



# SCIENCE BIODIVERSITY and SUSTAINABLE FORESTRY

A FINDINGS REPORT OF  
THE



NATIONAL  
COMMISSION  
ON SCIENCE  
FOR SUSTAINABLE  
FORESTRY

A Program Conducted by the



National Council for Science and the Environment  
*Improving the scientific basis for environmental decisionmaking*

## NCSE

NCSSF operates under the auspices of the National Council for Science and the Environment (NCSE), a non-advocacy, not-for-profit organization dedicated to improving the scientific basis for environmental decision making.

NCSE promotes interdisciplinary research that connects the life, physical, and social sciences and engineering.

Communication and outreach are integral components of these collaborative research efforts that link scientific results to the needs of decision makers.

**The mission of the National Commission on Science for Sustainable Forestry** (NCSSF or Commission) is to improve the scientific basis for developing, implementing, and evaluating sustainable forestry in the United States.

The Commission is an independent, non-advocacy, multi-stakeholder body that plans and oversees the NCSSF program. It includes 16 leading scientists and forest management professionals from government, industry, academia, and environmental organizations—all respected opinion leaders in diverse fields with broad perspectives. Members serve as individuals rather than as official representatives of their organizations. The Commission convenes at least twice a year to plan and oversee the program. Members' names and affiliations are listed on page 2.

The primary goal of the NCSSF program is to build a better scientific underpinning for assessing and improving sustainable forest management practices. The program strives to produce information and tools of the highest technical quality and greatest relevancy to improving forest policy, management, and practice.

The initial five-year phase of the program focuses on the relationship between biodiversity and sustainable forest management. The program addresses information needs for managed forestlands, both industrial and non-industrial, in the continental United States. Syntheses and surveys, research and assessments, tool development, and communication and outreach activities all contribute to the program's goals.

The Commission does not promote specific policy positions, promulgate management practices, or endorse any particular sustainable forest management certification systems. However, the results of the NCSSF program provide a stronger scientific basis for evaluating forest practices and certification systems, comparing them more objectively, effectively assessing their progress, and developing more innovative approaches to forest management.

Applications of the Commission's work include:

- informing forest management decisions, conservation plans, and governmental and private sector policies
- providing a sound ecological framework for long term economic management of forests
- refining and evaluating certification systems such as the Forest Stewardship Council (FSC), American Tree Farm System (ATFS), Green Tag, and Sustainable Forestry Initiative (SFI).

More information on the NCSSF program and results of specific projects are available on our web site at: [www.ncssf.org](http://www.ncssf.org).

*Sponsors of the National Commission on Science for Sustainable Forestry*



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**Washington, DC  
January 4, 2005**

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# COMMISSION MEMBERSHIP—2004

Hal Salwasser, PhD, Commission Chairman (2003-2005)  
Dean, College of Forestry  
Oregon State University

Greg Aplet, PhD  
Senior Forest Scientist  
The Wilderness Society

Ann Bartuska, PhD  
Deputy Chief, Research & Development  
USDA Forest Service

Joyce Berry, PhD  
Dean, College of Natural Resources  
Colorado State University

James Brown  
Natural Resources Policy Director, Retired  
Oregon Governor's Office

Bruce J. Cabarle, PhD  
Director, Global Forestry Programs  
World Wildlife Federation

Norm L. Christensen, PhD (chair 2002-2003)  
Professor of Ecology  
Nicholas School of the Environment, Duke University

Nils Christoffersen  
Deputy Director  
Wallowa Resources

John C. Gordon, PhD (chair 2001-2002)  
Pinchot Professor of Forestry (Emeritus)  
Yale School of Forestry and Environmental Studies

Sharon Haines, PhD  
Manager of Sustainable Forestry  
International Paper

Alan A. Lucier, PhD  
Senior Vice President  
National Council for Air and Stream Improvement

David Perry, PhD  
Professor (Emeritus)  
Oregon State University

H. Ronald Pulliam, PhD  
Regents Professor of Ecology  
University of Georgia

V. Alaric Sample, PhD  
President  
Pinchot Institute for Conservation

Tom Thompson  
Deputy Chief, National Forest System  
USDA Forest Service

Scott Wallinger  
Senior Vice President (Retired)  
Mead Westvaco, Forest Science Laboratory

---

J. Christopher Bernabo, PhD  
Director, NCSSF Program  
National Council for Science and the Environment

Aaron Lien  
Program Coordinator, NCSSF  
National Council for Science and the Environment

---

## Former Commission Members

Charles H. Collins  
Managing Director  
The Forestland Group, LLC.  
2001-2002

Wallace Covington, PhD  
Regents Professor of Forest Ecology  
Northern Arizona University  
2001-2003

Phil Janik  
Chief Operating Officer (Retired)  
USDA Forest Service  
2001-2002

Mark Schaefer, PhD  
President and CEO  
NatureServe  
2001-2003

Mark Schaffer, PhD  
Program Officer for the Environment  
Doris Duke Charitable Foundation  
(Formerly Defenders of Wildlife)  
2001-2003

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# OVERVIEW

The National Commission on Science for Sustainable Forestry (NCSSF or Commission) includes leading scientists and forest management professionals from government, industry, academia, and environmental organizations who collaboratively plan and oversee the NCSSF program. This independent, multi-stakeholder character enables the Commission to serve as an “honest broker” who can address controversial issues more objectively. The Commission has completed about half of its initial five-year program to advance the science and practice of biodiversity conservation in sustainable forestry.

The Commission has found that appropriate forest policies and practices can be beneficial to biodiversity. While gaps in knowledge remain, the Commission’s findings will help forestry practitioners working in the field, forest managers, and policy makers do a better job of conserving biodiversity within the context of sustainable forestry. These groups are the primary audience for this report because they can use NCSSF’s findings to develop and apply policies and practices that will conserve biodiversity more effectively. NCSSF also produces technical reports for use by researchers.

The Commission identified the major obstacles that practitioners, managers and policy makers face in applying sustainable forestry policies and practices through a nationwide survey and users’ workshops conducted in partnership with the National Forest Foundation (NFF). The users identified four major barriers to sustainable forestry, in priority order they are: (1) lack of data

and information, (2) polarization within the field, (3) misperceptions and lack of public awareness, and (4) lack of financial resources. The NCSSF program addresses the first three of these, which comprise more than three-fourths of the users’ identified barriers.

The Commission has synthesized existing information into useable knowledge, sponsored projects to fill key research gaps, developed tools for practical applications, and reached agreement on important issues related to biodiversity and sustainable forestry. The findings presented here are based on the results of NCSSF-funded projects, the Commissioners’ expertise, and three years of dialogue among themselves, as well as discussions with a wide range of experts and stakeholders. The NCSSF findings are an especially valuable resource for the broad forestry community because a wide range of sources have been reviewed, assessed and synthesized into consensus judgments by a credible independent body of diverse experts and representative stakeholders.

The greatest threat to forest sustainability and biodiversity lies in conversion of forestlands to other uses. This often results when markets undervalue natural systems and populations. With demands on forests increasing, not all forests can sustain the same benefits at all times. Forest reserves are necessary but insufficient for biodiversity conservation. In that context, NCSSF offers initial findings in four areas.

**Area 1:** The effectiveness of biodiversity conservation is largely determined by interactions between stand- and landscape-level patterns.

- **Finding 1A.** Biodiversity conservation requires knowledge and policies that cross landscape levels.
- **Finding 1B.** Stand-level diversity is heavily influenced by disturbance legacies.
- **Finding 1C.** Biodiversity correlates to spatial variability in forest management.
- **Finding 1D.** Forest fragments support reduced levels of biodiversity.

*Implications:* Landscape-level information is necessary to the full use of science in conservation efforts everywhere. The problem with a top-down, “how should the world look proportionally?” view of scientific findings is that a single management organization generally can’t change the mix of ownerships and management practices. Most landowners can’t control or influence both policy and ownership-level activities in combination. A further complication is that the specifics of many landscape-level management strategies can’t be generalized.

**Area 2:** Sustaining disturbance dynamics within appropriate ranges sustains biodiversity and ecosystem services.

- **Finding 2A.** The historical range of variation (HRV) is a useful but limited concept for managing biodiversity.
- **Finding 2B.** Fire significantly influences patterns of biodiversity within and among forest ecosystems.

- **Finding 2C.** An interdisciplinary scientific approach is necessary to address invasive species.
- **Finding 2D.** Variations in disturbance dynamics are often connected to changes in climate, human land use and management.

*Implications:* Departures from the historical range of variation (HRV) will often have adverse consequences for native biodiversity. The HRV concept must be updated and adapted with new information, such as data about climate change, invasive species, and fragmentation, to create a “future range of variation” (FRV). Attempting to restore ecosystems to a single set of conditions that existed before European settlement of North America won’t suffice because strategies must consider each site’s historical legacies and composition as well as climate forecasts and other anticipated future changes. Management efforts should focus on sites with the highest biodiversity values.

**Area 3:** Biodiversity indicators must be matched to land-use objectives.

- **Finding 3A.** Biodiversity is too broad a concept and too variable across forest types to be represented by a universal set of indicators.
- **Finding 3B.** Clear objectives and processes are crucial to selecting appropriate sets of indicators.

- **Finding 3C.** A logically structured process is needed for selecting indicators.
- **Finding 3D.** An effective set of indicators includes three different types that cover five separate functions.

*Implications:* Indicators are a relatively few measures that provide information about the status of as many unmeasured biodiversity elements as possible. There is a need to rethink the role of indicators and how they are selected and used in certification systems or regulatory programs. NCSSF found that commonly measured and monitored features of forestry, that were described by practitioners as biodiversity indicators, are not always congruent with the indicators best suited for measuring biodiversity values. An NCSSF-sponsored tool (Project A8) provides a flexible system to select indicators tailored to sustaining specific biodiversity values.

**Area 4:** Sustainable forestry and biodiversity conservation require management that recognizes and adapts to new information, changing environments, and shifting social priorities.

- **Finding 4A.** Management practices must adapt to evolving knowledge.
- **Finding 4B.** Biodiversity conservation requires traditional forestry practices and more.
- **Finding 4C.** Forest management under different ownership types has implications for biodiversity.

- **Finding 4D.** The increasing interest in and gathering of non-timber forest products has both positive and negative implications for sustaining biodiversity.
- **Finding 4E.** Effective management is benefited by access to accurate relevant information and decision support tools.
- **Finding 4F.** Biodiversity conservation theories require adaptive management to assess their validity.

*Implications:* Developing and applying cost-effective conservation strategies and practices can enhance biodiversity, but biodiversity conservation efforts are constrained by tract size and history, ownership patterns, and overall management goals. Uncertainties about complex interactions highlight the growing importance of using adaptive management approaches that bring scientists, managers, and stakeholders together to collaboratively analyze and assess policies, plans, and practices.

Over the next two years, NCSSF’s ongoing work will yield additional useful findings. Equally important, we will generate additional practical tools—based on science and tested for their utility—to enable practitioners to achieve more progress where it counts: across America’s diverse forest landscapes. The gaps that are revealed along the way will highlight areas where new research is most needed for further progress on the ground in the future.

# 1 INTRODUCTION

## The Commission's Role

**T**he National Commission on Science for Sustainable Forestry (NCSSF or Commission) is working to improve the scientific basis of sustainable forestry practice, management, and policy. NCSSF is funded by a consortium of foundations whose leaders recognize the need for better science to support sustainable forestry and biodiversity decisions. These sponsors include the Doris Duke Charitable Foundation, the Surdna Foundation, the Packard Foundation, and the National Forest Foundation.

NCSSF is unique in using a diverse group of stakeholders and experts to collaboratively plan and oversee a science program designed to yield results relevant to sustainable forestry applications. To ensure that the program includes both the best science and the most useful applications, about half of the Commission's 16 members are "producers" of information (researchers/educators) and the other half are "users" of that information (practitioners/decision makers). All of the members are leading professionals drawn from diverse sectors, including government, industry, academia, and environmental organizations.



BUREAU OF LAND MANAGEMENT

As an independent, multi-stakeholder body, the Commission works to develop consensus on the science and its implications, as well as finding and filling gaps in understanding and developing the tools needed to implement and evaluate sustainable forestry in the United States.

The Commission and its sponsors agreed that NCSSF would focus the program's first five-year phase on the critical intersection of biodiversity and sustainable forestry, an area with major gaps in understanding and lack of available tools. The potential benefits to society of forests on any geographic scale ultimately depends on the mix of plants and animals that comprise the forest. Better scientific understanding of biodiversity will provide a context for addressing the social, ecological, and economic aspects of sustainable forestry.

Through ongoing discussions among themselves and with stakeholders, the Commissioners:

- identify users' information needs
- define specific projects to meet users' needs
- integrate and interpret the program's results
- communicate the results and findings.

Priority needs identified by the Commission become requests for proposals (RFPs). To encourage the best qualified investigators and organizations to compete for the work, the RFPs are issued publicly on the NCSSF web site, advertised in journals, and sent by e-mail to thousands of potential applicants.

External review panels, composed of practitioners as well as scientists, evaluate submitted proposals to select those that are both of the highest technical quality and most relevant to users' needs. NCSSF also conducts projects and communication activities led by Commission members and other recognized leaders, as well as program staff.

Commission members remain actively engaged through the life of each project, serving as project stewards who oversee the research by tracking progress from inception to final product. This also provides a first level of critical review and establishes a relationship between researchers and the Commissioners. During its first three years, the Commission provided an average of more than



**Figure 1**

NCSSF Role Linking Science and Management Needs



\$1 million in project funding annually. This is less than 1% of total U.S. forestry research funding, so NCSSF has focused its efforts on filling the science gaps most crucial to advancing biodiversity conservation in the context of sustainable forestry.

In planning and implementing the program, the Commission uses adaptive management techniques, conducting research and outreach activities and then applying what has been learned to the next annual round of activities. The Commission regularly invites users to define their information needs by using surveys, public meetings, and workshops that bring producers and users together for mutual learning.

As the NCSSF program produces new tools and information, the Commission holds applications workshops to provide small groups with hands-on experience using NCSSF-funded products. This experience helps users understand the project results and provides feedback to the producers on how to improve their products to make

them more effective for practical applications.

Through a nationwide survey and workshops jointly conducted by NCSSF and the National Forest Foundation (NFF), NCSSF's target audience of information users identified the lack of data and information (Figure 2) as the most common barrier to sustainable forest management (SFM). The NCSSF program directly addresses this gap as its top priority, sponsoring projects to improve the information and tools available to implement and evaluate SFM approaches.

NCSSF's multi-stakeholder, consensus-building approach to identifying research needs and interpreting research results is intended to reduce polarization, the second most common barrier. The Commission's program and outreach activities help improve general awareness of technical issues and provide objective information to address public misperceptions, the third barrier.

## The NCSSF Program

The NCSSF program is science-based and results-oriented, with an emphasis on developing knowledge and tools that are most directly relevant to improving sustainable forestry over the next five to ten years. NCSSF addresses users' priority needs through four program areas:

- **Synthesis and Surveys:** Projects to evaluate and document the existing knowledge base, data, and models. Synthesizing and effectively communicating existing information is at least as important as developing new information and protocols that support biodiversity goals.

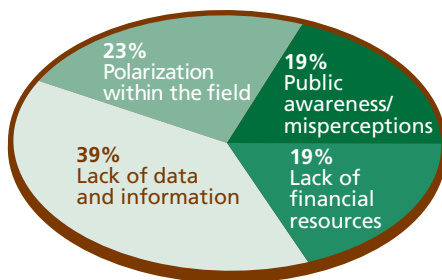
- **Research and Assessments:** Projects to develop relevant new knowledge and to assess the significance of current scientific understanding for improving sustainable forestry and biodiversity conservation.
- **Tool Development:** Projects to develop new tools to assess biodiversity trends, forest health, ecosystem functions, and decision support systems (DSSs) to provide scientific understanding in usable forms to help improve decision making.
- **Communication and Outreach:** Proactive efforts that involve stakeholders in the program to enhance the relevancy and acceptance of the results. Program results are widely communicated and disseminated through the NCSSF web site, workshops, symposia, briefings, reports, peer-reviewed journal articles, and popular publications.

Table A-I in the Appendix (pg. 46) lists NCSSF's projects and major activities to date, and Table A-II (pg. 49) shows the general timeline for the first five years of the NCSSF program.

## Report Purpose and Organization

The Commission has reached agreement on many important issues related to biodiversity and sustainable forestry. The findings presented in this report have value to the broad forestry community because this independent body of diverse stakeholders and experts has served as an "honest broker" as it reviewed and assessed a wide range of resources and synthesized them into consensus judgments.

**Figure 2**  
Obstacles to Sustainable Forestry



Source:  
NCSSF–NFF Users' Needs Workshops 2003

This report presents the Commission’s findings to date about sustainable forestry and biodiversity conservation, based on the results to date of NCSSF-funded projects and the Commissioners’ deliberations over the last three years. This Findings Report is intended primarily for readers who will use the information to make decisions—working foresters in the field, forest managers, and policy makers. NCSSF also produces technical reports and scientific journal publications to inform the research community.

- **Section 1, “Introduction,”** provides an overview of the Commission’s role and how the Commission defined the emphasis of the first five years of program activity.
- **Section 2, “Context,”** outlines the Commission’s consensus on major issues in biodiversity and sustainable forestry, developed through three years of dialogue among Commissioners and with stakeholders, and which guides priorities for the NCSSF program.
- **Section 3, “Findings and Implications,”** provides the major findings of the Commission to date and discusses the implications of those findings for sustainable forestry and biodiversity.
- **Section 4, “Work in Progress,”** outlines NCSSF projects currently underway, including work that expands upon new knowledge generated through the earliest NCSSF research efforts.

## Defining Terms Used in the Report

**Sustainable forestry** is the suite of forest policies, plans, and practices that seek to sustain a specified array of forest benefits in a particular place. Sustainability is a process and a goal, not a single end-point condition. The suite of benefits may include various values, uses, products, functions, and services from forests, including but not limited to wood, recreation, water quality, biodiversity, and atmospheric processes. This definition of sustainable forestry recognizes that not all forests can be expected to—or are capable of—sustaining the same suite of benefits at all times. The place can range from as small as a single tract of forest to an area the size of watersheds, states, regions, nations, or the world. As the defined place increases to the scale of a state or nation, the suite of forest benefits to be sustained increases to approach all possible values. The length of time over which the array of benefits is to be sustained in a particular place varies, but is commonly thought of in terms of decades or centuries rather than years, and it may be influenced over time by changes in demand for forest products and services, new information and technologies, changing environments and shifting social and economic values.

**Biological diversity** refers to the variety and abundance of all life forms in a place—plants, ani-

mals and other living organisms—and the processes, functions, and structures that sustain that variety and allow it to adapt to changing circumstances. This includes the complexity of gene pools, species, communities, and ecosystems at spatial scales from local to regional to global. It is also known simply as “biodiversity” or natural heritage, and commonly includes all of the plants, animals, and other organisms native or indigenous to a place. Biodiversity is the first of seven Montreal Process Criteria and Indicators (C&I), developed after the 1992 United Nations Conference on Environment and Development to assist countries to inventory the elements of sustainable forestry.

The following terms are used frequently throughout this report:

- **Forest structure** is the physical distribution of components of a forest including height, diameter, crown layer, and stems of trees, shrubs, non-woody understory plants, snags (standing dead trees), and downed woody debris.
- A **watershed** is an area drained by a single stream, river, or drainage network.
- **Landscape** is a general term that may imply scales from small watersheds to regions.
- A **stand** is a distinguishable, contiguous area of trees reasonably similar in age, composition, and structure.
- A **patch** is a relatively uniform area of vegetation that differs from its surroundings.

The NCSSF website at [www.ncssf.org](http://www.ncssf.org) contains more detailed information, including: summaries of projects in plain English, technical project reports for completed NCSSF projects, and abstracts of ongoing projects. The web site also contains summaries of past NCSSF sponsored meetings and workshops, a calendar of events, and an online version of this report.