal and policy and carbon cycles had only 3 percent and 1 percent, respectively.

The 2016 SFM criteria distributions represented a 40 percent increase of about 170 scientists for the biological diversity capacity numbers compared to 2002, and a 50 percent decline in scientists in the productive capacity criterion (figs. 8.2 and 8.3). This reflects the shift in Forest Service scientific disciplines, which were dominated by research foresters typically focused on productive capacity through the late 1990s and now are dominated by research ecologists typically focused on aspects

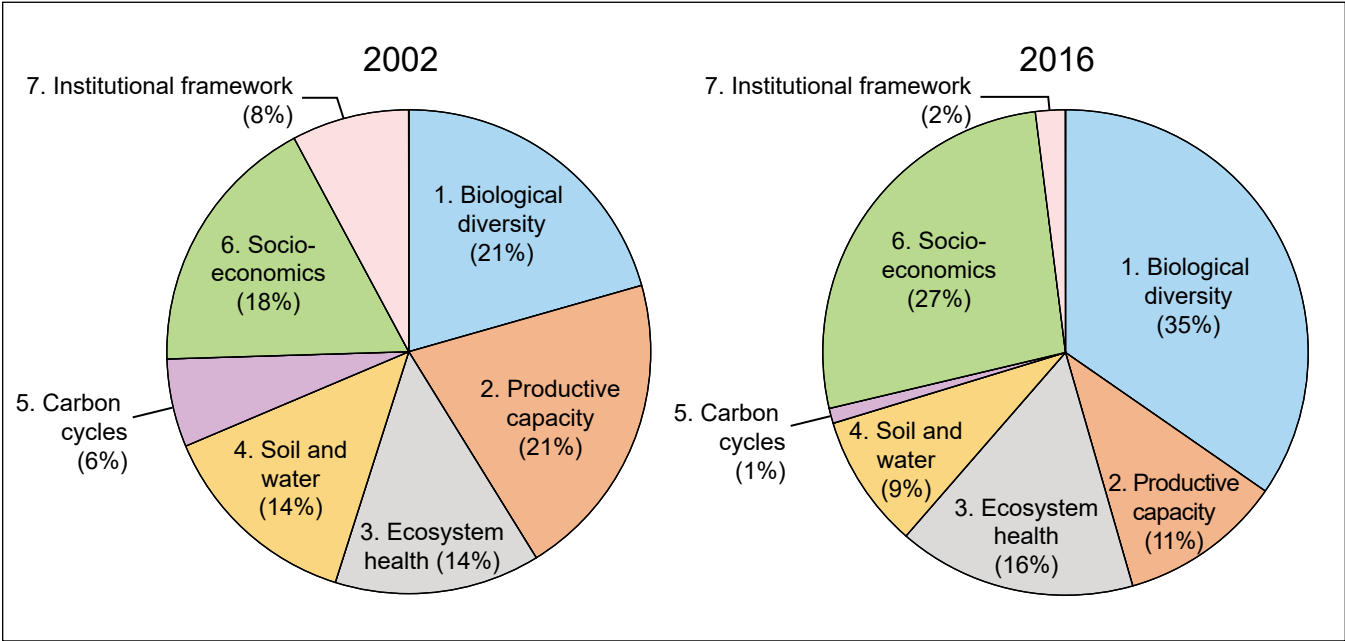


Figure 8.2—Percentage of U.S. forestry scientists and professors by sustainable forest management criterion, 2002 (total = 2,186) and 2016 (total = 1,764).

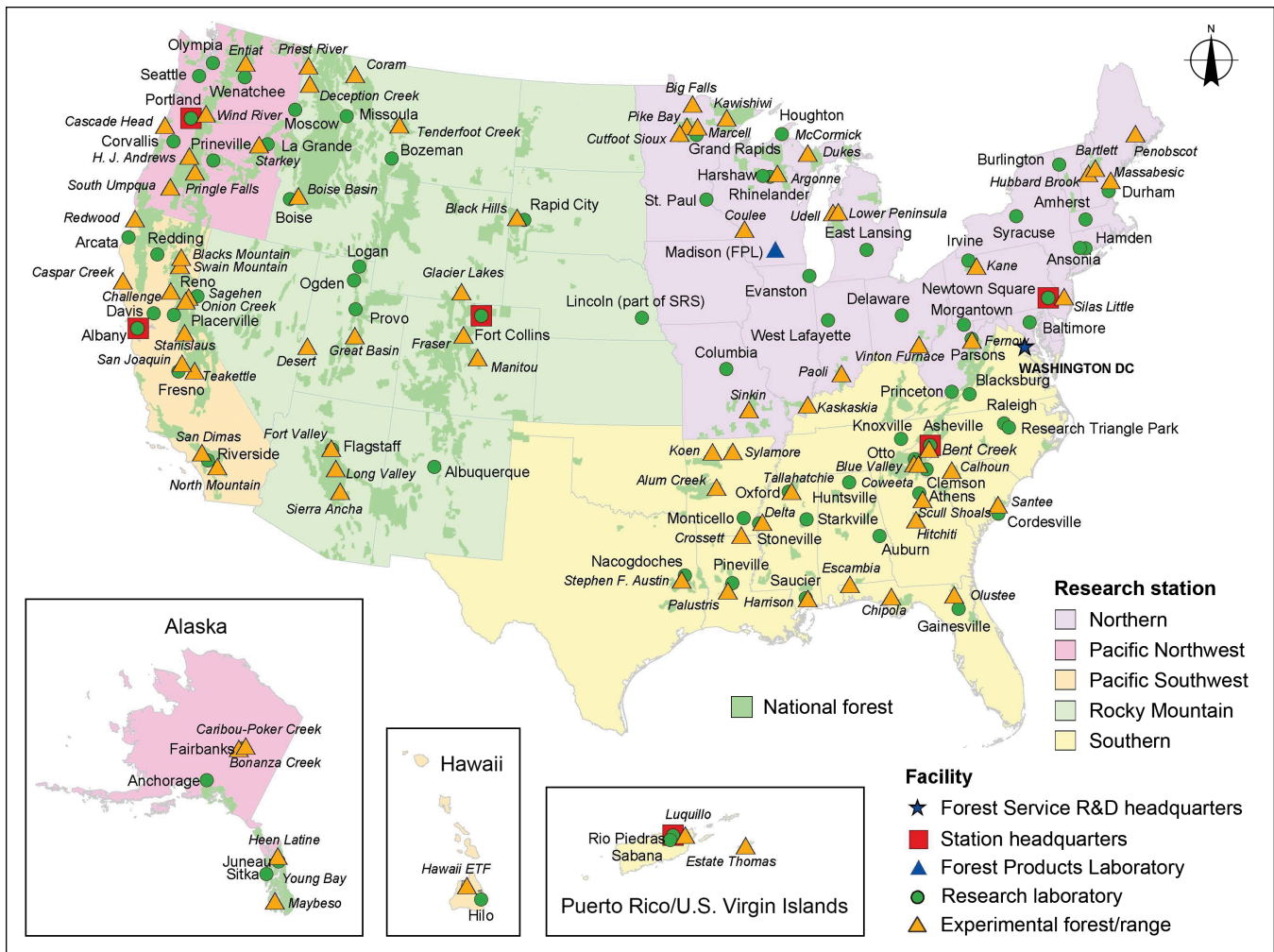


Figure 8.3—U.S. Department of Agriculture, Forest Service, Research and Development (RD) facility locations.

of forest biodiversity. The university sector had a notably greater percentage of its research capacity in biological diversity, productive capacity, and socioeconomic than the Forest Service; the Forest Service had proportionately more scientists in ecosystem health.

The regional distribution of the forestry research capacity indicates that the South has the most professors, with 492, or 40 percent of the nation's total. The North and West had more Forest Service researchers, however, with 38 percent each, and only 24 percent in the South. These regional differences across sectors are balanced out when university and Forest Service research capacities are considered together, with the South having 35 percent of the total number of professors and scientists. The North had 33 percent and the West had slightly less of the total forestry research capacity at 32 percent.

Other federal agencies such as the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), the U.S. Department of

Energy (DOE), and the U.S. Department of the Interior (DOI) also fund research and development for forests and forestry. According to McGinley et al. (2019), in 2014, funding for forest-sector research in the United States from most major sources was \$598 million, with five federal agencies providing 70 percent of the total (i.e., U.S. Forest Service: 50 percent; National Institute of Food and Agriculture (NIFA): 13 percent; NSF: 6 percent; NASA: 1 percent; DOE: 0.5 percent), followed by university funding from state appropriations and other nonfederal sources representing 20 percent of the total, and forest industries and organizations certified by SFI providing 10 percent. Environmental nongovernmental organizations also spend millions of dollars per year on forest-related research and development, but their totals are not available.

Private Sector Research

Exact data for private sector forestry research scientists and budgets are not currently available. Most of the large land management-oriented research centers with the vertically integrated forest products firms have been eliminated with the sale of industry forest lands. Very little of their research divisions and investments was rolled over to the timber investment management organizations (TIMOs) and real estate investment trusts (REITs) who now own these forests. A few TIMOs and REITs have maintained modest research programs and many are members of university cooperative research programs, which do leverage their private funds with public research personnel and funding.

The NRC (2002) reported 124 FTE private sector forest industry scientists and \$72 million in forest industry research funding through the Sustainable Forestry Initiative program in 2002.

Private sector research personnel has declined by about half to an estimated 60 private sector forest industry scientists in 2016 (McGinley et al. 2019). Private sector forest research budgets also are in decline. The Sustainable Forestry Initiative reports that its member companies—mostly private sector organizations—had invested early \$1.7 billion in forest research between 1995 and 2018 (SFI 2019). In 2018, SFI members invested approximately \$50 million in forest research, down from \$70 million in 2012 and from a peak of \$100 million in 2007 (SFI 2015, 2019). In 2018, 44 percent of SFI member research investments were designated for forest health and productivity—criteria 1 and 2; 15 percent for landscape/ecosystem management and biodiversity, also criterion 1; 12 percent for wildlife and fish—criterion 1 again; 9 percent for water quality—criterion 4; 5 percent for forest operations and economics—criterion 2 and 6; and 15 percent in other disciplines (SFI 2019).

Kellison (2014a, 2014b) chronicled a steady decline of forestry research capacity in the industrial sector, with the loss of hundreds of forestry research scientists since the 1980s, and a concomitant decline in industrial research and development funding. Kellison contrasts this loss in the United States with major public-private investment partnerships in Finland, Europe, and Canada, and proposes major new public-private partnerships in the United States to regain industrial competitiveness. A Forest Health Initiative and partnership among the Forest Service, Duke Energy, and the U.S. Endowment for Forestry and Communities, with an initial focus on the American chestnut, is proposed as a model for future efforts.

Aggregate Trends

The 2016 personnel numbers reflect about a 15 percent decrease in the total number of research scientists and professors since 2002. The declines were substantial, and there were shifts in the allocation of research effort among disciplines, with less focus on production forestry and more focus on ecosystems research. Forest Service funding increased in nominal terms and decreased in real terms, which probably would be tracked by slight declines in university funding, but overall funding for forestry was more stable than scientific employment. Private sector forestry research and funding fell by almost half since 2002. Many environmental nongovernmental organizations also perform research and analysis efforts that contribute scientific knowledge about the ecological, social, and economic components of forest resources, as do other federal agencies. Sustainable forest management research has almost certainly increased at these organizations since the early 2000s.

In 2016, 35 percent of forest research scientists and professors were dedicated to research related to biological diversity (Criterion 1), compared to 19 percent in 2002 for the combined U.S. Forest Service and university research efforts reported in the NRC National Capacity in Forestry Research report. Productive capacity (criterion 2) decreased the most from 2002 (19 percent) to 2014 (11 percent), and this decrease was exacerbated by declines in private sector research efforts that focused in this area as well. Ecosystem health (criterion 3) was fairly stable at 16 percent of the effort in 2002 and in 2016. Soil and water research dropped from 14 percent in 2002 to 9 percent in 2016. Socioeconomic research increased from 18 percent in 2002 to 26 percent in 2016, and legal and policy dropped from 8 percent to 3 percent, but much of this was likely due to changes made in the indicators associated with these criteria rather than personnel changes. Carbon cycles (criterion 5) fell from 6 percent to 1 percent. In 2016, the Forest Service had proportionately more ecological research, academic institutions somewhat more social and institutional research, and industry more productive capacity research.

The 2016 personnel numbers reflect about a 15 percent decrease in the total number of research scientists and professors since 2002.

Research Stations and Research Monitoring

There is no formal record of all the laboratories, research stations, experimental forests, and long-term experimental research facilities in the United States that includes both federal and university sites. The Forest Service is probably the world's largest single forestry research organization, with more than 500 research scientists, 58 laboratories and research locations, and 73 experimental forests and ranges as of 2014 (fig. 8.2). The 45 universities with SAF-accredited forestry programs are scattered across almost every forested state except in the Great Plains and a few states in the Northeast. Each of their forestry departments or programs include multiple research labs, and most forestry schools and universities have at least modest forests for onsite research and monitoring.

There also is extensive monitoring of forests in the United States, including efforts by the U.S. Geological Survey, which monitors the entire country with remote sensing and provides national land cover imagery every 5 years. The Forest Service, Forest Inventory and Analysis (FIA) program uses high-resolution aerial imagery and a systematic set of ground plots to monitor the status of forests in the entire continental United States, coastal Alaska, and Hawaii, along with Puerto Rico, the U.S. Virgin Islands, and many of the other politically affiliated island nations in the Pacific. U.S. reporting on Montréal Process Criteria 2 (productive capacity) and 5 (carbon cycles) widely utilize data produced by FIA.

The FIA aerial imagery is obtained from the National Agricultural Imagery Program. Phase 1 of the FIA program uses those data to identify forest and nonforest cover. Phase 2 of the FIA program collects forest inventory information across all forest land ownerships in the United States and maintains a network of more than 125,000 permanent forested ground plots across the conterminous United States and southeastern Alaska, with a sampling intensity of approximately one plot per 6,070 ac (2428 ha). FIA phase 3 plots represent a subset of these phase 2 plots, with one phase 3 plot for every 16 standard FIA phase 2 plot. In addition to traditional forest inventory measurements, data for a variety of important ecological indicators are collected from phase 3 plots, including tree crown condition, lichen communities, down woody material, soil condition, and vegetation structure and diversity, while data on ozone bioindicator plants are collected on a separate grid of plots (Potter 2013). The FIA program also collects data on timber products output and prepares reports on the status and trends in forest and timber products, as well as many related inventory research outputs.

In addition to the programs already mentioned, NASA provides vast amounts of remote sensing data and products pertinent to forests. These include higher spatial and spectral resolution data on forest cover, such as LANDSAT 8, MODIS, VIIRS, Quickbird, Sentinel-3, and WorldView.

Conclusions

Forest research capacity in terms of scientists and funding in the United States has been in decline since the early 2000s. The total number of full-time university professors and Forest Service scientists has declined approximately 15 percent since 2002, and industry research programs have been reduced more substantially. University research personnel in SAF accredited programs decreased 10 percent from 2002 to 2016. The number of Forest Service researchers decreased 19 percent from 2002 to 2016, but the agency has retained significant capacity for research in terms of laboratories and experimental forests, as well as technical staff and support for field research.

The focus of forest research efforts also changed considerably over this time period. Fewer professors and researchers are performing research on forest productivity per se or on SFM criteria of carbon cycles, soil and water, and social and legal issues. These declines have been largely offset by more professors and scientists working in the SFM criteria areas of biological diversity. These trends are likely to continue based on the importance of biodiversity, which does include most silviculture professors and scientists, and problems with forest pathogens. However, some of these professors and Forest Service scientists still do work on forest productivity problems but have relabeled the research to be more appealing to a broader set of stakeholders and funding sources. The gradual shift away from forest productivity research might be categorized as precipitous if one also included the substantial elimination of the private industrial research staff and funding for forest productivity.

The research funding for overall forest resource monitoring and evaluation, specifically the Forest Service FIA program, has maintained its personnel and funding levels to date, but costs for doing the field work have increased. Support for field research and maintaining experimental forests also has been stable or decreased, at federal and university facilities, but pressures to “do more with less” persist across sectors and disciplines as reflected in the declines in total public research personnel numbers by about 15 percent from 2002 to 2016. There also are perhaps two to three times as many support and technical staff employed by the Forest Service and universities, and many scientists in other university departments and some federal agencies as well that perform research on forests, but they are diffused across organizations, and were not tracked for this report. Private forestry research has declined the most, with about half the staffing and funding levels in 2018 compared to the early 2000s.

Forest research also has shifted toward proportionately more focus on biological and ecosystem functions, as well as socioeconomic factors, and comparatively less focus on production and commodities. Increasing focus on more fundamental

Fewer professors and researchers are performing research on forest productivity. These declines have been largely offset by more professors and scientists working in the SFM criteria areas of biological diversity.

research on forest factors, conditions, goods, and services reflects expanding societal and stakeholder goals for forests and their uses, as well as trends in scientific research overall and related funding. Nevertheless, investments in wood use and product development are critical for the innovation required to increase or even sustain the sector's competitiveness in global markets.

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Appendix 8.1: Key Websites

U.S. Forest Service Research and Development: <http://www.fs.fed.us/research/>

U.S. Forest Service Forest Inventory and Analysis: <http://www.fia.fs.fed.us/>

U.S. Department of Agriculture National Association of Food and Agriculture:
<http://www.nifa.usda.gov/>

National Association of University Forest Resource Programs:
<http://www.naufrp.org/>

Chapter 9: Partnerships to Support the Sustainable Management of Forests (Indicator 52)

Kathleen A. McGinley and Frederick W. Cubbage¹

Indicator Background and Rationale

Partnerships may involve individuals, communities, businesses, and organizations that work together toward a shared purpose and common goals. They can develop within and across sectors, ranging widely in scale and diversity of participants. Partnerships are important tools in building capacity; leveraging financial, technical, and human resources; strengthening political commitment; and developing public support to advance forest sustainability (Montréal Process 2014). Accordingly, Indicator 52 is intended to capture information on the development and outcomes of partnerships related to forests and their management.

Measurement Approach

We canvassed government, civil society, and private sector websites, budget reports and justifications, and refereed and grey literature to document and describe existing and emerging partnerships intended to support the sustainable management of forests at federal, state, and local levels in the United States. We report mostly descriptive information on an array of forest-related partnerships and their outputs and impacts. The information presented here represents a broad range of key partnerships focused on forests and their sustainability, but is not intended to be interpreted as a complete catalogue of such efforts. Although the major land management agencies maintain fairly extensive information on the partnerships they cultivate and support to advance their goals and objectives, as do some other government, civil society, and private sector organizations, there is no single source or clearinghouse of information on forest-related partnerships in the United States.

Status and Trends

Forests in the United States have benefited from a long history of partnership development among public entities, civil society, and private-sector organizations in pursuit of shared environmental, economic, and social objectives. Natural resource and land management based partnerships grew significantly with the rise in “grassroots

Partnerships are important tools in building capacity; leveraging financial, technical, and human resources; strengthening political commitment; and developing public support to advance forest sustainability.

¹ **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926; and **Frederick W. Cubbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008.

environmental movements” beginning around the early 1990s (McCreary et al. 2012, Weber 1998). Increasing use of partnerships by the public sector in the past decade or so has been concomitant with efforts to downsize government, do more with less, and enhance community participation and transparency in governmental decisionmaking (Parkins and Mitchell 2005, Seekamp and Cervený 2010; see also chapter 10).

Partnerships affecting forests and other natural resources in the United States are “expanding in their inclusiveness, scope, and impact across organizational sectors (e.g., public, nonprofit, commercial) and scales of governance” (Mowen et al. 2006). They increasingly evolve around cross-boundary issues, such as water conservation, land use, and climate change (see chapter 3). The U.S. government also partners with other nations to support forest sustainability at international levels through numerous binding and nonbinding agreements and other initiatives, such as the United Nations (UN) Convention on the International Trade in Endangered Species, UN Convention on Combatting Desertification, International Tropical Timber Agreement, Montréal Process on Criteria and Indicators, Tropical Forest Alliance 2020, and the Global Partnership on Forest Landscape Restoration.

Federal-Level Partnership Initiatives

Government agencies engage in formal and informal partnerships throughout the United States to conserve public lands and resources, increase efficiency in planning and action, facilitate cross-boundary solutions, and encourage opportunities for public involvement for conservation and management challenges (McCreary et al. 2012). For instance, federal agencies work together and with other levels of government, civil society, and the private sector across multiple sectors and issues to advance climate change science, mitigation, and adaptation (e.g., U.S. Global Change Research Program, U.S. Department of Agriculture Climate Hubs); landscape science and conservation (e.g., Cooperative Ecosystem Studies Units; Landscape Conservation Cooperatives; Regional Integrated Sciences and Assessments); wildland fire management and response (e.g., National Interagency Fire Center); and water conservation and watershed protection (e.g., Integrated Water Resources Sciences and Services Consortium; Urban Waters Federal Partnership, Healthy Watershed Initiative) (fig. 9.1).

U.S. Department of the Interior—

The U.S. Department of the Interior (DOI), which oversees more than 500 million ac of land, increasingly uses partnerships to promote conservation across diverse landscapes, to preserve natural and cultural resources, bring innovative approaches to resource management, and engage diverse entities, including youth. In fiscal year (FY) 2012, the DOI invested more than \$256 million in grants to state, tribal, international,

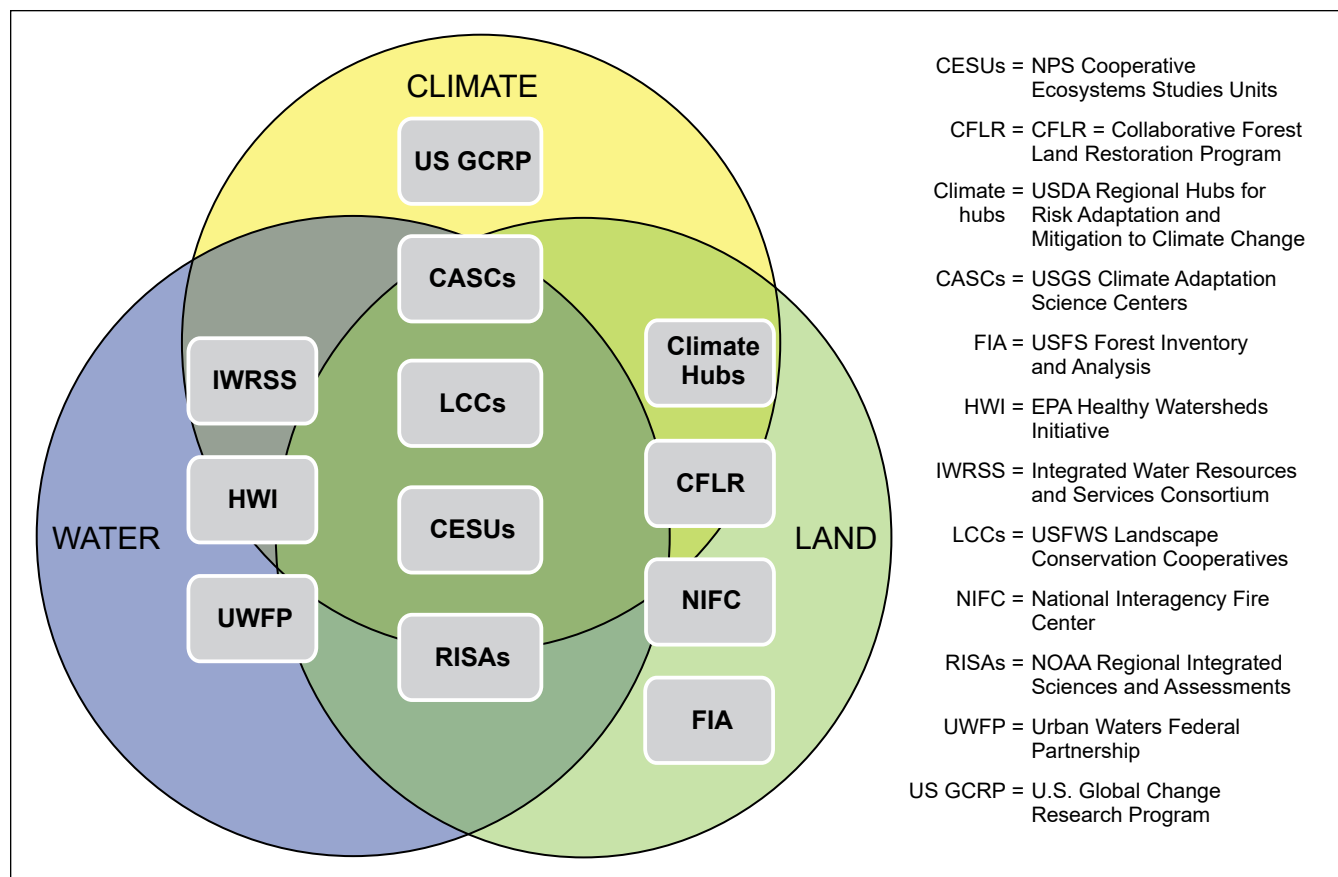


Figure 9.1—Select key partnerships and programs promoted by the U.S. federal government that directly support forest sustainability (see appendix 9.1 for partnership and program details). EPA = U.S. Environmental Protection Agency; NOAA = National Oceanic and Atmospheric Administration; NPS = National Park Service; USDA = U.S. Department of Agriculture; USFS = U.S. Forest Service; USFWS = U.S. Fish and Wildlife Service; USGS = U.S. Geological Survey.

community, and private partners for the conservation of wetlands, wildlife, endangered species, Neotropical birds, recreation, landscapes, and other conservation priorities (USDI 2012). The agency reports that it restored, protected, and enhanced more than 16 million ac of habitat for wildlife, waterfowl, and other species through these partnership investments and their matching funds during FY 2012 (USDI 2012).

U.S. Department of Agriculture, Forest Service (USDA Forest Service)—

The USDA Forest Service, which oversees 193 million ac of forests and grasslands, has worked with a range of organizations and interests since early in its establishment (Seekamp et al. 2011). As the complexity surrounding the management of public forests has grown, partnerships have become an increasingly prominent mechanism for pursuing the agency's social, economic, and ecological goals. The importance of Forest Service partnerships is reflected in the agency's current organizational structure with partnership-related positions prevalent throughout

As the complexity surrounding the management of public forests has grown, partnerships have become an increasingly prominent mechanism for pursuing the agency's social, economic, and ecological goals.

the agency, from local field stations to regional offices up through to its National Partnership Office in Washington, D.C.

The Forest Service regularly engages with at least 35 different types of partners, including other government agencies, universities, tribes, and community organizations (Seekamp et al. 2011, 2013). Most frequently, these partnerships focus on recreation, wilderness, and heritage; restoration; and vegetation and watershed management programs (Seekamp et al. 2013). These types of partnerships have increased steadily over time in recent history, but also have been documented to outpace the availability of related resources and capacity (Seekamp et al. 2013).

Between FY 2008 and FY 2012, the Forest Service averaged more than 7,800 partnership grants and agreements per year, leveraging hundreds of millions of annually appropriated funds through these partnerships with public, private, and international partners (USDA FS 2014). In FY 2012, the agency invested nearly \$780 million in more than 7,700 grants and agreements with its partners, who invested more than \$535 million in matching funds and resources, bringing the total value of the agency's partnerships to more than \$1.3 billion that year (USDA FS 2013a). These partnerships focused on a range of issues, including water supply and conservation, forest health and resiliency, ecosystem restoration, and community and youth engagement (USDA FS 2013a).

Numerous Forest Service and other federal land management policies promote partnership development. For example, the Collaborative Forest Landscape Restoration (CFLR) program, which was enacted through the Omnibus Public Lands Act of 2009, is intended to "encourage the collaborative, science-based ecosystem restoration of priority forest landscapes" (Public Law No. 111-11, title IV, 123 Stat. 991). It promotes partnerships with local communities and organizations to accelerate ecosystem restoration in high-priority areas, support economic stability in rural communities, and reduce the risks and associated costs of catastrophic wildfire (USDA FS 2013a). Bixler (2014) observed that "...the CFLR program is part of a longer term shift in national forest policy that has increasingly emphasized large-scale, collaborative, and adaptive planning [and] is one experiment in the emerging suite of new governance approaches that attempt to implement management activities in ways that are more flexible and adaptive, less hierarchical, and emphasize the role of collaboration and communities in setting goals and objectives on multiple-use landscapes."

As of 2015, the CFLR program supported 23 projects across 14 states ranging in landscape scale from 130,000 to 2.4 million acs (USDA FS 2015) (fig. 9.1). In its first 5 years of implementation (FY 2010 to FY 2014), the program supported more than 1.45 million ac of land with reduced risk of catastrophic fire and another 1.33 million ac with improved wildlife habitat (USDA FS 2015). During this period, the program produced more than 1.256 billion board feet of timber

volume sold, \$661 million in local labor income, and an average of 4,360 jobs annually (USDA FS 2015).

Partnerships also are promoted through the 2012 National Forest System Land Management Planning Rule (36 CFR Part 219) and its directives, which detail a four-part planning and learning cycle for national forests that encompasses assessment, planning, implementation, and monitoring in a continuous feedback loop. The science-based framework provides a blueprint for open and participatory land management and creates a structure within which land managers and partners work together to understand what is happening on the land and to adapt management in response to changing conditions and based on new information and monitoring. Collaboration with local communities and other key stakeholders is an essential element throughout the cycle, and partnership opportunities in particular are encouraged in plan components and their implementation.

State and Local Government

State and local forest and land management agencies also rely on partnerships to accomplish their mandates and goals. Together these agencies oversee about 10 percent of the nation's forests (i.e., state government: 9.2 percent; local government (e.g., counties, towns): 1.3 percent) (Hewes et al. 2014). They receive financial and technical support from federal partners and are responsible for administering multiple federal programs designated to assist private landowners in the management of their forested lands and the protection of those lands from insects, fire, disease, and other threats. In particular, state forestry agencies are critical partners in national wildfire protection and management initiatives (e.g., in 2014, 1.52 billion ac in the United States were under wildfire protection by state forestry agencies) (NASF 2015).

State forestry agencies also work through the National Association of State Foresters (NASF)—a nonprofit organization comprising the directors of forestry agencies in the states, territories, and the District of Columbia (NASF 2020). NASF works to collectively advance state priorities in forest management and protection, oftentimes in partnership with a broad spectrum of organizations, including all federal land management and environmental agencies and numerous public and private organizations. The NASF holds leadership positions in a range of high-level partnerships, including the National Interagency Fire Center, the Sustainable Urban Forests Coalition, the Continental Dialogue on Non-Native Forest Insects and Diseases, and the Joint Forestry Team—a cooperative effort between the NASF, Forest Service, Natural Resources Conservation Service, and National Association of Conservation Districts to strengthen cooperation toward better coordinated interagency delivery of forestry-related conservation assistance to private landowners (NASF 2020).

Collaboration with local communities and other key stakeholders is an essential element throughout the national forest management cycle, and partnership opportunities in particular are encouraged in plan components and their implementation.

Civil society organizations are another active partner in forest sustainability initiatives at local to global levels.

Civil Society

Civil society organizations (CSOs) are another active partner in forest sustainability initiatives at local to global levels. Several congressionally chartered nonprofit organizations have been created to promote sustainable land and resource use and conservation in the United States, including the National Forest Foundation, National Park Foundation, National Fish and Wildlife Foundation, and National Environmental Education Foundation. Other important CSOs include the U.S. Endowment for Forestry and Communities, Inc., a nonprofit corporation established in 2006 by the governments of the United States and Canada according to the terms of their Softwood Lumber Agreement (USEFCI 2016). The \$200 million endowment is earmarked for the development of educational and public-interest projects addressing forest management issues that affect timber-reliant communities and promoting forests as sources of building materials, wildlife habitat, bioenergy, recreation, and other values.

The UN, World Wildlife Fund, World Bank, The Nature Conservancy, Society of American Foresters, Conservation International, American Forest and Paper Association, and numerous others at local to global levels initiate and participate in partnerships to promote sustainable forest use and protection throughout the United States and beyond. There also is a large amount of federal-state-community-private research cooperation around forests, natural resources, and the environment. Federal forestry research efforts are summarized in chapter 8. Additionally, citizen science (2016) initiatives involving forests have expanded in recent years. These efforts merge scientific data collection, hypothesis testing, analysis, and advocacy across public and private sectors (Bonney et al. 2009).

Private Sector

Private sector organizations increasingly participate in and pursue partnerships with government and other stakeholders not only to reduce business and reputational risks associated with forests and their impacts on them, but to develop long-term positive effects on forests from private sector development (Jenkins and Kate 2006). For example, water utilities across the United States are recognizing the importance of intact forests and watersheds to water supply and quality and are engaging in a growing number of partnerships to promote improvements in forest and watershed conditions in many parts of the country. Other organizations, such as hydroelectric utilities, bottling companies, and others that depend on clean water supplies also are investing in healthy forests and watersheds. For example, the Coca-Cola CompanyTM and the USDA entered into a partnership in 2013, in which Coca-Cola agreed to support the recharge of more than 1 billion liters of water to the National Forest System through restoration and conservation practices (Coca-Cola Company 2013, Inez Ward 2014).²

Conclusions

Partnerships related to forests and their sustainable management are prevalent at local to national levels across the United States and involve a broad range of individuals, communities, businesses, and organizations. These types of partnerships have become increasingly important as many organizations—both governmental and non-governmental—attempt to find common ground and to do “more with less.” Forest-related partnerships have proved effective in building capacity; leveraging financial, technical, and human resources; strengthening political commitment; and developing public support to advance the sustainability of forests. Ultimately, pooling resources through partnerships can serve not only to leverage organizational assets but also to enhance programming, increase visibility and credibility, reduce service duplication across organizations, and build agreement on common goals and objectives.

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² The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

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Appendix 9.1: Key Partnerships and Programs Promoted by the U.S. Government That Directly Support Forest Sustainability

Climate Adaptation Science Centers (CASCs)—

<https://www.usgs.gov/land-resources/climate-adaptation-science-centers>

The U.S. Department of the Interior (DOI) established eight regional CASCs (formerly named Climate Science Centers) to provide scientific information and tools to natural and cultural resource managers as they plan for conserving these resources in a changing world and climate. The managing entity for the DOI CSCs is the U.S. Geological Survey's National Climate Adaptation Science Center (NCASC). The NCASC and CASCs are envisioned as integral parts of a climate science planning enterprise (NCASC-CASC enterprise). CASCs are located at partner universities and often are composed of multi-institution consortia, including other universities, tribal partners, and federal research units.

Collaborative Forest Land Restoration Program (CFLRP)—

<http://www.fs.fed.us/restoration/CFLRP/overview.shtml>

Congress established CFLRP with Title IV of the Omnibus Public Land Management Act of 2009. The purpose of the CFLRP is to encourage the collaborative, science-based ecosystem restoration of priority forest landscapes. The program was created and is funded to promote healthy forest ecosystems, job stability, reliable wood supply, and reduced emergency wildfire costs and risks. Under CFLRP, national forests work directly with communities and local organizations on restoration projects that benefit people, water, wildlife, and local economies.

Cooperative Ecosystems Studies Units (CESUs)—

<http://www.cesu.psu.edu/>

The CESU Network is a national consortium of federal agencies, tribes, academic institutions, state and local governments, nongovernmental conservation organizations, and other partners working together to support informed public trust resource stewardship. The CESU Network was established pursuant to the National Parks Omnibus Management Act of 1998 (16 USC § 5933) to serve as a platform to support research, technical assistance, education, and capacity building that is responsive to longstanding and contemporary science and resource management priorities through collaborative and interdisciplinary applied projects that address natural and cultural heritage resource issues at multiple scales and in an ecosystem context. Each CESU is structured as a working collaborative with participation from numerous federal and nonfederal institutional partners. CESUs are based at host universities and focused on a particular biogeographic region of the country. The CESU Network includes 358 partners, including 14 federal agencies, in 17 CESUs representing biogeographic regions encompassing all 50 states and U.S. territories.

Healthy Watersheds Initiative (HWI)—

<http://water.epa.gov/polwaste/nps/watershed/index.cfm>

Led by the U.S. Environmental Protection Agency, the HWI includes both assessment and management approaches that encourage states, local governments, watershed organizations, and others to take a strategic, systems approach to conserve healthy components of watersheds, and, therefore, avoid additional water quality impairments in the future. The healthy watersheds approach is (1) identifying healthy watersheds on a statewide basis and healthy components of other watersheds, and (2) conserving healthy watersheds and protecting healthy components of other watersheds. It is an approach that will protect the remaining healthy watersheds and prevent impacts to aquatic ecosystems (and, thus, water quality impairments) from land use changes and other perturbations (e.g., invasive species) in other watersheds.

Integrated Water Resources Science and Services (IWRSS) Consortium—

<http://www.hec.usace.army.mil/misc/IWRSS/>

The National Oceanic and Atmospheric Administration leads the IWRSS Consortium and the National Water Center in an innovative partnership of federal agencies with complementary operational missions in water science, observation, prediction, and management. IWRSS incorporates interagency collaboration in the information age consisting of a consortium of federal agencies with complementary missions in water science, observation, management, and prediction. Its overarching objective is to

enable and demonstrate a broad, integrative national water resources information system to serve as a reliable and authoritative means for adaptive water-related planning, preparedness, and response activities. IWRSS will also leverage federal capabilities to produce new summit-to-sea high-resolution water resource analyses, forecasts and services, a subset of which are being generated for snowpack information. This “summit-to-sea” approach will help stakeholders address changing needs in an uncertain future, across scales ranging from hillslopes to watersheds, in events from droughts to floods.

Landscape Conservation Cooperatives (LCCs)—

<http://www.fws.gov/landscape-conservation/lcc.html>

Landscape Conservation Cooperatives are critical partners of Climate Adaptation Science Centers (CASCs) and will help define the regional priorities of each CASC. LCCs are partnerships consisting of natural and cultural resource managers, from federal, state, tribal, and other entities whose mandate is to work collectively to identify key resource issues and provide information and other support for integrated, landscape-scale conservation planning. Although CASCs specialize in providing the fundamental science to support decisionmaking, LCCs apply that science to specific management challenges. LCCs are applied conservation science partnerships with two main functions. The first is to provide the science and technical expertise needed to support conservation planning at landscape scales—beyond the reach or resources of any one organization. Through the efforts of in-house staff and science-oriented partners, LCCs are generating the tools, methods, and data managers need to design and deliver conservation using the Strategic Habitat Conservation approach. The second function of LCCs is to promote collaboration among their members in defining shared conservation goals.

National Interagency Fire Center (NIFC)—

<http://www.nifc.gov/>

The NIFC, located in Boise, Idaho, is the nation’s support center for wildland fire-fighting. The NIFC comprises eight different agencies and organizations. Decisions are made using the interagency cooperation concept because NIFC has no single director or manager. The center was created to implement the Federal Wildland Fire Management Policy

Regional Integrated Sciences and Assessments (RISAs)—<http://cpo.noaa.gov/ClimatePrograms/ClimateandSocietalInteractions/RISAProgram.aspx>

The National Oceanic and Atmospheric Administration’s RISA program supports multidisciplinary integrated research teams that help expand and build the nation’s capacity to prepare for and adapt to climate variability and change. “Central to the RISA approach are commitments to process, partnership, and trust building.”

Urban Waters Federal Partnership (USFP)—

<http://www.urbanwaters.gov/>

Led by 11 federal agencies and coordinated by the Council on Environmental Quality and Domestic Policy Council, the USFP aims to reconnect urban communities with their waterways, particularly those communities that are overburdened or economically distressed, by improving coordination among federal agencies and collaborating with community-led revitalization efforts to improve the country's water systems and promote their economic, environmental, and social benefits. It aims to “break down federal program silos to promote more efficient and effective use of federal resources through better coordination and targeting of federal investments. The partnership closely aligns with and advances the work of the White House's place-based efforts, including the Partnership for Sustainable Communities and the Strong Cities, Strong Communities (SC2) Initiative.

U.S. Global Change Research Program (USGCRP)—

<http://www.globalchange.gov/>

The USGCRP was established by presidential initiative in 1989 and mandated by Congress in the Global Change Research Act of 1990 to “assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change.” It is a confederation of the research arms of 13 federal departments and agencies, which carry out research and develop and maintain capabilities that support the nation's response to global change.

USDA Regional Hubs for Risk Adaptation and Mitigation to Climate Change (climate hubs)—

http://www.usda.gov/oce/climate_change/regional_hubs.htm

The U.S. Department of Agriculture (USDA) chartered seven regional climate hubs and three subhub locations to deliver information to farmers, ranchers, and forest landowners to help them adapt to climate change and weather variability. The hubs are designed to build capacity within USDA to provide information and guidance on technologies and risk management practices at regional and local scales, focusing on maintaining and strengthening agricultural production, natural resource management, and rural economic development under increasing climate variability. The hubs develop and disseminate tools, strategies, and management options for climate change response, enabling landowners and managers to implement climate-smart management. Key partners in the networks include the public and land grant universities; cooperative extension; USDA researchers; the private sector; state, local, and regional governments; the National Oceanic and Atmospheric Administration; U.S. Department of the Interior; regional climate change experts; and nonprofits engaged in providing assistance to landowners.

Chapter 10: Public Participation and Conflict Resolution in Forest-Related Decisionmaking (Indicator 53)

Kathleen A. McGinley and Frederick W. Cabbage¹

Indicator Background and Rationale

The ability of people to participate in the decisions that affect their lives is a central foundation for democratic governance. Public participation pertains to processes by which individuals engage in the development and implementation of public policies and programs (Fiorino 1990). People participate in public decisionmaking in various ways. Members of the public engage in electoral processes, testify at public hearings and meetings, participate directly in collaborative decisionmaking and activities, and engage in protest actions.

Forests and other natural resources may be managed more sustainably when citizens have at least some responsibility for their use, management, and protection (Montréal Process 2015). Processes that promote public participation in forest-related decisionmaking can foster practical and political support for sustainable forest management. When conflicts arise around forests and other natural resources, open and transparent processes for their resolution can lead to decisions that are more widely accepted and that may reduce the propensity for litigation (Beierle and Cayford 2002). Indicator 53 is intended to provide information on the processes that promote public participation in forest-related decisionmaking and reduce or resolve conflict amongst forest stakeholders.

Processes that promote public participation in forest-related decisionmaking can foster practical and political support for sustainable forest management.

Measurement Approach

We reviewed and documented policy directives on public participation and conflict resolution as they relate to forest and natural resource decisionmaking in the United States at federal, state, and local levels. When available, we determined the number of and funding for related processes, groups, cases filed, etc., and changes over time. Also, we reviewed refereed and grey literature to document and describe public participation, collaboration, conflict resolution, and litigation of forest-related decisionmaking at different levels.

¹ **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926; and **Frederick W. Cabbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008.

We report primarily descriptive information related to the major policies, programs, and processes affecting public participation and conflict resolution as they relate to forest decisionmaking. The information reported here covers a broad range of information on the topic but is not intended to be interpreted as a complete catalogue or tally of such initiatives at any level. Information available from federal agencies and other sources provides a fairly robust representation of public participation, litigation, and conflict resolution related to forests at the federal level. Comparatively less information was readily available from subnational, private sector, and civil society actions and activities.

Status and Trends

Public Participation

Public participation in public land management decisions and related activities has become a fairly standard requirement of nearly all public resource agencies in the United States (Cheng 2006, Hibbard and Ellefson 2005). Federal authority to initiate public participation activities around forests and other natural resources emanates from administrative, environmental, and forest-specific legislation and related policy directives that have developed since the mid-20th century (see box 10.1). The Administrative Procedures Act (APA) of 1946 was the first of its kind in the United States, requiring federal agencies to keep the public informed of their organization, procedures, and rules, and provide for public participation in

Federal authority to initiate public participation activities around forests and other natural resources emanates from administrative, environmental, and forest-specific legislation and related policy directives that have developed since the mid-20th century.

Box 10.1

Major Statutory Rules With Public Participation Requirements Affecting Forests in the United States:

- Administrative Procedures Act of 1946
- Freedom of Information Act of 1966
- National Environmental Policy Act of 1969
- Federal Advisory Committee Act of 1972
- Forest and Rangelands Renewable Resources Planning Act of 1974
- Federal Land Policy and Management Act of 1976
- Government in the Sunshine Act of 1976
- National Forest Management Act of 1976
- Negotiated Rulemaking Act of 1989
- Administrative Dispute Resolution Act of 1990
- Healthy Forests Restoration Act of 2003
- National Forest System Land Management Planning Rule of 2012

the rulemaking process. The APA and state-level equivalents have substantially influenced public policy over the years by opening the regulatory aspects of the policy process to the public. Over time, the APA has evolved into “one of the major democratic mechanisms by which individual due process rights and access to government are ensured” (Nylander 2006).

The APA and the Freedom of Information Act of 1966, which was enacted to ensure the public’s “right to know,” aim to make the federal-level policy process more transparent, mostly by generating extensive, publicly available records of agency deliberations and decisions. Nevertheless, although open record laws reflect society’s desire to restrain government autocracy, they do not guarantee agency or administrative compliance. For instance, agencies routinely oppose some requests for information and continue to make decisions without public involvement or prior informed consent (Hendry 2004, Peterson et al. 2007).

The Federal Advisory Committee Act (FACA) of 1972 is another important statutory rule governing public participation in federal decisionmaking processes. It is intended to ensure equitable citizen involvement in federal decisions, such that no one individual or group has undue influence over another. Specifically, FACA regulates how the federal government interacts with outsiders, formalizing the process of advice and counsel and imposing procedural requirements on groups from which such advice is sought. It sets standards for the creation and operation of groups that influence the executive branch of the federal government, requiring openness, transparency, and balanced membership that is representative of associated public and private interests in the issue or agency.

Land management agencies initiate federal advisory committees for various reasons, including resource advisement and management, rulemaking, and scientific oversight. For example, the Federal Advisory Committee on Climate Change and Natural Resource Science advises the U.S. Secretary of the Interior on the establishment and operations of the National Climate Adaptation Science Center and Regional Climate Adaptation Science Centers (formerly known as the National Climate Change and Wildlife Science Center and regional Climate Science Centers, respectively). The committee is composed of 25 members representing federal agencies; tribal, state, and local governments; nongovernmental organizations; academic institutions; and the private sector. Another example is the Forest Resource Coordinating Committee (FRCC), authorized in the Food, Conservation, and Energy Act (Farm Bill) of 2008 to advise the U.S. Secretary of Agriculture on private forest conservation primarily on nonindustrial private forest land. Overall, in fiscal year (FY) 2018, the Forest Service worked with 132 committees receiving \$1.1 million in FY 2018; the U.S. Department of the Interior (DOI) worked with 104 FACA committees, which received \$5.9 million in funding in FY 2018 (<http://www.facadatabase.gov>).

Direct access to environmental policy- and decisionmaking in the United States first was granted through the National Environmental Policy Act (NEPA) in 1969.

Environmental policies and laws with public participation requirements—

Direct access to environmental policy- and decisionmaking in the United States first was granted through the National Environmental Policy Act (NEPA) in 1969. This act established national policy and goals intended to “encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; and to enrich the understanding of the ecological systems and natural resources important to the Nation” (42 USC § 4321). Its overarching aim is to improve the quality of governmental decisionmaking through procedural requirements intended to result in the identification of actions that meet agreed goals and objectives and that reduce unintended consequences to society and the environment (42 USC § 4321).

In practice, NEPA establishes an interdisciplinary approach to federal-level planning and decisionmaking that takes into account environmental factors alongside economic and other considerations. It prescribes different levels of environmental evaluations and requires provisions for public involvement through review, comment, and input. With specific and limited exceptions, all federal agencies in the executive branch of the federal government must comply with NEPA on a wide range of actions, including land management and development; construction projects; and approval of nonfederal activities through grants, licenses, and permits.

Since the enactment of NEPA in 1969, virtually every major piece of environmental legislation at national and subnational levels in the United States has incorporated requirements for public participation (Creighton 2005). For example, the Clean Water Act (CWA) of 1987 and the Clean Air Act (CAA) of 1990—which give the federal government significant authority to impose national standards for environmental protection everywhere, regardless of land ownership—require public participation as a means to better environmental decisions (Dietz and Stern 2008, Fischer and Forester 1993). The CWA and CAA also include provisions requiring public input and involvement in decision processes, as well as options for the public to appeal decisions and activities that affect society or the environment.

Over time, NEPA has been important in institutionalizing public participation in federal-level environmental planning and decisionmaking. Its design and implementation also have strongly influenced similar statutes and processes at lower levels of government. Nevertheless, implementation of NEPA has not been without its challenges, and disagreement over decisions is not uncommon, as discussed in the section below, on appeals and litigation.

Forest-related policies and laws with public participation requirements—

The National Forest Management Act (NFMA) of 1976 establishes a systematic and interdisciplinary approach to forest planning and management (16 USC § 1604[g]).

The act requires a participatory planning process for resource allocation decisions on the 193 million ac of forest and grasslands that comprise the National Forest System. It mandates the provision of opportunities for citizen comment on multiyear national forest management plans and creates an objection process for concerns or complaints with administrative decisions.

In 2003, the Healthy Forest Restoration Act (HFRA) was passed “to enhance the protection of communities, watersheds, and other lands at risk from catastrophic fires” in and around federal lands through ecological restoration, forest disease and pest management, biomass harvest and utilization, and other measures (16 USC § 6501). HFRA further institutionalizes collaborative processes for planning, prioritizing, and implementing hazardous fuel reduction projects and focuses funding on areas with Community Wildfire Protection Plans (CWPPs), requiring stakeholder involvement in their development and implementation.

Between 2003 and 2013, the U.S. Departments of Agriculture and the Interior treated nearly 50 million ac of federal lands at risk of wildfire through prescribed fire, mechanical means, and other activities under HFRA (USDA FS/DOI 2016). The majority of treated lands were associated with a CWPP. These plans have been deemed largely successful in addressing wildland fire management needs on the land treated in the United States, particularly in the wildland-urban interface (Jakes et al. 2011, NASF 2013). Their effectiveness is attributed in part to prescribed processes that provide a “fit to local social and ecological contexts at a scale where they can make something happen” (Jakes et al. 2011). In 2013, a total of 14,755 at-risk communities were covered by CWPPs, accounting for nearly 20 percent of the more than 72,000 at-risk communities across the country at that time, and up from 9,389 communities covered by CWPPs in 2011 (NASF 2013).

Furthering public access to federal forest land planning and decisionmaking, the Omnibus Public Lands Act of 2009 established the Collaborative Forest Landscape Restoration Program (CFLRP) to “encourage the collaborative, science-based ecosystem restoration of priority forest landscapes” (Public Law No. 111-11, title IV, 123 Stat. 991). This program is intended to promote healthy forests, a reliable wood supply, economic opportunity, and reduced emergency wildfire costs and risks through landscape-scale (>50,000 ac) restoration projects comprised primarily of National Forest System lands for a 10-year period and in partnership with local communities and organizations.

Bixler (2014) described “the CFLRP [as] part of a longer-term shift in national forest policy that has increasingly emphasized large-scale, collaborative, and adaptive planning [and] is one experiment in the emerging suite of new governance approaches that attempt to implement management activities in ways that are more flexible and adaptive, less hierarchical, and emphasize the role of collaboration

and communities in setting goals and objectives on multiple-use landscapes.” As of October 2014, CFLRP included 23 projects across 14 states that had created “an average of 4,360 local community jobs per year and generated more than \$661 million in total local income, treated more than 1.45 million ac to reduce the risk of megafire, restored 703 mi of fish habitat, improved more than 1.3 million ac of wild-life habitat, and sold more than 1.2 billion board feet of timber” (USDA FS 2016).

Most recently, the National Forest System Land Management Planning Rule of 2012 further codified the importance of active public engagement in national forest management. It requires public involvement through consultations and collaboration in the planning process, including cooperatively developed landscape and land management goals, plans, projects, and monitoring (36 CFR § 219.12). Public outreach, participation, and collaboration with adjacent agencies and landowners and with interested and affected individuals and communities also are required under this rule and its related directives. As of early 2018, a total of 31 national forests were in the process of revising their land management plans according to the new planning rule and its directives.

State, local, and private sector—

At the subnational level, all states have open record laws with similarities to the APA and Freedom of Information Act; 49 states have open meeting laws; and most states have laws, rules, and administrative directives that specifically require public participation in forest resource decisions and authorize citizen access to government information about forests (Hibbard and Ellefson 2005). Local governments often follow the lead of their state counterparts on matters of public access to government decisionmaking, yet few have specifically prescribed measures for public input to forest planning or management.

At least 20 states (and Puerto Rico as well) have enacted environmental policy acts or similar statutes establishing environmental review procedures for specific activities or activities in specific areas with public participation requirements such as opportunities for comment and review similar to NEPA (CEQ 2016a). Additionally, land use plans and zoning rules at the state and local level affect forests and may be contested in the public arena, as well as in the court system. For example, land use and zoning rules that require minimum lot sizes to limit nonforest uses or to assure economic viability of forest tracts have been challenged in many local and state courts (Hibbard and Ellefson 2005). These and other state statutes and requirements, however, range broadly in rigor, implementation, and compliance (McGinley et al. 2012).

Private sector actions to seek public input and participation in land management decisions are not subject to extensive regulatory requirements. Nonetheless, public participation in forest management on private lands is increasing in response to

At least 20 states (and Puerto Rico as well) have enacted environmental policy acts or similar statutes establishing environmental review procedures for specific activities or activities in specific areas with public participation requirements such as opportunities for comment and review similar to NEPA.

market signals, and as a result of growing engagement in partnerships, forest management and product certification, and other processes. Forest certification systems, including American Tree Farm System (ATFS), Forest Stewardship Council (FSC), Programme for the Endorsement of Forest Certification (PEFC), and Sustainable Forestry Initiative (SFI) require consultation with external stakeholders, measures to redress complaints, and public reporting on progress toward forest sustainability.

Objections, Appeals, and Litigation

Although there is increasing support for and development of stakeholder involvement in decisionmaking processes, in general, and specifically in terms of public land management, conflicting interests and policy and program impasses still arise and routinely result in appeals and litigation. Opportunities to question and object to decision alternatives, to appeal decisions once they are made, and to contest final decisions in the courts are standard requirements in environmental, natural resource, and land management laws throughout the United States (Creighton 2005). Objections, appeals, and litigation can be used by individuals or groups without access to or excluded from the decision process, as well as by those who have participated in the process but have become dissatisfied or deterred somewhere along the way. Additionally, some individuals and groups abstain from participatory processes or reject them altogether and in favor of appeals and litigation as their best chance of influencing decisions and outcomes (Burke 2013, Gray 1989).

Groups opposing federal or state agency actions in the court must prove that they have standing to successfully bring a case to the courts. According to the U.S. Supreme Court, “the irreducible constitutional minimum of standing contains three elements: (1) an injury-in-fact that is (a) concrete and particularized and (b) actual and imminent; (2) causation; and (3) redressability” (*Lujan v. Defenders of Wildlife*; 504 U.S. 555, 560 [1992]). In other words, plaintiffs must show tangible, individual harm; show that harm is imminent; and show that legal action can improve the problem to claim standing in a federal or state case.

Environmental groups frequently seek to expand their standing in federal and state decisions. In one classic example, the Sierra Club unsuccessfully tried to bring a suit against then Department of the Interior Secretary Rodgers Morton, claiming to speak on “behalf of the trees” to stop development of a ski resort in California’s Mineral King Valley. The Sierra Club was denied standing owing to failure to prove personal injury or loss (*Sierra Club v. Morton* 423 F.2d 24 [1970], 405 U.S. 727 [1972]).

NEPA requires opportunities for public participation in environmental analyses, but conflicts over decisions still arise, and some ultimately are contested in court. From 2001 to 2010, the U.S. Forest Service filed 1,387 environmental impact statement (EISs; the most rigorous level of environmental analysis under NEPA), followed by the

Bureau of Land Management (BLM) (400 EISs) and the National Park Service (NPS) (313 EISs) (CEQ 2016a) (box 10.1, fig. 10.1). During this period, 36 percent of the EISs submitted by BLM were challenged through litigation, followed by Forest Service (29 percent) and NPS (10 percent). Of these challenges, more than a third resulted in a court-issued injunction or remand against the agency (BLM, 31 percent; FS, 37 percent; NPS, 43 percent). Nevertheless, of the total number of EISs filed during this period, relatively low percentages resulted in an injunction or remand against each agency (i.e., NPS: 4 percent, BLM: 11 percent, Forest Service: 11 percent) (table 10.1, fig. 10.1).

The Forest Service prepares more environmental analyses under NEPA than any other federal agency, including about 140 EISs on average per year. Although

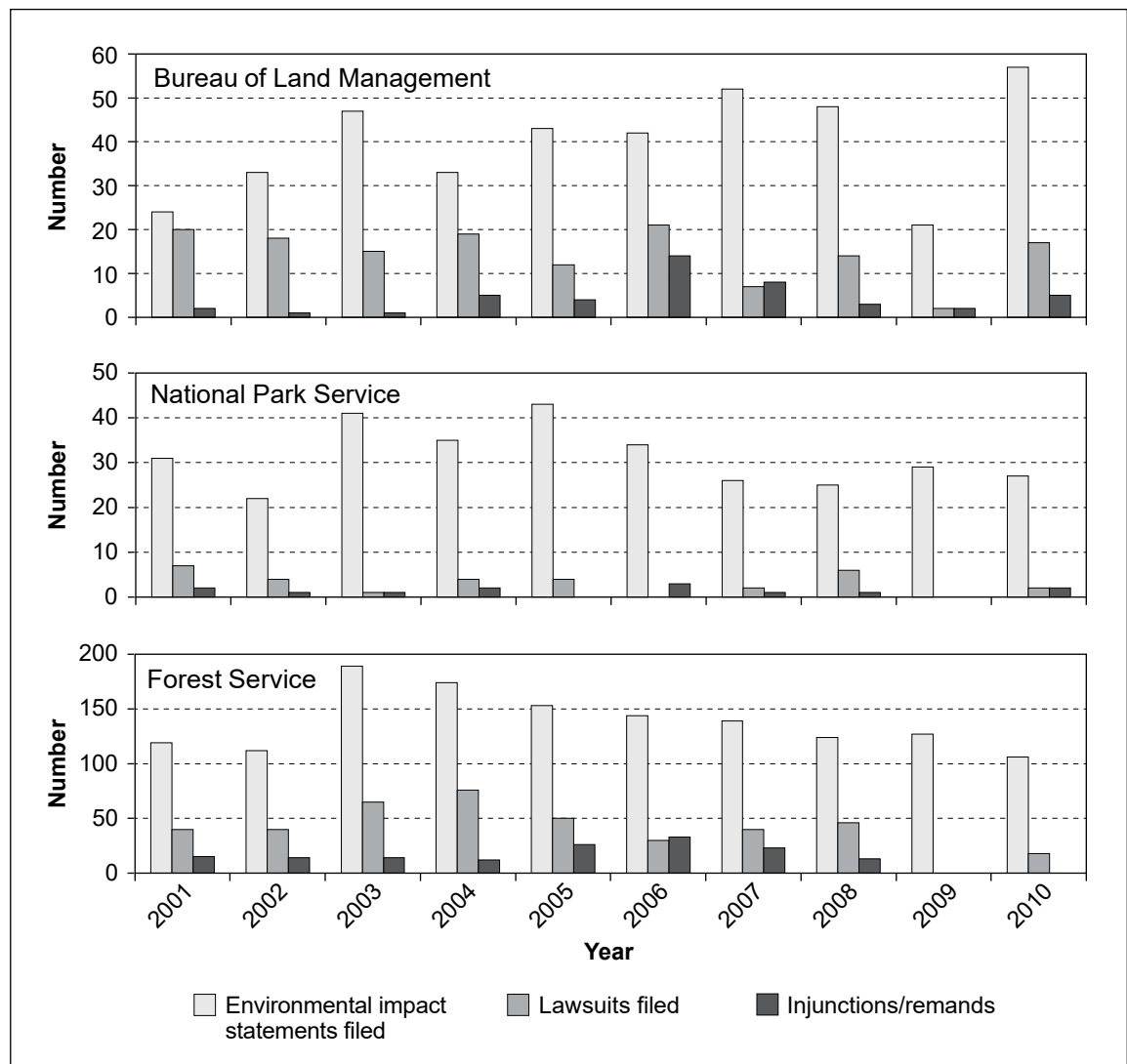


Figure 10.1—Environmental impact statements (EIS) filed by agency, cases filed against filed EISs, and injunctions or remands set against filed EISs by agency, 2001–2010.

Table 10.1—Environmental impact statements (EISs) filed, cases filed against filed EISs, and injunctions or remands set against filed EISs by agency, 2001–2010

Agency	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Forest Service:										
Filed EISs	119	112	189	174	153	144	139	124	127	106
Cases filed	40	40	65	76	50	30	40	46	ND	18
Injunctions/remands	15	14	14	12	26	33	23	13	ND	0
Bureau of Land Management:										
Filed EISs	24	33	47	33	43	42	52	48	21	57
Cases filed	20	18	15	19	12	21	7	14	2	17
Injunctions/remands	2	1	1	5	4	14	8	3	2	5
National Park Service:										
Filed EISs	31	22	41	35	43	34	26	25	29	27
Cases filed	7	4	1	4	4	0	2	6	0	2
Injunctions/remands	2	1	1	2	0	3	1	1	0	2

ND = no data.

Data source: CEQ 2016a.

a small percentage of these analyses are contested in court, the Forest Service typically is the federal agency with the highest number of NEPA-related cases filed against it in any given year (CEQ 2016a). From 1989 to 2008, a total of 1,160 federal cases were filed challenging a land management decision by the Forest Service (Miner et al. 2014). These cases most often relate to management of live vegetation, such as logging (24 percent), management of dead vegetation, such as postfire salvage logging (8 percent), and forest planning (5 percent) (Miner et al. 2014). Allegations of NEPA violations or noncompliance were the most frequent bases for litigation. The majority of litigants suing the agency sought decreased resource use or impacts in national forests, such as less logging or less recreation, although about one-fourth of the litigants sought greater resource use, such as more logging or more recreation opportunities (Keele et al. 2006).

Of the 1,160 cases examined by Miner et al. (2014), the Forest Service won slightly more (53.8 percent) cases than it either lost (23.3 percent) or settled (22.9 percent). There were more lawsuits in the Pacific Northwest (Oregon and Washington) than in any other Forest Service region. Overall, there were fluctuations in the ratio of Forest Service wins and losses over the 20-year period from 1989 to 2008, though the settlement of cases out of court generally increased over time (Miner et al. 2014). This may indicate an increasing trend in court-ordered mediation or other alternative dispute resolution practices for challenges to agency land and resource management decisions.

Some recent changes to national forest planning (36 CFR 219 Subpart B) and project-level review and objection process (36 CFR 218 Subparts A and B) were intended to involve stakeholders early and often in decisionmaking processes, to resolve issues and concerns before a decision is made, and ultimately, to reduce objections, appeals, and litigation. Under both processes, individuals and entities may file objections after an environmental analysis document is completed and before a decision document is signed. Similar to Forest Service appeal processes, responses to objections are provided by the next higher level line officer above the Forest Service official proposing to sign the project or land management plan decision.

Conflict Resolution

Complex and seemingly intractable environmental disputes or controversies can arise in high conflict and low trust settings and may lead to significant costs to landowners, government, and civil society in general. The rise of conflicts relating to the environment, natural resources, and public lands in the 1970s and 1980s led to multiple initiatives to find new and better ways to reduce and resolve conflicts. At the federal level, Congress passed the Environmental Policy and Conflict Resolution Act of 1988 to promote more effective conflict management and resolution in federal decisionmaking. This act also created the United States Institute for Environmental Conflict Resolution (USIECR) to provide mediation, training, and related services for addressing environmental disputes that involve the federal government.

Additional authorities and guidance on conflict prevention and resolution demonstrated a gradual shift from a focus on ex post conflict resolution to a focus on conflict prevention and collaboration a priori. These include the Administrative Dispute Resolution Act of 1996; Executive Order 12988 “Civil Justice Reform” of 1996; the Environmental Policy and Conflict Resolution Advancement Act of 2003; and Executive Order 13352 “Facilitation of Cooperative Conservation” of 2004, among others. In 2005, the Office of Management and Budget (OMB) and the Council on Environmental Quality (CEQ) issued a joint policy memorandum directing all federal agencies to increase the effective use of environmental conflict resolution and their institutional capacity for collaborative problem solving. In 2012, the OMB and CEQ broadened their guidance on environmental collaboration and conflict resolution through another joint memorandum that “explicitly encourage[es] appropriate and effective upfront environmental collaboration to minimize or prevent conflict and strengthen the focus on environmental conflict resolution” (OMB/CEQ 2012).

Environmental collaboration and conflict resolution (ECCR) in the federal government is promoted to reduce environmental conflicts and improve environmental decisions in mission critical areas including NEPA compliance, transportation infrastructure, environmental cleanup and restoration, natural resource management on

Authorities and guidance on conflict prevention and resolution show a gradual shift from a focus on ex post conflict resolution to a focus on conflict prevention and collaboration a priori.

federal lands, species and habitat conservation, coastal zone management, historical preservation, tribal consultation, and energy infrastructure development and management (USIECR 2012). It can be applied during policy development, rulemaking, administrative decisionmaking, program implementation, appeals and litigation. Measured benefits of these processes and practices include “avoided litigation costs, expedited work on projects, innovative solutions, cost-effective solutions, and improved working relationships among stakeholders... . Even when agreements are not reached, the benefits of ECCR are highlighted, including narrowing the issues that may end up in litigation” (USIECR 2012).

In the federal government, the use of ECCR increased about 7 percent from 2008 to 2013, and is most widely used in the areas of compliance, enforcement, planning, monitoring, and implementation of agreements. ECCR also is used in the contexts of policy development, permitting, rulemaking, and siting and construction (USIECR 2012). Regulatory agencies like the Environmental Protection Agency (EPA) use ECCR mostly in enforcement cases, whereas land and natural resource management agencies use it most frequently in planning and policy development (USIECR 2012). In particular, DOI and the Forest Service used neutral third-party involvement to assist in a collaborative or conflict resolution process in more than 2,700 cases from FY 2008 to 2013 (fig. 10.2). Today, state and local government, private sector, and civil society regularly engage in collaboration and conflict management processes related to federal decisionmaking. Additionally, more than half of the states have state-sanctioned alternative environmental dispute resolution offices and organizations (Herring, n.d.).

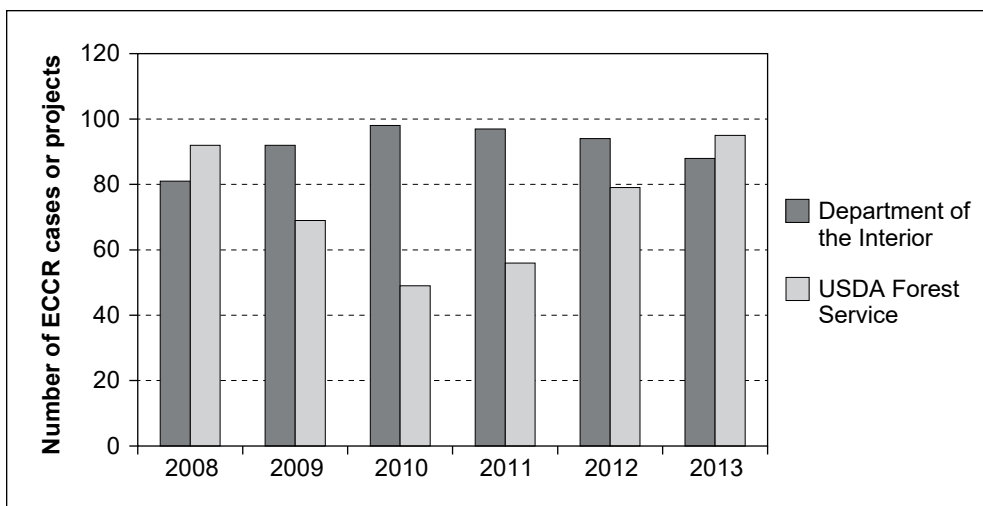


Figure 10.2— Environmental collaboration and conflict resolution (ECCR) cases or projects (i.e., instance of neutral third-party involvement in a collaborative or conflict resolution process) in the U.S. Department of the Interior (DOI) and U.S. Department of Agriculture Forest Service (USFS), 2008–2013 (Udall Foundation 2014).

Conclusions

People participate in forest-related decisionmaking in various ways, including through electoral processes, protest actions, public hearings, and collaborative partnerships. Historically, decisions about forests and other natural resources in the United States were made primarily through a top-down process carried out by government administrators, and public involvement was limited to the ballot box and demonstrations (Beierle and Cayford 2002). Today, these types of decisions increasingly are being made through participatory approaches with place-based networks of stakeholders that identify policies and programs intended to meet shared goals (Ansell and Gash 2008, Jakes et al. 2011). Collaborative decisionmaking that supports broad representation and participation by a range of actors and interests has grown throughout the country and has been shown to foster agreement and action in many places and cases (Brunner et al. 2005, Burke 2013, Moote et al. 1997). Nevertheless, conflicts over forests and other natural resources continue to arise; some of these remain intractable or go unresolved and may lead to objection, administrative review, and ultimately, litigation as the means for reaching resolution.

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Appendix 10.1: Key Data Sources and Websites

National Environmental Policy Act environmental impact statement filings: https://ceq.doe.gov/get-involved/eis_filings.html

U.S. General Services Administration Federal Advisory Committees: <http://www.gsa.gov/portal/content/244333>

Environmental Collaboration and Conflict Resolution Activities in the Federal Government: <http://www.udall.gov/OurPrograms/Institute/ECRReport.aspx>

Key Websites

American Tree Farm System: <https://www.treefarmssystem.org/>

U.S. Department of the Interior Forests and Rangelands (Healthy Forests Restoration Act Projects): <http://www.forestsandrangelands.gov/index.shtml>

Forest Stewardship Council: <https://us.fsc.org/>

Sustainable Forestry Initiative: <http://www.sfipogram.org/>

U.S. Institute for Environmental Conflict Resolution: <https://www.udall.gov/OurPrograms/Institute/Institute.aspx>

Chapter 11: Monitoring, Assessing, and Reporting on Progress Toward Sustainable Management of Forests (Indicator 54)

Kathleen A. McGinley, Frederick W. Cubbage, and Guy C. Robertson¹

Indicator Background and Rationale

An open and transparent monitoring, assessment, and reporting system that provides up-to-date and reliable forest-related information is essential for informed decisionmaking, in generating public and political awareness of issues affecting forests, and in developing policies to underpin the sustainable management of forests (Montréal Process 2015). Public discussion and decisions related to natural resource sustainability issues should be based on comprehensive, current, and sound data. Information regarding the frequency, coverage, and reliability of data provides analysts with critical information for evaluating and prioritizing sustainability needs. Indicator 54 is intended to provide information on the capacity to monitor, assess, and report on forests (Montréal Process 2015).

Measurement Approach

We summarized major data collection and dissemination efforts related to forests and their sustainability at national and subnational levels. Also, we assessed the status of information related to the Montréal Process criteria and indicators in terms of data coverage, currentness, frequency, and scale of reporting. Rankings were determined by the lead indicator or criterion investigator(s) and other core team members of the forthcoming *National Report on Sustainable Forests—2020*.

Forest Data Collection and Dissemination Efforts

Various laws and regulations govern data collection, analysis, and release in the United States. Major initiatives related to forests include the Forest Inventory and Analysis (FIA) program of the U.S. Department of Agriculture, Forest Service (USDA FS), which measures and monitors the status and trends in the nation's forests by assessing their composition, health, disturbance, production, harvest,

Various laws and regulations govern data collection, analysis, and release of information on forests in the United States, including the Forest Inventory and Analysis program and the Forest and Rangeland Renewable Resources Planning Act.

¹ **Kathleen A. McGinley** is a research social scientist, U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, 1201 Calle Ceiba, Jardín Botánico Sur, Río Piedras, PR 00926; **Frederick W. Cubbage** is a professor, North Carolina State University, Department of Forestry and Environmental Resources, Box 8008, 3118B Jordan Hall, 2800 Faucette Boulevard, Raleigh, NC 27695-8008; **Guy C. Robertson** is the national sustainability assessment program leader, U.S. Department of Agriculture Forest Service, Inventory Monitoring and Assessment Research, 201 14th Street SW, 2nd floor, Washington, DC 20250.

utilization, and ownership, among other aspects, through a continuous forest census that produces data annually. This program was authorized by the McSweeney-McNary Forest Research Act of 1928 (P.L. 70-466), with the first national forest inventories beginning in 1930. Through this program, forests throughout the United States and its territories and other politically affiliated jurisdictions are currently surveyed annually to determine “the status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership” (USDA FS 2016).

The Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (P.L. 93-378) is another federal law requiring the assessment, planning, and monitoring of the nation’s forests and rangelands including data collection, analysis, and periodic reporting on the status and trends in forest and rangeland renewable resources. Periodic RPA reports are produced by the Forest Service, which also collects and maintains data related to National Forest System visitor use and recreation (e.g., National Visitor Use Monitoring program) and nontimber forest products, among other topics. The National Resources Inventory is a periodic assessment of the status and changing conditions of the land use and the soil, water, and related resources on nonfederal lands, reported since the late 1970s, and now conducted by the USDA Natural Resources Conservation Service. Forest commodities and trade data for the United States are tracked and reported by the USDA Foreign Agriculture Service. The U.S. Census Bureau and the Department of Commerce collect, report, and provide important information on socioeconomic dynamics directly and indirectly related to forests. Many other programs and initiatives provide forest-related information at national and subnational levels through ongoing efforts as well as specific point-in-time studies.

State and university research and assessments also contribute to the availability and extent of forest information and statistics and help foster continuous improvement of forest-related data. Private sector forestry firms, nongovernmental organizations, and landowners also contribute to such efforts through voluntary assessments and reporting, often in cooperation with federal, state, and university partners. Private sector organizations also provide various production and trade statistics to forest industry trade associations, such as the American Forest and Paper Association. Additionally, certified forest organizations make publicly available at least some planning and management data. The full management plans for firms certified by the Forest Stewardship Council generally are available through the certifying organizations, and the Sustainable Forestry Initiative provides a summary of the certification audits for its forest management certificate holders.

Status of Data for the Montréal Process Criteria and Indicators in the United States

Data available for analyzing the 54 Montréal Process indicators as of 2018 ranged from anecdotal information to one-time studies to complete up-to-date coverage (table 11.1). Twenty-two of the 54 indicators showed improvements in the coverage, currentness, or collection frequency of data on forests and their sustainability compared to the 2003 and 2010 national reports on sustainable forests. For example, data on forest area and percentage by ecosystem type, age class, ownership, and other categories (1.01) have improved with enhancements to FIA data. Likewise, data on the area and percentage of forest in protected areas by different categories (1.02) have improved with new data from the Conservation Biology Institute that expanded the utility of FIA data used in previous reports to permit the coverage of additional vegetation classes. Improvements in the analysis of the area and percentage of forest land with significant soil degradation (4.19) also improved with new information on critical loads and some FIA soil resampling since the previous report. Overall, among the improvements, more were gained in the biophysical indicators than the socioeconomic or institutional. Two indicators were entirely new (7.46, 7.52) and the remaining 30 indicators had not changed significantly in terms of their data coverage, currentness, or collection frequency. No indicators were considered to have declined in these attributes.

Although some indicators have a full suite of current data, that are national in scope, and collected frequently (e.g., several indicators under C1, C2, C5, and C6), the majority do not. In some cases, this is the result of a lack of systematic data collection (e.g., 6.38; 7.45.53), in others, the indicator in question may not be amenable to a concise, quantified analysis and presentation, and systematic data collection activities would likely not be possible even if sufficient resources were available (e.g., 6.44; 7.46). Often, in these cases, proxy data have been used to provide some information to address the indicator. Certain proxy data series may have excellent characteristics (e.g., high reporting frequency and national consistency), but their applicability in measuring the underlying indicator varies depending on the indicator in question, and ultimately pose challenges to long-term sustainability reporting. Overall, research, monitoring, and assessment of a wide range of data on forests and associated conditions and trends in the United States have remained stable, if not improved since 2010, as reflected in table 11.1.

Data available for analyzing the 54 Montréal Process indicators as of 2018 ranged from anecdotal information to one-time studies to complete up-to-date coverage.

Research, monitoring, and assessment of a wide range of data on forests and associated conditions and trends in the United States have remained stable, if not improved since 2010.

Table 11.1—Status of and trends in Montréal Process indicator data in the United States, 2018

Criteria (C) and indicators	Coverage^a	Currentness	Frequency	Changes since 2010
C1. Conservation of biological diversity:				
1.01 Area and percentage of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure	1	1	1	I
1.02 Area and percentage of forest in protected areas by forest ecosystem type and by age class or successional stage	1	1	1	I
1.03 Fragmentation of forests	1	1	2	I
1.04 Number of native forest-associated species	1	1	1	I
1.05 Number of native forest-associated species at risk, as determined by legislation or scientific assessment	1	1	1	I
1.06 Status of onsite and offsite efforts focused on conservation of species diversity	1	1	1	I
1.07 Number and geographic distribution of forest-associated species at risk of losing genetic variation and locally adapted genotypes	1	1	1	I
1.08 Population levels of selected representative forest-associated species to describe genetic diversity	1	1	1	S
1.09 Status of onsite and offsite efforts focused on conservation of genetic diversity	1	1	1	S
C2. Maintenance of productive capacity of forest ecosystems:				
2.10 Area and percentage of forest land and net area of forest land available for wood production	1	1	1	I
2.11 Total growing stock and annual increment of both merchantable and nonmerchantable tree species in forests available for wood production	1	1	1	I
2.12 Area, percentage and growing stock of plantations of native and exotic species	1	1	1	I
2.13 Annual harvest of wood products by volume and as a percentage of net growth or sustained yield	1	1	1	I
2.14 Annual harvest of nonwood forest products	3	1	3	S
C3. Maintenance of ecosystem health and vitality:				
3.15 Area and percentage of forest affected by biotic processes and agents (e.g., insects, disease, invasive alien species) beyond reference conditions	2	1	1	S
3.16 Area and percentage of forest affected by abiotic agents (e.g., fire, storm, land clearance) beyond reference conditions	2	1	1	S
C4. Conservation and maintenance of soil and water resources				
4.17 Area and percentage of forest whose designation or land management focus is the protection of soil or water resources	2	2	2	S
4.18 Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources	2	1	1	I

Table 11.1—Status of and trends in Montréal Process indicator data in the United States, 2018 (continued)

Criteria (C) and indicators	Coverage ^a	Currentness	Frequency	Changes since 2010
4.19 Area and percentage of forest land with significant soil degradation	2	2	2	I
4.20 Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water-related resources	2	1	1	I
4.21 Area and percentage of water bodies, or stream length, in forest areas with significant change in physical, chemical, or biological properties from reference conditions	2	1	2	I
C5. Maintenance of forest contribution to global carbon cycles				
5.22 Total forest ecosystem carbon pools and fluxes	1	1	1	I
5.23 Total forest product carbon pools and fluxes	1	1	1	S
5.24 Avoided fossil fuel carbon emissions by using forest biomass for energy	1	1	1	I
C6. Maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies				
6.25 Value and volume of wood and wood products production, including primary and secondary processing	1	1	1	S
6.26 Value of nonwood forest products produced or collected	2	2	2	S
6.27 Revenue from forest-based environmental services	2	2	2	S
6.28 Total and per capita consumption of wood and wood products in roundwood equivalents	1	1	1	S
6.29 Total and per capita consumption of nonwood products	2	2	2	S
6.30 Value and volume in roundwood equivalents of exports and imports of wood products	2	2	2	S
6.31 Value of exports and imports of nonwood products	2	2	2	S
6.32 Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption	1	1	1	S
6.33 Recovery or recycling of forest products as a percentage of total forest products consumption	1	1	1	S
6.34 Value of capital investment and annual expenditure in forest management, wood and nonwood product industries, forest-based environmental services, recreation, and tourism	1	2	2	S
6.35 Annual investment and expenditure in forest-related research, extension and development, and education	2	2	2	S
6.36 Employment in the forest products sector	1	1	1	S
6.37 Average wage rates, annual average income, and annual injury rates in major forest employment categories	1	1	1	S
6.38 The resilience of forest-dependent communities	3	3	3	S
6.39 Area and percentage of forests used for subsistence purposes	3	3	3	S
6.40 Distribution of revenues derived from forest management	3	3	3	S

Table 11.1—Status of and trends in Montréal Process indicator data in the United States, 2018 (continued)

Criteria (C) and indicators	Coverage ^a	Currentness	Frequency	Changes since 2010
6.41 Area and percentage of forests available and managed for public recreation and tourism	2	2	2	S
6.42 Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available	2	2	2	S
6.43 Area and percentage of forests managed primarily to protect the range of cultural, social, and spiritual needs and values	2	2	2	S
6.44 The importance of forests to people	3	3	3	S
C7. Legal, institutional, and economic framework for forest conservation and sustainable management				
7.45 Legislation and policies supporting the sustainable management of forests	2	1	3	S
7.46 Cross sectoral policy and program coordination	2	1	3	N
7.47 Taxation and other economic strategies that affect the sustainable management of forests	1	1	3	S
7.48 Clarity and security of land and resource tenure and property rights	2	1	3	I
7.49 Enforcement of laws related to forests	2	1	3	I
7.50 Programs, services, and other resources supporting the sustainable management of forests	2	1	3	I
7.51 Development and application of research and technologies for the sustainable management of forests	1	1	2	I
7.52 Partnerships to support the sustainable management of forests	2	1	3	N
7.53 Public participation and conflict resolution in forest-related decisionmaking	1	1	3	I
7.54 Monitoring, assessment, and reporting on progress toward sustainable management of forests	1	1	2	S

^a Coverage: 1 = national (≥90 percent); 2 = some national or regional; 3 = varies or incomplete; 4 = modelled; Currentness: 1 ≥ 2010; 2 = 1995–2010; 3 = ≤ 1995; Frequency (of data collection/reporting): 1 = annual to <5-year periodic; 2 = ≥5 year periodic; 3 = one-time or incomplete; changes since 2010 report: I = improvements in data adequacy; S = no change/the same; D = declines in data adequacy; N = indicator is new to the framework/report.

Conclusions

Many laws and regulations govern the collection, analysis, and release of data directly and indirectly related to forests and their sustainability at national, state, and local levels in the United States. Since collection of information for the Montréal Process began in the late 1990s, some improvements have been made in the coverage, currentness, and collection frequency of forest-related data. Nevertheless, multiple indicators do not have data that are collected regularly, particularly in terms of some socioeconomic and policy indicators.

An open and transparent monitoring, assessment, and reporting system that provides up-to-date and reliable forest-related information is essential for informed decisionmaking, in generating public and political awareness of issues affecting forests, and in developing policies to underpin the sustainable management of forests. Data collection, analysis, and reporting efforts for forests demonstrate stability and some improvements, although they may need to be streamlined as demands increase while resources flatline or decline.

References

- Montréal Process. 2015.** The Montréal Process criteria and indicators for the conservation and sustainable management of temperate and boreal forests. 5th ed. <https://www.montrealprocess.org/documents/publications/techreports/MontrealProcessSeptember2015.pdf> (9 January 2020).
- U.S. Department of Agriculture, Forest Service [USDA FS]. 2016.** Forest Inventory and Analysis national program. <http://www.fia.fs.fed.us/>. (19 July 2016).

Appendix 11.1: Key Web Sites

- U.S. Forest Service Resources Planning Act assessment: <http://www.fs.fed.us/research/rpa/>
- U.S. Forest Service Inventory and Analysis: <http://www.fia.fs.fed.us/>
- U.S. Census Bureau: <http://www.census.gov/>
- U.S. Department of Commerce: <http://www.trade.gov/mas/ian/tradestatistics/>
- National Resources Inventory: U.S. Natural Resources Conservation Service: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/nri/>
- U.S. Department of Agriculture Foreign Agriculture Service commodities and trade data: <http://www.fas.usda.gov/data>
- U.S. Forest Service National Visitor Use Monitoring: <http://apps.fs.usda.gov/nvum/results/>

Metric Equivalents

When you know:	Multiply by:	To find:
Miles (mi)	1.609	Kilometers
Acres (ac)	.405	Hectares
Tons (ton)	907	Kilograms
Board feet	.00236	Cubic meters
Gallons (gal)	3.78	Liters



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