United States Department of Agriculture

DRAFT
National Report on Sustainable Forests – 2010

December 8, 2008

Note to Reviewers

This report is prepared to fulfill the United States' commitments to the Montréal Process Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests (http://www.mpci.org). Membership in the Working Group is voluntary and currently includes 12 countries from both hemispheres, having a wide range in natural and social conditions. The member countries represent about 90 per cent of the world's temperate and boreal forests in the northern and southern hemispheres, amounting to 60 per cent of all of the forests of the world.

This draft is the second national report prepared using the Montréal Process criteria and indicators. The initial report, *National Report on Sustainable Forests—2003*, is still available on the Forest Service website (http://www.fs.fed.us/research/sustain/2003SustainabilityReport). The refinements to the indicators and the fresh data gathered since 2003 are described in detail in the draft report.

We had several objectives in preparing this second report, beyond simply providing fresh data and refined indicators. Public comments on the 2003 report resulted in the following changes:

- ***Increased emphasis on electronic, web-based reports*** rather than paper copies. Reviewers are encouraged to view this draft report online, and self-print hard copies for their personal use if needed.
- ***More data and interpretations at the sub-national level***. Much of that information is on the website and not in this document; and
- ***Data on the tropical forests of the USA*** in addition to the Nation's temperate and boreal forests. A companion report focusing on tropical forests is being prepared and will be available on the website soon.

We are releasing this report now to obtain public review and comments on the content of the report and the supporting technical information on the 2010 report's website (http://www.fs.fed.us/research/sustain/2010SustainabilityReport). Both general comments and technical comments are sought. Each chapter of the main report has been divided into numbered sub-sections. Reviewers are encouraged to identify the specific sub-section and page number for each of their comments to facilitate the revision process. A team of more than 20 people worked on this report, so providing the appropriate sub-section and page number for each comment will assure that your comments are forwarded to the individual responsible for that part of the report.

The Forest Service will receive comments from the public on this report for 120 days, until April 10, 2009. Comments may be submitted using:

- Email: 2010SustainabilityReport@fs.fed.us
- Fax: 703-605-5131; Attn: 2010 Sustainability Report
- Mail: USDA Forest Service
  Attn: Quantitative Sciences Staff, Dr. Guy Robertson
  1621 North Kent Street , RPC4
  Arlington, VA 22209-2137

If you have a question about the report or supporting technical documents, please send them via email or fax, above, or telephone 703-605-4188.

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Content

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National Report on Sustainable Forests: 2010

Chapter 1

Introduction

1. Introduction

In 2003, the first National Report on Sustainable Forests reported on the state of forests in the United States of America (US) and the indicators of national progress toward the goal of sustainable forest management. It also provided examples of current actions and identified challenges to assessing the sustainability of forests (http://www.fs.fed.us/research/sustain/). The current report is the second in the series, and continues to track our nation's progress.

While the primary purpose of this report remains the same, there are notable differences in its content and structure relative to 2003. Through many consultations with partners and stakeholders, our collective understanding of 'sustainability' has evolved, as has the portfolio of values derived from the Nation's forests. As the sustainability concept has been refined, and the list of values grown, it is natural that this document has evolved.

The National Report on Sustainable Forests: 2010 provides factual information along with some context to inform and inspire dialogue about sustainability and our Nation's forests. Improvements in inventory and monitoring programs, fresh research developing new data and analysis methods, and emerging partnerships are providing new and more relevant information, which is reflected in the indicator reports found in Chapter 2. As this is the second report in this series, Chapter 3 begins to track some of the significant data trends through time for individual criteria and indicators. Beyond progress at the conceptual level, such as the development of new indicators and revision of others, there has also been progress at the practical level. New activities informed by and/or incorporating the Montréal Process criteria and indicators (MP C&I) have been undertaken at all geographic scales: county, State, regional, and national. Chapter 4 explores some of these activities and explains how they are helping to broaden and deepen our nation's commitment to sustainability.

Though the total area of forests in the United States has been relatively stable since 2003, the pressure on these lands from competing uses has intensified. These diverse and sometimes rival uses call for candid dialogue within the broad community of interests that value forests. To the extent that such dialogue can lead to broader and deeper shared support for policies and programs aimed at improving conservation and sustainable management of our forests, it will also benefit our society, economy, and natural environment. Chapter 5 makes some initial suggestions about how to convert this dialogue into action that will improve the condition of our forests.

2. Defining Sustainability

The 2003 report devoted substantial space to explaining the origins of this series of reports, and to the concepts of sustainable development and sustainable forest management. Discussions about the meaning and relevance of sustainability are ongoing, and this report has evolved in accordance with our appreciation of these issues. Readers searching for a presentation of these concepts as understood at the time the 2003 report was published should consult the websites of the US Forest Service (FS) (http://www.fs.fed.us/research/sustain) and the Montréal Process (MP) (http://www.mpci.org). The Montréal Process members are 12 countries, outside of Europe, with 90% of the globe's temperate and boreal forests.

Since the publication of the 2003 report, the Federal government has adopted a definition of "sustainable" which is included in an Executive Order signed in 2007 (see box), linking environmental, social, and economic intentions of the Federal government. As do most definitions of sustainability, the Federal government's definition recognizes three arenas in which the impacts of natural resource decisions are closely linked. These arenas – environment, society, and economy - are commonly referred to as "the triple bottom line", and their relationship is detailed in Figure 1 (Modeling Sustainability: Weak vs. Strong). When impacts to and influences of the triple bottom line are properly accounted for, natural resource decisions have a better chance of achieving sustainability. Natural resource decisions should account for societal and economic interests. In the case of Executive Order 13423, which set an executive definition of "sustainable", the Federal government enacted policy that tied together environmental, energy, and transportation management. Recognizing the interdependence of these three areas has led to policies that aim to improve energy efficiency and reduce greenhouse gas emissions.

Federal Definition of "Sustainable"

"Sustainable" means to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations of Americans.

Executive Order 13423—Strengthening Federal Environmental, Energy, and Transportation Management. January 26, 2007.

Modeling Sustainability: Weak vs. Strong

There are different ways of thinking and talking about sustainability, and today the "triple bottom line" is increasingly used as a shorthand way to describe agency and organizational commitment to sustainability. The "triple bottom line" concept refers to the need to measure progress on all three interrelated aspects of a system: the economy, the society, and the environment. Figure 1 below shows two different ways of viewing the "triple bottom line" and these interconnections. The two views also reflect different degrees of sustainability – referred to as "weak" and "strong" sustainability.

Early thinking about sustainability, shown on the left side of Figure 1 (Weak Sustainability) envisions the environmental, social, and economic realms as intersecting, yet separate parts of a system. A more recent depiction of sustainability is shown on the right-hand side of Figure 1 (Strong Sustainability). This updated model reflects the understanding that the environmental realm provides natural goods and services which cannot be duplicated through other means. This view of a sustainability community acknowledges that the human economy depends on people and social interaction. Society, in turn, cannot exist outside the environment which provides the basic necessities for people to exist: air, food, water, energy, and raw materials. This representation of the entire economy being reliant on society, which in turn is entirely dependent on the environment strengthens the dependencies of the economy and society on the natural environment (Maureen Hart, Guide to Sustainable Community Indicators).

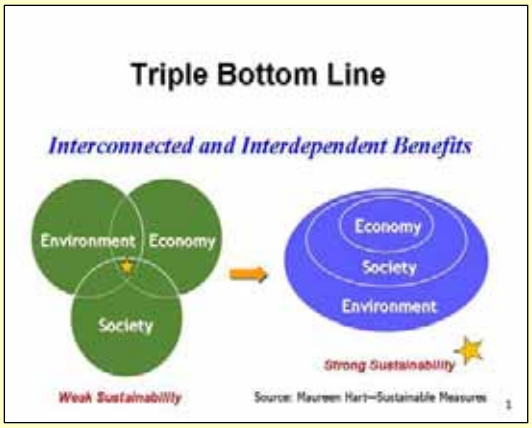


Figure 1: Working towards Strong Sustainability.

Several of today's most pressing forest issues (e.g.: fire danger and hazardous fuels, woody biomass for bioenergy, adaptation of forest management to potential climate changes, etc.) all have strongly interconnected and interdependent economic, social, and environmental linkages. Decisions made regarding these issues will widely impact areas of the economy and society beyond those directly related to forests; suggesting that these pressing issues cannot be resolved solely within the forest sector. Solutions will require dialog among a broader set of interests and the implementation of policy in the economic and/or social spheres to improve conditions in the environmental sphere. Achieving these solutions necessitates the involvement and support of a diverse group of interests, bridging not only different sectors, but also scales and generations.

2.1. Pursuing sustainability across sector, scale and through time

When broadening the concept of sustainability to a wider landscape scale, we should consider other systems and sectors outside of forestry that are present on the landscape. Management of water, rangelands, and urban development are all examples of sectors that are closely coupled with forest management. Chapter 4 of this report highlights several examples of cross-sectoral work, where partners are working together to positively impact their landscape.

Forests are part of that landscape, dominating in some ecosystems and having less influence in others. Place-based communities (linked by geography) and their economies are also part of a landscape, dominating in some ecosystems and having less influence in others. Those working towards sustainable solutions must take into consideration the conditions and relationships among the environmental, social, and economic spheres into account locally, as well as at the wider landscape scale.

The old notion of "thinking globally and acting locally", while a good first step, is too simplistic to address all of today's complex problems. Instead, we must attempt to understand the impact of our actions at multiple scales in order to achieve local, landscape-scale, and national improvements.

Today's challenges seem to be more global and more local at the same time; and human impacts on the environment are being recognized at the planetary scale. Sustainable solutions are sought that integrate environmental, social, and economic situations in particular places and that link them across geographic scales.

Most definitions of sustainability include some mention of the need to meet the needs of current and future generations. While an important sentiment, the simple acknowledgment of "intergenerational needs" does not explain how to integrate these needs. In fact, a great deal of uncertainty exists when attempting to predict the needs of future generations. Rather than attempting to make these decisions for future generations, a better alternative may be to leave resources and options available so that choices exist in the future. This may entail shifting our current consumption focus from "what can I take today" to "what do I need to leave so future generations will have the ability to make their own choices?".

The need to expand the sustainability dialogue is evident. What is less apparent are the means by which to do so. Representatives from diverse sectors and scales come to the table with different backgrounds, institutional awareness, and even languages to communicate about sustainability. Since the publication of the 2003 report, the MP C&I have continued to emerge as a tool to assist this communication. Whether by furnishing direct means to measure progress towards sustainability using individual indicators, or by the provision of a framework to structure discussions, MP C&I are being looked at by many as the common language of sustainability.

2.2. Montréal Process Criteria and Indicators as a common framework

Managing forest's sustainably requires linkages through time and across geographic scales and resource sectors; clearly a complex undertaking given the diverse audiences seeking to play a role in management discussions. This series of reports seeks to inform and engage those agencies, organizations, and individuals who have a stake in the future of our Nation's forests. Perhaps the series' most important contribution to this effort has been through its development, promotion, and application of the framework provided by the Montréal Process Criteria and Indicators. With each iteration of the report we

more firmly establish our ability to address the MP C&I and enhance their usefulness in reporting in this as well as other settings.

Consisting of seven criteria and 64 indicators, the MP C&I have undergone extensive scrutiny over the past decade by both the scientific community as well as practitioners from the international to the local scale. This scrutiny is evident in Chapter 2, which discusses in detail the rational behind each of the 7 criteria and how individual indicators have been revised. In Chapter 2, readers can explore how the scientific body of knowledge has been structured around the MP C&I. This framework provides organization to the numerous data sources and scientific efforts underway attempting to measure the state of our Nation's forests. In doing so, it provides a hierarchical structure to the science of sustainability. Individual indicators provide insight into specific criteria, and the seven criteria, when looked at in whole, provide a yardstick from which society can measure its progress towards sustainability goals.

In order for society to agree upon sustainability goals, there must be a way to communicate more clearly across diverse interests about complex issues. The MP C&I provide a framework for such dialogue. Grouping many of these interests into seven broad, but definitive criteria allow for diverse interests to coalesce shared values. Diverse interests, for example, may differ upon the specifics of how to conserve biological diversity, but they can agree that it has value and is an important component of sustainable forests.

The shared values encompassed by the seven criteria are another way the MP C&I contribute to a common sustainability language. The seven criteria create a platform for launching dialogue to advance these shared values. Over time and through increasing use and scrutiny, this platform has proven to be solid. Since 2003 the seven criteria have not changed. In fact, other criteria and indicator development efforts (some of which are highlighted in Chapter 4) have looked to the MP C&I, and the criteria in particular, for guidance.

Montreal Process Criteria for the conservation and sustainable management of temperate and boreal forests

1) Conservation of biological diversity
2) Maintenance of productive capacity of forest ecosystems
3) Maintenance of forest ecosystem health and vitality
4) Conservation and maintenance of soil and water resources
5) Maintenance of forest contribution to global carbon cycles
6) Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies
7) Legal, policy, and institutional framework

3. Development and Use of the Criteria and Indicators

3.1. International agreement on seven themes of sustainable forest management

In 2003, the International Conference on the Contribution of Criteria and Indicators for Sustainable Forest Management (known as CICI) was held in Guatemala. Attendees were drawn from all the major tropical, temperate, and boreal forest criteria and indicators processes around the world—including the Montréal Process. Throughout the conference, it became evident that all represented processes were using very similar criteria to categorize areas in which to measure progress towards sustainability.

Common thematic areas of sustainable forest management emerged from CICI that are strongly linked to and supportive of the seven Montréal Process Criteria. The themes (see box) effectively provide a common global framework and touchstones for dialogue about sustainable management of tropical, temperate, and boreal forests.

Common Thematic Criteria of Sustainable Forest Management

1. Extent of forest resources
2. Biological diversity
3. Forest health and vitality
4. Productive functions and forest resources
5. Protective functions of forest resources
6. Socio-economic functions
7. Legal, policy and institutional framework

In 2004, these same seven thematic areas were acknowledged by the international forest community at the fourth session of the United Nations Forum on Forests. Today they are being used by the United Nations Food and Agriculture Organization (FAO) as the framework for the 2010 Global Forest Resource Assessment and as the organizing framework for the agenda of the 2009 World Forestry Congress. In these instances, organizations have validated the use of these themes by different institutions, and for a variety of different types of forests. Each time an institution reaffirms the validity of these seven themes as a basis for sustainable forest management, they help legitamize and support the use of a common framework.

Given the wide array of support for the seven thematic areas of sustainable forest management, and how similar they are to the seven criteria from the Montréal Process, it is not surprising that the Montréal Process member countries have restated their commitment to the use of the MP C&I.

Following the release of individual Montréal Process member country reports in 2003, the ministerial-level Montréal Process Working Group met in Quebec and published a *First Forest Overview Repor*t (September 2003) summarizing some of the work completed internationally to advance sustainable forests. Although all countries were reported to have made some degree of progress, the capacity to collect and interpret data varied widely amongst countries, and no country was able to report on all 67 indicators. However they were able to agree, through the Quebec Declaration, to reaffirm their commitment to working together to better develop and implement criteria and indicators to achieve sustainable forest management through the Montréal Process.

Excerpt from Quebec Declaration

Reaffirm our commitment to implementing the Montréal Process Criteria and Indicators as an important means of national monitoring, assessing and reporting.

Québec City, Canada
22 September 2003

3.2. Continuing to Work on the Indicators

This continued commitment to the Montréal Process led to intensive discussions about the relevance and definitions of various indicators. The expectations of the member countries have always been that the indicators should be adaptable; that they would be tested and refined through use and discussion. Since the 2003 round of national reports, the MP C&I have evolved through workshops held by member countries. This report contains 64 indicators, not 67 as in the previous report, some having been dropped, some new indicators added, and several having been revised through substantial rewording to improve clarity and understanding. An important exception are those indicators for Criteria 7. Revisions to Criteria 7 indicators were agreed upon in November of 2008, but there was not time to include them in the 2010 reporting cycle. A complete listing of indicator changes can be found in Chapter 2.

Examples of Revised and New Indicators
(complete listing found in Chapter 2)

A Revised Indicator:

2003 Language—Nonconsumptive forest use and values (Indicator #43)

2010 Language—Revenue from forest based environmental services (Indicator #27)

Some New Indicators:

- Avoided fossil fuel carbon emissions by using forest biomass for energy (Indicator #24)
- Resilience of forest-dependent communities (Indicator #38)
- Importance of forests to people (Indicator #44)

Although relevant at the national scale, some indicators are more difficult to translate meaningfully at finer and more local levels. Annual investment and expenditures on forest related research (Indicator #35), for example, may be a valuable gauge of national investment, but irrelevant to the sustainability of an individual's 30 acre woodlot. The best indicators of biodiversity in a temperate forest may be very different then those of a tropical forest. Thus the indicators of the Montréal Process, developed to be relevant at a national level for temperate and boreal forests, have not achieved the same level of international consensus outside of the Montréal Process as have the seven criteria. Attempts are being made to create more locally meaningful indicators that gauge sustainability for each of the seven criteria of sustainable forest management. Several of these undertakings, at state and county levels, are highlighted in Chapter 4.

A national multi-stakeholder forum called the Roundtable on Sustainable Forests is focused on advancing understanding, assessment, and reporting of forest sustainability in the United States. Its mantra—*better data, better dialogue, better decisions*—captures the belief that better data will lead to better dialogue about the sustainability of the nation's forest resources, which will in turn lead to more informed, better decisions by stakeholders. Roundtable participants use the MP C&I as a common national framework to engage stakeholders at all levels in its work. In doing so, they have provided valuable feedback at many stages of this report, from data identification through review. Readers wanting more information about the Roundtable should consult its website (http://www.sustainableforests.net).

Since 2003, several other indicator-based projects have begun making advances in the United States, including the *State of the Nation's Ecosystems* project led by the H. John Heinz III Center for Science, Economics, and the Environment as well as the new complementary National Environmental Status and Trends (also known as NEST indicators) project launched in 2008 by the Executive Office of the President. These two efforts focus on environmental and natural resource conditions at the national level. Through these and other efforts, discussed more thoroughly in Chapter 4, a growing network of individuals within the United States is encouraging cooperation among organizations at national and various sub-national levels.

4. The 2010 Reporting Cycle

The 2010 reporting cycle pulls together the efforts of many people within the United States. The updated indicator definitions and data, in particular, reflect the work of more than thirty US Forest Service scientists and collaboration with universities, other agencies, and organizations. When complete, this cycle will include a suite of products, all of which will be available electronically and some in hard copy. They include:

- The National Report on Sustainable Forests: 2010
- Associated products:
  - Data reports for individual indicators
  - Partner reports on specific topics
  - Website with access to data and reports

4.1. National Report on Sustainable Forests: 2010

This document, the National Report on Sustainable Forests: 2010, takes a comprehensive and systematic approach at gauging our Nation's progress towards sustainable forest management through examination of the aforementioned criteria and indicators. It consists of 5 chapters, the second of which contains the results of scientific inquiry into each of the 64 indicators. These indicator reports are brief, 1-2 pages each, and are meant to serve as a reference resource into a broader portfolio of work. More detailed treatments of individual indicators can be found in the supporting data reports that will be published online. Chapter 3 of this document is where readers will find discussion about the significant conditions and trends that have emerged through analysis of the criteria and indicator reports. Chapter 4 takes a look at some of the ongoing efforts to broaden and deepen the impact of criteria and indicators on sustainability. Finally, chapter 5 examines ways to catalyze dialogue about sustainability into specific actions to improve the well-being of our Nation's forests.

Overview of the National Summary Report: 2010

Chapter 1: Introduction

Chapter 2: Presentation and Analysis of the Criteria and Indicators

Chapter 3: Significant Conditions and Trends

Chapter 4: Broadening and Deepening Commitments to Sustainability

Chapter 5: 2010 National Report and Beyond

4.2. Associated Products

Data reports for individual indicators. Though the individual indicator reports have been limited to 1 or 2 pages in the National Report, more in-depth reports will be published and made available via the Forest Service sustainability website. These more detailed reports will provide metadata, detailing sources, reference materials, and analysis techniques in support of the brief 1-2 page reports included here.

Partner Reports. We plan to produce a number of stand-alone, peer-reviewed partner reports in association with the 2010 reporting cycle. Currently, partners inside and outside government are working on supplemental information that will delve more deeply into a variety of related topics, including the state of sustainability of tropical forests in the United States, the sustainability of urban and agricultural forest resources, and more detailed considerations of certain indicators or syntheses between a number of indicators. These will be published in association with the 2010 National Report as they become available. We hope to add new subjects and titles in support of an ongoing discussion of various dimensions of forest sustainability that cannot be easily addressed within the context of a single indicator brief.

Online Presence. Along with the 2010 National Report, the Forest Service will be producing a webtool allowing for dynamic delivery and display of MP C&I indicator data according to user specified time spans and spatial units. This webtool will be subject to periodic updating of data and content on a regular basis. Directed feedback and weblog functions are anticipated in the future but will not be included in this initial rollout.

In addition to the US Forest Service website, more information regarding organizations using the MP C&I to inform work at national and sub-national levels is summarized and available via the website of the Roundtable on Sustainable Forests (www.sustainableforests.net).

4.3. Data foundations for the report

Reporting on indicators in 2010 reflects updated data as well as additional data made available through improved data gathering and new sources.

Data for many indicators have been updated and improved since 2003. As the last report was being prepared, the US Forest Service and partner State forestry agencies were in the midst of a major change in how forest inventories were conducted. Over the past five years, much more data has been collected using the new annualized forest inventory system, resulting in higher quality data that better

depict current conditions on-the-ground in most States. This new data, part of the Forest Service's Forest Inventory and Analysis Program (FIA), is fundamental to the biophysical indicators reported in Criteria 1-5. More information about the FIA program can be found at http://fia.fs.fed.us/.

Various other additional types of data have been used to enhance our reporting relative to 2003. For example, data gathering on forest soil conditions across all land ownership categories, most eco-regions, and forest and soil types has been developed and piloted; and is now operational in the FIA Program. Likewise, records of Forest Service permits for non-wood forest products are now available from BLM and Forest Service databases, and these have allowed us to improve our reporting on indicators addressing non-wood forest products These and other data additions are further described in Chapter 2.

4.4. Trends and Regional Differences

The 2003 report was a baseline report on sustainable forests for the United States using the MP C&I to organize information about forests and report on conditions. A number of the indicators in that report incorporated time-series data allowing for the analysis of trends. Other indicators, however, represented simply a snapshot in time. The 2010 report provides additional years for time-series analyses and what is essentially a second data point for indicators where time-series are not available. This, in turn, allows for more thorough analyses of the development of indicators over time. These are presented in the indicator briefs and discussed more broadly in the summarizations provided in Chapter 3.

Although this report has a national focus, review of the 2003 reporting process pointed out that the national presentation masked regional differences and did not inform discussions regionally. This report presents more information about conditions in sub-national regions and how they differ—both spatially among regions and over time. If data used for indicators show regional differences, then they are highlighted and often depicted visually in the 2010 report.

4.5. Summarizing Findings and Discerning Meaning

In this report the major findings are presented by criteria in Chapter 2; and a summary across all criteria is provided in Chapter 3. In addition, the findings are applied to some key issues confronting the United States to help inform subsequent dialogue nationally and in various parts of the country. By using this information to establish a basis for dialogue, perhaps the conversations among stakeholders will advance beyond a discussion of multiple perspectives as occurred following the release of the 2003 report to a discussion about trends, priorities, and actions needed to better conserve and sustainably manage the forests of the United States.

National Report on Sustainable Forests: 2010

Chapter 2

Presentation of the Criteria and Indicators

1. Introduction

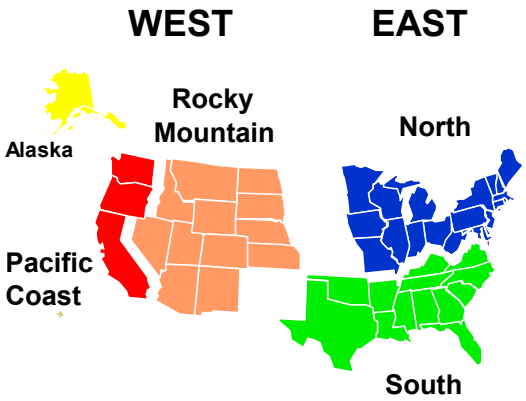
This chapter focuses on the state of the forests in the United States of America and presentation of indicators of national progress toward sustainable forest management. This information is intended to improve public dialog and decisionmaking on what outcomes are desired and what actions are needed to move the Nation toward this goal and to establish a baseline for future measurement of progress. The indicators reported here reflect many of the environmental, social, and economic concerns of the American public regarding forests and presents data primarily at the national or regional scale. Further interpretation and interaction of the indicators is provided in Chapter 3 of this report and more detailed data on the indicators is also available in the detailed Data Report found at http://www.fs.fed.us/research/sustain/2010SustainabilityReport
.

This update of the 2003 National Report on Sustainable Forests is driven by a multi-stakeholder process reflecting contemporary notions of sustainability that require information beyond what has been traditionally collected and reported. Since 2003, there have been no major changes in the Criteria but the indicators of each criterion, except Criterion 7, have been reviewed and revised. The indicators of Criterion 7 are the same as before but are scheduled for review and revision prior to the next major report in 2015. Over time, through repetition and refinement, the United States will continue to improve reporting on key indicators.

This chapter presents, individually, each of the 64 Montreal Process 2010 indicators. For most indicators, the presentation includes a graphical display of the data, an explanation of what the indicator is and why it is important, a narrative description of what the data shows, and, in some cases, an explanation of current limitations in reporting on the indicators. The presentation of each indicator and supporting technical documents, available at http://www.fs.fed.us/ research/sustain/, are intended to provide:

- available historical data on the indicators, recognizing that trend data for many indicators may be lacking.
- a basis for a broad public discourse concerning the interpretations of conditions and trends reported for the indicators to inform actions needed to assure progress in sustainable forest management.
- an important data source for future planning and decision making, as well as a basic data set for future monitoring of the indicators to reveal whether plans and decisions are leading to better outcomes.

Where possible the presentations in this chapter will provide information on the 5 major geographic regions depicted below.



Conceptual framework

As stated in "*Progress on Implementation of the Montreal Process on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests*" (February 1997, http://www.rinya.maff.go.jp/mpci/rep-pub/1997/prog1_e.html#2), the general conceptual framework for the Criteria and Indicators is:

An ecosystem based approach to forest management is reflected in the Montreal Process criteria and indicators. Taken together, the seven criteria and associated indicators suggest an implicit definition of sustainable management of forest ecosystems at the country level. No single criterion or indicator alone is an indication of sustainability. Rather, individual criteria and indicators should be considered in the context of other criteria and indicators.

The following summary provides an overview of Criteria and Indicator themes as provided in Annex D of the Technical Notes on the Implementation of the Montréal Process Criteria and Indicators (Second Edition, December 2007, http://www.rinya.maff.go.jp/ mpci/meetings/an-4.pdf). More explicit rationale statements are provided with the presentation of each indicator.

CRITERION 1: Conservation of biological diversity

Maintaining biologically diverse forests, particularly native forests, requires maintenance of a substantial proportion of the planet's biological diversity and terrestrial species. Biological diversity enables an ecosystem to respond to external influences, to recover after disturbance, and to maintain essential ecological functions and processes. Human activity as well as natural processes may impact biological diversity by altering and fragmenting habitats, introducing invasive species, or reducing the population or ranges of species. Indicators for this Criterion are divided into 3 thematic areas.

Ecosystem diversity - Maintenance of the variety and quality of forest ecosystems is necessary for the conservation of species. Without sufficient habitat size, adequate connectivity, necessary structural diversity and appropriate protection and management measures, species may decline and become vulnerable to extinction.

1.01 Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure
1.02 Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage
1.03 Fragmentation of forests

Species diversity - The greatest and most readily recognizable aspect of biological diversity is the variety of species and their population levels. A key objective for the conservation of biological diversity is slowing down the rate of population decline, and species depletion and extinction due to human factors. Changes in species population levels and distribution may also provide an early warning of changes in ecosystem stability and resilience, as will increases in the number of invasive, exotic forest-associated species.

1.04 Number of native forest associated species
1.05 Number and status of native forest associated species at risk, as determined by legislation or scientific assessment
1.06 Status of in situ and ex situ efforts focused on conservation of species diversity

Genetic diversity - Genetic diversity, or the variation of genes within populations and species, is the ultimate source of biological diversity at all levels and is important for the functioning of healthy forest ecosystems. Threats to gene pools come from climate change, catastrophic events and , human activities and pressures. High levels of genetic diversity within populations are usually a measure of their greater potential for survival. The loss of genetic variation within species also makes forest ecosystems less resilient to change.

1.07 Number and geographic distribution of forest associated species at risk of losing genetic variation and locally adapted genotypes
1.08 Population levels of selected representative forest associated species to describe genetic diversity
1.09 Status of in situ and ex situ efforts focused on conservation of genetic diversity

CRITERION 2: Maintenance of productive capacity of forest ecosystems

The maintenance of sustainable forest ecosystems relies on an understanding of the levels at which goods and services may be extracted or used without undermining the functioning of forest ecosystems and processes. Many communities depend on forests directly or indirectly for a wide range of forest-based goods and services and the nature of goods and services provided by these forests change over time due to social and economic trends, and technological developments. Monitoring changes in the productive capacity of forests provide a signal of forest

management practices or other agents that are affecting forest ecosystems in some way.

2.10 Area and percent of forest land and net area of forest land available for wood production
2.11 Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production
2.12 Area, percent, and growing stock of plantations of native and exotic species
2.13 Annual harvest of wood products by volume and as a percentage of net growth or sustained yield
2.14 Annual harvest of non-wood forest products

CRITERION 3: Maintenance of forest ecosystem health and vitality

The maintenance of forest health and vitality is dependent upon the ability of the ecosystem's functions and processes to recover from or adapt to disturbances. While many disturbance and stress events are natural components of forest ecosystems, some may overwhelm ecosystem functions, fundamentally altering their patterns and processes and reducing ecological function. A decline in forest ecosystem health and vitality may have significant economic and ecological consequences for society including a loss of forest benefits and the degradation of environmental quality.

3.15 Area and percent of forest affected by biotic processes and agents (e.g. insects, disease, invasive alien species) beyond reference conditions
3.16 Area and percent of forest affected by abiotic agents (e.g. fire, storm, land clearance) beyond reference conditions

CRITERION 4: Conservation and maintenance of soil and water resources

The maintenance of sustainable soil and water requires monitoring changes in the chemical, physical, and biological characteristics of soil, water and aquatic systems. Soil and water underpin forest ecosystem productivity and functions. Forest ecosystems play an important role in the regulation of surface and groundwater flow and, together with associated aquatic ecosystems and clean water, they are essential to the quality of human life. Indicators for this Criterion are divided into 3 thematic areas.

Protective function **-** Healthy and productive forests depend on the maintenance of the soil and water resource. Forests also regulate these resources by moderating the flow of water, controlling erosion and preventing catastrophic events such as flooding, avalanches and mudslides.

4.17 Area and percent of forest whose designation or land management focus is the protection of soil or water

Soil **-** Forest soils support forest productivity and other ecological and hydrological functions through their ability to hold and supply water and nutrients, store organic matter and provide habitats for plant roots and for a wide range of soil organisms. Not maintaining the soil resource may result in a decline and degradation in forest health and the provision of other environmental services.

4.18 Proportion of forest management activities (e.g. site preparation, harvesting) that meet best management practices or other relevant legislation to protect soil resources
4.19 Area and percent of forest land with significant soil degradation

Water **-** Water is one of the most valuable of forest ecosystem services. Forests and how they are managed, influence the quantity, quality and timing of surface and ground water flows. Changes to water quality and flow can have a severe impact on forest resources as well as human wellbeing. In addition, associated forest aquatic and riparian habitats are some of the most biologically diverse and productive forest ecosystems.

4.20 Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources
4.21 Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions

CRITERION 5: Maintenance of forest contribution to global carbon cycles

Monitoring forest carbon cycles and human activity related to them is critical to the maintenance of a sound environment. The biosphere has a significant influence on the chemical composition of the atmosphere and forests are one of the largest terrestrial reservoirs of biomass and soil carbon. Vegetation draws CO_2 from the atmosphere, through photosynthesis and returns it through respiration and the decay of organic matter. Thus, forests have an important role in global carbon cycles as sinks and sources of carbon. Carbon stocks in forests include

above ground biomass, below ground biomass, dead and decaying organic matter and soil carbon. And, carbon is also stored in wood products.

5.22 Total forest ecosystem carbon pools and fluxes
5.23 Total forest product carbon pools and fluxes
5.24 Avoided fossil fuel carbon emissions by using forest biomass for energy

CRITERION 6: Maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies

Maintenance of the socioeconomic benefits of forests requires monitoring a wide variety of social, cultural and economic goods, services and other benefits that contribute to meeting the needs of society. Many people and communities, including indigenous peoples, are dependent on forests for their livelihood and well being. Information on the production and consumption of forest products, investment and employment in the forest sector, forest-based recreation and tourism, and other social and cultural forest values illustrate the many benefits forests provide. Indicators for this Criterion are divided into 5 thematic areas.

Production and consumption **-** These indicators provide information on the contribution of wood and non-wood products and environmental services to national economies. The value, volume and revenues associated with domestic production and consumption of forest products and services, including through international trade, demonstrates the type and magnitude of the contribution of forests to domestic economies. They also provide information about market conditions relevant to forest management and the forest sector.

6.25 Value and volume of wood and wood products production, including primary and secondary processing
6.26 Value of non-wood forest products produced or collected
6.27 Revenue from forest based environmental services
6.28 Total and per capita consumption of wood and wood products in round wood equivalents
6.29 Total and per capita consumption of non-wood products
6.30 Value and volume in round wood equivalents of exports and imports of wood products
6.31 Value of exports and imports of non-wood products
6.32 Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption
6.33 Recovery or recycling of forest products as a percent of total forest products consumption

Investment in the forest sector **-** These indicators provide information on long-term and annual expenditures to enhance forest management, forest-based enterprises, and the knowledge and skills of people who are engaged in the forest sector. Maintaining and enhancing the long-term multiple socio-economic benefits derived from forests depends in part on investment in the forest sector, including both long-term capital investments and annual operating expenditures.

6.34 Value of capital investment and annual expenditure in forest management, wood and non-wood product industries, forest-based environmental services, recreation and tourism
6.35 Annual investment and expenditure in forest-related research, extension and development, and education

Employment and community needs **-** Forest-based and forest-related employment is a useful measure of the social and economic importance of forests at the national and local level. Wage and income rates and injury rates are indicators of employment quality. Communities whose economies are concentrated in forest industries, or who rely on forests for subsistence purposes, may be vulnerable to the short or long-term affects of economic or policy changes in the forest sector. These indicators provide information on levels and quality of forest employment, community resilience to change, use of forests for subsistence purposes, and the distribution of revenues from forests.

6.36 Employment in the forest sector
6.37 Average wage rates, annual average income and annual injury rates in major forest employment categories
6.38 Resilience of forest-dependent communities
6.39 Area and percent of forests used for subsistence purposes
6.40 Distribution of revenues derived from forest management

Recreation and tourism **-** Forests have long been used as a place for recreation and other leisure activities. The location and accessibility of forests and the availability of recreation facilities are important to forest-based recreation and tourism. Levels of use are an indication of the extent to which forests are valued by society for these uses.

6.41 Area and percent of forests available and/or managed for public recreation and tourism
6.42 Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available

Cultural, social and spiritual needs and values - People and communities, in both rural and urban areas, have a variety of social, cultural, and spiritual connections to forests based on traditions, experiences, beliefs, and other factors. Among them, the spiritual and cultural connections of indigenous people to forests often form part of their identity and livelihood. These values may be deeply held and influence people's attitudes and perspectives towards forests and how they are managed. These indicators provide information on the extent to which social, cultural, and spiritual needs and values exist and are recognized by society.

6.43 Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values
6.44 The importance of forests to people

CRITERION 7: Legal, institutional, and economic framework for forest conservation and sustainable management

Although it overlaps with the economic sphere, this criterion is centered in the social sphere of sustainability. Its first three subcategories provide for the assessment of laws, regulations, policies, planning, and public involvement pertaining to sustainable forest management. The last two subcategories address the nature and levels of forest research, monitoring, and reporting. Together, they reflect society's propensity and capacity to sustain forested ecosystems and associated economies. Indicators for this Criterion are divided into 5 thematic areas.

Extent to which the legal framework supports the conservation and sustainable management of forests

7.45 Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it—clarifies property rights, provides for appropriate land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides a means of resolving property disputes by due process
7.46 Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it—provides for periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including coordination with relevant sectors
7.47 Area and percent of forests used for subsistence purposes
7.48 Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it—encourages best practice codes for forest management
7.49 Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it—provides for the management of forests to conserve special environmental, cultural, social, and/or scientific values

Extent to which the institutional framework supports the conservation and sustainable management of forests

7.50 Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to provide for public involvement activities and public education, awareness, and extension programs, and make available forest- related information
7.51 Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to undertake and implement periodic forest-related planning, assessment, and policy review, including cross-sectoral planning coordination
7.52 Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to develop and maintain human resource skills across relevant disciplines
7.53 Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and to support forest management
7.54 Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to enforce laws, regulations, and guidelines

Extent to which the economic framework supports the conservation and sustainable management of forests

7.55 Extent to which economic framework (economic policies and measures) supports the conservation and sustainable management of forests through investment and taxation policies and a regulatory environment that recognizes the long-term nature of investments and permits the flow of capital in and out of the forest sector in response to market signals, nonmarket economic valuations, and public policy decisions in order to meet long-term demands for forest products and services

7.56 Extent to which economic framework (economic policies and measures) supports the conservation and sustainable management of forests through investment and taxation policies and a regulatory environment that recognizes the long-term nature of investments and permits nondiscriminatory trade policies for forest products

Capacity to measure and monitor changes in the conservation and sustainable management of forests

7.57 Capacity to measure and monitor changes in the conservation and sustainable management of forests, including availability and extent of up-to-date data, statistics, and other information important to measuring or describing indicators

7.58 Scope, frequency, and statistical reliability of forest inventories, assessments, monitoring and other relevant information

7.59 Capacity to measure and monitor changes in the conservation and sustainable management of forests, including compatibility with other countries in measuring, monitoring, and reporting on indicators member countries: Argentina, Australia, Canada, Chile, China, Japan, Republic of Korea, Mexico, New Zealand, Russia, United States of America, and Uruguay

Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services

7.60 Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services including development of scientific understanding of forest ecosystem characteristics and functions

7.61 Capacity to conduct and apply research and development aimed at improving forest management and development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems

7.62 Capacity to conduct and apply research and development aimed at improving forest management and new technologies and the capacity to assess the socioeconomic consequences associated with the introduction of new technologies

7.63 Capacity to conduct and apply research and development aimed at improving forest management and enhancement of the ability to predict impacts of human intervention on forests

7.64 Capacity to conduct and apply research and development aimed at improving forest management and the ability to predict impacts on forests of possible climate change

Indicator Presentation

The following sections present the rationale for each Criterion, a description of the changes in each Criterion's indicators since 2003 and a presentation of each 2010 indicator. Indicator 7.58 provides an overview of the coverage, recency, frequency and data sources for each indicator. Detailed information for each Indicator may be found in on-line Data Reports available at http://www.fs.fed.us/research/sustain/2010SustainabilityReport.

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Criterion 1

Conservation of biological diversity

What is this criterion and why is it important?

Forests support a substantial proportion of biological diversity, particularly natural forests. Biological diversity enables an ecosystem to respond to external influences, to recover after disturbance, and to maintain essential ecological processes. Human activities can impact adversely on biological diversity by altering and fragmenting habitats, introducing invasive species, or reducing the population or ranges of species. Conserving the diversity of organisms supports the ability of forest ecosystems to function, reproduce, and provide broader economic, intrinsic, altruistic, ethical, and environmental values.

The first three indicators, in covering ecosystem diversity, describe the kind, amount, and arrangement of forest and habitats – which when taken together provide a measure of the capacity of forest habitats to provide for organisms and essential ecological processes. The last six indicators, in sub-categories of species and genetic diversity, document the distribution and abundance of species within those habitats – all six of which are influenced by the three indicators of habitat capacity. The geographic range occupied by species, their population trends within that range and protection status of forest habitats.

What has changed since 2003?

The data - The most significant change since 2003 is the "freshness" of the data. In 1999, the Forest Inventory and Analysis (FIA) program shifted from periodic surveys of each State on a roughly 10-year cycle to an annualized survey which collects data in each State every year. The current exceptions are Wyoming (last survey 2001), Nevada (last survey 1989), Hawaii (last survey 1986) and interior Alaska (no complete previous survey) which are scheduled to begin annualized inventories pending sufficient program funding. In the long-term, this new approach will allow rolling average summaries of the status of forest inventory, health and harvesting data every year.

The indicators – The following table summarizes the revisions. Indicator reference numbers for 2003 and 2010 are provided to assist in comparisons with the previous report. A more detailed rationale for the revisions may be found at http://www.rinya.maff.go.jp/mpci/meetings/18_e.html.

Criterion 1 – Conservation of biological diversity

2003 Ref.	2003 Indicator	Revision action	2010 Ref.	2010 Indicator
	Ecosystem diversity	No change		***Ecosystem diversity***
1	Extent of area by forest type relative to total forest area	Merge 2003 indicators 1 and 2	**1.01**	Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure
2	Extent of area by forest type and by age class or successional stage	Merge 2003 indicators 1 and 2		
3	Extent of area by forest type in protected area categories as defned by IUCN or other classifcation systems	Merge 2003 indicators 3 and 4	**1.02**	Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage
4	Extent of areas by forest type in protected areas defned by age class or successional stage	Merge 2003 indicators 3 and 4		
5	Fragmentation of forest types	Change "forest types" to "forests"	**1.03**	Fragmentation of forests

	Species diversity	No change		***Species diversity***
6	The number of forest-dependent species	Change "forest-dependent" to "native forest associated"	**1.04**	Number of native forest associated species
7	The status (threatened, rare, vulnerable, endangered or extinct) of forest-dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientifc assessment	Change "forest-dependent" to "native forest associated" and delete "at risk of not maintaining viable breeding populations"	**1.05**	Number and status of native forest associated species at risk, as determined by legislation or scientific assessment
		NEW	**1.06**	Status of in on site and off site efforts focused on conservation of species diversity

	Genetic diversity	No change		***Genetic diversity***
8	Number of forest-dependent species that occupy a small portion of their former range	Change "forest-dependent" to "native forest associated" and reword	**1.07**	Number and geographic distribution of forest associated species at risk of losing genetic variation and locally adapted genotypes
9	Population levels of representative species from diverse habitats monitored across their range	Add " forest associated" and reword	**1.08**	Population levels of selected representative forest associated species to describe genetic diversity
		NEW	**1.09**	Status of on site and off site efforts focused on conservation of genetic diversity

Indicator 1.01 - Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure

What is the Indicator and why is it important?

This indicator uses age-class distribution by broad forest type as a coarse measure of the landscape-scale structure of the Nation's forests, Within forest types, this serves as a surrogate for stand development or successional stage. A diverse distribution of forest lands across forest types and age-classes is an indicator of tree-size diversity and is important for determining timber growth and yield, the occurrence of specific wildlife and plant communities, the presence of other nontimber forest products, and the forest's aesthetic and recreational values.

What does the Indicator show?

Forest area in the United States stands at 751 million acres, or about one-third of the Nation's land area. Forest area was about one billion acres at the time of European settlement in 1630. Of the total forest land loss of nearly 300 million acres, most occurred in the East (divided into "North" and "South" regions in the accompanying charts) between 1850 and 1900, as broadleaf forests were cleared for agriculture. For the last 100 years, the total forest area has been relatively stable, while the U.S. population has nearly tripled.

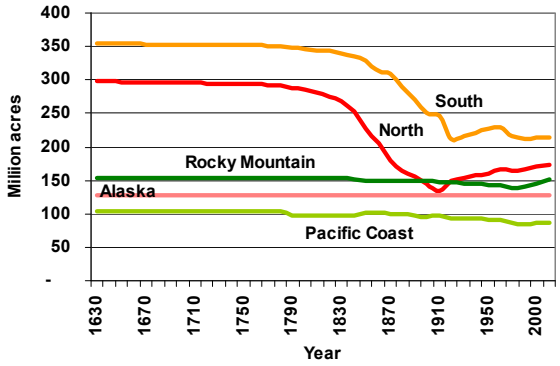

Figure 1-1. – Historic forest area in the U.S. by geographic region, 1630-2007

Today, regional forest cover ranges from a low of 19 percent of the land area in the Rocky Mountain region (Fig. 1-3) to 45 percent in the Pacific Coast region, 41 percent in the North, 40 percent in the South, and 34 percent in Alaska.

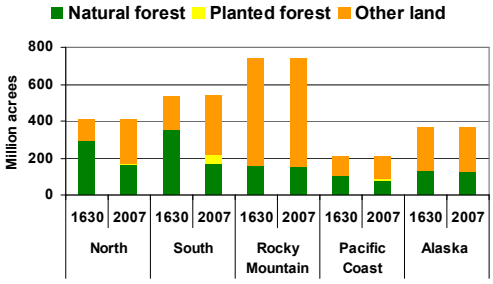

Figure 1-2. – Area of natural forest, planted forest and other land by geographic region, 1630 and 2007

Broadleaf forests. Broadleaf forests cover 290 million acres nationwide (figure 1-3), predominantly in the North and South (239 million acres). At 139 million acres, oak-hickory is the largest single forest cover type. It constitutes more than 19 percent of all forest land in the Nation and nearly half of all broadleaf forests. Covering 54 million acres, maple-beech-birch forests, are also dominant in the Eastern United States. Combined, these two upland forest types constitute nearly two-thirds of all broadleaf forests and have increased 25 and 39 percent, respectively, since 1977. Broadleaf types have a fairly normal age distribution, showing a bulge in the 40- to 79-year age-class, as second- and third-growth forests in the East continue to mature (figure 1-4).

Conifer forests. Conifer forests cover 409 million acres in the U.S. and are found predominantly in the West (314 million acres) and South (69 million acres). Pines are the single-most dominant group of conifer forests. Loblolly-shortleaf pine and longleaf-slash pine types in the South and ponderosa and lodgepole pine types in the West combine to cover 121 million acres, or more than one-fourth of all conifer forest types.

The largest single conifer type, with 58 million acres in interior Alaska, is the spruce-birch type. Douglas-fir follows closely, with 39 million acres found predominantly in the Pacific Coast Region. Conifer forests are somewhat bimodal in age structure with more acreage in younger age-classes because of more intensive management for wood production in the South and a preponderance of older stands in the West where most of the nation's old-growth forests occur.

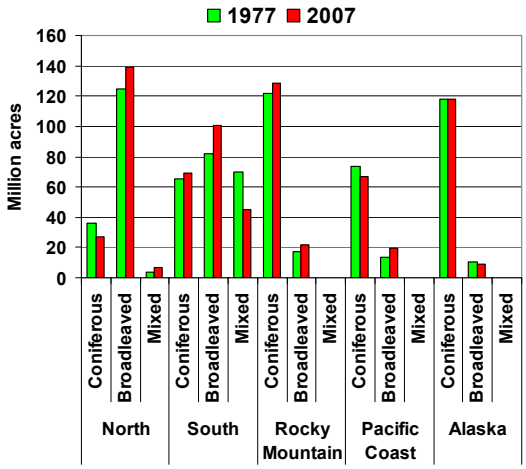

Figure 1-3. Area of forest land in the United States by major cover group, 1977 and 2007

Mixed forests. Virtually all of the nations mixed forests are found in the South, where oak-pine (30 million acres) and oak-gum-cypress (20 million acres) are the major forest types.. While oak-gum-cypress is found in the wet lowlands, oak-pine is usually found on the drier uplands of the South. The largest age class for these forests is 40-59 years old.

While trend data on forest age-class are sparse, historic data are available for average tree size in forest stands (figure 1-5). Stands averaging 0 to 5 inches in diameter increase as older stands are harvested and regenerated. The recent trend in this diameter class is slightly downward. Intermediate stands in the 6 to 10 inch diameter range have been declining, while stands averaging more than 11 inches in diameter have been rising. This later trend is indicative of shifts in management that have

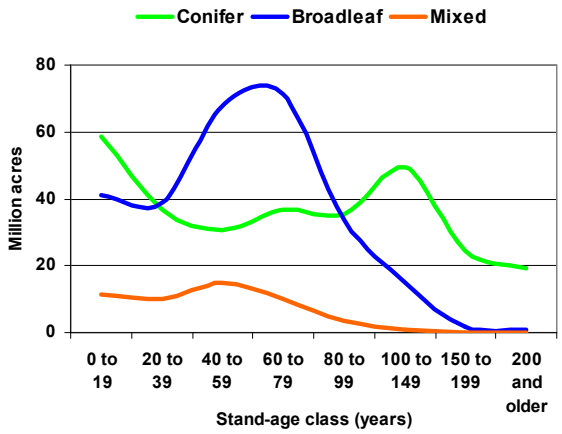

Figure 1-4. Forest area by stand-age class for conifer, broadleaf and mixed forests, 2007 (excludes Alaska)

harvesting on public forests in the West, thus increasing the acreage of larger diameter stands in that region, particularly in coniferous forests types.

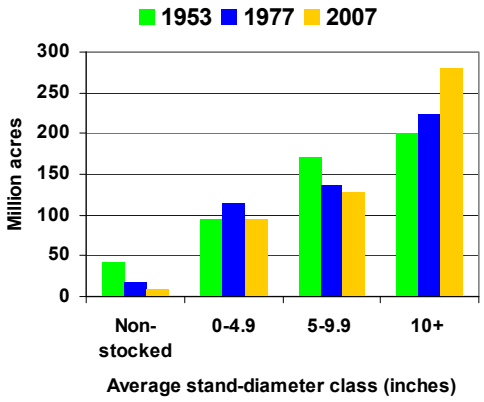

Figure 1-5. Trends in timberland area by average stand-diameter class, 1953-2007

Ownership patterns have a profound effect on forest management policies and activities. While forests of the North and South are predominantly in private ownership, the forests of the western regions are predominantly in public ownership (fig 1-6). Nearly 60 percent of all U.S. forests are in private ownership.

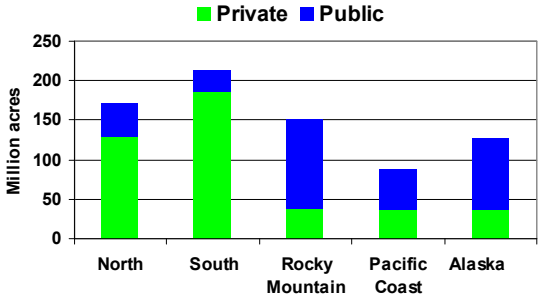

Figure 1-6. – Forest land ownership in the U.S. by geographic region, 2007

What has changed since 2003?

Forest land area has remained essentially stable since 2003. The data indicates an increase of 8 million acres (about 1 percent), but much of this increase came as result of changes in the classification of land cover types as either forest or non-forest. From a regional standpoint, there has been a general loss of forest in the coastal regions of the East and West with offsetting gains in forest area in the interior region.

Indicator 1.02 - Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage

What is the Indicator and why is it important?

The area and percent of forest ecosystems reserved in some form of protected status provides an indication of the emphasis our society places on preserving representative ecosystems as a strategy to conserve biodiversity. Important forest management questions also can be addressed by maintaining information on a network of representative forest types within protected areas. Traditionally, protected areas have been set aside, in part, for their conservation, scenic, and recreational values. The ecosystems in any one area might not represent the full range of biodiversity, but if it is part of a national conservation strategy (including rare and endangered species), then some degree of overall protection is available. Over time, forest types and their associated flora and fauna within protected areas will change and must be monitored as part of an overall strategy for conserving biodiversity. Adequate protection of the ecosystems and species in protected areas may also provide more management flexibility in forests under management for wood production and other uses.

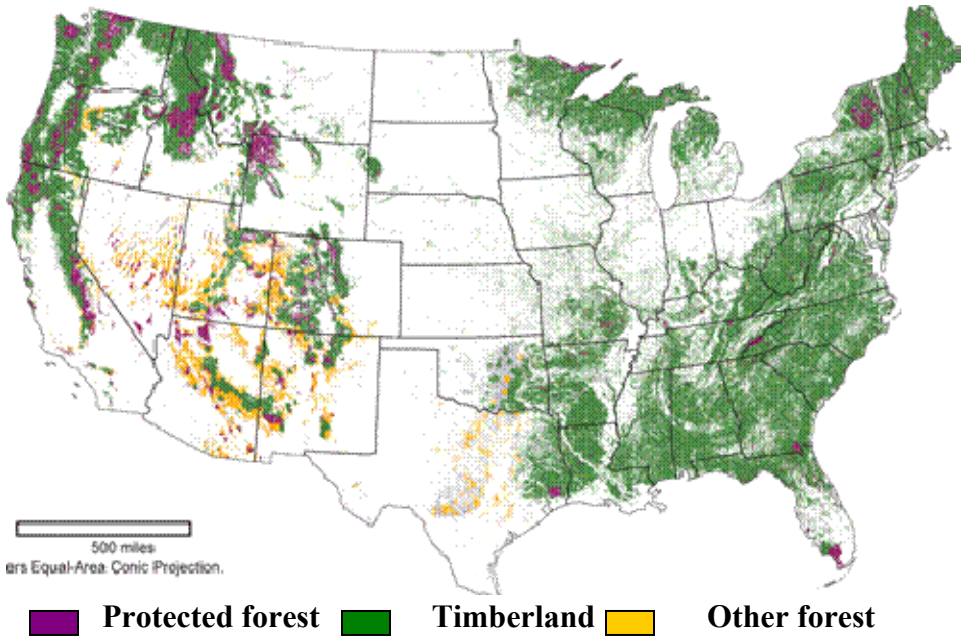

Figure 2-1. Forest land by major forest land class in the United States (excluding Alaska and Hawaii), 2007

What does the Indicator show?

The U.S. has a long history of forest protection. Yellowstone, one of the world's first National Parks, was set aside in 1872. In the late 1800's, the Forest Reserves (now the National Forests) were established to protect water and provide timber. The passage of the Wilderness Act in 1964 *(Public Law 88-577 , 16 U.S. C. 1131-1136)* provided further protection to millions of acres of forest throughout the nation. Protected forest areas are scattered throughout the U.S. but are most abundant in the West, predominantly on federal public land. In the East, the Adirondack and Catskills Reserves managed by the State of New York, at nearly 3 million acres total area, and set aside nearly 100 years ago as "wild forever," are two of the largest areas of protected forest in nonfederal ownership.

Protected areas in the U.S. are found within six IUCN categories (Wilderness, National Parks, National Monuments, wildlife management areas, protected landscapes, and managed resource areas), and are estimated to cover about 154 million acres (7 percent of all land) in the United States. An estimated 106 million acres of these protected lands are forested, representing 14 percent of all forest land (figure 2-1). Conifer forests, particularly on public lands in the West (Rocky Mountain, Pacific Coast, and Alaska Regions), have a larger percentage of area in protected status in the U.S. (figure 2-2a). The highest proportions of protection in conifer types are lodgepole pine at 49 percent, followed by

western white pine at 38 percent and fir-spruce at 34 percent of total forest area in each type.

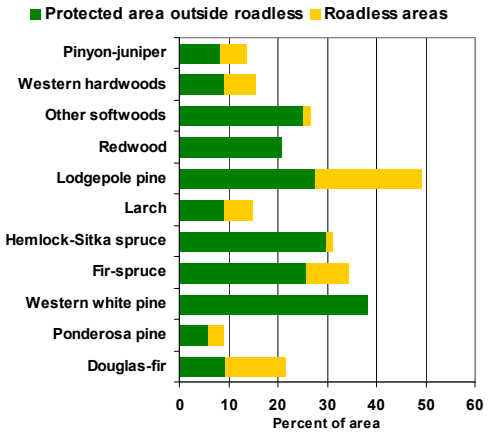

Figure 2-2a. – Percent of land protected by cover type in the West, 2007

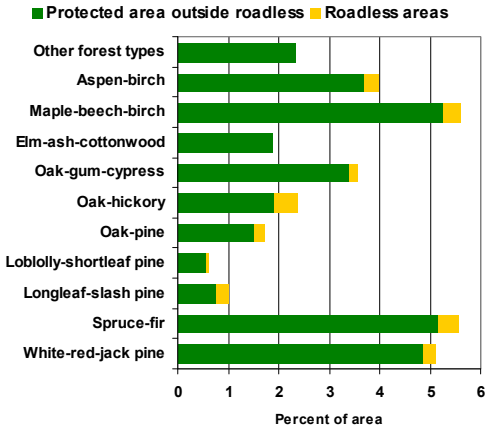

Figure 2-2b. – Percent of land protected by cover type in the East, 2007

A smaller proportion of broadleaf forests are in protected status since many of these forests are in the Eastern United States where private ownership is predominant. (figure 2-2b). The highest proportions of protection in the East are spruce-fir at 6 percent, maple-beech-birch at 6 percent and red-white-jack pine at 4 percent.

Protected forests are relatively older than those on non-protected lands (figure 2-3). Roadless areas have 52 percent of stands over 100 years old and other protected areas have 49 percent of stands over 100 years old, while all other forests outside protected areas only have 14 percent of stands over 100 years old. The more active management for wood products on the latter skews the forest area to younger age classes. Many of the younger stands in protected areas are the result of fires that have occurred in western forests at higher levels of frequency in recent years.

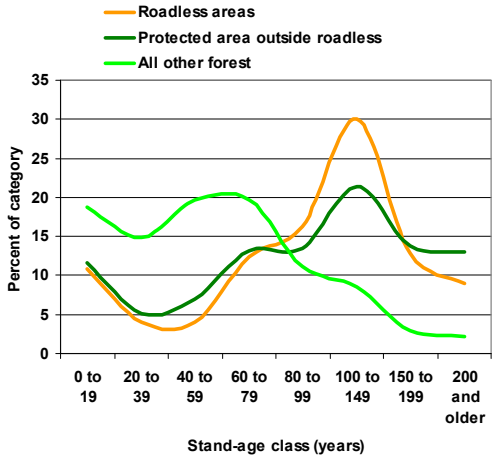

Figure 2-3. Protected and other forest land by stand-age class, 2007

If protected areas are not large enough to support the full range of habitat attributes need to sustain all ecosystem components, areas outside protected status are needed to contribute to biodiversity goals. The ability to manage both public and private unprotected forest lands for these broader goals will depend on the management objectives of the owners and their willingness to consider management options that can be integrated with those for protected areas.

What has changed since 2003?

The area of protected forests on public lands has changed little since 2003. However, as described in indicator 27, conservation easements and related mechanisms by which private lands are assured some level of protection are growing in importance. Currently the total area protected in this fashion is small relative to the area of publicly protected lands, but it is growing rapidly with the support of both public and private funding sources.

Indicator 1.03- Fragmentation of forests

What is the Indicator and why is it important?

This indicator provides information on the extent to which forests are being fragmented over time by human activities and natural processes. Fragmentation may lead to the isolation and loss of species and gene pools, degraded habitat quality, and a reduction in the forest's ability to sustain the natural processes necessary to maintain ecosystem health. The fragmentation of forest area into smaller pieces changes ecological processes and alters biological diversity. This indicator includes several measures of the extent to which forests are fragmented at several spatial scales of analysis.

What does the Indicator show?

Analysis of fragmentation is scale dependent. Consequently, maps or summaries of fragmentation differ depending on whether the forest image or map is separated into small or large pieces (landscapes) for analysis.

Maps of forest land derived from satellite imagery at 0.22-acre resolution (circa 2001) show that while forest is usually the dominant land cover in places where forest occurs, fragmentation is extensive. Simply stated, places that are forested tend to be clustered in proximity to other places that are forested, but blocks of forest land are usually fragmented by inclusions of nonforest land. This pattern is repeated across a wide range of spatial scales. For landscapes up to 160 acres in size, at least 76 percent of all forest land is in landscapes that are at least 60 percent forested. For larger landscapes up to 118,000 acres in size, at least 57 percent of forest land is in forest-dominated landscapes (figure 3-1).

Core forest is forest on landscapes that are completely forested. The larger the landscape being examined, the less likely that it will be core forest. For 10-acre landscapes, 46 percent of all forest land is classified as core forest. Less than one percent of forest land is classified as core forest in landscapes that are 1,500 acres or larger.

Interior forest is forest on landscapes that are more than 90 percent forested. As with core forest, larger landscapes are less likely to have interior forest. When examining landscapes that are 10 acres in size, 60 percent of all forest land is interior forest. However, for landscapes larger than 250 acres, less than one-third of forest land is classified as interior forest. Forest area in landscapes dominated by forest (more than 60 percent forest) is greater than either core or interior forest, and dominant forest area also decreases with increasing landscape size.

Edge habitats have a different microclimate and often support a different species mixture than forest which is distant from an edge between forest and nonforest land. Overall, 54 percent of forest land is within 185 yards of forest land edge, 74 percent is within 330 yards of forest land edge, and less than 1 percent is at least 1900 yards (1.1 miles) from forest land edge.

What has changed since 2003?

Due to changes in land-cover mapping protocols, the statistics shown here are not directly comparable to those shown in the 2003 Report.

Are There Important Regional Differences?

Western forests (Pacific and Rocky Mountain regions) are less fragmented than eastern forests (North and South regions). This difference is most pronounced for landscapes smaller than 250 acres in size (figure 3-1).

Why Can't the Entire Indicator be Reported at This Time?

Regional baseline conditions and the specific ecological implications of observed levels of fragmentation are mostly unknown. The available data permit an analysis of overall forest land fragmentation but do not incorporate the influence of small roads nor differences in land ownership ("parcelization").

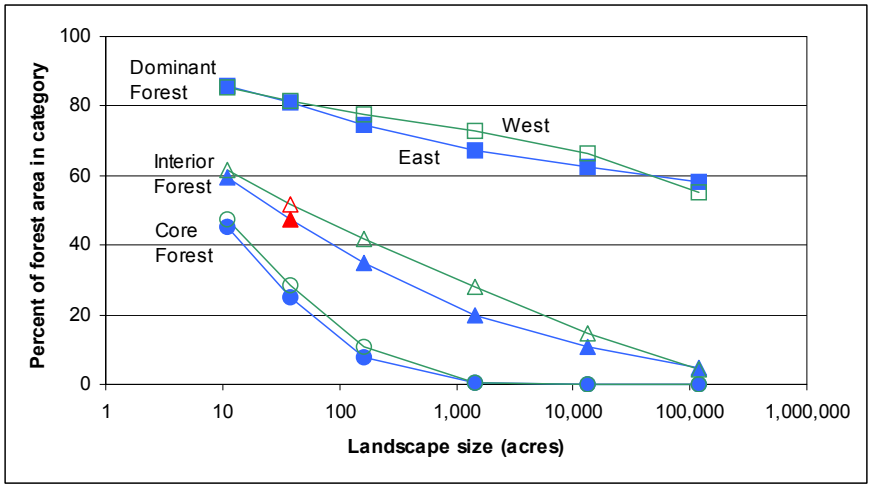

Figure 3-1. Forest land fragmentation from national land-cover maps. The chart shows the percentage of forest land in the coterminous United States that is considered core (completely forested landscape), interior (>90 percent forested), or dominant (>60 percent forested), and how those proportions decrease with increasing landscape size. The West includes the Pacific and Rocky Mountain regions; the East includes the North and South regions. Red symbols identify the conditions mapped in Figure 3-2.

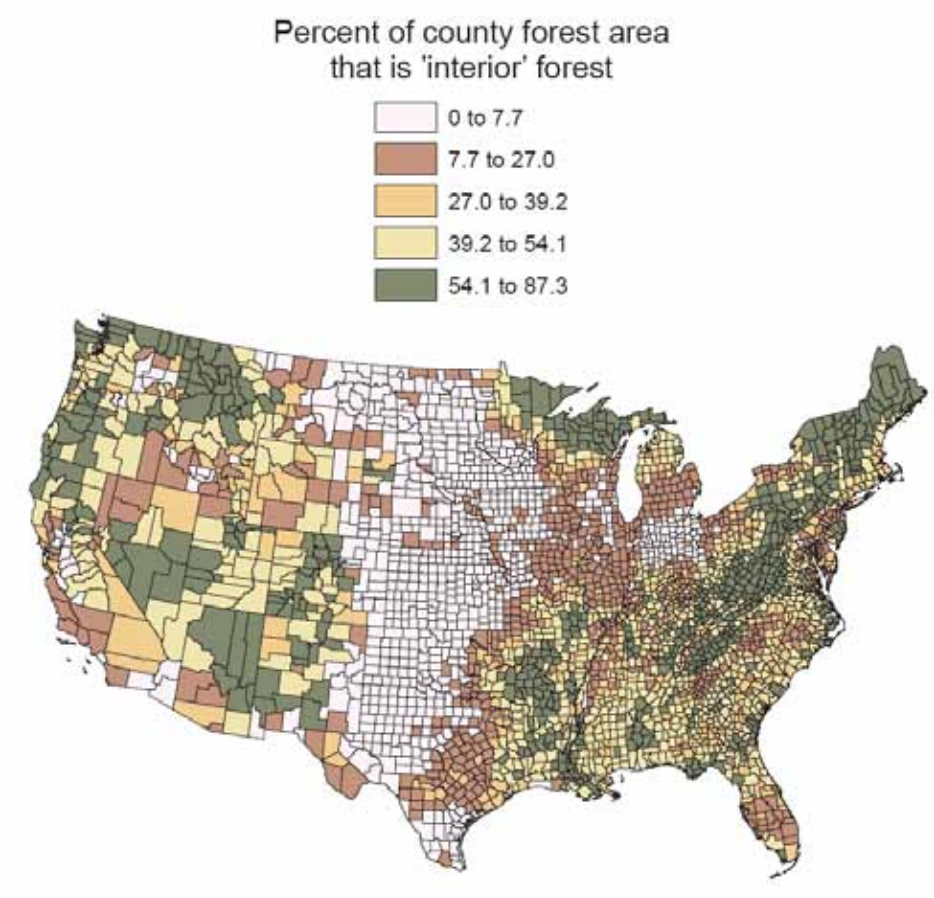

Figure 3-2. The percent of all forest in a county that is interior forest (> 90 percent forested) when analyzed at an approximately 40-acre scale (corresponding to the red symbols in figure 3-1). Larger values indicate that a larger share of the existing county forest is relatively intact, in comparison to forest in other counties. In this quantile map, equal numbers of counties are shaded with each color.

Indicator 1.04 - Number of native forest-associated species

What is this indicator and why is it important?

This indicator provides information on the health of forest ecosystems through the number of native forest-associated species. Because one of the more general signs of ecosystem stress is a reduction in the variety of organisms inhabiting a given locale, species counts are often used in assessing ecosystem well-being. The count of forest-associated species in a region will change when species become extinct; new species colonize; or species are merged or split according to shifting taxonomy. Although change in species counts due to swings in taxonomic convention is unrelated to biodiversity conservation, extinction and colonization can alter ecological processes in ways that affect the kinds and quality of ecosystem services that humans derive from forest ecosystems. Therefore, the loss or addition of species in an ecosystem can provide valuable insights into the overall health and productivity of that system.

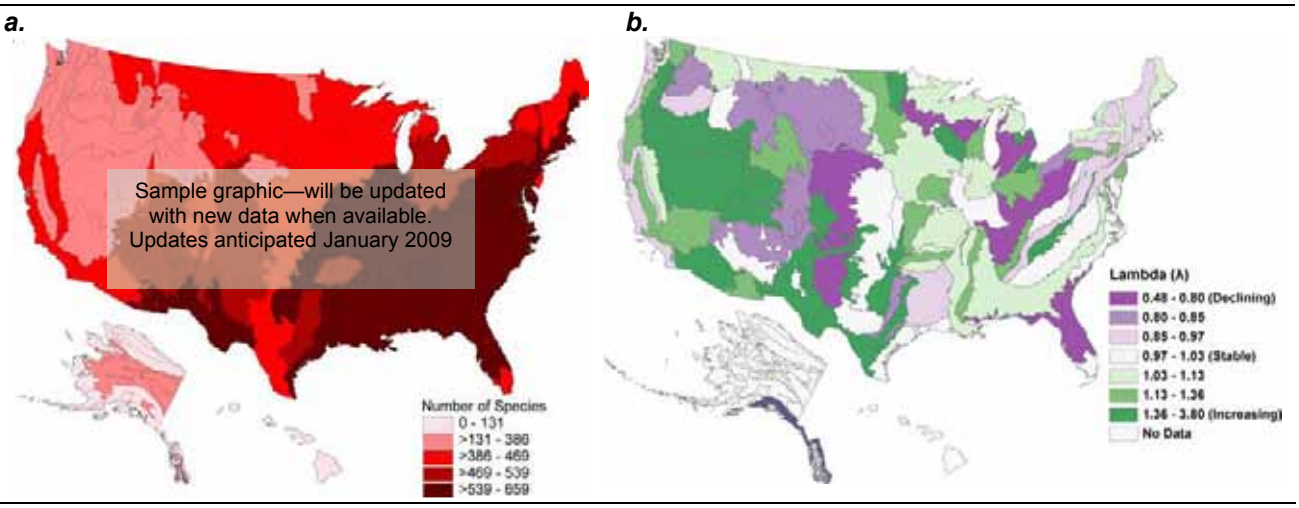

Figure 4-1 (a) The number of vascular plants, vertebrate, and invertebrate species associated with forest habitats. (b) The estimated change in the number of forest-associated bird species from 1975–2006. Change is measured as λ (2006 species count/1975 species count). Values of λ>1.0 indicate increasing species counts (green shades); values of λ<1.0 indicate declining species counts (purple shades). Data provided by NatureServe and the U.S. Geological Survey

What does the indicator show?

A substantial proportion of the needed for this indicator will be updated for the final report. Updates will be incorporated into the review draft as new data becomes available (updates anticipated January 2009. Numbers subject to updating are denoted by "###."

Data on the distribution of #### vascular plants and #### animal species associated with forest habitats (including ### trees, ### mammals, ### birds, ### amphibians, ### reptiles, ### freshwater fish, and ### invertebrates) reveal notable differences in the number of species that occur in major ecoregrions of the U.S. The number of forest-associated species is highest in the Southeast and in the arid ecoregions of the Southwest (Fig. 4-1*a*). Long-term (1975-2006) trends in number of forest bird species within these ecoregions have been mixed (Fig. 4-1*b*). Ecoregions where the number of forest bird species has had the greatest estimated increase include the desert systems of the intermountain West; the southern semi-arid prairie and plains; and scattered forest systems within the Great Lakes region. The greatest estimated decline in forest bird numbers were observed in the semi-arid prairies of the central Great Plains; the southern coast plain of peninsular Florida; and the plateau and mixed woodlands of the upper Midwest.

What has changed since 2003?

Since the 2003 Report there has been an increase in #### forest-associated species with notable increases in vascular plants (+### species) and invertebrates (+### species). These increases reflect new understanding of the full compliment of species that inhabit forest ecosystems and don't reflect national gains in forest species. Our knowledge of which bird species are associated with forest habitats has not changed since the 2003 Report and we had sufficient data to quantify trends in the numbers of forest-associated bird species. Many regions throughout the coterminous U.S. have shown continued increases in the number of forest bird species or have changed to increasing trends since the 2003 Report (Fig. 4-2a).

Of particular note are the Appalachian Mountains from Maine to northern Alabama; the southeastern coastal and Mississippi alluvial plains; the temperate prairies of the northern Great Plains; the cold deserts of the central intermountain West; and the Cascade Mountains of the Pacific Northwest. Those regions where the number of forest bird species have continued to decline or have to decreasing trends since the 2003 Report (Fig. 4-2b) are prominent throughout the semi-arid prairies of the Great Plains; the piedmont and plateau regions that straddle the Appalachian Mountains; coastal areas in New England, Texas, and the Pacific Northwest; and the regions that comprise the intensive agricultural lands in the upper Mid-west.

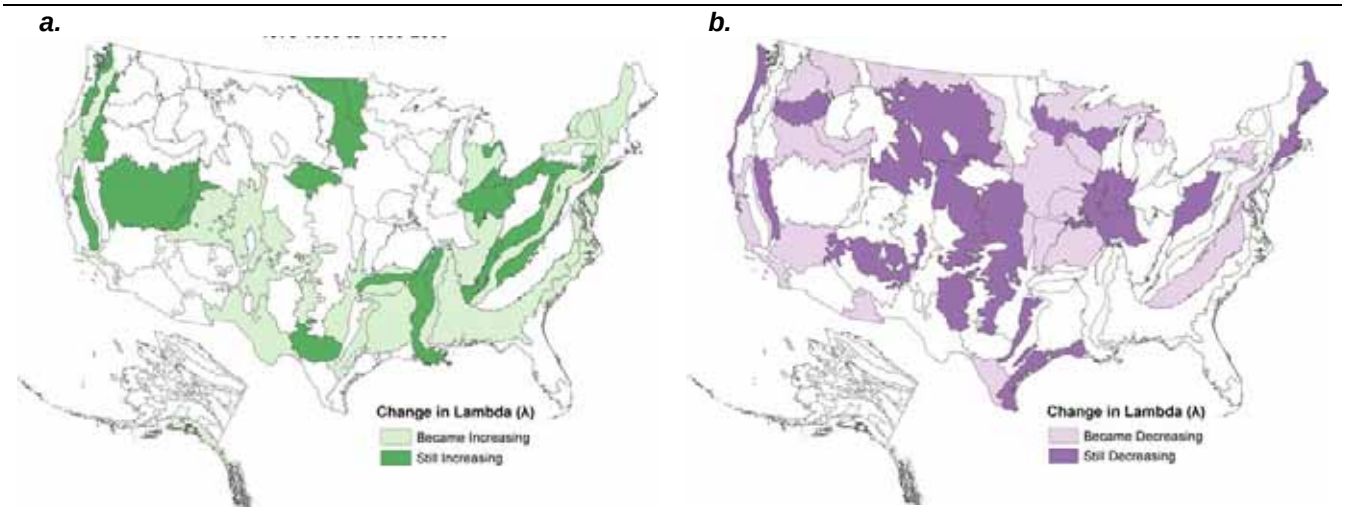

Figure 4-2 A comparison of the 2003 Report trends (1975-1999) to recent trends (1999-2006) in forest bird species counts. (a) Those strata that have continued to see increases in bird species counts or were declining in the 2003 Report but have become increasing. (b) Those strata that have continued to see decreases in bird species counts or were increasing in the 2003 Report but have become decreasing.

Why can't the entire indicator be reported at this time?

Monitoring the count of different species over large geographic areas is difficult. For this reason we lack systematic inventories that permit the estimation of species numbers for many groups. The increase in the number of forest-associated species reported here reflects growing inventory coverage among groups for which our understanding of habitat associations has been incomplete (e.g., vascular plants, invertebrates). Until comprehensive biodiversity inventories are implemented, trends in the number of native forest species will have to be interpreted cautiously. The most fundamental need is to develop monitoring programs that are economically feasible and applicable across the diverse groups of species that inhabit forest ecosystems.

Indicator 1.05- Number and status of native forest-associated species at risk, as determined by legislation or scientific assessment

What is this indicator and why is it important?

This indicator provides information on the number and status of forest-associated species at risk or in serious decline. It accomplishes this by monitoring the number of native species that have been identified by conservation science or mandate to be at risk of local, regional, or global extinction. As the number of species considered to be rare increases, the likelihood of species extinction also increases. Demographic and environmental events such as failure to find a mate, disease, disturbance, habitat loss, and climate change interact to increase extinction risk as populations become smaller. Because important ecosystem functions (e.g., productivity, nutrient cycling, or resilience) can be degraded with the loss of species, there is concern that the goods and services humans derive from ecological systems will become diminished as more species become rare. For this reason, tracking the number of at-risk species and their status is a measure of the health of forest ecosystems and their ability to support species diversity.

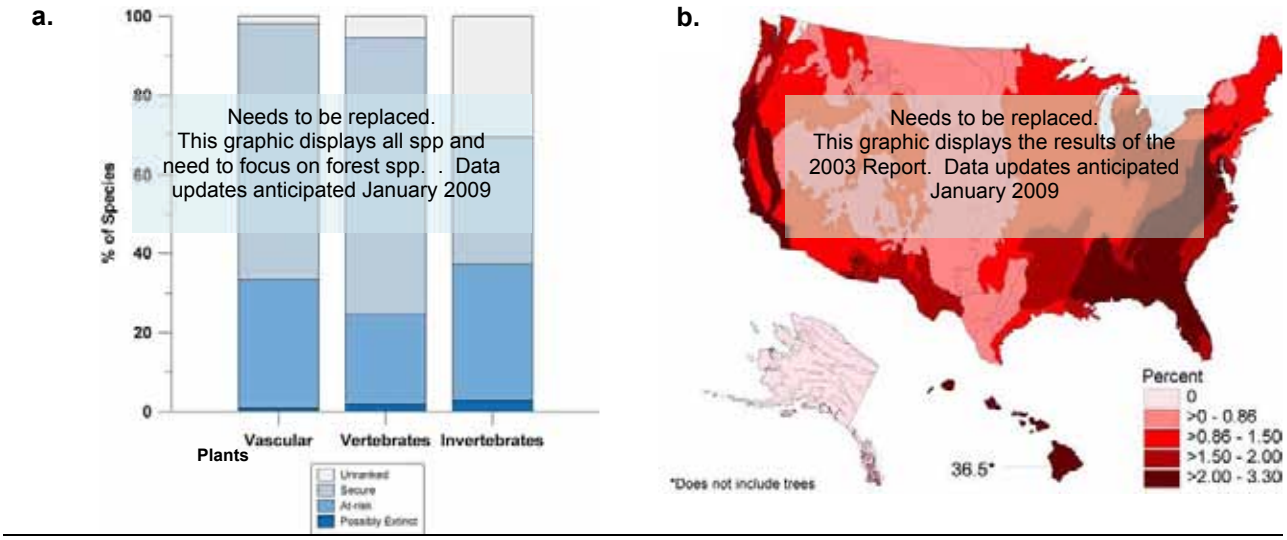

Figure 5-1 (a) The proportion of vascular plant, vertebrate, and invertebrate species associated with forest habitats determined to be possibly extinct, at risk of extinction, secure, or unranked. (b) The percentage of forest-associated species (vascular plants, vertebrates, and invertebrates) occurring in each ecoregion determined to be at risk of extinction. Data provided by NatureServe.

What does the indicator show?

The data and figures presented in this indicator brief will be updated for the final report. We are currently waiting on new data, which we anticipate should be available in January of 2009.

Among all forest-associated species, 614 (2%) were determined to be presumably or possibly extinct, 11,172 (32%) were determined to be at-risk of extinction, and 17,493 (51%) were determined to be apparently secure. The number of species in each conservation status category varies by taxonomic group (Fig. 5-1a). The number of possibly extinct and at-risk species is proportionately the greatest among invertebrates (37%), followed by vascular plants (33%) and vertebrates (25%). Within vertebrates, the greatest proportion of possibly extinct and at-risk species is found among amphibians (43%). Fishes (30%), reptiles (20%), mammals (18%), and birds (14%) show proportionately lower numbers of species that are of conservation consern. At-risk species that are associated with forest habitats are concentrated geographically in Hawaii, coastal plain and montane habitats of the Southeast, arid montane habitats of the Southwest, chaparral and sage habitats of Mediterranean California, and in the coastal and inland forests of northern and central California (Fig. 5-1b).

What has changed since 2003?

Since the 2003 there has been an increase in the number of forest-associated species that are considered possibly extinct or at risk of extinction, with the greatest gain observed among invertebrates (+2,254 species). Vascular plants (+270 species) and vertebrates (+32) also observed gains in the number of species of conservation concern. This gain appears to be largely attributable to new status assessments that have been completed since the 2003 Report. Evidence of this comes from the fact that the proportion of vascular plants, vertebrates, and invertebrates considered possibly extinct or at risk of extinction has remained relatively stable since the 2003 Report (Fig. 5-2a). This pattern even holds among the relatively well-known vertebrate species groups (Fig. 5-2b). Another contributing factor to the relative stability of the proportionate number of species that are of the greatest conservation concern stems from the fact that this indicator is a trailing indicator – changes in habitat (Indicators 1.01, 1.02, 1.03), population levels (Indicator 1.08), and geographic range (1.07) are expected to be observed before a species conservation status changes.

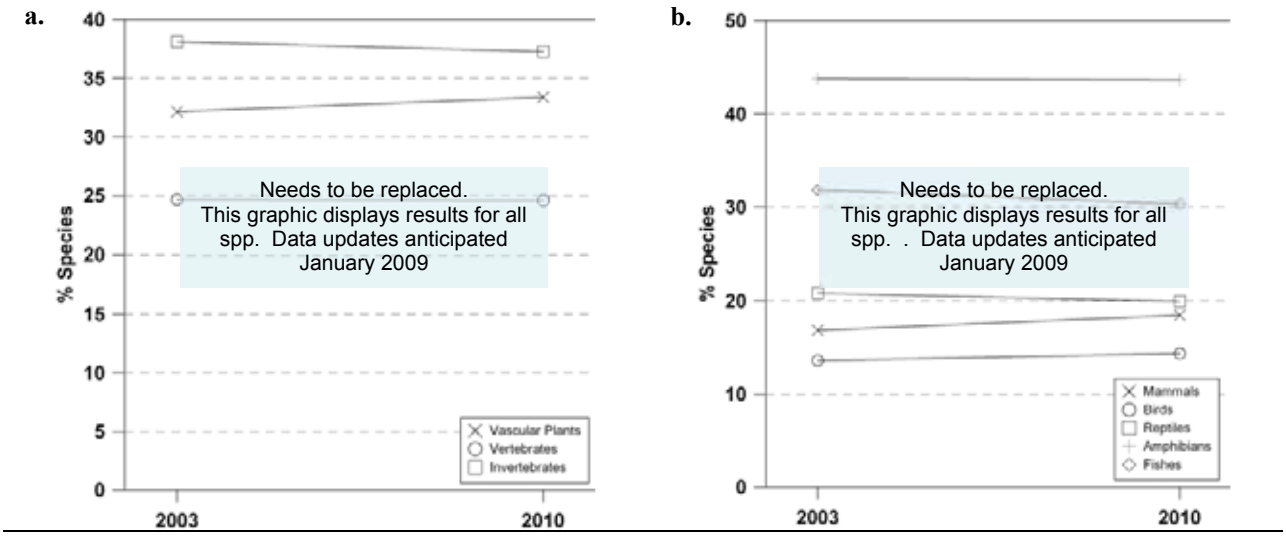

Figure 5-2 A comparison of the proportion of forest-associated species that have been determined to be possibly extinct or at risk of extinction between the 2003 and 2010 Reports among (a) vascular plants, vertebrates, and invertebrates, and (b) among the relatively well-know mammal, bird, reptile, amphibian, and fish vertebrate groups.

Why can't the entire indicator be reported at this time?

Information on the conservation status of obscure species is lacking in many cases. Among all species (not just forest associated), 323 (2.0%) vascular plant, 155 (5.3%) vertebrate, and 4,569 (30.6%) invertebrate species have not been, as yet, assigned a conservation status category nor a habitat affinity. Much of the uncertainty in these status assessments are concentrated among flowering plants (312 species), fish (148 species), insects (3,324 species), and mollusks (719 species). Given the number of species for which conservation status ranks are forthcoming, trends in the number of forest-associated species by conservation status will have to be interpreted cautiously since gains are expected as unranked species are evaluated. In addition to this data limitation, trend analysis was also limited by the fact that the ecoregional stratification changed from the 2003 to the 2010 Reports.

Indicator 1.06- Status of on site and off site efforts focused on conservation of species diversity

What is the Indicator and why is it important?

This indicator provides information that describes on site and off site efforts to conserve species diversity. Some forest species and habitats may have declined to such an extent that intervention is required to safeguard them for the future. As a result of the biological diversity losses caused by human pressure, different sectors of society (governments, nongovernmental organizations and individual citizens) are increasingly involved in conservation measures. Among others, the scope of initiatives includes scientific studies about species at risk, keystone species assessments, laws and projects that reinforce conservation of biological diversity, forest restoration and connectivity through both on site (in the forest) and off site (green houses, arboreta, zoos, and other facilities) efforts.

It is more practical to estimate expenditures associated with efforts to conserve biological diversity than to directly measure the results of those efforts. Expenditures by public agencies directed at conservation of biological diversity fall into three broad categories: (A) research associated with biological diversity, including among others, knowledge about keystone species, threatened species, functional groups, and spatial distribution; (B) environmental education and information about the importance of biological diversity, and (C) conservation projects related to habitat restoration and biological diversity conservation management. A fourth category of this indicator is (D) the proportion of forest area managed for biological diversity conservation, outside of protected areas, relative to the values for the entire national forests base. This indicator is closely related to indicators 2 and 9.

What does the Indicator show?

Expenditures for research, education, and management associated with conservation of forest biological diversity are concentrated in five federal agencies: the U.S. Forest Service, the National. Park Service, the Bureau of Land Management, the U.S. Fish and Wildlife Service, and the U.S. Geological Survey. In combination, those agencies spent approximately $2 billion in 2008 on research, education, and management that fosters conservation of forest biological diversity (Table 6-1). These expenditures are the equivalent of $2.68 for every acre of forest land in the U.S.

State natural resource agencies make additional expenditures associated with research, education, and management for conservation of species diversity. Virtually all of the Nation's school districts include biological diversity in their science curricula. Hundreds of nongovernmental organizations support research, monitoring, education, and management for biological diversity. Although these expenditures related to biological diversity conservation and education are impractical to compile and track separately over time, collectively they represent a significant investment are assumed to have significant impacts.

Table 6-1. Expenditures by five U.S. agencies on research, education, and management associated with conservation of species diversity, 2008. Expenditures for conservation of biological diversity in general or conservation of species diversity in particular are not tracked separately in agency budgets. Therefore, values for each agency are a compilation of activities closely aligned with conservation of biodiversity and adjusted for relative proportion of forest vs. nonforest land affected.

Agency	Fiscal Year 2006 (million $)	Fiscal Year 2007 (million $)	Fiscal Year 2008 (million $)	Net change 2006 to 2008 (million $)
Forest Service	974	986	969	-5
Fish and Wildlife Service	428	435	458	30
Park Service	379	396	416	37
Geological Survey	124	109	110	-15
Bureau of Land Management	62	63	63	1
Total	1,967	1,989	2,015	48

Most public forestland is managed to conserve species diversity. However, management for species diversity is usually pursued as an integral part of a multi-objective management strategy. Of the 751 million acres of forestland in the United States, 328 million acres (44 percent) are in public ownership (Figure 6-1) (also see Indicator 1). Nationally, 106 million acres of predominantly public forestland are classified as protected (see Indicator 2). Another 37 million acres of private land (forest land and other land) is protected in conservation trusts. Protected areas are an integral part of a national and global strategy to conserve biological diversity, but management of some species of concern requires management prescriptions that are incompatible with protected area regulations. Consequently, forestland outside of protected areas is also essential to conservation of species diversity.

What has changed since 2003?

This indicator was not reported in 2003. Expenditures summarized in Table 6-1 were compared to expenditures for the two prior years. Comparable federal expenditures related to conservation of biological diversity increased by $48 million from 2006 to 2008.

Are there important regional differences?

A majority of public lands are found in the West. These lands are managed for conservation of biological diversity as part of a multi-objective management strategy (Figure 6-1).

Why can't the entire indicator be reported at this time?

Conservation of species diversity is often linked with other management objectives and associated Federal expenditures are often impossible to fully separate from these other objectives. Moreover, states, school districts, and nongovernmental organizations, and private landowners play a large role in many aspects of species diversity conservation research, education and management. Consequently, this indicator underestimates the full magnitude of efforts directed at conservation of species diversity.

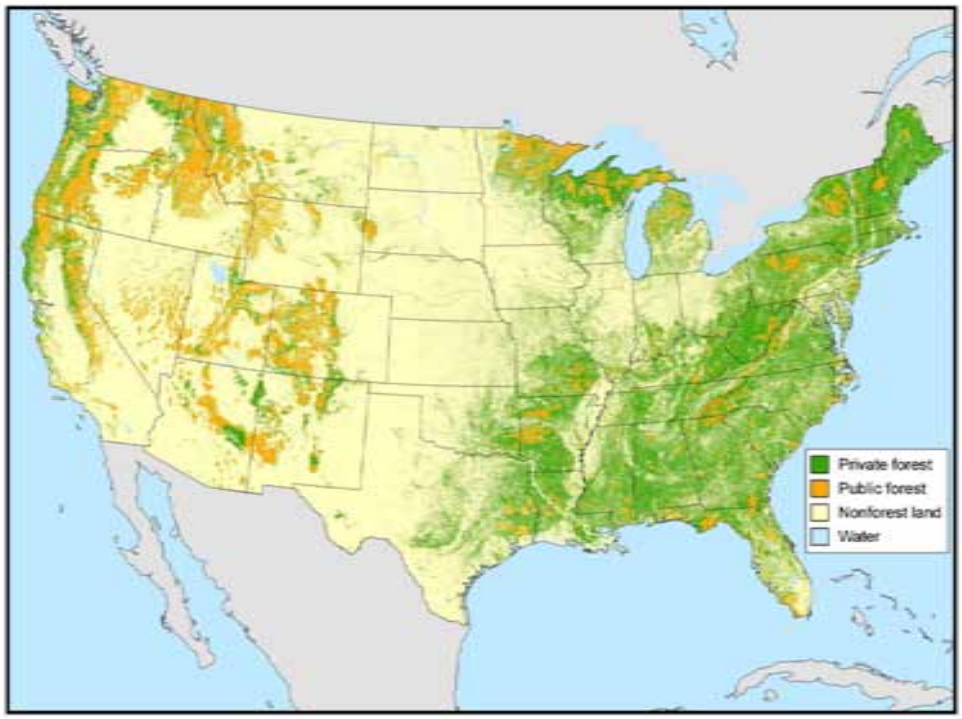

Figure 6-1. Forest land ownership in the conterminous United States. Public forestland is managed to conserve biological diversity, usually as part of a multi-objective management strategy. Public forest land is concentrated in the West. Alaska (72%) and Hawaii (34%) also have large proportions of their forest land in public ownership. [map produced by the Forest Inventory and Analysis Program, Northern Research Station, USDA Forest Service]

Indicator 1.07- Number and geographic distribution of forest-associated species at risk of losing genetic variation and locally adapted genotypes

What is this indicator and why is it important?

This indicator provides information on the number and distribution of forest-associated species at risk of losing genetic variation across their population. It is quantified by comparing a species' current geographic distribution with its historic distribution as a means of identifying those whose distributions have contracted significantly. Human activity, through land use conversions and resource management, are accelerating changes in species' distributions though alteration of native habitats, the introduction of exotic species, and direct exploitation. The size of a species' distribution is often related to the number of genetically distinct populations that exist. Consequently, species that currently occupy a smaller portion of their former distribution signals a potential lost of their genetic variation. This erosion in genetic variation makes species less able to adapt to environmental change. Ultimately, erosion of genetic variation increases the risk of species extinction and lowers the resilience of forest ecosystems to change.

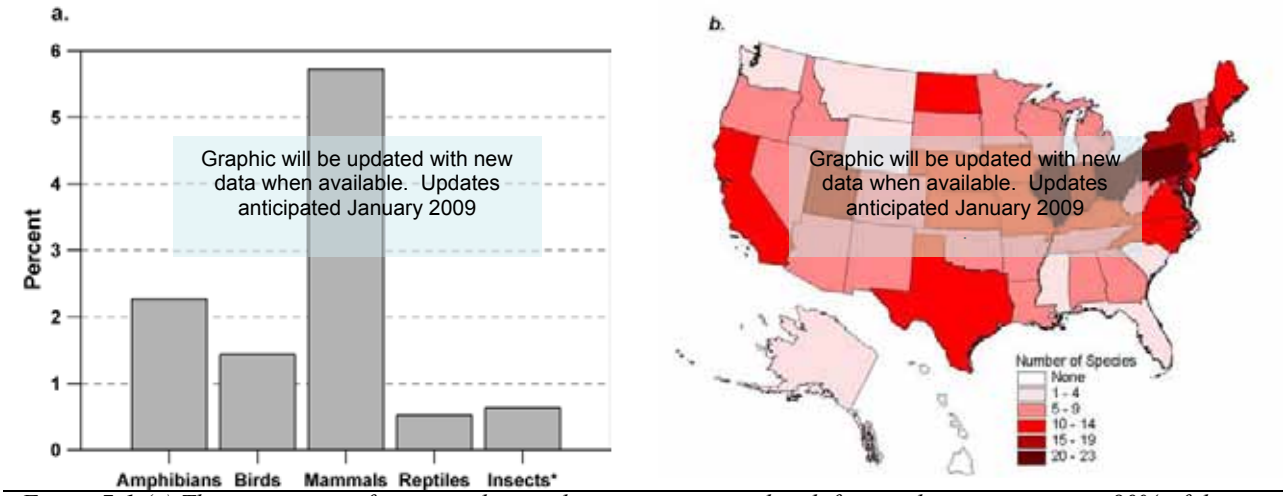

*Figure 7-1 (a) The percentage of terrestrial animal species associated with forests that now occupy ≤ 80% of their former geographic distribution (based on state-level occurrence data). (b) The number of terrestrial animal species associated with forests that have been extirpated within each state. Data provided by NatureServe. * Insects includes butterflies and grasshoppers only.*

What does the indicator show?

The data and figures presented in this indicator brief are from the 2003 report. We are currently waiting on new data, which we anticipate should be available in January of 2009. All text and graphics will be updated accordingly.

The geographic ranges of most species have not been appreciably reduced. Geographic range data for 1,642 terrestrial animals associated with forests show that 88% of species fully occupy their former range as estimated by state-level occurrence. Of the 193 species that have been extirpated from at least one state, 72% still occupy ≥ 90% of their former range. The number of species that now occupy ≤ 80% of their range varies by taxonomic group (Fig. 7-1a). Range contraction of this magnitude is most commonly observed among mammals (5.7%), followed by amphibians (2.3%), and birds (1.4%). Geographically, states that have lost the greatest number of terrestrial animal species associated with forests are concentrated in a band of states located along the southern edge of the Great Lakes (Fig 7-1b).

What has changed since 2003?

text pending receipt of data

Why can't the entire indicator be reported at this time?

Estimates of species' geographic distributions are a basic need of conservation plans. Although historical records, species collections, and expert opinion are available to estimate the distribution of most vascular plant and vertebrate species, we lack much of these data for those species groups that collectively represent the majority of described species (e.g., invertebrates, fungi). Even among vascular plants and vertebrates we lack data from which to quantify changes in the occurrence of species across the landscape. In particular, reconstruction of former ranges is hampered by the absence of comprehensive historic records. Although efforts are underway to document species distributions, these compilations are often based on expert opinion that provides an estimate of the current range only. Because a species' geographic distribution is dynamic, a statistically designed inventory that permits an objective and systematic assessment of range occupancy over time is needed to fully meet the intent of this indicator.

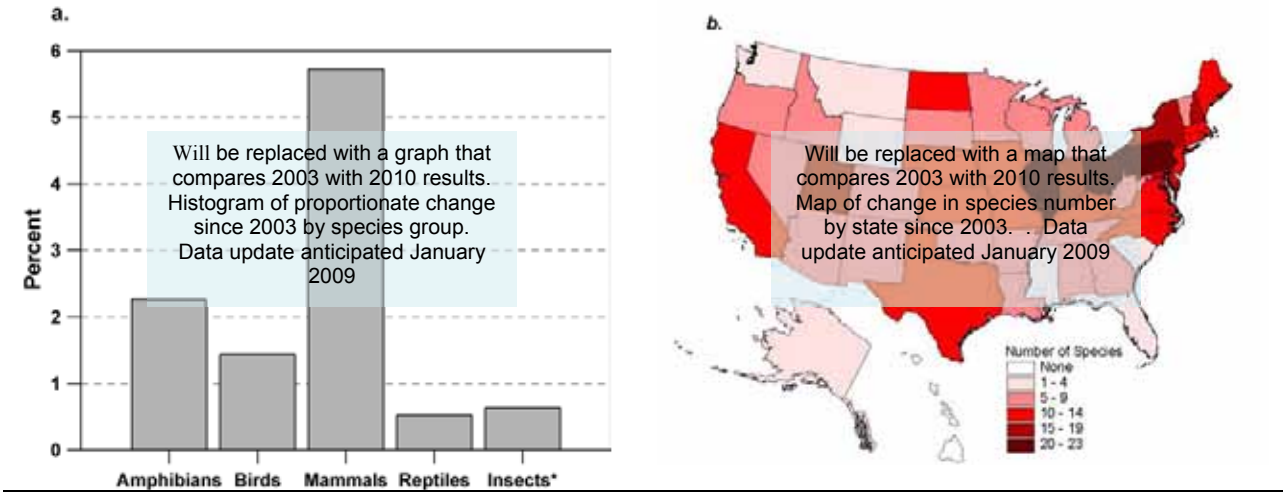

Figure 7-2 A comparison of the 2003 and 2010 Reports on (a) the proportion of forest-associated species that now occupy ≤ 80% for their former geographic distribution (based on state-level occun between the 2003 and 2010 Reports among (a) vascular plants, vertebrates, and invertebrates, and (b) among the relatively well-know mammal, bird, reptile, amphibian, and fish vertebrate groups.

Indicator 1.08- Population levels of selected representative forest-associated species to describe genetic diversity.

What is this indicator and why is it important?

This indicator uses population trends of selected bird and tree species as a surrogate measure of genetic diversity. Population decreases, especially associated with small populations, can lead to decreases in genetic diversity and contribute to increased risk of extinction. There are many forest dependent species that rely on some particular forest structure, forest vegetation associations or ecological processes. Monitoring population levels of such representative species will indicate the status of the associations of species dependent on specialized conditions. Management use of this indicator will ensure forest health conditions are being monitored and may help avoid species extinction.

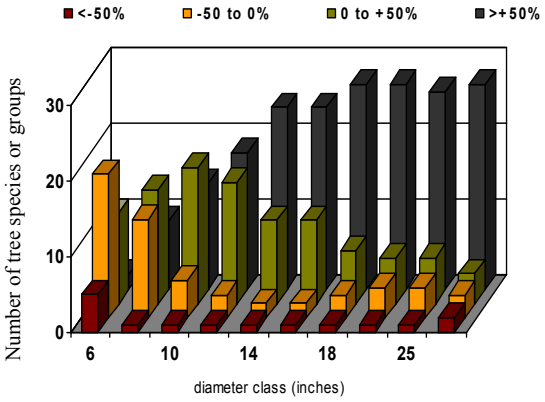

Figure 8-1 Number of tree species or groups of species in the Forest Inventory and Analysis database with decreasing and increasing stem numbers (a measure of tree population size), by diameter class mid-points, for trees > 5 inches diameter breast height, between 1970 and 2006.

What does the indicator show?

Between 1966 and 2006, about 27% of forest-associated bird species increased and 25% decreased; for nearly half the species there was no strong evidence for an increasing or decreasing trend. The majority of the 38 tree species or species groups tracked by the Forest Inventory and Analysis program showed increases in number of stems of >50% for moderate to large diameter classes (> 12 inches in diameter) between 1970 and 2007 (Fig. 8-1). State wildlife agency data indicate that populations of many big game species increased in the last 25 years, but forest-associated small game species showed mixed trends.

Are there important regional differences?

The South has the greatest proportion of physiographic regions with higher numbers of bird species with significantly decreasing trends compared to bird species with significantly increasing trends (Fig. 8-2). For tree species, the Pacific Coast region has a greater number of tree species or species groups showing declines in large diameter classes compared to other regions (Fig. 8-3).

What has changed since 2003?

The majority of forest associated bird species with significantly decreasing population trends between 1966 and 2003 also had decreasing trends between 1966 and 2006. Bird species associated with early successional and wetland habitats are among those with declining population trends; populations of some generalist bird species and some favored by burning have increased (Fig. 8-4a). Most tree species tracked by Forest Inventory and

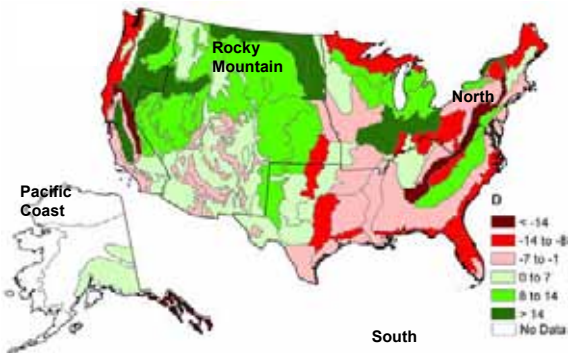

Figure 8-2 Difference (D) between the number of forest bird species with significantly ($P \leq 0.1$) increasing and decreasing population trends, by physiographic region, between 1966 and 2006, calculated from the Breeding Bird Survey (BBS) database

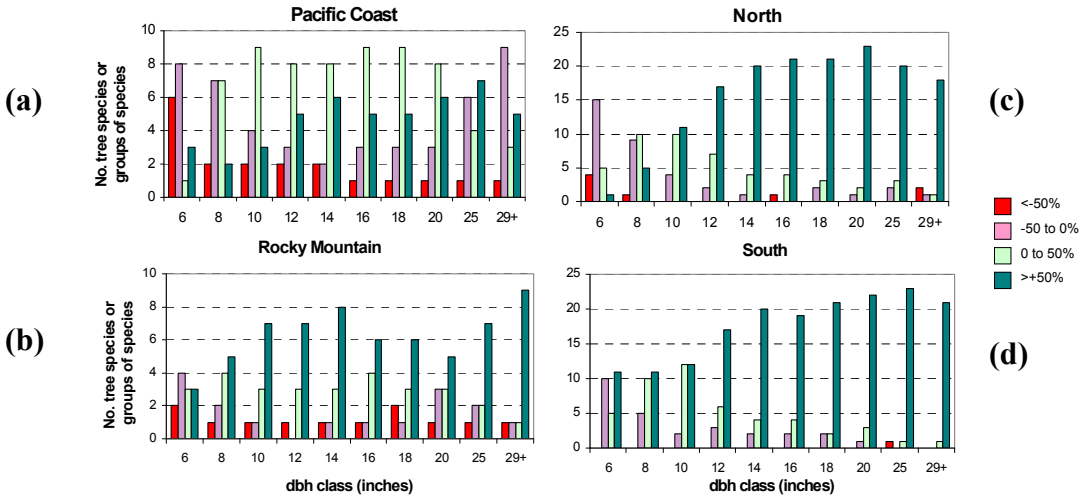

Figure 8-3. Number of tree species or groups of species in the Forest Inventory and Analysis database with decreasing and increasing stem numbers, by diameter class midpoints, for trees >5 inches diameter breast height, between 1970 and 2007, by region: (a) Pacific Coast, (b) Rocky Mountain, (c) North and (d) South.

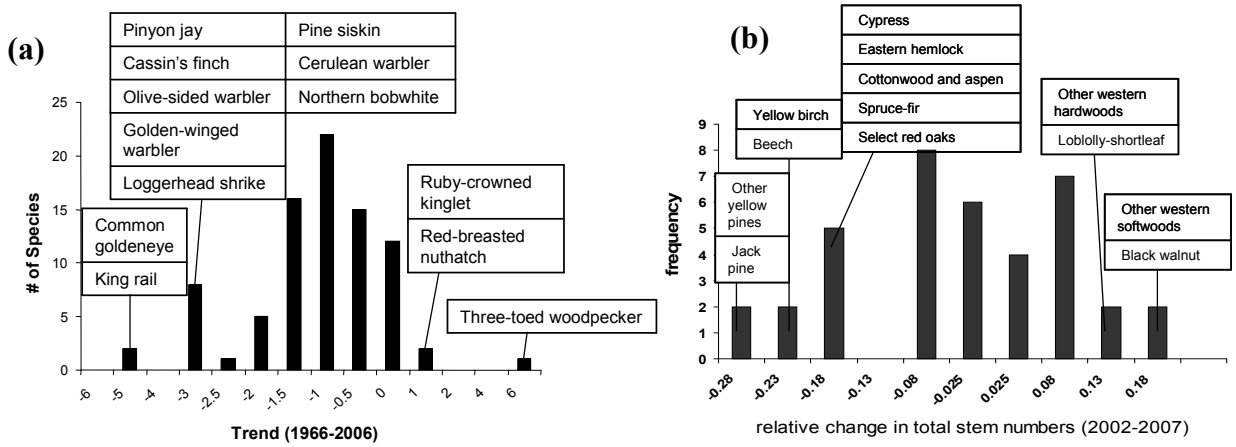

Figure 8-4(a). Number of forest bird species by population trend classes between 1966 and 2006 for the subset of species that had significantly ($P \leq 0.1$) decreasing population trends between 1966 and 2003, calculated from the Breeding Bird Survey (BBS) database. (b) Frequency of tree species or groups of species in the Forest Inventory and Analysis database by relative change classes in total stem numbers between 2002 and 2007.

Analysis showed relatively small changes in stem numbers since 2002, although a few species such as black walnut had increases >15% and other species such as jack pine decreased by >25% (Fig. 8-4b).

Why can't the entire indicator be reported at this time?

There is paucity of population data for taxa other than trees, birds, and a small subset of hunted species. We need systematic strategies for monitoring population levels of other taxa and an objective approach for selecting a minimum subset of species that will adequately represent the status of genetic diversity across the full biota.

Indicator 1.09- Status of on site and off site efforts focused on conservation of genetic diversity

What is the Indicator and why is it important?

This indicator describes the extent of on site and off site conservation efforts for native species at the genetic level. On site efforts are those conducted in the field, such as efforts to increase populations of endangered species. Off site efforts are conducted in laboratories, greenhouses, arboreta, seed banks, seed orchards, and similar facilities. Sustainable forest management requires a commitment to conserve locally or regionally adapted populations of native species using a combination of on-site and off-site approaches.

What does the Indicator show?

On site conservation of genetic diversity is provided by parks and other protected areas, genetic and ecological conservation areas, reserved stands and planned natural regeneration. On site conservation efforts for genetic diversity of plants and animals vary greatly in spatial extent and intensity of management. Most public forests are managed in their entirety for genetic conservation for common species and managed intensively for species that are rare, threatened, endangered or of special concern. Some private forests also are managed to conserve genetic diversity. These efforts to conserve genetic diversity largely overlap with efforts to conserve species diversity that are described for Indicator 6, and that material is not duplicated here.

Off site genetic conservation efforts tend to be intensive and are often focused on breeding programs or archival programs. These measures are sometimes undertaken, for example, to ensure that seed used for replanting after harvest has sufficient genetic diversity. Off site genetic conservation occurs at zoos, seed banks, seed orchards, clonal archives, arboretums, and similar facilities. These are summarized in Table 9-1. Institutions differ in the proportion of total effort that is focused on forest species. Some institutions work on global as well as domestic forest genetic diversity conservation.

What has changed since 2003?

This indicator was not reported in 2003.

Are there important regional differences?

Many broad-scale on site efforts to conserve genetic diversity are associated with public forestland and protected areas. Most public forestland is managed to conserve species diversity and genetic diversity, often as part of a multi-objective management strategy. Public forest land and protected forests in all ownerships are concentrated the western United States. Indicators 2 and 6 provide additional details on this point.

Off site efforts to conserve genetic diversity are are not as constrained by the public land distribution governing on site conservation. Zoos, arboretums, and seed banks often work on global as well as national issues associated with genetic conservation. Facilities such as seed orchards, clonal archives, and provenance tests are constrained by the climate where they are located, but they also can participate in international efforts to conserve genetic material.

Why can't the entire indicator be reported at this time?

Conservation of genetic diversity occurs in many places and many ways. Arboreta, herbaria, seed collections, seed orchards, zoos, and dedicated breeding programs are intensive approaches (primarily off site) to conservation of genetic diversity. These are funded by federal, state, and local governments as well as by nongovernmental organizations and foundations. Ecologists, botanists, biologists, and foresters at universities across the Nation are engaged in projects that conserve genetic diversity of forest plants and animals. State and local native plant societies organize private individuals devoted to both genetic and species conservation. There is no practical way to enumerate all such efforts or the proportion of their efforts that is concentrated on forest associated species.

Extensive (primarily on site) efforts aimed genetic conservation take place on public and private lands across the Nation. Most management decisions affecting forest land managed by the U.S. Forest Service, Fish and Wildlife Service, Park Service, Bureau of Land Management and Corps of Engineers consider impacts on genetic and species diversity, with particular emphasis on species of regional, national or global conservation concern. State, county and private forests are often managed with similar attention to conserving biodiversity. It is not

possible to enumerate all such efforts, nor is it possible to discern the proportion of such efforts that is associated with conservation of genetic diversity of forest associated species. The quantitative information presented in this indicator does not include many of these efforts and thus underestimates the total magnitude of work devoted to the conservation of genetic diversity.

Table 9-1. Summary of agencies, institutions, and organizations that work on conservation of genetic diversity.

Category	Number
Arboretums affiliated with the American Public Gardens Association. Arboretums work largely, but not exclusively, with trees and other woody species. The American Public Gardens Association also has 176 affiliated botanical gardens and 14 native plant gardens. Some of these include forest associated species and some (e.g., Missouri Botanical Garden) work on issues related to global forest diversity sustainability.	91
Zoos accredited by the Association of Zoos and Aquariums. All focus on education, some have active research programs, and many feature forest-associated species from outside the United States.	181
Accredited aquariums. Populations of freshwater and anadromous fish, in particular, are closely tied to forest ecosystems.	37
States that fund forest tree nursery programs with total expenditures of $37 million. Many have associated seed orchards. Hundreds of private tree nurseries compliment state efforts as do the 58 commercial suppliers of tree and shrub seed.	33
The Forest Service National Seed Laboratory which conducts research and provides technical assistance for seed collection, certification, storage, testing, processing, and planting. The Forest Service National Seed Laboratory also houses the National Seed Coordinating Center for the Exchange of Forest Tree Germplasm, which coordinates seed exchange among member countries of the United Nations Food and Agriculture Organization. The U.S. Department of Agriculture National Center for Genetic Resources Preservation cooperates in the storage of forest species germplasm. The U.S. cooperates with other international gene bank programs including the Consultative Group on International Agriculture Research and the Svalbard Global Seed Vault.	1
The Plant Conservation Alliance is a consortium of ten Federal agencies and 270 non-federal cooperators representing various disciplines within the conservation field. Cooperators include many of the arboretums and botanical gardens mentioned above. Agencies and cooperators work collectively to solve the problems of native plant extinction and native habitat restoration, ensuring the preservation of our ecosystem. Federal agencies in the Alliance include the Forest Service, Fish and Wildlife Service, Bureau of Land Management, National Park Service, and Geological Survey.	280
Native plant societies in the United States. They collect, preserve, and propagate native seed sources for use in restoration projects. Many are associated with the Plant Conservation Alliance.	88
Herbaria in the U.S. that maintain millions of plants specimens. They document plant biodiversity, serve as a valuable reference for plant taxonomy, and can also serve as a source of DNA. The U.S. National Seed Herbarium is part of the U.S. National Arboretum.	697
Databases such as NatureServe and the U.S. Department of Agriculture Plants database compile information about taxonomy, range, and status of many forest-associated plants and animals. This is a valuable resource that assists in conservation of forest biodiversity.	Several

Criterion 2

Maintenance of Productive Capacity of Forest Ecosystems

What is this criterion and why is it important?

Forests, directly or indirectly, provide a wide range of extractive and non-extractive goods and services. The nature of theses goods and services change over time as a consequence of changes in social and economic demands, technology, and actions taken in the forest to provide the goods and services. Changes in the productive capacity of forests could be a signal of unsound forest management or unforeseen agents affecting ecosystems. This criterion has five indicators for evaluating the productive capacity of forest ecosystems. The first four indicators track traditional measures related to status and trends in forests available for wood supplies and the final indicator addresses trends nonwood related goods and services of the forest. The presentations in this criterion in will provide information by major geographic region.

What has changed since 2003?

The data - The most significant change since 2003 is the "freshness" of the data. In 1999, the Forest Inventory and Analysis (FIA) program shifted from periodic surveys of each State on a roughly 10-year cycle to an annualized survey which collects data in each State every year. The current exceptions are Wyoming (last survey 2001), Nevada (last survey 1989), Hawaii (last survey 1986) and interior Alaska (no complete previous survey) which are scheduled to begin annualized inventories pending sufficient program funding. In the long-term, this new approach will allow rolling average summaries of the status of forest inventory, health and harvesting data every year. For nonwood products, there are a wider range of datasets available for public lands since 2003, but data for private lands is still incomplete.

The indicators - Readers wishing to compare results of the 2003 and 2010 reports need to be aware of changes in the Criteria and Indicators. In 2007, the Montreal Working Group completed a review and revision of the indicators in Criteria 2 based on the experiences of the first round of country reports. The following table summarizes the revisions. Indicator reference numbers for 2003 and 2010 are provided to assist in comparisons with the previous report. A more detailed rationale for the revisions may be found at http://www.rinya.maff.go.jp/mpci/meetings/18_e.html.

Criterion 2 – Maintenance of productive capacity of forest ecosystems

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2003 Ref.	2003 Indicator	Revision action	2010 Ref.	2010 Indicator
10	Area of forest land and net area of forest land available for timber production	Change "timber" to "wood"	**2.10**	Area and percent of forest land and net area of forest land available for wood production
11	Total growing stock of both merchantable and non-merchantable tree species on forest land available for timber production	Change "timber" to "wood"	**2.11**	Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production
12	The area and growing stock of plantations of native and exotic species	No change	**2.12**	Area, percent, and growing stock of plantations of native and exotic species
13	Annual removal of wood products compared to the volume determined to be sustainable	Add comparison to "net growth"	**2.13**	Annual harvest of wood products by volume and as a percentage of net growth or sustained yield
14	Annual removal of non-timber forest products (e.g. fur bearers, berries, mushrooms, game), compared to the level determined to be sustainable	Change "timber" to "wood"	**2.14**	Annual harvest of non-wood forest products

Indicator 2.10- Area and percent of forest land and net area of forest land available for wood production

What is the Indicator and why is it important?

This indicator provides information fundamental to calculating the wood production capacity of existing forests and shows how much forest is potentially available for wood production, compared with total forest area. The availability as well as the capability of forest land to provide desired goods and services is a critical indicator of the balance of forest ecosystems relative to potential end uses. The multi-temporal nature of the management objectives and planning guidelines for the nation's diverse owners, however, make it difficult to summarize the area of forest available for wood production in a single value at a single point in time, much less consistently over time. Within the context of this report, forest available for wood production will be defined as forest land not precluded by law or regulation from commercial harvesting of trees or "timberland". In practice, the area available for wood production at any given time will always be a value less than total timberland. The amount of the area adjustment required to determine the actual availability of timberland will depend on the ownership mix and the management constraints in place at the time of analysis. This adjustment will affect all other indicators in Criterion two as well.

What does the Indicator show?

Forest land in the U. S., totaling 751 million acres, is nearly equally distributed between East and West, with 387 million acres in the East (North and South Regions) and 365 million acres in the West (Rocky Mountain, Pacific Coast, and Alaska Regions). Timberlands, including natural/semi-natural stands and planted forests comprise the largest category of forest (figure 10-1) with 514 million acres nationally; 368 million acres (72 percent) of this total is in the East and 146 million acres in the West. Planted forests currently comprise 12 percent (63 million acres) of all U.S. timberland and the area is increasing.

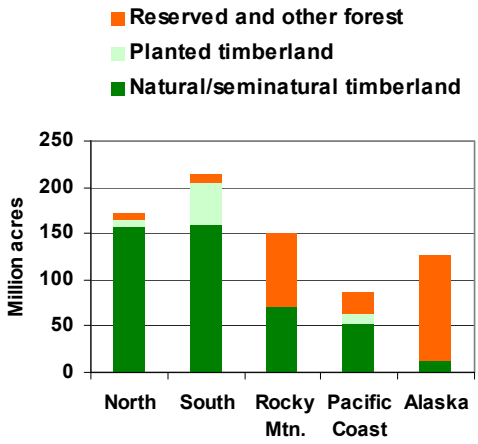


Figure 10-1. Forest land by Region and forest class, 2007

Planted forests are most common in the South where 45 million acres (72 percent) of all such forests in the U.S. occur. Planted forests are discussed in more detail in indicator 2.12. The total area of timberland in the U.S. has been stable over the past 50 years with an overall loss of only one percent (figure 10-2).

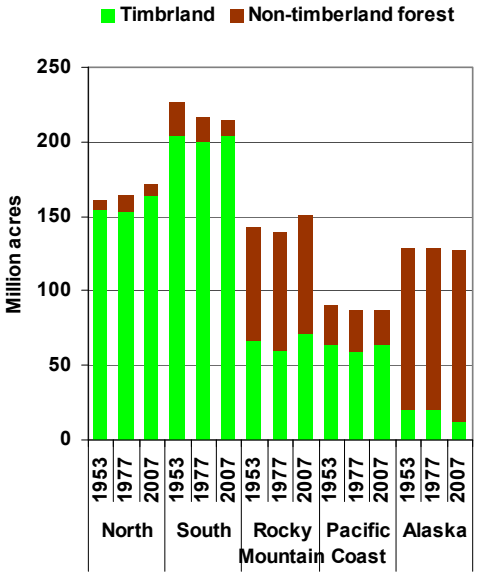


Figure 10-2. Timberland and non-timberland forest area by Region, 1953,1977 and 2007

Ownership also plays a key role in the area available for the nation's wood production. Timberland is generally concentrated on private lands in the East (figure 10-3) and public lands in the West. Overall, private timberlands account for

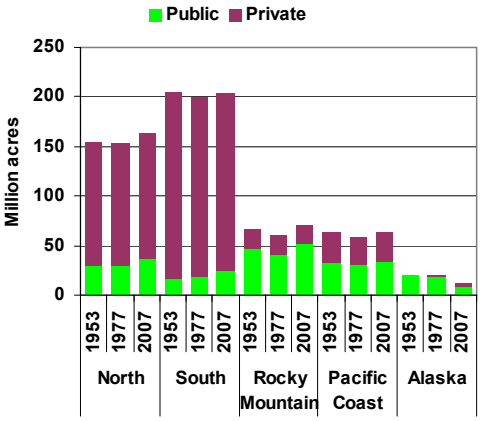


Figure 10-3. Timberland area by ownership and region, 1953, 1977 and 2007

Conifer forest types are fairly equally distributed between the East and West while broadleaf types are dominant in the East.

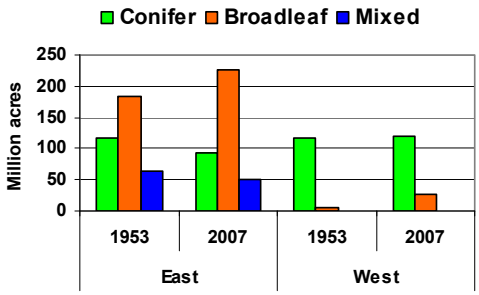


Figure 10-5. Timberland in the U.S. by major cover type, 1953 and 2007

Private timberlands currently account for 91 percent of the nation's wood production, compared to 86 percent in 1952 (figure 10-4). While public ownerships have the benefit of very long-term tenure, recent public land policy shifts toward reducing the amount of wood harvested from public lands have contributed to increased pressure on private forests in the U.S. and increased imports to meet the nation's wood needs.

356 million acres, about 69 percent of all forest available for wood production in the U.S.

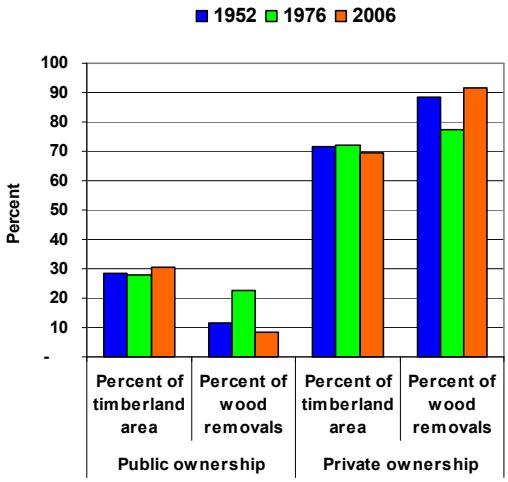


Figure 10-4. Percent of timberland area and wood removals by ownership group

The notion of sustainability of forest available for wood production is linked to the demand for these forests for other uses. Natural events, as well as competing societal forces can also affect availability. Fire, weather and insect and disease outbreaks can seriously impact supplies at any given time. Forest productivity can also be altered by pollution and human-caused degradation. Consumer preferences, recycling and investments in the forestry sector and availability of workers also play a significant role in wood production. Sound institutional frameworks that provide continuous monitoring of critical aspects of forests are invaluable. Simply put, wood production relies on the existence of available forest land and all of the factors that influence the sustainability of that land.

What has changed since 2003?

Timberland has increased by 7 million acres in the East (2 percent) and 3 million acres in the West (2 percent) since 2003. Much of the increase came from the reclassification of previously marginal timberlands or areas, particularly in the mid-section of the country, that were previously classified as nonforest. This reclassification is more consistent with national standard definitions, and was applied to areas that tended to be in private ownership.

Indicator 2.11- Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production

What is the Indicator and why is it important?

Growing stock is a fundamental element in determining the productive capacity of the area identified as forest available for wood production. Knowledge of growing stock of the various species that make up the forest and how it changes over time is central to considerations of a sustainable supply of wood for products and the sustainability of the overall ecosystems that provide them.

What does the Indicator show?

The nation's timberlands contain over 800 species of trees. Since changes in markets and technology dictate species use for wood products, it is difficult to assign the status of "non-merchantable" to any given species short of those with rare or endangered status. Variability in the condition of the size and quality of these trees has considerable bearing on their value in wood products. Generally speaking, about 94% of all live tree volume on timberland in the U.S. is considered to be growing stock or wood capable of being used for commercial products. The remaining 6% are trees of poor form, small stature, or otherwise unsuited for wood products. Given the minor influence of non-merchantable volume relative to total live volume of timber on forests available for wood production, the remainder of the discussion for this indicator will focus on merchantable or growing stock volume.

Overall, growing stock volume (Figure 11-1) has been rising in all regions of the country, for the past 50 years. The exception being the Pacific Coast and Alaska where harvesting of large timber and losses of high volume timberlands to reserves in the 1970s and 1980s resulted in declines. Recent reductions in harvest in this region have reversed this trend.

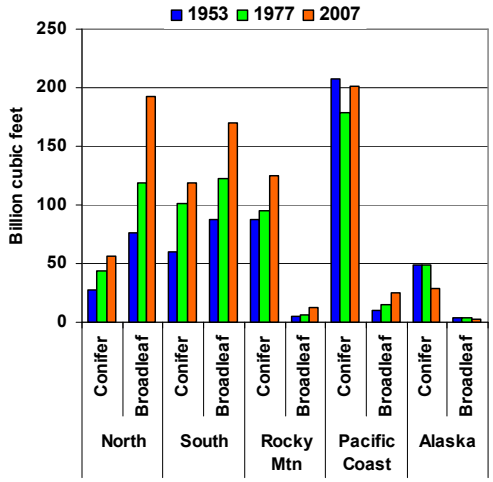


Figure 11-1. Growing stock volume on timberland by Region , 1953, 1977 and 2007

With a relatively stable base of forest land available for timber production or timberland (Indicator 2.10) and a historic pattern of growth exceeding removals (Indicator 2.13), the volume of growing stock in the U.S. has been rising steadily for more than 50 years. The current total of 932 billion feet of growing stock is 51% higher than the volume in 1953. The Nation's conifer growing stock volume totals 529 billion cubic feet or 57 percent of all growing stock. Conifer growing stock volume is concentrated primarily in the West and South. Broadleaves, at 403 billion cubic feet, account for 43 percent of all growing stock volume in the United States. Broadleaf volume has risen 118% since 1953 as second and third growth forests of the North and South continue to mature.

Growth rates on timberland have increased on all land ownerships (figure 11-2). The higher rate of increase on National forests due, in part, to a response to vigorous young stands replacing older slower growing stands harvested in the 70s and 80s or lost to fire. The higher overall rates and lower net change on private lands reflects the history of these lands being the primary source of wood production in the U.S. for decades.

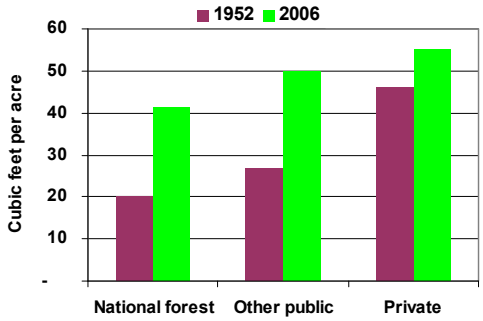


Figure 11-2 -Average Growing stock growth per acre on timberland by ownership group , 1953 and 2007

As mentioned in other indicators in this Criterion, ownership has a direct bearing on management policy and access to available timber. Timber volumes are distributed unevenly among owners because of many factors, among

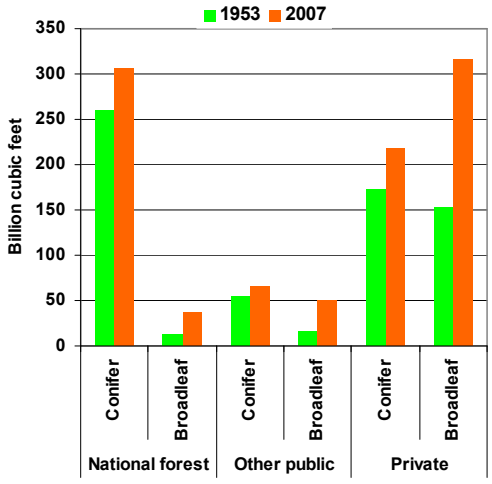


Figure 11-3.- Growing stock volume on timberland by Region, owner and species group, 1953 and 2007

them history of use, land productivity, and degree of management. As public agencies have adjusted management policies to respond to increasing demand for uses of public forest land for recreation, wildlife habitat, and biodiversity conservation, the area and corresponding volume of wood available for harvest from public timberlands is declining and placing additional pressure on private timberland and imports. This pressure is further heightened by improved technologies which allow a shift to broadleaves, which are dominant on private timberlands, for many uses previously dominated confiers such as paper and composite products to meet demand. Overall, growth on private timberland is increasing, but has slowed in response to increasing demand caused by shifts in policy and technology and the slowing growth of maturing braodleaf stands. This will likely abate slightly as regeneration following the recent increase in harvesting gets established.

National Forests, which account for only 19 percent of the Nation's timberland, have 30 percent of all timber volume, and 46 percent of all conifer timber volume. Changing management policies have significantly affected the National Forests and the wood they supply. The National Forests supplied 15 percent of the nation's wood in 1976, today they supply 2 percent. The future of wood supplies from this source is in question, but is likely to remain low.

What has changed since 2003?

Growing stock volume increased from 856 billion cubic feet to 932 billion cubic feet (9 percent) as net growth continues to exceed removals. Current conifer volume increased 8 percent (37 billion cubic feet) from the 492 billion cubic feet reported in 2003 and broadleaves increased 11 percent (39 billion cubic feet) from the 364 billion cubic feet reported in 2003. Recent large divestitures of timberlands by private corporate landowners, particularly forest industries, have left the future of what these lands will provide under their new ownership uncertain. However, arrangements for wood availability from these lands, ranging for 10 to 50 years, were part of the forest industry divestiture strategy.

Indicator 2.12- Area, percent, and growing stock of plantations of native and exotic species

What is the indicator and why is it important?

This indicator is a measure of the degree to which forest plantations are being established in response to increasing demand for forest products as well as competing nontimber uses for forest land. The provision of forest products from intensively managed plantations, which are more productive and efficient, can enhance the potential range and quantity of goods and services available from the forest.

What does the Indicator show?

In contrast to many other countries, virtually all tree planting in the United States is of native species with non-native species comprising less than one percent of all planted forest. Two types of planting can be identified; traditional plantations of intensively managed trees where other vegetation is actively suppressed, and planting to augment stocking of naturally regenerating forests. The former, predominantly occur in the East and the latter, predominantly in the West. Although conifers overwhelmingly dominate, broadleaves such as high value species like black walnut and oaks are planted as well. Additionally, a non-native hardwood, royal Pawlonia (*Paulownia tomentosa*) is planted to produce wood for export markets. While forest planting is common in the U.S., it should be noted that fully two-thirds of all of the annual 11 million acres of forest harvested in the U.S. regenerate by natural means.

Over the last 50 years more than 100 million acres of forest have been planted in the U.S. (Fig. 12-1), including regeneration after harvest of previously planted stands and converted natural stands. During this time incentive programs established millions of acres of planted forest including the Soil Bank Program in the 1950s and the Conservation Reserve Program during the late 1980's and early 1990's. While most of these planted forests were established on private land, public funding was often used to help put them into place. Historically, forest industries also leased private forest land or offered management assistance to private landowners to establish or maintain planted forests to assure future wood supplies. Recent large divestitures of most forest industry land, however, may have altered this practice and data from the new owners are needed to evaluate this situation.

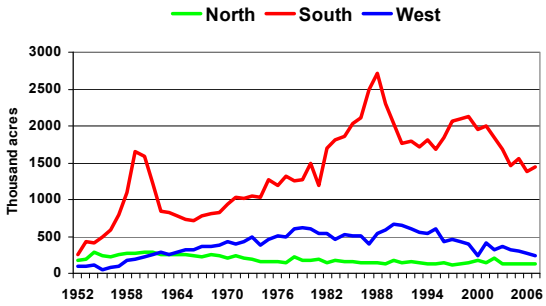


Figure 12-1. Area of tree planting in the U.S. by major geographic region, 1952-2006

Overall, planted forests account for 8 percent of all U.S. forest land and 12 percent of timberland, predominately comprised of conifer species. In the West, planted forests account for an estimated 12.2 million acres or 19 percent of all planted timberland (Table 12-1). About 95 percent of these occur in the Pacific Coast Region. In the East, planted forest totals 51 million acres or 80 percent of all planted timberland. Most planted forests are in the South which has 45 million acres, or about 71 percent of all planted timberland, and are primarily comprised of longleaf, slash, loblolly or shortleaf pine. Planted forest acreage continues to rise in the South and currently accounts for 22 percent of all timberland in the region. Increases at the current rate are not likely to continue as incentive programs subside and as previously planted stands are harvested and reestablished with no increase in net area in planted timberland.

Planted forests make up a substantial component of only a few forest type groups across the country. In the South, loblolly-shortleaf pine has the greatest acreage of planted timberland (figure 12-2) at 30 million acres or 48 percent of all planted timberland followed by longleaf-slash pine with nearly 8 million acres. In the North Region, white-red-jack pine planted

Table 12-1 Area of forest land and planted and natural timberland

Region and type	Forest land	Timberland		
		Total	Planted	Natural
EAST		*Million acres*		
Loblolly-shortleaf pine	55	55	30	24
Longleaf-slash pine	15	14	8	6
White-red-jack pine	11	10	3	7
Oak-pine	30	29	4	24
Other types	277	260	6	255
Total	**387**	**368**	**51**	**317**
West				
Douglas-fir	39	35	7	28
Ponderosa pine	25	23	1	22
Hemlock-fir-spruce	92	34	1	33
Other types	209	54	3	52
Total	**365**	**146**	**12**	**134**
U.S. total	**751**	**514**	**63**	**451**

timberlands are the most common with 2.8 million acres. And, in the West, Douglas-fir has the largest area of planted timberland at 7 million acres.

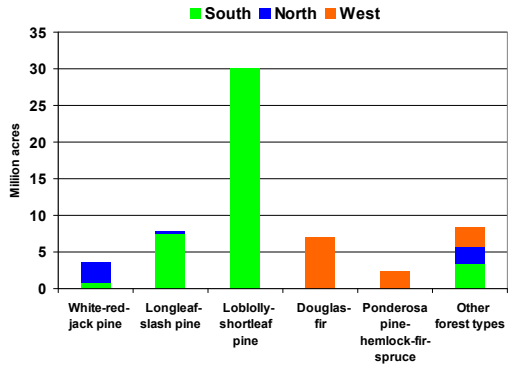


Figure 12-2. Area of planted timberland by major type and region, 2007

Nationwide, about 75 billion cubic feet of growing-stock inventory are contained in planted stands, about 8 percent of total growing-stock inventory (Table 12-2). This seemingly low contribution to inventory relative to percentage of all timberland planted (12 percent) is due to the young age class structure of the planted resource. Because of high productivity, planted stands make a significant contributions to timber inventory, even with a very young age-class structure.

In the South, planted stands are currently providing two-fifths of the region's softwood removals—a percentage that will rise as the relatively young stands increase in age. A forecast that planted timberlands in the South would supply more than one-half of the softwood removals in the region by 2010 appears to be on track.

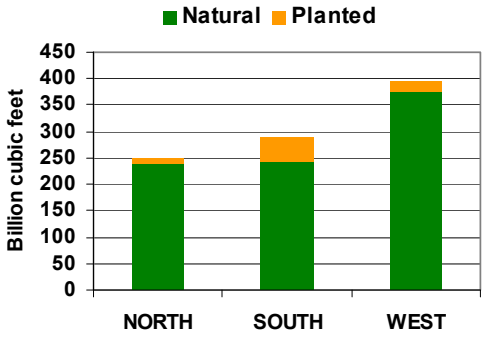


Table 12-3 Growing stock volume on planted and natural forest by region, 2007

Plantations are considered to be one of the best alternatives for maintaining wood supplies in the face of shrinking areas of forest available for wood production due to competing uses. Since the South will likely continue its dominance as the nation's wood basket well into the future this region's high yield planted forests will likely continue to play a crucial role in sustaining U.S. wood production.

Over the past decade, significant changes in forest ownership have occurred in the United States. Large-scale divestiture of landholdings by forest industry has resulted in the shift of millions of acres of these acres primarily to timber investment management organizations (TIMOs) and real estate investment trusts (REITs). Future changes in wood availability created by these shifts will need to be monitored.

What has changed since 2003?

The broader definition of planted forest vs. plantations allowed for the inclusion of large areas of forest where augmented stocking of natural regeneration takes place, mainly in the West. On this basis, planted forests increased from 56 million acres in 2003 to 63 million acres currently. The South continues to be main area for planted forests and increased from a reported 38 million acres in 2003 to 45 million acres in 2007. Volume on planted forests increased from an adjusted 57 billion cubic feet in 2003 to 75 billion cubic feet in 2007, a 32 percent increase. Volume in the South increased from 30 to 42 billion cubic feet (40 percent).

Indicator 2.13- Annual harvest of wood products by volume and as a percentage of net growth or sustained yield

What is the Indicator and why is it important?

This indicator compares net growth with wood harvest (removals) for products on timberland. This is a frequently-used method of assessing whether or not wood harvesting is reducing the total volume of trees on forest available for wood production. Growth is the net annual increase in the volume of growing stock between inventories after accounting for effects of mortality, but before accounting for the effects of harvest. Removals are a measure of the average annual volume of growing stock trees harvested between inventories. Timberland is assumed to be the subset of forest land on which some level of wood harvesting is potentially allowed. So long as growth (net of mortality) exceeds removals, the volume of trees on timberland is considered sustainable. This measure, however, conveys no information about quality, biodiversity, other attributes of ecology, or management objectives, and it should be considered in conjunction with other indicators to monitor the sustainability of a specific species or resource attribute. It needs to be evaluated in conjunction with other measures in other Criteria as part of an analysis of overall objectives for forest ecosystem sustainability.

What does the Indicator show?

Growth has exceeded removals on US timberlands for several decades (figure 13-1), while the area of timberland has remained relatively stable. The result has been a substantial increase in the volume of growing stock on U.S. timberlands. In the last decade, growth continued to exceed removals for both publicly and privately owned timberlands in the East (North and South Regions) and West (Rocky Mountain, Pacific Coast and Alaska Regions). Trends in growth on timberland since 1952 are attributable to several factors. In general, positive growth trends reflect regrowth and maturation of forests on lands that had been harvested prior to 1952. Investments in fire protection, landowner education, and silviculture are also reflected in the trends. Changes in harvest patterns in the 1990s resulted in growth and removals shifts by ownership and region. Historically, most harvesting occurred on private timberlands in the East and recent data show a further shift of removals from public timberland in the West to private timberland in the East as policies to reduce harvesting on public lands in the West were implemented. Thus, growth has been exceeding removals by a wider margin in the West while the gap has been decreasing in the East.

While this situation is significant, recent major planting of conifers in the South are rapidly becoming of commercial size and are expected to improve the situation in that region. Current growth measures in the South may not fully reflect anticipated growth on these planted forests. Currently, 91 percent of the Nation's wood output is produced on private lands.

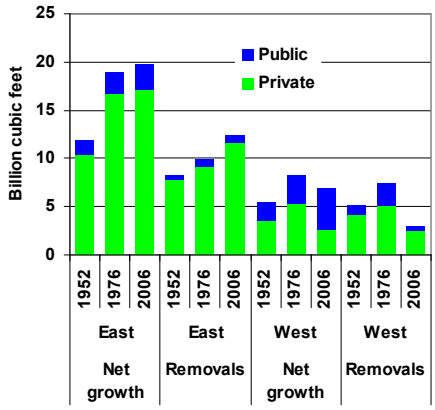


Figure 13-1 Growth and removals of growing stock by owner group and region, 1952-2006

Since 1952, overall conifer volume has increased 23 percent and broadleaf volume has increased 118 percent. The lower percentage for conifers is reflective of higher demand for wood products from these species. Growth exceeding removals in all regions for both conifers and broadleaves is reflective of this trend (figures 13-2 and 13-3).

Based on site productivity data measured during field inventories, an estimate can be made of the productive potential of U.S. forests and how they relate to the current situation (figure 13-4). This measure provides and estimate of the productive capacity of forests based on maximum growth at the culmination of mean

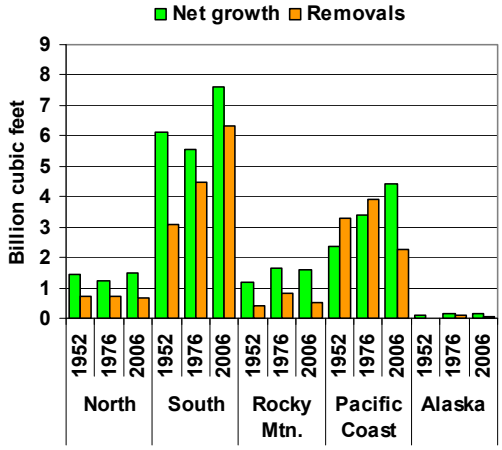


Figure 13-2. Net growth and removals of conifers in the United States, 1952-2006

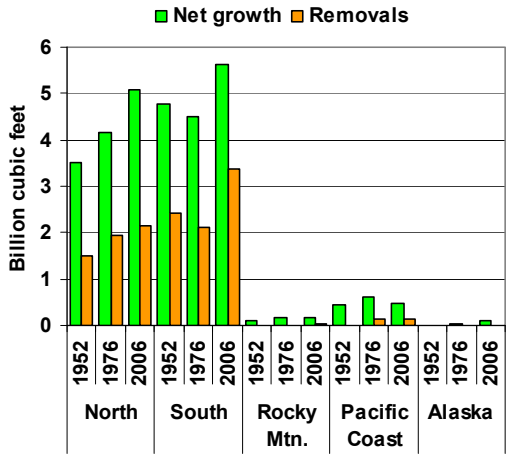


Figure 13-3. Net growth and removals of broadleaves in the United States, 1952-2006

annual increment. Overall, U.S. timberlands are growing at 51 cubic feet per acre per year, as opposed to a potential of 71 cubic feet. Thus current growth is 66 percent of its estimated maximum potential. Clearly there is capacity to sustain present levels of timber harvest from a pure wood volume standpoint, even at current growth rates. However, there are many reasons why the potential may not be achieved. The main reason is that the diverse objectives of the many different owners of the nation's timberlands may not have the maximization of wood fiber production as their primary objective.

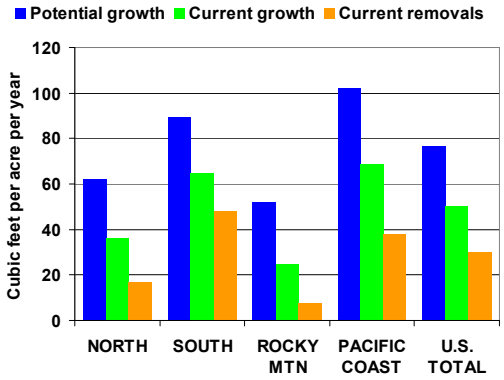


Figure 13-4. – Potential and current growth and removals on timberland by region, 2006

Saw/veneer logs and pulp wood are the dominant primary wood products from U.S, timberlands comprising 94 percent of all wood removals, up from 75 percent in 1953.

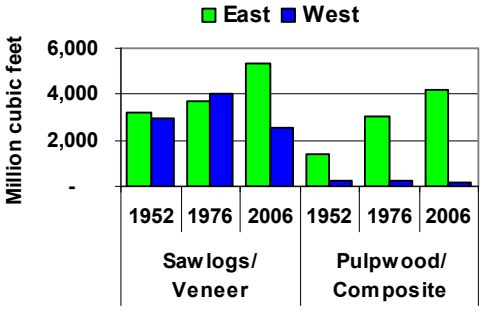


Figure 13-5 Removals of growing stock for major forest products, 1952, 1976 and 2006

Timberland is concentrated on private lands in the East and public lands in the West. Recent studies indicate that 58 percent of non-corporate private owners have harvested wood on their land. Recent large divestitures of forest land by private corporate landowners, particularly forest industries, have left the future viability of these lands for wood production less clear.

What has changed since 2003?

Growth continues to exceed removals on U.S. timberlands, as it has for over 50 years. Overall, domestic removals of growing stock have declined from 15.8 to 15.5 billion cubic feet since 2003. This is also reflected in the statistic that conifers and broadleaf removals were 75 and 58 percent of growth respectively in 2003, and currently these values are 65 and 49 percent respectively. Demand has not subsided, and imports continue to rise to meet the nation's wood needs (Indicators 6.28, 6.30 and 6.32).

Indicator 2.14- Annual harvest of non-wood forest products

What is the Indicator and why is it important?

This indicator measures harvest levels of non-wood forest products (NWFPs). Non-wood Forest Products include medicinal plants, food and forage, floral and horticultural products, resins and oils, arts and crafts materials, and game animals. As demand for these products grows, it becomes increasingly important to monitor the removal of products from forests, and the effects of their removal on the viability of current and future forest ecosystems.

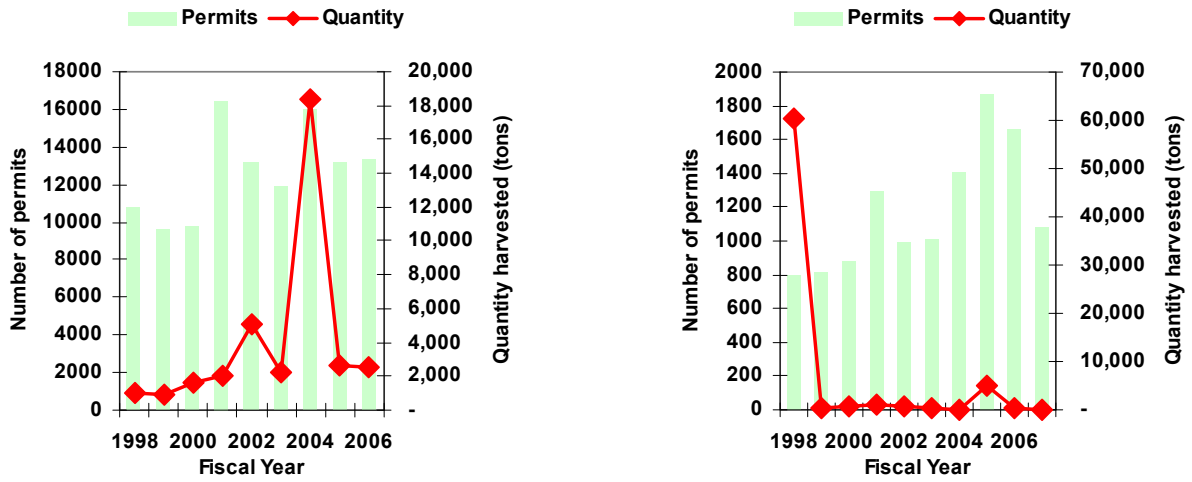
What does the Indicator show?

Non-wood Forest Products run the gamut from pine cones to fur-bearing animals, so it is not possible to measure a total harvest for the United States across all categories or even within an individual category. Instead, harvest levels are given here for representative products of particular importance or interest ecologically, economically or socially. Information on additional products for which data are available can be found in the supporting technical document in the Data Report.

Medicinal Plants- Seventeen of the 22 medicinal plants studied by the American Herbal Products Association in 2004-2005 were wild-harvested as opposed to cultivated. Harvests of medicinal plants occur throughout the country, though the temperate forests of the Eastern United States supply larger quantities of medicinal plant species. Of the species recorded by AHPA (2004-2005), 13 came from eastern forests. Ginseng (Panax quinquefolia) is one of the most well-known and frequently studied medicinal plants in the U.S. Over the last 3 decades (1978-2006), approximately 2.7 million pounds of ginseng have been harvested from eastern hardwood forests. Kentucky, West Virginia, Tennessee, Virginia, and Indiana comprise the top five ginseng producing states for those 3 decades. Kentucky was the largest producer during that time period, with a total harvest of 489,000 pounds of dried root (18% of total ginseng harvest). In 2006, 25 percent of total ginseng harvest came from Kentucky forests, and 70 percent of the total came from the combined states of Indiana, Kentucky, North Carolina, Tennessee, and West Virginia.

Food and Forage Plants- Contracts and permits issued by the U.S. Forest Service show that in 2006, over 13,000 permits and contracts were issued for the collection and/or consumption of food and forage plants on National Forests. Categories used for this analysis included fruits and berries, mushrooms and other fungi, and forage. Approximately 156,000 pounds of fruits and berries were harvested using those permits, 468,000 pounds of mushrooms and other fungi were collected, and over 2,000 tons of forage were consumed and/or otherwise harvested. The quantities of edible products harvested on National Forests have increased in all categories since 1998, except mushrooms and other fungi, which have experienced cyclical increases and decreases in harvest quantities (figure 1). Nearly 13 times the amount of fruits and berries harvested in 1998 were harvested on National Forests in 2006, although the number of permits and contracts issued only increased by 65% (less than double). Nearly 3 times the amount of grass was consumed or otherwise harvested in 2006 as in 1998, while permits and contracts issued only increased by 62% (less than double). On Bureau of Land Management (BLM) properties in the western United States, 1,086 permits for harvesting edibles and medicinals, mushrooms & fungi, and food & forage plants were issued in 2007—a 37 percent increase from 1998, but a 42 percent decline from a high of 1,869 permits issued in 2005. Most of those permits (99%) were for mushroom harvests. The number of permits only increased by 37 percent but the volume of mushrooms harvested nearly quadrupled. These trends suggest that people requesting permits are harvesting larger quantities on publicly owned land than they harvested in the past. Although data on the volume of NWFPs harvested on private land is lacking, a 2006 survey of United States private forest landowners indicated that, of an estimated 10 million private landowners nationwide (excluding AK, HI, west OK, and west TX), 10 percent collected edible plants for either sale or personal consumption (Butler in press).

Christmas trees, Floral, Horticultural, Arts, and Crafts- Many NWFPs can be used in both the floral industry and the arts and crafts industry, so it is difficult, if not impossible, to separate harvest data based on predicted end-uses. Therefore, this report has combined the two categories to make summarization more feasible. Permits issued on National Forests for Christmas tree harvest have declined steadily since 1998. In 2006, a little more than 50,000 permits and contracts were issued for Christmas tree collection—an increase of 20 percent from 2005,



F igure 1. Number of Permits, Contracts, and Quantity of harvest of combined food & forage categories on NFS land 1998-2006 (on left) and BLM land 1998-2007 (on right).

but a decrease of 71 percent since 1998 (figure 2). Christmas tree permits declined 66 percent from 1998 to 2007 on BLM land, also. The number of Christmas trees harvested on BLM land decreased from 27,709 trees in 1998 to 13,866 trees in 2007.

Both National Forest Systems and BLM have issued a fairly steady number of permits for the collection of mixed foliage, limbs, boughs & mosses every fiscal year since 1998. Harvest quantities on National Forests have ranged between a high of approximately 266,000 tons in 2005 and a low of about 7,000 tons in 2006. The number of permits issued by BLM for the collection of boughs, foliage, and mosses ranged from 1,496 in 1998 to 1,792 in 2007. BLM harvest quantities have generally ranged between 700 and 1,000 tons, with the exception of 2005, which experienced a low harvest of 285 tons. An estimated 727,000 private landowners collect NWFPs for decorative use, according to 2006 surveys.

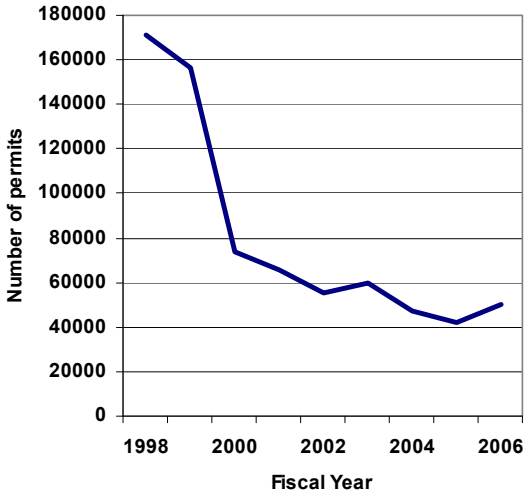


Figure 2. Number of permits and contracts issued for collecting Christmas trees on NFS land, 1998-2006.

Game animals and Furbearers- No updates have been made to available datasets since the 2003 synopsis of game animal and furbearer use in the United States. Therefore, we are simply re-stating the statistics from 2003 in this report update. From 1975 to 1996, the numbers of big-game hunters and time spent hunting big-game has increased, while the number of small-game and migratory bird hunters has decreased. Fur harvests declined from 20 million pelts harvested in 1980 to 3 million pelts in 1991.

What has changed since 2003?

The availability of a wider range of datasets represents the most significant change since the 2003 sustainability report. Based on the available data, nonwood forest products continue to be in demand, although the cultivation of some resources (for example, Christmas Tree farms) may be replacing the wild harvesting of select products. Although we now have the data necessary to track some harvest levels on public land, and some information about use on private land, we still lack the ability to determine the level of harvest that could be considered "sustainable."

Criterion 3

Maintenance of ecosystem health and vitality

What is this criterion and why is it important?

Ecosystem health depends on the functionality of natural, nondegraded ecosystem components and processes. The underlying premise is that forest species and ecosystems have evolved to function within particular environmental conditions determined largely by geological and climatic forces. Humans, meanwhile, have historically (and prehistorically) adapted their economic and social activities to environmental conditions and to the resulting ecological processes. Substantial modification of environmental conditions therefore threatens species' adaptive capacities, ecosystems' functional capacities, and that of the associated human economies and societies. For example, many local and regional U.S. economies depend on forests. To the extent that exotic species, air pollution, or diseases threaten the forests, the associated economies and communities are likewise threatened.

What has changed since 2003?

The data- The indicators in this criterion have benefited from data improvements resulting from ongoing survey efforts undertaken by the Forest Service's Forest Health Protection program.

The indicator- The following table summarizes the revisions. Indicator reference numbers for 2003 and 2010 are provided to assist in comparisons with the previous report. A more detailed rationale for the revisions may be found at http://www.rinya.maff.go.jp/mpci/meetings/18_e.htm .

Criterion 3 – Maintenance of ecosystem health and vitality				
15	Area and per cent of forest affected by processes or agents beyond the range of historic variation	Merge biotic components of 2003 indicators and change "historic variation" to "reference conditions"	**3.15**	Area and percent of forest affected by biotic processes and agents (e.g. insects, disease, invasive alien species) beyond reference conditions
16	Area and percent of forest land subjected to levels of specific air pollutants (e.g., sulfates, nitrate, ozone) or ultraviolet that may cause negative impacts on the forest ecosystem.	Merge abiotic components of 2003 indicators and change "historic variation" to "reference conditions"	**3.16**	Area and percent of forest affected by abiotic agents (e.g. fire, storm, land clearance) beyond reference conditions
17	Area and percent of forest land with diminished biological components indicative of changes in fundamental ecological processes (e.g., soil nutrient cycling, seed dispersion, pollination) and/or ecological continuity (monitoring of functionally important species, such as fungi, arboreal epiphytes, nematodes, beetles, wasps, etc.)	See above		

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Indicator 3.15- Area and Percent of Forest Affected by Biotic Processes and Agents (e.g. insects, disease, invasive alien species) beyond reference condition

Figure 1. Predicted Insect & Disease Risk, National 2006 Composite Insect and Disease Risk = 58 million acres (red)

Figure 2. Insect & Disease Mortality and Defoliation, indicating acres with mortality mapped 2003-2007 (red)

What is the Indicator and why is it important?

Observed activity and impacts from key biotic agents and processes measured by indicator 15 shows that forest ecological conditions have changed over time. The "reference condition" is defined as the previous reporting period used in the 2003 National Report on Sustainable Forests (i.e. the period including 1997-2002). Current analysis of these agents and processes, systematically measured at regular intervals and contrasted with reference condition provides natural resource professionals information necessary to support prudent forest health planning and management. The indicator relies on primary data collection (mainly aerial survey) augmented by modeling and analysis techniques. The technique is repeatable, and, with a growing database, increasingly reliable.

What does the Indicator show?

Figure 1 shows areas of predicted risk to disturbance by biotic indicators. Figure 2 shows areas with broad-scale forest decline and tree mortality detected for this indicator during the last 5 years. Recently mapped impacts show a three-fold increase in readily detectable processes relative to the 1997 to 2002 reference period, representing a significant departure from reference condition and confirming changing ecological conditions.

Within the broad context of this cursory report, evidence that biotic processes are significantly out of range lies in what is directly observed as well as what is inferred (by extrapolating these results to account for understory impacts not readily observed and to areas not regularly monitored, and by predicting risk into the future). Not described in detail within this report, yet detected and reportable at finer resolution are localized departures from reference condition. As predicted by risk modeling, and confirmed by site specific observations, actual impacts at local or regional levels are often extreme.

Overall, the indicator shows a continuing and increasing trend in forest decline. Spikes in mortality during the reporting period are largely due to a combination of high stand density in unmanaged forests and drought. Cumulative impacts are occurring within previously surveyed areas and expanding into new areas

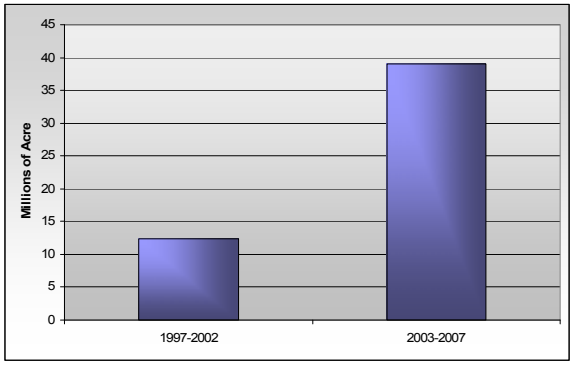

Figure 3. Lower 48 cumulative total area with mortality for select indicators (cumulative impacts occur where mortality continues in previously mapped areas and expands into new areas)

Aerial and ground survey results presented in this report include a high proportion, but not all, of total forested area (annual aerial surveys cover approximately 70% and 20% of forested area in the lower 48 and Alaska respectively). Consequently, the departure from reference conditions may be underestimated.

What has changed since 2003?

Annual mortality estimates within the last decade peaked in 2003 (Figure 4) then declined somewhat during subsequent years. However, the overall trend continues to increase. (A similar trend is evident for Alaska – see data report for details). Mortality within any given year during the current period has not dropped below any given year during the reference period for the lower 48.

Within the lower 48 states cumulative total forested area with mortality has increased to 37 million acres, compared to the reference condition of 12 million acres. Bark beetle, engraver beetle, gypsy moth-caused mortality and mortality in the pinon-juniper type are leading contributors to this increase. Areas impacted by root disease are documented as decreasing; however, it should be noted that currently reported insect-caused mortality often includes complexes of both insects and diseases, so disease acreage is probably higher than recorded. Cumulative total forested area with defoliation has decreased by approximately 60% compared to reference conditions. Some of this decrease is attributable to gypsy moth suppression and eradication efforts and repeated defoliation events, moving those areas into the mortality category. The cumulative total forested area with mortality and defoliation since 2003 is approximately 50 million acres or 8% of the total hardwood/conifer forested area (considering all agents, not restricted to those specifically addressed in this report).

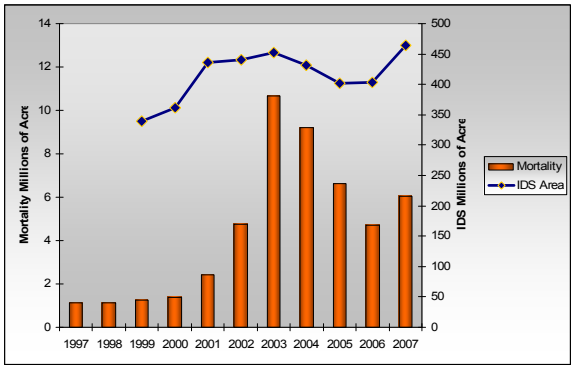

Figure 4. Annual insect and disease survey (IDS) results for mortality and surveyed area within the Lower 48; includes areas with pinon, oak and aspen mortality, select beetles and root diseases for other tree species (reporting IDS area flown began in 1999)

Aerial detection surveys in Alaska show yellow cedar decline, spruce beetle, larch beetle and engraver beetles are leading contributors to current mortality. Overall comparison to reference indicates defoliation increasing and mortality decreasing (see technical report for details). Current mortality and defoliation for Alaska should be considered grossly underestimated since, owing to remoteness and logistical constraints, surveys currently cover only a fraction of the total forested lands in the state.

Are there important regional differences?

Cumulative impacts from native and non-native pathogens are particularly evident at regional scales. These disturbances are occurring within previously surveyed areas and expanding into new areas.

Non-native invasive insects and diseases include: sudden oak death, Port-Orford cedar root disease in the West; gypsy moth (Figure 5), hemlock woolly adelgid, sirex woodwasp and emerald ash borer in the Northeast; salt-cedar in the Southwest, chestnut blight and butternut canker in the East; white pine blister rust, Dutch elm disease, tree-of-heaven, spotted knapweed and more. These often become established and readily spread within forested regions currently out of the range of natural variability. For example, stands becoming dominated by tanoak due to a variety of factors (shade tolerant dominance resulting from fire exclusion, absence of harvest practices that increase age and species diversity, etc.) provide optimum conditions for the disease causing sudden oak death to become established and spread.

Native pest activity similarly indicates a threat to sustainability by impacting normal tree species distribution and the overall number and extent of live trees. Tree species composition, abundance and other environmental factors contribute to epidemics that in some cases result in forest type conversion. Examples of regional impacts affecting sustainability have been observed in Southern California 2003, Douglas-fir/spruce beetles in the Northwest; mountain pine beetle in the Rocky Mountains, and more.

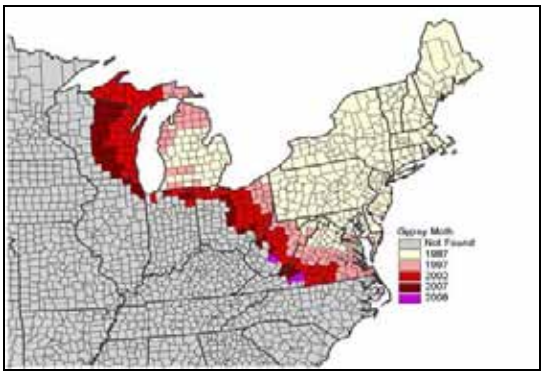

Figure 5. Gypsy moth counties impacted and progression of quarantine 1987-2008 (though geographic distribution varies, similar displays are available for counties confirmed with sudden oak death, emerald ash borer, hemlock wooly adelgid and sirex woodwasp)

Unique to Alaska is the issue of yellow cedar sustainability. Though many biotic indicators are present, current evidence points to poorly drained soils as perhaps the leading cause of yellow cedar decline. Cumulative acreage totals show a 24-fold increase in yellow cedar decline over reference condition. Monitoring regional indicator impacts is critical to early detection in order to apply management strategies for prevention and control within 1) impacted areas and 2) areas currently in a predisposed condition, and 3) areas that, without management, sustainability will soon be at risk.

Indicator 3.16- Area and Percent of Forest Affected by Abiotic Agents (e.g. fire, storm, land clearance) beyond reference conditions

What is the Indicator and why is it important?

Various abiotic agents, both natural and human-induced, can change forest structure and species composition. Where such change goes beyond some critical threshold, forest ecosystem health and vitality may be significantly altered and its ability to recover from disturbance is reduced or lost, often meaning a reduction or loss of benefits associated with that forest ecosystem. Monitoring of the area and percent of forests affected by abiotic agents beyond reference conditions may provide information needed in the formulation of management strategies to mitigate risk.

What does the Indicator show?

Of the Abiotic Agents that affect the forested ecosystem, five were selected that have a dominant impact—fire, weather, pollution, development and climate change. Given the breadth of disturbance agents, it was not possible to treat any one of them in detail. Interested readers should look at the supporting data report for this indicator.

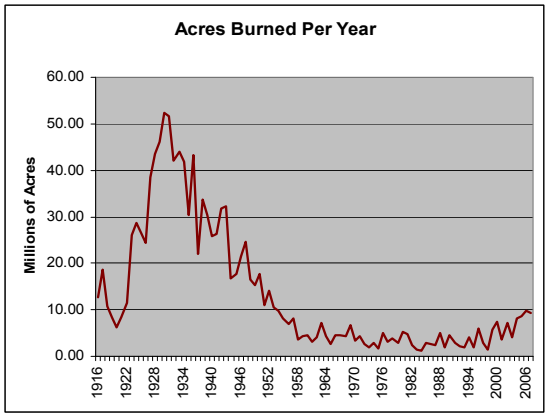

Figure 1. Total Acreage burned

As the most dominant in area impacted across the landscape, fire is an integral part of many forested ecosystems. Over the last seventy years, fire suppression has substantially reduced the annual acreage burned. Figure 1 summarizes acreage burned for all land cover types, with the majority of the acreage occurring in grasslands. Though a tally of acreage and fire occurrences are kept, the geo-spatial context is such that a direct overlay with a forest/non-forest type map can not be made to yield a precise area estimate of impacted forest. The estimates of total impacted area (both forest and grassland) indicate a significant increase in fire damage in recent years, with the cumulative area impacted over the 2003-2007 period (40 million acres) over one and a half times that impacted in the 1997-2002 period (25 million acres).

In the past, frequent low-intensity fires dominated many eco-regions. Due to the lower-frequency of fires experienced over the last 7 decades, fuel loadings have increased and fires have been burning at higher intensities for longer durations as a result of the abundance of forest fuels. Recent efforts have been made to map the severity of large fires (USDA Forest Service – RSAC). Currently, data has only been tabulated for the Western region.

Storm damage has been tracked through the USDA Forest Service's aerial survey program. Weather related damage caused by influences of drought, flood, ice (hail), lightning, wind (hurricane/tornado), and avalanche agents (Figure 2) is represented in only areas that have been surveyed and may not represent all of the area impacted by an agent. Areas flown are often pre-selected due to known active agents and a total area estimated can not be determined based upon a proportioned survey due to pre-selection bias. Other sources of data, such as the National Climate Data Center storm event database, do not specifically track forest damage; though it is possible to build a geospatial dataset to produce relative damage probabilities. Damage from storm events shows that 1.8 million acres were impacted by hurricanes, wind, tornado, avalanche, and lightning from the period of 2003-2007, amounting to approximately 0.3% of the forested area.

Figure 2. Surveyed Weather Damage

Pollution impacts on forests are indicated by Critical Acid Loading (CAL), which incorporates SO4 and NO3 and their relationship with soil properties. From 1994-2000, 74 million acres, or 17%, of US Forest soils exceeded their CAL by more than 98.4 equivalents per ac/yr, these areas are predominately

located in the Northeastern US (McNulty et al 2007, see also indicator 19).

Surface ozone (O3) is also an important air pollutant that affects vegetation. There is not yet any evidence linking FHM ozone bio-indicator response data to a specific tree health problem or regional decline. Nevertheless, the mapped data demonstrate that plant damaging concentrations of ozone air pollution are widespread in parts of the nation (Coulson 2005). While the impact of Ozone is far greater in the Eastern region, the 5-year trend indicates a decline in the impact, while the Pacific Coast region has experienced an increase.

In 2000, there were 31 million forested acres in urban and suburban (<1.68 ac per unit) residential housing density nationwide (coterminous USA), but there were slightly over seven times that (226 million ac.) in exurban housing density (1.68–39.98 ac per unit). From 1980-2000, the developed footprint has grown from 10.1% to 13.3% of forest land , roughly at a rate of 1.60% per year. This rate of land development outpaced the population growth rate (1.18% per year) by 25%. Based on model forecasts (Theobald, 2005), urban and suburban housing densities will expand 2.2% by 2020, whereas exurban development will expand by 14.3% of forest land.

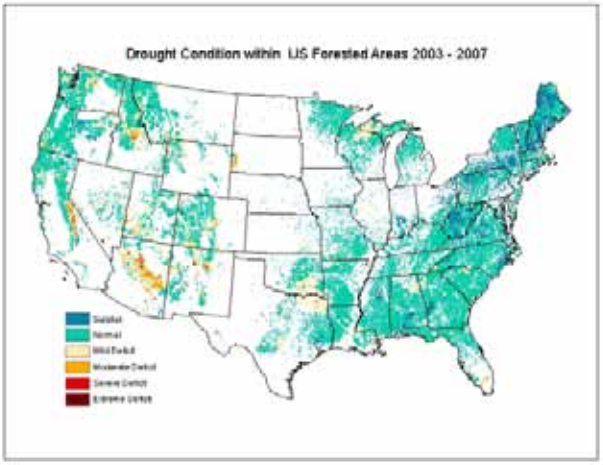

Figure 3. Drought Conditions 5-yr Period

Climate change may manifest itself with prolonged drought (Figure 2). Mortality due to drought is immediately noticeable. However, changes in productivity and regeneration success of species within their historic range would not be discernable at the five-year reference period. Drought can be measured by moisture deficit. While the cumulative amount of acres impacted by drought over the 2003-2007 period is over 6 times that of the1997-2002 reference period, the year-on-year variation is extremely high, and the 2001 estimate of approximately 10 thousand acres is considerably less than the reference period average.

What has changed since 2003?

A detailed comparison of the sub-indicators between the current period and the reference period is provided in the data report associated with this indicator. For burned area, the current period shows an increase over the reference period; however both of these periods are substantially less than the historic 5-year period maximum that occurred in the late 1920's as illustrated in Figure 1.

Burn severity data for the entire US will not be available until 2011, however in examining the Western US, an increase in severity in the forested areas can be detected in comparing the current 5-year period with the previous 5-year period.

Weather related damage has increased over the prior 5-year period with drought being the largest increase in acreage impacted. Area impacted by development has expanded since 2003 and is predicted to continue doing so.

Are there important regional differences?

Current burn severity data exists for only two years, 2004 and 2005, and based upon these datasets, conclusive statements cannot be made. However, it is observed that the intensity for Alaska and Southern regions have increased between the two years while the West and Northeast regions held steady (Figure 3).

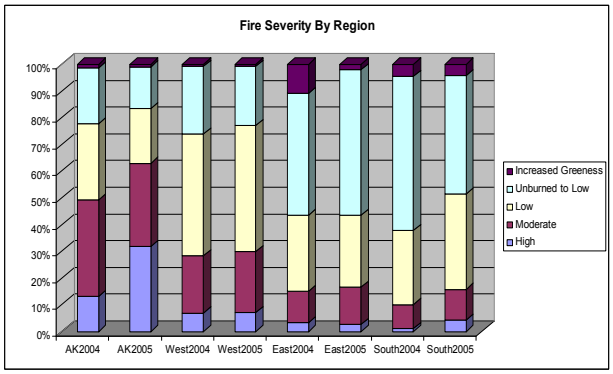

Figure 4. Fire Severity by Region

Criterion 4

Conservation and maintenance of soil and water resources

What is this criterion and why is it important?

Soil and water are primary stocks of natural capital in all terrestrial ecosystems. They constitute the foundation for the human economy and for the "economy of nature" with its birds, mammals, fish, reptiles, amphibians, invertebrates, and plants. Forest ecosystems differ from other types of ecosystems in that the soil and water resources support the growth of trees (which themselves constitute a form of natural capital). The amount of soil and water and their characteristics determine the capacity of ecosystems to sustain forests, forest economies, and forest-dependent societies.

What has changed since 2003?

The data - Indicator 17 was not reported in the 2003 report. Data for this indicator in the 2010 report were taken from the USEPA National Assessment Database. Indicators 18 and 20 are new in this report and data were taken from the National Association of State Foresters (NASF) survey. The FIA Soil Indicator database used for Indicator 19 is greatly expanded since 2003. A different database (USEPA National Assessment Database) than that used in the 2003 report has been used for Indicator 21 in this report.

The indicators - The following table summarizes the revisions. Indicator reference numbers for 2003 and 2010 are provided to assist in comparisons with the previous report. A more detailed rationale for the revisions may be found at http://www.rinya.maff.go.jp/mpci/meetings/18_e.htm

The 2003 soils indicators 18, 21, 22, and 25 were merged into the new soil conditions indicator 4.19. The 2003 water indicators 20, 23, and 24 were merged into the new water quality indicator 4.21. New indicators 4.18 and 4.20 report on the extent to which best management practices are followed to protect soil and water resources. New indicators 4.19 and 4.21 report on the actual condition of soil and water quality on forested lands.

Criterion 4 – Conservation and maintenance of soil and water resources				
2003 Ref.	**2003 Indicator**	**Revision action**	**2010 Ref.**	**2010 Indicator**
		Add subcategory		***Protective function***
19	Area and percent of forest land managed primarily for protective functions (e.g., watersheds, flood protection, avalanche protection, riparian zones)	Wording change	**4.17**	Area and percent of forest whose designation or land management focus is the protection of soil or water
		Add subcategory		***Soil***
18	Area and percent of forest land with significant soil erosion	Merge to new indicator 4.19		
21	Area and percent of forest land with significantly diminished soil organic matter and/or changes in other soil chemical properties	Merge to new indicator 4.19		

22	Area and percent of forest land with significant compaction or change in soil physical properties resulting from human activities	Merge to new indicator 4.19		
25	Area and percent of forest land experiencing an accumulation of persistent toxic substances	Merge to new indicator 4.19		
		NEW	**4.18**	Proportion of forest management activities (e.g. site preparation, harvesting) that meet best management practices or other relevant legislation to protect soil resources
		NEW	**4.19**	Area and percent of forest land with significant soil degradation
		Add subcategory		***Water***
20	Percent of stream kilometers in forested catchments in which stream flow and timing have deviated significantly from the historic range of variation	Merge concept to new indicator 4.21		
23	Percent of water bodies in forest areas (e.g., stream kilometers, lake hectares) with significant variance of biological diversity from the historic range of variability	Merge concept to new indicator 4.21		
24	Percent of water bodies in forest areas (e.g., stream kilometers, lake hectares) with significant variation from the historic range of variability in pH, dissolved oxygen, levels of chemicals (electrical conductivity), sedimentation, or temperature change	Merge concept to new indicator 4.21		
		NEW	**4.20**	Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources
		NEW	**4.21**	Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions

Indicator 4.17- Area and percent of forest whose designation or land management focus is the protection of soil and water resources

Type of water body	Estimated total waters in US	Total waters assessed	% total waters assessed	Assessed waters designated as public water supply	% total waters designated as public water supply	% good	% threatened	% impaired
Rivers/streams, miles	3,589,765	822,340	22.9	187,433	5.2	79.6	1.1	19.3
Lakes/ponds/reservoirs, acres	42,003,669	16,610,248	39.5	7,801,087	18.6	78.6	1.9	19.5

Table 17-1. Total estimated waters reported by states, total assessed waters, and condition of US rivers/streams and lakes/ponds/reservoirs designated as public water supply use (USEPA National Assessment Database. http://www.epa.gov/waters/305b/index.html).

What is the Indicator and why is it important?

This indicator provides a measure of the extent to which soil and water resources in forested areas are protected by legislative or administrative designation or where their protection is the primary management focus. Such designations or management protections guard against degradation of soil resources, maintain soil quality, and prevent impairment of water supplies intended for public consumption.

This indicator is also related to indicators 18 and 20, which report on the overall use of forestry best management practices to protect soil and water resources. Forestry best management practices include a set of preventative measures designed to control or reduce movement of sediment, nutrients, pesticides, or other pollutants from soils to receiving water bodies.

What does the Indicator show?

Every two years, states submit water quality reports to the U.S. Environmental Protection Agency (EPA) under Section 305(b) of the Clean Water Act. The National Assessment Database summarizes the data submitted by the states (http://www.epa.gov/waters/305b/index.html). States designate water uses and assess water quality attainment in the National Assessment Database. Waters designated by the states as public water supplies are protected waters and are managed to protect soil and water resources in their watersheds. The total size of the watersheds containing assessed waters designated as public water supplies is unknown but will be directly proportional to the reported miles of rivers and streams and acres of lakes, ponds, and reservoirs.

The total miles of rivers and streams in the US as reported by the states in the 2006 National Assessment Database are 3,589,765 (Table 17-1). American Samoa, Northern Mariana Islands, Pacific Trust Territories, and the US Virgin Islands provided no data. Of these, 822,340 miles have been assessed (22.9% of total). A total of 187,433 miles (5.2% of total) have been designated by the states as public water supplies and thus meet the indicator 17 protection criterion. Thirteen states and territories without an explicit public water supply or overall use designation include Florida, Hawaii, Maryland, Minnesota, Mississippi, Ohio, South Carolina, Wisconsin, District of Columbia, American Samoa, Northern Mariana Islands, Pacific Trust Territories, and the US Virgin Islands. Thus, waters in those areas are not included in the protected total.

The total acres of lakes, ponds, and reservoirs in the US reported by the states are 42,003,669. Hawaii, American Samoa, Northern Mariana Islands, Pacific Trust Territories, and the US Virgin Islands provided no data. Of these, 16,610,248 miles have been assessed (39.5% of total). A total of 7,801,087 acres of lakes, ponds, and reservoirs (18.6% of total) have been designated as public water supplies. Eight states and territories did not assess any lakes, ponds, or reservoirs (Arkansas, Hawaii, Ohio, Pennsylvania, American Samoa, Northern Mariana Islands, Pacific Trust Territories, and the US Virgin Islands). These states and territories plus ten additional states (Florida, Maryland, Michigan, Minnesota, Mississippi, New Jersey, Oregon, South Carolina,

Wisconsin, and Wyoming), and the District of Columbia that do not have separate public water supply use or overall use designations did not contribute to the total.

Approximately 79.6% of the rivers and streams and 78.6% of the lakes, ponds, and reservoirs designated as public water supplies are in the "good" water quality attainment status (Table 17-1).

In addition to the specific protections associated with watershed management for public water supply, it should be noted that forest management regulations and practice involve soil and watershed protection measures. These involve a variety of federal, state and local regulations as well as voluntary stewardship practices, and they apply to varying degrees across different locations and across different forest ownerships.

What has changed since 2003?

No data were reported for this indicator in the previous report.

Are there important regional differences?

Because many key states did not report any data and many states do not have a separate use designation for public water supplies, it is not possible to determine whether there are regional differences in designation of protected water resources. Also, a majority of waters in each state have yet to be assessed.

Why can't the entire indicator be reported at this time?

This indicator implies that data will be reported in terms of forested land areas. However, the public database that most directly addresses this indicator collects and reports data in terms of miles of streams and rivers and acres of lakes, ponds, and reservoirs. Although watershed land area is directly proportional to the size of the water bodies within the watershed, the forested portions of watersheds containing waters designated as public water supplies are unknown. Nevertheless, since these are waters designated as public water supplies, they are inherently protected via management and forest land will be the major land use classification in those watersheds. The forested parts of HUC8 watersheds are known, but the necessary overlay of water use designation from the USEPA database and the forest land use database for each watershed was not available for this report.

Indicator 4.18- Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources

What is the Indicator and why is it important?

Forestry best management practices (BMPs) to protect soil resources are a set of preventive measures designed to control soil erosion caused by forest management activities. They are designed not only to avoid excessive loss of productive soils from the landscape but also to protect receiving water bodies from excess sediment loads from accelerated erosion.

What does the Indicator show?

Indicator 4.18 is closely related to indicator 4.20. Protection of soil resources leads to protection of water resources. The best way to protect water bodies from excess sedimentation, is to protect the soil resource from excess loss via accelerated erosion caused by unsound forest management. Because BMPs were developed and are used to protect water resources, an assessment of BMPs to protect water resources automatically provides an assessment for protecting soil resources. Therefore, this indicator is reported under indicator 4.20: Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources such as riparian zones, water quality, quantity, and flow regulation.

What has changed since 2003?

This indicator did not exist in the 2003 report.

Are there important regional differences?

See brief for indicator 4.20.

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Indicator 4.19- Area and percent of forest land with significant soil degradation

	Northeast[1]	North Central	South	Interior West	Pacific West	US
Total plots (N)	1716	1424	857	1461	543	6001
Soil Condition	% of plot area					
Bare soil > 50 % of plot area	0.4	1.6	1.6	5.5	1.8	2.2
Compaction > 50 % of plot area	1.3	4.7	1.9	0.3	1.8	2.0

Table 19-1. Percent of FIA P3 plots assessed from 1999 through 2005 with bare soil on more than 50% of plot area and showing evidences of compaction on more than 50% of plot area.

[1]Northeast: CT, DE, MA, MD, ME, NH, NY, NY, OH, PA, RI, VT, WV; North Central: IA, IL, IN, KS, MI, MN, MO, ND, NE, SD, WI; South: AL, AR, FL, GA, KY, LA, MS, NC, OK, SC, TN, TX, VA; Interior West: AZ, CO, ID, MT, NM, NV, UT, WY; Pacific West: AK, CA, HI, OR, WA; States in which the FIA Soil Indicator is not yet implemented: MS, OK, NM, AK, HI

What is the Indicator and why is it important?

Forest productivity and health are directly controlled by underlying soil conditions. Soil conditions as quantified by various physical and chemical properties determine overall soil quality. Changes in soil conditions as a result of disturbances or land use activities may adversely impact forest productivity and health. The goal of this indicator is to quantify changes in soil quality resulting from climate changes, disturbances, or land use activities. The Forest Inventory and Analysis (FIA) Soil Indicator was developed to assess the condition and trend of soil quality on all US forest lands and therefore directly meets this indicator goal.

What does the Indicator show?

Estimates of bare soil on FIA plots provide an indirect measure of soil erosion potential. Estimates of plot area showing evidences of soil compaction indicate the areal extent of disturbances that may change the physical properties of soils. Because the plots cover a nationwide monitoring grid across all ecoregions, forest types, and soil types, they are representative of overall conditions across all forested lands.

Most FIA plots have at least some bare soil, but only a very small percentage of plots (0.4 to 5.5 %) have bare soil covering more than half the plot area (table 19-1). These plots are at highest risk of accelerated soil erosion, but cover only a very small fraction of all forested lands.

Only 0.3 to 4.7 % of all plots show evidences of compaction on more than half the plot area (table 19-1). Thus, soil compaction is not a widespread problem on forested lands and is largely confined to trails and forest harvest operations.

Soils develop on the landscape in response to several interacting factors: parent material, topography (landscape position), organisms, climate, and time. In general, more highly weathered soils have lower levels of organic matter and nutrients and develop in warmer areas with ample precipitation. In time, forests adapt to these ambient soil conditions, but forests developed on low productivity soils have a higher risk of soils-related forest health decline if subjected to additional environmental stressors and are more prone to soil degradation if forest cover is lost.

Nutrient-poor and acid forest soil conditions are found throughout the US, but strongly acid soils with low Ca and high Al levels are concentrated in the Northeast and more South, primarily in the Appalachian regions (table 19-2). The most serious soils-related emerging forest health threat is increasing soil acidity and associated decreasing soil Ca reserves along with increasing potentially toxic levels of exchangeable Al. This soil condition is strongly related to atmospheric acid deposition.

The Soil Quality Index (SQI) in table 19-2 integrates 19 separate measured physical and chemical properties into a single index number that can be used to track soil quality condition and trend. Soils with lower SQI levels (< 50 %) are at increased risk of soils-related forest health decline. These soils tend to be concentrated in the Northeast and South where soils are more highly weathered and depleted of nutrients.

	Northeast[3]		North Central		South		Interior West		Pacific West	
	0–10 cm	10-20 cm	0–10 cm	10-20 cm	0–10 cm	10-20 cm	0–10 cm	10-20 cm	0–10 cm	10-20 cm
Soil Condition	% of plots									
Organic C < 1 %	1.4	15.0	4.3	33.9	15.3	62.4	19.4	34.6	8.0	18.0
Total N < 0.1 %	6.3	29.7	14.1	50.1	47.0	82.8	31.0	52.2	22.7	41.9
Water pH < 4.0	25.7	8.6	3.0	1.2	5.9	2.5	0.1	0.0	1.6	1.0
Exch[1] K < 100 mg/kg	73.6	90.4	55.4	76.3	73.4	85.4	11.1	23.0	20.7	28.3
Exch Mg < 50 mg/kg	58.3	73.2	19.9	35.3	45.9	61.6	6.3	10.0	17.9	28.3
Exch Ca < 100 mg/kg	38.0	57.1	7.0	18.2	27.2	48.7	0.6	1.7	3.7	9.2
Exch Al > 100 mg/kg	73.7	73.0	23.2	27.1	30.9	35.2	6.8	7.6	20.0	21.6
Bray 1 P < 15 mg/kg	81.7	83.8	63.8	67.7	83.8	89.2	39.3	53.4	31.3	41.5
Olsen P < 10 mg/kg	34.8	60.0	24.9	52.8	87.9	92.6	47.9	63.5	29.2	45.4
SQI[2] < 50 %	**33.2**	**52.5**	**10.3**	**31.4**	**39.7**	**69.7**	**6.5**	**14.4**	**5.4**	**14.3**

Table 19-2. Percent of FIA P3 plots (2000 – 2005) by region and soil depth with selected sub-optimal soil conditions and with increased risk of soils-related forest health decline.

[1]Exch = 1 M NH_4Cl exchangeable
[2]SQI = soil quality index (< 50 % indicates increased risk of soils-related forest health decline)
[3]Regions same as defined in table 1 above

What has changed since 2003?

Because of changes to the soil indicator and the more limited dataset collected in 2003, direct comparisons between then and now are, for the most part, not possible. The 2003 report was based on only two years of FIA data. In the 2003 report, 1.6 % of the plots (1999-2000) had evidence of compaction on more than half the plot area. With 6001 plots assessed from 1999 through 2005, that percentage has increased to just 2.0 % of all plots. This increase is probably attributable to a much wider geographic extent of the US having now been assessed.

Are there important regional differences?

The Interior West tends to have more bare soil in forested areas than other regions, likely the result of more open tree canopies and less forest floor accumulation of organic matter during the sustained drought of recent years. The North Central region tends to show more areas with evidence of soil compaction. The South has more highly weathered soils with lower organic matter and nutrients than other regions and the South and Northeast have a large percentage of strongly acidic soils with low Ca and high Al levels (fig. 19-1). The Ca:Al ratio map indicates a developing soils-related forest health threat. Continued loss of Ca and increase in Al throughout the Northern and Southern Appalachians puts Ca-sensitive tree species at risk of decline and die-off. Even though southern forests are adapted to soil conditions in that region, the already low organic matter and nutrient status of these soils indicates that these forests may be more susceptible to influences from additional stressors (e.g., industrial inputs, drought, insects, disease, etc).

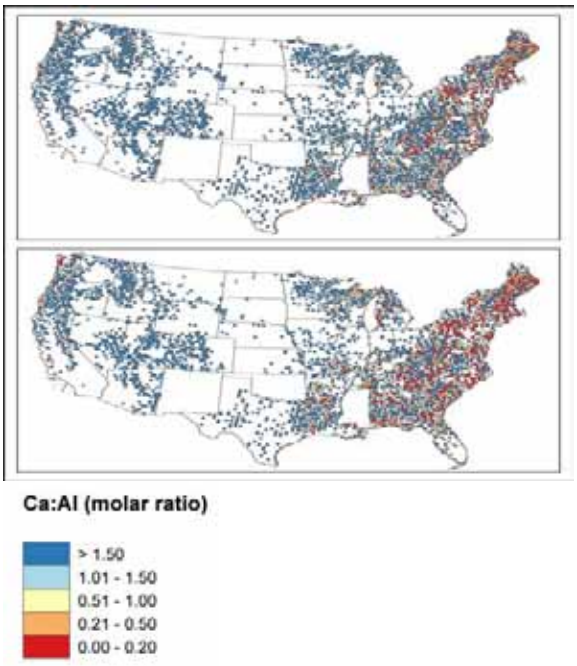

Figure 19-1. Spatial distribution of Ca:Al molar ratios by EMAP hexagon and soil depth (top: 0-10 cm, bottom: 10-20 cm). Source: US Forest Service, Forest Inventory and Analysis Soil Indicator, 2000-2004 data. Geographic base data provided by the National Atlas of the USA. EMAP hexagons provided by the US EPA.

Indicator 4.20- Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources such as riparian zones, water quality, quantity, and flow regulation

NASF Northeastern Region		NASF Southern Group		NASF Western Council	
State	Overall rate of BMP use, %	State	Overall rate of BMP use, %	State	Overall rate of BMP use, %
Connecticut		Alabama	97	Alaska	92
District of Columbia		Arkansas	89	Arizona	
Delaware	99	Florida	97	California	95
Iowa	25-50	Georgia	90	Colorado	80
Illinois		Kentucky		Guam	
Indiana	~80	Louisiana	93	Hawaii	
Massachusetts	85	Mississippi	89	Idaho	92
Maryland		North Carolina	83	Kansas	
Maine	76	Oklahoma	90	Montana	95
Michigan		Puerto Rico	n/a	North Dakota	100
Minnesota		South Carolina	94	Nebraska	
Missouri	Unknown	Tennessee		Nevada	
New Hampshire		Texas	92	New Mexico	
New Jersey		Virginia	91.4	Oregon	96
New York				South Dakota	
Ohio	80			Utah	
Pennsylvania	Unknown			Washington	
Rhode Island				Wyoming	94
Vermont	70				
Wisconsin	86				
West Virginia					
Northeast Region median	80	Southern Group median	91	Western Council median	95

Table 20-1. Overall rates of forestry best management practice use by state and National Association of State Foresters regions. Blank entries indicate no response or no data available.

What is the Indicator and why is it important?

Forestry best management practices (BMPs) to protect water resources are a set of preventative measures designed to control or reduce movement of sediment, nutrients, pesticides, or other pollutants from soils to receiving water bodies. When properly implemented, forestry BMPs prevent impairment of water bodies from silvicultural practices and other forest management activities. Since the protection of water quality primarily involves the management of soil conditions, the information presented in this indicator can also be applied to indicator 18, which assesses BMPs focused on soil protection.

What does the Indicator show?

The Water Resources Committee (WRC) of the National Association of State Foresters (NASF) conducts periodic surveys of state non-point source (NPS) pollution control programs for silviculture. The fifth survey in the series was published in 2004 (NASF, 2004). Forty-five states and two trust territories responded to the survey and the overall and detailed results are tabulated in the survey report (NASF, 2004). The term 'states' in the NASF report and the report for this indicator refers to states, the District of Columbia, and trust territories. Development of BMPs for silviculture has occurred in 43 states, while 4 states do not have silviculture BMPs (NASF, 2004).

Twenty-seven states reported on overall rates of use of forestry BMPs while twenty states responded 'unknown', 'non-applicable', or did not respond to this survey question. Of the responding states, the median overall use of silvicultural BMPs is 91% with a range of 25 to 100% (Table 20-1). Best management practice categories include pre-harvest, stream management, logging roads, stream crossings, site preparation, chemical use, roads to bed, and wetlands.

What has changed since 2003?

This indicator did not exist in the 2003 report.

Are there important regional differences?

Reported overall BMP use is slightly higher in the west and south than in the east.

Why can't the entire indicator be reported at this time?

Information for this indicator is dependent on state-level survey responses. Only twenty-seven states provided responses that were applicable in constructing the indicator. Furthermore, BMPs are developed at the state level and may differ considerably both in their specific requirements and in their overall level of protection.

Indicator 4.21- Area and percent of water bodies or stream length in forest areas with significant change in physical, chemical, or biological properties from reference conditions.

What Is the Indicator and Why Is It Important?

Water quality in forest ecosystems is controlled by climate and hydrology, catchment geology, natural disturbances, land management, and actual land use activities whether managed or not. Water quality in undisturbed forested catchments can serve as important baseline references for water quality in catchments with varying land use and management activities. Trends in physical, chemical, or biological properties can indicate effects of changing land use and management can be altered to preserve water quality.

What Does the Indicator Show?

Every two years, states submit water quality reports to the U.S. Environmental Protection Agency (EPA) under Section 305(b) of the Clean Water Act. The National Assessment Database summarizes the data submitted by the states (http://www.epa.gov/waters/305b/ index.html). States designate water uses and assess water quality attainment in the National Assessment Database. States also determine the principal sources of impairment for both linear water bodies (rivers and streams) and area-based water bodies (lakes, ponds, and reservoirs).

In the 2006 National Assessment Database, the total miles of rivers and streams reported by the states are 3,589,765. Of these, 822,340 miles have been assessed for water quality attainment (22.9 % of total). Sixteen states (Arizona, Alaska, Arkansas, California, Illinois, Kentucky, Louisiana, Montana, New Mexico, Ohio, Pennsylvania, Tennessee, Vermont, Virginia, West Virginia, Wisconsin) identified silvicultural activities as a source of impairment for 23,722 miles of rivers and streams (2.9 % of total assessed miles—see table 21-1).

Table 21-1. Sources of water quality impairment for assessed US rivers/streams and lakes/ponds/reservoirs[2].

Source of Impairment[1]	Rivers/streams		Lakes/ponds/reservoirs	
	miles	% of total assessed	Acres	% of total assessed
Physical changes	164,498	20.0	1,849,582	11.1
Crop production	114,849	14.0	1,988,175	12.0
Animal production	80,269	9.8	555,054	3.3
Forestry	23,727	2.9	316,071	1.9
Resource extraction	41,916	5.1	599,280	3.6
Municipal/Industrial	205,673	25.0	6,048,322	36.4
Natural	40,743	5.0	1,354,245	8.2
Unspecified/unknown	125,308	15.2	4,551,991	27.4
Total assessed	822,340		16,610,248	
Total US	3,589,765		42,003,669	

[1]Sources of impairment:

- Physical changes: hydromodification, flow regulation, dams/impoundments, water diversion, channelization, dredging, bank destabilization, habitat changes, loss of wetlands/riparian areas, erosion, sedimentation.
- Crop production: all agricultural sources related to irrigated and non-irrigated crop production.
- Animal production: all agricultural sources related to animal production including confined animal feeding operations (CAFOs) and upland and riparian grazing.
- Forestry: all silvicultural and forest industry activities, forest roads, fire.
- Resource extraction: mineral resource development, mining, oil/gas/coal production.
- Municipal/Industrial: all municipal, urban, and industrial point and non-point sources including runoff; construction and development; waste disposal.
- Natural: mineral deposits, ecosystem nutrient cycling.
- Unspecified/unknown: all unidentified or unknown point and non-point sources.

[2]USEPA National Assessment Database. http://www.epa.gov/waters/305b/index.html

The various sources of impairment of rivers and streams identified by the states were grouped into eight broad impairment source categories (Table 21-1): 1) physical changes to the water body, 2) crop production, 3) animal production and grazing, 4) forestry (including silviculture, forest roads, and fire), 5) resource extraction, 6) municipal and industrial sources, 7) natural sources, and 8) unspecified or unknown sources. Of these eight broad sources of impairment, forestry-related activities impaired the fewest miles of rivers and streams (2.9 % of total assessed). In contrast, all agricultural activities (crop and animal production including grazing) impaired about 8 times as many miles (about 24 % of total assessed).

The total acres of lakes, ponds, and reservoirs reported by the states in the 2006 National Assessment Database is 42,003,669. Of these, 16,610,248 have been assessed for water quality attainment (39.5 % of total). Just eleven states (Arizona, California, Illinois, Louisiana, Montana, New Mexico, North Dakota, Oklahoma, Utah, Vermont, West Virginia) identified silvicultural activities as a source of impairment for 316,071 acres (0.8 % of total acres, 1.9 % of total assessed acres, 1.8% of all impaired acres) (Table 21-1).

As in the case of rivers and streams, forestry-related activities impaired the fewest acres of aerial water bodies (1.9 % of total assessed). In contrast, all agricultural activities related to crop and animal production impaired about 8 times as much water body acreage (about 15 % of total assessed).

What Has Changed Since 2003?

How this indicator is evaluated has changed since the 2003 report. In 2003, water quality data were reported as the percentage of counties with HUC8 watersheds with water quality parameters significantly different from other counties within each region. The 2003 report data could not be unambiguously analyzed solely for forested areas. On the other hand, states were able to identify silvicultural activities as a source of impairment for the National Assessment Database. Thus, it is not possible to directly compare the data in this report with that from the 2003 report.

Are There Important Regional Differences?

Because many states do not specifically identify silviculture as a source of water quality impairment, and because many waters have yet to be assessed, it is not yet possible to determine regional differences.

Why Can't the Entire Indicator Be Reported at This Time?

There are many other sources of water quality impairment identified in the National Assessment Database. Some of these such as flow and habitat modification, sedimentation, riparian vegetation removal, grazing impacts, resource extraction, and others occur in forested areas. Unfortunately, other than silviculture, the National Assessment Database does not separate sources of impairment by land use. Thus, it is not possible to separate resource extraction impairments, for example, in forested areas from other land use classification areas.

Another problematic issue is sources of impairment may originate inside or outside of forested areas. Also, the National Assessment Database does not indicate the degree of impairment. Some impairments may be transitory, others more permanent. Although individual stressors and pollutants are identified, quantitative water quality data summarized by forested area across the entire US are lacking. To fully report this indicator, quantitative water quality data summarized by land and water use, vegetative cover, sources and origins of impairments, and stressors and pollutants are needed. A full integration of EPA assessment and USGS water quality data by forested hydrologic unit code (HUC) would best meet the intent of the indicator.

Criterion 5

Maintenance of forest contribution to global carbon cycles

What is this criterion and why is it important?

More than any other criterion, this one reflects the fact that forests exist within a context of the global environment and the world's economic and social activities. Criterion 5 embodies a direct link between the environment and the economy, because carbon cycling concerns result from the fossil fuel combustion that powers the human economy. The capacity of forests to sequester carbon may be—or may become— a primary factor for determining the capacity of fossil fueled economies. The global economy, in other words, may be a function not only of the global environment, but particularly of the forested environment.

What has changed since 2003?

The data - The majority of this criterion's data continue to be based on: greenhouse gas inventories conducted by the U.S. Environmental Protection Agency, forest inventories conducted by the USDA Forest Service, surveys of electricity generation by the U.S. Department of Energy, and models/simulations of carbon pools/fluxes based on said data sources.

The indicators - The following table summarizes the revisions. Briefly, the forest ecosystem and product pools have been separated into their own respective indicators, while a new indicator focused on avoided fossil fuel emissions through forest biomass utilization has been created. Indicator reference numbers for 2003 and 2010 are provided to assist in comparisons with the previous report. A more detailed rationale for the revisions may be found at http://www.rinya.maff.go.jp/mpci/meetings/18_e.htm .

Criterion 5 – Maintenance of forest contribution to global carbon cycles

2003 Ref.	2003 Indicator	Revision action	2010 Ref.	2010 Indicator
26	Total forest ecosystem biomass and carbon pool, and if appropriate, by forest type, age-class, and successional stages	Add fluxes, delete type and age	**5.22**	Total forest ecosystem carbon pools and fluxes
27	Contribution of forest ecosystems to the total global carbon budget (standing biomass, coarse woody debris, peat, and soil carbon)	DELETE		
28	Contribution of forest products to the global carbon budget	Add fluxes, delete global context	**5.23**	Total forest product carbon pools and fluxes
		NEW	**5.24**	Avoided fossil fuel carbon emissions by using forest biomass for energy

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Indicator 5.22- Total forest ecosystem carbon pools and fluxes

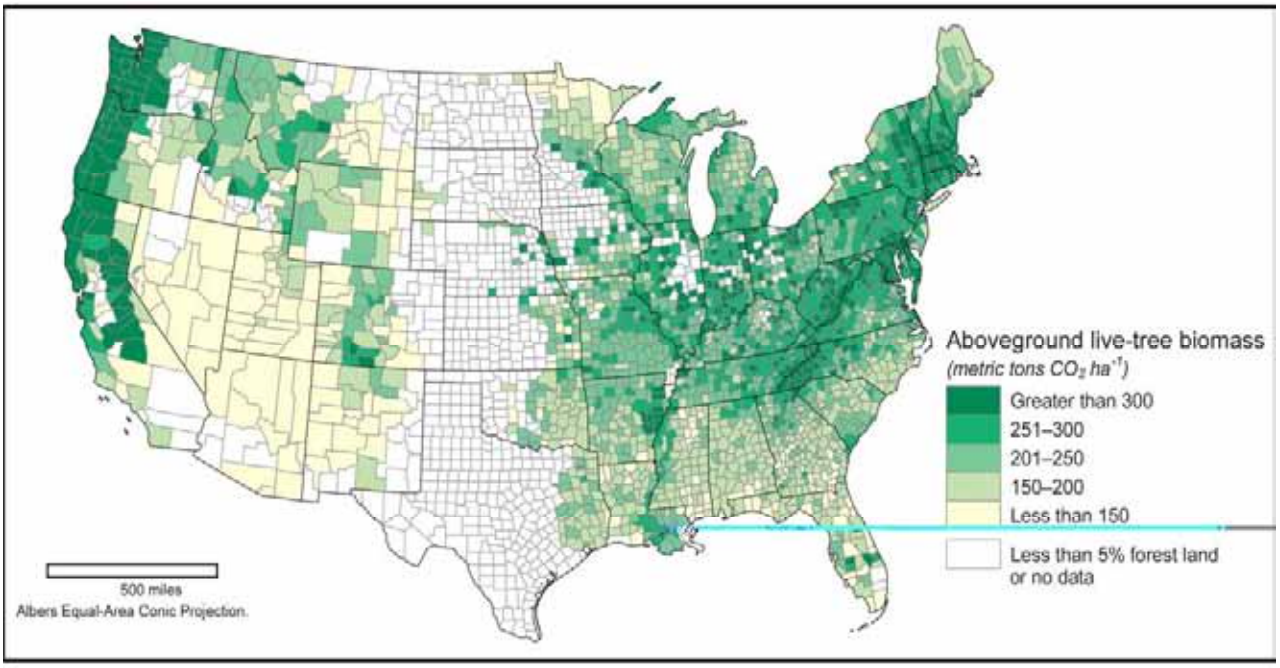

Figure. 22-2. Forest aboveground live biomass carbon stocks by county for United States, 2006.

What is the Indicator and why is it important?

The United States emitted a gross 5.9 billion metric tons of CO_2 in the year 2006. Because plants use carbon dioxide in the photosynthesis process, forests provide a primary vehicle to sequester carbon from the atmosphere. During this process, the carbon becomes part of the plant mass. Once forest biomass dies, carbon continues to remain in the forest ecosystem and cycle through dead trees, dead wood, duff/litter, and finally soil carbon pools. Thus, managing forest ecosystems to sequester carbon reduces the net amount of carbon dioxide accumulating in the atmosphere. Less carbon dioxide in the atmosphere may help reduce the possibility/extent of human-induced climate change. In contrast, forests can also serve as a net emitter of CO2 during year's of extreme wildfires or widespread disturbance. In addition to showing current estimates of carbon pools, this indicator provides estimates of annual forest carbon changes (fluxes) that may be subtracted from the gross emissions to estimate net emissions.

What does the Indicator show?

All carbon pools, with the exception of soil carbon, are estimated using the USDA Forest Service's Forest Inventory and Analysis measured data or imputed data, along with inventory-to-carbon relationships, developed using information from ecological studies . Thus, trends of volume and area in other indicators based on FIA data should be consistent with this information. Forest ecosystem carbon stocks in the United States continue to represent a substantial carbon pool of over 165,000 Tg (Fig. 22-1), with live trees and soil organic carbon accounting for the majority of this stock. The forest carbon stock is equivalent to over 27 years of CO_2 emissions in the United States. The live tree carbon stock is concentrated on the west coast, Rocky Mountains, Appalachian Mountains, and in other areas of the eastern U.S. (Fig. 22-2).

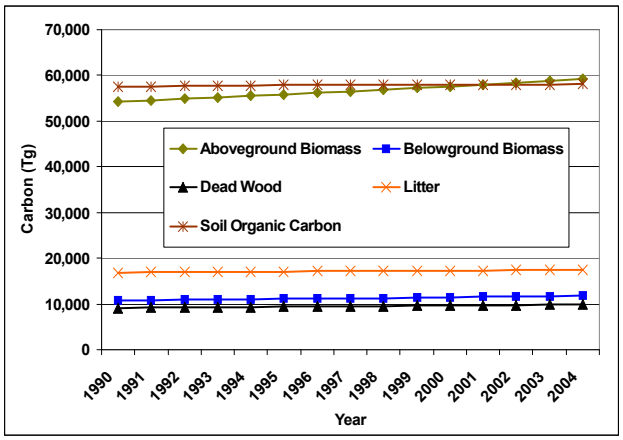

Figure 22-1. Total carbon stocks by forest ecosystem component in the US, 1990-2007

In terms of annual changes or carbon flux, both above- and below-ground forest ecosystem living biomass components account for the majority of annual carbon sequestration (Fig. 22-3). These rates of sequestration have remained rather static since 2000. The spatial distribution of forest sequestration is evenly distributed within forested regions of the country (Fig. 22-4). U.S. forests offset over 11 percent of total annual CO_2 emissions in 2006. This rate of offset has remained relatively constant for the past two decades (Fig. 22-5). Overall, the tremendous forest carbon stocks of the U.S. continue to gradually increase while increasing greenhouse gas emissions continue to greatly outpace what can be sequestered by forests annually.

What has changed since 2003?

Total forest ecosystem carbon stocks were maintained with positive increases from forest area expansion and growth. Despite these increases, total U.S. greenhouse gas emissions still outpaced forest ecosystem gains.

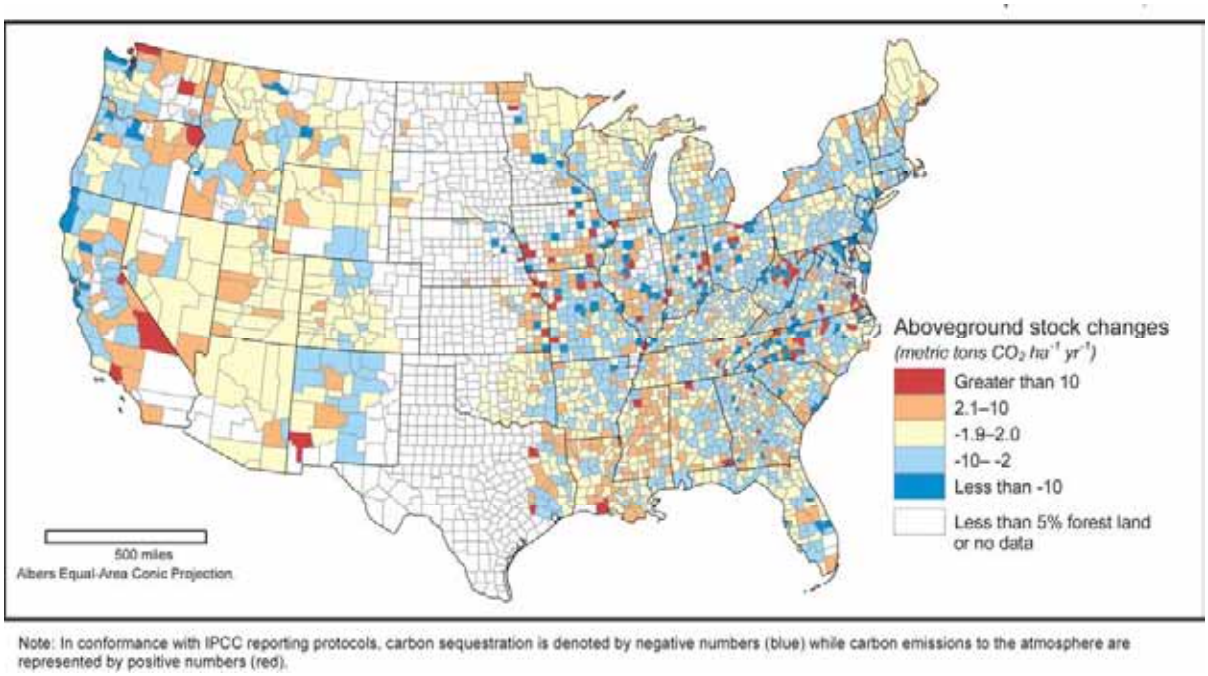

Figure 22-4. Total forest ecosystem carbon stock annual flux by county in the United States, 2006

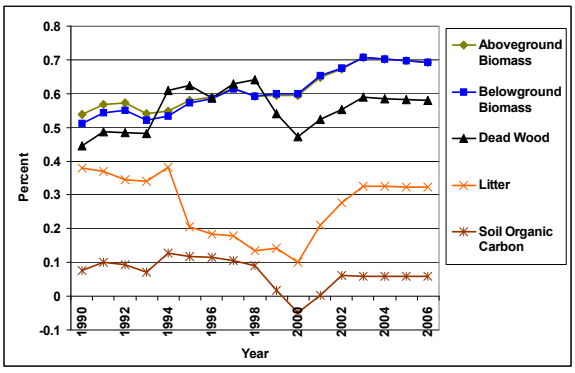

Figure 22-3. Percent of total carbon stock by forest ecosystem component sequestered annually in the United States, 1990-2006

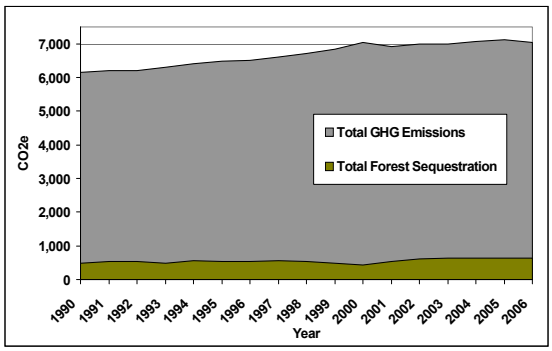

Figure 22-5. Total greenhouse gas emissions versus total forest ecosystem sequestration, 1990-2006

Indicator 5.23- Total forest product carbon pools and fluxes

What is the indicator and why is it important?

This indicator assesses the role that forest products play in the sequestration, cycling, or emission of carbon. Long-term storage of carbon in products and landfills delays or reduces emissions. Use of wood products can also reduce emissions if they substitute for products with higher carbon emission processes. As forest biomass is harvested carbon is shifted from forest ecosystems to forest products held in products and landfills. The rate of accumulation of carbon in products can be influenced by the mix of products and uses (e.g. lumber in housing versus paperboard in boxes) and by patterns of disposal, recycling, and landfill management. This indicator shows the harvested wood product (HWP) contribution to the combined system of annual CO_2 emissions and removals by forests and products. This indicator primarily uses the Production accounting approach to track the HWP contribution. This approach tracks carbon in wood that was harvested in the U.S. including carbon held products that are exported. The U.S. uses this approach to report the HWP contribution under the UN Framework Convention on Climate change. HWP contributions are also shown for the Stock Change approach which tracks carbon stock changes in the U.S. and the Atmospheric flow approach which tracks net carbon exchange with the atmosphere. Estimates are made using IPCC recommended methods.

What does the indicator show?

In 2006, under the Production approach, HWP contribution due to carbon additions to forest products in use and in landfills was 110 million tons CO_2 equivalent or about 17 percent of the value of annual carbon additions to forest ecosystems. In 2006 this contribution offset emissions equal to about 34% of the CO_2 emitted by fossil fuel combustion in residential housing. The annual contribution is now less than in 1990 due in part to decreasing U.S. timber harvest and replacement of domestic harvest by imported products. Under the Stock change accounting approach, HWP contribution has increased notably since 1990 due to increases in imports. Annual contributions under the Atmospheric flow approach are about the same as for the Production approach (Fig 23-1).

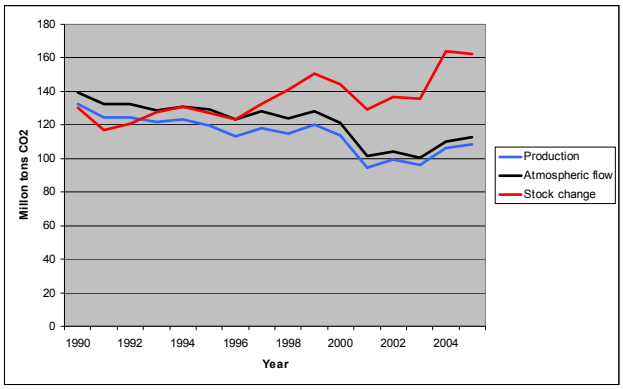

Figure 23-1 HWP Contribution to CO_2 removals under the three accounting approaches, 1990 to 2006 (Tg CO_2 equivalent)

Under the Production approach, additions to carbon storage have been increasing for solidwood products in landfills, and decreasing for solidwood in uses, and for paper in uses and landfills. Annual additions to paper in uses were negative for 2001-2003. (figure 23-2).

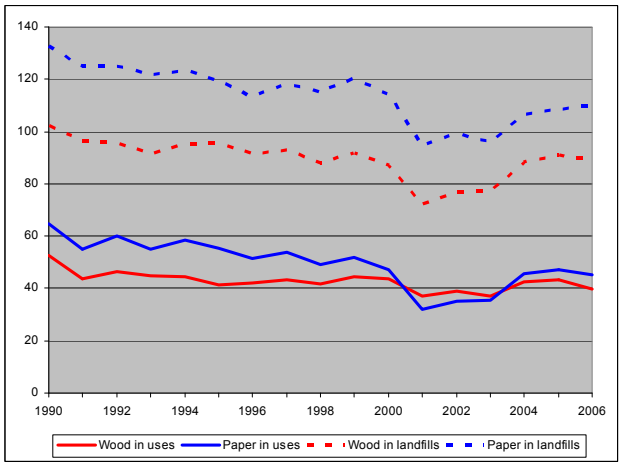

Figure 23-2 Cumulative annual HWP contribution by location of storage – wood and paper products in use and wood and paper product in landfills, 1990-2006 (Tg CO2 Equivalent)

The annual amount of HWP contribution as a percent of total forest carbon stock has decreased since 1990 (Fig. 23-3).

In 2007, total carbon stored in forest products in use and in landfills under the Production approach equaled more than 8,000 Tg CO_2 equivalent or over 1 years worth of CO_2 emissions in the U.S.

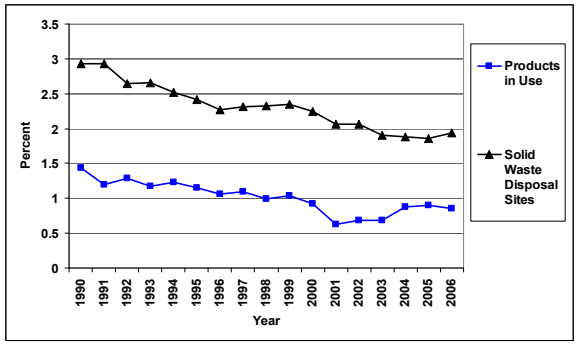

Figure 23-3. Annual HWP carbon additions as a percent of total forest + product carbon stock in the United States, 1990-2006

A rough estimate of the greenhouse gas emission savings due to building wood framed single family detached homes in 2005 instead of building homes using example designs that use steel or concrete walls is 1.7 million tons of CO_2 equivalent. This potential savings is due to lower GHG emissions associated with production of wood products. This is only part of the total savings which would also include wood framed single family attached and multifamily houses. Single family detached houses provided about 54% of the total housing floor area build in 2005.

What has changed since 2003?

The estimates of HWP contribution to forests and products emissions and removals has been improved and now better tracks effects of changes in product production, use and disposal. It is now estimated that the HWP contribution has decreased since 1990 under the Production and Atmospheric flow accounting approaches.

Are there important regional differences?

Regional differences in contribution to carbon storage in products were identified by estimating the contribution each county makes to wood carbon storage. The objective is to estimate the portion of carbon harvested in 2006 that is still stored after 100 years. To do this we estimate the wood harvest in each county, estimate the wood products that are produced (lumber, panels, paper), the end uses where those products are used (e.g. housing, paper products), the rate of discard from use, the rate of disposal to landfills and their decay from landfills. The amount still stored after 100 years has offset an equivalent CO_2 emission for 100 years – which is the approximate lifetime of a CO_2 molecule emitted in the year the wood was harvested.

Figure 23-4 shows the estimated amounts of carbon still stored in products from 2006 harvest in U.S. counties after 100 years in tons of carbon per hectare of timberland. Storage is highest for timberland in midwest and mid atlantic states. The amount stored per hectare after 100 years is influenced by the harvest per hectare and by the mix of sawlogs or pulpwoods and softwoods or hardwoods produced. About 30% of carbon from both hardwood and softwood sawlogs is stored after 100 years along with about 20% from hardwood pulpwood and 10% from softwood pulpwood.

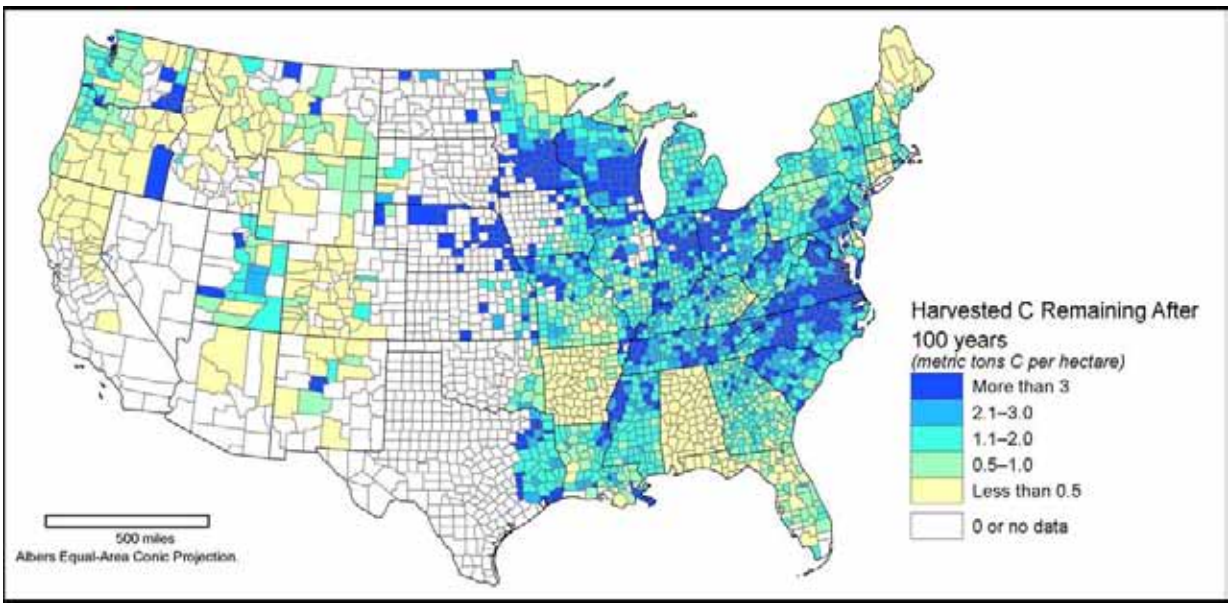

Figure 23-4 Estimated amount of carbon still stored in 100 years from wood harvest in 2006 by county (tons carbon per hectare of timberland).

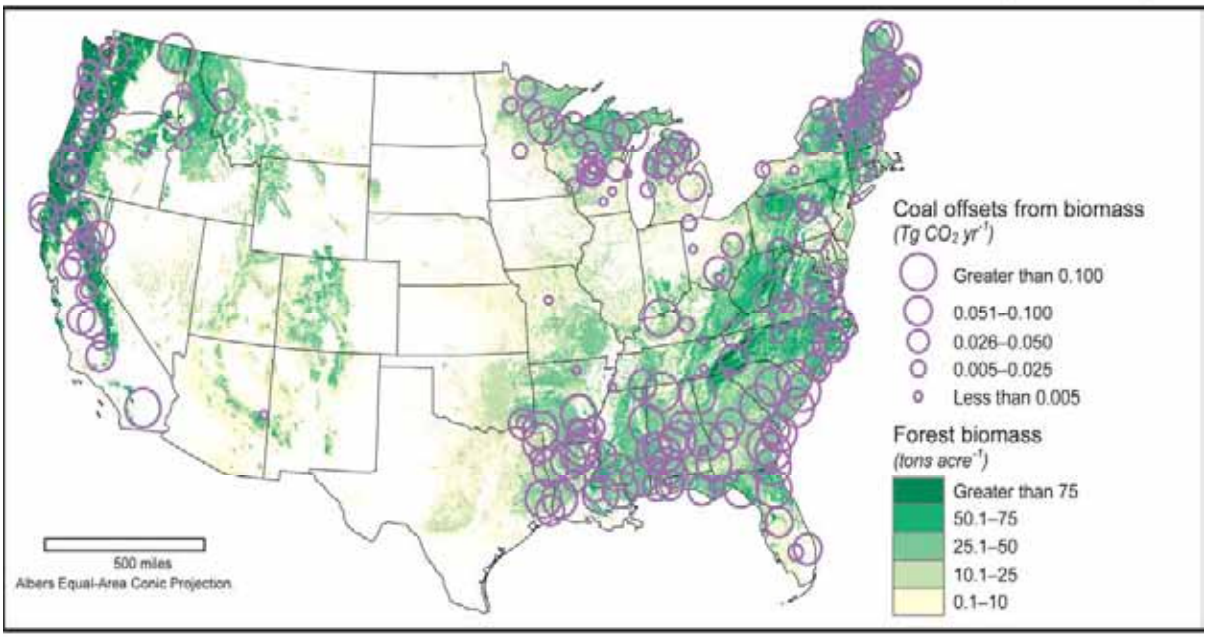

Fig. 24-3. Location and avoided CO2 emissions (assuming coal burning) of electric utilities using wood as a power generation source, 2007

What is the Indicator and why is it important?

Nearly 80 percent of the gross 7,054.2 Tg of CO_2 equivalents emitted by the United States in 2007 came from the combustion of fossil fuels for energy. If the combustion of forest biomass for energy occurs in lieu of burning fossil fuels, then fossil fuel emissions may be avoided. It is assumed that the removed/harvested forest biomass will be regenerated and thus a net reduction in greenhouse gas emissions since the burning of non-renewable fuels (e.g., coal) was avoided.

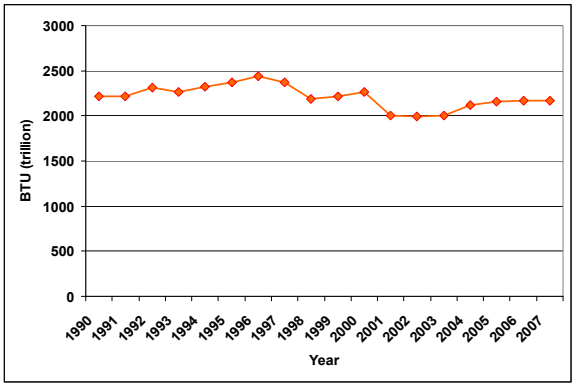

Figure 24-1. Total energy produced through burning of wood in United States, 1990-2007.

What does the Indicator show?

In 2007, over 2,100 trillion BTU's were generated in the U.S. from the combustion of wood in the form of fuelwood logs, wood chips, mill wastes, and black liquor at pulp mills (Fig. 24-1). This amount is about 2 percent of all energy consumed in 2007. The remaining generation of BTU's is overwhelmingly produced by burning of fossil fuels. Most wood energy was used by industrial users (67 percent), followed by residential (21 percent), electric utility (8 percent) and commercial (3 percent) users. The energy generated by burning of wood has decreased from a high 1989. But wood used for electric power production has increased about 90% from a low level in 1989. Since the burning of wood avoids the emissions of many possible fossil fuels, the avoided CO_2 emissions may be stated in terms of offsetting the burning of several alternate fossil fuels. The burning of wood for energy in 2007 avoided the emissions of approximately 217, 129, or 176 Tg CO_2 if coal, natural gas, or fuel oil was the fossil energy source, respectively (Fig. 24-2). There have been a great variety of electric utilities that used wood as a source of energy across the U.S. in 2007 (Fig. 24-3). Most of the electric utilities are located near sources of forest biomass, such as west coast, Lake States, northeast, and southeast. There are currently 100's of electric utility plants that use wood for power generation and thus avoid emission of greenhouse gases but the amount of power production is a small fraction of fossil fueled electric power production.

What has changed since 2003?

The use of wood as an energy source and thereby avoidance of fossil fuels emissions has been decreasing since the mid-1990's. Although there is widespread use of and access to wood as an energy source in the U.S., it still represents less than 1 percent of power generation nationwide.

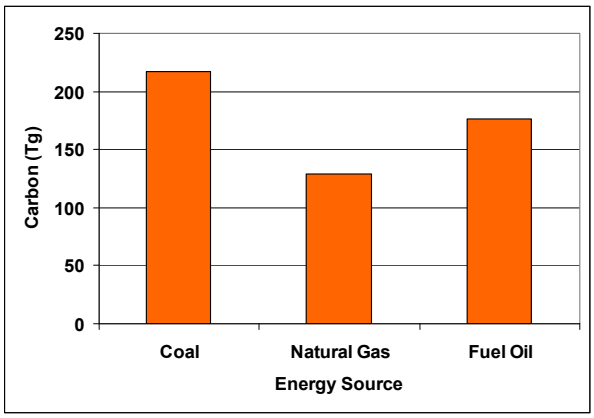

Fig. 24-2. Avoided greenhouse gas emissions in terms of coal, natural gas, or fuel oil through burning of wood in United States, 2007.

Criterion 6

Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

What is this criterion and why is it important?

While the first five criteria are centered in the environmental sphere of sustainability (with the exception of criterion 2, which clearly overlaps the economic sphere), criterion 6 is centered firmly in the economic sphere. As the sole criterion with an economic focus, it has more (20) indicators than any of the environmental criteria. Its first two subcategories reflect the basic economic breakdown of goods (e.g., wood products) and services (e.g., tourism). The investment subcategory provides indicators of society's attention to forest maintenance. The cultural subcategory includes the most social of the socioeconomic indicators, and the employment subcategory provides indicators of the forests' capacity to provide work, wages, and subsistence.

The data – Significant data changes have occurred since 2003 including 1) addition of new indicators with new data, particularly on environmental services, distribution of revenue, resilience of communities and importance of forests, 2) expansion of time trends related mostly to forest products and nonwood products, and 3) expansion of data on regional differences in amounts and trends for more indicators including forest products, nonwood products, and recreation. Coverage for some data has changed because one time studies done for 2003 were not repeated the same way, for example updates of employment in forest based recreation in tourism for 2010 are for more limited categories of employment.

The indicators - The following table summarizes the revisions. Indicator reference numbers for 2003 and 2010 are provided to assist in comparisons with the previous report. A more detailed rationale for the revisions may be found at http://www.rinya.maff.go.jp/mpci/meetings/18_e.htm .

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies

2003 Ref.	2003 Indicator	Revision action	2010 Ref.	2010 Indicator
	Production and consumption			***Production and consumption***
29	Value and volume of wood and wood products production, including value added through downstream processing	Improve wording, restrict value added to secondary products	**6.25**	Value and volume of wood and wood products production, including primary and secondary processing
30	Value and quantities of production of nonwood forest products	Improve wording	**6.26**	Value of non-wood forest products produced or collected
			6.27	Revenue from forest based environmental services
31	Supply and consumption of wood and wood products, including consumption per capita	Improve wording	**6.28**	Total and per capita consumption of wood and wood products in round wood equivalents
32	Value of wood and nonwood products production as a percentage of GDP	DELETE		
34	Supply and consumption/use of nonwood products	Improve wording	**6.29**	Total and per capita consumption of non-wood products
		NEW	**6.30**	Value and volume in round wood equivalents of exports and imports of wood products

		NEW	**6.31**	Value of exports and imports of non-wood products
		NEW	**6.32**	Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption
33	Degree of recycling of forest products	Include percent of total consumption	**6.33**	Recovery or recycling of forest products as a percent of total forest products consumption
	Investment in the Forest Sector			***Investment in the Forest Sector***
38	Value of investment, including investment in forest growing, forest health management, planted forests, wood processing, recreation, and tourism	Include annual expenditure	**6.34**	Value of capital investment and annual expenditure in forest management, wood and non-wood product industries, forest-based environmental services, recreation and tourism
39	Level of expenditure on research and development and on education	Confine to "forest-related" only	**6.35**	Annual investment and expenditure in forest-related research, extension and development, and education
40	Extension and use of new and improved technologies	DELETE		
41	Rates of return on investment	DELETE		
	Employment and Community Needs			***Employment and Community Needs***
44	Direct and indirect employment in the forest sector and the forest sector employment as a proportion of total employment	Improve wording	**6.36**	Employment in the forest sector
45	Average wage rates and injury rates in major employment categories within the forest sector	Restrict to forest sector	**6.37**	Average wage rates, annual average income and annual injury rates in major forest employment categories
46	The viability and adaptability to changing economic conditions of forest-dependent communities, including indigenous communities	Broaden context	**6.38**	Resilience of forest-dependent communities
47	Area and percent of forest land used for subsistence purposes	No change	**6.39**	Area and percent of forests used for subsistence purposes
			6.40	Distribution of revenues derived from forest management
	Recreation and Tourism			***Recreation and Tourism***
35	Area and percent of forest land managed for general recreation and tourism in relation to the total area of forest land	Improve wording	**6.41**	Area and percent of forests available and/or managed for public recreation and tourism
36	Number and type of facilities available for general recreation and tourism in relation to population and forest area	Merge to new 6.42		
37	Number of visitor days attributed to recreation and tourism in relation to population and forest area	Merge with above to new 6.42	**6.42**	Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available

	Cultural, Social, and Spiritual Needs and Values			***Cultural, Social, and Spiritual Needs and Values***
42	Area and percent of forest land managed in relation to the total area of forest land to protect the range of cultural, social, and spiritual needs and values	Improve wording	**6.43**	Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values
43	Nonconsumptive use forest values	DELETE		
		NEW	**6.44**	The importance of forests to people

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Indicator 6.25– Value and volume of wood and wood products production, including primary and secondary processing

What Is the Indicator and why is it Important?

The value and volume of wood and wood products indicates the relative importance of forests as a source of raw material for a wide variety of uses. Tracking the values and volumes of goods and services through the production process from the forest to the end of secondary processing explains a key dimension of the economic contribution that forests make to local and national economies.

What does the indicator show?

The volume of total roundwood harvest (including fuelwood) in the U.S. increased fairly steadily from about 10 billion cubic feet (cf) in the 1930's to 18.8 billion cf in 1989. Since 1989 harvest has declined, reaching a level of 16.4 billion cf in 2006 (fig 25-1), a figure equivalent to about 25 percent of world harvest. Industrial roundwood production increased steadily between the mid 1930's and 1989 and has since been roughly constant.

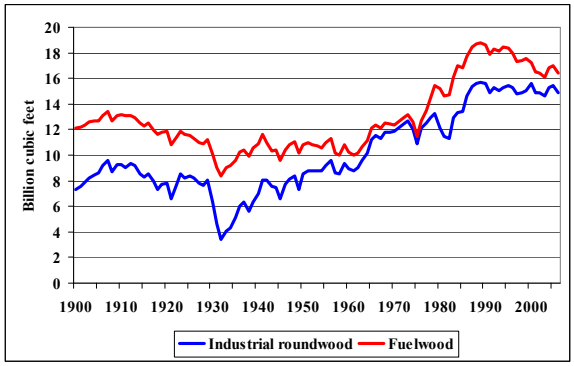

Figure 25-1. Volume of U.S industrial roundwood and fuelwood production (harvest), 1900 – 2006 (billion cubic feet) (fuelwood line includes industrial roundwood amounts)

The amount of primary wood and paper products produced in the U.S. increased relatively steadily from 82 million tons in 1950 to 203 million tons in 1999 and has since then declined to 191 in 2006 (fig 25-2). In comparison, in 2006, the United States produced 9.5 million tons of steel and 142 million tons of Portland cement.

The decline since 1999 is due primarily to declines in production of pulp and paper, hardwood lumber and softwood plywood. These declines offset an increase of 29% in OSB production. In 2006 the largest share of production, by weight, was for pulp and paper (51%) followed by softwood and LVL lumber (21%), hardwood lumber (10%), non structural panels (6%), OSB (5%), softwood plywood (4%) and other industrial products (3%) (fig 25-2).

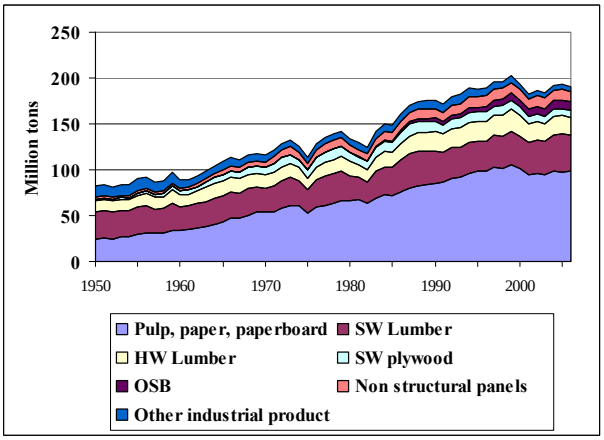

Figure 25-2. Weight of wood and paper products produced by product 1950-2006 (million tons)

Wood energy use was 2.2 Quadrillion BTU in 2006 (roughly 2.4 percent of U.S. consumption), down from 2.7 Quad in 1983. Industrial use (primarily in forest products firms) was 1.5 Quadrillion BTU in 2006 which is somewhat lower than highs in 1983 and 2000. Residential wood energy use has also declined but wood use for electric power has increased from 0.10 Quad in 1989 to 0.18 Quad in 2006 (fig 25-3). (also see Indicator 24).

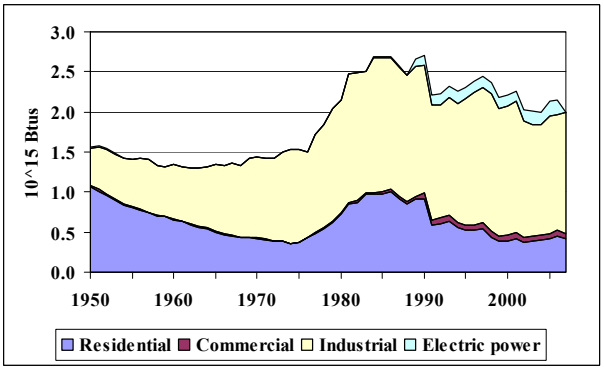

Figure 25-3. Wood energy produced, by consumer, 1950-2006 (10^15 Btu)

Total value of shipments for wood, paper and furniture industries, using SIC industry codes, increased between 1973 and 1996 from $288 to $356 million (all values adjusted for inflation and presented in 2005$). Between 1997 and 2006, using NAICS industry codes, shipments decreased from $322 million to $309 million (fig 25-4). The decrease was due to a 10% decline for paper industries. Furniture industries increased 13% and wood products industries were about constant.

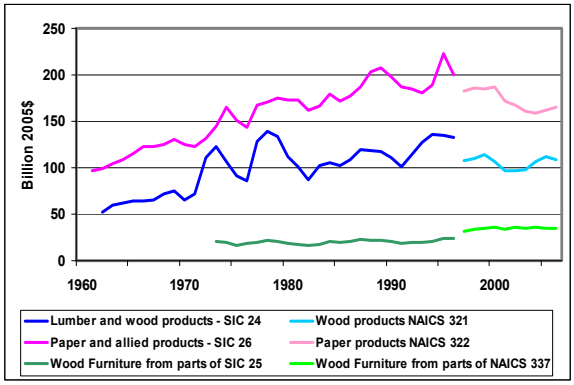

Figure 25-4. Value of shipments for forest products industries by SIC Code 1961-1996, by NAICS code, 1997-2006 (billion 2005$) (each line is added to the line below)

What has changed since 2003?

Volume of roundwood harvest and total weight of primary products production has remained relatively stable between 2000 and 2006 although the weight of production has increased for softwood lumber, OSB and miscellaneous products and declined for other primary products – pulp and paper, hardwood lumber, softwood plywood, and non-structural panels.

The value of paper industry shipments decreased 12% between 2000 and 2006 from $187 to $165 million, but values were about the same between 2000 and 2006 for wood products and wood furniture shipments (fig 25-4).

Are there important regional differences?

The most important development in wood products production from a regional standpoint has been the marked increase in roundwood harvests in the South along with concurrent reductions in the North and Pacific Coast Regions. Industrial roundwood harvest volume increased 80% in the South between 1970 and 2006, accounting for 62% of the US total in 2006. In 2006 the North provided 18%, followed by the Pacific Coast at 16%, and the Rocky Mountains at 3%. Harvest decreased between 1991 and 2006 in all regions except the South (fig 25-5).

Percent changes in harvest are not fully reflected in the value of final product shipments, which have remained much more stable across the regions (fig. 25-6). Even though the South had the largest volume of harvest in 2006, the value of shipments for wood and paper industries was highest for the North, at $108 billion, followed by the South, at $104 billion. Value of shipments has declined since 1997 in the North, South and Pacific Coast, and has increased in the Rocky Mountains. The Region with the highest total value of primary products shipments may change if wood furniture industries were included. But state level wood furniture values were not available for this report.

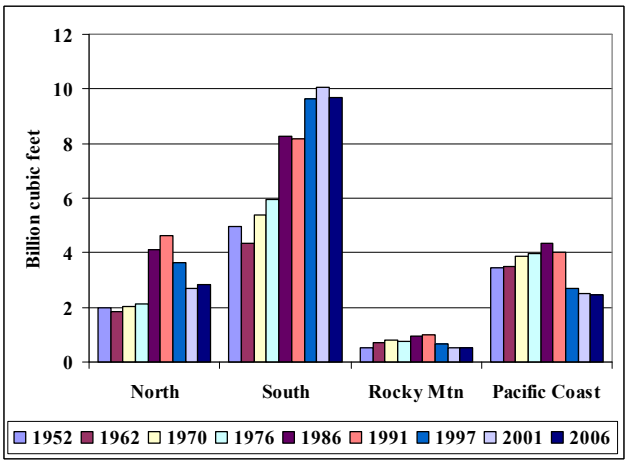

Figure 25-5. Volume of all industrial roundwood harvested by region, 1952-2006 (million cubic feet)

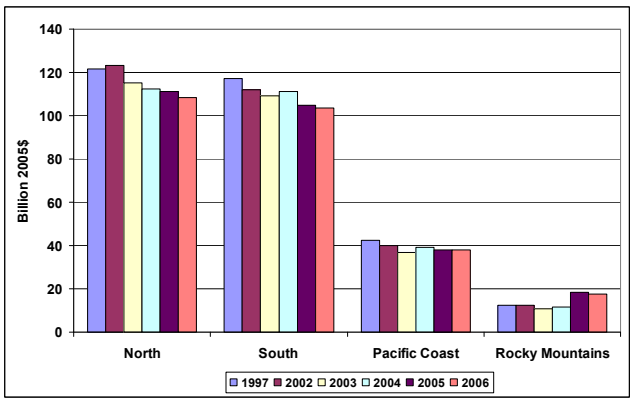

Figure 25-6. Value of shipments in wood and paper products industries (NAICS 321, 322) by region (billion 2005$)

Indicator 6.26– Value of non-wood forest products produced or collected

What is the Indicator and why is it important?

Non-wood forest products are items harvested or gathered from forests that are not traditional wood products. Non-wood forest products are important components of the economic value of forests and their collection and processing makes an important contribution to economic activity. Many of these products also are important to indigenous people and others for their contribution to cultural values and subsistence activities.

In this indicator we cover non timber forest products (NTFP), which includes both 1) non-wood products that do not include the main stem of trees, and 2) selected secondary wood products – fuelwood, posts & poles, and Christmas trees that do include the main stem of trees. The secondary wood products are included because we estimate their value using the same methods as for non-wood products. We also include the value of game animals taken by hunting and trapping.

What does the Indicator show?

The value of permit and contract sales of non timber forest products (NTFP) from USFS and BLM land declined overall by about 30% between 1998 and 2007, from $9.5 to $6.5 million (all dollar figures adjusted for inflation and reported in 2005$). Non wood products decreased 18% and secondary wood products decreased 36% (fig. 26-1). These fluctuations are expected with products that fruit better in some years than others, such as fungi or pine nuts. The non-wood products value declined from 2.6 to $2.1 million and the secondary wood products value declined from $6.9 to $4.4 million.

Non-wood products include many plants, lichens, and fungi from forests, including understory species used in floral markets, for seasonal greenery, as wild foods, for medicinals, as plant extracts, and for transplants.

Secondary wood products include fuelwood, posts and poles, and Christmas trees. Production of these are significant in many regions.

Although annual or regularly collected data on domestic production and prices for NTFPs are generally not available, permit and contract data from the US Forest Service (USFS) and the Bureau of Land Management (BLM) can serve as a benchmark to assess use and value for many NTFPs. Information about game animal and fur-bearer populations and harvest is collected by State and Federal agencies, but national information is not generally available for all species. Prices for many NTFPs in the U.S. are influenced by international supply and demand, by seasonal fluctuation in availability, and by rising domestic demand. USFS and BLM sales data is used to assess NTFP first point of sales value by several categories including landscaping uses; crafts and floral uses; regeneration and silvicultural seeds and cones; edible fruits, fungi, nuts and saps; grass, hay and forage; herbs and medicinals; and for three categories of secondary wood products including fuelwood, posts and poles, and Christmas trees.

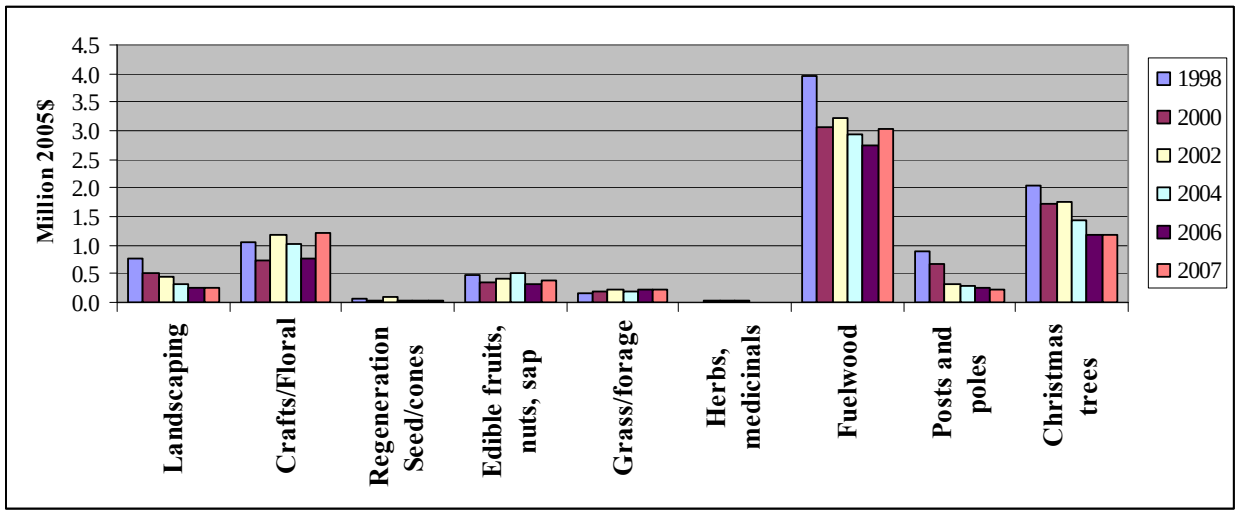

Figure 26-1. US Forest Service and BLM receipts for wild-harvested non timber forest products. 1998-2007 (Million 2005$)

It is possible to make a rough estimate of total national wholesale value for those types of NTFPs that are provided from USFS and BLM land by first assuming that the value per unit that the USFS and BLM receives is 10 percent of value per unit received at the first point of sales. Second, we assume that the USFS and the BLM provide particular proportions of total national production depending on the category. As a general guide about proportions we note that the National Forest land constitutes about 20 percent of total forest land in the US, and the BLM about 1.5 percent. Sometimes particular products are harvested more on Federal land than elsewhere, and sometimes less. The third step is to assume the first point of sale values are 40% of wholesale values. First point of sale value refers to the initial transaction by which a product enters the marketplace. It is comparable to "farm values", which commonly run about 40 percent of wholesale value.

The resulting estimate in 2007 for national wholesale value of non-wood products produced was about $232 million (down 19% since 1998) and for secondary wood products was about $391 million (down 35% since 1998) for a total of about $622 million (down 30% since 1998) (table 26-2).

These are very rough estimates, and actual values may be quite different. For example, alternate estimates of national first sale value for moss production value (part of the Crafts/ Floral category) have ranged from $6 million to $165 million compared to our estimate of first sale value of about $55 million for that entire Crafts/ Floral category in 2007

What has changed since 2003?

NTFP appraisal methods and monitoring of commercial harvesting have improved considerably on USFS land as a result of the federal Pilot Program of Charges and Fees for Harvest of Forest Botanical Products established in 2000. The law defines botanical products as florals, mushrooms, etc. removed from Federal forests (excluding wood products), defines "fair market value", and requires that permit fees be based on a determination of "fair market value" and sustainable harvest levels

Why can't the entire indicator be reported at this time?

Prominent data gaps include personal use of NTFPs, and production and value from private lands. Determination of first point of sales value is problematic. There is no single source of data for NTFPs, nor is it expected that there ever will be. It is unclear how consistent or comparable data sources are in terms of value and scale. Personal use values for NTFPs have not been estimated.

Table 26-2. Estimated wholesale value of wild-harvested nontimber resources in the US, assuming US Forest Service and BLM sales receipts are 10 percent of first point of sales value; US Forest Service sales represent approximately 20 to 30 percent and BLM sales represent approximately 2 to 15 percent of total supply; and first point of sales value is 40% of wholesale price. (Million 2005$)

Product Category	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Landscaping	89	73	56	54	51	44	37	35	28	28
Crafts/Floral	119	105	83	112	134	126	118	87	89	138
Seed/cones	6	2	5	5	12	6	3	5	3	3
Edible fruits, nuts, sap	56	38	41	56	47	49	58	46	35	42
Grass/forage	15	14	16	19	20	19	17	24	19	19
Herbs, medicinals	1	2	2	0	3	3	2	2	1	2
Subtotal	285	234	202	246	267	247	236	199	175	232
Fuelwood	397	367	306	312	323	310	294	271	273	302
Posts and poles	89	65	67	35	33	40	29	33	26	24
Christmas trees	114	94	96	102	97	96	80	82	66	65
Total	885	760	671	695	720	693	639	585	540	622

Indicator 6.27– Revenue from forest based environmental services

Why is the Indicator Important?

In addition to wood and non-wood forest products, forests also provide a number of environmental or ecosystem services. Although there have been many attempts to estimate the value for environmental services in the absence of working markets for them, this indicator focuses on the sub-set of environmental services for which actual markets and/or payments to landowners exist. When decisions are being made about forest productivity or assessments of the overall contribution of forests to economies and well-being, revenues from these services should be taken into account along with the market values for wood and non-wood forest products.

While the values presented here provide needed information that should be considered in decision making, it is important to remember that they do not measure the total value of the benefits supplied by forests to society, since many of these values are not reflected in market transactions. The revenues presented here simply a measure of the amount of revenues landowners actual receive for producing ecosystem services rather than a measure of underlying values.

What does the Indicator Show?

For reasons described further below, it is virtually impossible to obtain a full accounting of payments for ecosystem services. We can, however, tabulate currently available data for the major payment streams. The results presented here reflect data from Federal and State agencies, sales of offsets in the voluntary carbon market, and purchases of conservation easements and fee simple purchases by non-government organizations.[1] Data are currently unavailable for determining the forest component of the following Federal programs: Wetland Reserve Program (WRP), Landowner Incentive Program (LIP) and Private Stewardship Grants Program (PSPG). LIP and PSGP are relatively small programs with total annual payments ranging from $6-13 million in 2005-2007. Total WRP payments, however, were about $240 million in 2007 and could significantly influence the results. We expect to receive the WRP data on forest related payments by December 2008 and will add them to subsequent drafts of the report. Data from the following states were also not available at the current time: Arizona, California, Colorado, Idaho, Michigan, Mississippi, New Jersey, New Mexico, North Dakota, Tennessee, Washington, and Wisconsin. Data on payments by non-government sources are not currently available for wetlands and conservation mitigation banking.

	2005	2006	2007
Government			
Federal Programs	$ 248	$ 243	$ 248
State Programs	$ 8.4	$ 8.9	$ 12.0
Non-government			
Voluntary Carbon Market	$ 0.2	$ 0.4	$ 5.5
Conservation Easements	$ 69	$ 92	$ 111
Fee Simple Purchases	$ 142	$ 177	$ 177
TOTAL PAYMENTS	$ 468	$ 521	$ 553

Table 27-1. Total payments for environmental services from Federal and State agencies and non-government organizations and individuals in constant 2005 dollars ($1000,000s).

Payments to landowners from all sources from which data are available were $553 million in 2007 with Federal agencies providing $248 million, States $12 million, and non-government sources accounting for $294 million (Table 27-1). Of the non-government sources carbon offsets amounted to $5.5 million, conservation easements $110 million and fee simple purchases $176 million in 2007. Note, however, that the actual revenues to landowners for selling conservation easements are under-estimated as a large but unknown portion of the benefit to the landowners derives from tax incentives for which data is currently unavailable.

What has Changed Since 2003?

Comparisons to 2003 are not possible because this indicator is new for 2008 and therefore was not reported in 2003. However, we are able to report changes in payments for environmental services from 2005 to 2007. Figure 27-1 shows the relative payments made to landowners by the Federal and State agencies and by non-government organizations from 2005 to 2007 in constant 2005 dollars. Government payments have remained fairly constant during that time period ranging from $256 million in 2005 to $260 million in 2007. In contrast, payments by non-government

[1] Federal payments reflect the following programs: Wildlife Habitats Incentive Program (WHIP), Environmental Quality Incentives Programl (EQIP), Conservation Reserve Program (CRP), Forest Land Enhancement Program (FLEP), Forest Legacy Program (FLP) and Partners for Fish and Wildlife (PFW).

organizations for carbon offsets and conservation easements (and fee simple purchases) grew from $213 million in 2005 to $294 million in 2007 with payments for carbon sequestration services increasing from $204,000 in 2005 to $5.48 million in 2007 and conservation easement and fee simple purchase payments increasing from $211 billion to $287 billion.

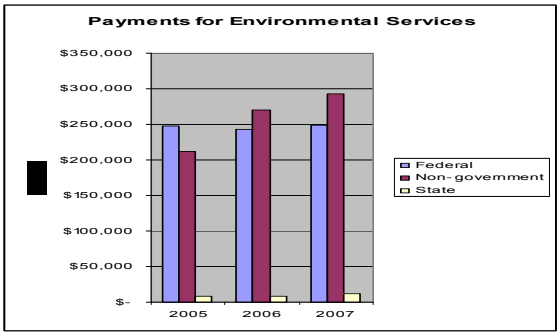

Figure 27-1. Total payments from Federal and State agencies and non-government organizations and individuals in constant 2005 dollars ($1000s).

Are there Important Regional Differences?

Figure 27-2 shows the distribution of payments between States for environmental services from all sources, in 2007 (the darker the shade of green, the larger the total payments). In 2007, Alaska landowners received the lowest payments ($276,000) while Georgia received the highest ($52 million).

Figure 27-2. Total payments in 2007 from Federal and State agencies and non-government organizations and individuals in constant 2005 dollars ($1000s).

Figure 27-3 shows the percent change in payments received by landowners in each state from 2005 to 2007. Red, yellow and orange states witnessed decreased payments for environmental services while the green states saw payments increase between 2005-2007. Total payments decreased in 22 states between 2005 and 2007. In six states payments decreased from 2-4%, while sixteen states saw payments decrease between 16 and 95%. Wyoming experienced the largest decrease with payments 95% lower in 2007 than in 2005. In contrast, 38 states experienced increases in payments between 2005 and 2007. Payments increased from 1 to 17% in nine states, from 30 to 100% in 6 states, and from 110 to 1400% in 12 states with Connecticut reporting the largest percentage increase.

Why Can't the Entire Indicator be Reported at this Time?

We had hoped to report revenues generated for specific environmental services. However, the data available from government and non-government sources does not allow us to disaggregate the revenues paid by individual services. Indeed, with the exception of carbon offsets, it appears that few payments are made for single environmental services. Most payments are made to landowners to produce a bundle of services and it is virtually impossible at this time to allocate the payments to specific environmental services. Furthermore, while consistent quantified data does exist to describe certain revenue categories, we find that a good deal of the activity in this area takes place in the form of one-off deals between public and private entities involved in the joint production of multiple goods and services, for example payments by municipalities and regional water authorities for watershed management and protection to improve water quantity and quality. Payments in this latter category are virtually impossible to fully quantify in terms of a national census or to accurately allocate to specific ecosystem services. A Partner Report is being produced to address these problems.

Figure 27-3. Percentage change in total payments from Federal and State agencies and non-government organizations between 2005-2007.

Indicator 6.28– Total and per capita consumption of wood and wood products in roundwood equivalents

What Is the Indicator and Why Is It Important?

The quantity of wood and wood products consumed is an indicator of the relative importance of forests as a source of raw materials. Information on the consumption of forest products, especially when compared to production levels, helps to illustrate the balance between supply and demand. When demands for consumption are not balanced by supplies—net domestic production plus imports—the imbalance creates price pressures that often have repercussions in the forest sector or elsewhere in the economy and society that may call into question long-term forest sustainability.

Consumption per capita is an indication of the value people and businesses place on wood products, given their prices, prices of substitutes; their perceived use qualities; and environmental benefits and costs. It is also integrally linked to timber harvest and the many factors that influence it, including investment, management, regulation, and owner objectives. These, in turn, change timber productivity and ecosystem conditions in various regions. Harvest of wood for imports to the United States and export of U.S. products influences forestry and the forest industry in other countries.

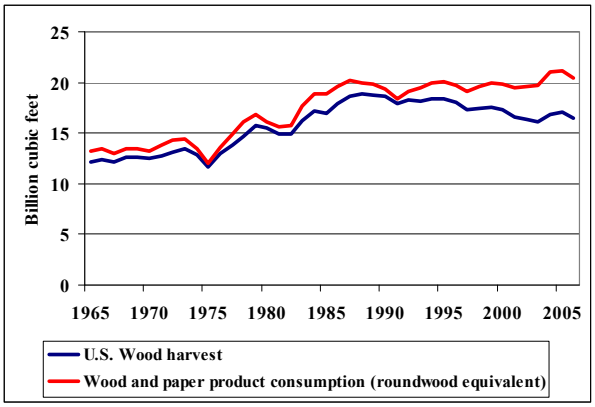

Figure 28-1. U.S. Wood production (harvest) and wood & paper product and fuelwood consumption, in roundwood equivalents, 1965-2006

What does the indicator show?

Total consumption of wood and paper products and fuelwood, in roundwood equivalents, increased between 1965 and 1988 from 13.2 to 18.9 billion cubic feet (cf). Since 1988 total consumption has been between 19 and 21 billion cf per year (fig 28-1). While, over this same period, U.S. wood harvest declined.

Excluding fuelwood, wood and paper products consumption, in roundwood equivalents, increased steadily between 1965 and 2006, from 12.3 to 18.8 billion cf (fig 28-2). Over this same period use of softwood and hardwood roundwood increased 53% and 56%, respectively. Fuelwood consumption increased to a high of 3.6 billion cf in 1984 and had declined to 1.6 billion cf in 2006. Most of the increase in wood and paper products consumption occurred between 1965 and 1988. The rate of growth in consumption was significantly less between 1988 and 2006.

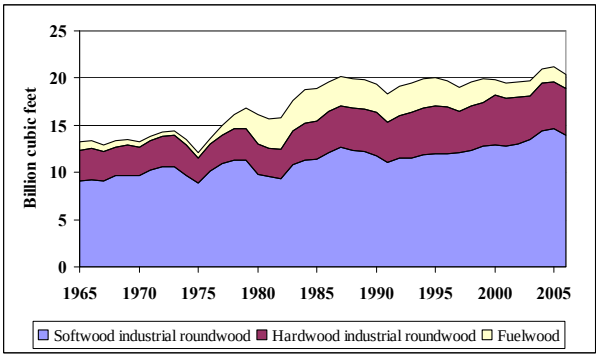

Figure 28-2. U.S. Wood & paper product consumption – subdivided into softwood, hardwood and fuelwood, in roundwood equivalents, 1965-2006 (each line is added to the line below)

Per capita consumption of wood and paper products and fuelwood, in roundwood equivalents, increased between 1965 and 1987, from 68 to 83 cf per year. From 1987 through 2006 per capita consumption has declined by 18% to 68 cf per year (fig 28-3). Over this period per capita harvest decreased 28%.

Excluding fuelwood, per capita consumption of wood and paper products, in roundwood equivalents, has been relatively stable, – averaging 63 cf per year. So, in roundwood equivalents, wood and paper products consumption has been increasing at roughly the pace of population (fig 28-4). Fuelwood use per capita increased to 15.3 cf in 1984 and has declined to 5.2 cf in 2006.

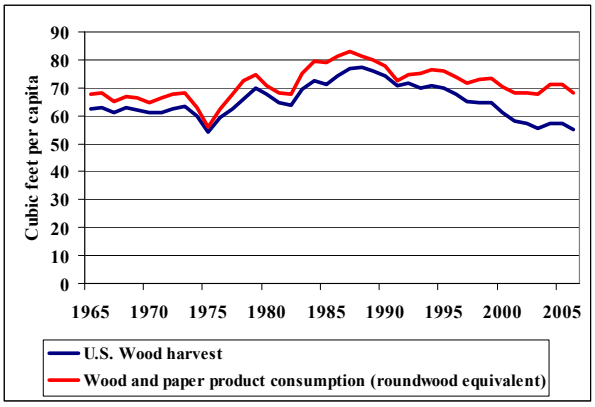

Figure 28-2. Per capita wood production (harvest) and wood & paper product production in roundwood equivalent, 1965-2006

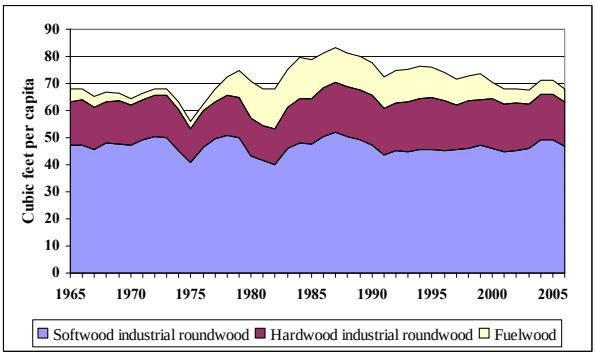

Figure 28-4. Per capita U.S. Wood & paper product consumption – subdivided into softwood, hardwood, and fuelwood, in roundwood equivalents, 1965-2006 (each line is added to the line below)

What has changed since 2003?

Trends have not changed markedly since 2003 despite three years of robust construction and economic growth in the U.S. Total consumption of wood and paper products (including and excluding fuelwood) have continued to increase although at a slower rate. Per capita consumption of wood and paper products alone has remained at about 63 cf. Per capita, and fuelwood consumption has continued to decline.

Are there important regional differences?

The data available for this report does not support the calculation of different rates of per capita consumption for different regions in the U.S. Assuming uniform per capita consumption rates, total regional consumption will depend directly on population, with the greatest consumption occurring in the populous east, followed by the South, the Pacific Coast, and lastly, the Rocky Mountain region.

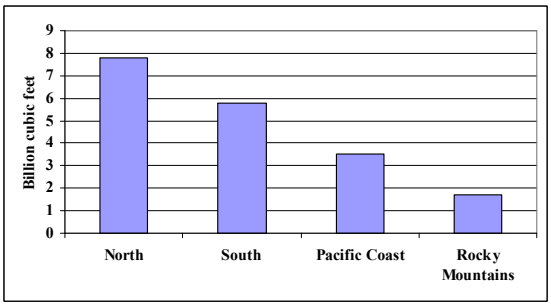

Figure 28-4. Estimated wood and paper products consumption by RPA region assuming uniform per capita consumption, in roundwood equivalent, 2006

Indicator 6.29– Total and per capita consumption of non-wood forest products

What is the Indicator and why is it important?

Non-wood forest products are items harvested or gathered from forests that are not traditional wood products. The quantity of non-wood forest products consumed indicates the relative importance of forests as a source of products other than wood and wood products. Information on the consumption of non-wood forest products, especially when compared to sustainable production levels, helps to illustrate the balance between supply and demand. When consumption and available supplies are not balanced, price changes are likely to occur that cause economic impacts in the forest sector or elsewhere in the economy. Estimates are provided for non-timber forest products and non-wood forest products. See definitions for these terms under Indicator 26.

Although annual or regularly collected data on domestic production and prices for NTFPs are generally not available, permit and contract data from the US Forest Service (USFS) and the Bureau of Land Management (BLM) can serve as a benchmark to assess use and value for many NTFPs. Non-wood forest products specifically included in U.S. export data generally have long traditions of international trade. There is also evidence of emerging significance in international trade of some crops from native species, such as American matsutake (mushrooms). For purposes of estimating consumption for this indicator, production data (Indicator 26) were adjusted by known trade (Indicator 31) and the result was assumed to be equivalent to consumption.

What does the Indicator show?

From Indicator 26 we have estimates of wholesale value of production for nonwood products and for nontimber forest products. The estimate in 2007 for the national wholesale value of non-wood products produced was about $232 million 2005$, down 19% since 1998 (all values adjusted for inflation and presented in 2005$). For secondary wood products it was about $391 million (down 35% since 1998) for a total of about $622 million (down 30% since 1998) (fig 29-1).

To estimate value of consumption we first estimate the value of net imports of selected non wood and secondary wood products and then add these estimates to wholesale production estimates. We divide these consumption values by population to obtain the value of consumption per capita.

We obtained value of imports and exports for selected nonwood and secondary wood products using Harmonized Trade Data codes. It was assumed that these selected import and exports are representative of all nonwood forest product trade. This is an imperfect assumption, as nonwood forest products may be included under many different trade codes, but it is not possible to split nonwood forest products out of all categories.

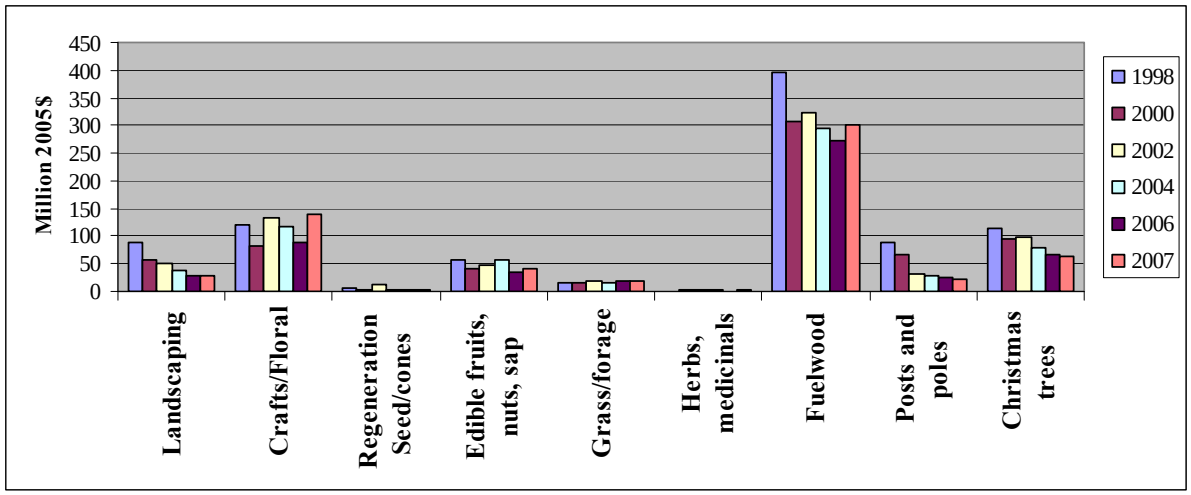

Figure 29-1. A rough estimate of national wholesale value for selected non timber forest products, 1998-2007 (Million 2005$)

Under these assumptions we estimated that the US is a net importer of nonwood forest products. Estimated net imports decreased between 2003 and 2007 from $157 to $113million or 28%.

The net value of US nonwood forest product trade (imports minus exports) is heavily influenced by vanilla, most of which is imported. Vanilla beans come primarily from Madagascar, and imports of vanilla beans from that country have dropped precipitously since cyclone Hudda in 2003 devastated Madagascar's vanilla-growing regions.

After adding net imports to production we estimate that total consumption of nonwood products decreased between 2003 and 2007 from $404 to $345 million or 15% (Table 29-1). These consumption values should be considered a lower bound estimate as they do not include personal use, undocumented harvest, and certain products that cannot be differentiated in the trade data.

In 2007 the value of net imports of nonwood forest products were about 33% of consumption.

Per capita consumption of nonwood forest products has decreased between 2003 and 2007 from $1.4 to $1.1 per person (Table 29-1).

If we add the net imports of nonwood products to production of all nontimber products, we find that total consumption has increase between 2003 and 2007 from $748 to $815 million; per capita consumption has increased from $2.6 to $2.7.

These consumption estimates are quite uncertain because error in any of a several assumptions could strongly influence the result.

Trade in non-wood forest products has been a small but regionally important part of the U.S. economy for generations. International trade in species native to North America is subject to many different influences, including globalization of labor markets, movement of processing to countries with competitive advantages, and changes in taste and style. International trade in non-wood forest products, in turn, influences sustainable forest practices, or the lack thereof, throughout the world.

What has changed since 2003?

NTFP appraisal methods and monitoring of commercial harvesting have improved considerably on USFS lands as a result of the federal Pilot Program of Charges and Fees for Harvest of Forest Botanical Products, established in 2000. The law defines botanical products as florals, mushrooms, etc. removed from Federal forests (excluding wood products), defines "fair market value", and requires that permit fees be based on a determination of "fair market value" and sustainable harvest levels

Why can't the entire indicator be reported at this time?

Results do not include consumption for personal use. Regional or national data on both harvest and price of nontimber forest products is not available, other than ginseng.

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Table 29-1 Total wholesale value of consumption, and per capita consumption of nonwood (not including secondary wood products) and nontimber forest products (including selected secondary wood products), adjusted for trade, (million 2005$)

	2003	2004	2005	2006	2007
Non-wood forest products consumption	404	396	270	301	345
Non-timber forest products consumption (includes non-wood products)	748	746	656	701	815
US population in millions	290	293	296	299	302
Non-wood forest products consumption per capita	1.4	1.4	0.9	1.0	1.1
Non-timber forest products (includes non-wood products) consumption per capita	2.6	2.5	2.2	2.3	2.7

Indicator 6.30– Value and Volume in round wood equivalents of exports and imports of wood products

What Is the Indicator and Why Is It Important?

For many countries, international trade is a significant factor in the commercial use of forests. Exports are, in some cases, a significant source of value for regional and national economies. Imports may either supplement or be a substitute for production from domestic sources. The values and volumes of wood product exports and imports are important because of the increasing importance of global markets in determining economic developments in our domestic forest sector and in impacting the sustainability of forest ecosystems both domestically and throughout the world.

What does the indicator show?

Between 1990 and 2006 the overall value of forest products imports increased 73% - from $24 to $41 billion (all dollar values adjusted for inflation and reported in 2005$), but increases have been small since 1999. At the same time, the value of exports increased 15% - from $20 to $24 billion with most of the increase occurring in the early 1990s and subsequent declines in more recent years (figs 30-1 and 2). In 2006, export value was about 71% higher than import value.

Import value for all groups of forest products increased between 1990 and 1999. Since 1999 the value of imports of wood and paper products has not increased, while the import value in the "other wood" and log & chip categories have continued to rise (though the log & chip import value is extremely small relative to the other categories).

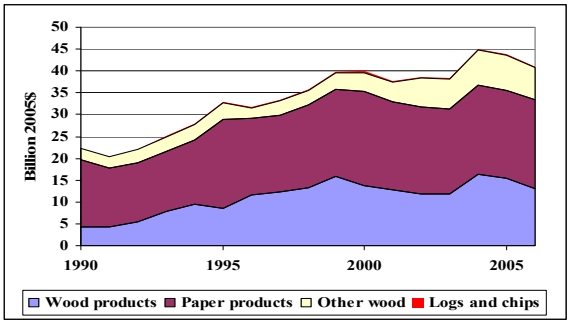

Figure 30-1. Value of forest products imports by product group, 1990-2006 (2005$) (each lines value is added to the line below)

Wood products include lumber, veneer and panels. Other wood includes poles and piling, fuelwood, wood charcoal, cork, wood containers, wood doors, and other miscellaneous products. Paper products include paper, paperboard, pulp, and recovered paper.

In 2006 the largest share of import value was for paper products (49%), followed by wood products (32%), other wood products (18%) and logs and chips (1%).

Export value increased a small amount overall between 1990 and 2006. The export value for paper and other wood increase modestly during the first half of the 1990s but has remained steady since then. In contrast, the export value for both wood products and logs and chips declined steadily between 1990 and 2006. (fig 30-2).

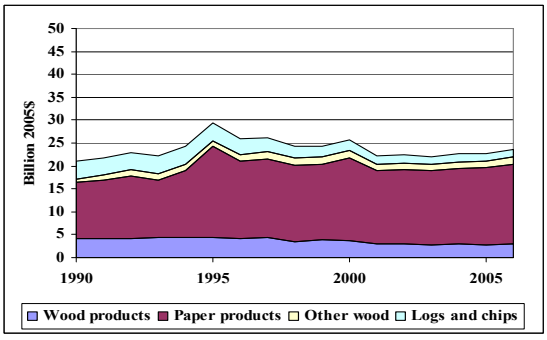

Figure 30-2 Value of forest products exports by product group, 1990-2006 (2005$) (each lines value is added to the line below)

We now shift to data on imports and exports in terms of roundwood equivalent – the amount of wood needed to make various products. These estimates do not include roundwood equivalent of imports and exports of recovered paper.

Between 1990 and 2006 overall imports have increased 67% - from 2.6 to 4.3 billion cubic feet, while exports have decreased 53% - from 1.8 to 0.8 billion cubic feet. Note that export volume has decreased while export value has increased. In 2006, import volume is over 400% larger than export volume (figs 30-3,4). This margin is much greater than the margin of import value over export value.

Import volume increased for all forest product groups between 1990 and 2005, and declined for all groups in 2005 and 2006 (fig 30-3). The strong increase in

volume through 2004 is in contrast to the limited increase in import value over the same period.

The product groups used when estimating roundwood equivalent of imports and exports are lumber, plywood and veneer, pulpwood based products (including OSB) and logs & chips.

In 2006 the largest share of import volume, was for lumber (76%), followed by pulpwood based products (18%), plywood and veneer (4%) and logs & chips (2%). These shares give a distorted view of what roundwood is used for because about half of the roundwood used to make lumber ends up in residues used to make paper or panels.

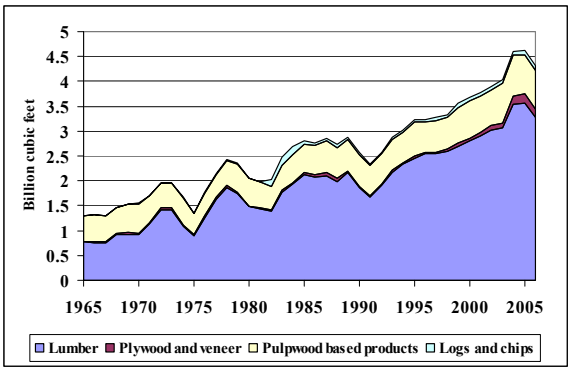

Figure 30-3. Imports of forest products in roundwood equivalent (excluding pulp and recovered paper), 1965-2006 (each line is added to the one below)

Export volume declined for all product groups between 1990 and 2006. Exports of lumber, plywood & veneer, and logs & chips all decreased by more than 65% while pulpwood based products decreased 1%. These declines occurred after increases from 1965 to 1990 (fig 30-4).

What has changed since 2003?

Trends in imports and exports evident prior to 2003 have continued. Import value is stable to higher, export value is level to declining, import volume is higher, and export volume is trending lower.

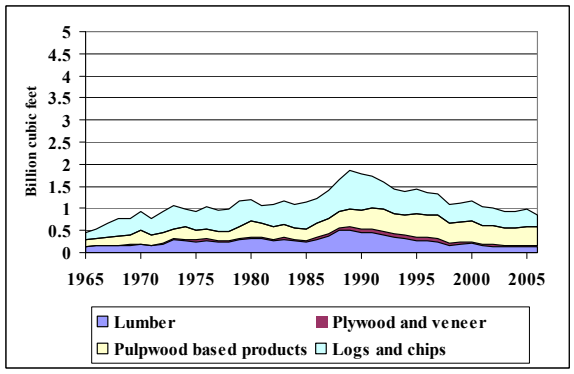

Figure 30-4. Exports of forest products in roundwood equivalent (excluding pulp and recovered paper), 1965-2006 (each line is added to the one below)

Are there important regional differences?

In 2005 the largest share of export value of forest products (fig 30-5) was from the South (44%), followed by the North (31%), Pacific Northwest (13%) and other West (12%).
Between 1990 and 2005:

- Value for the North increased then stabilized above $6 billion (2005$) after 1999;
- Value for the South peaked in1995 and has since declined
- Value for the Pacific Northwest has declined steadily
- Value for the other West increased until about 1997 then stabilized at above $ 2 billion (2005$)

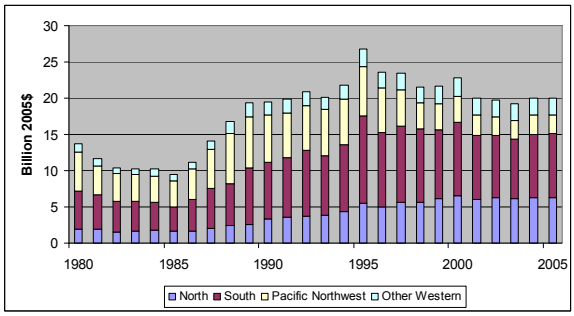

Figure 30-5. Value of forest products exports by region of customs districts, 1980-2005 (2005$)

Indicator 6.31– Value of exports and imports of non-wood products

What is the indicator and why is it important?

For many countries, international trade is a significant factor in commercial use of forests. Exports are, in some cases, a significant source of value for regional and national economies. Imports may either supplement or be a substitute for production from domestic sources. The values and volumes of wood product exports and imports are important because of the increasing importance of global markets in determining prices in domestic markets, the sustainable use of domestic resources, and the profitability of domestic industries.

What does the indicator show, and what has changed since 2003?

Value of 12 types of exported non-wood forest products (fig 31-1) increased from $332 to $457 million between 2003 and 2007 (all values adjusted for inflation and reported in 2005$). The value of imports of the same products decreased from $757 to $650 million between 2003 and 2007. Export values may be underestimated as discussed below.

The non-wood forest products included in U.S. national export data have long traditions of trade. Products that have become important in export markets recently include wild edible fungi, mosses, and lichens. For some species there is a distinction in data between wild and cultivated species. Pecans and cranberries are mostly cultivated. Blueberries and ginseng maintain separate trade markets for wild and cultivated crops, with the wild crop being smaller and more valuable per unit of production. Some exports such as American matsutake [*Tricholoma magnivelare*], appear to arise more from international demand than from U.S. marketing efforts.

All internationally traded goods are classified with a six-digit Harmonized Trade Code (HTC) number. Each nation can then add four additional digits to track goods that are of special interest to that country. National export data can be used to help assess domestic harvest and total trade for products where little other data is available.

For some products there are additional local export data that differ notably from national export data. The harvest and trade figures for moss are a case in point. For moss harvests from the Pacific Northwest and the Appalachian regions there is a difference between moss harvests reflected in land management agency permit data, and national moss and lichen export data. The US Forest Service and Bureau of Land Management issued permits for moss from 1997 to 2002 that averaged about 100,442 air-dry kg/year, with average annual permit revenues of about $19,650. An examination of export permit data from 1998 to 2003 showed 4.6 to18.4 million air-dry kg/year were exported, with a value between $6 and $165 million per year. These values are considerably higher than the national export values of $4.2 million for 2003 and $0.8 million for 2007. In fact, the upper bound of the export value estimate ($165 million) would place moss at the top of the list of export earners as opposed to the relatively minor position it holds in the current export statistics.

The discrepancies and range in the estimates illustrate how little is known about the moss trade. Policy makers and land managers lack critical information on which to

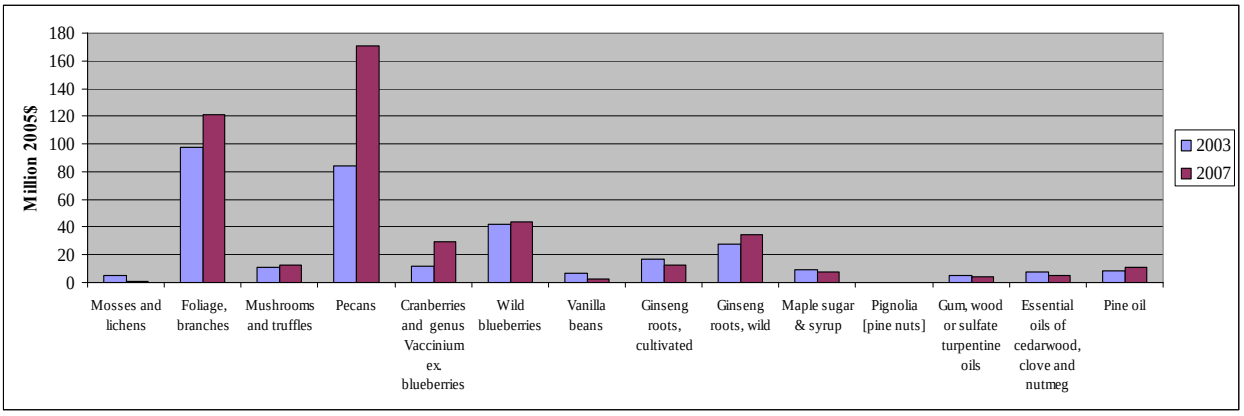

Figure 31-1. Value of exports of selected nonwood forest products, 2003 and 2007 (million 2005$)

base resource management decisions. This lack of knowledge has been noted about other wild-harvested non-wood products traded in commercial markets, such as floral greens and mushrooms.

Figures 31-1 & 31-2 show the value of non-wood forest products exported from and imported to the U.S. exports listed in this report focus on non-wood products from species native to North America, Included are native species growing wild in forests, forest openings, and woodlands, products from select native species grown agriculturally, and select products from native species growing in non-forest environments, whether wild or domesticated. Some trade codes are so broad that it is impossible to describe trade in specific species. For example, fresh foliage and branches (HTC 0604.91.0000) covers many species, wild and domesticated, from forests and agricultural lands. Some codes may include products that are grown in agroforestry environments, intentionally sown but allowed to grow in wild simulated environments, such as wild ginseng (HTC 1211.20.0040). A few codes are exclusive to wild-harvested non-wood forest products, such as fresh wild blueberries (HTC 0810.40.0024).

The U.S. mushroom trade data since 2002 has split out the most commonly domesticated mushrooms, including the white button mushroom common in grocery stores (*Agaracus* spp.), wood ears (*Auricularia* spp.), and jelly fungus (*Tremella* spp.). Mushroom trade data in Figures 31-1 & 31-2 do not include these domesticated species, and can be assumed to be highly influenced by amounts of wild-harvested fungi such as morels (*Morchella* spp.), chanterelles (*Cantharellus* spp.), American matsutake (*Tricholoma magivelare*), and various truffle species.

The top four exported non-wood forest products, in both 2003 and in 2007 were: 1) pecans, 2) foliage and branches, 3) wild blueberries, and 4) wild ginseng. Values for all four increased from 2003 to 2007.

The top four imported non-wood forest products in 2003 were 1) vanilla beans, 2) pecans, 3) maple syrup products, and (4) foliage and branches. The top four imports in 2007 were 1) pecans, 2) maple syrup products,3) wild blueberries, and 4) foliage and branches. Vanilla beans come primarily from Madagascar, and imports from that country dropped precipitously since cyclone Hudda in 2003 devastated Madagascar's vanilla-growing regions. Imports for the other top imports increased between 2003 and 2007.

Commerce in non-wood forest products has been a small but regionally important for the U.S. economy for generations. International trade in species native to North America are influenced by a number of factors, including globalization of labor markets, movement of processing to countries with competitive advantages in processing, and changes in taste and style. When one country experiences an event that puts it at a disadvantage, such as the cyclone in 2003 that affected Madagascar's vanilla bean growing areas, other regions or countries will hurry to fill the gap, particularly if prices rise due to the shortage. International trade in non-wood forest products likewise help determine sustainable forest practices. Trade information must be used along with other data, such as estimates of domestic consumption, to assess impacts on regions or countries.

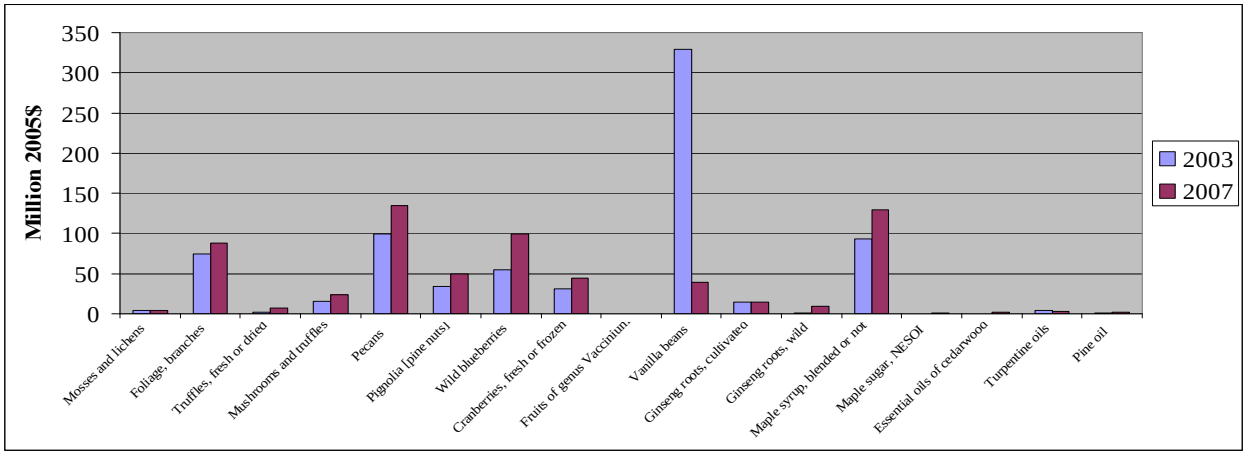

Figure 31-2. Value of imports of selected nonwood forest products, 2003 and 2007 (million 2005$)

Indicator 6.32– Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption

What Is the Indicator and Why Is It Important?

This indicator provides information on the relative importance of international trade in wood and wood products to domestic production and consumption. This indicator is used to evaluate the role of trade in the forest sector and thereby its impact on forest sustainability across social, economic, and ecological dimensions.

What does the indicator show?

The U.S. has become progressively more reliant on imports to meet consumption needs. In terms of roundwood equivalents, imports of wood and paper products as a share of consumption increased from 13% to 30% between 1965 and 2005. Over this same period there was initially a concurrent trend toward increasing exports as a share of production, which reached a high in 1991, but these exports have since declined. Exports as a share of production increased from 5% in 1965 to a high of 16% in 1991 then decreased to 10% in 2006 (fig 32-1).

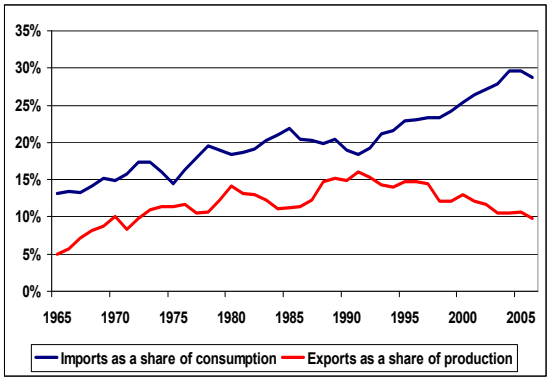

Figure 32-1. Wood and paper products imports as a share of consumption, and exports as a share of production 1965-2006 (on volume basis in roundwood equivalents)

The sustained increase of the overall import share to the historically high level of 30% is due largely to growth in the softwood lumber import share, which reached a level of 38% in 2006. This is up from 15% in 1965. The import share for other products was relatively stable between 1965 and the 1990's, but has since also increased (fig. 32-2, 3).

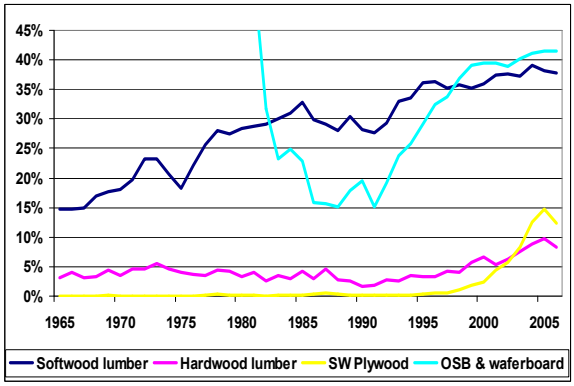

Figure 32-2. Wood products imports as a share of consumption, 1965-2006 (cubic units imported per cubic unit consumed)

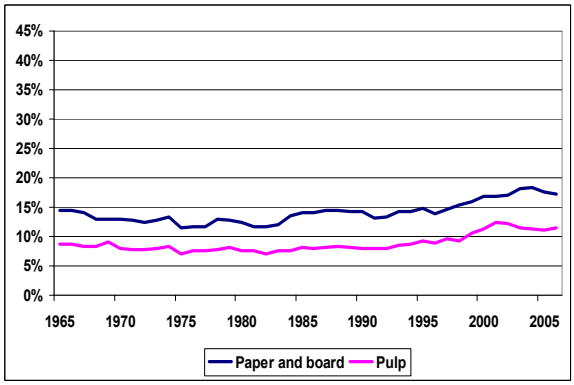

Figure 32-3. Pulp, paper and board imports as a share of consumption, 1965-2006 (tons imported per ton consumed)

The trend in overall export share of production, an increase then a decline, is due to initial increases and subsequent declines for softwood lumber, softwood plywood, and paper and paperboard. For hardwood lumber the share has continued to increase, and for pulp the share increased then levelled off after the mid 1990's. (figs. 32-4 and 5).

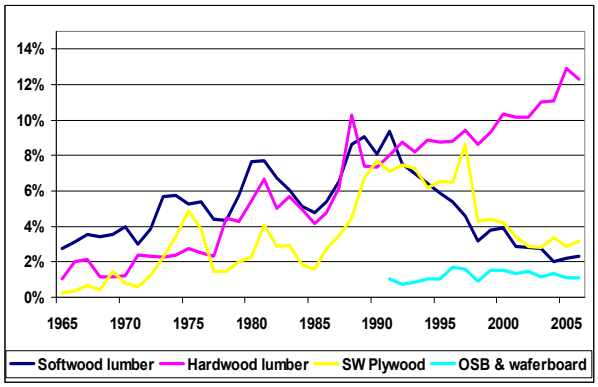

Figure 32-4. Wood products exports as a share of production,1965-2006 (cubic units exported per cubic unit produced)

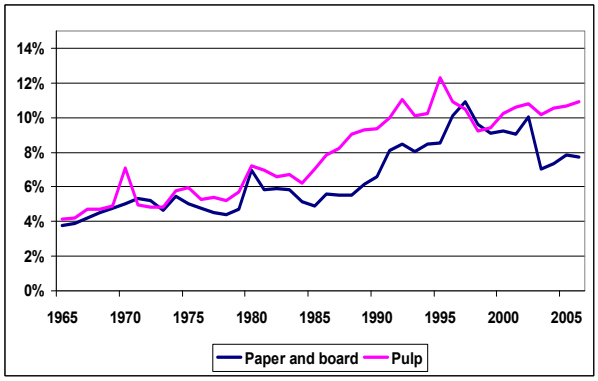

Figure 32-5. Paper and paperboard, and pulp exports as a share of production, 1965-2006 (tons exported per ton produced)

What has changed since 2003?

The overall trends in import share (increasing) and export share (decreasing) that appeared before 2003 have continued through 2006.

Are there important regional differences?

Data are not available for interstate imports and exports for U.S. regions, so import and export shares cannot be provided by U.S. region. However, it is possible to roughly estimate which regions are net importers of wood and paper products, in roundwood equivalent, if we assume that consumption per capita is uniform across regions. In terms of roundwood equivalent, of the four RPA Regions, only the U.S. South is a net exporter of wood and paper products (fig 32-6).

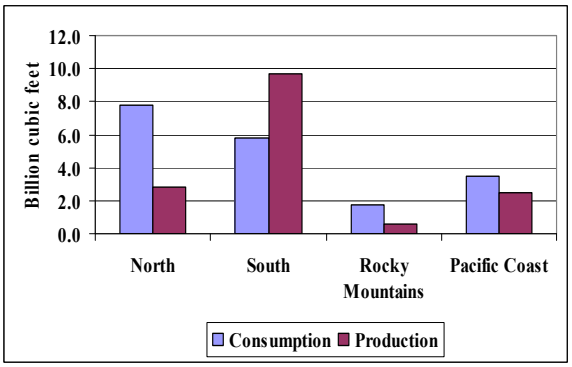

Figure 32-6. Wood and paper products consumption and production by region in roundwood equivalents, 2006 (billion cubic feet) (Regional consumption is estimated by assuming national per capita consumption of 63.5 cubic feet is uniform across regions)

Why can't the entire indicator be reported at this time?

It is not clear if data on value of wood and paper industry shipments covers the same range of products as the value of wood and paper imports and exports, so import and export shares on a value basis have not been provided.

Indicator 6.33– Recovery or recycling of forest products as a percent of total forest products consumption

What Is the Indicator and Why Is It Important?

This indicator identifies the extent to which forest products are recycled or re-used and provides a measure of the national efficiency of forest products usage. Recovered products are an important raw material for many forest products industries as well as some industries outside the wood products sector. Recycling forest products reduces the quantity of waste deposited in land fills or incinerated and enables a country to increase consumption of wood products without an increase in timber harvesting—both positive influences on sustainability.

Key sources of post-consumer wood and paper materials that are recovered for re-use in products include paper and paperboard, wood pallets, construction waste, demolition waste and wood/paper in municipal solid waste. For this indicator recovered amounts do not include amounts of waste wood and paper that are used for energy.

There are two basic measures used for this indicator:

- The recovery rate is the amount of wood or paper recovered for reuse in products (includes exports) divided by the amount of source products consumed in a year
- The utilization rate is the amount of wood or paper recovered divided by the amount of products produced in a year

The utilization rate indicates the degree to which use of recovered wood or paper holds down or substitutes for use of virgin wood in U.S. production of wood and paper products.

What does the indicator show?

The recovered paper utilization rate increased from 22% to 38% between 1970 and 1996, but then stabilized at 37-38% between 1996 and 2006 (fig. 33-1). In contrast the recovery rate for paper and paperboard increased from 22% in 1970 to 45% in 1999 and then continued to rise to 51% in 2006. In the last decade, the recovery rate has continued to increase even though the utilization rate has leveled off because almost all the increase in recovery since 1996 has gone to exports. Exports of recovered paper increased from 3% in 1970 to 18% and then nearly doubled since 1999, rising to 34% in 2006. For the purpose of comparison, in 1999 the total consumption of paper and paper products by all developed countries was 252 million tons annually, and their average recovery rate was 43 percent.

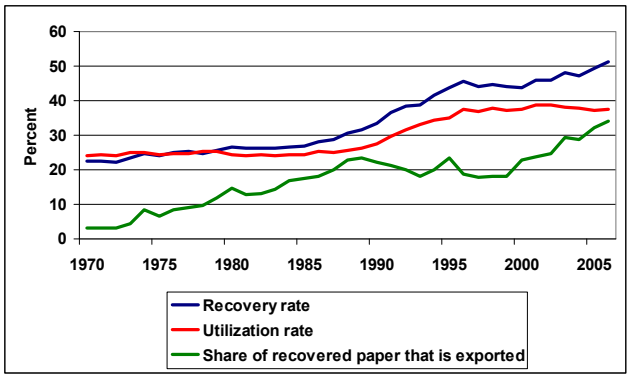

Figure 33-1. Paper and paperboard recovery rate, utilization rate and share of recovered paper that is exported, 1970-2006

The utilization rate of recovered wood products (for reuse as wood products) is uncertain due to incomplete data. We estimate the amount of recovered wood that is reused for products to include all recycled wood pallets and one-half of the wood recovered from municipal solid waste. We further assume that: (1) the other half of wood from MSW is used for fuel or uses that do not displace wood products use; (2) wood recovered from demolition and construction sites goes for uses (e.g. fuel or mulch) that do not displace wood products use; (3) the amounts of wood recycled via deconstruction are still small; and (4) recovered amounts are all used in the U.S. with no exports. With these assumptions the estimated recovered wood utilization rate has increased from an insignificant amount in 1990 to 10% in 2006 (fig 33-2). The recovered wood utilization rate for wood pallets alone has increased from 2% in 1993 to 34% in 2000 and 38% in 2006.

The total utilization rate for wood and paper combined increased from 12% in 1990 to 21% in 1998 and has since been stable at 21-22% through 2006 (fig 33-2).

What has changed since 2003?

U.S. recovery of paper is has increased from 45% in 1999 to 51% in 2006 with virtually all of the increasing recovery share going for exports.

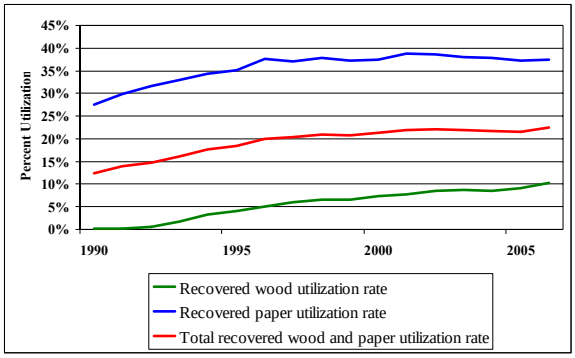

Figure 33-2. Recovered wood and paper utilization rates, separately and combined, 1990-2006

Are there important regional differences?

Total U.S. recovered paper consumed at U.S. mills increased by 2 percent between 2003 and 2006, from 33.7 to 34.5 million tons. Recovered paper consumption increased in mills in every region except the North. In 2006 the South had the highest recovered paper consumption (15.4 million tons) but the lowest recovered paper utilization rate (29%). The next highest level of consumption was in the North (13.4 million tons) where the utilization rate was (50%), followed by the Pacific Coast (4.8 million tons and a 49% utilization rate) and the Rocky Mountains (1.2 million tons, where utilization rate was highest at 59%) (fig 33-3).

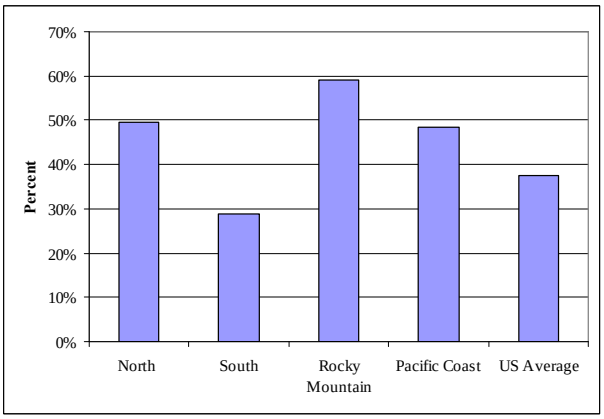

Figure 33-3. Recovered paper utilization rate by region, 2006

Why can't the entire indicator be reported at this time?

Data are not available on the amount of wood reused for products from demolition and construction sites and from deconstruction of building. We have assumed amounts are currently small. Value of recovered material, except for grades of recovered paper, are not available on a national scale.

Indicator 6.34– Value of capital investment and annual expenditure in forest management, wood and non-wood product industries, forest-based environmental services, recreation and tourism

What is the indicator and why is it important?

This indicator measures investments made to maintain and/or enhance the ability of forests to produce goods and services for the benefit of a nation's economy and people. Sustainable forest management is not possible in the long run without regular investments in forest protection and management operations, forest industries and enterprises, and forest-based environmental services. When capacities to protect, manage, and use forests erode, through lack of funding, the benefits that forests provide also decline.

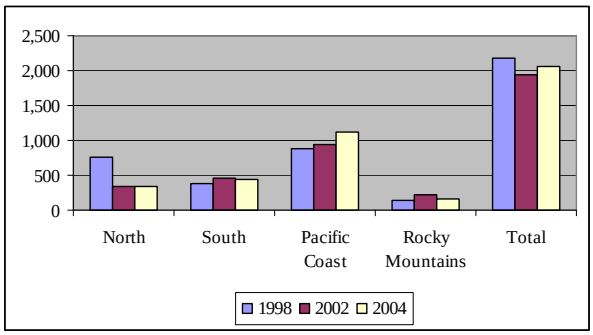

Figure 34-1. Annual state forestry program expenditures/ costs by region, 1998, 2002, 2004 (million 2005$)

What does the indicator show?

Capital investment toward protecting and managing forests includes investment in facilities, road, and trails by the USDA Forest Service which was $501 million in 2005 and $390 million in 2007 (adjusted for inflation and expressed in 2005$). Annual expenditures for Forest Service programs for national forests and grasslands decreased between 2004 and 2007 from $3.0 to $2.7 billion and expenditures for wildfire management increased from $1.7 to $2.1 billion (all in 2005$).

Total annual expenditures for State forestry agency programs has been about the same in 1998, 2002 and 2004 at $2.0 to $2.2 billion (2005$). Over this time state expenditures increased for Pacific Coast states by 27% after inflation, primarily in California, and decreased in the North. The decrease in the North is due primarily to an urban forestry expense in 1998 in New Hampshire not present in 2002 or 2004.

Capital investment in forest recreation and tourism are made by a variety of entities on both public and private land, as well as for infrastructure for businesses that provide the goods and services that make forest recreation possible. On the national level, investments into public recreation facilities include those made by the U.S. Forest Service and the U.S. Department of the Interior National Park Service (NPS). For 2009 the Forest Service budgeted $405 million in capital improvement and maintenance costs, which is an eight percent decrease from 2008 ($474 million). The National Park Service expenditures on facility maintenance increased from $389 million in 2006 to $393 million in 2007, and is budgeted for $461 million in 2008.

Private capital investment in forest recreation infrastructure was estimated for businesses that provide forest recreation services and those that provide the equipment which makes forest recreation possible. In 2006, total capital expenditures within the forest recreation sector were an estimated $1.47 billion, with $1.03 billion towards structures and $442 million in equipment expenditures. This is approximately 8.5 percent of total expenditures in the leisure industry.

In 2006, NPS concessions provided an estimated $48.3 million in the form of franchise fees paid to the National Park Service and in the form of facility improvements for National Parks, with $21.6 million of this being solely dedicated to facility improvements. As much as 90% of the fees and improvements may support forest-based recreation.

Capital investment in wood products industries decreased from $3.4 billion in 1997 to $2.2 billion in 2003 but increased to $3.5 billion in 2006 (all in 2005$). Capital investment in paper products industries declined more – from $10.2 billion in 1997 to $5.3 billion in 2004 but increased to $7.4 billion in 2006 (all in 2005$). Capital investment in the wood furniture industry was $837 million in 1997 and $873 million in 2002. Capital investment in logging industry was $0.9 billion in 1997 (2005$). More recent data from US Bureau of Census is not available.

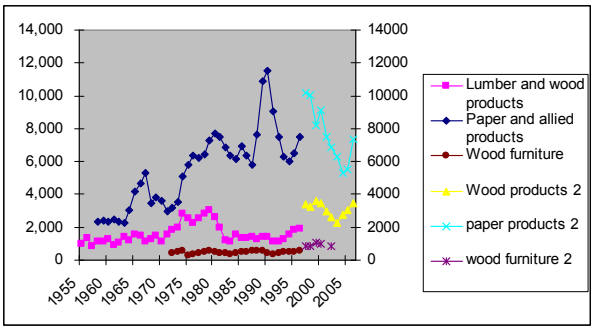

Figure 34-2. Expenditure in forest products industries, 1955 – 2006 (million 2005$)

Annual expenditures for payroll and materials by the wood products industries decreased between 1997 and 2003 about 9% from $82 to $75 billion then increased to $84 billion in 2006 (2005$). Annual expenditures for payroll and materials for paper product industries decreased 15% from 1997 to 2003 from $121 to $104 billion then increased to $107 billion in 2006 (2005$).

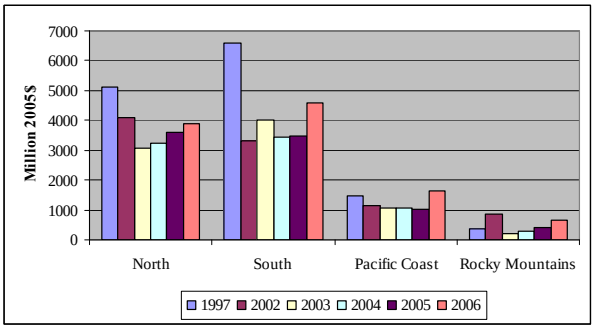

Figure 34-3. Capital expenditure in wood products and paper products industries by Region, 1997 and 2002 to 2006 (million 2005$)

What has changed since 2003?

Annual capital investment in wood and paper industries declined 40% between 1997 and 2004 and increased 34% between 2004 and 2006. In contrast annual expenditures for payroll and materials remained relatively stable between 1997 and 2006 (in 2005$).

In recent developments, during 2007 and early 2008, the US Department of Energy announced grants of up to $585.3 million for capital costs to build 13 commercial or demonstration cellulosic liquid biofuels plants. Six of the plants—with DOE capital funding up to $230.3 million—will use wood biomass or wood pulp extract as feedstock. Additional funds will be invested by individual businesses. In addition to the DOE funded plants, there are 3 other wood based biofuels plants being prepared. All together these wood-based plants expect to use 2300 tons per day or more of wood biomass (720,000 tons per year).

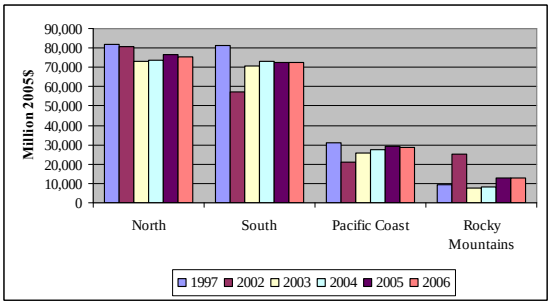

Figure 34-4. Payroll and material costs for wood and paper products industries by region, 1997, 2002-2006 (million 2005$).

Are there important regional differences?

The regional share of U.S. expenditures for state forestry agency programs in 2004 is highest for the Pacific Coast (54%), followed by the South (21%), North (16%) and Rocky Mountains (8%). Between 1997 and 2006 the share of total U.S. annual capital investment in wood and paper product industries ranged from 35% to 49% in the North, 36% to 43% in the South, 11% to 15% in the Pacific Coast and 3% to 9% for the Rocky Mountains. The share increased from 11% to 15% for the Pacific Coast region and decreased for the North and South regions. The regional shares of annual payroll and material expenses have been a little more stable and are highest in the North and South, 39%, 38%, respectively followed by the Pacific Coast (15%) and Rocky Mountains (7%).

Why can't the entire indicator be reported at this time?

Capital expenditure and annual expense data are not available for a number of entities that protect and manage forests, including county/ local governments, conservation organizations, and certain corporate land owners (e.g. TIMOs, REITs). Capital and annual expense data are not available by region for forest based recreation and tourism. Data specifically on capital and annual expenses for providing forest-based environmental services are not available although some cited total expenses by the Forest Service and state forestry agencies support these services.

Indicator 6.35– Annual investment and expenditure in forest-related research, extension and development, and education

What is the indicator and why is it important?

Capital investments and annual operating expenditures on forest-related education, research and development increase human capital. Funds invested in communicating the results of research and development to practitioners and the public build awareness, and hopefully support, for sustainable forest management. These investments and expenditures increase knowledge and skills and, over time, increase a country's ability to practice sustainable forest management.

Research and development, extension, and education areas include all disciplines that influence forest resource management decision making. Forests in the United States are threatened by fragmentation, invasive species, the effects of climate change, as well as the disconnect of our children and increasingly urban populations from the natural world. Forest related education and extension, as well as the communication of research and development to both forestry practitioners and the general public can build awareness and support for sustainable forest management. Thus, it is critical to examine the level of funds invested annually towards forest related education, extension, and research and development.

What does the indicator show?

Forest resource management-related research and development efforts are centered in the USDA Forest Service, in universities, and in industry, with additional efforts by other agencies and nongovernmental organizations. USDA Forest Service funding for research, including construction, and net of inflation, has increased from $259 million in 2000 to $326 million in 2008 (both in year 2005 dollars) although funding has been relatively constant above $300 million per year (2005$) since 2002 (Figure 35-1).

USDA Forest Service publications (including those in peer reviewed journals) have increased from 1,886 in 1981, to 2,718 in 1998, and most recently to 3,182 in 2007.

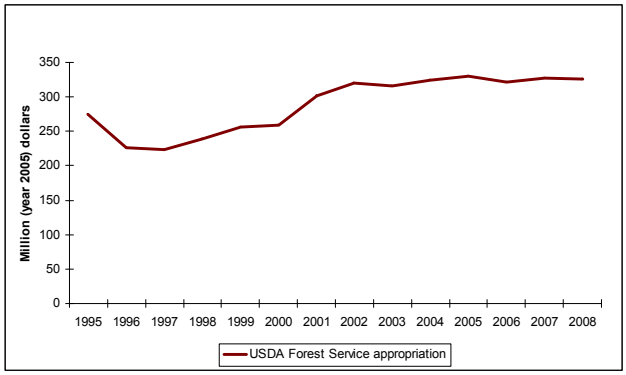

Figure 35-1. USDA Forest Service Research & Development appropriations 1995-2008 (millions of year 2005 dollars)

Funding available for forestry research at universities that receive federal funding increased from $256 million in 2000 to $282 million in 2006 (2005$). Funding in 2006 was highest in the North ($92 million), followed by the South ($84 million), Pacific Coast ($65 million), and the Rocky Mountains ($39 million) (Figure 35-2).

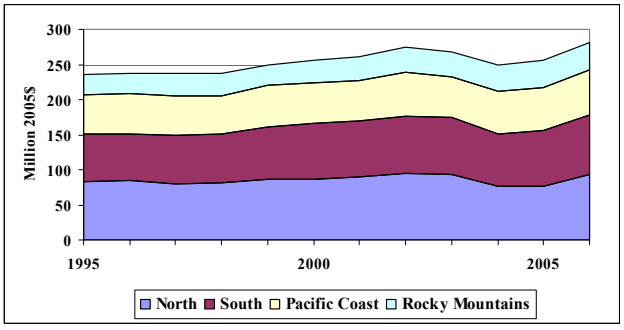

Figure 35-2. Forestry research funding at U.S. universities that are partially funded by the Cooperative State Research, Education, and Extension Service by RPA Region, 1995-2006 (million 2005$)

Forest industry also provides funding for both internal and external research. The Agenda 2020 is a key federal and industry partnership that provides funds from the Federal government and industry for research on a wide range of topics including improved fiber recovery and utilization, decreasing capital costs, reducing environmental effect, the forest bio-refinery, and improved housing systems. Funding for 2003 was about $30 million each from industry and the federal government.

Additional sources of funding for forestry research are available, from other federal sources as well as nongovernmental organizations.

Baccalaureate, masters, and doctorate degrees awarded in forest science programs decreased 20% from 2,263 in 2001 to 1,810 in 2006. Over that period, the number of baccalaureate degrees decreased 28% and doctorate degrees 15%, while masters degrees increased almost 4%.

In 2007, funding appropriated through the Renewable Resources Extension Act for forest stewardship and health extension programs, resulted in 1,495 education events nationwide, the development of 1,574 stewardship plans, and impacted over 12 million acres.

Forest Service Conservation Education activities and programs, which are funded from numerous sources within and external to the US Forest Service, reached 4,400,000 people in FY 2006. 35% of those reached came from urban areas, 10 % were underserved, and 33% were youth and/or their educators. FY 2006 data indicate a significant increase over previous years for the number of activities conducted, audiences reached, partnerships developed and improved, and total dollars spent, though this data is collected from a voluntary, self-reporting database (Table 35-1).

	2004	2005	2006
Activities	655	1,007	1,335
Audience reached	2,100,000	982,000	4,400,000
Partnerships	641	825	1,578
Total $ Spent (2005$)	$8.3 M	$9.7 M	$17.9 M

Table 35-1. Impact from and dollars spent towards US Forest Service Conservation Education activities, 2004-2006. (million 2005$)

Forest resource education is also provided by public schools, and by a wide range of nongovernmental organizations.

What has changed since 2003?

There has been an increase in the amount of funds available for forest research since 2003, both for federal and university research. In the same time period, the amount of forest science degrees awarded has decreased by 20%.

Why can't the entire indicator be reported at this time?

Investment in forest education for primary school-aged children is important for this indicator but a forestry-specific, nationwide dataset was not found. Information is not available on funding for forestry related research and education from other federal sources such as Department of Interior or NASA, nor is data available funds for research done by many non governmental organizations.

Indicator 6.36– Employment in Forest Products sector

What Is the Indicator and Why Is It Important?

Employment attributable to forests is one measure of the social and economic importance of forests. It includes employment that is both forest-based and forest-related. Employment is a tangible and widely understood measure of economic and social well being.

What does the indicator show?

Jobs in the forest products industries decreased by about 15% between 1997 and 2006, falling from 1.51 million to 1.29 million. Declines included 21% for forestry and logging, 6% for solidwood products, 28% for pulp and paper, and 3% for wood furniture (fit 36-1). Within the furniture category nonupolstered wood furniture decreased 44% from 127,703 to 71,544 and architectural woodwork and millwork increased 31% from 24,390 to 32,033. Forestry and logging jobs had been relatively constant between 1986 and 1996.

In 2006, 74% of forest industry jobs noted above were in the wood products and paper products industries (536,094 and 414,049, respectively). Combined they were 1.1 percent of all U.S. jobs and 7.1 percent of manufacturing jobs. This is down from 824,000 and 485,000 in 1950 when combined they were 2.5% of all jobs and 8.6% of manufacturing jobs.

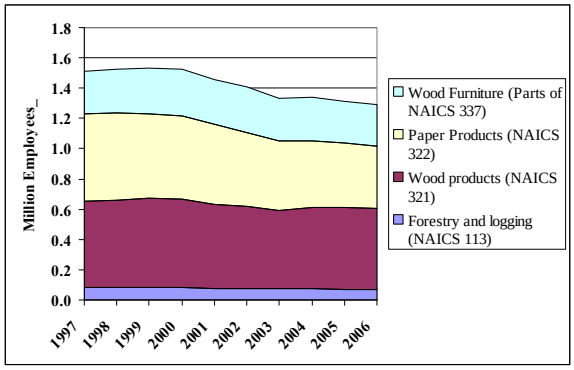

Figure 36-1. Number of employees in forest products industries, 1997-2006

Jobs in forest management and protection include

- permanent USDA Forest Service, National Forest System jobs, which have declined from 30,632 in 1991, to 24,605 in 2000, and 22,867 in 2006 (fig 36-2);
- permanent employees in state forestry agencies – which has been about constant between 1998 (15,836) and 2004 (15,455) (fig 36-3);
- total state agency employees which have increased by about 2000 after including temporary employees – 22,269 in 1998 to 24,507 in 2004;
- employees in Department of Interior agencies that manage forests was about the same level in 2007 (43,085) as in 1998 (44,003); and
- an undetermined number in county and municipal governments, private land management organizations, private consultants, and private forest-resource related organizations.

Nationwide, fire fighting and support jobs during fire season have ranged between 12,000 to 15,000 in recent years.

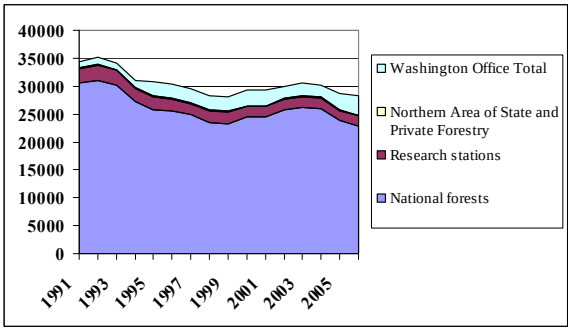

Figure 36-2. USDA Forest Service permanent employees by branch, 1992-2006

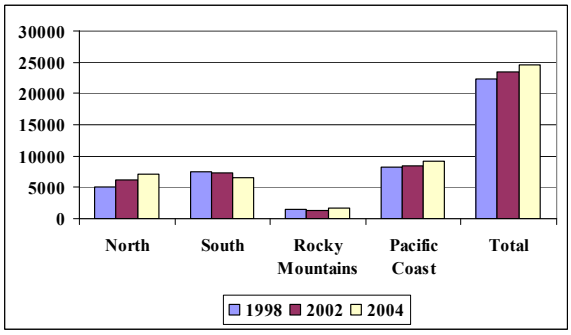

Figure 36-3. Permanent and temporary State forestry agency employees, by region, 1998, 2002, 2004 (State data missing: 2002 - PA, NV; 2004 - OH, ME, IL, AR)

The number of jobs associated with forest-based recreation is uncertain. For 2006 we estimate about 551,000 direct forest-based recreation jobs. An increase may be inferred by the increase in participation in U.S. forest recreation. However, the fact that the estimate for

the 2003 Report on Sustainable Forests (made using different methods) was 1.1 million direct forest-based recreation jobs underscores the tenuous nature of employment estimates in this category. For 2005, direct jobs associated with recreation on National Forests are estimated to be 97,600

Jobs in producing non-wood forest products including medicinals, food and forage species, floral and horticultural species, resins and oils, arts and crafts, and game animals and furbearers probably number in the tens of thousands. Many, if not most, are informal businesses whose characteristics are not recorded in Bureau of Census surveys. There are two exceptions. The sector "Forest Nurseries and gathering of forest products" included 231 businesses in 2006 with 2098 employees. The sector "Hunting and trapping" included 348 establishments with 1,875 employees in 2006. These jobs have decreased from 2,702 in 2002.

Jobs in forest related education and research include those at colleges and universities and research jobs include those in the USDA Forest Service. For the 2003 Report on Sustainable Forests we estimated 1,361 jobs in forest related education and research for 2001. Jobs at Forest Service research stations have decreased from 2,469 in 1991, to a low of 1,708 in 2000, and were 1,760 in 2006. For the 2003 Report on Sustainable Forests we estimated 124 industry research jobs for 2001. In addition there are an undetermined number of forest resource education jobs within private associations and organizations.

Total forest-related direct jobs are estimated to be close to 3 million or about 2 percent of all U.S. employment. This does not include indirect jobs generated by expenditures of government agencies, businesses, or others.

What has changed since 2003?

Jobs in forest products industries have declined considerably – by 81,791 or 8% between 2001 and 2006.

Are there important regional differences?

In 2006, forest products industry employment (excluding wood furniture) was highest in the North (400,000), followed by the South (341,000), Pacific Coast (130,000), and Rocky Mountains (73,000). Between 2001 and 2006 these jobs decreased in the North, South, and Pacific Coast but increased in the Rocky Mountain region. Forestry and logging jobs in 2006 were highest in the South (36,013), followed by the Pacific Coast (14,538), North (11,839) and Rocky Mountains (3,914).

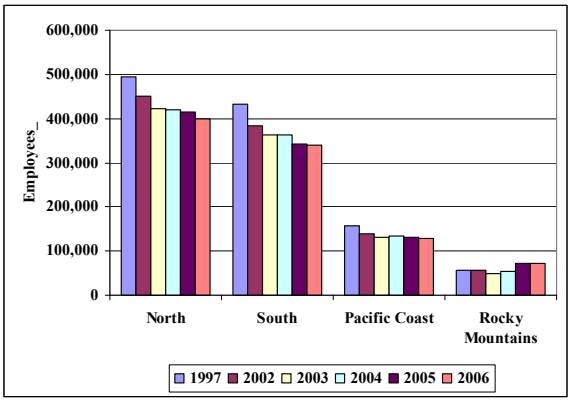

Figure 36-4. Employees in wood and paper products industries (NAICS 321, 322) by region , 1997, 2002-2006

In 2004, total employment in state forestry agencies was highest in the Pacific Coast (6121 permanent and 3109 temporary) followed by the North (2,791 permanent and 4,320 temporary), the South (5492 permanent and 1,043 temporary), and Rocky Mountains (1,051 permanent and 581 temporary). Between 1998 and 2004 state forestry agency seasonal/temporary jobs increased for the North (more than doubled), and for the Pacific Coast and Rocky Mountains, but declined for the South.

Why can't the entire indicator be reported at this time?

Little data is available on jobs in producing non-wood forest products since many businesses are very small and part of the "informal economy" which has casual hiring and non-reported income.

Data are not available on jobs related specifically for providing environmental services such as carbon storage, biodiversity, or water supply. But a number of jobs counted in the Forest Service and state agencies help provide environmental services.

Updated data are not available on forest related education and research jobs at colleges and universities.

Data are not available on forest related jobs in county and municipal governments, private land management organizations, private consultants, and private forest-resource related organizations.

Indicator 6.37– Average wage rates, annual average income and annual injury rates in major forest employment categories

What is the indicator and why is it important?

Wages, income and injury rates are measures of the quality of employment. Wages and income are indicators of the economic returns to workers in forest-based and forest-related enterprises. Decreasing injury rates may reflect improved occupational health and safety and employment quality, which provide both personal and community social benefits.

What does the indicator show?

Average annual incomes related to forest management and protection employment includes the salaries of full time permanent employees of the USDA Forest Service which have increased from a median of $41,300 in 1992 to $48,200 in 2000, to $50,500 in 2006 (all firures adjusted for inflation and expressed in 2005$).

Salary of full time permanent employees in state forestry agencies in 1998, for entry level foresters, ranged from a high of $48,000 for the Pacific Coast, $39,000 in the North, $35,000 for the Rocky Mountains and $28,000 for the South. Values for district foresters for the same regions were $62,000; $63,000; $43,000 and $50,000 respectively. Salary data are not available for more recent years.

In the forest products industries annual income per full time equivalent employee is higher and has increased more for workers in the paper products industries than those in the wood products industries. For paper products, annual income increased from $39,954 to $52,572 between 1975 and 2006 while wood products annual income increased from $30,866 to $34,239 (fig 37-1). Annual income for paper products continues to be above the average for all manufacturing and that for wood products is below.

Average annual income for persons working in the forest recreation and tourism sector during 2006 was estimated to be $22,782 which is only a slight increase from the $21,939 figure estimated for 2003. This is about 37% less than the 2006 national average per capita annual income of $36,276. One likely reason for the lower income is that jobs offered in this sector tend to be lower wage and seasonal jobs.

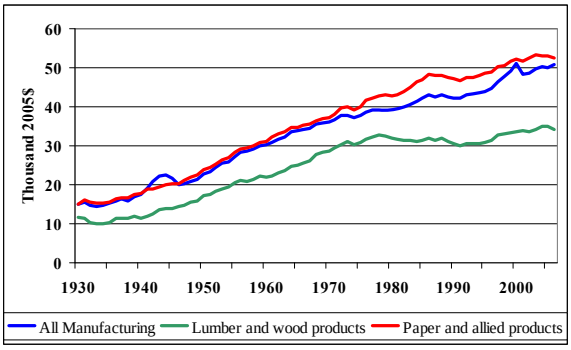

Figure 37-1. Wage and salary accruals per full-time equivalent employee for all manufacturing, lumber and wood products industries and paper and allied product industries, 1930-2006 (thousand 2005$)

Injury and illness rates for forest products industries have steadily declined since the early 1990's with rates for wood products and furniture industries being somewhat higher than for all manufacturing, and paper products industries being somewhat lower (fig 37-2). In 2006 injuries and illness per 100 employees were 8.5 for wood products, 7.1 for wood furniture, 4.3 for paper products and 6.0 for all manufacturing.

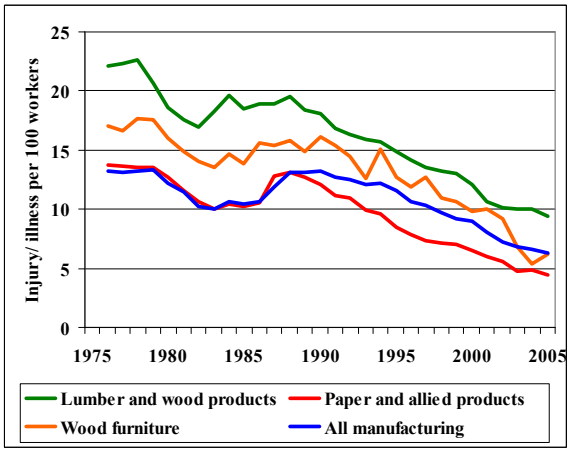

Figure 37-2. Rate of injury and illness cases per 100 full-time workers for lumber and wood products, paper and allied products and all manufacturing industries, 1976 – 2006. Are there important regional differences?

Hourly wages for wood products industries production workers are slightly higher than the national average for the Pacific Coast and slightly lower for the South (fig 37-3). Wages for paper products industries are slightly

higher in the South, Pacific Coast and North than in the Rocky Mountains.

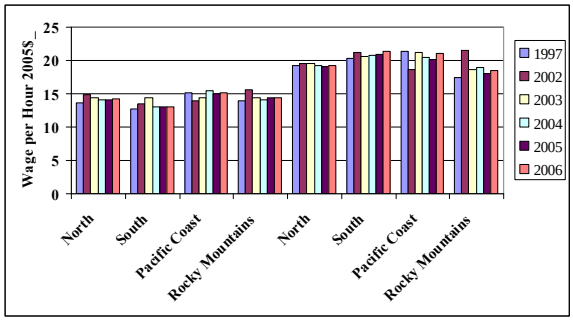

Figure 37-3. Wage per hour for production workers in wood products industries (left side) and paper products industries (right side) by region, 1997, 2002-2006

Average income in forest-based recreation and tourism in 2006 was highest for the Pacific Coast, $24,566 and lowest for the Rocky Mountains, $17,620 (both in 2005$) (fig 37-4). Although these differences could be a function of forest-based recreation and tourism demand driving labor markets, fluctuations in regional economies are likely to be the major drivers of these rankings.

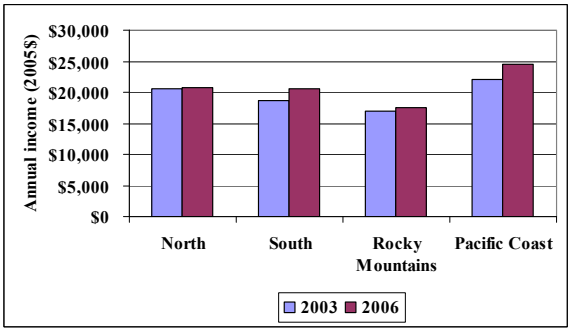

Figure 37-4. Annual average income for persons employed in the forest recreation and tourism sector by region, 2003 and 2006.

Why can't the entire indicator be reported at this time?

Wage and annual income estimates are not available for State forestry agencies, non-wood products industries, forestry schools in colleges and universities or for local governments and non governmental organizations that contribute to forestry. Special surveys would be required to collect this information. Injury rate information is not available for most forest management jobs or for the non-wood forest products sector or jobs in forest recreation and tourism. Some forest management jobs are included in wood and paper industry data. Non-wood forest products workers operate in the informal economy not covered by surveys or other standard income reporting services. Gathering products in the forest can be dangerous, and there are reports in the media of people becoming lost or injured every year.

Indicator 6.38– The Resilience of Forest-Dependent Communities

What is the indicator and why is it important?

Communities whose social and economic structure and well-being are tightly tied to forest-based or forest-related economic activities may be particularly vulnerable if confronted with either short or long term economic changes from the rise and fall of business cycles or the emergence of alternative products or technologies that increase competition. This indicator is intended to measure the ability of these communities to successfully adapt to changing circumstances. Resilient communities are successful in adapting to changing circumstances.

Community resilience as used to address this indicator is defined as the existence, development and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability and surprise. Members of resilient communities intentionally develop personal and collective capacity that they engage to respond to and influence change, to sustain and renew the community and to develop new trajectories for the communities' future.

The premise behind this definition of Community Resilience is that all communities have access to numerous kinds of resources, otherwise known as capitals. These include natural, human, cultural, financial, built, social and political capital. A resilient community actively develops and utilizes all of its capitals, includes all community residents in community endeavors, engages various groups to work together, works strategically toward the development of the community, and works to ensure equity across community members. As the community invests in and develops its various capitals, it develops capacity to respond effectively to change, i.e., it creates Community Resilience.

The concept of Community Resilience, as defined here, can be divided into eight dimensions. These are; 1) Community Resources, 2) Development of Community Resources, 3) Engagement of Community Resources, 4) Active Agents, 5) Collective Action, 6) Strategic Action, 7) Equity, and 8) Impact. To measure these, we have designed an assessment tool. The Community Resilience Self Assessment collects information from community members on these dimensions.

What does the indicator show?

I38 will show the resilience of selected communities across the United States. Community Resilience will be portrayed with a radar chart for each community (See Figure 1). The chart displays scores for the eight Community Resilience Dimensions. Additionally, it displays the Community Resilience Index, which is an average score of the community's overall resilience.

Communities surveyed can be categorized into different groups by region, forest ownership, type of forest dependence, particular forest policies or forest conditions. Comparisons can be made between and within groups. The data from a sample of communities can help in making decisions about more in-depth studies on issues of concern, either at the community level or at a policy level.

What has changed from 2003?

Indicator 38, Resilience of Forest Dependent Communities, replaces Indicator 46, Community Viability and Adaptability. Indicator 46 was created to highlight community response to changing economic conditions. It considered the community's economic dependence on the forest and its social well-being. Social well-being was described as including the community's socio-economic status, i.e., viability, as well as its capacity to respond to change, i.e. adaptability. Adaptability and Community Resilience refer to the same phenomenon. Though the indicator represented a good initial approximation of community well-being, it required improvement in at least two areas.

First, the indicator addressed two substantially different characteristics of community well-being, i.e., viability and adaptability. Including two different indices in one indicator necessarily compromised the integrity of both as neither could be accurately and sufficiently measured. It, hence, confounded conclusions that could be gleaned from the resultant data. To produce vital data about social systems as complex as communities, more than one indicator is required. Viability and adaptability needed to be measured independently.

Secondly, the measures utilized in Indicator 46 (employment, population density, percent minorities and availability of forestlands) were obtained from

standard statistical sources reported at the county scale. While this facilitated ease of reporting, both the types of statistics available, and the scale at which they were reported, do not accurately portray a community's resilience.

Research on Community Resilience indicates that the way in which a community invests in, develops and utilizes its resources provides a strong measure of a community's resilience. These data are not available in standardized data sets. They are unique to each community and change with the changing conditions of a particular community. Further, data related to a community's resilience is held in the expertise and knowledge of the people in the community. Hence, the data need to be collected from community members utilizing data collection methods that provide access to community members' knowledge. The method selected to gather this information is the Community Resilience Self Assessment.

Sample Graphic

Figure 1 illustrates a set of Community Resilience scores for a sample community. Each dimension is scored on a 3 points scale, with 1 being low, 2 medium and 3 being high. In this example, the community scored itself high on Community Resources (2.5), indicating that it has a good number of resources from which to draw. It also scored itself high on Active Agents (2.5), indicating that community members believe there are a few people who are actively involved in working on community endeavors. However, the community scored itself low on Equity (1) and Collective Action (1.2), indicating that resources from throughout the community are not being accessed and that people from different groups are not working together very much. Finally, the community scored itself low on Engagement of Resources (1.5), indicating that the community is not utilizing all of its resources or is not using them very well.

With limited access to the community's resources, unequal involvement by people from throughout the community and low levels of collective action, the community cannot efficaciously engage its resources. Hence, its impact will be low. And, its capacity to effectively deal with change is compromised.

The community could improve its resilience by actively involving more of its members, developing resources throughout the community and developing more opportunities for people to work together in collective endeavors toward shared community objectives.

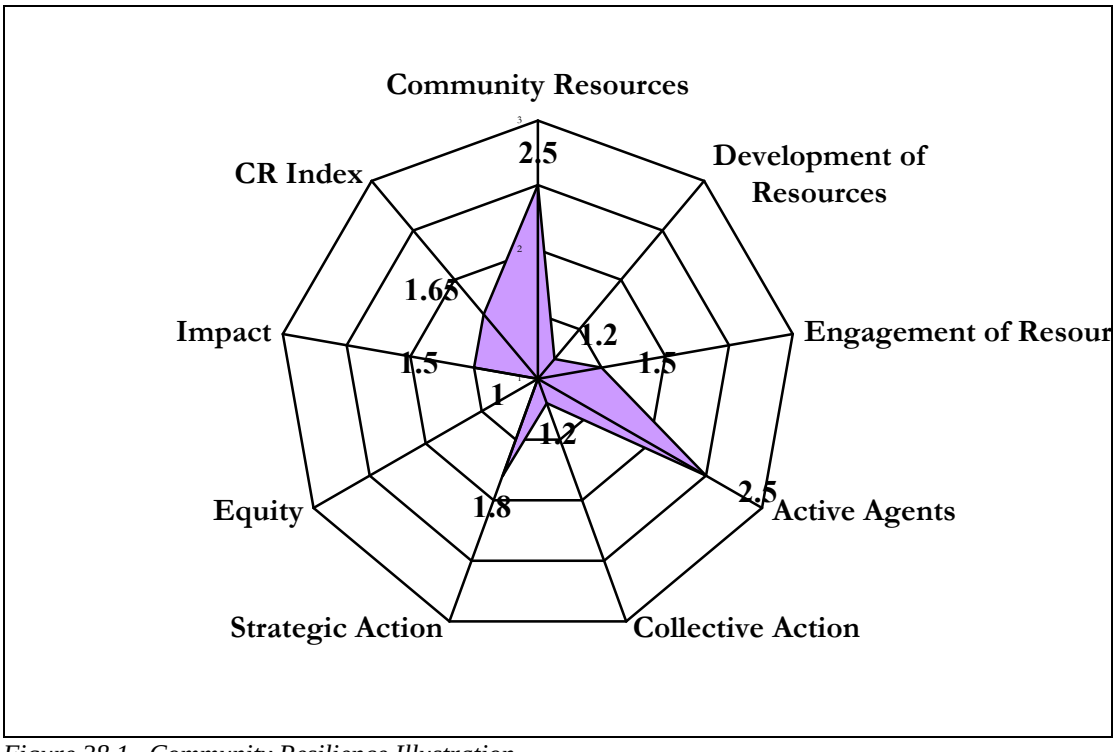

Figure 38.1. Community Resilience Illustration

Indicator 6.39– Area and percent of forests used for subsistence purposes

What is the indicator and why is it important?

In many countries, indigenous groups, rural communities and others use forests for subsistence purposes, although this use of forests may not be broadly recognized. This indicator measures the extent to which forests are used as a source of basic commodities, such as food, fuel, shelter and medicinal plants. In addition to the tangible benefits it provides, for many people subsistence use has a deep cultural and often spiritual significance.

What does the indicator show?

Our growing understanding of subsistence use of forests indicates that people from diverse ethnic backgrounds make use of subsistence resources from forests in every region of the United States. These activities have particular cultural importance for indigenous peoples. Three cannons of law provide legal guarantees for subsistence practices of selected populations: 1) treaty law, 2) the Hawaii State Constitution, and 3) the Alaska National Interest Land Conservation Act. Subsistence activities tend to be associated with poverty in the popular imagination. However, many who hunt, fish, trap, and gather to meet their basic needs regard these practices as a form of wealth, which frequently benefits not only the individual but also extended family and a larger community. Access to forests for subsistence resources appears to be declining with changes in land use and land ownership that include increases in posting to restrict trespassing and the establishment of exclusive hunting leases.

What has changed since 2003?

We were able to gather more evidence of subsistence activities in the State of Hawaii, particularly on the island of Molokai. Additional data on Alaskan subsistence was available thanks to ongoing research by the Subsistence Division of Alaska's Department of Fish and Game, where subsistence access is guaranteed on federal lands (Fig 39-1). We also had more time to look into the contested nature of subsistence. Although subsistence is guaranteed by ANILCA, the Hawaiian State Constitution, and treaties with Indian tribes, litigation over the exercise of those rights has been, and continues to be, ongoing. In several places around the country, federal and state agencies have entered into Memoranda of Understanding and Agreement that assure access by members of local tribes to hunting, fishing, and gathering resources for purposes that include subsistence. In 2007, the Inland Consent Decree between the State of Michigan and five tribes

Figure 39-1. Federal lands in Alaska, which are generally open to rural Alaskans for subsistence harvest (map courtesy of USFWS).

affirms treaty-guaranteed access to hunt, fish, and gather on state and some private lands and inland waters in an area that covers 13,827,207 acres (Fig 39-2). Finally, Norris's 2002 history of the National Park Service provides a detailed picture of how NPS policies toward subsistence have evolved over the last 90 years.

Are there important regional differences?

Yes, in Alaska, subsistence is formally recognized by the state and federal governments as a vital social, economic and cultural activity. ANILCA – The Alaska National Interest Land Conservation Act (P.L.96-487, Dec. 2, 1980) – provides for the subsistence use of forest resources by all rural Alaskans regardless of race or income. The Hawaiian Constitution protects the customary and traditional rights of Native Hawaiians, including subsistence use of marine and terrestrial resources. Some federally recognized tribes retain treaty rights to hunt, fish, trap, and gather on specified off-reservation lands. Subsistence activities by other groups in other locations do not enjoy formal legal status under U.S. or state laws.

Why can't the entire indicator be reported at this time?

The indicator addresses area and percent of forests used for subsistence, yet relevant data currently are collected by federal and state agencies only in Alaska. These agencies quantify subsistence by metrics such as numbers of users, poundage of subsistence resources harvested, and numbers of persons giving or receiving subsistence goods in barter or gift exchange. Providing a spatial display of forested areas used for subsistence is challenging because subsistence does not occur in discreet areas but is diffuse and, if anecdotal evidence is indicative, widespread. It is not possible to summarize these sorts of data into simple numerical measures.

The fact that Hawaii and Alaska have specific state provisions protecting subsistence use indicates the importance of subsistence in these states. However, the absence of such provisions (or data for that matter) in other states, does not necessarily indicate that subsistence activities are largely absent or unimportant.

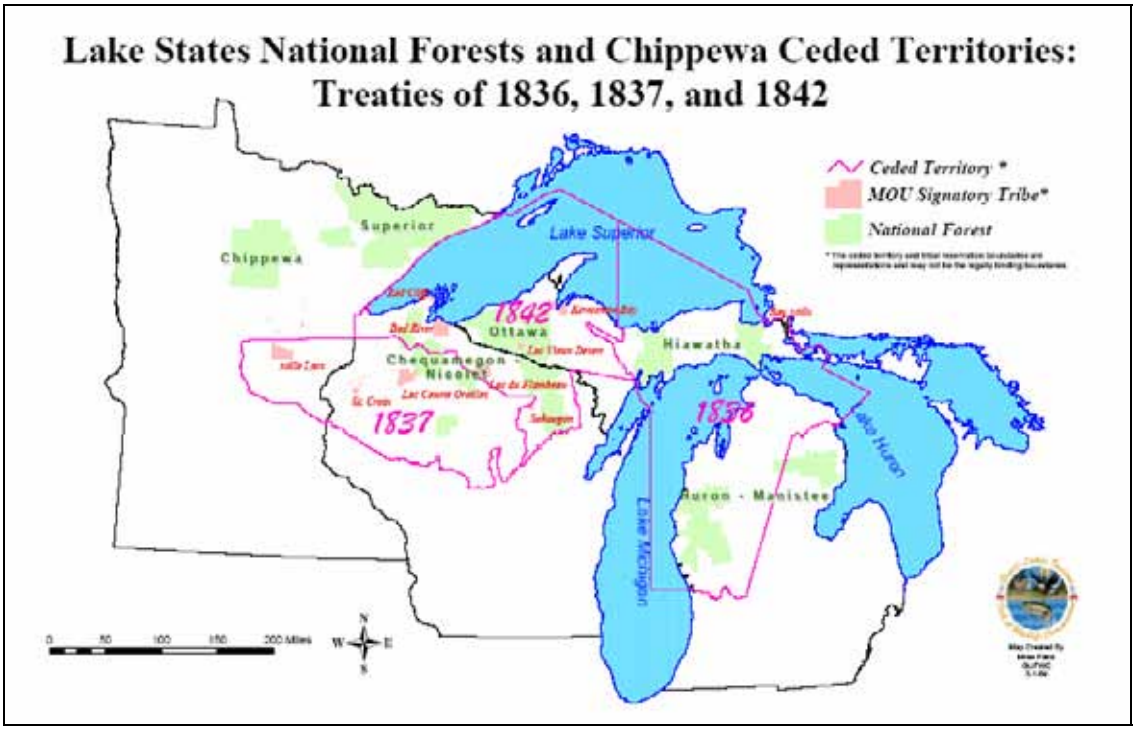

Figure 39-2. 2007 Inland Consent Decree area (map courtesy of the Great Lakes Indian Fish and Wildlife Commission).

Indicator 6.40– Distribution of revenues derived from forest management

What Is the Indicator and Why Is It Important?

Revenues derived from forest management activities, including the sale of forest products and environmental services, are one of the principal sources of funds for paying annual operating costs and making capital investments in the forest estate. This indicator tracks who shares in the revenues—workers through wages and income, communities through taxes, and others at different geographic scales. Therefore, information on the collection and distribution of these revenues will be useful in understanding economic support for sustainable forest management

What does the indicator show?

We first look at who shares in the revenues from the operation of forest products industries. These industries include forestry and logging, wood products, paper products, and wood furniture. Figure 40-1 displays the shares of revenues in these industries that go to workers in the form of wages, to business owners in the form of profits, and governments in the form of taxes. In 2002, of a total $72.5 billion (2005$) in wages, profits and taxes, 80% went to wages, 18% to profits and 2% to taxes.

Of the $72.5 billion total, 43% was provided by paper products industries, 35% by wood products industries, 17% by wood furniture industries and 5% by forestry and logging. The share of revenue going to workers was somewhat higher for the paper and wood furniture industries, 82% and 83% (with correspondingly lower profit shares), than for the wood products and forestry and logging industries, 76% and 79%.

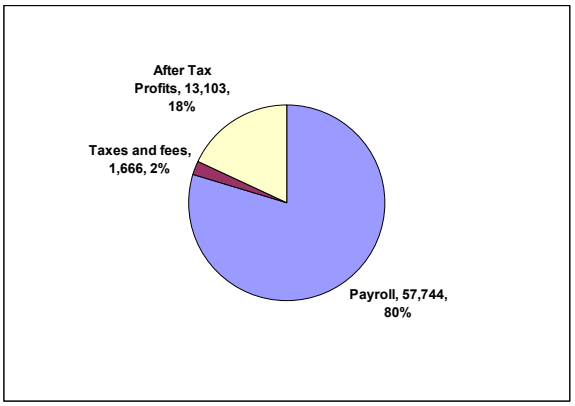

Figure 40-1. Payments going to forest products business owners (profits), forest products firm employees (payroll) and to governments (taxes and fees), 2002 (million 2005$ and percent)

We next look at who shares in the revenues from sale of timber from forest land. We have data for 1997 that indicate how this revenue is shared among various forest land owners including owners of National Forests, Other public forest land, Industry forest owners, and Other private forest owners. Based on rough estimates for the total stumpage sales value in 1997 of $22 billion (2005$), - 5% went to National Forests, 6% went to other public lands, 33% went to industry land owners, and 56% went to other private landowners (fig 40-2). Since 1997 a significant amount of industry forest land has been sold to Timber Management Organizations and Real Estate Investment trust, so the share of stumpage revenues going to industry land owners has probably declined.

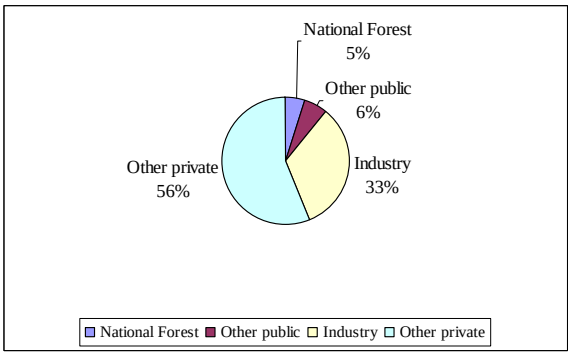

Figure 4-2. Share of stumpage revenue from U.S. timber harvest by owner, 1997

A considerable amount of Native American land is forested. These forests provide wood and non wood forest products and other values that are vital to Native American communities. Therefore it also important to note the share of U.S. timber stumpage revenues that goes to Native Americans.

There are approximately 18 million acres of forest land on Indian reservations in the United States, of which 5.7 million acres are classified as commercial timberland. In 2001 these lands provided $95 million of revenue (2005$) mostly from industrial timber harvest. This 2001 stumpage revenue is 0.4% of the estimated total U.S. 1997 stumpage revenue of $22 billion (2005$). The 18 million acres of Native American *forest land* is about 2% of total US forest land (749 million acres). The 5.7 million acres of Native American *timberland* is about 1% of total US timberland (504 million acres).

For Native American forest land in 2001, the Northwest region accounted for over 70 percent of the harvested timber volume and more than 85 percent of revenue, followed by the Lake States at 13.5 percent of the harvested timber volume and over 7 percent of revenue.

What has changed since 2003?

Data are not available to determine a time trend in share of revenue received by various groups from forest industry activities or from timber sales.

Are there important regional differences?

The estimated share of timber stumpage revenues going to various land owners varies widely among regions. In 1997, the share going to public owners (National Forest and Other Public) is highest in the Rocky Mountains (37%) followed by the Pacific Coast (23%), North (14%) and South (1%). The share going to other private owners (non industry) was highest in the South (75%) followed by the North (70%), Rocky Mountains (33%) and Pacific Coast (24%).

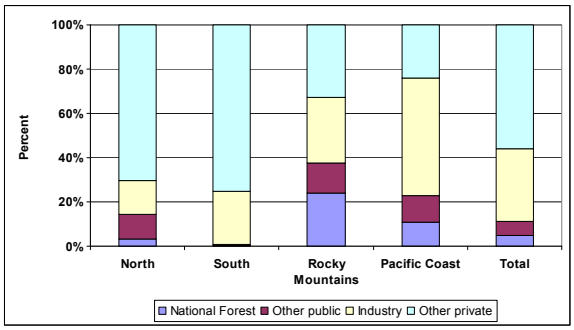

Figure 40-3. Share of stumpage revenue from U.S. timber harvest for each type of forest owner, by region, 1997

Another way to look at the geographical distribution of revenue shares is by looking at where various types of owners receive most of their stumpage revenue. For 1997 the largest share of National Forest or other public land stumpage revenue came from the Pacific Coast (68%) followed by the North (18%), Rocky Mountains (10%), and South (4%). The largest share for other private land owner revenue came from the South (66%) followed by the North (18%), Pacific Coast (14%) and Rocky Mountains (2%) (fig 40-4).

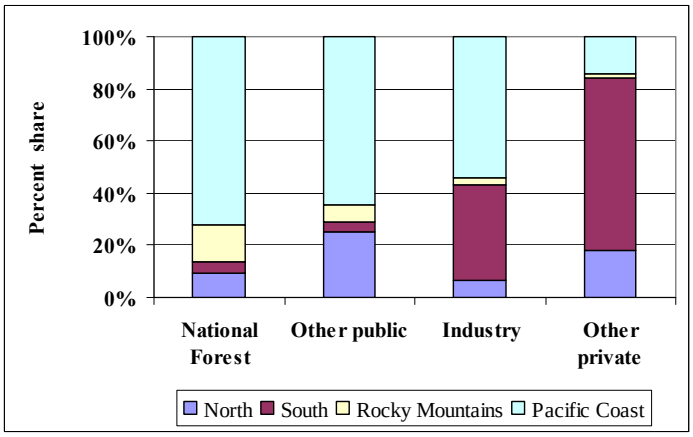

Figure 40-4. Share of stumpage revenue from U.S. timber harvest for each region by type of forest owner 1997

Why can't the entire indicator be reported at this time?

Data are not available to determine a time trend in share of revenues received by various groups.

Information of overall revenues from environmental services is shown under Indicator 27. However data are not available on the shares of such revenues going to workers, businesses, and governments. Nor are data available on the shares of revenues from such services going to various types of forest land owners.

Indicator 6.41– Area and percent of forests available and/or managed for public recreation and tourism

What is the indicator and why is it important?

This indicator measures the extent to which forests are managed to provide opportunities for recreation and tourism as a specific objective in forest management plans of public agencies and private landowners. As the economic well-being of a country increases, transportation infrastructure is improved, and disposable income grows, public use of forests for recreation grows. These activities are increasingly important as a source of forest-based employment and income. Engaging in outdoor recreation and tourism in forests tends to build support among participants for protecting and managing those forests, indirectly building support for sustainable forests.

What does the Indicator show?

Forest area in the United States is just over 751 million acres, and has remained relatively constant for the last 100 years. Almost 44 percent of the current U.S. forest land area is publicly owned (Figure 41-1); one third is federally owned; Over 18 percent is owned by private corporations, and almost 38 percent is privately owned by non-corporate entities. Of this non-corporate private forest land, over 92 percent is family or individually owned. With negligible exceptions, even including federal experimental forests, government forest lands at all levels are open to someone for some form of outdoor recreation. However, given that an inventory of forest tracts by management objectives is not available for the U.S., it is not possible, for the most part, to ascertain the degree to which forests under different ownerships are managed specifically for recreation and tourism.

Government, corporation, and organization-owned forest lands. Open federal forest lands include forests on national forests, national parks, Bureau of Land Management lands, wildlife refuges, and any other federally managed public land. State forest lands include state forests, state parks, and other state management areas. Local forests include municipal watersheds, local parks, local forest preserves, greenways, and other local government forests. Private forest lands include corporation owned forest-industry lands, other corporation forest lands, individual and family lands, and other non-corporation private lands. Like public lands, it is assumed for this indicator report that forest industry, other corporate, and other non-corporate lands are open to some forms of recreational uses, although access to them is most likely restricted. For corporation lands, data are not available for estimating the acreages generally open to anyone versus acreages restricted for use by employees, executives, lessees, or exclusively to others. Over half of the forest industry forests are in the South. Large portions of corporation lands not owned by forest industry are located in the Pacific Coast and South regions. Other non-corporate private forest lands (not including family and individual ownerships) lie mostly in the North and Rocky Mountain regions.

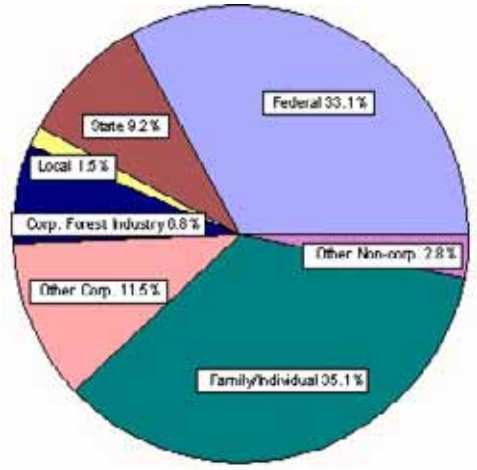

Figure 41-1. Percent of forest land in the United States by ownership category, nationally, 2007 (1,000s of acres, Percentages sum to 100.). (All lands are open for some form of recreation, although who may have access may be restricted.)

Family and individual forest lands. Almost half of the family and individually owned private forest land is in the South region, nearly 36 percent is in the North region, and much smaller percentages are in the Rocky Mountain and Pacific Coast regions. Figure 41-2 shows the percentages of family and individually-owned forest land nationally. Over 42 percent of this forest land is posted to limit access. Posting does not mean not used for recreation, it means access is restricted. The percentage of land posted is highest in the Pacific Coast and lowest in the North regions. The National Woodland Ownership Survey estimated that about 54 percent of family forest land was open only to family or friends,

and no others. Just 14.6 percent of the family forest area was open to the public with permission of the owner. Almost 8 percent of the family forest area was leased in the last 5 years for recreational uses. Percentages open to the public were highest in the North and Rocky Mountain regions. Leasing was greatest in the Rocky Mountains.

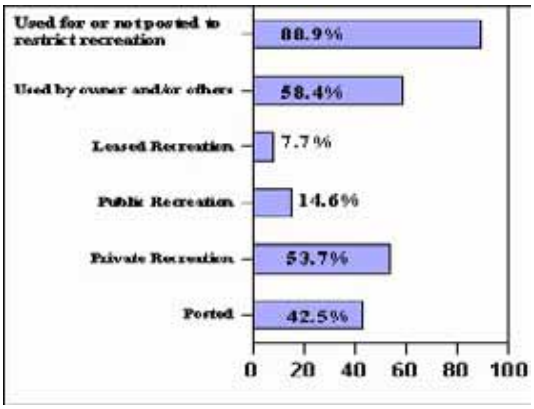

Figure 41-2. Percentage of family or individually owned forest land area posted, used only by owners and associates, used by the public, leased, total used by anyone, and total used or not posted to restrict recreation, 2006 (area in 1,000s).

Figure 41-3 shows area of family forest land by reasons for owning in 2006. Beauty appreciation is at the top, followed by passing the land to heirs, gaining privacy, protection of nature, and having it as part of a home or cabin site. Smaller acreages were considered important because of hunting, fishing, or other recreation activities.

Differences across regions. All of the 751 million acres of forest land in the United States is open to someone for some form(s) of recreation. Almost 29 percent of this forest land is in the South, and just over 28 percent is in the Pacific Coast region, which includes Alaska. Almost 23 percent is in the North, followed by the Rocky Mountain region with 20 percent. Most of the public forest land (especially federal forests) is in the western two regions. Public lands in the West are essentially open to anyone for recreation, except for certain military or laboratory sites.

Most of the private land is in the eastern states (North and South regions). Recreation use is more restricted on private lands than on public lands. The South has by far the greatest area of family or individually owned forest land in the U.S., followed in order by the North, the Rocky Mountains and Pacific Coast regions. The North, however, has the greatest area of family forest land open to the general public, 17.2 million acres, 18.3 percent of the region's total. Next is the South with 12.2 million acres, 9.9 percent of the region's total family forest land. The South has the greatest area of family forest leased for recreation, 12.4 million acres, 9.7 percent. This is followed by the Rocky Mountains at 4.1 million acres, 16.9 percent of family forest in that region.

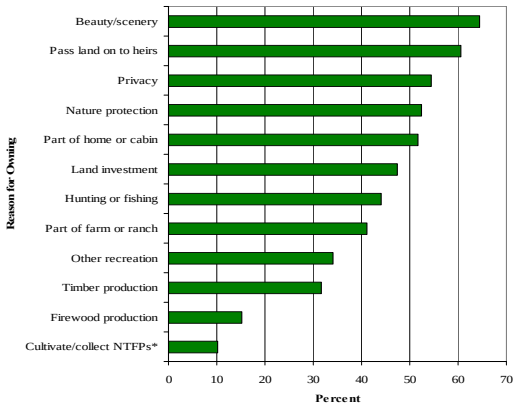

Figure 41-3. Percent of family forest land area in the United States by reasons for owning, 2006. Source: Butler 2008. Includes owners who rated the specific objective as very important (rating = 1) or important (rating = 2) on a seven point Likert scale with one defined as very important and seven as not important.

What has changed since 2003?

Total area of public forest land at all levels of government has increased slightly. Thus the trend for public land available for recreation is up slightly. Percentages of non-industrial land available to the public at large, however, are modest and have been trending downward over the last several decades. In 1985-86, nearly 25 percent of owners permitted some public access. This percentage dropped by 1995 to nearly 14.5 percent (Cordell 1999). In 2000-01, it was estimated that only 10.9 percent of owners permitted access to the general public. The lowest percentage was in the West, at 8 percent, and the highest was in the North, at 13 percent. Based on the National Woodland Ownership Survey, it was estimated that 14.6 percent of family forest area is open to the public. This estimate closely resembles those earlier reported, although the source is different and not directly comparable.

Indicator 6.42– Number, type, and geographic distribution of visits attributed to recreation and tourism, and related to facilities available.

What is the Indicator and why is it important?

This indicator provides a measure of recreation and tourism use of forests. These activities are increasingly important as a source of forest-based employment and income. Engaging in outdoor recreation and tourism in forests tends to build support among participants for protecting and managing those forests, indirectly building support for sustainable forests. This indicator focuses on forest recreation visits, facilities, and capacities.

What does the Indicator show?

***Number of recreation visits to forests for selected recreation activities*.** The top 10 forest recreation activities in terms of numbers of visits are walking for pleasure; viewing and photographing natural scenery; viewing and photographing flowers, trees and other forest vegetation; viewing and photographing birds; viewing and photographing wildlife; day hiking; visiting wild areas; off-highway driving; family gatherings; and visiting nature centers (Table 42-1). The numbers of annual forest recreation activity days among these activities (roughly equivalent to visits) range from a high of almost 7.5 billion to just over 680 million. Snowmobiling, mountain climbing, cross country skiing, rock climbing and snowshoeing engage much smaller numbers of recreation activity days, but still they add up to sizeable numbers of visits (ranging between about 20 to 62 million). Obviously, Americans are strongly interested in viewing and photographing forest natural life.

Over all activities listed in Table 42-1, the percentage of forest-based activity days that occur on *public lands* ranges from under 50 percent (for example, small-game hunting, horseback riding, off-road driving, and gathering mushrooms and berries) to over 75 percent (for example, visiting wilderness, day hiking, visiting nature centers, and backpacking). Over all activities, the percentage of forest-based recreation activity days that occur in *urban forests* ranges between roughly 15 percent to around 45 percent. Lowest percentages in urban forests are activities such as hunting, camping, and backpacking. Highest percentages in urban forests include activities such as walking, picnicking, family gatherings, and visiting nature centers. Public lands and urban forests clearly play significant roles in providing opportunities for outdoor recreation.

Table 42-1—Millions of annual forest recreation activity days by activity, and percentages on public forest lands and in urban forests, 2007-2008.

Forest Recreation Activity	Number of Activity Days	% on Public Forest	% in Urban Forests
Walk for pleasure	7,493.3	53.8	44.5
View/photograph natural scenery	6,170.6	61.9	31.8
View/photograph wildflowers, trees, etc.	4,858.9	55.4	36.3
View/photograph birds	3,738.3	51.3	37.6
View/photograph other wildlife	3,086.8	57.7	32.2
Day hiking	1,234.8	76.2	34.0
Visit a wilderness or primitive area	947.6	76.4	24.6
Off-highway driving	837.5	50.4	23.2
Family gathering	805.3	55.9	43.5
Visit nature centers, etc.	683.9	77.6	45.2
Gather mushrooms, berries, etc.	623.4	47.9	32.3
Mountain biking	463.3	60.2	32.1
Picnicking	455.9	68.4	44.4
Developed camping	356.0	72.8	21.3
Big game hunting	279.8	45.7	16.5
Primitive camping	211.4	75.8	21.4
Backpacking	198.8	78.5	22.1
Visit historic Sites	182.8	60.0	39.1
Horseback riding on trails	177.5	50.8	34.4
Small Game hunting	161.5	46.8	17.4
Visit prehistoric/ archeological sites	138.9	70.0	41.6
Snowmobiling	62.1	55.1	27.4
Mountain climbing	57.1	78.6	20.5
Cross country skiing	41.9	60.5	33.7
Rock climbing	34.1	68.8	26.9
Snowshoeing	19.9	60.2	27.6

Source: NSRE 2005-2008, Versions 1-3b.

Number and capacity of recreation facilities in forests for selected types of recreation activities. Across the nation, there are over 6,000 federal campgrounds; most are in the west, including the Rocky Mountains/Great Plains and Pacific Coast, where abundant federal lands exist. Private sector businesses in the U.S. analyzed for this indicator include RV parks and campgrounds, snow skiing areas, marinas, historic sites, nature parks and similar sites, and sightseeing and related tourism transportation services.

In 2005 there were an estimated 1,586 privately operated forest-based RV parks and campgrounds, almost half of which were in the North and just over 25 percent in the South. There were just over 180 forest-based, privately-run snow skiing facilities in 2005, mainly downhill ski slopes. The large majority of these skiing facilities were in the North region, over 70 percent. Privately operated historic sites in forested areas were estimated at about 330, almost all of which, 89 percent, are in the East. Estimated number of private, forest-based nature parks and similar sites in the U.S. was about 200 nationally, of which about 77 percent are in the East, mostly in the northeast portion of this region. There were nearly 160 private forest-based scenic and sightseeing transportation businesses, mostly in the East.

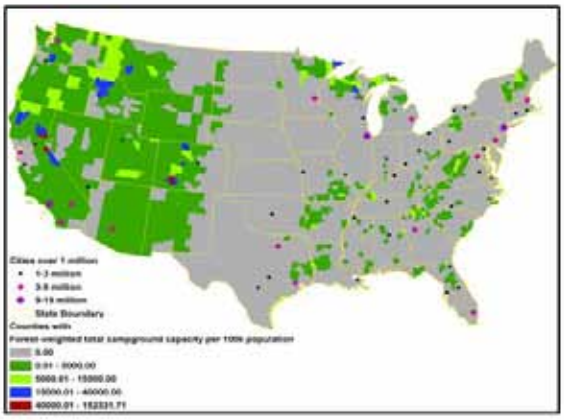

Figure 42. Location of forest-based federal campground capacity per 100 thousand population. Source: The primary source is the U.S. Census Bureau, County Business Patterns, 2001 and 2005.

Figure 42-1 shows the county-level distribution of federal forest campground capacity relative to county population and the location of major cities. The greatest amount of federal forest campground capacity is in the Southern Appalachians, the Ozarks, the Great Lakes area, the Southern Rockies, California, and the Pacific Northwest. Figure 42-2 shows the distribution of capacities summed across a variety of private, forest-based recreation and tourism businesses. Greatest concentrations are in the New England states, the Great Lakes area, the Pacific Northwest, California, and the southern Rocky Mountain region. Private facilities, sites, and services are also scattered throughout the South, the Ozarks area, and the Mid-Atlantic region including Virginia, West Virginia and Maryland. Many of these businesses are located near federal and state public lands. Significant amounts of the private forest recreation capacity mapped here lies within a 2-hour drive of U.S. population centers of 1,000,000 or more (shown as red dots and scaled by size).

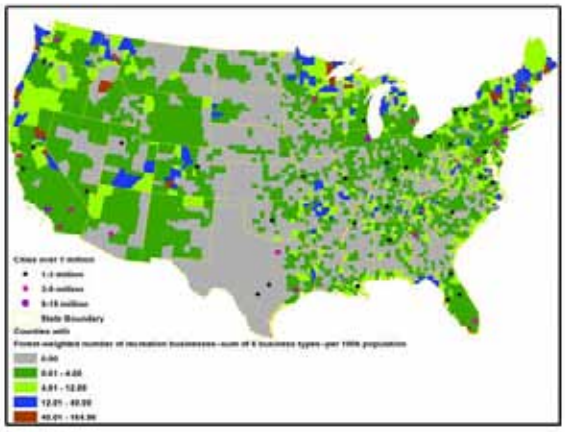

Figure 42-1—Location of cities and forest-based recreation businesses (5 types) per 100,000 population.

What has changed since 2003?

Overall, between 2000 and 2007, the trend has been increased participation in outdoor recreation activities. As reported in *Forest History Today* (Cordell 2008), the total number of people who participated in one or more outdoor activities grew by 4.4 percent between 2000 and 2007 (see Figure 42-3). At the same time, the number of recreation activity days, summed across all participants and activities, increased approximately 25 percent. Number and capacity of public and private forest-based recreation sites and capacities have remained about constant or increased slightly.

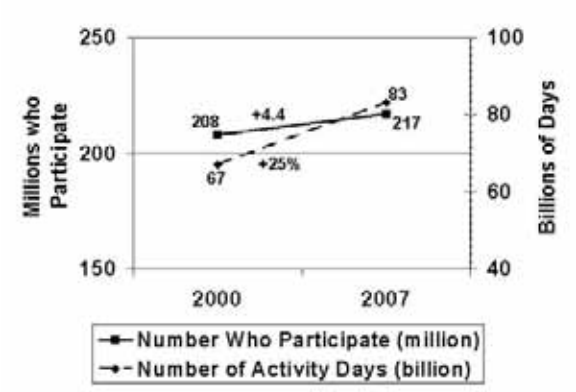

Figure 42-3. Growth in number of people and number of recreation activity days in 60 outdoor recreation activities in the United States, 2000–2007 (reproduced from Forest History Today article, Cordell, 2008).

Indicator 6.43– Area and percent of forests managed primarily to protect the range of cultural, social, and spiritual needs and values

What is the indicator and why is it important?

This indicator measures the area of forest land managed primarily to protect cultural, social, and spiritual values. These values are important dimensions of social well-being for people concerned about forests—whether they live in or near forests or great distances from them. Where people with unique needs for cultural, social, or spiritual values are only able to meet their needs in unique places; this places a premium on the protection and management of those locations.

What does the Indicator show?

Americans favor protecting wild forest areas, in all regions of the country for the protection of air quality, water quality, and wildlife habitat; for use by future generations; for the protection of unique plants and animals, and for the protection of rare and endangered species. People living in different regions of the country differ very little in what they value about protected wilderness and other public lands (Cordell, 2008--http://warnell.forestry.uga.edu/nrrt/nsre/IRISWild/IrisWild1rpt.pdf).

Protected public forests. Protected government-owned forest land in the U.S. is shown in Table 43-1. An estimated 328 million acres of forest is protected through federal, state or local government ownership. Of all forest land area in the U.S., almost 44 percent is protected by government ownership. The World Commission on Protected Areas (WCPA) employs a classification system to categorize protected natural areas. Using this system, categories of protected public forests in the U.S. are described. WCPA Category 1a (science natural areas) is represented by experimental forests across the country. There are a total of over 940 thousand acres of public forest designated as experimental forests in the U.S. Over 58 percent of the total experimental forest area is in the Pacific Coast region; about one-fourth is in the Rocky Mountain region. Experimental forests represent about 0.1 percent of the United States' total forest area.

Table 43-1 also shows acreages of public forest land in WPCA Categories Ib through VI. Just over 20 percent of public forest is protected as wilderness (National Wilderness Preservation System, Category 1b), just under 7 percent, is in national parks (Category II), and 0.4 percent of public forest area is designated as natural monuments. Thirteen percent of government-owned forest is in WPCA Category IV, mainly wildlife refuges; and 0.2 percent is within the boundaries of protected national lakeshores and seashores. The largest category of government protected forest (Category VI) includes managed lands such as national forests, Bureau of Land Management lands, and other state and local government lands. This category makes up almost 60 percent of total U.S. protected public forest lands. The region with the greatest acreage of government owned forest is the Pacific Coast region, which runs from California to Alaska, and includes Hawaii. Next highest is the Rocky Mountain region.

Table 43-1.--Acres (in 1,000s) and percent of public forest land by region and by category of protection using the World Commission on Protected Area classification system. (Percentages sum down to 100, except in last column. Percentages in the last column are of all U.S. forest land, 751.2 million acres.)

WCPA category	North	South	Rocky Mtns	Pacific Coast	U.S. Total	Pct of all U.S. forest
Ia: Strict Nature Reserves	86.5 (0.2%)	71.2 (0.2%)	233.8 (0.2%)	548.7 (0.4%)	940.2 (0.3%)	0.1
Ib: Wilder-ness	1,559.1 (3.5%)	2,384.9 (8.3%)	21,338.7 (18.9%)	40,853.1 (28.6%)	66,135.9 (20.2%)	8.8
II: National Parks	951.9 (2.2%)	2,941.5 (10.3%)	7,836.1 (6.9%)	10,124.5 (7.1%)	21,854 (6.7%)	2.9
III: Natural Monu-ments	3.7 (0%)	28.7 (0.1%)	865.2 (0.8%)	423.0 (0.3%)	1,320.7 (0.4%)	0.2
IV: Habitat/ Species Mgmt Areas	1,563.8 (3.6%)	3,440.9 (12%)	7,226.7 (6.4%)	31,083.0 (21.8%)	43,314.4 (13.2%)	5.8
V: Protected Land-scape/ Seascapes	179.9 (0.4%)	332.9 (1.2%)	0 (0%)	33.8 (0%)	546.6 (0.2%)	0.1
VI: Managed Protected Areas	39,634 (90.1%)	19,479 (67.9%)	75,255 (66.7%)	59,720 (41.8%)	194,087 (59.1%)	25.8
All public forest	43,979	28,679	112,755	142,786	328,199	43.7

Sources include responsible government agencies, Wilderness.net, and Brad Smith. Forest Resources of the U.S., 2007. Washington, DC: USDA. Forest Service. 2008.

Protected private forests. Conservation of private land through land trusts has been increasing over the last few years (Figure 43-1 shows the increase in state and local trusts). The National Land Trust Census Report (Aldrich and Wyerman 2005) indicated that total acreage conserved through private means in 2005 was 37 million acres, representing a 54 percent increase since 2000. This includes land protected by local and state land trusts, *and* land protected by large national land conservation groups. Examples of large national groups include The Nature Conservancy, Ducks Unlimited, The Conservation Fund, and The Trust for Public Land.

A land trust is a nonprofit organization that actively works to conserve land through conservation easements, direct fee simple acquisitions or by stewardship of easements. The Land Trust Alliance of the U.S. has been organized to unite organizations in local communities for natural area conservation (www.landtrustalliance.org). Internationally, organizations such as the World Commission on Protected Areas works within the framework of the United Nations to track and stimulate countries around the globe to designate forests and other lands as protected areas.

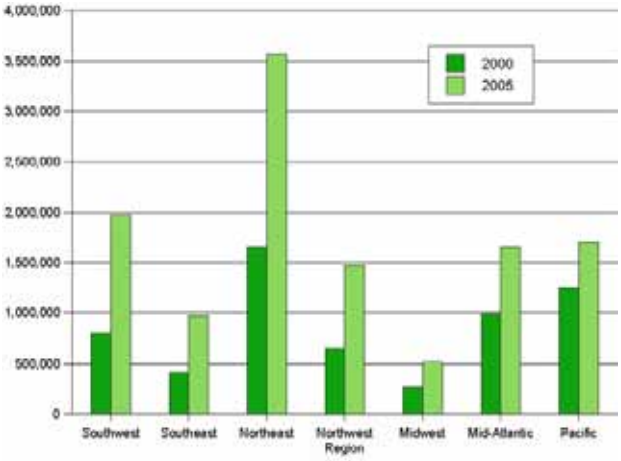

Figure 43-1. Private land protected by local and state land trusts in the United States, 2000 – 2005
Source: National Land Trust Census Report for 2005.

The Forest Legacy Program (FLP) is a federal program managed by the U.S. Forest Service in partnership with states. This partnership is aimed at protection of environmentally sensitive private forest lands. Mostly, FLP easements restrict development and require sustainable forestry practices. FLP can also directly support land acquisition. As of 2008 in the U.S., almost 1.6 million acres of privately owned forest land have been protected (Table 43-2). About 85 percent of this national total (roughly 1.3 million acres) has been protected through state-level conservation easements (FLP supported specifically). Another 0.2 million acres (about 15 percent) was protected through fee simple acquisition. Much of this protected private forest land is in the North region, over 70 percent. By far, the state of Maine was the most successful single state in protecting forest land through the FPL. That state's program added well over 600 thousand acres through easements and purchase. Next was New Hampshire, followed by Montana.

Table 43-2 -- Total private forest acres protected by conservation easements or fee simple purchases through the Forest Legacy Program as of February 2008 by RPA Region.

RPA Region	Acres protected	Percent
North	1,116,810	70.9
South	114,099	7.2
Rocky Mountains	281,209	17.8
Pacific Coast	64,176	4.1
U.S. Total	1,576,294	100.0

Source: USDA Forest Service, Forest Legacy Program. (http://www.fs.fed.us/spf/coop/programs/loa/flp_projects.shtml).

What has changed since 2003?

A significant total area of forest land has been added to the U.S. experimental forest system (national increase of 65 percent since 2003). Much of this increase has been in the Pacific Coast region, mainly by adding a Hawaiian tropical forest (almost 313 thousand acres of state land) and over 7 thousand acres of the Tahoe National Forest in California. Slight loses of public land overall in the North and South are primarily reflecting differences in land area estimation methods between the different time periods. For private forest land, there has been a dramatic increase since 1985 in total private forest acres protected.

Indicator 6.44– The importance of forests to people

What is the indicator and why is it important?

Forests are important to people for a wide variety of reasons. Research studies have enumerated the breath of values and services that people associate with forests. These lists suggest a mix of values and services that extend from consumptive to non-consumptive uses and include items that relate to economic, ecological and social benefits. The enumerated values and services are provided to greater and lesser degrees by different types of forests, patches or trees and even individual trees.

This indicator describes and measures the breadth and intensity of the emotions through which individuals and communities connect with trees and forests. These feelings are important motivators of human behavior and are often the reasons why individuals—alone or as members of groups—support or oppose specific forest management activities related to sustainability. This indicator can be used to help understand regional or demographic differences in the importance of trees and forests to people and to monitor changes in perception of the importance of trees and forests over time.

What does the indicator show?

Twenty-five focus groups with 178 individuals were conducted with a diversity of populations across the U.S. to determine similarities and differences with respect to the importance of forests. Diversity was represented by age, gender, geographic location, and race and ethnicity (Table 44.1). Participants offered a very wide range of reasons why forests were important to them personally and to their communities (Table 44.2) The depth and breadth of the discussions support earlier research that indicates that trees and forests are important to Americans in diverse ways and that they are able to clearly articulate this importance.

Table 44.1- Demographics

Gender	**Percent**
Male	46.4%
Female	53.6%
Total	100.0%
Location	**Percent**
Rural	25.4%
Urban	40.6%
Suburban	32.6%
Total	*98.6%
Education	**Percent**
Less than High School	21.2%
High School	8.8%
Some college	18.2%
2 yr grad	7.3%
4 yr grad	10.9%
Some Grad	12.4%
Grad Degree	16.1%
Prof Degree	2.9%
Trade	2.2%
Total	100.0%
Race	**Percent**
White	53.6%
Black	10.9%
Hispanic	10.1%
Asian/Pacific Islander	4.3%
American Indian	15.9%
Multi	3.6%
Other	1.4%
Total	100.0%

*not all participants responded to this question

Focus group participants also discussed ways that their interactions with trees and forests have changed over time(Table 44.3), negative feelings they have about forests (Table 44.4) and concerns they have about forests (Table 44.5).

Table 44-2- Categories of importance of trees & forests to individuals & their communities (frequency of mention) (n=178).

1st Order Category	2nd Order Category	Freq
Environmental/Biological		**299**
	Animals	61
	Air	53
	Shade	51
	Water	41
	Processes	34
	Ecological Relationships	24
	Shelter	19
	Climate Change	8
	Plants	8
Cultural Heritage		**293**
	Memories	76
	Community	75
	Family Relations	60
	Traditional Knowledge	35
	Community Service	28
	Literature & Folklore	19
Recreation		**243**
	Non-consumptive Activities	166
	Consumptive Activities	54
	Adventure	23
Products		**212**
	Wood Products	143
	Non-Wood Products	69
Sense of Place		**180**
	Identity	64
	Attachment	63
	Individual trees	34
	Dependence	19
Health & Well-being		**149**
	Psychological Benefits	93
	Well-Being Activities	56
Aesthetics		**134**
Spiritual		**101**
Diversity		**65**
	Habitat	28
	Biodiversity	19
	Forest Type	18
Education		**59**
Economics		**58**
Privacy		**31**

Table 44.3- Changes over time

Changes in interactions tree and forests over time	
Changes	Frequency
Interactions/Perspectives	95
Reduced Natural Resources	38
Policy/Politics	23
Competition	16
Economic Changes	6
Pollution	4
Increased Natural Resources	2

Table 44.4- Negative feelings

Negative feelings people have about trees and forests	
Negative Feelings	Frequency
Tree/Home Interactions	52
Safety & Fear	28
Animals	27
Management	20
Plants	18
Restricted Use/Exclusion	16

Table 44.5- Concerns

Concerns people have about trees and forests	
Concerns	Frequency
Degradation	125
Sustainability	63
Management & Policy	53
Forest Condition	52
Lost Connections	35
Competition	23
Economics	8
Urban Ecosystems	6

The results of the focus groups clearly indicate that forests are important to Americans in many ways and that a broad cross-section of Americans are able to articulate these factors. The results also show that Americans have multiple concerns about the future of forests.

While there are many similarities across the diversity of people who participated in the focus groups, there are also some significant differences based on race and ethnicity (feelings of exclusion and fear associated with forests among African-Americans), rural vs. urban geography (rural respondents were more concerned with forest policy and management issues as well as forest degradation while urban respondents were more concerned with damage to their home), and age (younger respondents actively interacted with forests while to older respondents aesthetics and the trees they could see out their windows were more important). These differences reinforce the need to reflect the demographic diversity of the U.S. when considering the acceptability of forest management activities focused on sustainability.

Criterion 7

Legal, institutional, and economic framework for forest conservation and sustainable management

What is this criterion and why is it important?

Criterion 7 addresses the social framework within which we manage forests for sustainability. Owing to the challenges inherent in addressing this criterion, we have developed a different overall approach than that used for the other indicators. This is described in greater detail in the section immediately following the Criterion 7 indicator list presented below.

The data – The data for Criterion 7 comes from a variety of sources and are addressed on an indicator-by-indicator basis in the indicator briefs.

The indicators - The following table summarizes the revisions. Indicator reference numbers for 2003 and 2010 are provided to assist in comparisons with the previous report. A more detailed rationale for the revisions may be found at http://www.rinya.maff.go.jp/mpci/meetings/18_e.htm

Criterion 7: Legal, institutional, and economic framework for forest conservation and sustainable management

2003 Ref.	2003 (and 2010) Indicator	Revision action	2010 Ref.
Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it:			
48	—clarifies property rights, provides for appropriate land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides a means of resolving property disputes by due process	No Change	**7.45**
49	—provides for periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including coordination with relevant sectors	No Change	**7.46**
50	—provides opportunities for public participation in public policy and decision-making related to forests and public access to information	No Change	**7.47**
51	—encourages best practice codes for forest management	No Change	**7.48**
52	—provides for the management of forests to conserve special environmental, cultural, social, and/or scientific values	No Change	**7.49**
Extent to which the institutional framework supports the conservation and sustainable management of forests:			
53	--including the capacity to provide for public involvement activities and public education, awareness, and extension programs, and make available forest- related information	No Change	**7.50**
54	--including the capacity to undertake and implement periodic forest-related planning, assessment, and policy review, including cross-sectoral planning coordination	No Change	**7.51**
55	--including the capacity to develop and maintain human resource skills across relevant disciplines	No Change	**7.52**
56	--including the capacity to develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and to support forest management	No Change	**7.53**
57	--including the capacity to enforce laws, regulations, and guidelines	No Change	**7.54**

2003 Ref.	2003 (and 2010) Indicator	Revision action	2010 Ref.
Extent to which the economic framework supports the conservation and sustainable management of forests:			
58	--through investment and taxation policies and a regulatory environment that recognizes the long-term nature of investments and permits the flow of capital in and out of the forest sector in response to market signals, nonmarket economic valuations, and public policy decisions in order to meet long-term demands for forest products and services	No Change	**7.55**
59	--through investment and taxation policies and a regulatory environment that recognizes the long-term nature of investments and permits nondiscriminatory trade policies for forest products	No Change	**7.56**
Capacity to measure and monitor changes in the conservation and sustainable management of forests			
60	--including availability and extent of up-to-date data, statistics, and other information important to measuring or describing indicators	No Change	**7.57**
61	--including scope, frequency, and statistical reliability of forest inventories, assessments, monitoring and other relevant information	No Change	**7.58**
62	--including compatibility with other countries in measuring, monitoring, and reporting on indicators member countries	No Change	**7.59**
Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services			
63	--including development of scientific understanding of forest ecosystem characteristics and functions	No Change	**7.60**
64	--and development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems	No Change	**7.61**
65	--and new technologies and the capacity to assess the socioeconomic consequences associated with the introduction of new technologies	No Change	**7.62**
66	--and enhancement of the ability to predict impacts of human intervention on forests	No Change	**7.63**
67	--and the ability to predict impacts on forests of possible climate change	No Change	**7.64**

Introduction to Criterion 7 Legal and Institutional Framework

Overall Strategy

Efforts by the U.S. to address the components of Criterion 7 have been complicated by the lack of information sources to provide quantifiable data to establish baselines. Other Montreal Process Working Group Countries have had similar results with their efforts, resulting in the Working Group current work to revise the Criterion 7 indicators. Accordingly, this iteration of the U.S. report is an opportunity to bridge between past, current, and future indicators. To achieve this, we have drawn on the thorough Criterion 7 analysis performed for the 2003 National Report on Sustainable Forests (Ellefson et al. 2005—see supporting data report for citations referenced in this section), and then developed a new **Forest Policy and Governance Matrix** as a means to classify the relevant policies and levels of governance addressed in Criterion 7. These two approaches combine the detailed data analyses and summaries from the 2003 Report with a policy sciences theory-based model to provide better inferences about the Indicators.

The Forest Policy and Governance Matrix

To analyze the written or stated forest policy content of laws, regulations, and certification standards, we drew from theory and research on "smart regulation" (Gunningham et al. 1998), forest regulatory "rigor" (Cashore and McDermott 2004), analysis of policy instruments (Sterner 2003, Cubbage et al. 2007), and non-state governance in sustainable forestry (Cashore et al. 2004). Based on this literature McGinley (2008) developed a model for analyzing the forest policy structure of government regulation and forest certification in Latin America. This structure was modified to

Table 7.1 - U.S. Forest Policy and Governance Matrix by Geographic Scale, Mechanism, and Approach – Indicators Worksheet Version

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	**Process or Systems Based**	**Performance or Outcome Based**	**Private Enterprise**
Non-Discretionary/ Mandatory[a]					
Informational/Educational[b]					
Discretionary/Voluntary[c]					
Fiscal/Economic[d]					
Market Based[e]					

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

analyze Criterion 7 Indicators. A component was added to include the role of markets and market-based policy instruments in setting institutional policy, per Sterner (2003) and Cubbage et al. (2007). Scale of policy and program implementation was another consideration. The resulting two-sided classification schema became the matrix used to classify U.S. SFM institutions under Criterion 7 (Table 7.1).

Using the Matrix Model

The first column, "mechanism", identifies the means (mandatory, voluntary) through which policies and programs are implemented. The second column denotes scale. The final four columns show the policy structure. Policy structure refers to the approach (prescriptive, process-based, performance-based, private enterprise) that the policy employs. Each row in the "mechanism" column contains a code letter to add further detail to the "approach" columns, with the most prescriptive policies appearing in the upper left of the matrix and the most voluntary appearing in the lower right. To some extent these are continuous scales, not categorical, but we used the categories to facilitate analysis and discussion.

The model displayed in Figure 1 was used in the analysis of Criterion 7 to illustrate the legal and institutional framework of the U.S. for each indicator. The scale of the institutional responses is particularly relevant for Criterion 7 since there is wide variation among the 50 U.S. states, not to mention the numerous local government jurisdictions. Furthermore, many U.S. approaches and institutions are actually determined by private markets, not government policies and programs. Finally, there is substantial variation in the level of compulsion, as well as the approach, by states county/parish, and municipal governments. The analysis formed by the policy and governance matrix, combined with the prior analyses performed for the 2003 Report, provides the basis for the text summarizing each indicator. These will then form the basis for revisions in Criterion in the future, and for assessing trends in a more systematic manner.

As illustrated in Figure 1, a *prescriptive policy* mandates a preventive action or prescribes an approved technology be used in a specific situation. It generally allows little interpretation on part of the duty holder, offers administrative simplicity and ease of enforcement, and is most appropriate for problems where effective solutions are known and where alternative courses of action are undesirable.

A *process-based policy* identifies a particular process or series of steps to be followed in pursuit of a management goal. It typically promotes a

more proactive, holistic approach than prescriptive-based policies.

Performance-based policy specifies the management outcome or level of performance that must be met, but does not prescribe the measures for attainment. It allows the duty holder to determine the means to comply, permits innovation, and accommodates changes in technology or organization.

Private enterprise relies on voluntary market exchange to allocate many of the forest resources in the world, both in private markets and for allocation of goods and services on public lands. Many new market-based conservation incentives are being developed as well.

Application

The summaries from the 2003 National Report and the Forest Policy and Governance Matrix is used as a framework to discuss each Indicator in Criterion 7 and to make more general observations about the U.S. legal and institutional approach to SFM. The effectiveness of the Criteria and Indicators in achieving SFM does rely ultimately on normative measures about the effectiveness of policies and institutions. The framework can enhance the rigor and clarity of this discussion and analysis, help clarify gaps and weaknesses in our institutions, and identify opportunities for improvement in the pursuit of sustainable forest management.

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Indicator 7.45 - Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it clarifies property rights, provides for appropriate land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides a means of resolving property disputes by due process

What is the indicator and why is it important?

Stable property rights and the assurance that those rights will be protected, or disputed through due process, are essential for sustainable forest management. It is suggested that those who depend on forests for daily subsistence and livelihood, or who have a connection to forests over long periods of time, will take responsibility for better long-term care of the land if they are able to own the forest or can be assured access to needed forest resources.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S,L	L,R,I,G	L,R,G	L,R,G	G
Informational/Educational[b]					
Discretionary/Voluntary[c]					
Fiscal/Economic[d]					
Market Based[e]	N,S,L				M,E

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

Property rights govern the ability of forest and other landowners to acquire, manage, use, and dispose of their land and its products and services. These rights are exclusive, but not absolute. Property and tenure rights are determined by the government, and may be changed at the behest of government with due process that includes the interests of the community and the landowners. Landowners' tenure and property rights are generally circumscribed by limits on externalities, such as preventing soil and water pollution, or on usufructuary requirements to leave land in good condition for future generations, such as seed tree or tree planting requirements. Broader landowner and zoning restrictions also have been made to provide for wildlife habitat protection, recreation access, or cumulative landscape effects, although these occur mostly in more urban and developed areas.

Clear property rights are arguably the fundamental requirement for sustainable forest management, and a process to assign those rights, determine who controls and determines those rights, and a means to resolve disputes must be clear and accessible to all owners.

In the United States, property may be owned by any public or private organization, ranging from local private property owners, to corporations, to national public lands to Native American land reservations. So the scale of ownership for land tenure in the U.S. varies widely. Approximately 65% of all land in the

United States is owned privately, and 35% by various government sectors, including 28% federal and 7% state and local owners.

Holding clear and absolute title to land is provided by law in the U.S., and these administrative services to track ownership are usually provided by various local, county, or parish governments. Land titles may be complete or partial, depending on the bundle of rights that are conveyed with a piece of property. Specific prescriptive laws govern the use and transfer of land; legal processes of contracts and torts govern how land rights are exercised or exchanged; and courts can resolve disputes when they arise. The Fifth and Fourteenth Amendment of the U.S. Constitution protect the rights of private landowners from the taking of private property without due compensation. These amendments have rarely been involved in direct application to limits of forest regulations of private landowner actions in legal challenges, but do provide significant checks on excessive government regulation.

There are many different products and services associated with the rights to land, and they may be and are often owned separately. Rights to manage and protect forests may be separate from rights to exploit minerals or extract oil or water, and often are subservient to more valuable uses, on both public and private lands. Landowners also may sell some or all of their rights in land, for fixed periods or perpetuity.

Conservation easements have increased considerably in the United States in the last decade. These easements usually set aside part of the land to protect it from development, and may allow only passive uses such as recreation and hunting, or may permit more active uses such as timber management. Private markets, conservation groups, and government organizations negotiate prices, swaps, and loans for land and its produce, and these agreements are recorded as contracts, conditions on property titles, liens, or other legally binding instruments that reside with the land title.

Reservation lands owned by Native Americans may be controlled by separate tribal laws and regulations for management, sale, and acquisition, but still subject to federal environmental restrictions or laws.

Indicator 7.46 - Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it provides for periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including coordination with relevant sectors

What is the indicator and why is it important?

The sustainability of forests depends on society's ability to comprehensively evaluate trends and conditions in diverse sectors and to subsequently take responsive actions that will ensure the sustained use, management, and protection of forest resources and the communities that are dependent upon them. These actions are typically predicated on well-focused and technically sound plans, assessments, and policy reviews that are sensitive to a range of forest values and are coordinated with a variety of forest-related sectors.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N, R, S, L	L,R,I, G	L,R,I,G		
Informational/Educational[b]	R,N,S,L	E,R,A	E,R,A		E,R,A
Discretionary/Voluntary[c]					
Fiscal/Economic[d]	N,S		I		
Market Based[e]	L				M

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

National, regional, state, and local governments perform periodic forest planning, assessment, and policy reviews. Planning is a prescriptive requirement for all federal land management agencies for the lands under their jurisdiction, and is similarly required in some fashion for most state and county forest lands. Some regional planning efforts also occur, voluntarily or not. These government planning efforts typically have a required process, usually including some type of public input and appeals. Private landowners do not have required forest planning, although many large companies and landowners plan as part of business. Specific processes are not required for these owners.

The federal and state governments also write federal or state forest plans for private forest lands in the country or state. But these plans do not usually dictate or create mandatory rules, regulations, incentives, or other government interventions in markets. Instead, they generally summarize information about forest resource conditions and trends; identify issues and opportunities; and suggest possible policies that could enhance sustainable forest management. Exceptions to this do occur, such as the Chesapeake Bay Area Planning, which spawned many environmental regulations in the Maryland and Virginia area to protect the coastal waters.

Educational, research, and analysis policy mechanisms are usually an integral part of forest planning efforts, at all scales from national to local. These policies provide education to forest managers and policy makers on forest conditions, threats, and management responses. Various incentives have been provided for private or public forest landowners to meet the recommendations contained in forest plans.

Forest management plans are required in private market certification under all the forest certification systems in the country. The Forest Stewardship Council, Sustainable Forestry Initiative, and American Tree Farm System have certified more than 100 million acres in the U.S. as of 2008. FSC, with about 24 million acres, requires consultation with external stakeholders as part of its forest certification system.

Indicator 7.47- Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it provides opportunities for public participation in public policy and decision-making related to forests and public access to information

What is the indicator and why is it important?

Forests may be managed more sustainably if citizens have responsibility for their use, management, and protection. If citizens are given an opportunity to identify areas of interest and concern about forests, they are more likely to support the management of forests and the principles of sustainability. Public participation processes can foster practical and political support for sustainable management. Access to timely, complete, and accurate information about forests, forest resources, and socioeconomic trends will enhance those participatory processes and promote better forest management.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N, S, L	L, R, G	L, R G	L, R, G	
Informational/Educational[b]	N,S,L	E,T,R	A		
Discretionary/Voluntary[c]					
Fiscal/Economic[d]					
Market Based[e]	R, N, L		C		C

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

Federal agencies all provide some level of opportunity for public participation in policy and decision making, and varying levels of access to information. The Administrative Procedures Act of 1946 provides public oversight of federal agencies, including public comment on proposed rules; a rigorous process of draft publication, public review; required agency response to comments; and final publication in the Federal Register. This process leads to final rules with reviewable record and science basis.

States usually have similar but less rigorous open process and information laws. Local government entities eventually must respond to citizen's interest, but seldom have prescribed measures for public input to forest planning. Nonindustrial private owners do not need to consult other interests or owners in making decisions or release information publicly, although many businesses do as part of their annual reports and other communications.

Extensive public participation for National Forest planning is required as part of the U.S. National Forest Management Act of 1976 (191 million acres), as amended by the Healthy Forest Restoration Act of 2003. The Bureau of Land Management, with 266 million acres, requires planning and local advisory boards for input. Other federal agencies, including the Fish and Wildlife Service (84 million acres),

National Park Service (84 million acres), and Department of Defense have varying levels of planning that affects their lands, including forests.

The federal agencies also provide educational, technical assistance, research, and assessment support for sustainable forestry and public participation in the country, as do many states. This includes mandates for state forest resource planning and input, and support through the U.S. Department of Agriculture. As noted, the Forest Stewardship Council, with about 24 million acres, requires consultation with external stakeholders as part of its forest certification system, and requires that the forest management plan audits be available publicly.

If the public or individuals are dissatisfied with the openness of federal public records, they may seek redress through legal actions such as a Freedom of Information request (FOIA), and similar laws exist in most states. Such contentious issues are uncommon in natural resources, but not unheard of.

Indicator 7.48 - Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it encourages best practice codes for forest management

What is the indicator and why is it important?

Forest management practices that are well designed are fundamental to the sustainability of forest resources. At all levels (stand, landscape, local, regional, national, global), forests depend on the application of forest practices that are capable of ensuring sustained use, management, and protection of important social, economic, and biological values. Well-founded best practice codes, and the forest management practices that comprise them, can ensure sustained forest productivity for market goods; protection of ecological values; and protection of the various social, cultural, and spiritual values offered by forests. They can be among the most important tools for responding to national trends and conditions involving forests.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S,L	L,R,G	L,R,G	L,R	
Informational/Educational[b]	N,S,L	P,T,R	E,T,R	E,T,R	
Discretionary/Voluntary[c]	N,S	B	B	B	B,S
Fiscal/Economic[d]					
Market Based[e]	N,S,L				C

[a]Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

National, state, and local government landowners, as well as all private landowners, have various levels of recommended or required forest best management practices (BMPs). More than 20 states have required BMPs for forestry, and all but one forested state has developed BMPs that are recommended. Even states that do not have legally required BMPs often have water quality laws that prevent substantial erosion in water bodies of the state, and can be used to enforce BMP compliance. Local governments also implement BMPs for private forest lands, along with other land use controls on development, agriculture, or mining.

BMPs may be prescriptive and mandatory, as required in the state forest practice laws of all the states on the West Coast and in West Virginia; may require that forest managers and loggers follow specific processes, such as in Virginia; or may be performance or outcome based, ensuring that water quality is protected, such as in North Carolina. BMPs also may cover a variety of practices, such as timber harvest, road construction, fire, site preparation and planting, and the designation of natural resources to be protected, such as water quality, air quality, wildlife, endangered species, or visual impacts.

The federal government and most states provide detailed technical assistance for information and education about BMPs, as well as research about

efficacy, benefits, and costs. The private sector including forest industry, large timberland investors, nonindustrial private forest owners, and forest consultants have been actively involved in development and promotion of BMPs. BMP compliance also is required as part of the the standards of all three major forest certification standards in the U.S.—the Sustainable Forestry Initiative, Forest Stewardship Council, and American Tree Farm System.

Indicator 7.49 - Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests, including the extent to which it provides for the management of forests to conserve special environmental, cultural, social, and/or scientific values

What is the indicator and why is it important?

Forests often possess unique or otherwise special social, cultural, scientific, and environmental values. Formal legal mechanisms are often needed to protect those values from certain uses and activities. Since the values to be protected are often large in number and wide in scope, the resulting legal framework is frequently complicated and broadly dispersed among Federal, State, and local governments.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S,L	L,R,I,G	L,R,I,G	L,R,G	R
Informational/Educational[b]	N,S,L		E,T,P,R,A		
Discretionary/Voluntary[c]	N,S,L				S
Fiscal/Economic[d]	N,S,L				I,T,P
Market Based[e]	R,N,S,L	C,W		C,W	W,T,M,C,E

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

National, state, and local laws, along with international agreements, are used to provide for the management of forests to conserve special environmental, cultural, social, and scientific values. For federal, state, and local government ownerships, these laws are usually mandatory and prescriptive, being the strictest on federal lands. At a minimum, they may require that such lands be considered in forest planning and protection through an explicit or implicit process. They also may require specific regulations to protect sites with special values, or at least require that an acceptable outcome or level of protection is achieved.

International agreements, including the World Heritage agreement and Ramsar (for wetlands) require federal efforts to protect these sites on their lands. The U.N. Man and the Biosphere program or nongovernment organization designations such as the World Wildlife Fund biodiversity hotspots designation encourage protection of such sites also.

A variety of federal, state, and local government informational policies encourage protection of special sites. These include educational and technical assistance programs about the sites for private owners, designation of sites as protected areas, research regarding protection and management, and planning and analysis to provide protection. Private landowners often are not required to protect these sites, but large corporate and timber investors often do so as part of their commitment to corporate social responsibility.

Some federal, state, and nongovernment organizations also provide incentives such as tax breaks or subsidy payments to protect these special sites on private lands. This includes programs such as the Environmental Quality Incentives Program in the federal farm bill, or conservation easements obtained by nongovernment organizations, or wetland banking and payment systems throughout the country.

Forest certification has explicit standards for protecting special sites listed under this Indicator. Wetland banks also provide a mechanism to do so, under a de facto cap-and-trade system where no net loss of wetlands is permitted (the cap), and developer must purchase wetland credits to offset any destruction or loss that does occur (the trade). These are both prescriptive—mandatory rules—or performance based-depending on the special site protected. A variety of market based mechanisms, including free trade, cap-and-trade, forest certification, wetland banks, or conservation easement mechanisms may protect special sites on private lands.

Indicator 7.50 - Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to provide for public involvement activities and public education, awareness, and extension programs, and make available forest- related information

What is the indicator and why is it important?

Well-informed and knowledgeable citizens and forest owners create a foundation of support for applying principles of sustainable forest management. To accomplish such a purpose requires institutional conditions (agencies and organizations) that are capable of promoting programs considered necessary to inform the public and private forest owners about forest resource sustainability.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S,L	L,R,G			
Informational/Educational[b]	N,S,L		E,T,R,P,A		E,R,A,T
Discretionary/Voluntary[c]					
Fiscal/Economic[d]	N,S,L				
Market Based[e]	N,L				C

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

There are federal, state, and local government programs that provide education, awareness, and extension programs. Most conspicuously, the Cooperative Extension Service is a nation-wide partnership between the federal government, individual states, and local counties. This program has forestry as one of its components, although agriculture and rural development, and consumer and home economics are perhaps more prominent in many parts of the country. The U.S. also has separate state efforts for environmental and natural resource education, and a plethora of local governments run such programs for the general public and school children.

Many entities provide information and education about forests as part of their ongoing educational, technical assistance, research, forest protection, and planning efforts. These include not only government, schools, and universities, but also most environmental nongovernment organizations, such as forestry associations, professional societies, forestry interest groups, broad conservation organizations, and environmental activist groups.

Outreach and education also are required as part of forest certification systems. And many companies have some environmental education activities and facilities, although these have dwindled with the decrease in vertically integrated forest products firms that own forest land.

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Indicator 7.51 - Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to undertake and implement periodic forest-related planning, assessment, and policy review, including cross-sectoral planning coordination

What is the indicator and why is it important?

The sustainability of forests depends on society's institutional ability to comprehensively evaluate trends and conditions in diverse sectors and to subsequently make responses that will ensure the sustained use, management, and protection of forest resources and the communities that depend on them. Such actions are typically predicated on institutional conditions that foster well-focused and technically sound plans, assessments, and policy reviews that are sensitive to a range of forest values and that are coordinated with a variety of forest-related sectors.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S,L	L,R,I,G	L,R,I		
Informational/Educational[b]	N, S	E,R,A	E,R,A		E,R,A
Discretionary/Voluntary[c]	N				S
Fiscal/Economic[d]					
Market Based[e]	L				M

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

Indicator 7.51 is quite similar to indicator 7.46 in that it is related to forest planning and policy review, though perhaps with a slightly narrower focus. As a result, the following paraphrases the presentation given for indicator 7.46. These two indicators are apt to be consolidated in future revisions of the MP C&I.

National, regional, state, and local governments perform periodic forest planning, assessment, and policy reviews. Planning is required as a prescriptive for all federal land agencies for lands under their jurisdiction, and is similarly required in some fashion for most state and county forest lands. Some regional planning efforts also occur, voluntarily or not. These government planning efforts typically have a required process, usually including some type of public input and appeals. Inter-sectoral consultation and planning is frequently required as part of the process. The federal and state governments also write federal or state forest plans for private forest lands in the country or state. These plans usually do not dictate or create mandatory rules, regulations, incentives, or other government interventions in markets. Instead, they generally summarize information about forest resource conditions and trends; identify issues and opportunities; and suggest possible policies that could enhance sustainable forest management.

Educational, research, and analysis policy mechanisms are usually an integral part of forest planning efforts, at all scales from national to local. These policies provide education to forest managers

and policy makers on forest conditions, threats, and management responses. Various incentives have been provided for private or public forest landowners to meet the recommendations contained in forest plans

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Indicator 7.52 - Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to develop and maintain human resource skills across relevant disciplines

What is the indicator and why is it important?

Extensive knowledge and skills applied by persons engaged in the development and implementation of forest resource policies and programs are critical to accomplishing the wide-ranging goals of forest sustainability and conservation. These disciplinary and resource skills are developed via formal educational programs for field workers, technical staff, and natural resource professionals, as well as via professional work experiences and access to continuing education opportunities.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S	L,R	L,R,G		
Informational/Educational[b]	N,S		E,T,R,A	E	E,R
Discretionary/Voluntary[c]					
Fiscal/Economic[d]					
Market Based[e]	N,L		M	M	M

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

There are various national and state laws and regulations that affect worker safety and training in the forestry sector. Most laws and regulations would fall under the auspices of the Occupational Health and Safety Administration (OSHA), and similar state agencies. Related laws cover highway and trucking safety and operator licensing. These require use of safety equipment, training in safe operations, and now, use of Best Management Practices to avoid adverse environmental impacts.

Most of the actual education and training is conducted by states, either through their educational institutions such as Land Grant universities or community colleges, or through their industry trade associations in cooperation with the relevant state agencies. They also offer technical assistance, research on better methods and procedures, and planning to improve performance.

Similarly, education is provided for forest resource professionals, in addition to field forest workers. This professional education is led by accredited forestry programs in most states, complemented by research and extension efforts. This involves Bachelor of Science and graduate degree programs, often capped by state registration and licensing programs or the national Society of American Foresters Certified Forester program.

Professional education is offered for other forest-related disciplines, including wildlife and fisheries, natural resources, soils and hydrology, environmental sciences, ecology, and others. Several of these, but not all, have professional certification or registration procedures. Some private as well as public

institutions offer forestry programs as well, for field operators, technicians, and professionals.

Indicator 7.53 - Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and to support forest management

What is the indicator and why is it important?

Capital resources of physical infrastructure (e.g., roads, utilities, processing facilities) are essential to the management of forests and ultimately to economic development and quality of life in rural forested areas. Investments in public infrastructure, such as roads, bridges, sewerage and sanitation systems, schools, parks, and other physical facilities, are important government initiatives that complement the capital investments of private firms. Together, these investments constitute the capital basis for protecting forests and related resources and for producing the goods and services that sustain economies of forested areas. Some people have suggested that forest ecosystems per se can be considered a form of infrastructure ("green" infrastructure).

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S,L	L,R,G			
Informational/Educational[b]	N,S	T,R	T,R,A		
Discretionary/Voluntary[c]	S,L	B	B	B	S
Fiscal/Economic[d]					T
Market Based[e]	N,L			M	M,C

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

Development and maintenance of adequate physical infrastructure to facilitate the supply of forest products and services to support forest management would be the responsibility of governments who own public lands, teach, or perform research, and of private sector firms and forest owners who manage forests or forest products manufacturing facilities. This might be considered prescriptive for government forest management, education and research activities, and largely performance or outcome based activities for private sector forest managers.

Informational and educational mechanisms that are required could include technical assistance and research to provide adequate facilities and forest infrastructure such as roads, firebreaks, fire fighting gear, and harvesting equipment. Some of these are required by laws, and often such infrastructure is required in terms of processes to develop adequate capacity for forestry activities.

Private sector firms develop physical infrastructure and institutional capacity through private market, free enterprise efforts. They develop internal firm or trade association rules, processes, or outcome

guidelines as necessary, with either voluntary compliance or self-regulation, including through forest certification. Their ultimate success in developing efficient infrastructure is measured by market performance and profits in the long run.

Direct government subsidies have seldom been employed in developing private forestry infrastructure, but many parts of the federal tax code related to accelerated depreciation, tax deductions, and tax credits promote investments and manufacturing plants and facilities and in-woods equipment.

Indicator 7.54 - Extent to which the institutional framework supports the conservation and sustainable management of forests, including the capacity to enforce laws, regulations, and guidelines

What is the indicator and why is it important?

Markets processes allocate many forest resources. However, laws, rules, and regulations are needed to set the rules needed to maintain competitive markets even for private forests, and more than a third of U.S. forests are publicly owned. Effective laws, regulations, and guidelines must promote tenure rights, sustainable forest management, environmental protection, and a competitive market environment .

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S,L	L,R,I,G	L,R,I,G		R
Informational/Educational[b]	N,S,L		E,R,T		E,R,T
Discretionary/Voluntary[c]					
Fiscal/Economic[d]					
Market Based[e]	N,S,L				M,C

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

Laws, regulations, and guidelines for sustainable forest management in the United States are enforced well. U.S. laws differ widely among regions and landowner types, ranging from detailed laws and regulations for national forests and for all lands governed by the state forest practice acts in the West Coast to voluntary Best Management Practices in the southern and midwestern states.

Federal government forest lands have complex laws and policies governing forest management, biodiversity, public input, and workforce diversity. Private lands must comply with the relevant mandatory and voluntary standards. State forestry agencies monitor compliance with forest practice acts, BMP use, and water quality laws. These regulations directly affect private as well as public lands, and may involve up to several thousand inspections of forest operations each year in many states.

Education, technical assistance, and research are used to help in the training of forestry professionals, monitoring of laws and regulations, and continuous improvement of the mandatory and voluntary practices. These policy mechanisms are used both for the public and private forest land managers who implement the laws, and for the professionals who monitor, inspect, and enforce the rules and regulations.

Private sector firms comply with mandatory laws, and with voluntary guidelines as well. Frequent surveys have found that BMP compliance rates are very high in all states, as is compliance with laws and regulations. Similarly, forest certification provides a clear means to demonstrate that private and public

forestry organizations conform with the standards and guidelines for sustainable forest management.

Indicator 7.55 - Extent to which economic framework (economic policies and measures) supports the conservation and sustainable management of forests through investment and taxation policies and a regulatory environment that recognizes the long-term nature of investments and permits the flow of capital in and out of the forest sector in response to market signals, nonmarket economic valuations, and public policy decisions in order to meet long-term demands for forest products and services

What is the indicator and why is it important?

The sustainability of forests and the many benefits they are capable of providing requires high levels of sustained investment in their management and protection. Investments are driven by a number of economy-wide factors and government policies, including product or service costs and prices, capital costs, management efficiency, forest land productivity, and tax and incentive policies.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S,L	L,R,I,G	L,R		L,R,G
Informational/Educational[b]	N,S		R,P,A		R,P,A
Discretionary/Voluntary[c]	N				S
Fiscal/Economic[d]	N,S,L	I,S,T		I,S,T,P	I,S,T,P
Market Based[e]	N,S,L				C,W,T,E,M

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

The United States has a wide variety of investment and taxation policies that favor long-term forest resource investments, provide consistent market based incentives and signals, and provide some payments for investments in nonmarket values. These are provided at the national, state, and local level, affecting income taxes, property taxes, and production of a variety of forest resource goods and services. The regulatory environment is addressed in other indicators, and ranges from strict regulations on public lands and mountainous West Coast states, to voluntary BMPs in states with mostly private forest lands in the South and East. Prescriptive regulations occur at the federal level for federal lands, and state level for state and private lands. These include requirements for specific BMPs and for notification, harvesting permits, and/or timber management plans in a few states.

Federal and state income tax policies for timber production are generally more favorable than for other sources of income such as wages and salaries. For active investors, timber management expenses may be deducted as a cost of business, similar to agricultural operations. Timber income is currently taxed at a long-term capital gains rate that is less than the marginal tax rates for middle income or higher level individuals. And it receives an accelerated tax deduction for reforestation and planting, rather than waiting for the end of a harvest rotation to apply the

deduction as a cost of business. This federal tax treatment is carried over to the state income taxes.

Property tax treatment for forest land owners also is generally favorable for active forest land owners and managers, although this does vary substantially among states and even within states. Property tax rates without special tax treatment can be almost punitive, at up to $30 to $50 per acre per year. But most states offer current use of forest use valuation, which reduces these high rates to less than $10 per acre, at least for landowners who meet program criteria and guarantee to enroll for a fixed program length. Some states also tax timber as real property, but offset the increasing tax values by collecting a yield tax on the timber portion of the asset, while only the land is taxed at actual assessed values.

Many forest incentive programs also promote forest investments in timber, conservation, or environmental activities. The periodic federal farm bill has contained more provisions for tree planting, crop retirement, and environmental land use programs in each of its authorizations and appropriations since the 1960s. Recent relevant federal farm bill programs included the Conservation Reserve Program, Wildlife Habitat Incentive Program, Environmental Quality Incentive Program, and Forest Stewardship Program. Almost 20 states also provide state incentive payments to landowners who plant trees or perform qualifying forest management and planning activities.

Informational and educational programs promote participation in these programs, including program enrollment processes, forest practice requirements, and cost-share payment rates. Research and protection programs help ensure that these incentives and practices remain productive and secure, and extensive federal and state planning and program development provide the foundations for program delivery.

Private market policy tools also address timber production, ecosystem goods and services production, and environmental protection for sustainable forest management. These specifically include market based programs such as forest certification for SFM, wetlands banks for wetland functions and values, cap-and-trade for carbon storage or Endangered Species Protection, conservation easements for fixed term or permanent protection from development, and even outright purchase of forest lands by nongovernment organizations or government organizations.

Indicator 7.56 - Extent to which economic framework (economic policies and measures) supports the conservation and sustainable management of forests through investment and taxation policies and a regulatory environment that recognizes the long-term nature of investments and permits nondiscriminatory trade policies for forest products

What is the indicator and why is it important?

This indicator provides information about the Nation's trade policies and how they may affect markets in ways that can affect sustainable forest management. If trade policies, such as import or export quotas, mask market signals that affect domestic timber harvest, they may adversely affect economic, social, or environmental components of sustainable forest management.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S	L,R,I	L,R,I	L,R,I	
Informational/Educational[b]					
Discretionary/Voluntary[c]					
Fiscal/Economic[d]					
Market Based[e]	N				M

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

Trade policies are obviously the purview of the federal government, both as logic dictates and as stated explicitly in the U.S. Constitution. Many national and international laws, rules, regulations, and international agreements address trade in forest products, protection of endangered species and important natural habitats, and potential discrimination. The United States is a net forest products importer, but also exports considerable amount of wood as well. It imports mostly sawnwood and panels, and exports pulp and paper and roundwood, but much less on a volume basis.

Trade from Canada and the U.S. has been contentious. The U.S. imported about 39% of its sawnwood consumption and 28% of its panel consumption in 2004, with almost 90% of this coming from Canada. U.S. trade is governed partially by the North American Free Trade Agreement (NAFTA) and by some accords under the World Trade Organization (WTO)as well as agreements stemming from General Agreement on Trade and Tariffs (GATT). The legal Canadian-U.S. lumber dispute reached a fragile resolution in 2006, and remains in force.

The U.S. also participates in international agreements that have environmental and social objectives. The Convention on International Trade in Endangered Species (CITES) protects endangered fauna and flora; Ramsar protects endangered wetlands; the North American Migratory Bird Treaty acts to protect those bird species whose migration routes include North America; and the North American and Central

American Free Trade Agreements (NAFTA and CAFTA) include environmental protection and worker protection standards. The U.S. Lacey Act of 1900 forbade import of foreign animal or interstate commerce in illegally taken wild animals or birds, and was extended in 2008 to combat imports from illegal logging in other countries.

Concerns with non-trade barriers such as phyto-sanitary standards and now illegal logging strictures under the 2008 Lacey Act Amendments still require temperate policy responses and monitoring to ensure that fair trade continues. Private sector forest products firms and forest landowners generally operate completely within these laws, rules, regulations, and international agreements.

Indicator 7.57 - Capacity to measure and monitor changes in the conservation and sustainable management of forests, including availability and extent of up-to-date data, statistics, and other information important to measuring or describing indicators associated with Criteria 1-7

What is the indicator and why is it important?

This indicator assesses the availability of information needed to measure or describe the indicators associated with criteria 1 through 7. Successful implementation of the criteria and indicator concept requires the availability of information to report on the indicators.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,S	L,R,G			
Informational/Educational[b]	R,N,S	R,A	R,A		
Discretionary/Voluntary[c]	N,R,S,L				S
Fiscal/Economic[d]					
Market Based[e]	N,S,L				M,C

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

Compilation and development of up-to-date data, statistics, and other information is mostly a federal government responsibility, with some data collected by states as well. Various laws and regulations govern data collection, analysis, and release. For example, the federal Renewable Resource Planning Act (RPA) mandates data collection and analysis to monitor the trends of the forest conditions in the United States. The federal Forest Inventory and Analysis (FIA) program measures forest inventories, forest health, and selected forest resource characteristics in the U.S.

FIA also collects and publishes much of the forest products production data in the U.S. These data are complemented with trade data from the Foreign Agriculture Service (FAS) and the National Resource Lands Inventory (NRLI), which measures land use and change for all lands in the U.S.

As of the 2003 *National Report on Sustainable Forests*, 5 of the 67 Montreal Process Indicators had data available at the national scale, and 17 had partial data at the national scale. The rest had only data available at the state or local scale, if at all.

Federal, state, and university research and assessment contribute to the availability and extent of the statistics, and help foster continuous improvement of the data generated within the budget constraints. Forestry sector private firms and landowners also contribute to such efforts through voluntary reporting and cooperation with federal partners. They also provide various production and trade statistics to forest industry trade associations, which compile and publish them annually or periodically. Certified forest organizations also report some management

data at least, and perhaps much of their management planning information.

Indicator 7.58 - Capacity to measure and monitor changes in the conservation and sustainable management of forests, including scope, frequency, and statistical reliability of forest inventories, assessments, monitoring and other relevant information

What is the indicator and why is it important?

Public discussion and decisions related to natural resource sustainability issues should be based on comprehensive, current and sound data. Information regarding the frequency, coverage, and reliability of data provides analysts with critical information for evaluating and prioritizing sustainability needs.

What does the indicator show?

Data for the 64 indicators range from full current coverage to one-time studies, to very anecdotal information. By looking at a cross section of the information in three broad categories, a brief overview of the situation for each Criterion can be seen. While some indicators have a full suite of data that is current, national in scope, and collected frequently, many do not. In some cases, this is the result of a lack of systematic data collection, in others, the indicator in question may not be amenable to a concise, quantified presentation, and systematic data collection activities would likely not be possible even if sufficient resources were available. Often, in these cases, proxy data have been used to provide some information to address the indicator. Certain proxy data series may have excellent characteristics (e.g. high reporting frequency and national consistency), but their applicability in measuring the underlying indicator will vary depending on the indicator in question.

The current status of data for each indicator is summarized in the table below along with its status as recorded in the 2003 report. The rankings are based on the judgment of each indicator's lead investigator and the project analysis team as a whole. They are currently provisional. The rankings may assume different meanings depending on the indicator in question. In particular, the appropriateness of proxy data is not fully reflected in the stoplight categorizations presented in the table below.

KEY				
Notes on the rating system: ***This rating provides a general overview of the data supporting the indicators. Green means few gaps, yellow means several gaps, red means no data or numerous gaps, and blue indicates data that has been modelled.***	**Data coverage**	**Data currentness**	**Data frequency**	**Reporting scale**
Data generally complete nationally, current, and relaible.	National (90%+)	2000+	Annual to < 5-year periodic	Regional or national
Data may not be consistent nationally, slightly dated, and not measured frequently enough.	Regional or some national	1985-1999	5+ year Periodic	
Data are from inconsistent sources or non-existent, more than 15 years old or partial, and has no consistent plan for remeasurement.	Varies or incom-plete	Incomplete	One-time or incomplete	
Data are modelled [currency and frequency dots refer to model referemce data]	Modelled			

=Triangle shows status of variable in 2003 Report.

Criterion	Old	New	Indicators	Data status			Reporting Scale
				Coverage	Current-ness	Frequency	
1 **Conservation of biological diversity**	*1,3*	**1.01**	Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure				Regional
	2,4	**1.02**	Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage				Regional
	5	**1.03**	Fragmentation of forests				Regional
	6	**1.04**	Number of native forest associated species				Regional
	7	**1.05**	Number and status of native forest associated species at risk, as determined by legislation or scientific assessment				Regional
		1.06	Status of in situ and ex situ efforts focused on conservation of species diversity				Regional
	8	**1.07**	Number and geographic distribution of forest associated species at risk of losing genetic variation and locally adapted genotypes				Regional
	9	**1.08**	Population levels of selected representative forest associated species to describe genetic diversity				Regional
		1.09	Status of in situ and ex situ efforts focused on conservation of genetic diversity				National
2 **Maintenance of productive capacity of forest ecosystems**	*10*	**2.10**	Area and percent of forest land and net area of forest land available for wood production				Regional
	11	**2.11**	Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production				Regional
	12	**2.12**	Area, percent, and growing stock of plantations of native and exotic species				Regional
	13	**2.13**	Annual harvest of wood products by volume and as a percentage of net growth or sustained yield				Regional
	14	**2.14**	Annual harvest of non-wood forest products				Regional
3 **Maintenance of ecosystem health and vitality**	*15*	**3.15**	Area and percent of forest affected by biotic processes and agents (e.g. insects, disease, invasive alien species) beyond reference conditions				Regional
	16,17	**3.16**	Area and percent of forest affected by abiotic agents (e.g. fire, storm, land clearance) beyond reference conditions				Regional
4 **Conservation and maintenance of soil and water resources**	*18,19*	**4.17**	Area and percent of forest whose designation or land management focus is the protection of soil or water resources				Regional
	22	**4.18**	Proportion of forest management activities (e.g. site preparation, harvesting) that meet best management practices or other relevant legislation to protect soil resources				Regional
	21,25	**4.19**	Area and percent of forest land with significant soil degradation				Regional
	20	**4.20**	Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources such as riparian zones, water quality, quantity and flow regulation				Regional
	23,24	**4.21**	Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions				Regional
5 **Maintenance of forest contribution to global carbon cycles**	*26,27*	**5.22**	Total forest ecosystem carbon pools and fluxes				Regional
	28	**5.23**	Total forest product carbon pools and fluxes				National
		5.24	Avoided fossil fuel carbon emissions by using forest biomass for energy				National

Criterion	*Old*	New	Indicators	Data status			Reporting Scale
				Coverage	Current-ness	Frequency	
6 **Maintenance and enhancement of long term multiple socio-economic benefits to meet the needs of societies**	*29*	**6.25**	Value and volume of wood and wood products production, including primary and secondary processing				Regional
	30	**6.26**	Value of non-wood forest products produced or collected				National
	43	**6.27**	Revenue from forest based environmental services				National
	31	**6.28**	Total and per capita consumption of wood and wood products in round wood equivalents				National
	34	**6.29**	Total and per capita consumption of non-wood products				National
	32	**6.30**	Value and volume in round wood equivalents of exports and imports of wood products				National
		6.31	Value of exports and imports of non-wood products				National
		6.32	Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption				National
	33	**6.33**	Recovery or recycling of forest products as a percent of total forest products consumption.				Regional
	38	**6.34**	Value of capital investment and annual expenditure in forest management, wood and non-wood product industries, forest-based environmental services, recreation and tourism				Regional
	39-41	**6.35**	Annual investment and expenditure in forest-related research, extension and development, and education				National
	44	**6.36**	Employment in the forest sector				Regional
	45	**6.37**	Average wage rates, annual average income and annual injury rates in major forest employment categories				Regional
	46	**6.38**	Resilience of forest-dependent communities				National
	47	**6.39**	Area and percent of forests used for subsistence purposes				Regional
		6.40	Distribution of revenues derived from forest management				National
	35-36	**6.41**	Area and percent of forests available and/or managed for public recreation and tourism				Regional
	37	**6.42**	Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available				Regional
	42	**6.43**	Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values				Regional
		6.44	The importance of forests to people				National

Criterion	*Old*	New	Indicators	Data status			Reporting Scale
				Coverage	Current-ness	Frequency	
7 Legal, institutional, and economic framework for forest conservation and sustainable management.	*48*	**7.45**	Clarifies property rights				National
	49	**7.46**	Provides for periodic forest-related planning, assessment, and policy review				National
	50	**7.47**	Provides opps for public participation in public policy and decision making				National
	51	**7.48**	Encourages best practice codes for forest management				National
	52	**7.49**	Provides for the mgmt.t of forests to conserve special environmental values				National
	53	**7.50**	Provide for public involvement activities and public education, etc				National
	54	**7.51**	Undertake and implement periodic forest-related planning, assessment, etc				National
	55	**7.52**	Develop and maintain human resource skills across relevant disciplines				National
	56	**7.53**	Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services				National
	57	**7.54**	Enforce laws, regulations and guidelines				National
	58	**7.55**	Investment and taxation policies and a regulatory environment which recognizes the long-term nature of investments				National
	59	**7.56**	Non-discriminatory trade policies for forest products				National
	60	**7.57**	Availability and extent of up-to-date data, statistics, and other information				National
	61	**7.58**	Scope, frequency, and statistical reliability of forest inventories, etc				National
	62	**7.59**	Compatibility with other countries in meas., monitoring and reporting				National
	63	**7.60**	Development of scientific understanding of forest ecosystems				National
	64	**7.61**	Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies				National
	65	**7.62**	New technologies and the capacity to assess socioeconomic consequences				National
	66	**7.63**	Enhancement of ability to predict impacts of human intervention on forests				National
	67	**7.64**	Ability to predict impacts on forests of possible climate change				National

Indicator 7.59 - Capacity to measure and monitor changes in the conservation and sustainable management of forests, including compatibility with other countries in measuring, monitoring, and reporting on indicators member countries

What is the indicator and why is it important?

Consistent data among Montreal process countries will facilitate comparative monitoring of sustainable forest management and trends over time. The member countries are: Argentina, Australia, Canada, Chile, China, Japan, Republic of Korea, Mexico, New Zealand, Russian Federation, United States of America, and Uruguay.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,R		I		
Informational/Educational[b]	N,R,S		E,T,R,A	E,T,R,A	R,A
Discretionary/Voluntary[c]					
Fiscal/Economic[d]					
Market Based[e]					

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

The U.S. works with other countries in the Montreal Process through Technical Advisory Committees to help agree on indicator revisions and develop common data formats. Each country may have laws and geophysical situations that are unique, but as much as possible, common data formats for the indicators are adopted. Data compatibility is of course the responsibility of the federal government.

The participating countries in the Montreal Process use education, technical assistance, research, and planning to seek common data formats and reporting methods. State forestry agencies, private sector forest products firms and forest landowners may contribute to these efforts by reporting data in the formats sought for the U.S. and Montreal Process reports.

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Indicator 7.60 - Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services including development of scientific understanding of forest ecosystem characteristics and functions

What is the indicator and why is it important?

This indicator is a measure of the capacity to understand forest ecosystems processes and components. This understanding is essential to the conservation and sustainable management of forest ecosystems.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N,R,S	L,R,I,G			
Informational/Educational[b]	N,S		E,T,R,A	E,T,R,A	T,R
Discretionary/Voluntary[c]					
Fiscal/Economic[d]					
Market Based[e]	R,N,L		C		M

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

Federal, state, and university research and development efforts are authorized by relevant government programs and laws, which prescribe that research programs must provide scientific information for forest resource management and protection. Development of research to improve scientific understanding of forest ecosystem characteristics and functions is a blend of national research and development performed by the federal government, universities throughout the country, a few state forestry and natural resource agencies, environmental nongovernment organizations, and the forest industry and forest landowning firms.

According to the 2003 *National Capacity in Forestry Research* report, as of 2002, the USDA Forest Service research program had 723 scientist-years of personnel, with about 500 research scientists, and a budget of $241 million. As of 1993, U.S. universities had 1459 full time employees, with about half of those scientist years of effort being dedicated to research, and the rest to teaching and extension. Forest industry reported $72 million in research funding through its Sustainable Forestry Initiative program efforts, although this surely has declined as the vertically integrated forest products firms have sold their timberland and eliminated most forestry research.

Other federal agencies such as NASA, the National Science Foundation, the Department of Energy, and the Department of Agriculture probably spent $40 to $50 million on forest related research in 2000. Environmental NGOs also spent millions on forest related research and development. More recent data are lacking, but in total, the direct forestry expenditures and effort exceed 1,000 research

scientists and budgets of more than $500 million per year. Observations suggest that these funds and personnel levels have declined in recent years, but current data are lacking. Other private sector research and development for forestry equipment for land and harvesting operations also contributes significantly to the total expenditures on forestry research, but this amount is not known.

The scientific understanding is developed and disseminated through educational, technical assistance, research and planning efforts. The private sector also participates in these efforts. Forest certification standards, particularly in the Sustainable Forestry Initiative, require demonstration of forest research.

As the U.S. vertically integrated forest products sector is disappearing, so is its forest land management research. To some extent, timber investment management organizations (TIMOs) and real estate investment trusts (REITs) have maintained modest research programs and are members of university cooperative research programs. And at least a few research branches of former forest products firms have been spun off and started their own forestry research and development organizations in areas such as in biotechnology and management information systems.

Indicator 7.61 - Capacity to conduct and apply research and development aimed at improving forest management and development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems

What is the indicator and why is it important?

This indicator assesses the ability to fully account for the costs and benefits of public and private decisions on forest resources. While information on traditional economic measures of forest market values is usually available, information on social and environmental values is incomplete. Lack of such information in national accounting frameworks can result in a poor allocation of forest resources.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N	L,R	L,R		
Informational/Educational[b]	N,S		R,A		
Discretionary/Voluntary[c]					
Fiscal/Economic[d]	N,S	I,S,T			
Market Based[e]	N,L				C,W,T,M

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

There are no specifically required mechanisms to develop and incorporate environmental and social costs and benefits into national accounting systems in the United States and its forest resources at this time. There are, however, many means by which public policies consider environmental impacts related to federal and state projects, and at times private land actions. These include the process-based National Environmental Policy Act, which requires analysis of the impacts of major federal actions on the environment.

The Endangered Species Act prescribes specific measures to protect threatened and endangered species and rigorous means to list such species. The National Forest Management Act federal regulations include detailed restrictions to protect ecosystem biodiversity, which combine process requirements and prescriptive standards. Public actions also may require social impact analyses and at least public input processes.

Research and planning are used as part of informational and educational policy mechanisms to implement these environmental and social components of national forest planning actions. Various incentives, subsidies, and taxes also are provided for planning by states, and the protection of endangered, threatened, or rare species and ecosystems. These include specific federal or state

programs and private market actions in forest certification, wetlands banking, and cap-and-trade systems for endangered species or carbon storage. Most forest products firms and organizations now also have adopted official sustainability policies and are championing corporate social responsibility actions to guarantee their positive environmental image and gain market recognition.

Indicator 7.62 - Capacity to conduct and apply research and development aimed at improving forest management and new technologies and the capacity to assess the socioeconomic consequences associated with the introduction of new technologies

What is the indicator and why is it important?

This indicator is a measure of the capacity to assess the effects of new technologies in a broadly defined forest sector on the socioeconomic structure in which the technologies are applied (e.g., employment, industrial output, valued added, or productivity in the forest sector). New technology drives economic efficiency but has social and environmental consequences that should also be considered.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]	N	L			
Informational/Educational[b]	N,S		R,A		R,A
Discretionary/Voluntary[c]	N				S
Fiscal/Economic[d]	N				I,S,T
Market Based[e]	N				M

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

Development of new technologies for sustainable forest management is largely a research and planning exercise, but is not mandatory or prescriptive in most cases. Federal research was classed as prescriptive earlier, so it is included here for consistency. But the brunt of technology development and assessment is derived from informational, educational, fiscal, or economic policy mechanisms.

Private enterprise drives much of the new technologies based on the research performed as described in Indicator 7.60. This occurs through voluntary adoption of promising technologies, and the government provision of a variety of incentives, subsidies, and taxes. Most of this technology adoption is market driven, based on public research that is disseminated through extension, education, and scientific publications, conferences, and technical meetings.

Little direct evaluation of the socioeconomic consequences of the introduction of new technologies exists, although some socioeconomic studies and rural development analyses include this as a component of their analyses.

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Indicator 7.63 - Capacity to conduct and apply research and development aimed at improving forest management and enhancement of the ability to predict impacts of human intervention on forests

What is the indicator and why is it important?

This indicator is a measure of the capacity to predict how humans affect forests in a quantifiable, aggregate scale. This understanding will help conservation and sustainable management of forest ecosystems.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]					
Informational/Educational[b]	N, S	E,R,A	E,R,A		
Discretionary/Voluntary[c]					S
Fiscal/Economic[d]					
Market Based[e]					M

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

The ability of the nation to predict the effects of human intervention on forests could be construed to mean the assessment of the impacts of research, development, and forest management on forest extent, composition, functions, and values. This is a broad subject, without an easily identifiable set of specific variables to be measured. to the point that no specific data are collected at a national, regional, or state level.

Analysis of the effects of human intervention on forests at a stand level or perhaps a landscape level occurs routinely for forest management actions and for research and demonstration. But these assessments are seldom accumulated into an integrated data base for monitoring or analysis of trends.

Occasional assessments such as the Pacific Northwest Forest Plan, the Northern Forest Lands Assessment, or the Southern Forest Resource Assessment make integrated analyses that occur periodically. The national Renewable Resources Planning Act assessments also contain estimates of the effects of human intervention on forests in general, but not couched in the context of this indicator specifically.

Most of these analyses of the effects of human intervention on forests in response to normal forest management activities occur as informational and educational policy mechanisms, through research, professional education, and planning. The private sector is becoming more involved in these analyses at least in terms of risk analysis, and for long range planning as well.

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Indicator 7.64 - Capacity to conduct and apply research and development aimed at improving forest management and the ability to predict impacts on forests of possible climate change

What is the indicator and why is it important?

Climate change may affect forest distribution, extent, pathogens, and productivity. Capacity is needed to quantify those effects on forest productivity, plant and animal species range shifts, carbon sequestration, water yield, forest health and changes in stand structure, as is the ability to integrate impacts across atmospheric, ecological, and economic systems. Improved understanding of climate change impacts will increase the capability to make better informed and earlier climate change mitigating actions, thus improving the likelihood that forests will be managed on a sustainable basis.

Policy and Governance Classification

Mechanism	Scale: National, Regional, State, Local	Approach			
		Prescriptive	Process or Systems Based	Performance or Outcome Based	Private Enterprise
Non-Discretionary/ Mandatory[a]					
Informational/Educational[b]	N,R,S		R E		
Discretionary/Voluntary[c]					
Fiscal/Economic[d]					S
Market Based[e]					M

[a] Laws (L), Regulations or Rules (R), International Agreements (I), Government Ownership or Production (G)
[b] Education (E), Technical Assistance (T), Research (R), Protection (P), Analysis and Planning (A)
[c] Best Management Practices (B), Self-regulation (S)
[d] Incentives (I), Subsidies (S), Taxes (T), Payments for Environmental Service (P)
[e] Free enterprise, private market allocation of forest resources (M), or market based instruments and payments, including forest certification (C) wetland banks (W), cap-and-trade (T), conservation easement or transfer of development rights (E)

What does the indicator show?

In comparison with the apparently modest research on assessing impacts of traditional forest management on forests, the U.S. is now devoting considerable amount of scientific resources to analysis of the effects of global climate change on forests, at an aggregate national and regional scale. These efforts model likely climate change scenarios; probable biological effect on forest distribution and growth and pathogens; economic consequences; and possible policy responses. These efforts include several components of the Montreal Process Criteria and indicators.

Most of these analyses of the effects of human intervention on forests in response to climate change or normal forest management activities occur as informational and educational policy mechanisms, through research, professional education, and planning. The private sector is becoming actively involved in these analyses in terms of risk analysis, and for long range planning. Insurance firms, at the very least, are becoming involved in quantitatively estimating climate change impacts, as are agricultural and forest production firms such as equipment manufacturers and herbicide/pesticide manufacturers.

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Chapter 3

Summary of Significant Conditions and Trends

1. Introduction

The preceding chapter provides information specific to each indicator contained in the MP C&I. While the individual indicator findings are important, a comprehensive picture of the current condition and sustainability of the Nation's forests requires a synthesis of the information between indicators within each criterion, and across criteria. This chapter begins that task, recognizing that a full assessment of current conditions and sustainability is well beyond the scope of a single report. An assessment of sustainability may more appropriately emerge from a broad-based public dialogue about what the data mean. This chapter begins the synthesis that launches that dialogue

This chapter begins with a summary of key findings from each criterion. The following section summarizes key findings across all criteria and then relates them to three overarching issues of central concern to the Forest Service: climate change, bioenergy and biofuels production, and the loss of forest land. Data quality and availability impacts every aspect of the sustainability reporting effort and is the subject of the next section. The chapter concludes with a discussion of the implications of current findings for future work in the application of the MP C&I in particular and in forest sustainability reporting in general.

We chose a narrative approach for this chapter, while realizing that other approaches may be used to synthesize findings. For example, a more explicit assessment of forest sustainability using a formal participatory process, perhaps run through the Roundtable for Sustainable Forests, would be a valuable addition to the reporting process.

In choosing and synthesizing key findings in this chapter, we are inevitably engaging in an interpretive exercise involving numerous judgment calls, but we try to stay close to the data. Readers are encouraged to develop their own observations and conclusions based on their review of this chapter and the information provided in chapter 2. Review comments to this effect will help is in drafting the final version of this report and contribute to the public dialogue that we think is a necessary part of the process of assessing the sustainability of our Nation's forests.

2. Summary of Key Findings by Criteria

This section identifies key developments for individual criteria and describes, in general terms, the data and analyses that underlie them. By summarizing by criteria, we are explicitly using the MP C&I as framework to make sense of the various pieces of information contained in the indicators. Current rationale statements from the MP Working group for each criterion and sub-criterion were presented at the beginning of chapter 2. Readers who are interested in viewing the entire set of rationale statements for the entire MP C&I, including suggested measurement approaches for individual indicators can go to [www.mpci.org/].

2.1 Criterion 1—Conservation of Biological Diversity

The MP divides this criterion into three sub-criteria: (1) ecosystem diversity; (2) species diversity; and (3) genetic diversity. The indicators in the criterion are organized accordingly, addressing first the extent, conservation status and structure of different forest ecosystem types, then the number and

status of forest-associated species along with related conservation efforts, and, finally, a similar set of indicators describing genetic diversity of forest-associated species. Several of the indicators in the species and genetic diversity sub-criteria identify "species at risk" in their titles, a category comparable to the concept of threatened or endangered species in the United States but more broadly defined (and lacking the same legal import).

Current data allow us to present a relatively complete picture of the overall extent of forest ecosystem types and their conservation status. Overall, the total area of forests in the United States has been stable to slightly increasing in recent decades. Gains in broadleaved forests in the South and interior North have been largely offset by declines in forest area in the more developed coastal regions, particularly in coniferous forests.

While forest area may be relatively stable, the other indicators in the criterion paint a more ambiguous picture about forest sustainability. Although the data on forest fragmentation presented in this report are not directly comparable to those in 2003, indications are that the area of forests impacted by fragmentation has been increasing at a steady rate. This includes lands on the fringes of major population centers as well as in rural areas where growth in smaller centers and in the number of second homes continues to drive development and thereby fragmentation. This conclusion is supported by the information on the impacts of housing development on forest area included in indicator 3.16.

Species richness and genetic diversity of forest-associated species are closely linked to the availability and quality of forest ecosystems. These ecosystems, in turn, are impacted by human and natural forces such as development patterns, fire suppression, and climate change. As a result, species diversity and healthy populations of "keystone" species are viewed as crucial indicators of forest sustainability. (As of this writing, we are still waiting for critical data inputs for indicators on species population and diversity. We have provided fully developed templates that we hope to populate with fresh data in the very near future. These updates will be made available through the project website (http://www.fs.fed.us/research/sustain/).

In addition to the indicators in criterion 1 that describe the extent and condition of forests and their biological components, three of the indicators in this criterion describe societal efforts to conserve these resources. Of these, only indicator 1.2, which measures the area of protected forests, was reported in 2003. The area of forests formally protected by government designation totals some 106 million acres and this number has changed little since 2003. At the same time, alternative ways of protecting forests through land trusts and conservation easements have been gaining popularity, accounting in total for over 10 million acres in 2005 (http://www.landtrustalliance.org/). This is a small number relative to the officially designated protected areas, but it is an important addition to our portfolio of protected forest lands, especially since the number of acres in this category has been growing rapidly. Indicator 6.27, which tracks payments for ecosystem services including conservation easements, and its associated background material provide more information on this topic.

Indicators 1.6 and 1.9 describe our Nation's efforts to conserve species and genetic resources respectively. These are new indicators, and, since they cover a broad spectrum of activities on the part of government, academia and the private sector, they are not easy to measure. The information presented for these indicators in chapter 2 provides a picture of the breadth of current activities in this area, ranging from research, to experimental forests, zoos and seed banks. It does not, however, indicate whether these activities have increased nor does it answer the crucial question of whether they are adequate to help secure the sustainability of biological diversity in our forests. Future editions of this report should be able to better answer these questions.

2.2 Criterion 2—Maintenance of Productive Capacity of Forest Ecosystems

Criterion 2 addresses the ability of the Nation's forest to continue to provide raw materials for the wood products industry and non-wood forest products for sale and personal use. This criterion has five indicators. The first three indicators track traditional measures of timber production capacity, and the last two track measures of harvest of timber and non-wood forest products, respectively. The indicators in this criterion support the conclusion that our current use of the Nation's forests is sustainable from the perspective of timber production capacity; the area of timberland is stable and timber stocking on these lands has been increasing. In the case of non-wood forest products, the data are not sufficient to reach a definitive conclusion about the sustainability of productive capacity.

Capacity for timber production. Timberland is defined as the potential area of forest land available for, and capable of wood production. As is the case with forest land, the area of timber land in the United States has been very stable over the past 50 years. It currently stands at 514 million acres (69 percent of all forest land). The highest concentration of timberland is in the South, where 95 percent of the forest is classified as belonging to this category. A similar percentage of the Northern forests is also timberland, but the total area of timberland there is 20 percent less than in the South. Smaller amounts of timberland are located in the Rocky Mountain and Pacific Coast regions where, owing to lower stocking and productivity (notably in the Rocky Mountain region) as well as more area in higher protection categories (see indicator 1.2), the proportion of timberland to forest land is relatively less. Alaska also has considerable forest lands, but only 7 percent is classified as timberland because of low productivity and relative inaccessibility.

Ten percent of the Nation's timberland is classified as mixed forest. The remainder is either predominantly conifer or broadleaf forest types, with the former constituting the overwhelming majority of timberlands in the western half of the country and the latter found mostly in the Eastern half. 41 million acres (44 percent) of the 93 million acres of conifer forest types in the East were of planted origin, mainly in the South.

In contrast to the stable area of timberlands, timber growing stock volume on these lands has steadily increased over the last 50 years, reaching a current level of 932 billion cubic feet—51 percent higher than that reported in 1953. Most of this increase was in the Northern and Southern regions. As a result of initially high stocking volumes in mature stands and continued harvest offsetting growth in younger stands, The Pacific Coast region saw only a four percent increase in growing stock over the last five decades.

There are currently 63 million acres of planted timberlands in the United States, consisting mainly of pine plantations in the South. The small proportion of planted land relative to total timberlands (only 12 percent) belies their importance as a timber resource. Owing to their high growth rates, easy operability, and overall intensity of management, planted lands play a large role in current and anticipated future supplies of timber, and, as a result, the South is expected to continue to serve as the Nation's major timber producing region well into the future. Since 1982, more than 2 million acres have been planted annually, virtually all with native species. A significant percentage of the planted conifer seedlings also come from tree improvement programs emphasizing superior growth grades, form class, and disease resistance.

The South supplied 62 percent of all timber removals in 2006, up from 49 percent in 1953. On public lands in the West, where timber management has been sharply curtailed in recent years, removals have declined from 4.4 billion cubic feet in 1976 to 2.8 billion cubic feet in 2006, a fall of 35 percent. Net growth in timber stocks currently exceeds harvest by a considerable extent in all regions of the United States.

Non-timber forest products The indicators in this criterion that track timber production capacity benefit from an extensive and well established set of statistics, primarily from the Forest Service's Forest Inventory and Analysis program. Non-timber forest products (NTFPs) do not enjoy the same statistical foundation

The data we do have indicate that NTFPs represent a major source of economic activity and value from use for many people. In 2006, over 14,000 permits and contracts were issued for the collection and/or consumption of food and forage plants on National Forests and Bureau of Land Management (BLM) properties. Approximately 156,000 pounds of fruits and berries, 468,000 pounds of mushrooms and other fungi, over 7,000 tons of decorative foliage and over 2,000 tons of forage were consumed and/or otherwise harvested using these permits. Since 1998, the number of permits and contracts issued has increased by 65 percent Although data on the volume of NTFPs harvested on private land is lacking, a 2006 survey of private forest landowners indicated that nearly 10 percent of the estimated 10 million private forest landowners collected edible plants, nuts and berries for either sale or personal consumption. Over the last 3 decades, an estimated 2.7 million pounds of ginseng have been harvested from eastern hardwood forests.

2.3 Criterion 3—Maintenance of Ecosystem Health and Vitality

Criterion 3 measures forest disturbance processes and contains only two indicators. The first (indicator 3.15) addresses biological processes, such as insect infestations and the influx of invasive species, that can impact forest health, and the second (indicator 3.16) addresses physical processes, such as fire and storms, that likewise impact forests. The relatively small

number of indicators, however, is no indication of the relative importance of this criterion. The processes described here have a crucial impact on the health, character and extent of forest ecosystems and are thus closely linked to all the other indicators contained in this report.

In many cases, forest disturbances—biological and physical—can be seen as leading indicators foreshadowing changes in the distribution of forest ecosystem types across the landscape. Disturbances also affect the ability to provide an array of valuable goods and services, whether traditional commodity outputs like timber or livestock forage, ecosystem services such as water purification and stream-flow regulation, or more intangible values such as aesthetic character or species habitat. The indicators in this criterion may register major changes that are not yet apparent in the other indicators describing the biophysical characteristics of forests.

An important example here is the growing problem of insect infestation and related tree mortality in the inter-mountain West, where infestations increase to the risk of larger and more intense fires and, ultimately, the loss of myriad forest values plus the potential alteration of long-term ecosystem patterns at the regional scale. In this sense, the indicators in this criterion may point to major issues or problems in the future. Moreover, to the extent that climate change will impact our forests, these impacts will likely first be clearly apparent within criterion 3.

A certain level of disturbance is natural in healthy ecosystems. The real question is not the absolute level of disturbance, but whether it represents a significant departure from the background, or "natural," level of disturbance for a given ecosystem. For this reason, the Montreal Process definitions for both indicator 3.15 and 3.16 stipulate "reference conditions" against which current levels of disturbance are to be measured. Of course, determining valid reference conditions can be a difficult and controversial undertaking. The strategy used in this report is to identify the average measures for the 1997-2002 time period as the reference and analyze current measures accordingly. This approach, is not without its problems, since the1997-2002 reference period may not represent a natural or sustainable level of disturbance. Owing to fire suppression activities throughout much of the last century, for example, fire incidence in many of our forests is less than occurred prior to suppression, and, as a result of accumulated fuels, fire intensity is higher today in many fires that do burn. So the reference conditions should be taken merely as a benchmark for comparison and not as a goal representing an ideal situation.

The findings for the indictors in this criterion point to a substantial increase in the levels of biotic disturbance and an increase in fire extent and intensity relative to the 1997-2002 reference period. In the lower 48 states, cumulative total forested area with notable mortality has risen to 37 million acres, compared to the reference condition of 12 million acres. Bark beetle, engraver beetle and gypsy moth are the leading contributors to this increase, along with increasing mortality in the pinon-juniper forest type. When defoliation is taken into account alongside mortality, the number of acres affected since 2003 rises to 50 million, or 8 percent of forest area in the lower 48 states.

Drought and the increasing density of forest stands owing to tree growth and fire suppression have been cited as important factors undermining forest health and thereby the ability of trees to resist insects and disease. Another factor may be the increased senescence of shorter lived species such as lodgepole pine [*Pinus contorta*], which are now reaching older ages in the absence of traditional disturbance agents such as fire. In the future, climate change may further complicate the picture, as water availability, precipitation patterns and the ranges of certain insects and pathogens are expected to change. The causes and possible impacts to forest ecosystems are complex, and many of the processes themselves can be considered natural, even if they are in response to anthropogenic changes such as fire suppression or climate change. Therefore, the implications of these changes for sustainability are difficult to determine both in a conceptual and in a practical sense. What is clear, however, is that the findings for indicator 3.15 point to a major increase in biotic forest disturbance with the potential for broadscale impacts, many of which society will likely find undesirable.

For most forest ecosystems, fire is the most important abiotic (non-biological) disturbance category in indicator 3.16. Other disturbance factors considered in the indicator include weather damage, damage from airborne pollutants, and impacts from human development. Climate change is also identified as a potential abiotic disturbance factor, but there are numerous specific pathways through which it can impact forests, including biotic disturbance agents alongside more direct paths such as drought and fire. This brings up an important point: disturbance factors are often linked through various biophysical processes, and evidence of one type of disturbance may indicate

the presence, or probable future occurrence, of other types of disturbance. Catastrophic fire following insect induced mortality is a common example of this.

Fire. The findings for indicator 3.16 point to an increase in fire extent and intensity relative to the 1997-2003 time period. Current fire levels are significantly less than those witnessed prior to the advent of broadscale fire suppression efforts in the first half of the last century, but the fires that do burn are likely more intense, and, without significant forest management efforts, the number and extent of fires are likely to continue to increase in the future. Increases in biotic disturbance and mortality documented in indicator 3.15 support this conclusion.

Weather. Weather-related damage has also increased significantly relative to the reference period, rising from approximately 800 thousand acres to nearly 1.8 million acres over the last decade. Most of this is related to a roughly ten-fold increase in the forest area impacted by drought, and this, in turn, may foreshadow increases in other disturbances, such as fire and disease, to which drought-stressed trees are more susceptible.

Pollution. There is little direct evidence linking airborne pollution to widespread forest mortality or decline at the regional scale, but this does not necessarily mean pollution is not a problem; it is just hard to identify and may be more clearly seen in other indicators such as indicator 4.19, which addresses soil degradation.

Development. Human development impacts a growing area of forest land. In 2000, the last year for which consistent data was available for this report, our development footprint (i.e. impacted area) accounted for over 13.3 percent of total land area in the United States, up from 10.1 percent in 1980. This expansion significantly exceeds population growth, and it has no doubt continued since 2000.

Climate Change. Climate change will potentially impact forests in numerous and complex ways. Some of these are identified in the analysis of indicator 3.16. But as yet there is little data documenting these impacts or providing direct evidence that climate change is the proximate cause.

2.4 Criterion 4—Conservation and Maintenance of Soil and Water Resources

Soil is a major building block for healthy forest ecosystems. Water, in addition to being a limiting resource determining forest type and vitality in many areas, often constitutes a valuable forest output for downstream users. These two substances, while perhaps not as visible as the trees, plants and animals considered in criteria 1, 2, and 3, are nonetheless crucial components in understanding forest ecosystems and their sustainability.

Soil and water are closely linked through the processes of erosion and sediment transfer. As a result, indicators of watershed condition often treat the two simultaneously, and forest management activities aimed at water quality and flow regulation usually have a strong soil conservation component. This linkage is clearly evident in our reporting for the indicators in this criterion.

The 5 indicators in criterion 4 measure the current condition of soil and water resources in our forested ecosystems as well as our management actions designed to conserve these resources. As such, they draw upon qualitatively different data sources and analysis techniques. Indicators 4.19 and 4.21, which respectively measure soil degradation and physical changes in forest streams, rivers and lakes, rely upon direct observations of biophysical conditions or inferred measurements modeled on these direct observations. Indicators 4.17, 4.18 and 4.20, on the other hand, measure forest areas subject to certain land use designations or management practices. The first set of indicators provides a direct measurement of actual conditions, the second a measure of our efforts preserve and enhance these conditions.

A recent expansion of the Forest Service's Forest Inventory and Analysis program (FIA) to include certain types of soils information has allowed us to more fully report on forest soils conditions for indicator 4.19 in this report. We cannot yet determine trends over time, but we can point to regional differences and areas of concern. In this regard, the Northeastern and Southern regions both contain substantial areas of degraded or otherwise suboptimal soils, to a degree that substantial negative impacts to certain forest ecosystems may result. Acid rain from airborne pollutants is cited as a factor underlying this degradation. Whether these conditions mark a deterioration or improvement relative to the past is not yet clear, but we will be able to determine this in the future with continued reporting for this indicator.

Indicator 4.21, which measures water conditions in forested ecosystems, does not benefit from the same systematic sampling that provides the soils information in indicator 4.19. Instead, we have used state-level water quality reports that are reported

biennially to the U.S. EPA by the States. This does not allow for a direct measurement of water conditions, but it does identify the sources the water degradation as perceived by state reporting agencies. The indicator finds that municipal and industrial development is the largest cause of water degradation in the United States. Forestry activities, on the other hand, account for the least amount of damage of all sources identified—about one tenth of the impairment attributed to development activities. These results, however, do not shed much light on conditions and trends in water quality in forest streams and lakes, the intended focus of the indicator. Here, as in many other cases, we are limited by the data on hand, and significant improvements in reporting can be hoped for in the future if water monitoring can be expanded and improved.

Indicators 4.17, 4.18, and 4.20 focus on management practices and land-use designations designed to protect soil and water resources. Since there is a strong biophysical linkage between soils and hydrological functions, conservation land-use designations and best practices for forest management usually combine soil and water conservation objectives. For data, these indicators rely largely upon State level reports of management activity and land-use designations. The lack of consistency in these reports presents considerable challenges in addressing the indicators. None of these three indicators were included in the 2003 report, and relevant comparisons could not be drawn with past activities in order to determine significant trends. We hope to improve on this situation in future reports, but the lack of consistency in the underlying data streams will continue to present challenges. In any case, the importance of intact forest ecosystems in conserving soil and water resources is widely recognized, as evidenced in forest practice regulations and watershed rehabilitation efforts across the Nation.

2.5 Criterion 5—Maintenance of Forest Contribution to Global Carbon Cycles

Criterion 5 describes stocks and flows ("pools" and "flux") of carbon in forested ecosystems (indicator 5.22) and forest products (indicator 5.23) along with avoided carbon emissions from the use of forest biomass for energy (indicator 5.24). As such, the criterion provides valuable information regarding the current and potential role of forest management efforts in offsetting or otherwise mitigating carbon emissions from fossil fuels and associated sources. It also provides an indication of how broadscale ecosystem processes may mitigate or exacerbate carbon balances, and thereby climate change, in the long-term.

Indicator 5.22 relies directly on FIA forest inventory data. The process by which these data are translated into carbon stocks for various components (live biomass, forest soils, etc.) involves a number of assumptions and modeling techniques, which continue to be developed and refined over time. The inclusion of carbon stocks in forest soils, which were omitted in the 2003 report, is a major innovation in the current report.

According to indicator 5.22, forested ecosystems in the United States currently contain an amount of carbon equivalent to over 165 billion metric tons of CO_2, a figure close to 27 times the 5.9 billion tons of CO_2 emitted nationally every year through the burning of fossil fuels and similar sources. Live trees and forest soils account for the bulk of forest-based carbon stocks. In terms of flows, forests sequester approximately 650 million metric tons of additional CO2 every year, offsetting close to 11 percent of total U.S. annual carbon emissions. This rate of sequestration has been relatively stable for several decades, reflecting the long-term increases in forest volume described in criterion 2.

Indicator 5.23 measures carbon stored in forest products, underlining the important fact that many long-lived forest products continue to sequester carbon long after the trees that supplied their raw materials have been harvested. The indicator shows that carbon equivalent to around 8 billion metric tons of CO_2 are currently stored in long-lived forest products and in discarded forest products in land-fills. Annual rates of sequestration are approximately 100 million tons, substantially less than 650 million tons annually sequestered by forests but still a significant number. As in the case of indicator 5.22, indicator 5.23 measures broad processes, though in this case social rather than ecological. Major variations are not likely in the short-term, except in so much as they are driven by major changes in overall economic activity. Over the long-term, the indicator will provide information on major shifts in consumption patterns and their relative carbon intensities, and thereby the role of forest products in global carbon balances.

Using forest biomass to produce energy is another means by which forests may help mitigate greenhouse gas concentrations in the atmosphere. Indicator 5.24 measures avoided carbon emissions resulting from the replacement of energy from fossil fuels with that generated by the use of forest biomass.

While this process releases the carbon stored in the biomass, it is assumed that the subsequent re-growth of forests will sequester an equivalent amount and thus the process is considered to be "carbon-neutral" (at least in the long run). This is a simplification of a complex argument, but it is nonetheless broadly accepted that replacing fossil fuel consumption with energy from forest biomass will result in reduced carbon emissions.

The indicator shows that annual production of energy from the combustion of wood in the United States is around 2,100 trillion BTUs (about 2 percent of the 101 quadrillion BTUs consumed in 2007). When converted to avoided carbon emissions, this number translates to between 100 and 200 million metric tons of carbon depending on the energy source used for comparison. Contrary to what one might expect, this number has been slightly falling since the mid 1990s, but the result is less surprising if one considers the fact that the use of fire wood for heating purposes has been declining for decades and that the wood products industry has long used wood residues and byproducts to generate energy as part of its production processes. Consequently, Indicator 24 may be tracking developments in these more traditional uses more than measuring the emergence of a nascent bioenergy sector. To the extent that forest-based bioenergy becomes more important in the future, this trend may be reversed in subsequent reporting cycles.

2.6 Criterion 6—Maintenance and Enhancement of Long Term Multiple Socio-economic Benefits to Meet the Needs of Society

While Criteria 1-5 mostly describe biophysical conditions in our Nation's forested ecosystems, Criterion 6 covers a broad range of factors associated with providing social and economic benefits that are closely linked to forested ecosystems, their health and their management. The criterion includes 20 indicators divided into five sub-criteria. These are:

- Production and Consumption
- Investment in the Forest Sector
- Employment and Community Needs
- Recreation and Tourism
- Cultural, Social and Spiritual Needs and Values

Each will be summarized in turn below.

Production and Consumption. Indicators in this sub-criterion track changes in the provision of traditional wood and paper products, non-wood forest products, and, various ecosystem services.

Information on traditional wood products is largely available from the US Department of Commerce, including the Census Bureau's periodic Economic Census and annual Survey of Manufactures, which provide periodic or annual data sometimes at the State level.

Non-timber forest products, on the other hand, encompass a broad array of forest herbs, mushrooms and related products that are not tracked in standard industrial reporting statistics—with the exception of some trade statistics—and are not always fully integrated into the cash economy. Reporting in this category is significantly more challenging. Nevertheless, through the compilation of data not available to the 2003 report, we have substantially improved our reporting for products in this category.

A new indicator (Indicator 27) tracks revenue derived from ecosystem services such as water quality enhancement, carbon storage, or the provision of green-space. The work presented in relation to this indicator lays the foundation for future reporting by defining terms, identifying sources of quantifiable data and explicitly recognizing activities that are not captured by these data.

The indicators covering timber and wood products (indicators 6.25, 6.28, 6.30, 6.32 and 6.33) show that both timber harvest and wood products production are down slightly relative to 2003. At a little over 20 billion cubic feet, consumption has remained relatively stable, though levels dropped off in 2006 due to slowing in the housing construction market (more severe impacts reflecting the current crises in the housing market can be expected in the 2007 and 2008 statistics, once they become available).

The difference between production and consumption has been filled increasingly by imports, which now total 5.4 billion cubic feet, or 26 percent of total consumption. The recovery of recycled paper products has also increased its contribution to domestic production and consumption. The total volume of recovered fiber now equals about half of total domestic paper consumption. However, a growing proportion of recycled paper is exported, so domestic utilization of recycled fiber in paper products has remained stable at about 38 percent for the last decade. Most of the developments described here follow long-term trends established in the last decades of the past century.

Production and trade figures for non-timber forest products (indicators 6.26, 6.29 and 6.31) present a more complicated picture. While the total value of production in this category is down 30 percent relative to 1998, exports are up 38 percent since 2003. Much of this may be related to difficulties in measurement and the dominant role of specific products (e.g., fuelwood in the case of production and pecans in the case of exports). In any case, the values reported for these indicators in 2007 are substantial, with a total estimated retail value of production of $1.4 billion and exports exceeding $450 million.

Payments for environmental services are also substantial. The indicator identifies payments of $553 million for ecosystem services in 2007 from public and private entities, but it also stresses the fact that these estimates are incomplete. While federal payments have been relatively stable, payments from private entities in the form of carbon offset purchases, conservation easements and outright land purchases for conservation objectives are growing rapidly, increasing 38 percent in the last three years alone and now accounting for over a third of total payments identified in this report.

Investments in forestry and the forest sector. This sub-criterion contains two indicators that call for measures of investments in forest-related economic sectors, and in research and education, respectively. These indicators point to investments whose effects will play out over many years, and, consequently, they constitute two of the most forward-looking indicators in the entire Montreal Process indicator set.

Indicator 6.34 includes both private sector and public sector investments in productive capacity (e.g., buildings and machinery) and forest management activities. Private sector capital investments in the wood products industry are extremely volatile, following both broad market cycle fluctuations and developments specific to the wood products sector. Investments in the wood products and pulp and paper sectors totaled $10.9 billion in 2006, up from $7.5 billion in 2003 but still substantial lower than the $13.6 billion reported for 1997 (all figures are in constant 2005 dollars). Indicator 6.34 also tracks substantial investments in silviculture, forest management and recreation management on the part of public agencies like the Forest Service. These public investments are driven by the political process and have been much more stable than the private sector investments listed above.

Investments in research, extension services and education (indicator 6.35) rely primarily on public sources for their funding. Forest Service research expenditures and academic research funding from federal sources are the primary investment streams reported for this indicator. Overall, research funding in these categories totaled $608 million in 2006, an increase of 18 percent in inflation adjusted terms since 2000. These expenditures, however, are only one piece of a larger pie involving state, local and private investments in research and extension. The number of baccalaureate and post-graduate degrees are a measure of investment in human capital, and, in contrast to research funding, these numbers have declined from 2,263 to 1,810 in the 2001-2006 time period, but this may represent a shift to environmental studies and similar programs rather than an absolute reduction in scholarship and training related to forest resource management. The sustainable management of forests benefits from both areas of training.

Employment and community needs. The indicators in this sub-criterion track economic and social developments that directly impact individuals and communities that depend on forests for their livelihood and important aspects of their quality of life. They include economic measures such as employment and income in the forest sector, which are generally available from standard statistical reporting sources, but they also include more complex indicators involving concepts of community resiliency, wealth distribution and the amount of resources available to support subsistence activities.

Employment in the forest sector, measured in indicator 6.36, includes a broad range of activities. Major categories covered in this report include public agencies engaged in forest management activities at the federal and state levels (data for counties and municipalities, though certainly important, was not available for this report), employees in the solid wood products and paper products sectors, and workers in the forest-based recreation sector. Forest products industry employment, which currently stands at 1.3 million employees, decreased by about 15 percent since 1997, with much of the drop concentrated in the pulp and paper sector. This decline reflects stable to slightly declining production levels (see indicator 6.25) in combination with increasing labor productivity requiring fewer workers to produce the same quantity of goods. Public sector employment is about one tenth of that in the forest products sector and has been relatively stable with the notable exception of the US Forest Service, which has declined to around 23,000 employees from a recent peak of 31,000 in 1991. The

2003 Report estimated that forest-based recreation directly generated 1.1 million jobs, and it is assumed that this number has grown along with recreation participation in the intervening years.

Private sector wages in these major employment categories (indicator 6.37) have generally been increasing, but at a relatively slow rate, especially in the lumber and wood products sector, where wages are currently well below the US average for all manufacturing. Public sector wages have fared better in recent years. Injury rates in the wood products industry have continued a long term decline with the exception of the furniture industry, which has experienced an up-tick in the last few years—a development that bears watching.

Indicator 6.38 addresses the resilience of forest-dependent communities and is the only indicator that directly treats community conditions and well-being. This is a complex indicator requiring considerable effort both in conceptual development and in practical application. In 2003, we used county level census and employment data to develop indexes for "vitality" and "adaptability." While this was a logical and cost effective approach, it was widely deemed inadequate for capturing the many dimensions that characterize the well-being of forest-dependent communities. Also, counties proved to be a poor surrogate for communities. For the revised indicator (the concept of "resiliency" has been substituted for "vitality" and "adaptability" in the indicator title), the 2010 report has taken a different tack, relying on survey and community assessment techniques to characterize the resiliency of individual communities. This is a pilot effort, and, while survey and analysis protocols have been developed, data from actual assessments were not available for inclusion in this review draft. We hope to have pilot data collected and analyzed for the final report.

The remaining two indicators in this sub-criteria address the area of forests devoted to subsistence use and the distribution of forest-derived revenues (indicators 6.39 and 6.40, respectively). Subsistence use typically includes hunting, fishing and gathering for personal consumption, but for many users, particularly in the Native American community, it also denotes a lifestyle involving a deep connection to nature and cultural traditions. This is in addition to tangible economic benefits in terms of foregone purchases of food and similar items. As with several of the other MP indicators that call for measures of forest land devoted to specific activities, providing quantified measures for the subsistence indicator is complicated by the fact that much of the Nation's public access forest lands are designated for multiple use including, but not restricted to, subsistence activities. Indicator 6.40, the distribution of forest-derived revenue, is a new indicator. In this report we identify the major revenue sources as coming from wood products industry activity and from the sale of "stumpage," or standing timber. Major recipients include industry (via profits), labor (wages), government (taxes), and landowners (stumpage). Payments to labor and non-industrial landowners comprise the majority of revenues and come from the wood products industries and stumpage sales respectively.

Recreation and tourism. Recreation and tourism is a major and increasing use for the Nation's forests. It provides direct benefits to citizens, contributes to a diverse and growing industry, and fosters appreciation for the importance of conservation and sound stewardship. The two indicators in this sub-criterion track the availability of forest land for recreation activities (indicator 6.41) and the number and type of these activities (indicator 6.42).

In the United States almost all public forest lands are available for a broad range of recreational activities, with some restrictions on uses that adversely impact the environment or the experiences of other users. Currently, 44 percent of forest land is in public ownership, much of it in federal custody in the Western states. The remainder is in private hands, where family and individual ownerships predominate. Indicator 6.41 estimates that only about 15 percent of family forests are available to the public for recreation, and this number has been falling for at least the past two decades. While the area of public forest lands have increased to a very slight degree since 2003, the falling percentage of private lands that are accessible for recreation use points to an overall decline in forest land available to recreation. The is increasingly important in the Eastern U.S. where private forest lands predominate and large population centers mean higher demands for outdoor recreation activity

At the same time that available lands for recreation are decreasing, recreation use has been rapidly increasing. As shown in indicator 6.44, the number of recreational "activity days" has increased by 25 percent since 2000 and currently stands at 83 billion. At 4.4 percent, the number of people "participating" in these activities has increased at a slower pace. 217 million people are estimated to have participated in forest-based recreation activities in 2007 (both of these measures have specific definitions that need to be considered when comparing them with other

measures—see the data report for details). Walking for pleasure and nature viewing are the most popular activities, and a majority of these occur on public lands.

Cultural, social and spiritual needs and values. The other sub-criteria and respective indicators in criterion 6 mostly measure specific outputs, values and activities associated with forest ecosystems. The two indicators in this sub-criteria seek to address the more intangible values and attachments people have to forests.

Indicator 6.43 calls for the measurement of land area protected specifically for cultural, social and spiritual values. However, in this report it simply measures the total amount of forest land in protected status of all types in the United States. The logical connection between protected status and cultural, social and spiritual values lies in the fact that many people view natural landscapes as a source of spiritual renewal and their conservation as a transcendent goal. The indicator shows only a slight increase in protected public lands since 2003, but it also notes the rapid increase in protected private lands through mechanisms such as conservation easements and outright purchase (see indicator 1.2 for additional information).

Indicator 6.44 seeks to measure the importance of forests to people. This is a new indicator, and it involves considerable challenges both in conceptual development and in actual measurement. The pilot approach explored in this report relies on survey techniques to assess the various dimensions of people's relationship to forests and the importance they attach to them. Owing to the difficulty in obtaining a truly representative sample, the team tasked with addressing indicator 6.44 has opted for a focus group approach, and has conducted some 30 focus groups as of this writing. Results highlight the diversity of feelings people have for forests, and the fact that these are largely determined by cultural background.

2.7 Criterion 7—Legal, Institutional, and Economic Framework for Forest Conservation and Sustainable Management

Criterion 7 contains 20 indicators and addresses the crucial question of whether current legal, institutional and economic structures are adequate to sustainably manage the Nation's forests. Most of the indicators in the criterion, however, are not amenable to concise quantified measurement. Characterizing national trade policies in terms of their impact on forests sustainability, for example, entails an analysis framework and synthesis of information more appropriate to a full research paper than to a limited set of numerical indicators presented in a two page brief. Consequently, much of the indicator development for Criterion 7 in the 2003 report relied on separate narrative assessments that identify key concepts and policy components, but which are difficult to update in a consistent fashion.

For the 2010 report, we have used a more comprehensive approach, applying a common framework for analysis across all of the indicators in the criterion. This framework characterizes the various policy elements covered by the indicators in terms of their scale (e.g., national or local); their mechanisms (e.g. command-and-control or market-based); and their approach (e.g. process-based or outcomes-based). This has lead to a more integrated approach entailing more front-end theoretical development than the other indicators, as evidenced by the presentation in Chapter 2.

Initial conclusions from the application of this approach to Criterion 7 reinforce the conclusion that there are a wide variety of legal, institutional, and economic approaches that encourage sustainable forest management in the United States, at all levels of government. Public laws govern public lands, which comprise about one-third of the Nation's forests. They dictate management and public involvement in various specific ways. Federal and state laws also provide for technical and financial assistance, research, education and planning on private forest lands, but they do not prescribe specific actions or standards. Federal and state environmental laws protect wildlife and endangered species in forests on all public and private lands, and foster various levels of forest practices regulation or best management practices to protect water quality, air quality, or other public goods depending on the states. Private markets allocate forest resources on most private forest lands, and market contracts for goods and services, or cost minimization at least, are integral parts of forest management on public lands. Many new market based mechanisms, including forest certification, wetland banks, payments for environmental services, conservation easements, and environmental incentives are also being developed to implement sustainable forest management in the United States.

Ideally, the new approach taken in addressing Criterion 7 will help us develop a better understanding over time of the ways in which policy and institutional capacity affects forest sustainability. It should be noted, however, that the Montreal Process revised the

Criterion 7 indicators in November 2008, due in part to the difficulties experienced in addressing them in the 2003 report. The outcome of this process will determine the extent to which the work on Criterion 7 presented in this document becomes a foundation for future reporting. In any case, the analysis presented here should provide a useful way of characterizing and understanding a broad and complex topic area.

Of the many indicators in the criterion, Indicator 7.58 stands out as a special case. It provides a summarization of data adequacy for all of the indicators addressed in the report. We consider this indicator more fully in a separate section addressing fundamental data issues.

3. Summary of Conditions and Trends Across all Criteria

From the broadleaved forests of the East to the conifers of the West, the United States continues to benefit from a large and diverse inventory of forests distributed across the Nation. Since the beginning of the last century, the size of this inventory has been relatively stable and much of it remains largely intact. This result is in marked contrast to many countries where broadscale deforestation remains as pressing concern.

The relatively stable area of forests in the United States is a positive development in terms of forest sustainability. This, however, provides little indication of the quality of our forests and whether it has been improving or declining over time. In this regard, the indicator results are less promising. In spite of notable reversals in the population declines of some forest animals (wolves in the inter-mountain West for example), the overall diversity of forest fauna and flora remains threatened. Steady pressure for residential and other development continues to fragment forest ecosystems both in urban areas and in more natural environments that are targets for vacation and retirement home development. And, perhaps most importantly, the Nation's forests are subject to increasing levels of disturbance, such as insect infestation and fire, as a result of processes we often cannot control and may not always fully understand.

As we evolve as a society, our relationship with the forest also evolves, as evidenced in many of the indicators in Criterion 6. We are recognizing new ways in which forests contribute to our society while, at the same time, more traditional uses and outputs remain as important as ever. Much of this bodes well for forest sustainability. The growing awareness of ecosystem services, and the establishment of revenue streams associated with them, provides new emphasis on conservation and management along with new mechanisms and added resources to achieve them. The information on non-wood forest products provide evidence that traditional gathering activities are not disappearing, but, in fact, are more important than previously assumed and are attracting new participants. And the diverse set of recreation activities and users portrayed in the indicators on recreation point to the fact that forests provide direct benefits to many Americans on a regular basis.

At the same time, commodity production of wood products remains an essential function served by the Nation's forests. The indicators on wood products production and trade indicate a slight decline in overall industry production in the last decade matched by a accompanying increase in imports, changes that are even more pronounced at the regional scale. The indicators in criteria 1 and 2 point to stable or increasing timber stocking throughout much of the Nation. This supports the conclusion that declining production is not driven by physical resource constraints. These developments are important not only for their potential impact on forest dependent industries and communities here in the U.S., but also for their potential impacts on industries, communities, and ecosystems in other countries. For example, from a volume standpoint, the increasing stocking in some areas indicate that opportunities may exist to use woody biomass for bio-energy, perhaps with minimal impact on other wood-using industries. Further, the decline or disappearance of wood harvesting operators and infrastructure in certain localities will influence forest management and land-use patterns in ways that are not always beneficial to forest ecosystems, particularly in areas subject to housing development pressure or where overstocking and fuel loading get so high as to create forest health issues and fire danger.

Our institutional capacity to effectively care for our forest ecosystems is a final, and essential, aspect of forest sustainability. Many of the indicators in Criteria 7 are difficult to quantify in a consistent and replicable fashion, but the information we do have points to stable capacity in United Stated government and academic institutions. Additionally, the sustainability activities highlighted in chapter four of this report point to growing collaboration between multiple organizations and stakeholders with the aim of strengthening our understanding, and

informing our actions in relation to forest sustainability.

4. Regional Differences

One of the aims of this 2010 Report is to provide improved coverage of regional and local variation in conditions and trends across all the indicators and their associated analysis. Given the breadth of indicators included in the MP C&I, this is a very challenging task. In particular, providing detailed regional analysis in the indicator briefs in chapter 2 and the summary analysis in this chapter would significantly increase the length of what is already a long document. As a result, we have not provided explicit regional detail in the summaries presented here, though we have noted some regional differences in the course of discussion. The indicator briefs now include a separate section on important regional variations, and this, along with the discussion of changes since 2003, is the reason we moved from a one-page to two-page format for the briefs. The two-page format, however, is still quite limiting, and it was impossible for most of the briefs to delve into substantial regional detail in their analysis. Furthermore, both the indicator briefs and the summary analyses in this chapter treat regional variation in terms of its significance for national reporting objectives. The central question here is whether the national results obscure important regional variation and not what specific conditions or findings are important for specific regions.

However, many of the indicators do have substantial regional detail underlying their analysis, even if it could not be included in the report. Some of this information will be available in the supporting "data reports" we will be providing for each indicator. We will be posting these to the project website (http://www.fs.fed.us/research/sustain/) as they become available. Also, in the future we will be constructing a site for online data delivery and analysis, including, where possible, data at regional and state levels.

One thing that is clear from a review of the indicators is that the regions differ considerably in terms of both current conditions and trends. This is not surprising given the diversity of ecosystem types and socioeconomic conditions across our Nation. The most important differences include: (1) the continuing importance of the Southern region as the Nation's primary producer of timber; (2) the growing influence of disturbance agents (insects and fire) in the pine forests of the Rocky Mountain region; (3) the predominance of public lands in the Western and Rocky Mountain regions, and their role in providing amenities and other public goods tracked by many of the indicators; and (4) general development pressures in the more populous Eastern region, including pollution deposition and impacts on forest soils.

5. Overarching Issues and Synthesis

The individual indicators of the MP C&I provide information and references for narrowly defined issues and concerns. To understand their broader significance for forest sustainability, they have to be integrated both with other indicators and within a broader context. The MP criteria provide an explicit framework for undertaking this sort of synthesis. We have used this fact to organize the summaries presented earlier in this chapter. Another approach is to focus on specific issues or topics that span the breadth of the indicators and their respective criteria. Three such issues have been identified as primary concerns for the Forest Service and forests in general(see chapter 5): (1) climate change; (2) bioenergy and biofuels production from forest biomass; and (3) loss of forest land. In the following sections we look at each of these in terms of their relationship to the MP C&I.

5.1 Climate Change

Climate affects forest in various and profound ways. At the same time, through processes such as carbon sequestration, transpiration, and the influence of vegetative cover on the reflective properties of the earth's surface (termed albedo), forests can affect climate both locally and globally. Accordingly, our consideration of the relationship between the MP C&I and climate change can be divided into the potential impacts of climate on forests, on the one hand, and the potential impact of forests on climate on the other.

The initial impact of climate change on forests will be primarily through changes in forest composition and productivity and forest disturbance regimes. In the case of the former, increases in atmospheric carbon along with changes in temperature, availability of water and the length of growing seasons, will affect the relative health and productivity of different species in complex ways. For forests in some areas, the net result may be a boost in growth. In the case of forest disturbance regimes, these factors will likewise affect the range and intensity of biological disturbance agents (i.e., insects and invasives) and the prevalence of abiotic disturbance agents, primarily fire. Researchers are

just beginning to understand the complex interaction between changing climate and composition/ productivity plusses and minuses at the landscape level. These results, combined with changing disturbance patterns and intensities will drive changes in the type and pattern of forest cover across the landscape, and the benefits we receive from the ecosystem services that changing forest ecosystems will provide.

Many of the indicators track the sort of developments discussed in the previous paragraph. The indicators in criteria 1 and 2, for example, measure different aspects of forest cover and productivity. The indicators in criterion 3 characterize forest disturbance, and, as argued in the summary for that criterion, they act as perhaps the primary leading indicators we have for detecting impacts from climate change. But, in order to do so, they have to be viewed in the context of the other indicators as well as information outside of the MP C&I. In this regard, the increases in insect infestations, drought and fire registered in indicators 3.15 and 3.16 may well be the partial result of climate change, but we cannot yet say so with any degree of certainty. This complex set of changes will call for adaptation of forest management to sustain healthy and productive forests. Management actions may need to favor different species or land management objectives in the face of climate changes, resulting in significant changes in the composition of forests and how they are used by the middle of this century.

In assessing the impact of forests on climate change, the indicators in Criterion 5 provide a direct measure of the influence of forests on national carbon accounts; this is exactly what those indicators are designed to do. Here, the role of forests in mitigating carbon emissions through sequestration is clearly evident. The yearly accumulation of carbon on forests lands is estimated to offset 11 percent of total national carbon emissions, with accumulations in long-lived forest products providing another 1-2 percent. Additionally, the fact that the total amount of carbon stored in forests is equivalent to 27 times our annual emissions provides some indication of the overall role forests play in global carbon balances and the potential impact should substantial areas of forest be lost through natural or human causes.

Since forests provide a potential vehicle by which we can positively affect climate change through forest management decisions, several of the indicators in criterion 6 and 7 are also important here. Indicator 6.27, for example, shows a 20-fold increase in activity in the voluntary market for carbon offset credits from forestry operations. Similarly, indicator 6.34 tracks investment in forest management and wood products industries. The indicator notes that federal grants of $230 million have been slated for use, in conjunction with private investments, to promote wood-based biofuels—a carbon neutral energy source.

The potential of forests to mitigate emissions and atmospheric concentrations of greenhouse gases also suggests that active, long-term afforestation programs on abandoned lands may be warranted, funded by the ecosystem services—namely mitigation—they provide. Further, forests in close proximity to heavy emission areas, such as in and around cities, may become more highly valued, leading to significant changes in land use and land cover patterns, and related regulations, in developed areas.

Finally, many of the indicators in Criterion 7 measure our society's capacity to manage forests effectively in terms of both achieving carbon sequestration and responding to changing forest conditions resulting from climate change and other causes. While it is difficult to discern a clear signal from the Criterion 7 indicators in this regard, continuing development of the indicators should improve this situation in the future. What is clear, though, is that a legal and institutional framework that supports a supportive environment for investments in sustainable management of forests is vital today and will be more so in the future. This is not only important at the federal level, but also at the state and local levels. To the extent that policies at all these scales are mutually supporting, the easier it will be to practice sustainable management to boost mitigation and foster successful adaptive management.

5.2 Bioenergy and Biofuels Production from Forest Biomass

Energy production from forest biomass is directly linked to climate change through its potential impact on carbon balances as well through the role that broader climate change policies will play in determining its future. Many of the relationships between indicators that were described in the previous section apply here as well. At the same time, however, bioenergy production represents a nascent forest products industry with the potential to radically transform certain aspects of forest management, the wood products sector, and its respective markets, with impacts across the whole range of ecological, social and economic dimensions covered in the MPC&I. At present this is still just a potential, so the course of

developments in the bioenergy sector will depend on a number of developments both within and outside of the forest sector.

One important role for the MP C&I here is simply to track the emergence of activity in bioenergy production. Indicator 5.24 measures avoided carbon emissions through the use of wood for energy, and the tabulation of wood-based energy production constitutes the core of this indictor. Because liquid biofuels production from woody biomass is still in its infancy, the data in this report focus on energy generated from burning wood. It shows that wood-based energy production represents two percent of total national energy production. In spite of a near doubling of electricity generation in the last twenty years from the burning of wood, total wood-based energy production has been decreasing since the mid-1990s, due in most part to declines in the use of wood for heating—both in homes and as part of industrial processes. In the future, Indicator 5.24 will directly register changes in bioenergy and biofuels production, should they occur.

Several other indicators are also directly related to this issue. As noted in the previous section on climate change, Indicator 6.34 tracks investment in the forest sector, including bioenergy (though consistent long-term tracking will depend on Department of Commerce and Department of Energy statistical reporting practices). Here, investment will again serve as a leading indicator. The indicators tracking wood products production and trade in Criterion 6 will provide additional information of activity in this area, but, once again, this will depend on consistent statistical reporting practices for various types of power (e.g. electricity generation versus liquid transportation fuels) and raw fuels and feedstocks (e.g. cellulosic ethanol versus starch ethanol, or woody biomass from forests versus agricultural residues). And the information on forest area, stocking and productivity found in Criterion 2 will provide important information on the long-term sustainability of bioenergy and biofuels production, particularly if they develop, as expected, into major industries.

A final connection between the MP C&I and forest bioenergy and biofuels can be seen in the disturbance indicators in Criterion 3. The link here lies in the fact that the much of the increase in insect infestation and fire disturbance found in those indicators can be linked to overstocking on forest lands. The use of forest biomass for energy production could serve as an important commercial outlet, and revenue source to landowners, for the woody material that needs to be removed from these stands as part of forest health treatments.

5.3 Loss of Forest Land

Loss of forest land through fragmentation and outright conversion to other uses is the last overarching issue considered in this section. The indicators in Criterion 1, particularly indicator 1.1, that addresses the distribution of forest ecosystems by type and ownership class, and indicator 1.3, that addresses forest fragmentation, are directly related to this issue. Indicator 1.1 shows, at the national level, that forest area has remained quite stable for the last century. The implication here is that forest loss from land conversion is most important at the local, landscape or regional scale, particularly near population centers.

Data on forest land impacted by development, presented in indicator 3.16, indicates that impacted lands have increased steadily over the last decades, accounting for 13.3 percent of total forest land in 2000 and projected to reach 14.3 percent by 2020. The great majority of this development has taken place in the "exurban" housing density category (1.7 - 40 acres per unit), and the impacts here are likely more in the form of forest fragmentation than wholesale forest overstory loss. These impacts are significant at the national level, and they are far more so at regional and local scales.

Changing ownership and the shift of private forest lands away from active management (i.e. "working forests" producing a full array of ecosystem goods and services) is an important dynamic underlying forest fragmentation and loss. Discerning these changes and their underlying causes is a complex task, and none of the indicators provide direct measures. Indicator 1.1 does contain information on forest ownership, but it is not the sole focus of the indicator, and the level of detail provided in this report is not sufficient to track forest land divestiture or parcelization. Focused research is underway by experts who have contributed to this report, so future reports should have better data.. The indicators covering timber harvest, wood products production, and forest sector investment provide an indication of the broadscale shifts in forest sector activity, and these in turn will indicate where and to what extent forest land is taken out of production forestry.

5.4 Other Issues of Overarching Significance

The three issues identified above in no way exhaust the range of important topics facing forests today. One approach taken to address some of these issues in the 2010 reporting process is to commission stand-alone "Partner Reports" that use the MP C&I as their starting point in addressing selected topics in much greater detail than can be presented here. We currently anticipate Partner Reports on (1) tropical forests in the United States and its off-shore holdings; (2) urban and agroforestry resources; (3) ecosystem services; (4) non-wood forest products; (5) subsistence use of forests, and (6) forest-dependent communities. Another report, organized through the Roundtable for Sustainable Forests, is expected to focus on a more comprehensive and in-depth effort at interpreting the MP indicators in relation to the overall issue of sustainability. Additional reports could be considered based on the results of the 2010 Draft Report review process.

6. Data Availability and Adequacy

The MP C&I is a comprehensive framework requiring a broad range of data inputs spanning ecological, social and economic dimensions. Producing the 2010 Report involved an intensive search for available data undertaken by researchers with intimate knowledge of their respective fields. Consequently, the 2010 report represents, among other things, a compendium of data sources that address forest sustainability in the United States. The adequacy and sufficiency of these data to address the indicators is an essential question, not just for the MP C&I reporting process, but as a way of characterizing the ability of our current data to support sustainable forest management and science as a whole.

Indicator 7.58 displays our judgments of data adequacy for each of the indicators in terms of coverage, recency, and frequency of reporting. Owing to their reliance on FIA data, the indicators in Criterion 1 that track forest characteristics enjoy excellent coverage, as do all of the indicators in Criterion 2. The coverage for the species and forest fragmentation indicators in Criterion 1 is either less complete or less current. The indicators on forest disturbance in Criterion 3 are supported in main part by forest inventory and aerial survey data, which have not yet achieved complete national coverage but are improving over time. Criterion 4 draws on a number of different data sources, including point sampling of ecosystem characteristics and state level reports about land-use designation and forest management practices. Data adequacy in Criterion 4 varies on an indicator-by-indicator basis, with soils condition enjoying the best coverage due to a recent expansion of FIA sampling to include soil characteristics. The carbon accounting information in Criterion 5 likewise relies on FIA data, but in this case, forest inventory information has to be converted into estimates of above-ground and below-ground carbon volumes, an additional step that requires a number of assumptions and analytical techniques.

Criterion 6 covers a broad range of social and economic conditions, and data coverage varies accordingly. Generally speaking, those indicators describing activity in the traditional wood products sector are well covered by standard reporting of production, trade and employment statistics. In the case of non-wood forest products, similar statistics are not available, and the indicators have relied heavily on federal permitting data for harvest of these products. The new indicators on community resiliency (indicator 6.38) and the importance of forests to people (indicator 6.44) are unique in that primary data collection through surveys is being undertaken to address them. Data for the recreation indicators in this criterion benefit from a now well established program of visitor sampling on forest service lands and enjoy relatively complete national coverage.

Criterion 7 is particularly challenging in terms of both data collection and interpretation. For the 2010 Report we have constructed an overarching framework for analyzing the various pieces of information we have describing policies and institutional arrangements. It is not clear, however, whether we will be able to move this to a consistent and replicable reporting process, and much will depend on the new set of Criterion 7 indicators which have emerged from the Montreal Process.

Overall, data adequacy has improved somewhat relative to the 2003 report, but many challenges remain. Some of these can be addressed through an expansion of ecosystem sampling activities in areas such as forest disturbance, forest fauna, and forest stream conditions. In regards to Criterion 6, better tracking of forest benefits and outputs outside of traditional forest products categories would constitute a substantial improvement. An important question here is whether current industrial reporting categories will allow for adequate measurement of bioenergy and biofuels production from forest biomass.

Although we are confident that most of the national data sets relevant to the indicators in question

have been identified, it is possible that a few important data sources have been overlooked in the process of compiling this report, Should reviewers have salient data that are consistent for the entire U.S., they are encouraged to contact the writing team.

7. Implications for Future Reporting

The 2010 Report marks the second iteration of our work in addressing the question of forest sustainability in the course of fulfilling our commitment to the Montreal Process. One of the things we've learned through this effort and similar efforts taking place across the United States and around the world, is that sustainability reporting cannot be seen simply as a one-time effort after which everyone returns to their other responsibilities until the next time report deadlines become due. Rather, reporting and accountability in the practice of sustainable forest management needs to be an ongoing process involving continuous improvement in data, analysis, interpretation and communications guided by a robust public participation and scientific review process.

One strategy we intend to use to achieve continuous improvement is the institution of a website for delivery of data and other information related to specific indicators and the reporting process as a whole. This will involve regular updates of data at multiple scales, focusing on those data sets that enjoy consistent national coverage and relatively frequent reporting cycles. In conjunction with this routine data reporting activity, innovation efforts can be targeted at the development of new data streams or reporting methods for specific indicators on an incremental basis. These improvements can then be incorporated into the website. This web-based information resource will serve as the foundation for future national reports in line with the Montreal Process timeline.

In the course of putting this draft together, we have identified a number of areas where additional depth and synthesis is called for, and we will address these through the production and publication of stand-alone partner reports. Ideally, these reports will also be instituted on a continuous basis, with new reports commissioned as the need or interest arises. Collaborators and stakeholder groups, notably the Roundtable for Sustainable Forests, will serve as an essential resource in generating ideas, interest and support for this work.

The 2010 Report focuses on the delivery of information, through the presentation and discussion of indicators in chapters 2 and 3, the description of other sustainability efforts in chapter 4, and the discussion of Forest Service policy perspectives in chapter 5. We have purposefully avoided a concerted effort to interpret this information in terms of the overall sustainability of the Nation's forests. At the same time, however, various examples of strategies for more explicitly linking the information inherent in the MP C&I to the question of sustainability are emerging in the course of sustainability efforts such as those described next in chapter 4. These could serve as a means of moving the national reporting process forward, but this will have to take place in the context of broader public dialogue. Fostering this dialogue in a concerted fashion will be an important aspect of continuing work in the sustainability reporting process—a point taken up in chapter 5.

National Report on Sustainable Forests: 2010

Chapter 4

Broadening & Deepening Commitments to Sustainability

1. Purpose of Chapter 4

This chapter explains how the Montreal Process Criteria and Indicators (MP C&I) are currently being used as a practical and functional framework for monitoring, assessing, and reporting, on the state of natural resources in the United States. What it means to use the MP C&I as a framework in the United States (US) is revealed through experiences. The examples highlighted here provide insights into how the MP C&I are being used to broaden and deepen the dialogue about and commitment to sustainable forest management across boundaries and geographic scales. Such dialogue is also occurring within other natural resource sectors throughout the US. This cross-sectoral and multi-scale use helps to track environmental progress and to foster collaboration needed to achieve more comprehensive ecosystem and sustainable development goals.

Given the growing use of sustainability indicators and the wide variety of indicator activities underway, within the US, the MP C&I are no longer regarded as just an experiment or as only useful at the national scale.

2. Montreal Process Criteria and Indicators as a Framework

A framework is a supporting structure or system of ideas. The MP C&I were conceived as both a conceptual and an operational framework for the conservation and sustainable management of forests. In this regard the MP C&I outline a set of key environmental, social, and economic parts of a complex task. Theoretically, as the set of interrelated parts is better understood and integrated, more sustainable outcomes should be possible.

The criteria broadly outline important categories or dimensions of forests that reflect public values and scientific principles, such as the conservation of biological diversity. The indicators are value-neutral measures—quantitative and qualitative—of the criteria and define the status and trends for each. When considered together over time, the indicators will point to whether or not the US is moving toward or away from the desired goal of sustainable forest management. Chapter 5 of the report is a call to action. It conveys assumptions about the context for having dialogue and making decisions; and suggests issues that may be ripe for attention.

2.1. Using the MP C&I as a Framework in the US

Montreal Process member countries, including the US, talk about the importance of the MP C&I as a framework. Experience within the US is moving the conversation about the MP C&I as a framework from hypothetical to operational.

The US is a diverse country—ecologically, culturally, and economically. Through the work of many individuals, representing a range of agencies and organizations, a better understanding of the relevance and utility of the MP C&I at multiple geographic and time scales is emerging.

Although use of the MP C&I within the US is still a work-in-progress, three basic yet enduring questions continue to focus the nationwide conversation. They are:

- Are conditions improving?
- Are we moving toward a more sustainable future?
- How do we collectively know?

The activities shared in this chapter reveal that the MP C&I are being used as a framework in many ways—all helping to broaden and deepen the commitment of the US to sustainable forest and natural resource management within more comprehensive sustainable development efforts.

Various Ways the MP C&I are being used as a Framework

Conceptualizing
Example: National Association of State Foresters has used the MP C&I to characterize forest sustainability in its *Principles and Guides for a Well-Managed Forest*

Visioning and Planning
Example: Baltimore County, Maryland, is using the MP C&I to envision desired future conditions, engage citizens in dialogue, and set goals

Implementing
Example: State & Private Forestry Deputy Area of the US Forest Service used the MP C&I to update the Forest Stewardship Program for family and other non-industrial private forest landowners

Monitoring, Assessing, and Reporting
Example: Several states, including Maryland and Oregon, are using the MP C&I as the basis for conducting assessments of forest conditions

Informing and Communicating
Example: Twenty states in the Northeast and Midwest are using the MP C&I as a framework to organize and improve accessibility to data and a set of base indicators

Organizations referenced in the examples above are not the only ones using the MP C&I for the purpose listed, but they are notable—each an early adopter and user of the MP C&I to help frame the dialogue and take actions within their respective spheres of influence. These and other examples are summarized and available via the website of the Roundtable on Sustainable Forests (described in the next section).

3. Broadening the Dialogue in the US

Broadening the dialogue about sustainable forest management, and our overall commitment to sustainability, recognizes that responsibilities for forests are widely shared in the US across a continuum of small to large ownerships within rural and urban areas. Public, private, and tribal land owners and managers share on-the-ground stewardship responsibilities. Policy makers and the general public at all levels, whether or not they own or manage forest land, also greatly impact the status and trends of forests in rural and urban places when making decisions about land use, energy alternatives, and consumption.

Broadening—Enlarging the Network

Broadening the dialogue about sustainable forests means increasing the number and diversity of individuals and organizations involved. Being involved includes understanding the value of forests as forests, practicing sustainable forest management, and/or fostering sustainable outcomes that include trees, woodlands, and forests. It also involves cooperating across administrative, ownership, and jurisdictional boundaries as well as engaging across natural resource sectors—forests, rangelands, water, and more—to improve ecosystem health and achieve other mutually desired environmental, social, and economic benefits.

Forest issues are now part of an increasingly wide array of concerns confronting the US that require connecting knowledge and actions across boundaries as well as across natural resource sectors. This necessitates an active network of citizens who own, manage, and otherwise influence the conditions and trends of the Nation's forests, including tropical forests, and other natural resources.

3.1. Increasing the Number and Diversity of Forest Stakeholders

Sustainable forest management as understood today builds upon decades of work—ranging from on-ground stewardship activities to international conversations about forests and sustainable development. Increases in the number and array of people and places involved in these activities are not bounded by geography or proximity to one another. Efforts underway, including the Roundtable on Sustainable Forests described below, bring together people who share similar concerns or interests in regards to forests (communities of interest) as well as people who are concerned about the health of trees and forests in their respective locales (communities of place).

Example—Roundtable on Sustainable Forests

Nationally, a multi-stakeholder Roundtable on Sustainable Forests (RSF) is helping advance use of the MP C&I as a common framework.

Stakeholders met for the first time in September 1998 and the RSF was initially self-chartered in February 1999 "to serve as a forum to share information and perspectives that will enable better decision making in the US regarding sustainable forests." The initial focus of the Roundtable was "to implement and promote utilization of the Criteria and Indicators (C&I) contained in the Santiago Declaration of the Montreal Process as a means of measuring national progress towards achievement of this goal."

Though the charter has since been revised, the work of the RSF continues to be based upon the MP C&I and the mantra "better data, better dialogue, better decisions." That is "better data leads to better dialogue, and better dialogue leads to better decisions."

Participants in the RSF are now focusing on four themes identified in its work plan through 2011:

- Reporting and monitoring progress toward sustainable forests;
- Coordinating with related national data and indicator efforts;
- Fostering sustainable forest management through the application of the MP C&I; and
- Engaging the broader community of forest stakeholders at multiple scales.

The RSF is an open, inclusive body with participants representing federal land management agencies, federal and national research organizations, government agencies at state and local levels, tribal entities, non-governmental organizations (NGOs) including national associations and environmental NGOs, scientific societies, and universities. Many RSF participants are also working regionally and locally to encourage place-based efforts aimed at fostering ecosystem-appropriate improvements and socially-relevant outcomes. A Southern Roundtable on Sustainable Forests, for instance, is stimulating a variety of efforts, including the development of a Report Card on Sustainability for Western North Carolina organized by the seven MP Criteria. The US Forest Service (FS) Southern Research Station is working with a variety of partners to develop the report card for eighteen western North Carolina counties as a way to assist local governments, interest groups, and the public in using timely resource information and to stimulate locally-led actions that promote forest sustainability through community involvement.

Those looking for more information about the RSF should visit its website (http://www.sustainableforests.net). This resource includes meeting and workshop summaries as well as background information and links to related efforts such as the Southern Roundtable.

3.2. Cooperating across Boundaries

Using the MP C&I as a framework to help improve data, dialogue, and decisions involves cooperating across administrative, ownership, and jurisdictional boundaries. To this benefit, actions taken by government agencies not only influence work done on publicly owned lands, but can influence collaborative work across ownership and jurisdictional boundaries. A noteworthy effort underway in the Northeast and Midwest is encouraging regional cooperation.

Example—Collaboration in the Northeast and Midwest

The Northeastern Area State and Private Forestry (NA) of the FS and twenty (20) State forestry agencies from Maine to Minnesota and from Missouri to Maryland are collaborating to deploy a system for understanding and measuring forest sustainability across the Northeast and Midwest. A Forest Sustainability Indicators System, informed by the MP C&I, includes:

- Selection of 18 base indicators, with at least one indicator per MP criterion, to track at regional and state scales;
- On-line reports and data download capabilities to track trends in forest health and sustainability at state, multi-state, and regional scales;
- A sourcebook on C&I; and
- Links to additional data and resources related to forest sustainability.

Other mutually supportive efforts are underway within the 20-state region, with the MP C&I and 20-state indicators system informing multi-state and state-level efforts. In the Great Lakes basin, where forests cover sixty percent of land, every two years a bi-national conference is held by the governments of the US and Canada to report on the

state of the Great Lakes under a 1987 water quality agreement. Since 2004 a working group of the State of the Lakes Ecosystem Conference (known as SOLEC) has been using the MP C&I as a starting point in its selection of forest indicators. Also in the Upper Great Lakes region, the Great Lakes Forest Alliance, Inc. is working with the states of Michigan, Minnesota, and Wisconsin and the Canadian province of Ontario to focus on pressing issues threatening the region and to connect the issues-based work to assessment efforts informed by the MP C&I. State-level efforts such as Maryland's Strategic Forest Assessment and Wisconsin's Forest Sustainability Framework also are helping test and refine the MP C&I as a framework, complementing national-level assessment and reporting activities led by the FS.

The Forest Sustainability Indicators Information System, in particular, helps facilitate communication and data sharing among multiple efforts and across state borders; and helps reveal differences within the region as well as cumulative effects across States and over time. The system also helps advance work at other scales, some of which are summarized in later sections of this chapter.

Currently the formative work is being used to prepare for and inform the development of State Forest Resource Assessments to be completed by each state by 2010 in accordance with the Food, Conservation, and Energy Act of 2008. The Pennsylvania Bureau of Forestry, for instance, along with partners is using the MP C&I to develop a report about why people should care about Pennsylvania's forests.

Consult the FS website with information about Sustainability of the Northeastern Area (http://www.na.fs.fed.us/sustainability) for more information about the base indicators and related efforts.

3.3. Learning about Tribal Perspectives

Concepts of sustainability vary among forest owners, managers, and users. Forest lands managed by or for tribal communities in the US exist in many states, however, developing a collective voice on tribal views of forest sustainability is difficult. A number of efforts within the US have been pursued in recent years to better understand tribal perspectives about forest sustainability and to learn about the use of the MP C&I to inform tribal efforts.

Following the release of the *National Report on Sustainable Forests—2003* the Intertribal Timber Council (ITC) worked with the Evergreen Foundation, FS, and other participants of the Roundtable on Sustainable Forests to gather tribal perspectives. The perspectives were shared in a special Winter 2005-2006 issue of the *Evergreen* magazine on "Forestry in Indian Country: Models of Sustainability for our Nation's Forests?".

Managers of the Yakama Reservation Forest contributed to the special issue and were inspired to do additional work to more fully develop its prescription for sustainable forest management by including indicators of cultural resources.

Example—Cultural Resources on the Yakama Reservation Forest

Managers of the Yakama Reservation Forest, totaling 650,000 acres within the 1.4 million-acre Yakama Reservation in south-central Washington State, pursued a multi-year project to more broadly understand cultural resources after reviewing the 2003 set of MP C&I. They believe the MP C&I too narrowly define cultural resources within just two indicators of Criterion 6. The managers wanted to develop quantitative and qualitative indicators for assessing the effectiveness of Yakama Nation land management policies and practices in sustaining cultural resources. Interviews of tribal elders were completed and field assessments were conducted; and the results were used to improve forest management planning and a long-term strategy for improving forest health problems. Cultural resources being protected via the forest plan include native plants as well as artifacts and traditional sites.

Yakama forest managers' views about cultural resources and the use of related indicators have been shared domestically with others through meetings of the ITC and the RSF. They also were presented at an international conference in 2007 on Sharing Indigenous Wisdom sponsored by the College of Menominee Nation located in Wisconsin. Presentations made by participants in the Yakama project are available on the conference website (http://www.sharingindigenouswisdom.org).

3.4. Understanding Tropical Forests in the US

Forests within the US include tropical forests, virtually all on islands. The tropical islands in the Caribbean include the two US territories of Puerto Rico and the US Virgin Islands; and in the Pacific the tropical islands include the state of

Hawaii, three US territories (American Samoa, Commonwealth of the Northern Mariana Islands, Guam), and three freely associated states (Republic of the Marshall Islands, Federated States of Micronesia, Republic of Palau).

In 2000 the State of Hawaii reviewed the MP C&I and released a First Approximation Report that attempts to measure forest sustainability in Hawaii. The Hawaii Division of Forestry and Wildlife identified the collective state of knowledge about Hawaiian forests and highlighted data needed to better assess Hawaii's progress towards sustainable forest management in the future. The information available in the *State of Hawaii's Forests 2000* report provides information for decision makers at the state and federal levels.

During recent years other important steps have been taken by FS units in the Commonwealth of Puerto Rico (PR) and the US Virgin Islands as well as the states of California, Oregon, and Hawaii. This work, linked to the Forest Inventory and Analysis (FIA) Program and the Forest Health Monitoring Program, considers appropriate measurement protocols for islands having dramatic changes in elevation and topography.

The FS International Institute of Tropical Forests headquartered in PR has evaluated the MP C&I against indicators developed for tropical countries and determined the MP C&I are suitable for use in the Caribbean. In addition the FS's Pacific Northwest Research Station completed a needs assessment for Pacific Islands and implemented trial plots for the FIA Program, the Pacific Southwest Region headquartered in California worked with the Pacific Islands Imagery Consortium to complete a Pacific Island Vegetation Mapping Project, and the Pacific Southwest Station's Institute of Pacific Islands Forestry in Hawaii has worked with FS and State counterparts to conduct related research and do outreach needed to restore, protect, and sustain forests of the Pacific. These formative efforts provide the foundation for a companion project underway which will report on tropical forests of the US using the MP C&I as the organizing framework. Data collection and a summary are being developed as part of the 2010 reporting process.

3.5. Engaging across Natural Resource Sectors

The pathway to sustainability involves more integrated environmental and natural resource policies and actions. Recent successes in using criteria and indicators are not limited to the forest sector. Organizations interested in sustainable natural resource management are drawing inspiration and lessons from the use of the MP C&I as a framework. Other national multi-stakeholder processes focusing on rangelands, water resources, and minerals have identified related criteria and indicators.

Example—Sustainable Rangelands Roundtable

Since 2001 the Sustainable Rangelands Roundtable (SRR) has brought together representatives of agencies and organizations concerned about the nation's 770 million acres of rangelands.

The SRR participants began its work by identifying major issues of importance to rangelands and then organizing them into the following five criteria for rangeland sustainability:

- Conservation and maintenance of soil and water resources;
- Maintenance and conservation of plant and animal resources on rangelands;
- Maintenance of production capacity on rangelands;
- Maintenance and enhancement of multiple economic and social benefits to current and future generations; and
- Legal, institutional and economic framework for rangeland conservation and sustainable management.

SRR participants then identified a set of twenty-seven core indicators to be used for a more general initial assessment of the status and trends of factors affecting rangeland sustainability. Adoption and monitoring of key indicators of sustainable rangeland management in the US remains the highest goal of the SRR and its stakeholders. The first national report is targeted for completion in 2010.

Three agencies from two federal departments participating in the SRR—FS, Natural Resources Conservation Service, and Bureau of Land Management—share responsibilities for various aspects of rangeland inventory and assessment. They are pursuing a pilot project in eastern Oregon to demonstrate how they can work together to assess and report on rangeland conditions for national level reporting using a common set of core indicators.

Collaboration is underway both locally as well as globally. Locally, a ranch-level assessment project underway in Wyoming is testing metrics and the application of indicators. A Global Rangeland Assessment Partnership is emerging as an outgrowth of the SRR model. Discussions about the global partnership began in 2008 at a session of the International Grassland Congress and International Rangeland Congress held jointly in China.

Information about the SRR is available at: http://sustainablerangelands.warnercnr.colostate.edu/]

Example—Sustainable Water Resources Roundtable

The Sustainable Water Resources Roundtable (SWRR) was created in 2002 under the existing Advisory Committee on Water Information to promote the exchange of information among representatives of government, industry, and environmental, professional, public interest, and academic groups.

Rather than choosing a strict definition of sustainability that all could agree upon, the SWRR adopted the Brundtland Commission definition of sustainable development as a starting point for discussions about water sustainability. Through its work it now proposes a five-part framework for organizing water sustainability indicators:

- Water availability;
- Water quality;
- Human uses and health;
- Environmental health; and
- Infrastructure and Institutions.

As part of its mission, the SWRR also developed a framework for tracking and understanding changes to the health of its fresh and coastal waters, surface and ground water, wetlands and watersheds. Participants worked on a methodology to understand the implications of long-term changes for ecosystems, communities, and industry.

More information regarding the SWRR is available at: http://acwi.gov/swrr/.

Example—Sustainable Minerals Roundtable

Mineral and energy resources are fundamental to human well-being; and integral parts of virtually every sector of the economy. Although they are nonrenewable resources, they have a very long lifecycle. Nonetheless, management of nonrenewable resources is controversial for many reasons.

In 1999 concerned individuals representing government, the energy and mineral industries, and the environmental community sought to find ways to include minerals and energy systems in dialogue about sustainable development and formed the Sustainable Minerals Roundtable (SMR). It is no longer active, however, during its life, the FS and US Geological Survey provided leadership and a series of meetings were convened by the University of Nevada's Mining Life Cycle Center in Reno.

During its work four of the seven MP Criteria were determined to be applicable to mineral and related energy resources, although in two cases some adaptation was required. The remaining three criteria were either deemed to fall outside the scope of its work and/or were being addressed by other Roundtable processes. The four criteria deemed applicable to sustainable minerals management are:

- Maintenance of capacities to produce commodities;
- Maintenance of environmental quality;
- Maintenance of long-term social, economic, and cultural benefits to meet the needs of societies; and
- Legal, institutional, and economic framework to support sustainable development.

A list of eighty-two indicators was developed and a prioritization scheme was then used to identify thirty-eight priority indicators. A First Approximation Report was written with a listing of the indicators, a discussion of the process, and write-ups for a small number of indicators.

From its initiation, SMR participants engaged internationally with others working on sustainability indicators. They were involved in deliberations leading up to and during the World Summit on Sustainable Development (WSSD) in 2002. The WSSD Johannesburg Plan of Action calls on nations to take a life-cycle approach to the environmental, economic, health, and social impacts and benefits of mining activity; and to identify measures, monitoring and assessment mechanisms including life-cycle analysis, and national indicators for measuring progress. Work linking mining, minerals, and sustainable development continues. More information is available at: http://www.unr.edu/mines/smr/.

4. Deepening the Dialogue in the US

Deepening the dialogue about sustainable forests involves agencies and organizations working together to advance use of the MP C&I as a common framework—not only across organizational boundaries but also across geographic scales to improve forest and landscape conditions. Making deep connections involves social as well as natural processes. Together they provide context about institutional systems as well as nature-based ecosystems within which individual and collaborative actions are taken. The result is a web of relationships rather than neatly defined up-down hierarchies.

In different parts of the country various processes are underway for advancing and linking use of the MP C&I across geographic scales. One approach has been has been quite deliberate—encouraging linkages and providing mutual support while testing and using the MP C&I as a common framework. Another approach has been more laissez faire—testing and using the MP C&I at various scales and letting the institutional linkages and associated actions across scales emerge.

Deepening—Understanding Systems and Working across Geographic Scales

Deepening the dialogue about sustainable forests involves more completely understanding one's own interests in the context of both nature-based ecosystems and human-centric institutional systems. And making improvements at broader landscape or spatial scales includes finding ways to connect the natural and human systems at and across geographic scales. It links the knowledge gained from using a common framework to develop data and other information to decisions made and actions taken individually and collaboratively at and across scales.

4.1. Encouraging Linkages across Geographic Scales

In an attempt to advance sustainable forests in more interconnected ways, the MP C&I may be a way to collectively focus on the range of conditions people care about, to mutually support each other, and to gain some efficiency through more seamless approaches to monitoring, reporting, and more.

By being more intentional some believe the likelihood increases that many individual actions will connect and add up to landscape-level improvements—crossing the continuum of rural and urban places and connecting to other sectors outside the forest community. For instance in the Northeast and Midwest where FS and State forestry agencies are using the MP C&I as a basis for monitoring and tracking progress across a twenty-state region, collaboration in Maryland is leading to strategic efforts at the state and local levels as well as within the broader Chesapeake Bay Watershed.

Example—Collaboration in Maryland

Nested and networked efforts within the State of Maryland draw support from each other and present opportunities to unify themes and actions. They also create the potential to feed into larger landscape-level efforts, such as the Chesapeake Bay Watershed. Maryland's forests are an important part of the Chesapeake Bay Watershed—where there is recognition that what happens on the land influences the health of the bay. In 2006 the Chesapeake Bay Executive Council signed a directive on forests to reduce forest loss, necessitating use of best available tools to locate areas where retention and expansion of forests is most needed to protect water quality.

Strategic Actions by the State of Maryland: In Maryland the quest to protect and manage forests is a challenge due to urban development, forest land fragmentation and parcelization, and other pressures. Forests that once covered more than ninety percent of Maryland's landscape now only cover forty-one percent; and the responsibility for what is left is shared with counties, landowners, and others.

The State's Department of Natural Resources has used the MP C&I to do state-level assessments and to prioritize State investments. Its Strategic Forest Lands Assessment (SFLA), completed in 2003, provides information and geographic information system tools to strategically identify important forests and support land management planning and land use decisions needed to protect forests and the State's natural lands (referred to as green infrastructure).

Use of the MP C&I to help organize state-level forest resource information for assessing forest conditions and identifying strategic forests has helped facilitate dialogue across scales, ownership boundaries, and program goals—a complex mix from site-level to county to statewide to the bay. The assessment data, indicators, and computer tools are being used for county planning, watershed planning, landowner outreach, and much more. Maryland's use

of the MP C&I has assisted the US in testing and refining them for use at the national level. State employees believe that applying the MP C&I at multiple scales encourages data coordination and the sharing of technology and 'know how', and facilitates the tracking of changes such as forest loss.

More information about the State's efforts can be found on the Internet at: http://www.dnr.state.md.us/forests/planning/sfla/index.htm.

Local Initiatives by Baltimore County, Maryland: Baltimore County, through its Forest Sustainability Program, is increasing understanding about forest benefits, organizing information, setting goals, and taking action in collaboration with State and federal agencies and others to assess forest health, protect forests, strategically reforest, and enhance landowner stewardship.

By way of Green Infrastructure training efforts offered by The Conservation Fund and others, the Baltimore County Department of Environmental Protection and Resource Management became involved in a project to help link communities to the MP C&I as a framework for sustainable forest management. The county's work has been captured in a case study which is being used in an ongoing Green Infrastructure training program to help communities and their partners make natural resources and natural systems part of local/regional plans and community decisions.

Baltimore County's Natural Resource Manager used the MP C&I as a tool for engaging stakeholders and developing a Forest Sustainability Strategy for the county in 2005, resulting in a report on *The State of Our Forests—2007*. Implementation is progressing with and through partners: Criteria-level work is underway (e.g., compilation of data), the county's Strategy is being linked with other local initiatives through capital and operating programs, and the county's experiences are being shared with others in the state, region, and nation through networks reaching forest stakeholders and local governments. Locally, forest sustainability efforts are part of Baltimore County's Green Renaissance Initiative which includes an explicit focus on forests and trees. They also link to state-level strategies and programs for retaining and expanding forests in furtherance of Maryland's Green Infrastructure Assessment and the SFLA as well as the Chesapeake Bay Program. A workshop in September 2008 hosted by Baltimore County introduced forest sustainability and the MP C&I as a common framework to other local governments in the state and region.

Baltimore County's Forest Sustainability Strategy and 2007 report are available online at: http://www.baltimorecountymd.gov/agencies/environment/workgroup/programimplementation.html. The case study is on the Green Infrastructure website at: http://www.greeninfrastructure.net.

The forest-based initiatives underway by Baltimore County are increasingly being recognized domestically and internationally. Domestically, a number of means have been used to share progress—with forest stakeholders through the Roundtable on Sustainable Forests and with local government planners and other officials through the American Planning Association and the National Association of Local Government Environmental Professionals. Internationally, the Baltimore County story is included in a forthcoming report of the Food and Agriculture Organization of the United Nations (FAO).

4.2. Letting Connections across Scales Emerge

In the US, natural resource management responsibilities are shared by many institutions, with each having their own management objectives. Desires to use a more unifying framework, like the MP C&I, across geographic scales are being revealed in other parts of the country through the sharing of information and/or the tackling of specific issues which require more cohesive approaches.

In the western US, for instance, the MP C&I have been used by various organizations to inform their own work or advance their own efforts; linkages across geographic scales are beginning to be discussed. Most notably, opportunities for greater collaboration in Oregon are emerging across geographic scales as well as organizational boundaries.

Example—Efforts Underway in Oregon

In Oregon, as in other places, there exist polarizing political views and varying economic benefits from forests for different sectors of society. Over half the forest land in Oregon is federally managed. Some believe the C&I processes hold potential for stimulating ideas on ways to address

problems and to collectively move trends in a more desired directions.

Statewide Efforts led by State Forestry Organizations: In Oregon forest leaders seek to reduce polarization and encourage building common ground on forest policies by adapting sustainable forest management concepts being used nationally and internationally. The State of Oregon, via the Oregon Board of Forestry and the Oregon Department of Forestry, is using the MP Criteria as an integrated policy and technical framework. The State has adapted the MP Criteria to develop forest policies, strategies, and actions as a way to talk about all forests in the State and to measure progress.

The *2003 Forestry Program for Oregon* is a strategic plan that sets out the Board's vision for all the state's public and private forests, and goals and objectives to guide the Board's decisions. The seven goals of the *Forestry Program for Oregon* are directly related to the MP. The Board has also endorsed nineteen (19) Oregon Indicators of Sustainable Forest Management. Although the indicators remain neutral, the state of Oregon has set forth desired trends or targets for each of the indicators.

The *Forestry Program for Oregon* was developed through a deliberative process, and recognized that to be sustainable and successful the state had to manage different forests for different purposes. The State was able to reach a wide audience through advisory committees. Its approach to consensus-building embraces the diversity of its population, rather than considering it a barrier.

Based on the *Forestry Program for Oregon and the Oregon Indicators*, interactions with the FS are underway about National Forest System planning and monitoring, statewide assessments required by State and Private Forestry law, and an Interagency Mapping and Analysis Project being led by the Pacific Northwest Research (PNW) Station. The research station and other cooperators seek to integrate forest indicators with other data to develop alternative futures and management strategies at multiple scales.

In very concrete ways, the Board of Forestry is creating a dialogue in the State through the use of the MP C&I. Next steps being considered at the state level include development of an Oregon Indicators of Sustainable Forest Management website and integration of Oregon's indicators into the State Forest Resource Assessment to be done by 2010.

The *2003 Forestry Program for Oregon* as well as the associated *2007-2009 Oregon Forests Report* is available online via a State website: http://www.oregonforestry.org. The ongoing work of the State of Oregon is recognized not only domestically, but also internationally through the MP and other means including the FAO.

Sustainability Efforts by the Mount Hood National Forest: One of the State's federal cooperators is the Mount Hood National Forest (NF) located in western Oregon adjacent to the Portland/Vancouver Metropolitan Area. The NF is part of the urban landscape and backyard to over two million people who depend upon it for a range of environmental, social, and economic benefits. Since the 1990s the Forest Supervisor has been using a systems approach to advance sustainability. As the federal commitment to sustainable natural resource management has increased, the NF has participated in scientific, market, policy, and operations-based sustainability efforts—all informed in some way by the MP C&I as a framework.

A scientific approach was taken to complete a Local Unit C&I Development project (known as LUCID); and a market-based approach was used to participate in a national forest evaluation of forest management certification processes. From a policy perspective, the NF is matching its annual Forest Plan Monitoring Report to the format of the *Forestry Program for Oregon.* And in its day-to-day operations, the NF is participating in agency efforts to change its levels and patterns of consumption.

NF employees believe use of a common set of criteria and consistent use of indicators assists communications and facilitates coordination across boundaries and scales. They also believe it is in accordance with the National Forest Management Act of 1976 which directs the FS to use monitoring and assessment to evaluate the effects of land management. The agency's National Forest System Monitoring and Evaluation Framework combines the consistency needed by the FS as a whole with the flexibility necessary to respond to local circumstances.

NF monitoring reports and results of studies mentioned above are available on the NF website: http://www.fs.fed.us/r6/mthood/.

5. Integrating Efforts to Achieve Landscape Scale Improvements

Understanding the health of forests and the ecosystem contributions of trees and forests to landscapes involves complex and dynamic natural and social relationships. The condition of forests is influenced by both nature-based ecosystem processes and human-centric institutional processes. Dialogue about desired conditions is aided by scientific information about forests and ecosystems as well as discussions about societal values. The Manomet Center for Conservation Sciences, during its study of the selection and use of indicators for sustaining forests, learned from indicator practitioners that indicator selection and use is primarily a social process to be informed and supported by data and science. By being intentional in selecting indicators, the probability increases that place-based actions will connect and add up to larger landscape-scale improvements. This being said, it is important to understand that making improvements at the landscape level is a learning process. As in other adaptive processes we learn by doing, checking outcomes against expectations, and adjusting actions over time.

The MP C&I are helping individuals and organizations develop a shared understanding about the fundamental components of sustainable forest and natural resource management in our country's quest toward sustainable development.

5.1. Understanding Ecosystem Conditions

Understanding what it takes to keep ecosystems healthy and what it takes to restore degraded ecosystems challenges forest managers, scientists, and others. Strong sustainability discussed in Chapter 1 of this report suggests that opportunities for making social and economic progress must be pursued within environmental realities. Thus, understanding the state of the Nation's ecosystems, including but not limited to forests, is critical.

Example—State of the Nation's Ecosystems Project

The State of the Nation's Ecosystems project is a collaborative venture commissioned by the White House Office of Science and Technology Policy (OSTP) in 1997, with the Council on Environmental Quality (CEQ) picking up the mandate in 2002. The work is led by The Heinz Center for Science, Economics, and the Environment; and is supported by corporate, foundation, and federal funds. Activities are accomplished via working groups and multi-stakeholder technical committees, all aimed at designing and reporting on sets of indicators depicting conditions and trends for six of the Nation's ecosystems—coasts and oceans, farmlands, forests, fresh waters, grasslands and shrub lands, and urban and suburban landscapes.

A hallmark of the Heinz Center project was a very focused and deliberate effort to obtain balanced representation from four social sectors—academia, industry, advocacy organizations, and public agencies.

The initial report from the project was released in 2002. A second version was released on June 17, 2008, titled *The State of the Nation's Ecosystems 2008: Measuring the Lands, Waters, and Living Resources of the United* States. The 2008 report has more data and improved indicators, with a core set of thirteen national indicators describing the overall condition and use of the nation's ecosystems. More information, including key findings, is available at http://www.heinzcenter.org.

A companion policy document to the 2008 report, *Environmental Information: Roadmap to the Future*, notes critical gaps in environmental information and highlights management challenges.

5.2. Linking Institutional Commitments and Actions

The potential for creating more integrated efforts across geographic scales depends upon finding ways to link institutional commitments and actions. In the US this work is being shaped by many individuals and organizations. Over time champions are finding ways to link their efforts and mutually support each other.

In previous sections of this chapter collaboration underway by the FS and the 20 state forestry agencies in the Northeast and Midwest is highlighted along with strategic actions being led by the State of Maryland and local initiatives underway by Baltimore County, Maryland. These actions are institutionally linked to a number of other national- and state-level activities described below and displayed in Table 4-1.

Example—Principles and Guides for a Well-Managed Forest

The National Association of State Foresters (NASF) is a non-profit organization representing the directors of all fifty state forestry agencies, the eight US territories, and the District of Columbia. It has a long history of supporting greater use of the MP C&I and advocating support for nationwide forest inventory and monitoring efforts which underpin much of biological indicators in Criteria 1 through 5. In 1998, NASF and five other organizations encouraged the CEQ as well as the Office of Management and Budget (OMB) within the Executive Office of the President to support federal actions and encourage federal interagency coordination to better implement the MP C&I.

It is not sufficient, however, to focus only on the actions of federal agencies. Over two-thirds of the nation's forests are privately owned by more than ten million owners living in rural, suburban, and urban areas who make decisions every day about how to protect, manage, and use their trees and woodlands. Approximately forty-five percent of all forestland in the US is under non-industrial private ownership. Because of this, NASF has taken actions in collaboration with others to support family and other non-industrial forest landowners in their work.

Policy and program guidance: The NASF took steps within its authority and committee structure to work with the FS Cooperative Forestry Staff to develop *Principles and Guides for a Well-Managed Forest.* The principles can be used to assess the potential effectiveness and capacity of any system or program aimed at helping a forest owner or manager achieve a well-managed forest while attaining her/his objectives. The seven principles outlined in the guidance were released in February 2003 and follow the seven MP Criteria.

The next step taken by NASF, based upon the *Principles and Guides*, was to develop guidance for non-industrial private landowners to help them manage their own forests. In February 2005, the NASF released *A Stewardship Handbook—A Handbook for Planning, Managing and Protecting Your Woods, Your Investment and Your Environment.* Subsequently, the FS used the *Principles and Guides* to revise the national Forest Stewardship Program Standards and Guidelines to help private forest landowners develop plans for the sustainable management of their forests. The revised program direction, issued in September 2005, is available online at (http://www.fs.fed.us/spf/coop/programs/).

Table 4-1. Linking Institutional Commitments and Actions Informed by the Montreal Process Criteria and Indicators

Scale	Activities	Lead Organization(s)
International	MP Criteria & Indicators (MP C&I)	Twelve MP countries, including United States
National	Principles and Guides for a Well-Managed Forest; and *A Stewardship Handbook—A Handbook for Planning, Managing and Protecting Your Woods, Your Investment and Your Environment* Forest Stewardship Program Standards and Guidelines	National Association of State Foresters (in collaboration with US Forest Service) US Forest Service State & Private Forestry (Cooperative Forestry)
Multi-State Regional	Forest Sustainability Indicators System (including 18 base indicators)	FS Northeastern Area State & Private Forestry (in collaboration with 20 State forestry agencies)
State-wide	Strategic Forest Lands Assessment Educational Assistance to Private Forest Landowners	Maryland Department of Natural Resources Member universities of the Sustainable Forests Partnership (e.g., Pennsylvania State)
County-wide	Forest Sustainability Strategy; and *The State of Our Forests—2007*	Baltimore County, Maryland

Educational assistance to private forest landowners: Recognizing the MP C&I as a framework for achieving stewardship goals, universities are using the NASF handbook to help educate private landowners about the concepts and practices of sustainable forest management. Through the university-based Sustainable Forests Partnership (SFP), five academic institutions are working with their respective state forestry agencies to translate the handbook guidance into state-specific educational materials to supplement the handbook. The educational materials, developed by the following universities in collaboration with forest landowners and state forestry representatives, step down the MP C&I to local stewardship principles that landowners can use to clarify their ownership goals:

- Auburn University (in Alabama) created web-based information organized by the seven MP Criteria;
- Oregon State University chose to use a county-based approach for developing guidance and sources of information for private landowners, and intends to create supplements for western and eastern parts of the State;
- Pennsylvania State University created a four-fold brochure tied to state level resources and is now working on a series of related newsletters;
- Cornell University (in New York) is developing a webinar series on stewardship principles; and
- Virginia Polytechnic Institute and State University is developing field manuals and short courses for underrepresented populations and forest landowners.

The universities are working with State forestry personnel, extension agents, and woodland owner associations to disseminate the materials. Although the state-specific materials address the more local concerns and forest management dynamics such as invasive plants, fire prevention, and carbon sequestration, they can be duplicated and customized by other states. Project results and materials are also being shared at national extension education and natural resource conferences.

The educational materials are available via the SFP website (http://sfp.cas.psu.edu/CI.html), including a link to the Alabama Stewardship Handbook available online.

5.3. Increasing Institutional Capacity

While completing national reporting on sustainable forests it has become clear over the years that the institutional capacity of agencies and organizations to collaboratively and continuously monitor, assess, and report on forest conditions needs to be strengthened. The need for increasing institutional capacity is also now recognized within larger natural resource and environmental arenas.

Example—National Environmental Status and Trends Indicator Project

As the Heinz Center and its partners have worked together on the State of the Nation's Ecosystems project, discussions also have progressed about the institutional capacity of federal agencies responsible for monitoring, assessing, and reporting on natural resources and the environment. Shortly after the initial *State of the Nation's Ecosystems* report was issued in 2002, the CEQ convened discussions among federal agencies about the capacity to report regularly on natural and environmental resources using a comprehensive set of indicators.

The CEQ-led dialogue resulted in agency representatives developing options for assembling data and reporting regularly on resource conditions and trends using a small set of high-level environmental indicators as a counterpart to the principal federal economic indicators regularly reported by the OMB and the current economic indicators reported by the Department of Commerce.

In 2006 an inter-agency group worked with the National Association of Public Administration to assess institutional options. A report released in November 2007 concluded that the US needs a system of crosscutting environmental indicators as a strategic management tool. In response the Chairman of the CEQ, the Director of the OSTP, and the Deputy Director of the OMB issued a joint policy memorandum on June 17, 2008, calling on the Departments of Agriculture, Commerce, Interior, and EPA to begin work on National Environmental Status and Trends (known as NEST) Indicators. A pilot project is underway focusing on indicators of water availability.

6. Summary

This chapter has highlighted ways in which the MP C&I are being used at national and sub-national scales. The activities—while far from an exhaustive listing—demonstrate that the MP C&I provide a useful framework at multiple scales for monitoring, assessing, and reporting on resource conditions and trends. The examples also illustrate that the MP C&I serve as a useful framework for broadening and deepening the dialogue among a growing network of forest stakeholders. The MP C&I help people understand issues, better frame policy and management options, and provide impetus for taking action. In short, the MP C&I are socially relevant and valuable catalysts for dialogue.

We have seen that the MP C&I can help people connect what has happened to forests in the past with what their aspirations are for forests in the future, and can link discussions about forests with other natural resource sectors and ecosystem concerns. The old cliché *"Think globally, act locally"* is limited, at least as it relates to forests. Instead, today we need to think globally, nationally, regionally, and locally; and act in ways that contribute to goals at all scales. Balancing the contributions of proposed policies and management activities to the various values at the several scales is what makes forestry in the 21st Century so challenging. In the next and final chapter of the report, two FS leaders who also serve as federal co-leaders of the Roundtable on Sustainable Forests offer their views about next steps needed to tackle significant issues and mobilize concrete actions towards improving the sustainability of the Nation's forests.

National Report on Sustainable Forests: 2010

Chapter 5

A Call to Action

1. Introduction

The current conditions and recent trends in the Nation's forests have been described and analyzed in the preceding chapters. What steps should be taken to respond? Over the next several years, the United States faces both opportunities and challenges to better conserve, manage, and use its forests. The path forward is not yet clear, nor will it be easy. But if this generation is to leave America's forests in better condition for future generations, actions are needed beyond just reporting.

In this chapter, several steps are suggested that could mobilize and catalyze concrete actions towards improving the sustainability of America's forests. No doubt, others will have additional ideas. A diversity of ideas is necessary. Moving beyond ideas to actions is essential. This report presents the best data available on the current conditions and recent trends. Better dialogue is now needed about what these conditions mean and what steps might be taken—individually and collectively—to improve the sustainability of America's forests. But dialogue alone is not enough. The dialogue needs to build support for decisions and actions to make change happen on the ground.

It is recognized that situations differ from place to place across the United States and that private landowners may decide to take actions that differ from steps taken on public lands. But private and public lands are all part of the same landscape and the sustainability of the landscape and the communities that depend on it is a shared responsibility of private landowners and public land managers. Although actions on the ground may differ from place to place or by landowner, all have to live with the collective results of the multitude of actions implemented across the landscape.

2. The Context for Discussions, Decisions, and Actions

There are several fundamental assumptions that help to set the context for sustainable forest management in the United States of America. Often, these are unmentioned during dialogues. But it is important to be explicit about them to help establish and clarify the setting and the scope for dialogue about the future of the nation's forests. Although these ideas may be widely shared, some people may hold different views about them. Left unspoken and unexplored, these differences in perspective may hinder dialogue and decisions about sustainable forest management.

2.1. Landscapes Are the Critical Spatial Scale for Sustainability

While it is useful to know the status of the forests of the United States from a national perspective, it is more important to know what is happening at the sub-national scale because meaningful progress towards sustainability is best evaluated at the regional and local levels. The combined impact of the many individual decisions and actions taken across a landscape is what determines the progress being made towards sustainability. So the landscape level is the best vantage point for tracking progress towards sustainability.

Watersheds are especially useful landscape units for tracking changes from forest management and evaluating sustainability. Trees are the key to healthy watersheds. Restoring and maintaining healthy watersheds and sustainable forest management are two sides of the same coin—you cannot have one without the other. Even in watersheds where developed areas predominate, how the trees and forests are managed in

those watersheds goes a long way toward determining overall watershed health and condition. Watersheds are the landscape units where all the effects of human activities become clear; whether development activities and natural resource management activities together are sustainable.

It is heartening to see the recent successes at local, State, and regional scales, described in Chapter 4. To build broader and deeper momentum for managing both public and private forests in more sustainable ways, watershed by watershed, those successes should be highlighted and used to stimulate dialogue about actions possible elsewhere.

2.2 Sustainable Forests and Sustainable Development—You Can't Have One Without the Other.

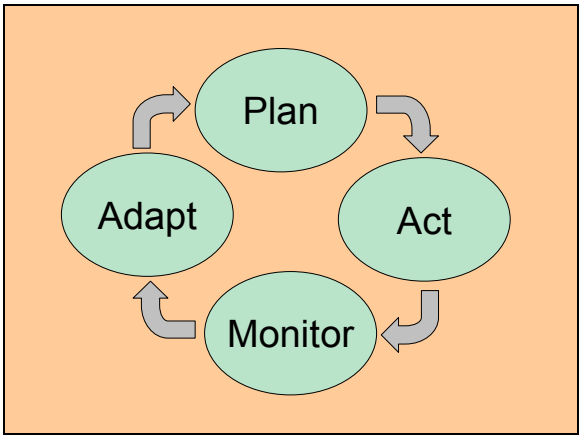
Today's forest issues did not arise solely within the forest sector nor can they be solved within the forest sector alone. Actions taken outside the forest sector often lead—directly or indirectly—to impacts on forests and issues for private forest landowners, public forest managers, and the people who love and use those forests. For example, the emerging issue of producing liquid transportation fuels from forest biomass is rooted in worthy goals, including reducing petroleum energy consumption, improving domestic energy security, and reducing greenhouse gas emissions. While considerable forest biomass exists in some places, initiating large-scale biomass energy production in those areas will lead to changes in conditions in those watersheds, affecting forests and many other things, and set up tradeoffs among development and resource management goals. A key question is: Will there be effective dialogue among the communities of interest, including energy interests, economic development interests, and forest interests, to discuss whether and how these changes might be managed to serve both sustainable economic development and sustainable forest management goals?

It does not seem possible to have sustainable economic development without simultaneously having sustainable forests. One without the other might be tolerable in the short-run, but probably prove untenable in the long-run. To achieve sustainable forest management goals will require additional focus on achieving sustainable development goals in other sectors. This leads to another implication: If sustainable economic development and sustainable forests are so tightly linked, then it is unproductive for dialogue about sustainable forests to only occur within the circle of those keenly interested in forests. Broadening participation in the dialogue about sustainable forests to include those interested in sustainable development is vital. Those interested in promoting sustainable development need to see that conservation and sustainable management of forests serves their interests. A corollary is the necessity for those interested in sustainable forests to engage in dialogue about sustainable development, because development that threatens sustainable forests is unsustainable development. So those interested in sustainable forests should simultaneously widen the circle of participants in dialogues about sustainable forests, and go out to other dialogues about different aspects of sustainable development, such as loss of croplands to suburban sprawl, and engage there on their issues too.

2.3. Sustaining Forests Requires Active, Adaptive Management.

It is impossible to achieve sustainable forests or sustainable development without active decision-making and on-the-ground activities to implement the decisions. Some may argue that a policy of doing nothing—"benign neglect"—is the only safe course to sustainability. While taking no action at a particular place or for a particular time may be an important component of a sustainable resource management plan, taking no action everywhere forever leads neither to sustainable development nor sustainable forests. Choosing wisely how to use present landscapes while simultaneously choosing and improving what to leave for future generations is the essence of sustainability.

Advocates of sustainable forest management often use the cycle of "Plan-Act-Monitor-Adapt." They have found that dialogue during all four steps of this cycle improves decisions and public support for actions.



Effective dialogue throughout the cycle is the essence of sharing leadership and responsibility for sustainable forest management

During the planning stage, dialogue can not only help shape decisions about where and why actions are needed, dialogue can help evaluate and build support for specific management activities. Further, effective dialogue during the planning stage can help to justify where and when the best action to achieve desired outcomes is no on-the-ground activity.

Dialogue during the action stage is important to help interested parties understand what is happening in the forests and across the landscape and how the activities being implemented contribute collectively to achieving the desired sustainable outcomes. Active resource management changes conditions in the forest and throughout the landscape—sometimes in ways not fully foreseen during planning. Dialogue with stakeholders should be an integral part of implementing the planned activities so that unforeseen changes can be dealt with openly.

The last two steps in the management cycle—monitoring and adapting—have sometimes been overlooked in the past. Observing and documenting responses of forests and landscapes to management decisions and activities provides the basis for evaluating whether desired outcomes are being achieved. If not, the monitoring information provides impetus for adapting decisions and activities to get back on track.

The United States is indeed fortunate to have a rigorous, credible monitoring program, the Forest Inventory and Analysis (FIA) program that tracks conditions and trends in forests and is scalable from sub-State landscapes and watersheds up to the national level (see http://www.fia.fs.fed.us),. In recent years, the FIA program has been expanded so monitoring can be intensified and better data created for evaluating whether the collective impact of management plans, decisions, and actions are leading our nation towards its sustainability goals.

An important dimension of dialogue during the monitoring stage is discussing how interested parties can work together to gather and analyze monitoring information. Working together on monitoring often leads to sturdier support for making decisions about how to best adapt future plans, management actions, and monitoring activities during the next iteration of the management cycle.

The Food, Conservation, and Energy Act of 2008 contained a number of provisions that call for more active, adaptive, forest management. One provision calls for State Forest Resource Assessments. This bill is reinvigorating the partnership between the Forest Service, State forestry agencies, and landowners to plan effectively at watershed and larger landscape levels and act cooperatively to tackle the most important threats to forest sustainability. Also, it added new momentum to actions already underway in several States to use the Montreal Process Criteria and Indicators as a foundation for planning, acting, monitoring, and adapting to changing conditions. Completed assessments are expected to provide additional impetus for practicing sustainable forest management at the local level.

Sustainable forests just don't "happen." Sustainable forests result from deliberate dialogue and deliberate decisions that lead to focused management activities. Monitoring and adaptation, based on the monitoring results, are essential components of sustainable forest management.

2.4. Open, transparent, public dialogue about sustainability provides the social mediation that is essential to creating the public support for sustainable forest management actions.

The pathway to sustainable forests should emerge from an open, transparent public dialogue. The alliances formed during the dialogue are essential components of the collaborative leadership needed to achieve sustainable forest management and sustainable development in this democratic society.

To the extent that the dialogue is open to all interested parties and the substance of the discussions is freely and widely shared, the dialogue process itself becomes an integral part of creating the social and political legitimacy necessary for practicing active forest management.

Over the past decade, the Roundtable on Sustainable Forests (RSF), composed of over 100 participants, has engaged in the kind of open and transparent dialogue that is especially valuable for creating legitimacy, support, and momentum for action. RSF dialogue has motivated and legitimized actions at the county, State, regional, and national scales. RSF meetings have provided the social settings needed to explore what sustainability means to each participant. Each participant has gained a fuller and more

comprehensive understanding of the perspectives of the others. It is a testimonial to value of the RSF dialogue that similar roundtables formed in the rangeland and water sectors after stakeholders in those sectors observed the benefits enjoyed by RSF participants. The emergence of additional roundtables has helped to change the dynamics of relationships within the broader community of interests for forests, rangelands, and watersheds in ways that have had positive social results for the entire natural resource community.

But more can be accomplished with better dialogue in the future. Leaders of the RSF believe that forging closer working relationships among the roundtables would create additional benefits for all the sectors. Since the *National Report on Sustainable Forests: 2003* was completed five years ago, several issues have emerged and grown more important. The time is ripe to form partnerships and together create opportunities for dialogue focused on specific emerging issues of joint interest, because these issues are already affecting the forests, rangelands, and water resources of the United States. Addressing these complex natural resource issues will require the best efforts of all of us in the forests, rangelands, and water communities. Open, transparent dialogue is essential for achieving the best combination of sustainable forests, sustainable rangelands, and sustainable water resources—sustainable landscapes and sustainable development—for the citizens of the United States over the coming decade.

3. Confronting the Issues of Today and Tomorrow

The indicator results and analyses in previous chapters highlighted a number of issues. In thinking about the threats that these issues pose to sustainable forests and the best ways to broaden and deepen the dialogue about sustainability, three issues rise to the top that need more focused attention in the immediate future: climate change, use of forest biomass for bio-energy and bio-fuels, and loss of working forests. These issues have the potential to change the Nation's forests dramatically in a very short period of time. Broader and deeper dialogue on these issues is essential to create the opportunity and support for actions addressing them.

3.1. Climate Change.

Climate change has been a science issue for twenty years. Each of the past three administrations have had high-level science teams studying various aspects of the issue. Researchers around the world have also worked on the issue. Despite all the research, questions remain about how much and how rapidly climates will change, how soon the changes will become apparent in ecosystems, and how specific landscapes will be affected. Now climate change is emerging as a major policy issue. Although uncertainties remain, sharper and more focused planning for action is needed along with increased dialogue to build the necessary support for actions.

The interactions between forests and climate change are complex. On the one hand, forests can help mitigate climate change impacts. Rising atmospheric CO_2 levels result in increased forest growth, assuming sufficient nutrients and water are available, resulting in more carbon being stored in woody biomass. So the more trees there are the more carbon that they can pull out of the atmosphere, which helps to lessen the impact of climate change across landscapes. This is an important ecosystem service that forests provide. Policies and management actions that help keep forests healthy and productive increase their importance as carbon sinks to help offset carbon emissions elsewhere. But the ability of forests to help mitigate climate change effects is only one facet of this complex issue.

Evidence is also emerging that climate changes causes a mixture of both desirable and undesirable impacts on forests. But by carefully selecting management activities, landowners and land managers can help forests adapt to climate change; taking advantage of the desirable and reducing the undesirable effects. Choosing the right management actions is increasingly important because evidence is emerging that climate changes strongly influence forest disturbances, such as droughts, storms, insect and disease outbreaks, and fires. Although disturbances are normal occurrences in forested ecosystems, climate changes are altering historic disturbance patterns, frequencies, and intensities. The initial presumption about climate change was that it would only influence temperature and precipitation patterns, leading to direct impacts on forest health and productivity. The ramifications of the secondary or indirect impacts on forests from changes on disturbance patterns have only recently become clearer. This complicates the policy issue and increases the necessity for clear dialogue.

The Forest Service is taking action to both help the national forests mitigate climate changes by sequestering more carbon and help them adapt to climate change. But climate change is not something that the Forest Service can tackle alone. Two-thirds of the Nation's forests are owned by over 11 million

private landowners. Mobilizing private landowners to manage to both improve mitigation and adapt their management actions to climate change is a bigger task than mobilizing a single agency. Federal and State agencies need to join with private landowner advocacy groups to develop workable plans and actions for both mitigation and adaptation. Sustaining forests and adapting forest landscapes to climate change to maintain healthy watersheds will require integrated, coordinated endeavors by private land owners and public land managers.

3.2. Using Forest Biomass to Produce Bio-Energy and Bio-Fuels

In 2007, 4.3 percent of all the energy consumed in the USA came from renewable sources. Forest biomass provided over half of that renewable energy. The vast majority of woody biomass energy comes from combustion. Whether in a large municipal facility, industrial plant, or an individual home, burning wood is a technology that is well-known and widely implemented.

In recent years, increasing demands and tightening supplies for oil and natural gas have led to substantial price increases for electricity and transportation fuel. The price fluctuations for energy have created rippling impacts throughout the economy and society. Energy price fluctuations have also led to a re-examination of energy's role in sustainable development and added momentum to the search for alternative energy sources. One of the priorities that emerged was developing alternative sources of liquid transportation fuels, especially from biomass.

The focus on increasing production of liquid bio-fuels (ethanol and bio-diesel) from biomass arises from several desires, including to reducing oil consumption and greenhouse gas emissions and improving domestic energy security. The technology to produce ethanol from corn was well-known, so that technology was the initial focus for liquid bio-fuel production. Between 2000 and 2007, corn-based ethanol production quadrupled to 6.5 billion gallons; 4.6 percent of the gasoline pool. In 2007 alone, ethanol production increased 32 percent. This rapid shift has had substantial impacts on grain prices and rippling effects--both inside the agricultural sector and out into other sectors. Concerns about the long-run sustainability of corn-based ethanol production led the Departments of Energy and Agriculture to accelerate efforts to commercialize cellulosic ethanol production. Forest biomass and byproducts of forest products manufacturing (e.g., sawdust, bark, other wood waste, paper mill byproducts) are expected to be important feedstocks for cellulosic ethanol production.

The Healthy Forest Initiative, Healthy Forest Restoration Act of 2003 Encourage Biomass Energy Production. Indicator 2.11 reported that the current volume of wood on forest land available for timber harvesting is 51 percent higher today than the volume in 1953—a result of a relatively stable amount of forest available for timber production (Indicator 2.10) and a historic pattern of growth exceeding removals (Indicator 2.13). In many places, forests have become unnaturally dense, and vulnerable to severe disturbances, including unnaturally severe wildfires, insect infestations, and disease outbreaks. To combat this situation, the President launched the Healthy Forest Initiative in August 2002 and in 2003, the Healthy Forest Restoration Act was enacted. Among other goals, the Initiative encourages biomass energy production through grants and assistance to local communities, creating market incentives for removal of otherwise valueless forest biomass from Federal lands. The Food, Conservation, and Energy Act of 2008 also contains several provisions on producing bio-fuels from woody biomass.

Increasing the Use of Woody Biomass for Bio-Energy and Bio-Fuels Will Create Ripples Through the Landscape, Economy, and Society. The forest products industry has a long history of generating power for their mills by burning wood waste and byproducts—solving a solid waste disposal problem. In some localities, municipal power plants have been constructed using woody biomass (including wood, wood waste, and byproducts) as their primary fuel or sometimes to augment solid waste. Using wood as the primary or a supplemental fuel reduces reliance on fossil fuels and promotes energy self-reliance.

Over the past two years, higher prices and tightening supplies for fossil fuels have led many municipalities and public utilities to study the economic feasibility of converting existing power plants to burn woody biomass and of developing new biomass power plants. Those same studies have documented the impacts of increased competition for wood chips that is likely to occur if new wood-burning energy plants are constructed in areas where pulp and paper mills currently purchase wood chips. Higher prices for woody biomass could stimulate increased timber harvesting and put more money into the pockets of private landowners while at the same time increase the wood costs and perhaps threaten the continued viability of some forest products mills. Jobs and communities are affected both ways.

Increased demand for woody biomass—whether for combustion or ethanol production—is likely in some locales in the near future. Energy provisions of the Food, Conservation, and Energy Act of 2008 provide incentives for research, development, and commercialization of bio-energy, particularly on cellulosic ethanol. These provisions are expected to stimulate demand for biomass from forests. Increased demand for biomass will have consequences—positive and perhaps also negative—on sustainable forests and sustainable development. The rapid increases in corn-based ethanol production created major consequences and price hikes for corn in certain areas that rippled through the agriculture sector down to consumers throughout the nation. Although the likelihood of a stampede to increased use of wood for energy may have diminished somewhat in the past few months as the economic slowdown led to declining oil prices, the potential for major consequences in the forest sector is probably only delayed, not reduced. This delay creates the opportunity for more intensive engagement by the forest community with the energy community to develop and evaluate options that are "win-win" for both energy and forest interests. By working together, solutions can be identified that both improve domestic energy security and sustainable forest management while they protect watersheds and restore healthy forests. Inside government, the Departments of Energy and Agriculture are collaborating on this issue. Now is the time to broaden and deepen the involvement of the sustainable forestry community outside of government in these endeavors to find sustainable solutions for the contributions of the Nation's forests to national energy goals.

3.3. Forest Fragmentation and Loss of Working Forests are Changing Landscapes and Reducing Ecosystem Services.

Healthy forests are ecological life-support systems. They provide a full suite of goods and services that are vital to human health and livelihood, natural assets called **ecosystem services** that include wildlife habitat and diversity, clean water, clean air, carbon storage, and scenic landscapes. Historically, ecosystem services have been undervalued, considered free "public goods" provided to society by both privately-owned and public forests.

All forests "work" by providing ecosystem services, but a "working forest" is one that is actively managed using a forest stewardship plan as the guide.

Working forest landscapes present an opportunity to protect not only the value of ecosystem services, but also the economic and community benefits that arise from a forest's production of marketable goods and services. But when working forests are undervalued, they are susceptible to development pressures and conversion to non-forest land uses. Recognizing the economic and social value of ecosystem services provided by working forests can help promote sustainability and more responsible decision-making about whether and how to actively manage a forest.

Forest Fragmentation Affects Working Forests. Two types of fragmentation are of concern. The first is a reduction on the size of contiguous forest areas. As the size of forest stands grows smaller and as the patches of forest in a landscape become more separated, the integrity and pattern of the landscape changes, which often results in a decreased capacity of the remaining stands of trees to provide ecosystem services. The second type of fragmentation is a social construct often called "parcelization." From this perspective, as the number of private forest landowners in a landscape increases and the existing forest is split into smaller and smaller parcels divided among more owners, the forest becomes more fragmented. Some recent research suggests that when parcel sizes drop below 50 acres, owners of parcels less than 50 acres in size have significantly different land management objectives than owners of larger parcels.

The data in this report (Indicator 1.03) provide evidence that forests are becoming increasingly fragmented from both perspectives. As working forests become increasingly fragmented in a landscape, it becomes progressively more difficult to manage smaller and smaller stands and obtain all the ecological, economic, and social benefits provided by more intact working forests. At some point, active stewardship and management of small stands is abandoned. Benign neglect may then emerge as the best alternative to converting the forest fragments to other non-forest uses. But it is hard to defend this as responsible forest stewardship.

Loss of Working Forests Diminishes Ecosystem Services. Although from a national perspective, the acreage of forest has varied little in recent years, this obscures the losses and gains that are occurring in specific areas. Suburban expansion into adjoining forests is a leading cause of losses in working forests, and consequently diminished ecosystem services in those areas undergoing forest conversion to other land uses.

Suburban expansion into forested areas became an increasingly important issue in the last half of the 20th century. Up until the 1880s, most towns and cities were surrounded by a ring of woodland where the trees were managed by frequent and repeated cutting to provide fuel wood for heating, cooking, and transportation (steam locomotives) for nearby residents. A transformative technological change occurred in the 1880s—coal replaced wood as the primary energy source for American society. The working forest that provided fuel wood for two centuries and more was idled, retired, sometimes abandoned. A period of benign neglect ensued. All the while, the forests continued to grow. By the 1950s, many older towns and cities in the eastern half the country found themselves surrounded by more forests than had existed at anytime since initial settlement (late 1600s to early 1800s) and enjoying many of the ecosystems services the regrown forests provided. The latter half of the 20th century saw major changes in land use that directly impinged on these forests. The rapid expansion of the post-war years—population growth, changing social preferences for single-family homes in the suburbs and commuting to work over an increasingly dense network of highways—changed landscapes everywhere, including the forests in those landscapes. Forests near urban areas declined. In some settings, the overstory trees remained, but houses and streets occupied the understory where once saplings and seedlings had grown—the next generation of the working forest destroyed. Consequently, many of the ecosystem services provided by forests in suburban areas were lost or diminished despite the fact that a few overstory trees remained.

Today, the magnitude of the loss in essential ecosystem services that forests near urban areas once provided has become glaringly evident. In recent years, some localities became sufficiently alarmed by the loss of these services that forest retention and tree retention ordinances were passed. These required developers to protect existing trees. Some ordinances went further, requiring that forests cleared for houses are replaced through forest restoration plantings elsewhere in the town or county. Another landscape management and forest stewardship tool emerged—conservation easements—that helps protect the remaining capacity of fragmented forests to provide some ecosystem services to nearby communities.

In the past several years, some stellar examples have emerged of forward thinking to restore and expand working forests and manage them on a sustainable basis. The work by Baltimore County, Maryland, described in Chapter 4, is the kind of local action that could be emulated in many places throughout the country. Local officials, supported by local interests, created innovative landscape-level stewardship plans and implementation actions to conserve the forests that remained, to restore the forests that needed help, and to reintroduce forests where they had disappeared. The result is a changing landscape, where forests and the ecosystem services that they provide are helping to provide clean water, ameliorate storm water runoff, and boost the quality of life county-wide. Baltimore County's forests are working forests and the values of the ecosystem services they provide are among the county's most prized assets.

Lack of Markets for Ecosystem Services Also Played a Role in Loss of Forests. An important contributing factor to the conversion of forests to other land uses was the fact that markets existed only for a few of the many ecosystem services forests provided. The value of timber was marketable. But few other ecosystem services had any market value, except perhaps hunting leases in some areas. Thus, despite the social values of the ecosystem services working forests provided, when faced with few income-generating opportunities and annual property tax bills that often rose as suburban development crept closer, converting forests to other uses often made economic sense to individual landowners. Creating viable markets for a broader array of ecosystem services could play an important role in keeping working forests working.

3.4. Lessons Learned

America's forests played a key role in the economic development of this Nation. Over the last 125 years, the forests of the United States have undergone several transformations. Despite the fact that total forest area in the U.S. has varied less than 5 percent over that period of time, the kinds of forests and where they are located have sometimes changed dramatically.

Looking ahead to the near-future, the three issues highlighted in this section---climate change, bio-energy and bio-fuels, and the fragmentation and loss of working forests—are this generation's challenges. What lessons can we draw from recent history to help this generation both meet our current needs and at the same time leave resilient, healthy, productive, working forests for future generations?

Lesson #1: Left unaddressed, these three issues will materially change forests—both here in the U.S. and globally. Experience since the 1950s with fragmentation and losses of working forests particularly to uncontrolled sprawl, shows two things.

That experience clearly illustrates the undesirable consequences of landscape changes that can result from inattention or ineffective engagement with these issues. Although there is a longer history and more experience with the issue of loss of working forests, there is little reason to expect that the changes resulting from climate change or unbridled expansion of bio-energy/bio-fuels industries would not result in similar undesirable consequences. Rather, the question is: Can integrated solutions be designed that create positive outcomes from climate change and bio-energy/bio-fuels prospects that help keep working forests working?

It is also important to recognize that forests in the United States only represent 7.6 percent of global forests. Yet these issues do not only affect forests in this country, they affect forests around the world. So although it is important to tackle these issues within this country, it is also important for the Forest Service and other members of the U.S. forest community to work with other countries and international organizations to address these issues at the global scale. A prime example is the Montreal Process Working Group of 12 member countries; the *raison d'etre* for this report.

The good news is that recent successes in several locations where these issues have been tackled offer hope for a more sustainable future. Notably, the use of a criteria-and-indicators approach to monitoring and using the monitoring results to adapt plans and management activities has yielded benefits. Further, successful efforts at county and State levels, such as Baltimore County, Maryland and the States of Oregon and Wisconsin, provide momentum for taking action to shape the future of America's forests in more desirable, more sustainable ways.

Lesson #2: These three issues are inter-related; therefore integrated solutions are likely to yield better outcomes than individual solutions.

Restoring and maintaining healthy, productive, working forests can help mitigate climate change. As markets emerge for increasing carbon storage in forests, those carbon payments may provide an important financial incentive for private landowners and public land managers to plant more trees and manage natural stands more actively, leading to more working forests and more ecosystem services in the future.

Increased use of woody biomass to generate bio-energy and produce bio-fuels can help achieve domestic energy policy and sustainable development goals and also mitigate climate change impacts. But the potential also exists for rapid shifts to cellulosic ethanol or wood-powered electricity generation to drive up prices for wood in a particular area. Although this would put more money in the pockets of landowners who harvest biomass, higher wood prices could also increase the competition for available wood supplies and decrease profit margins for current wood users—potentially affecting the viability of those mills and the jobs they provide. So the location of new wood energy facilities will need to be carefully decided to avoid undesirable consequences.

So long as the value of ecosystem services remains outside of a functioning market, they will tend to be undervalued and underrepresented in decisions. Although the magnitude of the impact may vary by location, undervaluing ecosystem services means they won't be properly considered in development decisions. Means are needed to create markets and market values for the services that working forests provide to society.

Lesson #3: The Forest Service cannot tackle these issues alone. Collective action is needed and collective action requires shared leadership.

The Forest Service is directly responsible only for 25 percent of the forests in the United States—the National Forest System. Other public agencies and private landowners are responsible for the other 75 percent. But we are concerned about what happens on these other lands, because sustainability depends on what happens across the entire landscape. So effective, landscape-level solutions to these issues will require collective action by the entire community people who value forests and the ecosystem services they provide. Although the Forest Service is already committing energy to addressing each of these issues, success will occur more quickly and at more places across the landscape if others join us. The more we can broaden and deepen the dialogue and the more open and transparent that dialogue, the greater the public support and easier it will be to reach collective decisions and take effective, coordinated actions. We understand that this requires shared leadership. The Forest Service's history of participation in the three roundtables demonstrates its willingness and commitment to shared leadership at the national level. There are many additional examples—some highlighted in Chapter 4—of shared leadership at regional, State, and local levels.

4. Hopes for the Future

The year 2011 has been designated as "The International Year of Forests." During this year, special attention and focus will be given to raising awareness and promoting actions aimed at conserving and

sustainably managing all types of forests. The year-long global celebration of forests will highlight their importance to people and communities and the threats forests are facing. What better time than this to move from dialogue about the issues facing U.S. forests to the decisions and actions needed to conserve, manage, and use them wisely?

The Roundtable on Sustainable Forests is well positioned to begin the broader, deeper dialogue needed to tackle these issues. Dialogue will need to be on a different stage than just within the Roundtable itself. The dialogue will also need to be broader than collaborating with the other two roundtables.

Since 1882 there have been a series of 7 American Forestry Congresses. Each one was held at an important point, sometimes a key turning point, in the evolution of forest policies affecting the management of the Nation's forests. The 7th American Forest Congress was convened in 1996. It brought together over 1,500 citizens for focused dialogue on a vision for the future of America's forests. A dozen years have passed since then. Stickier, knottier, more complex issues have emerged in recent years. The time may be ripening—particularly with 2011 being designated as the "International Year of Forests"—to consider whether a similar, broad-based dialogue might be helpful in the face of climate change, increased demand for biomass/bio-energy, and the fragmentation and loss of forests and the ecosystem services they provide. Could such a dialogue help build a broader consensus about sustainability as a goal and a deeper commitment to better practice sustainable forest management? We hope so.

Over the past five years since the *National Report on Sustainable Forests: 2003* was released, the forestry community has witnessed many actions that have made important contributions to increasing sustainable forests. Landscapes are different today in several areas because of the foresight of these early adopters. Their actions are important demonstrations of the ability of people—working together—to create positive changes in forests and landscapes for the communities living there. These actions and their results strengthen our hopes about what might be achieved in the coming years.

Looking ahead, more actions are needed to deal with climate change, bio-energy/bio-fuels, and forest fragmentation and loss of forests. The actions must be brisk, in every sense of that word: lively and energetic; keen and sharply focused; stimulating and invigorating; effervescent! The actions must not only build momentum for change and for sustainable management of forests within the forest community, the actions must carry that momentum for sustainable management to stakeholders outside the forest community.

The next five years may be the period of most significant change in our Nation's forests since the 1870s. Back then, concerns about timber scarcity—unsustainable uses—led to the first inventory and study of forest conditions and productivity. The technological shift from wood as the primary home heating, cooking, and transportation fuel to coal led to major environmental, economic, and social changes in the 1880s, particularly in landscapes surrounding cities. Although we weren't there to witness those changes, those changes determined the trajectory for changes in forests, some we are still dealing with 130 years later.

Our actions in the coming five years—to help define the paths forward for adapting forests to climate changes and using them to mitigate greenhouse gas emissions; to help shape the role of forest biomass in offsetting increased use petroleum; and to help stem the loss of forests and the ecosystem services they provide—have the potential to shape for future generations the forests they will have to manage, conserve, protect, and use. Will future foresters and citizens 130 years from now be able to look back at this point in time and say, Well done! Will forest historians and policy makers then be able to point to actions taken now as turning points in the sustainable management of the Nation's forests? We hope so. But it will take brisk action from all of us.

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Glossary

Source References, in brackets, at End of Glossary

abiotic *[12]*
Pertaining to the nonliving parts of an ecosystem, such as soil particles, bedrock, air and water.

age-class *[11]*
A category into which the average age or age range of trees or other vegetation is divided for classification or use. Age-class is usually used in reference to even-aged stands of trees. It represents the dominant age of the main body of trees in a stand. In some mixed-aged stands, age-class can be used to describe the age of the dominant/codominant cohort of canopy trees.

air pollutants *[16]*
Gases, particles, or aerosols generated from management or combustion activities (industry, transportation, agriculture, management, etc.) that are released into the atmosphere, transported, and deposited in human and natural ecosystems. Air pollutants may be absorbed by forest ecosystems without effects (sink) or exceed the absorption capacity and have a deleterious effect on processes or components.

best management practice(s) (BMP) *[12]*
A practice or usually a combination of practices that are determined by a state or designated planning agency to be the most effective and practicable means (including technological, economic and institutional considerations) of controlling point and nonpoint source pollution at levels compatible with environmental goals.

biological diversity *[1]*
The variability among living organisms from all sources, including inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems

biomass (woody) *[17]*
The mass of the woody parts (wood, bark, branches, twigs, stumps, and roots) of trees (alive and dead) and shrubs and bushes, measured to a specified minimum diameter (d.b.h.). Includes above-stump woody biomass, and stumps and roots. Excludes foliage.

biotic *[12]*
Pertaining to living organisms and their ecological and physiological relations.

broadleaf (synonym: hardwood or deciduous species) *[11]*
A dicotyledonous tree, usually broad-leaved and deciduous.

carbon absorption *[6]*
The incorporation of the element carbon from the atmosphere into plant tissue.

carbon budget *[6]*
The inventory of the element carbon in carbon pools and the balance of exchange between the pools in the area of study.

carbon cycle *[15]*
The sequence of transformations whereby carbon dioxide is fixed as carbon or carbon compounds in living organisms by photosynthesis or chemosynthesis, liberated by respiration and/or death and decomposition of the fixing organism, used by heterotrophic species, and ultimately returned to its original state to be used again.

carbon flux *[24]*
The transfer (net flow) of carbon from one carbon pool (stock) to another. For example, for the atmosphere, common fluxes include carbon removed by plant growth and dissolved into the ocean and carbon added by mineralization, plant respiration, fossil-fuel burning and volcanic activity.

carbon pool (or stock) *[7]*
The absolute quantity of carbon held within a pool at a specific time. Examples of carbon pools are aboveground forest biomass, soil, wood products, and the atmosphere.

carbon emission *[6]*
The emission of the element carbon from organic matter into the atmosphere.

climate change *[3]*
The actual or theoretical changes in global climate systems occurring in response to physical or chemical feedback, resulting from human or naturally induced changes in planetary terrestrial, atmospheric, and aquatic ecosystems.

conifer (synonym: softwood, evergreen, or needleleaf species) *[11]*
A coniferous tree, usually evergreen, having needles or scale-like leaves.

criterion *[11]*
A category of conditions or processes by which sustainable forest management may be assessed. A criterion is characterized by a set of related indicators that are monitored periodically to assess change.

cultural value *[22]*
see social or cultural needs and values

damage to forest *[17]*
Disturbance to the forest that may be caused by biotic or abiotic agents, resulting in death or a significant loss of vitality, productivity, or value of trees and other components of the forest ecosystem.

diminished biological components *[11]*
A reduction in the diversity of biological species. An ecosystem is considered to have both biotic and abiotic elements. Many species of microflora or insects are important to soil building, plant reproduction, or nutrient cycling. The biotic elements are dynamic in occurrence and will change in response to natural vegetation succession or artificially induced changes. The concept of diminished biological components reflects reductions or shifts in biological processes in a given forest relative to what might be expected, based on an undisturbed, similar reference site.

direct employment *[11]*
The number of jobs created by public and private firms in the process of producing a good or service.In the process of producing the good or service, however, the primary firm also generates secondary economic activity in other sectors of the economy. The jobs created by this secondary economic activity are referred to as indirect employment.

ecosystem *[11]*
A dynamic complex of living organisms (plant, animal, fungal, and micro-organism communities) and the associated nonliving environment with which they interact.

ecosystem diversity *[11]*
Describes the variety of different ecosystems found in a region. A categorization of the combination of animals, plants, and micro-organisms, and the physical environment with which they are associated is the basis for recognizing ecosystems.

ecosystem services *[25]*
Ecosystem services are the conditions and processes through which natural ecosystems, and the species which make them up, sustain and fulfill human life. They maintain biodiversity and the production of ecosystem goods, such as seafood, forage, timber, biomass fuels, natural fiber, and many pharmaceuticals, industrial products, and their precursors. … In addition to the production of goods, ecosystem services are the actual life-support functions, such as cleansing, recycling, and renewal, and they confer many intangible aesthetic and cultural benefits as well.

ecological processes *[16]*
Processes fundamental to the functioning of a healthy and sustainable ecosystem, usually involving the transfer of energy and substances from one medium or trophic level to another.

endangered species *[8]*
A taxon is endangered when it is not critically endangered but is facing a high risk of extinction in the wild in the near future, as defined by any of the criteria A to E of IUCN (1998).

erosion (soil) *[11]*
The movement of soil materials from one place to another. The movement of soil due to natural processes should be distinguished from that related to forest harvesting, road construction, or other human alterations.

ex situ [12]
Off the site; away from the natural habitat.

exotic species (synonym: nonindigenous species) *[11]*
Any species growing or living outside its natural range of occurrence. Normally this refers to species purposely or accidentally introduced into countries or regions where they do not historically occur.

extinct species *[8]*
A species for which there is no reasonable doubt that the last individual has died or when exhaustive surveys in known or expected habitat throughout its historic range have failed to record an individual.

forest available for timber production *[14]*
Forest land that is producing or is capable of producing industrial wood and is not withdrawn from timber utilization by statute, administrative regulation, or formal conservation reserve purposes. Includes forest with conditions suitable for timber production even if so situated as to not be immediately accessible for logging.

forest ecosystem *[2]*
A dynamic complex of plant, animal, and micro-organism communities, and their abiotic environment interacting as a functional unit, where the presence of trees is essential. Humans, with their cultural, economic, and environmental needs are an integral part of many forest ecosystems

forest goods *[12]*
Things from the forest that are useful and beneficial, and that have intrinsic value or economic utility. Includes all flora and fauna, mineral, and water resources occurring or originating in the forest.

forest land *[4]*
Land with at least 10 percent tree crown cover (or equivalent stocking) and more than 0.5 hectare (1 acre) in area, including land that formerly had such tree cover and that will be naturally or artificially regenerated. The trees should generally be able to reach a minimum height of 5 meters (16.5 feet) at maturity in situ. May consist either of closed forest formations in which trees of various stories and undergrowth cover a high proportion of the ground; or of open forest formations with a continuous vegetation cover in which tree crown cover exceeds the minimum percent. Young natural stands and all plantations established for forestry purposes, which have yet to reach the minimum crown density or tree height, are included under forest, as are areas normally forming part of the forest area that is temporarily unstocked as a result of human intervention or natural causes, but which are expected to revert to forest.

forest type *[11]*
A category of forest defined by its vegetation, particularly composition, and/or locality, as categorized by each country in a system suitable to its situation. The broadest general groups are:
- Broad-leaved (hardwoods)
- Coniferous (softwoods)
- Mixed broad-leaved and coniferous

forest-associated species (flora and fauna) *[23]*
A species with a measureable dependence on a forest ecosystem(s) for any aspect of its life history (including indirect dependence e.g. consuming forest-based or derived resources).

forest management plan (or equivalent) *[11]*
A written scheme of forest management, aiming at defined management goals, which is periodically revised. These include:

forest management plans
Information (in the form of text, maps, tables, and graphs) collected during (periodic) forest inventories at operational forest units level (stands, compartments), and operations planned for individual stands or compartments to reach the management goals.

equivalents
Information collected on forest area, at forest management or aggregated forest management unit level (forest blocks, farms, enterprises, watersheds, municipalities, or wider units), and strategies/management activities planned to reach the management or development goals.

forest soil *[9]*
Soil with characteristics resulting from, or emphasized by, tree cover. *(See soil.)*

fragmentation *[11]*
Describes one aspect of habitat capacity. Refers generally to the reduction in size of forest patches with coincident decreases in forest connectivity and increases in patch isolation and amount of forest edge. The fragmentation of a forest into small pieces may disrupt ecological processes and reduce the availability of habitat.

genetic diversity *[11]*
Describes the variation of genetic characteristics found within a species and among different species.

goods and services *[12]*
The various outputs and benefits, including on-site uses, produced from forest and rangeland resources.

gross domestic product (GDP) *[19]*
A measure of country output composed of the market value of the goods and services produced by labor and property located in the country. Because the labor and property are located in the country, the suppliers (that is workers and, for property, the owners) may be either country residents or residents of the rest of the world.
Gross product, or gross product originating (GPO), by industry is the contribution of each private industry and of government to the nation's output, or gross domestic product (GDP). An industry's GPO, often referred to as its "value added," is equal to its gross output (sales or receipts and other operating income, commodity taxes, and inventory change) minus its intermediate inputs (consumption of goods and services purchased from other industries or imported). The industrial origin of value added is determined by the International Standard Industrial Classification (ISIC), rev. 2.

growing stock *[4]*
The living tree component of the standing volume on forest land consisting of the central stem volume of trees of at least 12.5cm (5 inches) Dbh measured from 0.3 m (1 foot) above the ground to a top diameter of 10cm (4 inches). Volume is net underbark.

growth (net annual) (synonym: net annual increment) *[4]*
Average annual volume over a given reference period of gross increment minus natural losses of all trees of at least 12.5cm (5 inches) DBH.

habitat *[3]*
The natural environment of a living organism, primarily determined by vegetation, climate, soils, geology, and topography.

indicator *[11]*
A measure (measurement) of an aspect of a criterion. A quantitative or qualitative variable that can be measured or described and that, when observed periodically, demonstrates trends.

indigenous people *[11]*
People descended from the first inhabitants of a nation or subnational region.

indirect employment *[11]*
The result of two types of economic transaction. First, jobs are created in secondary firms that provide materials, supplies, goods, and services to the primary firm. Second, employees of primary firms spend their wages and salaries in the local economy, which generates activities in the local retail and service sectors.

in situ *[12]*
On-site; within the natural habitat.

IUCN classification system *[8]*
The World Conservation Union (formerly the International Union of Conservation Networks) protected area classifications (IUCN categories) are:
Category I: an area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring or a large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

Category II: a natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area, and (c) provide a foundation for spiritual, educational, recreational, and visitor opportunities, all of which must be environmentally and culturally comparable.
Category III: an area of land and/or sea containing one or more specific natural or natural/cultural features which are of outstanding or unique value because of their inherent rarity, representative or esthetic qualities, or cultural significance.
Category IV: an area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.
Category V: an area of land with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant esthetic, ecological, and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance, and evolution of such an area.
Category VI: an area of land and/or sea containing predominantly unmodified natural systems, managed to ensure long-term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

land area *[20]*
An area of dry land and land temporarily or partly covered by water, such as marshes, swamps, and river food plains; streams, sloughs, estuaries, and canals less than 60 meters (200 feet) wide; and lakes, reservoirs, and ponds less than 1.8 hectares (4.5 acres) in area.

long term *[21]*
Occurring over or involving a relatively long period of time. In natural resources, generally periods of 50 years or more.

merchantable *[11]*
Trees of a size, quality, and condition suitable for marketing under given economic conditions, even if so situated as to not be immediately accessible for utilization.

monitoring *[11]*
The periodic and systematic measurement and assessment of change of an indicator.

mortality (annual) *[14]*
The average annual volume of sound wood in trees that dies from natural causes during a specified year or on average during the period between inventories.

native species (synonyms: indigenous species, autochthonous species) *[3]*
Usually, a species known to have existed on a site before the influence of humans. It depends on the temporal and spatial context of analysis, since long-established exotic species are often considered to be native by default.

net growth *[14]*
The average annual net increase in the volume of trees during the period between inventories. Components include the volume increment of trees at the beginning of the reference period surviving to its end, plus the net volume of trees reaching the minimum size class during the period, minus the volume of trees that died during the period and minus the volume of trees that became cull.

new and improved technologies *[11]*
Refer to changes to these methods that might improve the efficiency and/or effectiveness of their actions. The definition is deliberately broad to allow for changes relating to industrial methods and values as well as to nonwood and nonextractive activities in the tourism, recreation, and indigenous food sectors.

nonconsumptive forest use *[11]*
Forest uses that do not lead to the physical extraction of products from the forests. They might include recreation, photography, birdwatching, education, and contemplation or meditation.

nonmarket valuation *[13]*
Valuation of goods and services not allocated through traditional markets.

nonmerchantable *[11]*
A species that has no known commercial uses for wood products. Merchantability is usually judged according to the suitability of a species for pulp, paper, lumber, or specialty wood products. Both native and exotic tree species can be considered merchantable tree species.

nonwood forest products (synonym: nonwood products) *[11]*
Includes game animals, fur-bearers, nuts and seeds, berries, mushrooms, oils, foliage, medicinal plants, peat and fuel wood, forage, etc. In this context, such products do not include services provided by forests, such as water regulation, biodiversity conservation, recreational or spiritual values, and carbon release offsets.

persistent toxic substance *[16]*
A relatively nondegrading pollutant that after discharge becomes a long-term component of soils, aquatic systems, and other materials. Upon exposure, ingestion, inhalation, or assimilation into any organism, the substance can cause death or disease, mutations, deformities, or malfunctions in such organisms or their offspring.

plantation *[14]*
Forest stands consisting almost exclusively of planted trees of native or exotic species, and managed to generally maintain this composition at maturity. Management practices may include extensive site preparation before planting and suppression of competing vegetation. Forests that fall outside this classification are not necessarily natural forests.

population *[4]*
1. The number of organisms of the same species inhabiting the same area that potentially interbreed and share a common gene pool.
2. The total number of organisms over a large cluster of areas, such as a physiographic region or a nation.

productive capacity *[16]*
A classification of forest land in terms of potential annual cubic-measured volume growth of trees per unit area at culmination of mean annual increment in fully stocked forest stands.

protected area *[1]*
A geographically defined area that is designated or regulated and managed to achieve specific conservation objectives. Specific objectives include:
1. Strict nature reserves/wilderness areas
2. National parks
3. Natural monuments
4. Habitat/species management areas
5. Protected landscape/seascape
6. Managed resource areas

(See IUCN classification system.)

protective function *[16]*
An attribute of a policy or management decision that serves to preserve the essential components or processes of ecosystems, or specific components of an ecosystem, to maintain a desired quality and quantity of a resource commodity.

rare species *[5]*
A species regarded as having low abundance and/or small range.

recycling *[13]*
To wood fiber or other wood components in any form that is processed after initial use to regain material for human use. [This definition does not make sense]

reference Condition *[26]*
The baseline (or reference) is any datum against which change is measured. It might be a "current baseline", in which case it represents observable, present-day conditions. It might also be a "future baseline", which is a projected future set of conditions excluding the driving factor of interest. Alternative interpretations of the reference conditions can give rise to multiple **baselines.**

removals (annual) *[14]*
The net volume of trees, live or dead, of a specified minimum diameter (generally the same as for growing stock) removed from the forest during a specified year, or average for a reference period, by harvesting or cultural operation such as thinning or stand improvement, or by land clearing. Includes the volume of trees or parts of trees that are part of a harvest operation but are not removed from the forest.

representative species *[11]*
Species with habitat dependencies typical of a group of similar species, which are likely to respond to changes in availability of those habitats or resources. Examples include species dependent on mature forests, air quality sensitive species, wetland-dependent species, hollow tree-dependent species, and thermoregulation-dependent species. Selected species are relatively easy to identify and monitor.

resilience *[27]*
The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure.

sedimentation *[3]*
The deposition of eroded soil materials suspended in the water of creeks, lakes, or other water bodies. Sedimentation takes place when water velocity falls below a point at which suspended particles can be carried.

social or cultural needs and values *[22]*
A wide range of benefits from forests and other forms of nature perceived as required (needed) by or of worth (of value) to a society or a cultural segment of society to sustain lifestyles, tradition, history, health, and community.

soil *[15]*
The unconsolidated mineral and orgainic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

soil chemical properties *[13]*
The elemental and structural composition of the soil, modified by climate, weather, plants, soil insects, and microbes. They directly affect cycling of nutrients and toxic compounds, and are the basis for a healthy and sustainable forest ecosystem.

soil degradation *[28]*
Negative process often accelerated by human activities (improper soil use and cultivation practices, building areas) that leads to deterioration of soil properties and functions or destruction of soil as a whole, e.g. compaction, erosion, salinisation, acidification.

soil erosion *[11]*
The movement of soil materials from one place to another. The movement of soil due to natural processes should be distinguished from that related to forest harvesting, road construction, or other human alterations. Note: Significant erosion needs to be defined by each country and with respect to variation between different landscapes and soils.

soil organic matter (SOM) *[15]*
The organic fraction of the soil that includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population; commonly determined as the amount of organic material in a soil sample passed through a 2-millemeter seive.

small portion (regarding species range) *[11]*
Dependent on the initial (original or some level agreed as baseline) distribution of the species. Species with very limited natural ranges (which suggests they are a relict population or have very specific habitat requirements) cannot tolerate the percentage reduction in habitat that a widely distributed species can. Small might, therefore, be defined for relict populations as the majority of existing range or, for species with large populations and wide distribution, a lower percentage of the historical population distribution.

species at risk *[18]*
Federally listed endangered, threatened, candidate, and proposed species and other species for which loss of viability, including reduction in distribution or abundance, is a concern.

species diversity *[11]*
Describes the number and variety of species (flora and fauna) in a given area.

spiritual needs and values *[22]*
Relationships perceived as required (needed) or of worth for sustaining feelings of respect, reverence, connectivity, and stewardship with forests and other forms of nature.

stream flow *[16]*
The quantity of water in a watershed based on precipitation quantity and the ability of the watershed to store and slowly release water. Typically characterized by seasonal periods of high or low water flow. Changes in high or low flow patterns are indicative of changes in precipitation patterns and/or changes in the integrity of watersheds that affect its ability to absorb and regulate water flow patterns.

stream timing *[16]*
The seasonal patterns of high and low water flows based on precipitation patterns. Changes in timing of stream flows are indicative of changes in precipitation patterns or watershed integrity.

subsistence *[11]*
The harvesting or growing of products directly for personal or family livelihood. Subsistence needs generally include foodstuffs, fuel wood, clothing, and shelter. Subsistence goods can be considered any goods that are substitutes for a market good.

successional stage *[11]*
A characteristic of many ecosystems that experience a change in structure and/or species on a given site in relation to time since a major disturbance. Where they occur, seral stages include early successional vegetation through to later successional stages. In many cases, the successional stages reflect a shift from the dominance of shade-intolerant species to that of shade-tolerant species.

sustainable forest management *[12]*
The stewardship and use of forests and forest lands in such a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, and vitality, and their potential to fulfill, now and in the future, relevant ecological, economic, and social functions at local, national, and global levels, and that does not cause damage to other ecosystems.

The criteria and indicators are intended to provide a common understanding of what is meant by sustainable forest management. They provide a framework for describing, assessing, and evaluating a country's progress toward sustainability at the national level and include measures of:

1. Conservation of biological diversity;
2. Maintenance of productive capacity;
3. Maintenance of forest ecosystem health;
4. Conservation and maintenance of soil and water resources;
5. Maintenance of forest contribution to global carbon cycles;
6. Maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of society; and
7. Legal, institutional, and economic frameworks for forest conservation.

tenure *[12]*
The act of owning, using and controlling land under certain terms and conditions.

threatened species *[3]*
Plant or animal species likely to become endangered throughout all or a significant portion of their range within the foreseeable future.

value added *[19]*
(See gross domestic product.)

vulnerable species *[8]*
A species that because it is very rare and distributed only locally throughout its range, or because it has a restricted range (even if abundant at some locations) is considered to be facing a high risk of extinction in the wild.

wood consumption *[13]*
The amount of roundwood provided from domestic sources and other countries needed to make wood and paper products for domestic consumption.

wood products *[14]*
Logs, bolts, and other round timber generated from harvesting trees for industrial or consumer use. Includes wood chips generated from round timber for industrial use.

wood supply *[13]*
The amount of roundwood provided from domestic sources to meet domestic consumption needs.

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