This annual technical report is a product of the Forest Health Monitoring (FHM) Program. The report provides information about a variety of issues relating to forest health at a national scale. FHM national reports have the dual focus of presenting analyses of the latest available data and showcasing innovative techniques for analyzing forest health data. The report is organized using the Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests (Anon. 1995) as a general reporting framework.

While FHM is committed to reporting annually on the state of U.S. forests, there are not always enough new data available to warrant reporting on each indicator every year. In this report, indicators are included if a substantial amount of new data has become available since they were last reported by FHM, or if progress in the development and application of analytical techniques has enabled FHM to use the data to provide new insights into the health of U.S. forests. Earlier reports have strongly focused on indicators of forest condition and on levels of stressors that may be affecting forest health. In this report we also examine some of the mechanisms behind the stressors that affect U.S. forests, including the relationship of lightning to forest fires and pathways by which exotic insect pests can be introduced.

The Forest Health Monitoring Program

The FHM Program is a national effort to determine on an annual basis the status of, and changes and trends in, indicators of forest condition. The Forest Service, U.S. Department of Agriculture cooperates with State forestry and agricultural agencies to conduct FHM activities. Other Federal Agencies and universities also participate. The FHM Program has five major activities (Tkacz 2003):

- Detection monitoring—nationally standardized aerial and ground surveys to evaluate status and change in condition of forest ecosystems
- Evaluation monitoring—projects to determine extent, severity, and causes of undesirable changes in forest health identified through detection monitoring
- Intensive site monitoring—to enhance understanding of cause and effect relationships by linking detection monitoring to ecosystem process studies and to assess specific issues, such as calcium depletion and carbon sequestration, at multiple spatial scales
• Research on monitoring techniques—to develop or improve indicators, monitoring systems, and analytical techniques, such as urban and riparian forest health monitoring, early detection of invasive species, multivariate analyses of forest health indicators, and spatial scan statistics.

• Analysis and reporting—synthesis of information from various data sources within and external to the Forest Service to produce issue-driven reports on the status of and change in forest health at national, regional, and State levels.

In addition to FHM’s national reporting, each of the five FHM regions, as well as FHM’s partners both within the Forest Service and in State forestry departments, also produce reports. The regions, in cooperation with their respective States, produce “Forest Health Highlights” (available on the FHM Web site at www.fhm.fs.fed.us); State reports such as Keyes and others (2003), Laustsen and others (2003), Neitlich and others (2003), Steinman (2004), and Snyder (2006); and other forest health reports, such as Morin and others (2006) and Cumming and others (2006). FHM and its partners also produce reports on monitoring techniques and analytical methods, such as Smith and Conkling (2004) and O’Neill and others (2005).

**Data Sources**

The FHM Program strives to use a variety of data collected by the various branches of the Forest Service as well as data from other sources. A major data source is the Forest Service’s Forest Inventory and Analysis (FIA) Program. The FIA Program’s phase 2 consists of plots measured at regular intervals to collect data associated with traditional forest inventories. FIA’s phase 3 plots are a subset of the phase 2 plots. On phase 3 plots additional data are collected on many of the forest health indicators that were previously measured as part of the FHM detection monitoring ground plot system (Palmer and others 1991).

For this report, Forest Service data sources were: FIA periodic inventory and annualized phase 2 survey data (1990–2003); FIA phase 3 data—crown condition (2000–04), lichens (1998–2003); and Forest Health Protection (FHP) aerial survey data.

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About the Report

In this report we used the Santiago Declaration and accompanying criteria and indicators (Anon. 1995, Montreal Process Working Group 1999) that were adopted by the Forest Service as a forest sustainability assessment framework (Smith and others 2001, U.S. Department of Agriculture Forest Service 2004). The seven criteria are:

Criterion 1—conservation of biological diversity
Criterion 2—maintenance of productive capacity of forest ecosystems
Criterion 3—maintenance of forest ecosystem health and vitality
Criterion 4—conservation and maintenance of soil and water resources
Criterion 5—maintenance of forest contribution to global carbon cycles
Criterion 6—maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies
Criterion 7—legal, institutional, and economic framework for forest conservation and sustainable management

A complete evaluation of all the sustainability criteria is not appropriate here. We focus on criterion 3, which is directly related to issues of forest health.

Bailey’s ecoregion sections and provinces (Bailey 1995) as revised (Cleland and others 2005) were used as the assessment units for analysis (fig. 1.1) when the spatial scale of the

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4 Chapter 5, “Baseline Results from the Lichen Community Indicator Program in the Pacific Northwest: Air Quality Patterns and Evidence of a Nitrogen Pollution Problem,” is an exception. The analyst used an earlier version of Bailey’s ecoregion section delineations (McNab and Avers 1994) to be consistent with the results of earlier lichen analyses referenced.
Figure 1.1—Ecoregion provinces and ecoregion sections for the continental United States (Cleland and others 2005). Ecoregion sections within each ecoregion province are shown in the same color.
### Eastern ecoregion provinces
- Adirondack—New England Mixed Forest—Coniferous Forest—Alpine Meadow (M211)
- Central Appalachian Broadleaf Forest—Coniferous Forest—Meadow (M221)
- Central Interior Broadleaf Forest (223)
- Eastern Broadleaf Forest (221)
- Everglades (411)
- Laurentian Mixed Forest (212)
- Lower Mississippi Riverine Forest (234)
- Midwest Broadleaf Forest (222)
- Northeastern Mixed Forest (211)
- Ouachita Mixed Forest—Meadow (M231)
- Outer Coastal Plain Mixed Forest (232)
- Ozark Broadleaf Forest (M223)
- Prairie Parkland (Subtropical) (255)
- Prairie Parkland (Temperate) (251)
- Southeastern Mixed Forest (231)

### Western ecoregion provinces
- American Semi-Desert and Desert (322)
- Arizona—New Mexico Mountains Semi-Desert—Open Woodland—Coniferous Forest—Alpine Meadow (M313)
- Black Hills Coniferous Forest (M334)
- California Coastal Chapparal Forest and Shrub (261)
- California Coastal Range Open Woodland—Shrub—Coniferous Forest—Meadow (M262)
- California Coastal Steppe, Mixed Forest, and Redwood Forest (263)
- California Dry Steppe (262)
- Cascade Mixed Forest—Coniferous Forest—Alpine Meadow (M242)
- Chihuahuan Semi-Desert (321)
- Colorado Plateau Semi-Desert (313)
- Great Plains—Palouse Dry Steppe (311)
- Great Plains Steppe (332)
- Intermountain Semi-Desert (342)
- Intermountain Semi-Desert and Desert (341)
- Middle Rocky Mountains Steppe—Coniferous Forest—Alpine Meadow (M332)
- Nevada—Utah Mountains—Semi-Desert—Coniferous Forest—Alpine Meadow (M341)
- Northern Rocky Mountains Forest—Steppe—Coniferous Forest—Alpine Meadow (M333)
- Pacific Lowland Mixed Forest (242)
- Sierran Steppe—Mixed Forest—Coniferous Forest—Alpine Meadow (M261)
- Southern Rocky Mountains Steppe—Open Woodland—Coniferous Forest—Alpine Meadow (M331)
- Southwest Plateau and Plains Dry Steppe and Shrub (315)
available data made such analyses appropriate and when the indicator being analyzed could reasonably be expected to show some pattern relating to ecological regions. This is a national, hierarchical system of ecological units that classifies the United States into ecoregion domains, divisions, provinces, sections, subsections, landtype associations, and landtypes (McNab and others 2005). Ecoregion sections typically contain thousands of square miles. Areas within an ecoregion section are expected to be similar in their geology and lithology, regional climate, soils, potential natural vegetation, and potential natural communities (Cleland and others 1997). Ecoregion sections provide a common framework for an ecologically based assessment.

**Literature Cited**


