Examining forest governance in the United States through the Montréal Process Criteria and Indicators Framework

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SUMMARY

This paper examines laws, policies, organizations and other governance elements and arrangements that influence forest conservation and sustainable resource management in the U.S. through a set of 10 Indicators associated with Criterion Seven of the Montréal Process Criteria and Indicators Framework. The applicability and utility of these indicators as a measure of forest governance at the national level is examined and associated quantitative and qualitative data are presented and discussed. In the U.S., a broad range of laws governs public lands, dictating management processes and practices. Federal and state laws protect wildlife and endangered species on all public and private lands, and foster a range of prescribed and voluntary forest practices to protect water, air, and other public goods and services on private lands. Federal and state laws also provide for technical and financial assistance, research, education, and planning on private forest lands. Market based mechanisms increasingly are used to advance forest sustainability, as are policies, programs, and partnerships that link related policy networks, purposes, and desired outcomes across an expanding range of sectors. Nevertheless, challenges in advancing forest sustainability in the U.S. remain, particularly where incentives for sustainable forest management are low and pressures for development and agriculture are high. Furthermore, while such multilateral agreements 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.

Keywords: forest governance, forest policy, United States, Montréal Process Criteria and Indicators

Examination de la gestion forestière aux Etats-Unis en utilisant le cadre des indicateurs et des critères de procédure de Montréal

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Ce papier examine les lois, politiques, organisations et autres éléments et arrangements de gestion inluençant la gestion des ressources durables forestières et leur conservation aux U.S.A. au moyen de 10 indicateurs associés au Criterion Seven du Cadre des indicateurs et des critères de procédure de Montréal. L'application et l'utilité de ces indicateurs en tant qu'outils de mesure de la gestion forestière au niveau national sont examinées et des données associées quantititatives et qualitatives sont présentées et analysées. Un large éventail de lois gouverne les terres publiques aux U.S.A., dirigeant les processus et pratiques de gestion. Les lois fédérales et d'état protègent la faune et les espèces en voie de disparition sur toutes les terres publiques et privées, et encouragent un assortiment de pratiquees forestières prescrites et volontaires pour protéger eau, air, ainsi que d'autres biens et services publics en terre privée. Les lois fédérales et d'état soutiennent également assistance technique et financière, recherche, éducation et planification sur les terres forestières privées. Les mécanismes de marché sont de plus en plus utilisés pour améliorer la durabilité forestière, tout comme les politiques, programmes et partenariats liant les réseaux de politiques associés, les desseins et les résultats désirés sur une étendue croissante de secteurs. Toutefois, les défis faisant face à une avancée de la durabilité forestière aux U.S.A. demeurent, en particulier dans les cas où les encouragements à la gestion forestière durable sont moindres et où les pressions pour le développement de l'agriculture sont fortes. De plus, alors que de tels agréments multilatéraux aident à identifier les buts forestiers communs, à développer les mesures et à faire un rapport sur le status individuel d'un pays, ils ne peuvent absolument pas assurer des pratiques forestières spécifiques ni une bonne gestion des forêts.

Examinando la gobernanza forestal en los Estados Unidos a través del Marco de Criterios e Indicadores del Proceso de Montreal

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A través de un conjunto de diez indicadores asociados con el Criterio Siete del Proceso de Montreal, se examinan las leyes, las políticas, las organizaciones, y otros elementos y arreglos de la gobernanza que influyen en la conservación y el manejo sostenible de los bosques de los Estados Unidos. Se analizan datos cuantitativos y cualitativos asociados con estos indicadores y se consideran la aplicabilidad y la utilidad de los indicadores como una medida de la gobernanza forestal a nivel nacional. En los Estados Unidos, una gama amplia de leyes regula las

tierras públicas, dictando los procesos y las prácticas de la gestión y del manejo forestal. Las leyes federales y estatales protegen la vida silvestre y las especies en peligro de extinción en todas las tierras públicas y privadas y fomentan una serie de prácticas forestales prescritas y voluntarias para proteger el agua, el aire, y otros bienes y servicios en tierras privadas. También, las leyes federales y estatales proporcionan la asistencia técnica y financiera, la investigación, la educación y la planificación en tierras forestales privadas. En los Estados Unidos, se utilizan cada vez más los mecanismos basados en el mercado para promover la sostenibilidad de los bosques, al igual que las políticas, las asociaciones, y los programas que abordan cuestiones y propósitos intersectoriales. Sin embargo, persisten unos retos para avanzar en la sostenibilidad de los bosques de los Estados Unidos, particularmente donde los incentivos para el manejo forestal sostenible son bajos y las presiones para el desarrollo y la agricultura son altas. Además, si bien tales acuerdos multilaterales como el Proceso Montréal ayudan a identificar objetivos forestales comunes, a desarrollar métricas medibles, e informar sobre la situación forestal individual de cada país, no imponen prácticas forestales específicas ni garantizan una buena gobernanza forestal.

INTRODUCTION

Forests and the people who depend on them are confronted with increasingly complex challenges—such as pressures from land use change, illegal logging, and climate change. In response, government, civil society, and the private sector have recognized more and more the importance of sustainable forest management (SFM) in policies and practices, reflecting its rise in forest-related discourses from local to global levels (McDonald and Lane 2004, Arts *et al.* 2010, VanGossum *et al.* 2011). SFM generally encompasses ecological, economic, and social aspects of forests. It is defined by the United Nations General Assembly (2008) as a "dynamic and evolving concept, which aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations."

Just as important as sound technical practices to the sustainability of forests, are the laws, policies, norms, and other institutional factors that affect forests and how people interact with them; particularly, because some of the most significant changes to and effects on forests are the result of human activity. Together, these legal, political and institutional factors can provide the enabling conditions for advancing forest sustainability. Conversely, they may impede progress towards SFM, particularly where there are conflicting policies, lack of transparency or participation in decision-making, corruption, poor oversight, or other governance failures (Contreras-Hermosilla 2002, Tacconi 2007).

Long established forms of top-down, autocratic forest-related decision-making are giving way to newer forms of governance that involve multiple actors at multiple levels using multiple policy instruments (e.g., public-private partnerships, community forestry, payments for environmental services, forest certification schemes, decentralized decision-making and oversight) (Arts and Buizer 2009, Kooiman 2003, Agrawal *et al.* 2008). This shift from government to governance can be effective in managing forests as providers of public goods and services and in resolving persisting problems or conflicts, particularly given the multiplicity of actors and interests involved in forests and how they are used (Van Gossum *et al.* 2011). However, if the ways in which forests are governed are not conducive to their sustainability, for example where key stakeholders are left out of the decision process, or where policy making is dominated by special interests, simultaneously achieving the basic tenets of ecological, economic, and social sustainability often becomes elusive.

Comprehensive information about legal, political, and other institutional factors affecting forests is necessary for addressing governance failures and enhancing the sustainability of forests worldwide. If forest governance can be measured and assessed, stakeholders can better diagnose problems, advance reforms, monitor their impacts, and adapt if necessary (Kishor and Rosenbaum 2012). In the past decade or so, several initiatives have been developed, aimed at monitoring and evaluating forest governance at different scales (e.g., the World Bank's Framework for Forest Governance Reform; the World Resources Institute's Governance of Forests Initiative; UN-REDD/Chatham House Framework for Monitoring REDD+ Governance). Also, various frameworks of criteria and indicators (C&I) have been developed to facilitate forest sustainability assessments that include legal, political, and other institutional elements (e.g., Montréal Process Criteria and Indicators of Sustainable Management and Conservation of Temperate and Boreal Forests (MPC&I), Pan-European Criteria and Indicators of Sustainable Forest Management).[1]

In this paper, we discuss our use of Criterion 7 (C7) of the Montréal Process to examine key elements of forest governance in the U.S. The work presented here is associated with a broader initiative led by the U.S. Forest Service (USFS) to regularly measure, monitor, and report on forests in the U.S. using the MPC&I. The MP C7 focuses on the legal, institutional, and economic framework for forest conservation and sustainable development (Montréal Process 2014). In the following sections, first we review some of the key frameworks for assessing SFM and forest governance at the national level. Then, we describe the Montréal Process and its framework of C&I, focusing on C7. Next, we present our methods, followed by a presentation and discussion of the

[1] Criteria are categories of conditions or processes by which a goal, in this case – sustainable forest management, may be assessed. A criterion is characterised by a set of related indicators, which are quantitative or qualitative variables that can be measured or monitored periodically to assess change (Montréal Process 2014).

results, which comprise quantitative and qualitative data on forest laws, policies, instruments, organizations, and other governance factors. These results provide the institutional context for understanding the ecological, economic, and social conditions of and trends in forests at national and subnational levels in the U.S. Finally, we examine the utility and merit of the MP C7 indicators as a framework for measuring forest governance and discuss the overall implications of the research approach and findings.

Frameworks for assessing forests and their governance

Criteria and indicators of forest sustainability

The development of C&I of forest sustainability and conservation was pioneered by the International Tropical Timber Organization (ITTO), producing its first framework of C&I for tropical forests in 1992 (Castañeda 2000). Further developments at international levels were catalyzed by agreements made at the United Nations Conference on the Environment and Development (UNCED), held later that year in Río de Janeiro, Brazil. By the mid-1990s, multiple efforts were underway to develop C&I for forests in specific regions and for specific forest types. Eventually, close to 150 countries participated in at least one of nine international processes to develop C&I to measure, assess, and report on forest sustainability (Castañeda 2000).

To date, the most active initiatives to develop and implement C&I for forests have been the African Timber Organization Initiative for Humid Africa, the Lepaterique Process for Central America, the Pan-European Forest Process, the Tarapoto Process for the Amazon Basin, and the Montréal Process for temperate and boreal forests (Grainger 2012). The Pan-European and Montréal processes have gone the furthest in establishing permanent secretariats, convening regular meetings, and reporting on C&I every five years or so (idem). Overall, the impacts of these various initiatives have been mixed, with some significant progress in C&I developments for several forest regions and types, with comparatively less progress in their national-level uptake, institutionalization, and regular reporting, and quite limited measured effects on forests and their governance (Poore 2003, Wijewardana 2008, Grainger 2012).

Frameworks for assessing forest governance

Governments, civil society, and the private sector have developed various initiatives to measure and monitor forest governance, including the World Bank Framework for Forest Governance Reform; the World Resources Institute (WRI) Governance of Forests Initiative; and the Chatham House Framework for Monitoring REDD+ Governance. Although these initiatives may demonstrate differences in their target audience and specific aims and objectives, they all incorporate accepted elements of 'good governance' including transparency, accountability, and participation across standard components of forest related- rules, actors, and practices. Moreover, comparative analyses of these initiatives show considerable concordance among them on key elements and characteristics of forest governance (Kishor and Rosenbaum 2012, PROFOR-FAO 2011).

In 2010, the World Bank's Program on Forests (PROFOR) and the Food and Agriculture Organization (FAO) worked with forest agencies and organizations from around the world to develop a common framework for measuring, monitoring, and assessing forest governance (PROFOR-FAO 2011). They took into account several existing frameworks focused on forests and their governance, including the WRI Governance of Forests Initiative, the ITTO C&I for tropical forests, and the MPC&I. The resulting framework identifies three 'pillars' of forest governance: policy, legal, institutional, and regulatory frameworks; planning and decision-making processes; and implementation, enforcement, and compliance. These pillars are associated with 13 components and numerous subcomponents of forest governance that incorporate aspects of accountability, effectiveness, efficiency, equity, participation, and transparency (PROFOR-FAO 2011).

The Montréal Process

Following on 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. In 1995, participating countries signed the Santiago Declaration, agreeing on a comprehensive framework of C&I for measuring and reporting on forest conservation and sustainable management (Table 1). Normative assessments of forest sustainability by decision-makers 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 that characterize the essential components of SFM and 54 indicators that provide a means for their measurement.

TABLE 1 *Montréal Process Criteria of the Sustainable Management and Conservation of Temperate and Boreal Forests*

Criterion (Number of Indicators)
1. Conservation of biological diversity (9)
2. Maintenance of the productive capacity of forest ecosystems (5)
3. Maintenance of forest ecosystem health and vitality (2)
4. Conservation and maintenance of soil and water resources (5)
5. Maintenance of forest contributions to global carbon cycles (3)
6. Maintenance and enhancement of socio-economic benefits from forests to meet the needs of societies (20)
7. Legal, institutional, and economic framework for forest conservation and sustainable management (10)

Source: Montréal Process 2014.

Today, 12 countries voluntarily participate in the Montréal Process: Argentina, Australia, Canada, Chile, China, Japan, the Republic of Korea, Mexico, New Zealand, Russia, Uruguay, and the U.S. 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 U.S. 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 measure, monitor, and report on forest conditions and trends at national and subnational levels (USFS 2011). It has reported on the MPC&I three times since 1997, with a fourth assessment report planned for release in 2017 (USFS 1997, 2004, 2011). Most member countries have used the MPC&I at least twice to examine their forests. Over time, the MP indicators have been revised based on experiences with their implementation, their effectiveness in measuring SFM, and evolving international priorities to measure and monitor forests; the seven MP criteria have been maintained as originally crafted (Montréal Process 2015).

Montréal Process Criterion 7: forest legislation, policies, and economic measures

In 2009, member countries agreed on revisions to the indicators associated with C7. These revisions reduced the original subset from 20 to 10 indicators, maintaining some of the original indicators, modifying or combining several, and adding two new indicators on forest-related partnerships and cross-sectoral policy and program coordination. Specifically, these 10 indicators focus on: (1) forest-related legislation, (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).

The revised C7 indicators reflect many of the critical elements identified in the forest governance monitoring and assessment frameworks cited above. In particular, the MP C7 indicators directly address 10 of the 13 key components outlined in the PROFOR-FAO (2011) forest governance assessment framework, indirectly addressing two more, and implicitly, but not specifically addressing forest sector corruption (Table 2). The alignment between these frameworks indicates that the MP C7 indicators may provide a sound structure for examining critical elements of forest governance at national and subnational levels, which we explore further in the following sections and in our conclusions.

METHODS

For each of the C7 indicators, we developed multiple metrics for measuring each indicator at national and subnational levels (Table 3). The MP Technical Advisory Committee developed technical notes on the application of the MPC&I, providing information on their justification and scope and reference for related data collection, assessment, and reporting (Montréal Process 2014). These technical notes were used as a primary reference in the identification of quantitative and qualitative metrics for each indicator. Once the indicator metrics were established, data sources were identified at national and subnational levels, and then available data were collected and analyzed according to the indicator objectives.

For example, the first indicator under Criterion 7 addresses legislation and policies supporting the sustainable management of forests. In the U.S., there is no specific national source for data on forest-related legislation and policies. There are in fact thousands of national, state, and local laws and regulations that affect forests. Through a legal, organizational, and literature review, we identified, cataloged, reviewed, and assessed the major U.S. federal laws that directly and indirectly affect SFM on public and private lands; reviewed and summarized international, federal, state, and local forest legislation; documented key references and web sites for federal, state, and local laws; and assessed major changes in law, policy, and implementation over time.

As another example, for the indicator on enforcement of laws related to forests, we collected information on formal and informal forest-related law enforcement processes and systems. Data on land area and law enforcement personnel, programs, and budgets were collected from federal land management agency websites and databases and supplemented with data obtained through direct consultation with program officers of the major land management agencies. Quantitative data on forest law enforcement at the subnational level was limited, although some information was available and analyzed from refereed and grey literature. Additionally, mostly qualitative information on local-level rule development, monitoring, and enforcement was available and collected for this study.

While some indicator metrics were associated with regularly collected or existing datasets in the U.S., most indicators required primary and/or secondary data collection for this assessment. Analysis and gaps in data availability were found at all levels, particularly at the subnational level. Even where information was available, challenges in aggregating data vertically as well as across geographies, organizations, and sectors were frequently encountered. An important outcome of this work was the identification of a wide range of data types and sources for assessing forest governance in the U.S.

RESULTS AND DISCUSSION

In the sections that follow, each of the indicators and related data and findings are presented. The discussion of each indicator begins with a brief description of its relevance to SFM. Then, the results and key findings are presented and discussed. The indicators are presented in a slightly different order than that laid out by the Montréal Process (2014) to provide a more fluid discussion of the legal, political, organizational and other governance factors influencing forest conservation and sustainable management in the U.S.

TABLE 2 *Comparison of key forest governance elements as outlined by PROFOR-FAO (2011) and the Montréal Process (2014)*

PROFOR-FAO Forest Governance Assessment Framework Key Components		Montréal Process Criterion 7: Indicators	
1.1	Forest-related policies and laws	7.1.a	Legislation and policies supporting SFM
1.2	Legal framework to support and protect land tenure, ownership, and use rights	7.3.a	Clarity and security of land and resource tenure and property rights
1.3	Concordance of broader development policies with forest policies	7.1.b	Cross sectoral policy and program coordination
1.4	Institutional frameworks	7.4.a	Programs, services, and other resources supporting SFM
1.5	Financial incentives, economic instruments and benefit sharing	7.2.a	Taxation and other economic strategies that affect SFM
2.1	Stakeholder participation	7.5.b	Public participation and conflict resolution in forest-related decision making
2.2	Transparency and accountability	Indirectly addressed through: 7.1.a Legislation and policies supporting SFM; 7.5.b Public participation, conflict resolution	
2.3	Stakeholder capacity and action	Indirectly addressed in part through: 7.4.a Programs, services, and other resources supporting SFM	
3.1	Administration of forest resources	7.4.a	Programs, services, and other resources supporting SFM, 7.4.b Development and application of research and technologies for the sustainable management of forests, 7.5.c Monitoring, assessment, and reporting on progress towards SFM
3.2	Forest law enforcement	7.3.b	Enforcement of laws related to forests
3.3	Administration of land tenure and property rights	7.3.a	Clarity and security of land and resource tenure and property rights
3.4	Cooperation and coordination	7.5.a	Partnerships to support SFM, 7.1.b Cross sectoral policy and program coordination
3.5	Measures to address corruption	Not directly or specifically addressed	

Legislation and policies supporting the sustainable management of forests (Indicator 7.1.a)

Markets efficiently provide many goods and services, including those from forests, but government intervention through laws, regulations, and other policy directives may be required to redress market failures associated with forests. Public policy and legislation on forests and their use may be necessary for the equitable allocation and management of forest goods and services. They also may be required to promote the consistent application of forest practices that ensure the sustained use and protection of important social, economic, and ecological forest values.

A broad range of policies and laws at local to international levels address and affect forests in the U.S. In fact, these policies and laws are so abundant that it is a challenge to summarize and assess them all succinctly. There is no single national forest law or policy that governs all forest lands in the U.S.; indeed there is no single policy that governs all public, or even all federal forest lands. Public lands, which include federal, state, and local government lands, are governed by a range of laws and policies addressing specific resources or issues and by specific laws dictating forest management and protection. For example, federal land management agencies oversee much of the federal forest lands. Each of these agencies is governed by an organic act that provides management authority and guidance in accordance with the agency's overarching mission and which is implemented through various laws, regulations, and other policy directives, including mandated land and resource planning requirements (Table 4).

Numerous national level policies and laws affect all forest lands – public and private. Among the most significant are the Clean Air Act (CAA) of 1970, the Clean Water Act (CWA) of 1972, and the Endangered Species Act (ESA) of 1973. Additionally, the National Environmental Policy Act of 1970 significantly affects federal forest lands, requiring a range of environmental analyses and public involvement for any proposed federal agency action with potential effects on the environment, including timber harvests and reforestation.

All states have legislation governing the management of state forest lands and the vast majority of states have forestry and/or environmental laws that affect private forest lands (Ellefson and Hibbard 2005a; Ma *et al.* 2009a, 2009b). Every state also has regulations governing prescribed forest fires and the prevention and control of human and naturally caused wildfires on all forest lands (Yoder *et al.* 2004). The sum of laws, regulations, required practices, and voluntary guidelines governing private forest lands vary by region and

TABLE 3 *Montréal Process Criterion 7 indicators and examples of metrics used for their measurement and evaluation*

Indicators	Example Metrics
Legislation and policies supporting sustainable forest management (SFM)	• Number and description of national, subnational, and international forest legislation and policies restricting, encouraging, protecting, etc. different forest uses • Provisions for periodic review in legal framework at national, subnational levels
Cross-sectoral policy and program coordination	• Number and description of interagency arrangements involving forests • Description of horizontal, vertical coordination involving forests • Description of cross-sectoral conflicts and coordination gaps
Taxation and other economic strategies that affect forests	• Description and funding of subsidies, incentives, taxes, etc. at national and subnational levels • Area of and trends in forestland enrolled in different economic strategies
Clarity and security of land and resource tenure and property rights	• Description of property and tenure rights, arrangements, and protections • Area of and trends in forest by property rights/tenure
Enforcement of laws related to forests	• Description of formal and informal forest-related law enforcement processes and systems • Number of and trends in forest-related prosecutions, convictions, and law enforcement officers per hectare per agency
Programs, services, and other resources supporting SFM	• Description of public and private organizations involved in SFM and their capacities • Number of and trends in universities with accredited forestry curriculum • Number of and trends in students enrolled in forestry curriculum
Development and application of research and technologies for SFM	• Description of rules and funding for forest research at national, subnational levels • Number of and trends in full time employee equivalents in forest science and research and development
Partnerships to support SFM	• Number, type, funding, and area covered by public-public, public-private, and private-private partnerships involving forests • Involvement in major forest related processes
Public participation & conflict resolution in forest-related decision making	• Description, number of, and trends in public consultation processes, disputes, and public advisory bodies related to forests and the forest sector
Monitoring, assessment, and reporting on progress towards SFM	• Public and private research efforts • Frequency, completeness, and currency of forest assessment by MP Criteria

Adapted from Montréal Process 2014.

resource, and most states use a variety of technical assistance, incentives, and educational policies and programs to promote SFM on private forest lands, mostly through voluntary best management practices. Still, private forest lands in the West and in parts of the Northeast are regulated by comparatively more rigorous state forestry laws, which require reforestation and environmental protection, among other mandated practices and processes (Ellefson *et al.* 2004, McGinley *et al.* 2012).

Other laws and policies also influence forests and their uses at local to larger scales. For example, county, local, and municipal regulations address tree protection/retention, logging practices, roads, and timber transport. At the other end of the spectrum, international hard and soft laws influence forest protection, production, and related trade (e.g., Convention on the International Trade in Endangered Species (CITES), General Agreement on Trade and Tariffs (GATT), North American Free Trade Agreement (NAFTA)). Ultimately, there is a vast and complex legislative framework governing public and private forest lands in the U.S., which reflects the diversity of forests, uses, ownerships, and scales of governance. How these laws, regulations, and other policy directives are developed and put into place are critical to understanding and evaluating forest governance. These aspects are examined through several of the following indicators.

Clarity and security of land and resource tenure and property rights (Indicator 7.3.a)

Generally, clear and secure land and resource tenure or property rights are prerequisites to forest sustainability (Deacon 1999, Larson *et al.* 2008, Robinson *et al.* 2014). Clear title to forest land identifies all rights and responsibilities with respect to land and resources under the law, and due process ensures that these rights can be protected or disputed. While private property rights certainly do not mark the only path to sustainable resource management (e.g., Ostrom 1990, Dietz *et al.* 2003), unclear or insecure ownership or tenure, or lack of due process may hinder the active engagement of stakeholders in SFM, or leave forests vulnerable to illegal or unsustainable uses (Barbier *et al.* 1991, Kant 2000).

Property and tenure rights in the U.S. are determined by the government, and may be changed at the government's

TABLE 4 *Major federal land management agencies in the US, their missions, and the organic act or law that gives them their management authority*

USDA Forest Service National Forest Management Act of 1976 "*Sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations*."
USDI Bureau of Land Management Federal Land Policy and Management Act of 1976 "*Sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations"*
USDI National Park Service National Park Service Act of 1916 "*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*."
USDI Fish and Wildlife Service National Wildlife Refuge System Administration Act of 1966; National Wildlife Refuge System Improvement Act of 1997 "*Working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people*."

behest with due process that accounts for landowner and community interests (Freyfogle 2001). Property rights govern a landowner's ability to acquire, manage, use, and dispose of land and its products and services. In the U.S., these rights are exclusive, but not absolute. Historically, U.S. property rights governed the fee simple ownership of all the resources associated with forest land, above and below ground, in most cases. Notable exceptions to this rule have included below ground mineral rights (e.g., oil, gas, coal), which often have been sold separately from the land and other rights to forests, and which in fact often hold superior claims. Complete ownership of all property rights was common for commodity production of timber and even nontimber forest products through the 20th century (Cubbage *et al*. 2017).

More recently, increasing attention has been given to the separation and sale of some property rights, in part to protect or pay for the environmental services provided by forests and other natural areas. This may occur through the sale of development rights to forested land through conservation easements and other such arrangements to ensure the land remains in a natural state for a determined length of time or in perpetuity. The amount of land under conservation easement in the U.S. has increased significantly from about 500,000 acres in 1990 to nearly 25 million acres in 2016 (National Conservation Easement Database 2016). This approach has permitted the conservation of land and resources in the U.S. that may otherwise have been sold and converted to other uses.

Today, forests comprise about 33 percent of the total land area in the U.S. (Oswalt *et al.* 2014). Of the 766 million acres of forest, 58 percent (445 million acres) is privately owned. Specifically, individuals, families, Native American tribes, and other non-corporate private entities own about 298 million acres of forest in the U.S. (39 percent), while private corporate owners own about 147 million acres (19 percent) of forest lands (Hewes *et al.* 2014, Oswalt *et al*. 2014). Forty-two percent (321 million ac) of forest lands are publicly held by federal (32 percent), state (9 percent), and local (e.g., municipal, county) (1 percent) governments (idem). Forest ownership types vary considerably across the U.S., with federal and some corporate lands predominant in the West; a diversity of private and public, including the highest proportion of state and local government owners, in the upper Midwest or Lake States; and mostly private forest lands in the South and Northeast (Oswalt *et al*. 2014).

Private forest lands ownership patterns have changed in the U.S. in the past few decades, from mostly individual, family, and industrial (i.e., vertically integrated forest products companies (VIFPCs)) owners to a diverse group of private ownerships that still includes individuals, families, and industrial firms, but increasingly encompasses conservation organizations, trusts, timber investment and management organizations (TIMOs), real estate investment trusts (REITs) and others (Zhang *et al.* 2012).[2] The largest modern shift in forest lands ownership has been the rise of TIMOs and REITs, which came about as the major (previously) VIFPCs sold off their timberland due to a combination of factors, including market-driven asset liquidation, particularly during the recession in the late 2000s; lower tax rates as ascribed to TIMOs and REITs; and a growing supply of raw materials available from expanding global markets (Hickman 2007, Ince *et al.* 2007, Bliss *et al.* 2009). Virtually all of the major publicly traded forest products companies have sold most or all of their timberland or converted part of their organization to a REIT, such that none of the major VIFPCs are left intact in the U.S. today.

As of 2016, TIMOs and REITs owned about 65.8 million acres of forest lands in the U.S. (Mendell 2016). Some question the effects from the shift in forest lands ownership from VIFPCs to TIMOs and REITs, particularly in terms of the effects on forests and local communities (e.g., employment), private funding for forest research, and future forest retention. Research to date has demonstrated, for example, that the ecological disturbances associated with these newer ownership types are comparable to previously vertically integrated regimes (Noone *et al.* 2012). Also, Fernholz (2007) notes that TIMOs and REITs have increased the number and area of conservation easements used as conservation tools for these

[2] TIMOs are management companies that usually buy, hold, and manage timberland on behalf of other investors such as insurance companies, pension funds, wealthy individuals, foreign interests, or others. REITs are publicly traded forest land-owning companies (Zhang *et al*. 2012).

lands. Perhaps the greatest concern for some regarding TIMOs and REITs is whether their forest lands are more susceptible to future forest conversion given the need to produce acceptable returns on investment. While no scientific evidence to date supports or refutes this, ultimately, related decisions to develop or convert forestland under TIMO and REIT ownerships depends in large part on whether competitive economic returns are derived from well-managed, intact forests. The current favourable tax treatment of TIMOs and REITs compared to the traditional VIFPCs may help tip the scales towards acceptable returns and ultimately to forest retention.

Taxation and other economic strategies that affect SFM (Indicator 7.2.a)

Government policies and strategies on investment, taxation, and trade can impact forest use and the level of long term investment in forest production and conservation. Taxes and incentives affect SFM as a cost of doing forestry business, by favoring certain activities and sectors, and as tools to encourage forest production and conservation. Private sector economic strategies and initiatives, such as process and product certification, can influence forest-related decision-making as well. In the U.S., three certification systems actively certify forest management and product chains: the Sustainable Forestry Initiative, which is endorsed by the global Programme for the Endorsement of Forest Certification (PEFC 2014), and has certified about 62 million acres in the U.S.; the American Tree Farm System, which focuses on certification for small landowners and has certified about 22 million acres in the U.S. (PEFC 2014); and the Forest Stewardship Council (FSC 2014), which has certified about 35 million acres in the U.S. Some of this area is "dual certified" to more than one system, such that the total area equals about 119 million acres, or about 15 percent of all forests in the U.S. The total forest area certified in the U.S. includes natural, planted, and mixed forests on private and public forest lands. A larger share of the total private (about 25 percent) and non-federal public forest lands area (about 20 percent) is certified than the total public forest lands in the U.S.

A broad range of investment and taxation policies favor long-term forest resource investments, provide consistent market-based incentives and signals, and furnish some payments for the provision of environmental and nonmarket values in the U.S. These include direct conservation incentive payments through the periodic federal Farm Bill (an omnibus, multi-year law that governs an array of agricultural and food programs in the U.S.); 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; deductions for donating land or its development rights in perpetual conservation easements; and other public and private sector initiatives.

Almost all federal financial and technical assistance programs to encourage investment in natural resource management and protection stem from the Farm Bill, which has contained increasing provisions for tree planting, crop retirement, and environmental land use programs in each of its authorizations and appropriations since the 1960s. The 2014 Farm Bill authorized $56 billion over 10 years for a variety of natural resource conservation programs, but represented $6 billion in conservation spending cuts compared to the previous Farm Bill. Programs supporting forest establishment, retention, and management amounted to approximately $2 billion per year in the 2014 Farm Bill, which is about one-third of the annual conservation payments and about 5 percent of total farm payments including commodity programs and crop insurance.

Forest lands are affected by taxes at federal, state, and local levels, with the federal government levying income and estate taxes, most states levying income tax, and some levying estate or inheritance taxes. Also, state and local governments levy property taxes on forest lands (Butler *et al.* 2012). Federal income tax policies provide various operating cost and carrying charge tax deductions for forest landowners and active investors, including capital gains treatment of timber, reforestation amortization and deductions, operating expense and carrying charges deductions, and reduced tax rates for TIMOs and REITS compared to corporations (as discussed above). All states allow for the reduction or elimination of property taxes on forest land, including exemptions, rebates, yield taxes, modified assessment rates, and modified assessment property tax laws (Cubbage *et al.* 2017). Additionally, thirty-eight states have one or more preferential property tax program that require related actions or commitments by forest owners (Butler *et al.* 2012).

Market-based policy tools that address timber production, ecosystem goods and services production, and environmental protection for SFM also are widespread in the U.S. These tool include wetlands banks, cap-and-trade for carbon storage or endangered species protection, conservation easements for fixed term or permanent protection from development, and outright purchase of forest lands by government and nongovernment organizations. More than $1 billion were authorized for conservation easements in the 2014 Farm Bill (Plumer 2014). And once established, these conservation easements and similar land donations may receive federal and state income tax deductions in compensation for deeding development rights to conservation or government organizations.

Many forest landowners in the U.S. rely on economic measures to help offset the typically large up-front costs for tree planting and forest management and the long growing cycles for trees (Butler *et al.* 2012, Tenny 2014). These instruments have made measurable reductions in related taxes and offset forestry costs for participating forest landowners in most states in the U.S. Nevertheless, few programs are fully exploited by eligible land owners, diminishing their overall effect on conservation and SFM (Butler *et al.* 2010, Greene *et al.* 2013). For example, while millions of acres of forest lands are enrolled in preferential property tax programs across the U.S., this represents just a fraction of the total area eligible for benefits (Butler *et al.* 2010). Low enrollment rates in preferential tax programs and conservation incentives are attributed mostly to overly complex and/or restrictive requirements and to insufficient and ineffective program dissemination and education that leads to a general lack of landowner awareness or confusion (idem).

Enforcement of laws related to forests (Indicator 7.3.b)
Uptake of forest laws and regulations may be promoted through voluntary persuasive means, such as fiscal incentives and technical assistance. However, full compliance with the formal law of the land often also requires some form of enforcement, such as oversight and monitoring of conformity with the law and prosecution and penalization for noncompliance. These approaches may be necessary to deter harmful activities that threaten forests and their sustainable management (Montréal Process 2014), which also may be deterred by local participation in the development and oversight of rules and accepted practices (Ostrom Ostrom 1990, Chatre and Agrawal 2008).

Laws and other policy directives requiring enforcement actions relevant to forests are common in the U.S. They are present at national and subnational levels and address environmental conditions (e.g., air, water, hazardous waste), wildlife and fisheries (e.g., harvest limits, species preservation, subsistence hunting), timber resources and extraction (e.g., harvest limits, road construction, health and safety) and special features protection (e.g., sensitive or fragile areas, archeological sites), among many others. Traditionally, forest laws and regulations have been developed from the top-down and typically were enforced by the corresponding oversight agency in the U.S. More recently, local efforts to agree on, monitor, and even enforce, in some cases, forest-related rules are emerging from the bottom-up, often emerging out of community forestry and conservation efforts (e.g., Baker and Kusel 2003, Cheng *et al.* 2011). For example, collaboratively designed and implemented multiparty monitoring is a required facet of the Collaborative Forest Landscape Restoration Program (CFLRP) as authorized by the 2009 Forest Landscape Restoration Act, which focuses on and funds collaboratively designed restoration projects on National Forests. Other types of local monitoring and oversight of forests exist, but related data is dispersed or difficult to assemble.

Federal agencies with forest management and protection mandates in the U.S. have substantial authority and institutional capacity to enforce forest-related laws, regulations, and guidelines. These include the Bureau of Land Management (BLM), the National Park Service (NPS), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Forest Service (USFS), which together oversee more than 672 million acres of land. In fiscal year 2010, these four agencies employed more than 4,000 law enforcement personnel and invested more than $470 million in their law enforcement programs (Table 5). While federal-level forest and natural resource law enforcement budgets and personnel are significant, extensive federal land holdings mean the land area ratio to law enforcement officer can be very high, augmenting the challenges in detecting and investigating forest offenses and crimes. For example, the total land area overseen by the BLM averaged more than 800,000 acres per law enforcement officer in FY 2012 (BLM 2013). In some locations, such as Alaska, an individual officer's area of responsibility can exceed 25 million acres (idem). The total land area overseen by the USFS averaged about 250,000 acres per officer in FY 2010.

Reflecting their multiple-use missions, federal land management agency law enforcement programs address a range of violations and incidents 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 (USFS 2014). In the USFS National Forest System, for example, most forest-related violations and incidents are 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; about 42 percent of all forest-related violations in FY 2013), illegal/unauthorized use of or activity with off-highway vehicles (23 percent), and arson and human-caused fires (14 percent). Conversely, timber theft and trespass on national forests is a fairly small portion of total violations (< 10 percent) and represents a very small fraction of the total volume of timber authorized and harvested from national forests (< 0.1 percent) (USFS 2014).

At the state level, nearly all states have forest and/or 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. All states also provide guidelines on forestry best management practices (BMPs) designed to protect water and soil quality and quantity as required by the CWA. These BMPs are a key component of

TABLE 5 *Land area, number of units, number of visitors, enforcement personnel, and enforcement budget for key Federal land management agencies in the US, 2010*

Agency	Total Land Area (million ac)	Management Units (number)	Law Enforcement	
			Personnel (number)	Budget (million $)
USDI BLM	245	417	303	$28.5
USDI NPS[1]	84	401	3,097	$232.7
USDI FWS	150	561	326	$65.8
USDA FS	193	175	766	$145.1

[1] 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 LE budget is directed toward resource protection against vandalism and for archaeological safeguards. Total wilderness area of the NPS is about 44 million acres.

forest oversight and protection at the state level, whether implemented through regulatory, voluntary, or mixed policy approaches, which vary by state. Regional and national data demonstrate generally high and increasing levels of BMP implementation across the U.S. (Ice *et al.* 2010). In 2013, the average implementation rate of forestry BMPs nationwide was estimated at 91 percent, though BMPs differ significantly across states and forest types (NASF 2015). While compliance with BMPs and related forest regulations does seem to require some level of oversight, enforcement, and penalties for noncompliance, evidence also indicates that uptake and compliance are enhanced through education and outreach, technical assistance, and fiscal incentives (Ice *et al.* 2010, NASF 2015). State forest agencies, as well as federal agencies with forest mandates, also rely on partnerships and other collaborative arrangements to encourage sound forest use and law compliance, as discussed further in related indicators below.

Public participation and conflict resolution in forest-related decision making (Indicator 7.5.b)

The ability of people to participate in the decisions that affect their lives, for example through involvement in the development and implementation of public policies and programs, is a central tenet of democratic governance (Fiorino 1990). People participate in public decision-making in a variety of ways, including voting, protesting, testifying in court, and participating directly in collaborative decision-making. Processes that promote public participation in forest-related decision making can foster practical and political support for SFM and deter activities that may harm forests and the communities that depend on them. Open and transparent processes for conflict resolution also are important, as they can lead to decisions that are widely accepted and reduce the propensity for litigation (Beierle and Cayford 2002).

Forest-related decision-making in the U.S., at least involving public lands, increasingly incorporates collaborative processes involving place-based networks of stakeholders using participatory approaches to identify policies and programs that meet shared goals (Hibbard and Ellefson 2005, Cheng 2006, Rose *et al.* 2012). Administrative, environmental, and forest-specific legislation requiring public participation activities around forests and other natural resources has developed over the past 70 years or so. The Administrative Procedures Act (APA) of 1946 was the first law to require federal agencies to keep the public informed of their organization, procedures, and rules, as well as provide for public participation in the rulemaking process. Other administrative laws and policies have opened up the policy process further to the public, including the Freedom of Information Act of 1966, the Federal Advisory Committee Act of 1972, the Negotiated Rulemaking Act of 1990, among others. Since their establishment, the APA and other administrative policies and state-level equivalents have substantially influenced public policy, requiring increased openness and public access to the regulatory aspects of the American governmental process (Nylander 2006).

Direct access to environmental policy and decision making in the U.S. government first was granted through the National Environmental Policy Act (NEPA) in 1969. Since the enactment of NEPA in 1969 virtually every important piece of environmental legislation at national and subnational levels in the U.S. has incorporated requirements for public participation (Creighton 2005). For example, the CWA and the CAA 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 and/or the environment. Other forest-related legislation incorporating public participation requirements include the National Forest Management Act of 1976, the Healthy Forests Restoration Act of 2003 and the Collaborative Forest Landscape Restoration Program (CFLRP) established in the Omnibus Public Lands Act of 2009. As observed by Bixler (2014), "the CFLRP 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."

Despite a growing mandate for stakeholder involvement in public decision making, in general, and specifically as it pertains to natural resources and public land management, some places and issues still generate conflicting interests and policy and program impasses that routinely result in protest and ultimately may end up in court. Litigation has had a prominent role in public land decision-making over the past several decades, particularly for forests. For example, from 2001 to 2010, about one of every three environmental impact statements (EISs) prepared by the Bureau of Land Management and the US Forest Service were challenged in court and about one in 10 of these EISs received a court ordered injunction or remand, often delaying or even changing the tone or direction of management decisions (CEQ 2016).

The rapid rise of conflicts relating to the environment, natural resources, and public lands in the U.S. in the 1970s and 1980s led to increasing demands from public and private actors for new and better ways to reduce and resolve conflicts (Gray 1989). At the federal level, Congress responded with the passage of the Environmental Policy and Conflict Resolution Act of 1988 to promote more effective conflict management and resolution in federal decision making. Today, multiple authorities and guidance address the prevention and resolution of forest-related and other environmental conflicts around federal lands and decision making. Collectively, they demonstrate a gradual shift from a focus on *ex post* conflict resolution to a focus on conflict prevention and collaboration *a priori* (McGinley 2017). Nevertheless, while federal and some state and local government agencies have increased their use of environmental collaboration and conflict resolution, controversies over public forest lands certainly persist in the U.S. and continue to be taken up in the courts. Moreover, formal collaboration among private land managers remains rare.

Partnerships to support the sustainable management of forests (Indicator 7.5.a)

Partnerships supporting SFM 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 can be critical factors in building capacity; leveraging financial, technical, and human resources; strengthening political commitment; developing public support; and enhancing forest sustainability.

There is a long history of forest-focused partnerships among public entities, local communities, civil society, and private-sector organizations in the U.S. These partnerships have focused on the pursuit of shared environmental, economic, and/or social objectives associated with forests. While forest-related partnerships predate the early 1900s, they increased significantly with the rise in 'grassroots environmental movements' towards the end of the 20th century (Weber 1998, McCreary *et al.* 2012). Federal agencies, like the USFS and the BLM, have long engaged in partnerships to advance their missions and goals, but have "expanded in their inclusiveness, scope, and impact across organizational sectors (e.g., public, nonprofit, commercial) and scales of governance" over time (Mowen *et al.* 2006). The rise in partnerships promoted by the federal government has been concomitant with increasing efforts to enhance community participation in governmental decision-making, but also reflects stagnant or in some cases declining budgets and efforts to 'do more with less' (Parkins and Mitchell 2005, Seekamp and Cerveny 2010).

State and local forest and land management agencies also rely on partnerships to accomplish forest-related goals. In particular, state forest agencies receive financial and technical support from federal partners and are responsible for administering key federal program funds to assist private landowners in managing their forested lands and protecting those lands from insects, fire, disease and other issues. Local communities, civil society, and private sector organizations also drive the development of forest-related partnerships. For instance, water utilities, local communities, and local governments increasingly engage in partnerships and other collaborative relationships to promote the protection of and improvements in forest and watershed conditions with mutual benefits for all partners (Barten and Ernst 2004, U.S. Endowment for Forestry Communities and Sustainable Forestry Initiative 2013). Additionally, international partnerships, for example between the U.S. government and other countries, are formed to support forest sustainability through binding and non-binding agreements and other types of arrangements. Overall, partnerships centered on forests and the people and systems that depend on them are a prominent institutional factor in the U.S.

Cross-sectoral policy and program coordination (Indicator 7.1.b)

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. Policies and programs with coordinated aims, strategies, and instruments across multiple sectors can produce comprehensive solutions to the complex problems threatening forests and their sustainability (Dube and Schmithusen 2003, Tikkanen *et al.* 2002, Shannon and Schmidt 2002). Although forest issues traditionally have been dealt with in a relatively autonomous policy sector in the U.S. (e.g., federal and state level forestry agencies), 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 spanning multiple ownerships or management authorities.

The Federal Government generally encourages, and in some cases, requires the development of multi- and cross-sector plans to address the intersecting effects between forests and water, air, wildlife, and other resources. For example, the Cooperative Forestry Assistance Act of 1978 directs State forestry agencies to develop plans that focus on statewide forest resource conditions and trends within the context of the broader environmental, social, and economic system as part of federal financial assistance requirements. More recently, the 2008 Farm Bill required states and territories to develop Forest Action Plans that assess forest conditions and trends on public and private lands and that provide strategies to address forest threats and improve forest health across all land ownerships and policy sectors as part of eligibility requirements for related program funding.

The public sector, private sector, and civil society also have begun to work more and more across traditional silos to address critical areas, like climate change science, mitigation, and adaptation (e.g., U.S. Global Change Research Program, USDA Climate Hubs); landscape science and conservation (e.g., NPS Cooperative Ecosystem Studies Units, USFWS Landscape Conservation Cooperatives, NOAA Regional Integrated Sciences and Assessments); and water conservation and watershed protection (e.g., Integrated Water Resources Sciences and Services Consortium, Urban Waters Federal Partnership, EPA Healthy Watersheds Initiative). Nevertheless, forests continue to be affected by forces beyond the forest sector. For example, total forest cover in the U.S. has remained fairly stable at the national level for more than a decade, but forest losses to urban sprawl and development do throughout the country and especially in the coastal regions of the East and West persist. Thus far, these losses have been offset at the national level by forest expansion in the nation's interior, mostly on abandoned agricultural lands, but may level off or tip the scales toward overall forest loss in the not too distant future (USFS 2011). In some places, land use change may well be in the common interest of local communities and other stakeholders, but where forest loss is not well accepted or driven by extra-sectoral pressures, cross-sectoral coordination and communication may be absent or deficient.

Programs, services, and other resources supporting the sustainable management of forests (Indicator 7.4.a)

The sustainable management of forests is supported in part by well-equipped and trained people and sound and stable public

and private institutions. Human capital, including professionals, scientists, educators, and extension workers, in government, academia, nongovernment organizations, and the private sector with knowledge in the natural and social sciences is important to SFM. Other important resources include formal education and training programs as well as physical infrastructure for accessing forests and transporting forest goods (e.g., buildings, roads, utilities).

Forestry training and education has a long history in the U.S. Today, most college- level forestry education is conducted by land grant universities, private universities, and community colleges. As of 2014, 45 universities in the U.S. had Bachelor of Science or Master of Science forestry degree programs accredited by the Society of American Foresters (SAF) (SAF 2014a, 2014b). Most of the SAF accredited institutions also provide continuing professional education for foresters, and offer programs for forest landowners, other professionals, and the public. The 67 member institutions that form part of the National Association of University Forest Resources Programs (NAUFRP), which include the 45 SAF accredited programs, enrolled about 25,000 students in their natural resources programs in 2012, including about 4,500 forestry and wood science/products students (Sharik *et al.* 2015). While current enrollments are similar to those in the early 1980s, there have been recent declines in natural resources enrollments despite substantial increases in total enrollments across most other disciplines during the same time period (1980–2009) (Sharik *et al.* 2015). Nevertheless, availability of and enrollments in non-accredited broader environmental studies degrees (e.g., less science- or management-focused) have increased significantly across the U.S. since the 1980s (idem). Overall, these changes in education opportunities and enrollments affect the current and future human and institutional capacity to address forest sustainability in the U.S. and likely reflect broader market conditions and sectoral developments.

In terms of forest-related employment, the USFS is the biggest forest-based employer in the U.S., with approximately 29,500 permanent employees and more than 15,000 temporary/seasonal employees in fiscal year 2014. Employment in the USFS has declined about 20 percent in terms of full time equivalent employees in the last decade or so (USFS 2015). At the state level, forest agencies employed 25,830 persons in FY2015, including 7,756 foresters. This was a slight increase over FY2014 and FY2013, but numbers were down from the most recent peak in employment in FY2008 of 26,797 employees (NASF 2015). Universities also employ forestry affiliated personnel as faculty, staff, and cooperative extension program personnel, including about 1,200 forest-related professors in 2016 (USFS forthcoming). Additionally, the private sector employs numerous forest-related professionals in the U.S., though these numbers are more difficult to come by.

Infrastructure available to and supporting the forest sector in the U.S. is vast and varies by subsector and region, making it difficult to summarize succinctly. For example, federal and state governments own public lands, develop and maintain infrastructure, teach, and perform research. The USFS alone maintains 14,077 recreation sites, 42,085 buildings, 143,346 miles of trails, and 374,883 miles of roads across 193 million acres of national forests and grasslands (USFS 2009). However, due to more frequent and larger forest fires occurring throughout the country, the agency's firefighting budget now exceeds that for national forest and grassland management. States and private sector firms and forest owners also develop and maintain infrastructure for forest management, particularly where forest lands are extensive and productive. Similar to the USFS, many state forestry budgets also are increasingly dominated by firefighting costs, which certainly enhances forest fire fighting capacity, but often negatively affects funding for other maintenance and ongoing operations.

Development and application of research and technologies for the sustainable management of forests (Indicator 7.4.b)
Research and development provide a scientific basis for SFM. In the U.S., forest-related research and development is promulgated and authorized by government programs and laws at national and subnational levels in the U.S. Various laws and regulations at national and subnational levels provide for the funding, collection, analysis, and release of data related to forests. For example, the Morrill Act of 1863 established state and federal land grant colleges to promote the development of applied agriculture education, including forestry. Since 1962, McIntire-Stennis Act funds have been made available to forestry schools and programs at these land grant universities, as well as state agricultural experimental stations for forestry research and graduate education. These funds totalled nearly $44 million in FY2016. Another example of federally mandated and funded research comes through the federal Renewable Resources Planning Act of 1974, which requires monitoring, evaluation, and reporting on the status of and trends in U.S. forest conditions on public and private lands. Civil society and private industry also promote and participate in research and development to improve scientific understanding of forest ecosystem characteristics and functions, as well as social and economic processes, though associated data are not readily available.

In terms of forest research capacity, the USFS is the largest forest research organization in the country, with 58 laboratories and research locations, as well as 73 experimental forests and rangelands. Its appropriated budget for forest and rangeland research was $293 million in fiscal year 2014, increasing nominally from fiscal year 2002 ($241 million), but demonstrating about a nine percent decrease in real terms from the 2002 research appropriation when adjusted for inflation. Other federal agencies such as the National Aeronautics and Space Administration, the National Science Foundation, the Department of Energy, and the Department of Interior also conduct research related to forests, with several multi-million dollar initiatives related to climate change, bioenergy, genomics, and other disciplines. Many forestry schools and departments conduct significant forest research and own experimental or research forests. Private sector forest industry conducts some research and development, though far less than historical investments, for example that which was conducted by the VIFPCs. Finally, civil society forest-oriented and conservation organizations design and carry out related research and development.

Monitoring, assessment and reporting on progress towards the sustainable management of forests (Indicator 7.5.c)
Forest-related decision-making benefits from open and transparent monitoring, assessment and reporting that provide up-to-date and reliable information, activities that also are important in generating public and political awareness of issues affecting forests, and in the development of policies to underpin the sustainable management of forests. Public discussion and decisions related to natural resource sustainability issues also benefit from comprehensive, current, and sound data.

Various laws and regulations govern data collection, analysis, and release in the U.S. at different scales. For example, the federal Renewable Resource Planning Act mandates data collection and analysis to monitor the trends in forest conditions in the U.S. The federal Forest Inventory and Analysis (FIA) program measures and monitors the status and trends in forest area, composition, health, disturbance, production, harvest, utilization, and ownership, among other information, through a continuous forest sampling framework that produces data annually. The National Resource Lands Inventory provides data on land use and change for all lands in the U.S. The Foreign Agriculture Service tracks forest commodities and trade data. The U.S. Census and the Department of Commerce provide important information on socioeconomic dynamics directly and indirectly related to forests. Numerous other programs and initiatives provide forest-related information at national and subnational levels through ongoing reporting efforts and single 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 contribute to such efforts through voluntary assessments and reporting, often in cooperation with federal, state, and university partners. With so many efforts to monitor, assess, and report on forests and related systems, many important aspects of forests are studied and monitored at multiple scales in the U.S. Yet, this leads to some overlaps in data collection, assessment, and reporting, and there are information gaps and shortfalls as well, which persist mostly around some socioeconomic and cultural forest factors, and at local scales of measurement (USFS 2011).

CONCLUSIONS AND APPLICATIONS

Summary Findings from the MP C7 for the U.S.
Montréal Process C7 focuses on the legal, institutional, and economic framework for forest conservation and sustainable development. In the U.S., there is an expansive body of law governing public lands, which comprise about one-third of the nation's forests. These laws dictate management processes and practices and public involvement in various detailed approaches. Federal and state laws protect wildlife and endangered species on all lands – public and private, 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 rarely 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 advance SFM across the country and demonstrate, in part, a movement from forest government towards forest governance.

Local communities, the private sector, civil society, and governmental actors support SFM through a range of practices and partnerships. Cross-sectoral policies and programs that link related policy networks, purposes, and desired outcomes have expanded, particularly in terms of those that address cross-boundary issues, such as climate change, land use, and water conservation. Nevertheless, governance challenges remain in addressing issues that cross ecological, social, political, legal, and other boundaries, particularly where decision-making is centralized and where there is a lack of horizontal and vertical coordination or participation. Additionally, forests and forestry continue to be threatened by competitive land uses, particularly in places where incentives for SFM are low and pressures for development and agriculture are high. Determining when and where forests and forestry should be prioritized over other land uses and sectors is generally facilitated by open, transparent, participatory, and equitable decision-making processes, of which there are increasing examples at multiple scales in the U.S. However, conflicts over forests and their use persist, and where they are irresolvable or entrenched, the associated decision-making processes likely lack at least some if not all of these characteristics of 'good governance'.

Applications and Limitations
Using the MP C7 indicators and guidelines for their application (Montréal Process 2014), we were able to identify quantitative and qualitative metrics on key factors of forest governance and collect a considerable amount of related data at multiple scales in the U.S. Analysing and summarizing these voluminous and frequently disparate data in meaningful ways for decision-makers and other stakeholders, and indeed for a paper such as this, continues to be challenging. However, evaluations of the legal, institutional, and economic framework for forest conservation and sustainable management in the U.S. are now significantly improved by the recently revised MP C7 indicators. These 10 indicators are considerably more germane, concise, streamlined, and measurable than the original 20 indicators and provide a clear structure for collecting, interpreting, and communicating information important for understanding key aspects of forest governance.

Collectively, the MP C7 indicators align fairly closely with other intergovernmental and multilateral frameworks for examining forest governance at national and sub-national scales (e.g., PROFOR-FAO 2011), but do not directly provide for a normative evaluation of forest governance *per se*. As designed, these indicators produce positive, or objective, information intended to inform dialogue and decisions, but

stop short of establishing performance standards that can be used to determine the overall efficacy or adequacy of forest governance. In fact, the MPC&I framework as a whole is intended to be positive rather than normative, providing a hierarchical structure that can be used to produce a holistic account of forests by which society can make value judgements on forest sustainability and measure its progress toward related goals (USFS 2011).

The impact of the MP to date remains limited to scientific measurement, tracking, and reporting on forest conditions and trends, as opposed to setting policy or enforcing any multilateral hegemony on forest retention, management, or governance. Even in the U.S., the distinction between measuring and reporting on forest area, productivity, health, laws, and other C&I, versus setting related policies is clearly delineated. Member country sovereignty and differences in forest baselines, conditions, and trends likely precludes the MP and similar intergovernmental initiatives from arriving at normative benchmarks of forest sustainability, in general, and of good forest governance, in particular, that fit across all parties. Nevertheless, such benchmarks are important to determining the attainment of societal goals and adapting practices and policies when undesired or unexpected trends in forests and their governance are detected.

The MPC&I framework has been useful in identifying and understanding shifts and changes in ecological, economic, and social forest conditions in the U.S. (USFS 2004, 2011, forthcoming). Although some trends in forest laws, institutions, and economic measures in the U.S. are detectable across reporting cycles (USFS 2004, 2001, forthcoming), the recent revisions to MP C7 provide the first parsimonious lens for examining key aspects of forest governance within the MPC&I framework. Future U.S. measurements of the MP C7 indicators and comparisons with the results presented here are expected to shed light on trends in forest-related legislation, incentives, land tenure, collaboration, conflict resolution, monitoring, enforcement, and other key governance factors at national and subnational scales. Although judging the adequacy of forest governance at national and subnational scales may fall outside the scope of the MP and related reporting efforts by the U.S., there is significant potential for linking related assessment results to accepted standards of good forest governance (e.g., Davis *et al.* 2014) or empirically-established principles of enduring governance regimes (Ostrom 1990, 2010). Future research and assessment efforts should build from the results presented here and explore further the effects of and trends in forest governance in the U.S.

ACKNOWLEDGEMENTS

This research was funded by the USDA Forest Service. We thank Ariel Lugo, Frank Wadsworth, Guy Robertson and three anonymous reviewers for their valuable comments on earlier versions of the manuscript.

REFERENCES

AGRAWAL, A., CHHATRE, A. and HARDIN, R. 2008. Changing governance of the world's forests. *Science* **320**(5882): 1460–1462.

ALIG, R.J., PLANTINGA, A.J., AHN, S. and KLINE, J.D. 2003. Land use changes involving forestry in the United States: 1952 to 1997, with projections to 2050—a technical document supporting the 2000 USDA Forest Service RPA assessment. Gen. Tech. Rep. PNW-GTR-587. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 92 p.

ARTS, B. and BUIZER, M. 2009. Forests, discourses, institutions: A discursive-institutional analysis of global forest governance. *Forest Policy and Economics* **11**(5–6): 340–347.

ARTS, B., APPELSTRAND, M., KLEINSCHMIT, D., PÜLZL, H., VISSEREN-HAMAKERS, I., EBA'A ATYI, R., ENTERS, T., McGINLEY, K. and YASMI, Y. 2010. Discourses, actors and instruments in inter-national forest governance. In: RAYNOR, J., BUCK, A., and KATILA, P. (ed.s) *Embracing complexity: meeting the challenges of international forest governance.* IUFRO, Vienna, Austria. p. 57–73.

BAKER, M. and KUSEL, J. 2003. *Community Forestry in the United States*. Island Press, Washington, D.C. 264 p.

BARBIER, E.B., BURGESS, J.C. and MARKANDYA, A. 1991. The economics of tropical deforestation. *Ambio* **20**(2): 55–58.

BARTEN, P.K., and ERNST, C.E. 2004. Land conservation and watershed management for source protection. *Journal of American Water Works Association* **96**(4): 121–135.

BEIERLE, T.C. and CAYFORD, J. 2002. *Democracy in practice: public participation in environmental decisions.* Resources for the Future, Washington, DC. 160 p.

BIXLER, R.P. 2014. Preparing for the mid-term: nearing five years of the Collaborative Forest Landscape Restoration Program. Pinchot Institute for Conservation, Washington, DC. www.pinchot.org/doc/493

BLISS, J.C., KELLY, C., ABRAMS, J., BAILEY, C. and DYER, J. 2009. Disintegration of the U.S. industrial forest estate: Dynamcis, trajectories, and questions. *Small Scale Forestry* **9**(1): 53–66.

BUREAU OF LAND MANAGEMENT (BLM). 2013. *Law Enforcement Year End Review 2012*. BLM Law Enforcement Office, Boise, ID. BLM/WO/GI-13/004+9260

BUTLER, B.J. 2008. *Family forest owners of the United States, 2006.* Gen. Tech. Rep. NRS-27. U.S. Department of Agriculture, Forest Service, Northern Research Station, Newtown Square, PA. 73 p.

BUTLER, B.J., HEWES, J.H., CARTANZARO, P.F., GREENE, J.L., KILGORE, M.A., KITTREDGE, D.B., LANGER, J., MA, Z., REUBEN, A. and TYRELL, M.L. 2010. *Effects of federal, state, and local tax policies on family forest owners*. FFRC Research Paper 2010-01. Technical Report, USDA Forest Service/University of Massachusetts Amherst, Family Forest Research Center, Amherst, MA. 76 p. www.familyforestresearchcenter.org/projects/taxes.html.

BUTLER, B.J., CARTANZARO, P.F., GREENE, J.L., HEWES, J.H., KILGORE, M.A., KITTREDGE, D.B., MA, Z. and TYRELL, M.L. 2012. Taxing family forest owners: Implications of federal and state policies in the United States. *Journal of Forestry* **110**(7): 371–380.

CASTAÑEDA, F. 2000. Criteria and indicators for sustainable forest management: international processes, current status and the way ahead. *Unasylva* **203**(51): 34–40.

CHATRE, A. and AGRAWAL, A. 2008. Forest commons and local enforcement. *Proceedings of the National Academy of Sciences of the United States of America* **105**(36): 13286–13291.

CHENG, A.S. 2006. Build it and they will come? Mandating collaboration in public lands management and planning. *Natural Resources Journal* **46**(3): 841–858.

CHENG, A.S., DANKS, C., and ALLRED, S.R. 2011. The role of social and policy learning in changing forest governance: An examination of community-based forestry initiatives in the U.S. *Forest Policy and Economics* **13**(2): 89–96.

CONTRERAS-HERMOSILLA, A. 2002. *Law compliance in the forestry sector: An overview.* World Bank, Washington, DC. 48 p.

COUNCIL ON ENVIRONMENTAL QUALITY. 2016. Environmental Impact State Filings. ceq.doe.gov/current_developments/eis_filings.html

CREIGHTON, J.L. 2005. *The public participation handbook: making better decisions through citizen involvement.* San Francisco: Jossey-Bass. 288 p.

CUBBAGE, F.W., O'LAUGHLIN, J. and PETERSON, M.N. 2017. *Natural Resource Policy.* Waveland Press Inc., Long Grove, IL. 505 p.

DAVIS, C., WILLIAMS, L., LUPBERGER, S. and DAVIET, F. 2013. *Assessing Forest Governance: The Governance of Forest Initiative Indicator Framework.* WRI, Washington, D.C. http://www.wri.org/publication/assessing-forest-governance.

DEACON, R.T. 1999. Deforestation and ownership: evidence from historical accounts and contemporary data. *Land Economics* **75**(3): 341–359.

DUBE, Y.C. and SCHMITHUSEN, F. (Eds.) 2003. *Cross-sectoral Policy Developments in Forestry*. FAO and CAB International, Rome, Italy. 264 p.

ELLEFSON, P.V. and HIBBARD, C.M. 2005. Forest planning, assessment, and policy review (Indicator 49). In: ELLEFSON, P.V., HIBBARD, C.M., KILGORE, M.A. and GRANSKOG, J.E. (eds.) *Legal, Institutional, and Economic Indicators of Forest Conservation and Sustainable Forest Management: Review of Information Available for the United States.* Gen. Tech. Rep. SRS-82. U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC. p. 24–43.

ELLEFSON, P.V., HIBBARD, C.M., KILGORE, M.A. and GRANSKOG, J.E. 2005. *Legal, institutional, and economic indicators of forest conservation and sustainable forest management: review of information available for the United States.* Gen. Tech. Rep. SRS-GTR-82. U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC. 221 p.

FERNHOLZ, K. 2007. TIMOs and REITs: what, why, and how they might impact sustainable forestry. 7 January 2017. http://www.dovetailinc.org/files/DovetailTIMOREIT0507wo.pdf, 3 July 2011.

FIORINO, D.J. 1990. Citizen participation and environmental risk: a survey of institutional mechanisms. *Science, Technology and Human Values* **15**(2): 226–243.

FOREST STEWARDSHIP COUNCIL (FSC). 2014. Global FSC certificates: type and distribution. 23 June 2014. https://ic.fsc.org/facts-figures.19.htm.

FREYFOGLE, E.T. 2001. Regulatory takings, methodically. *Environmental law reporter* **3**(31): 10,313.

GRAINGER, A. 2012. Forest sustainability indicator systems as procedural policy tolls in global environmental governance. *Global Environmental Change* **22**: 147–160.

GRAY, B. 1989. Collaborating: finding common ground for multiparty problems. Jossey-Bass, San Francisco, CA. 329 p.

GREENE, J.L., STRAKA, T.J. and CUSHING, T.L. 2013. Effects of taxes and financial incentives on family-owned forest land. In: WEAR, D.N., GREIS, J.G. (eds.) *The Southern Forest Futures Project: Technical Report.* SRS-GTR-178. USDA Forest Service, Southern Research Station, Asheville, NC. p. 261–292.

HEWES, J.H., BUTLER, B.J., LIKNES, G.C., NELSON, M.D. and SNYDER, S.M. 2014. Public and private foerst ownership in the coterminous United States: distribution of six ownership types. Forest Collins, CO: Forest Service Research Data Archive. http://www.fs.usda.gov/rds/archive/Product/RDS-2014-0002

HIBBARD, C.M. and ELLEFSON, P.V. 2005. Public participation and access to information (Indicator 50). In: ELLEFSON, P.V., HIBBARD, C.M., KILGORE, M.A. and GRANSKOG, J.E. 2005. *Legal, Institutional, and Economic Indicators of Forest Conservation and Sustainable Forest Management: Review of Information Available for the United States.* Gen. Tech. Rep. SRS-82. U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC. p. 44–57.

HICKMAN, C. 2007. *Property taxes and the loss of private forests.* Policy Analysis. USDA Forest Service, Washington, D.C. 18 p. www.timbertax.org/search/?cx=014632434319441917674%3Aueyioad7fvs&cof=FORID%3A10&ie=UTF-8&q=Hickman&sa=Search. 29 May 2014.

INCE, P., SCHULER, A., SPELTER, H., and W. LUPPOLD. 2007. *Globalization and structural change in the US forest sector: an evolving context for sustainable forest management.* General Technical Repoort FPL-GTR-170. USFS, Forest Products Laboratory, Madison, WI. 62 p.

KANT, S. 2000. A dynamic approach to forest regimes in developing economies. *Ecological Economics* **32**: 287–300.

KISHOR, N. and ROSENBAUM, K. 2012. Assessing and Monitoring Forest Governance: A user's guide to a diagnostic tool. Program on Forests (PROFOR), World Bank, Washington DC. 124 p.

KOOIMAN, J. 2003. *Governing as Governance*. Sage Publications Lmtd., London. 264 p.

LARSON, A.M., CRONKLETON, P., BARRY, D. and PACHECO, P. 2008. *Tenure Rights and Beyond: Community Access to Forest Resources in Latin America.* CIFOR Occasional Paper No. 50. Centre for International Forestry Research, Bogor, Indonesia. 92 p.

MA, Z., BECKER, D.R. and KILGORE, M.A. 2009a. Characterizing the landscape of state environmental review policies and procedures in the United States: a national assessment. *Journal of Environmental Planning and Management* **52**(8):1035–1051.

MA, Z., BECKER, D.R. and KILGORE, M.A. 2009b. Assessing cumulative impacts within state environmental review frameworks in the United States. *Environmental Impact Assessment Review* **29**(6): 390–398.

McCREARY, A., SEEKAMP, E., CERVENY, L.K. and CARVER, A.D. 2012. Natural resource agencies and their motivations to partner: the public lands partnership model. *Leisure Sciences* **34**(5): 470–489.

McDONALD, G.T. and LANE, M.B. 2004. Converging global indicators for sustainable forest management. *Forest Policy and Economics* **6**: 63–70.

McGINLEY, K. 2017. Natural resource participation, collaboration, and partnerships. In: CUBBAGE, FREDERICK, O'LAUGHLIN, J. and PETERSON, N. (eds.) *Natural Resource Policy*. Waveland Press, Long Grove, Illinois. pp. 461–486.

MEFFE, G., NIELSEN, L., KNIGHT, R.L. and SCHENBORN, D. 2002. *Ecosystem Management: Adaptive, Community-Based Conservation.* Island Press, Washington, DC. 336 p.

MONTRÉAL PROCESS. 2014. Technical notes on implementation of the Montréal Process criteria and indicators for the conservation and sustainable management of temperate and boreal forests. Criteria 1-7. Third edition June 2009 - Revised July 2014. 101 p.

MOWEN, A.J. and KERSTETTER, D.L. 2006. Introductory comments to the special issue on partnerships: Partnership advances and challenges facing the park and recreation profession. *Journal of Park and Recreation Administration* **24**(1): 1–6.

NATIONAL ASSOCIATION OF STATE FORESTERS (NASF). 2012. State Foresters by the Numbers: Data analysis from the 2010 NASF state forestry statistics survey. NASF, Washington, D.C. 25 p. www.stateforesters.org/sites/default/files/publication-documents/State%20Foresters%20by%20the%20Numbers%20Final.pdf.

NASF. 2015. State Foresters by the numbers. Data and analysis from the 2014 NASF state forestry statistics survey. NASF, Washington, D.C. 32 p. http://www.stateforesters.org/sites/default/files/publication-documents/2014%20State%20Foresters%20by%20the%20Numbers%20FINAL.pdf

NATIONAL CONSERVATION EASEMENT DATABASE. 2016. 19 November 2016. http://conservationeasement.us/

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA). 2015. National Environmental Policy Act environmental impact states (EIS) filings. https://ceq.doe.gov/current_developments/eis_filings.html

NOONE, M., SADER, S.A., and K.R. LEGAARD. 2012. Are forest disturbance rates and composition influenced by changing ownerships, conservation easements, and land certification? *Forest Science* **58**(2): 119–129.

NYLANDER, J. 2006. The Administrative Procedure Act. A Public Policy Perspective. Michigan Bar Journal. November 2006. www.michbar.org/journal/pdf/pdf4article1078.pdf

OSTROM, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action.*Cambridge Univeristy Press, New York.

OSTROM, E. 2010. Beyond Markets and States: Polycentric Governance of Complex Economic Systems. *American Economic Review* **100**: 641–672.

PARKINS, J.R. and MITCHELL, R.E. 2005. Public participation as public debate: a deliberative turn in natural resource management. *Society and Natural Resources* **18**(6): 529–540.

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION SYSTEMS (PEFC). 2014. Programme for Endorsement of Forest Certification Systems. Statistical Figures on PEFC Forest Certification. 23 June 2014 http://pefcregs.info/statistics.asp.

PLUMER, B. 2014. The $956 billion farm bill, in one graph. Washington Post Wonkblog. www.washingtonpost.com/blogs/wonkblog/wp/2014/01/28/the-950-billion-farm-bill-in-one-chart/.

POORE, D. 2003. *Changing Landscapes: the Development of the International Tropical Timber Organization and Its Influence on Tropical Forest Management*. Earthscan Publications, London. 312 p.

PROGRAM ON FORESTS and FOOD AND AGRICULTURE ORGANIZATION (PROFOR-FAO). 2011. *Framework for Assessing and Monitoring Forest Governance*. FAO, Rome, Italy. 36 p.

ROBINSON, B.E., HOLLAND, M.E., and NAUGHTON-TREVES, L. 2014. Does secure land tenure save forests? A meta-analysis of the relationship between land tenure and tropical deforestation. *Global Environmental Change* **29**: 281–293.

ROSE, G.A., MACCLEERY, D.W., LORENSEN, T.L., LETTMAN, G., ZUMETA, M.C., BOYCE, T.C., and SPRINGER, B. 2005.Forest Resources Decision-Making in the US. In: COLFER, C.J.P. and CAPISTRANO, D. (eds.) *The politics of decentralization: forests, power and people.* CIFOR/Earthscan, London, UK p. 238–252.

SEEKAMP, E. and CERVENY, L.K. 2010. Examining USDA Forest Service recreational partnerships: institutional and relational interactions. *Journal of Park Recreation Administration* **28**(4): 1–20.

SHANNON, M.A. and SCHMIDT, C.H. 2002. Theoreical approaches to understanding intersectorial policy integration. In: TIKKANEN, I., GLUCK, P. and PAJUOJA, H. (eds.) *Cross-Sectoral Policy Impacts on Forests.* EFI Proceedings No. 46. European Forest Institute, Joensuu, Finland. p. 15–26.

SHARIK, T.L., LILIEHOLM, R.J., LINDQUIST, W. and RICHARDSON, W.W. 2015. Undergraduate enrollment

in natural resource programs in the United States: trends, drivers, and implications for the future of natural resource professions. *Journal of Forestry* **113**(6): 538–551.

SOCIETY OF AMERICAN FORESTERS. 2014a. Accredited and candidate degree programs in forestry and urban forestry. www.safnet.org/education/AccreditedForestryUrbanForestryDegreeProgramGuide.pdf.

SOCIETY OF AMERICAN FORESTERS. 2014b. Accredited and candidate degree programs in forest technology. www.safnet.org/education/AccreditedForestTechnologyDegree ProgramGuide_1-8-14.pdf.

TACCONI, L. (ed.). 2007. *Illegal Logging: Law Enforcement, Livelihoods and the Timber Trade*. Earthscan Publications Ltd, London. 320 p.

TENNY, D. 2014. Time to unite around timber in the tax code. *The Forestry Source* **19**(4): 5.

TIKKANEN, I., GLUCK, P. and PAJUOJA, H. (eds.) 2002. *Cross-Sectoral Policy Impacts on Forests*. EFI Proceedings No. 46. European Forest Institute, Joensuu, Finland. 208 p.

UNITED STATES DEPARTMENT OF AGRICULTURE (USDA). 2009. *Summary Report: 2007 National Resources Inventory*. Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. 123 p. www.nrcs.usda.gov/technical/NRI/2007/2007_NRI_Summary.pdf

USDA. 2013. *Summary Report: 2010 National Resources Inventory*. Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. 127 p. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1167354.pdf

UNITED STATES ENDOWMENT FOR FORESTY AND COMMUNITIES and SUSTAINABLE FORESTRY INITIATIVE. 2013. *SFI and U.S. Endowment for Forestry and Communities Spur Collaboration Among Water Utilities and Forest Landowners to Protect Watersheds.* http://www.sfiprogram.org/media-resources/news/sfi-and-us-endowment-for-forestry-and-communities-spur-collaboration-among-water-utilities-and-forest-landowners-to-protect-watersheds/

UNITED STATES DEPARTMENT OF AGRICULTURE, FOREST SERVICE (USFS). 1997. *First approximation report for sustainable forest management: report of the United States on the criteria and indicators for the sustainable management of temperate and boreal forests*. USDA Forest Service, Washington, D.C.

USFS. 2004. *National Report on Sustainable Forests - 2003*. FS-766. USDA Forest Service, Washington, D.C. 139 p.

USFS. 2011. *National Report on Sustainable Forests – 2010*. FS-979. USDA Forest Service, Washington, D.C. 131 p.

USFS. 2013. Forest landowners' guide to the Federal income tax. Agriculture Handbook No. 731. USDA Forest Service, Washington, D.C.

USFS. 2014. USDA Forest Service, National Forest System, Law Enforcement and Investigations, Personal Communication, Kim Kinville. June 2014.

USFS. 2015. *Forest Service Research and Development Performance and Accountability Report. Fiscal Year 2015.* FS-1076. USDA Forest Service, Washington, D.C. 36 p.

USFS. Forthcoming. *National Report on Sustainable Forests – 2015*. USDA Forest Service, Washington, D.C.

VAN GOSSUM, P., ARTS, B., DE WULF, R. and VERHEYEN, K. 2011. An institutional evaluation of sustainable forest management in Flanders. *Land Use Policy* **28**(1): 110–123.

UNITED NATIONS GENERAL ASSEMBLY. 2008. Non-legally binding instrument on all types of forests. United Nations General Assembly Sixty-second Session Second Committee Agenda item 54. A/RES/62/98. 31 January 2008.

WEBER, E.P. 1998. *Pluralism by the Rules: Conflict and Cooperation in Environmental Regulation.* Georgetown University Press, Washington, D.C. 328 p.

WIJEWARDANA, D. 2008. Criteria and indicators for sustainable forest management: the road travelled and the way ahead. *Ecological Indicators* **8**: 115–122.

YODER, J., ENGLE, D. and FUHLENDORF, S. 2004. Liability, incentives, and prescribed fire for ecosystem management. *Frontiers in Ecology and the Environment* **2**(7): 361–366.

ZHANG, D., BUTLER, B.J. and NAGUBADI, R.V. 2012. Institutional timberland ownership in the US South: magnitude, location, dynamics, and management. *Journal of Forestry* **110**(7): 355–361.