

The Transition Towards Sustainability

Through the process of reporting on the 67 indicators of sustainable forest management, we have learned many things. The indicators provide a common language for dialog, and the report itself serves as a common base of information for shared learning. The report also provides factual information supporting actions on the ground leading to healthier forests and communities. The information in this report gives us a shared understanding of current resource conditions and a baseline against which to mark future progress in the continuing transition toward sustainability.

What Are the Challenges to Assessing the Sustainability of America's Forests?

This report represents a state-of-the-art baseline for reporting on the trajectory toward sustainable forests at the national scale. Still, many data gaps exist. We need clearer responsibilities and larger investments in monitoring the condition and use of America's forests. Specific challenges to assessing the sustainability of America's forests include:

- **Incomplete data.** Sustainable forest management is a function of the value that society places on indicators, individually and as a group, as well as the value assigned to particular indicator quantities, conditions, and trends. To make a definitive statement about sustainability, current information should be available for all 67 indicators. Data for 11 of the indicators is incomplete and data for 9 indicators was modeled. For a number of other indicators, the available data is more than 5 years old and in some cases much older. Consequently, a definitive statement about sustainability cannot be made within the context of these 67 indicators.

Even if data was available for all indicators, making a definitive statement about sustainability would require a collective assessment of the values for all the indicators. At present, an incomplete understanding exists regarding the importance that society places on each of the indicators. Central to achieving this understanding is a value-based dialog founded in part on indicator quantities, conditions, and trends.

- **Lack of subnational data.** The American public is interested in forest sustainability at multiple scales—local, community, regional, and national. A national-scale report inevitably obscures the importance of extreme conditions that exist in some localities. Currently, only a few indicators have data available to describe subnational trends. For most of the 67 indicators, the data is national with some regional coverage, which means a breakdown for all regions is not possible. Only the data for timber indicators in criterion 2 is generally complete, current, reliable, and available regionally or statewide. Opportunities exist, however, to develop databases and indicator analyses to better understand local conditions. We need to have the ability to "scale up" this local and

regional information to better understand national trends, while at the same time ensuring that information on local and regional "hot-spots" is fully displayed.

- **Diversity of forest ownership.** The mosaic of forests in the United States is owned and managed by a mix of owners—government and nongovernment. About one-third of the Nation's forests are federally owned, and forest management decisions are made by a number of Federal agencies, including the USDA Forest Service. The balance is controlled by non-Federal public agencies and nongovernmental interests, including 10 million private landowners—individuals, families, companies, tribes, and others—who share responsibility for managing the Nation's forests. Many other factors also affect the management and use of forests, including Federal, State, and local laws and regulations; private property rights; and public land management policies. The aggregate impact of these factors is critical to understanding forest sustainability.
- **Integrated and interdependent concept.** The criteria and indicators (C&I) are a construct to help us understand the sustainable forest management concept. Sustainable forest management is a highly integrated and interdependent concept. The environmental, economic, and social spheres exert joint, simultaneous, and inextricable influences on forests. Opportunities to shape one sphere affect the others. We need to think more about sustainable forest management in the context of linkages among the three spheres. We think certain inputs are important: population, preferences, and values in social systems; income, consumption, and trade in economic systems; and natural resource stocks and flows in environmental systems. Yet, we do not know enough about how forests function within the environmental sphere and in how the three interlinked spheres function, thereby affecting or being affected by forests, especially at the national aggregate level.

Dialog fostered by the report will help focus future investments on filling the gaps that promise the biggest gain in understanding forest sustainability. Better data will lead to better dialog on the sustainability of America's forests, which will in turn lead to better decisions.

What Can Be Done To Improve the Understanding and Reporting of Forest Sustainability?

We have learned much about the C&I from producing this national report and from the First Approximation Report (USDA Forest Service 1997).^{75 & 76} Substantial stakeholder and scientific input has come through a series of workshops organized by the Roundtable on

⁷⁵ <http://www.pwrc.usgs.gov/brd/Chapter5CI.htm>

⁷⁶ <http://www.fs.fed.us/global/pub/links/report/candi.htm>

Sustainable Forests and its predecessors. Suggestions for specific improvements in the reporting of forest sustainability are included in the Data Report supporting this document report and in the reports of the workshops.^{77 & 78}

What Information Needs To Be Gathered?

Indicator 61 summarizes the information available for each indicator, identifying where additional data is needed.⁷⁹ Three broad categories are described: data frequency, coverage, and reliability. Data is characterized as (1) having few gaps (generally complete nationally, less than 5 years old, and reliable); (2) having several gaps (not consistent nationally, slightly dated, and not measured frequently enough); (3) having numerous gaps (from inconsistent or nonexistent sources, more than 15 years old, or partial, with no consistent plan for remeasurement); or (4) constructed using various modeling approaches. The data for the 67 indicators span the spectrum from full coverage, to one-time studies, to very anecdotal information. Few indicators have a full suite of data that is recent, national in scope, and collected frequently. The most persistent gap is the lack of systematic, repeated national data collection.

The Federal memorandum of understanding (MOU) on sustainable forest management data establishes a mechanism for cooperation among Federal agencies having data responsibilities pertinent to the sustainable forest management goal announced in Presidential Decision Directive NSC-16 and endorsed in the Santiago Declaration.⁸⁰ The MOU provides a common interagency forum for Federal coordination to resolve issues integral to the ongoing collecting, analyzing, reporting, and disseminating of data and information related to the C&I. The MOU also provides a process for helping Federal agencies develop this national report. Twelve agencies have signed the MOU. The Sustainable Forest Data Working Group of the Federal Geographic Data Committee (FGDC) has responsibility for implementing the MOU.^{81 & 82}

The Data Report and the technical workshops identified many issues (appendix 3) with available information on the C&I.^{83 & 84} The Sustainable Forest Data Working Group has selected the following four high-priority issues for attention. Of course, progress will depend on the resources available.⁸⁵

1. Clarify the definitions of forest and rangeland.

Defining these terms is a long-standing, difficult, and contentious issue. The definition is fundamental

to any discussion of forests because it categorizes the land base that is inventoried. Currently, definitions of forest and rangeland overlap among Federal agencies, resulting in total land area estimates that exceed the actual combined area. Good conceptual definitions exist, as does general agreement on typical forests and rangelands. Agreement is needed, however, on operational definitions at the boundaries—land with some trees as well as some grasses and shrubs—to compare data and estimates. The Oregon Demonstration Project (Goebel et al. 1998) found a difference of 10 to 15 percent in the areas of rangelands and forests using the varying definitions that exist among Federal agencies. The differences relate to what is a tree and how many are needed for a forest. Species such as pinion pine and juniper can be classified as either trees or shrubs because their growth habits vary. One definition requires at least 25 percent crown cover for a forest while another requires only 10 percent. A stakeholder group including representatives of the Roundtable on Sustainable Forests, Sustainable Rangeland Roundtable, Federal agencies, and professional societies is working on developing standard definitions acceptable to both forest and rangeland groups.⁸⁶

2. Define taxonomy, measures, and values for nontimber forest products and services.

Examples of nontimber products include berries, worms, mushrooms, cedar bark, flowers, grasses, seeds, tubers, and herbs. Hunting, fishing, other recreational pursuits, and mining in the Nation's forests are highly profiled and valued activities. In most cases, data regarding the types, quantities, and market values of nontimber products removed from the various forests are either highly sporadic or nonexistent. Accurate forest inventories should include the resources being used or removed, the rate of removal, and the quantity being removed. More precise accounting of these types of information is essential, in many cases, to evaluate forest sustainability.

3. Develop a national strategy for monitoring human community and economic indicators relating to the social, economic, and cultural impacts of forests and forest management on regions and communities.

The cultures and economies of many communities are closely linked to the forests that surround them, and they need to be considered as part of sustainability. Information about the cultural and spiritual significance of American forests to various groups is available, but only in a qualitative format. Social scientists have developed techniques through which the value people place on the recreational and esthetic benefits of forests can be qualitatively estimated. No one has found a way, however, to assign a quantitative weight to cultural and spiritual values. Fully understanding these variables will require interaction with communities through case studies and immersion. The results of such efforts will remain

⁷⁷ <http://www.sustainableforests.net/>

⁷⁸ <http://www.fs.fed.us/research/sustain/>

⁷⁹ <http://www.fs.fed.us/research/sustain/>

⁸⁰ <http://www.pwrc.usgs.gov/brd/SFDMou.htm>

⁸¹ <http://www.pwrc.usgs.gov/brd/sfd.htm>

⁸² <http://www.fgdc.gov/>

⁸³ <http://www.fs.fed.us/research/sustain/>

⁸⁴ http://www.sustainableforests.net/C&I_workshops/ci_workshops.html

⁸⁵ <http://www.pwrc.usgs.gov/brd/sfd.htm>

⁸⁶ <http://www.pwrc.usgs.gov/brd/Definitions.htm>

qualitative, but they will identify attributes of the forests that transcend quantitative analysis and inform forest sustainability. The Communities Committee of the Seventh American Forest Congress is working on this issue.⁸⁷

4. Define forest fragmentation indicator composition.

Within the framework of the criteria and indicators that determines the structure of this report, fragmentation (indicator 5) describes one aspect of biodiversity (criterion 1). Therefore, in this report fragmentation is specified as a measure of forest patch size because the size and arrangement of forest patches influence habitat suitability for different species. Other specifications of fragmentation as an indicator of biodiversity are possible. Other definitions of fragmentation as indicators of different criteria are also possible. For example, fragmentation of the forest estate into ownership parcels of different sizes can influence forest management and productivity (criterion 2), socioeconomic variables (criterion 6), and institutional variables (criterion 7). A more holistic definition (or multiple definitions) of fragmentation that reflects these influences is needed, along with protocols for measuring fragmentation according to the new definition.

The following issues also deserve particular attention.

- **Resolve database management, consistency, and integration.** Little has been done nationally to ensure standardization of databases. In addition, critical resource information, such as metadata, is often lacking. For example, the methodologies used to determine plot location, such as Global Positioning System (GPS) information, and the calibration of measurement tools are critical to achieving accurate repeat measurements. Finally, format structures remain nonstandardized. Incompatibilities make it impossible to combine and transform data without introducing considerable uncertainty into results.
- **Improve measurement of biological diversity.** Current monitoring emphasizes trees and birds because they are interesting and easy to monitor. Monitoring programs should be expanded to survey important taxa that are not currently monitored and should include rare species and specialized habitats that are often missed. Where feasible, vital rates as well as population levels should be monitored for taxa to provide early warning of changes and to provide insights about the cause. Direct measurement of genetic diversity should be used for species at risk of losing genetic diversity, instead of relying on surrogate indicators. New methods should be developed to monitor changes in species ranges that are not well tracked by current methods. These improvements will enable monitoring of critical components of forest ecosystems and provide early warning of problems by monitoring more-sensitive components.

- **Implement the National Vegetation Classification (NVC) system and convert existing systems.**⁸⁸

The NVC system is the Federal standard for vegetation classification, but agencies have not yet fully implemented it. Using the same classification system is essential for sharing data. Agencies and organizations are strongly encouraged to adapt the NVC system as soon as possible and to crosswalk their current information into the NVC system. Where problems exist with the NVC system, efforts should continue to reach consensus on improvements.

- **Implement Forest Health Monitoring (FHM) and Gap Analysis Program (GAP) nationally.**^{89 & 90}

FHM is a national program designed to determine annually the status of, changes in, and trends in indicators of forest condition. The FHM uses data from ground plots and surveys, aerial surveys, and other biotic and abiotic data sources and develops analytical approaches to address forest health issues that affect the sustainability of forest ecosystems. FHM has been implemented in 34 States. GAP is a scientific means for assessing the extent to which native animal and plant species are being protected. The goal of GAP is to keep common species common by identifying those species and plant communities that are not adequately represented in existing conservation lands. National GAP coverage is scheduled to be completed in fiscal year 2005. These programs provide exceptionally useful information for analyzing sustainability.

- **Improve measurements of carbon budgets.**

Two critical reasons for carbon management are maintenance of forest health and strategies to mitigate climate change. The importance of carbon—carbon storage, carbon sequestration, carbon cycling, and turnover—in ecosystems is beyond question. Total carbon is not currently measured directly, so it is estimated, using proxy variables and models. Measurements and models need to be improved and expanded. More information on land use and its history and on life expectancy of wood products and decay rates is needed. We know that many forest soils, hence carbon, in the United States have been degraded by past use, especially when such soils were periodically cleared for crop production or livestock grazing. Over time, many such areas (for example, in the East) have reverted to forest cover and are currently in a recovery stage in which surface and subsurface soil horizons are in a state of aggradation. In some areas of the West, systems are not recovering, even with removal of the perturbation (for example, Glen Canyon, AZ). In fire-suppressed ecosystems, a buildup of live and dead wood may result in more carbon than is typically found in the ecosystem. More research is needed to understand and mimic levels of forest carbon that result in healthy forests and a stable climate.

⁸⁷ <http://www.communitiescommittee.org/>

⁸⁸ <http://biology.usgs.gov/fgdc.veg/>

⁸⁹ <http://www.na.fs.fed.us/spfo/fhm/>

⁹⁰ <http://www.gap.uidaho.edu/>

Should a Conceptual Model Be Developed To Understand Sustainability?

Sustainability is a highly integrated and interdependent concept. It is difficult to understand how systems (environmental, economic, and social) function, especially at the national aggregate level. Developing a conceptual model would help us understand and communicate the relationships within and among social, economic, and environmental systems.

Each of us has a somewhat different concept of how social, economic, and environmental systems work and how the components are related, and we may each emphasize different components based on our perspectives and experiences. Using a collaborative approach, a conceptual model provides a vehicle for resolving differences and reaching consensus among various stakeholders.

Finally, a conceptual model would also document the relationship between the measured indicators and forest sustainability through the development of reference values. Reference values specify for each indicator a range or threshold that describes desired future conditions consistent with achieving forest sustainability.

In describing the conceptual basis for the Northwest Forest Plan, Noon et al. (1999) present a six-step process for identifying and validating indicators.⁹¹

"To select indicators that reflect underlying ecological structure and function requires well-developed conceptual models of the resources of concern.... The model should demonstrate how the system works, with particular emphasis on anticipated system responses to stressor input. The model also should indicate the pathways by which the system accommodates natural disturbances and how the system may acquire resilience to disturbance... As a general goal, management will strive to maintain ecological processes. These functions, however, are often difficult or impossible to measure directly. Conceptual models should identify structural and compositional elements of the resources affected by, and affecting, the underlying processes.... Measurements and inferences from biological systems are affected by the scale of observation. Therefore, to determine the appropriate scale for measuring an indicator, the temporal and spatial scales at which processes operate and resources respond must be estimated (at least to a first

⁹¹ http://www.nature.nps.gov/im/monitor/gtr_437.pdf

approximation) and clearly identified in the conceptual model." (Noon et al. 1999: 33)

The USDA Forest Service's Local Unit Criteria and Indicators Development (LUCID) team conducted a pilot study that appraised the feasibility of monitoring sustainability systems at the forest management unit scale.⁹² Because sustainability issues involve multiple scales, achieving the national goals of sustainability rest, in large part, on actions that are carried out at the local or forest management unit scale. The LUCID team (Wright et al. 2002) found that conceptual models were very useful in the following:⁹³

- Clarifying team members' understanding of how things are related;
- Identifying areas of uncertainty, including how things are related (for example, direction);
- Identifying missing monitoring components or gaps;
- Identifying critical monitoring components and redundancies;
- Requiring team members to be specific about what and why elements were included; and
- Communicating complex ideas in a more straightforward, graphic means.

The Northwest Forest Plan and LUCID study are two examples that stress the importance of understanding the relationships among economic, social, and environmental systems as the first step in evaluating indicators. A conceptual model is an important tool in gaining that understanding and communicating the role of the C&I in measuring progress toward sustainability.

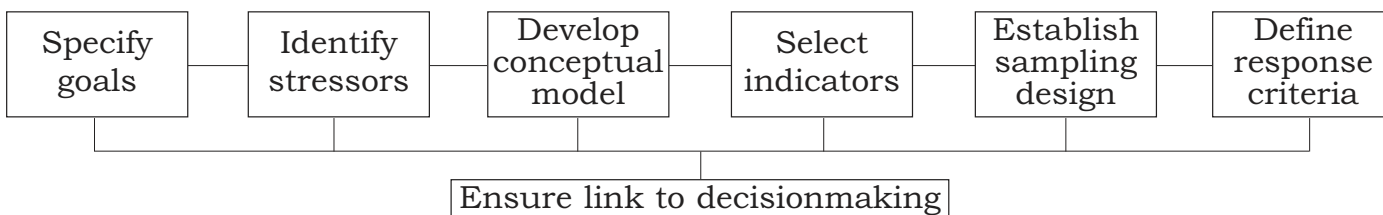
What Should Be Done To Review and Revise the Criteria and Indicators?

The 12 Montreal Process countries agreed to not change the C&I until after the countries issue their 2003 reports. With the experience of producing the U.S. report, we can begin the process of reviewing the effectiveness of the C&I in measuring progress toward sustainability. We can also draw on the experience of the Sustainable Rangeland Roundtable and Sustainable Minerals Roundtable, which are developing a similar set of criteria and indicators, and on the experience of the other countries in the Montreal Process.⁹⁴ The Heinz Center report on The State of the Nation's

⁹² <http://www.fs.fed.us/institute/lucid/>

⁹³ http://www.fs.fed.us/institute/lucid/final_report/LUCID_Management_Edition.pdf

⁹⁴ <http://www.cnr.colostate.edu/RES/srr/>;
<http://www.unr.edu/mines/smr/>



Steps in the design of a monitoring program (Noon et al. 1999)

Ecosystems provides another broad set of indicators, as does the Interagency Working Group on Sustainable Development Indicators.^{95 & 96}

The authors and the participants at the workshops have suggested a number of improvements. We anticipate that any changes will be evolutionary and not revolutionary, because it will be important to be able to compare future estimates with the estimates in this report and because many stakeholders have interests in the current C&I. A number of areas exist, however, in which the C&I can be improved. For example, the technical workshops found that none of the indicators measure genetic diversity, and those labeled "genetic diversity" actually measure other aspects of species diversity.⁹⁷ The review and revision of the C&I should be a collaborative process involving the domestic and international stakeholders. The domestic stakeholder group that developed the C&I has largely evolved into the Roundtable on Sustainable Forests, and that group would provide a good forum for the review and revision.⁹⁸ Federal agency efforts to review and revise the C&I should be coordinated through the Sustainable Forest Data Working Group of the Federal Geographic Data Committee, which is responsible for implementing the Federal MOU on Sustainable Forest Management Data.⁹⁹

What Should Be Done To Improve Regional and Local Access to Information?

A major issue at the stakeholder workshop in Portland, OR, was the need to provide C&I information at the regional and local levels.¹⁰⁰ This report provides information at the national level. We need to provide the same information at the regional and local levels to support sustainable forest management. In addition, we need the ability to "scale up" local and regional information to better understand national trends, while at the same time ensuring that information on local "hot spots" is not lost. The USDA Forest Service's LUCID project has made some progress at the forest management unit level, but its C&I differ from the national C&I.¹⁰¹ Although important scale issues in moving from the national level to the regional and local levels must be considered, compatible indicators at the different levels would be very desirable.

The data used for the national report exist at the regional and local levels for only a few of the indicators (see indicator 61). For indicators in which regional and local levels do not exist, data is sometimes collected but is not available in an accessible form. According to indicator 61, a total of 9 indicators use modeled data and another 11 have data that is incomplete. For

most (39) indicators, the data is regional with some national, which means a breakdown for all regions is not possible. At this time, 59 of the 67 indicators do not allow for complete reporting of regional data.

While regional reports probably would be possible, the need for reports at smaller and smaller scales will always exist, and the number of possible reports would be prohibitive. A better approach would be to improve accessibility of the data at local levels and provide an automated procedure for summarizing and analyzing the data at that level. This is already possible with some datasets; but producing a report on all the indicators at a local level would be especially challenging because of the difficulty in accessing and merging all the data. Considerable effort would be required to make data for all the indicators available at the regional and local levels, but much interest in that information continues.

What Can Be Done To Advance Sustainable Forest Management in the United States?

With this report, we begin an important national dialog on how we can improve our ability to assess forest sustainability, and how public and private landowners can use existing knowledge in the management of our Nation's forests. This national dialog should address the following questions:

- How can we demonstrate through results on the ground our commitment to sustainable forest management?
- How can we develop the public trust and confidence necessary to achieving those results?
- What can we do to broaden and deepen the collaboration embodied by the Roundtable on Sustainable Forests?
- How can we help the public better understand forest sustainability and what needs to be done to improve it?
- How can we bring the principles of sustainability to bear on policies and programs?
- What should we do to improve the collection, analysis, and reporting of each indicator?
- How can we use the findings of this report to better understand the interactions within and among economic, social, and environmental systems?

This report provides factual information. It explains what we know and do not know about forest sustainability. But this report will cause no change by itself. People—landowners, land managers, stakeholders, members of the public—cause changes to occur.

Our actions speak louder than words. This report gives us a golden opportunity to better understand sustainable forest management and to immediately begin doing what we know needs to be done on the ground to improve forest sustainability.

⁹⁵ <http://www.heinzctr.org/ecosystems/>

⁹⁶ <http://www.sdi.gov/>

⁹⁷ http://www.sustainableforests.net/C&I_workshops/ci_workshops.html

⁹⁸ <http://www.sustainableforests.net/>

⁹⁹ <http://www.pwrc.usgs.gov/brd/sfd.htm>

¹⁰⁰ http://www.sustainableforests.net/C&I_workshops/Summary_Review_WS_Portland_0206.PDF

¹⁰¹ <http://www.fs.fed.us/institute/lucid/>

