

The National Forest Health Monitoring (FHM) Program of the Forest Service, U.S. Department of Agriculture, produces an annual technical report on forest health as one of its products. The report is organized using the Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests (Montréal Process Working Group 2007) as a framework.

This annual report has two objectives. The first is to present information about forest health from a national perspective using various indicators and ancillary data. While in depth interpretation and analysis of specific geographic or ecological regions are beyond the scope of this report, the information is presented to allow identification of areas of interest that may require a closer investigation at a smaller scale. The second objective of the report is to present examples of useful techniques for analyzing forest health data new to the national reports and new applications of techniques formerly used. Examples in this report are in chapter 5, which presents the application of techniques for assessing tree mortality using the annual inventory data collected by the Forest Inventory and Analysis (FIA) Program of the Forest Service, and chapter 6, which presents an approach for analyzing FIA phase 3 ozone bioindicator data.

The Forest Health Monitoring Program

The FHM program is a national effort to assess and report on the status and trends in forest health. The Forest Service cooperates with State forestry and agricultural agencies and other Federal agencies and universities to accomplish these tasks. The FHM Program has five major components (Forest Health Monitoring 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-effect relationships by linking detection monitoring to ecosystem process studies and 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,

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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 status and change in forest health at national, regional, and State levels

The FHM program, in addition to national reporting efforts, has regional and State reporting activities. These reports may be produced with FHM's partners, both within the Forest Service and in State forestry and agricultural departments. Some examples are Keyes and others (2003), Laustsen and others (2003), Neitlich and others (2003), Steinman (2004), Snyder (2006), Lake and others (2006), Morin and others (2006), and Cumming and others (2006, 2007). The Forest Health Highlights series, available on the FHM Web site at <http://fs.fed.us/foresthealth/fhm>, is produced by the FHM regions in cooperation with their respective State partners. 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 tries to use a variety of data from sources both inside and outside the Forest Service. One major source of data is the FIA Program. The FIA Program's phase 2 is the annualized inventory measured on plots at regular intervals. FIA phase 3 plots are a subset of the phase 2 plots. Data for important ecological indicators are collected on phase 3 plots, in addition to traditional forest inventory measurements. These additional forest health indicators were measured as part of the FHM detection monitoring ground plot system prior to the 2000 survey (Palmer and others 1991).¹

In this report, Forest Service data sources include: FHM laurel wilt survey data collected in Florida, Georgia, and South Carolina (2004–07); FHM national sudden oak death survey data (2003–06); FHM plot and lichen data (1994–99); FIA phase 3 lichen data (2000–06); FIA phase 3 vegetation diversity data (2001–04); FIA phase 3 ozone bioindicator data (2003–05); FIA annualized phase 2 survey data (1999–2006); and forest cover data developed from Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery by the Forest Service

¹ Forest Service, U.S. Department of Agriculture, 1998. Forest health monitoring 1998 field methods guide. Research Triangle Park, NC: Forest Service, U.S. Department of Agriculture, National Forest Health Monitoring Program. 473 p. On file with: Forest Health Monitoring Program National Office, 3041 Cornwallis Road, Research Triangle Park, NC 27709.

Remote Sensing Applications Center. Other data sources were: the 2001 high-resolution, national landcover map (Homer and others 2007); road map data from the Environmental Systems Research Institute (Environmental Systems Research Institute 2005); average annual rainfall, average maximum July temperature, and average minimum January temperature (Daly and Taylor 2000); annual deposition of sulfate (SO_4^{2-}), nitrate (NO_3^-), and ammonium (NH_4^+) (Coulston and others 2004); national elevation dataset (U.S. Geological Survey 1999); ambient ozone data (2003–05) (U.S. Environmental Protection Agency 2004); available water capacity data (Miller and White 1998); National Oceanic and Atmospheric Administration Palmer Drought Severity Index data (2003–05) (National Climatic Data Center 1994); aspect and terrain relative moisture index data (U.S. Geological Survey 1993); population density data (U.S. Census Bureau 2004); and redbay mortality data (2006–07) (States of Georgia and South Carolina).

About the Report

We used the Santiago Declaration and accompanying Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests that were adopted by the Forest Service as a forest sustainability assessment framework (Smith and others 2001, Forest Service, U.S. Department of Agriculture, 2004). The seven criteria as listed in the December 2007 revision (Montréal Process Working Group 2007) 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 in this report. Criteria 1 and 3, which are directly related to issues of forest health, are the focus.

When possible, a common ecologically based framework was used for the forest health assessments. Bailey's provinces and ecoregion sections (Bailey 1995, as revised; Cleland and others 2005, 2007) were used as the assessment units for analysis (fig. 1.1) when the spatial scale of the data and expectation of identifiable pattern in the data were appropriate for use of the ecoregion sections. This system of ecologically based units is a national hierarchical

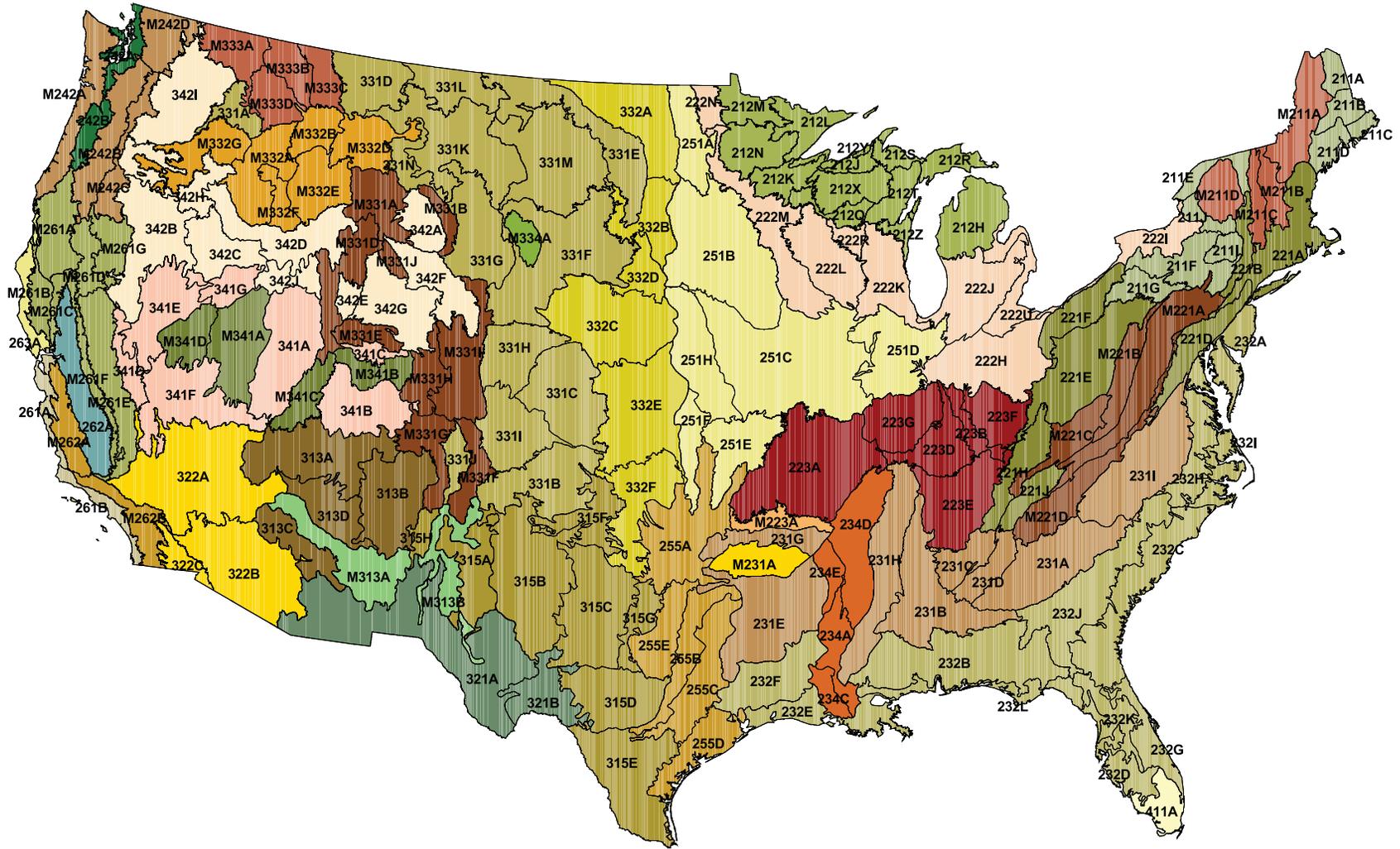


Figure 1.1—Ecoregion provinces and ecoregion sections for the continental United States (Cleland and others 2005). Ecoregion sections within each ecoregion province are shown in the same color.

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 Chaparral 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 (331)
-  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)

system that classifies the United States into ecoregion domains, divisions, provinces, sections, subsections, land-type associations, and land types (McNab and others 2007). Ecoregion sections may contain thousands of square miles and can be expected to have similar geology and lithology, regional climate, soils, potential natural vegetation, and potential natural communities.

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