Forest Health Monitoring

Program Overview

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National Program Manager

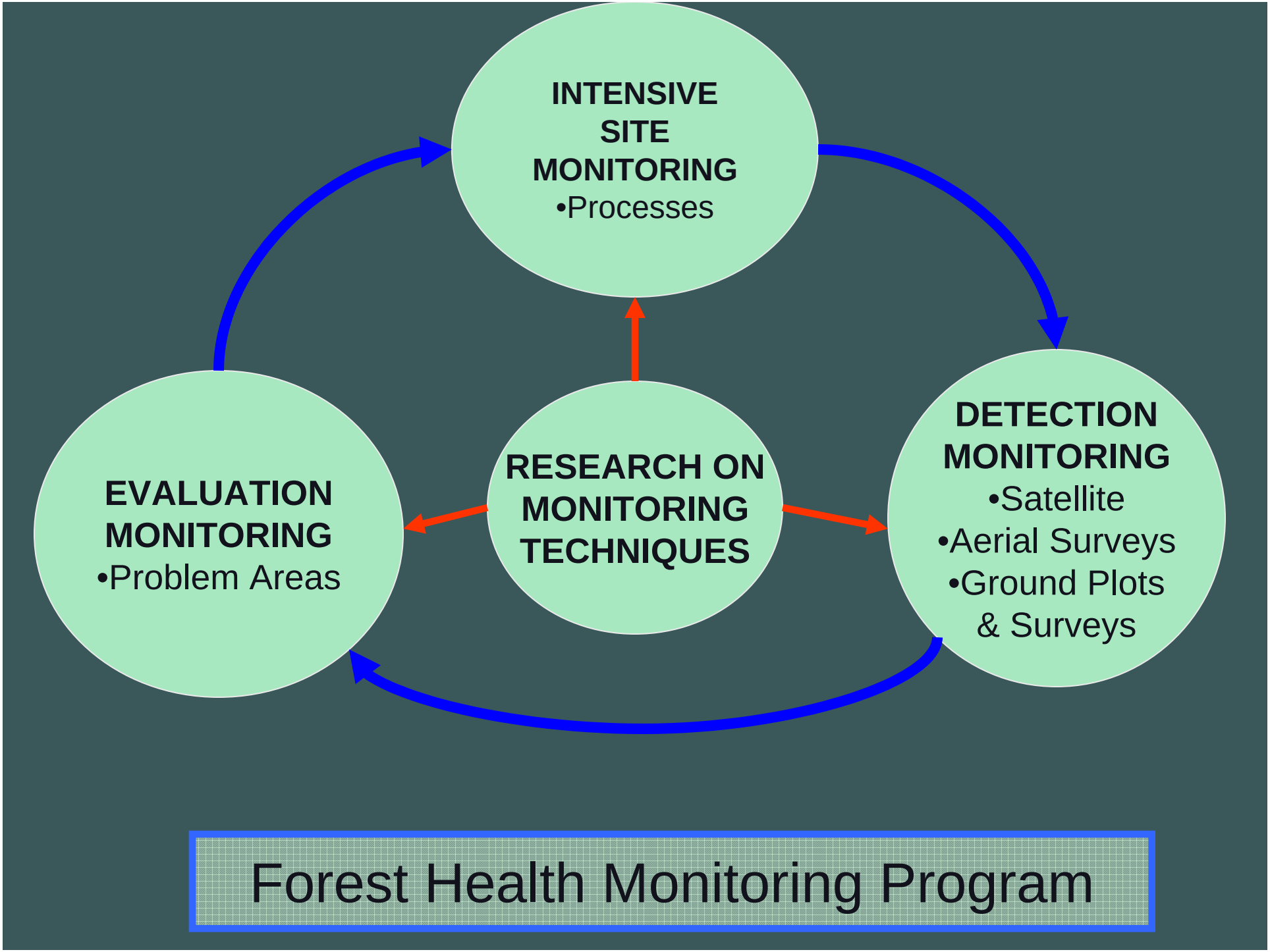
Forest Health Monitoring Program

- Initiated in 1990 to provide information on the status, changes, and trends in forest health and sustainability.
- The FHM program provides information on all forest lands to land-managers and policy makers that affects, directly or indirectly, all Americans.

Forest Health Monitoring(FHM)

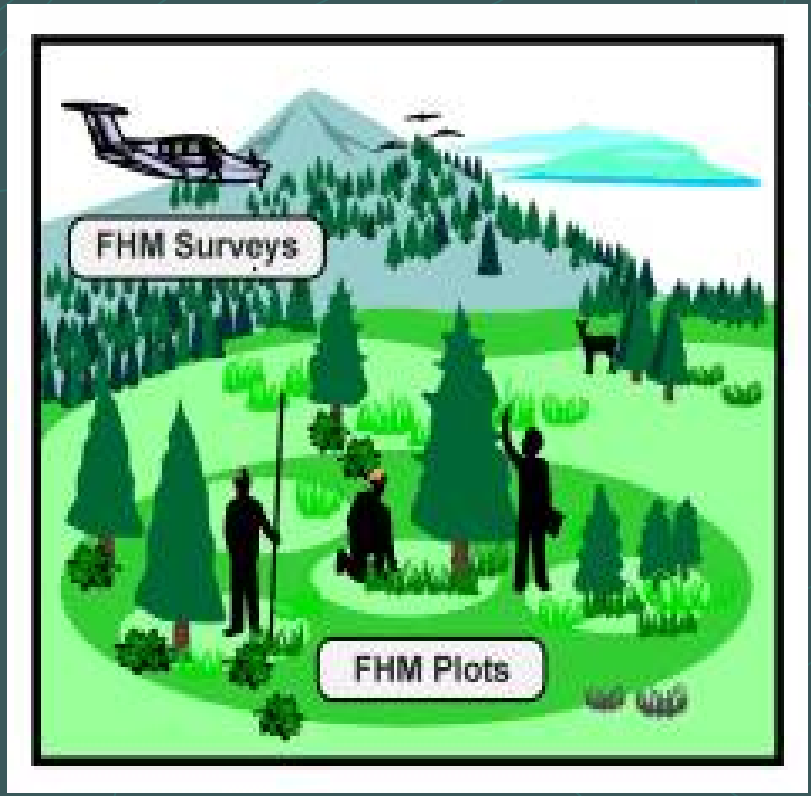
Objectives:

- Establish a monitoring system throughout the forests of the United States to determine detrimental changes or improvements that occur over time.
- Provide baseline and health trend information that is statistically precise and accurate.
- Report annually on status and changes to forest health.

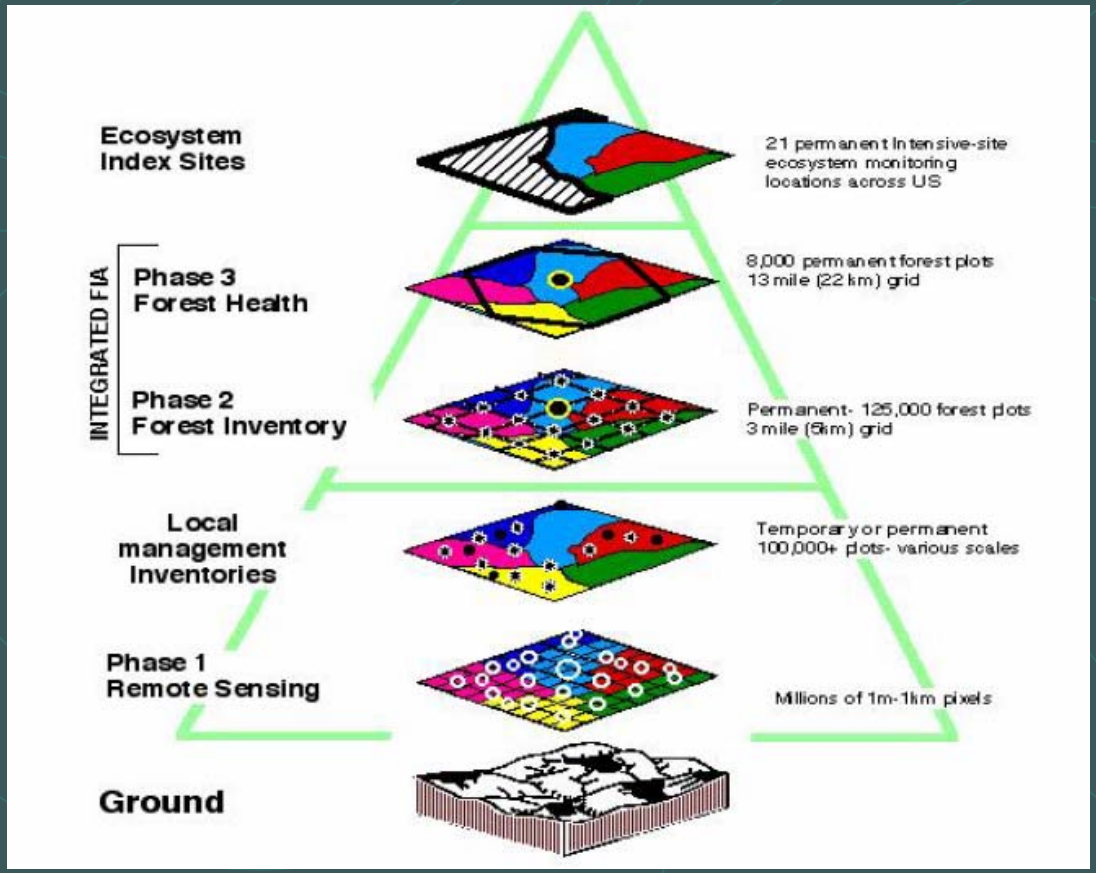

INTENSIVE SITE MONITORING
•Processes
DETECTION MONITORING
•Satellite
•Aerial Surveys
•Ground Plots & Surveys
RESEARCH ON MONITORING TECHNIQUES
EVALUATION MONITORING
•Problem Areas
Forest Health Monitoring Program

Detection Monitoring

- Nationwide grid of permanent sample points
- Aerial damage detection surveys
- Special ground surveys

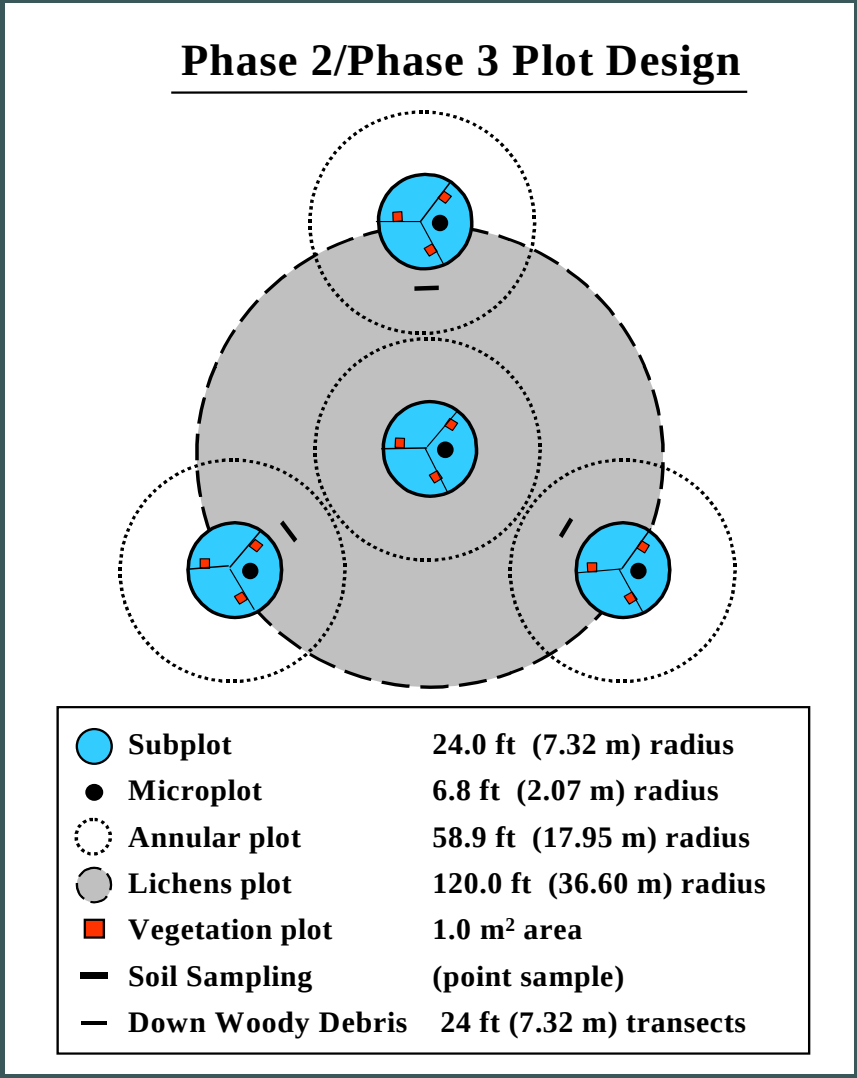


Integrated Monitoring Framework

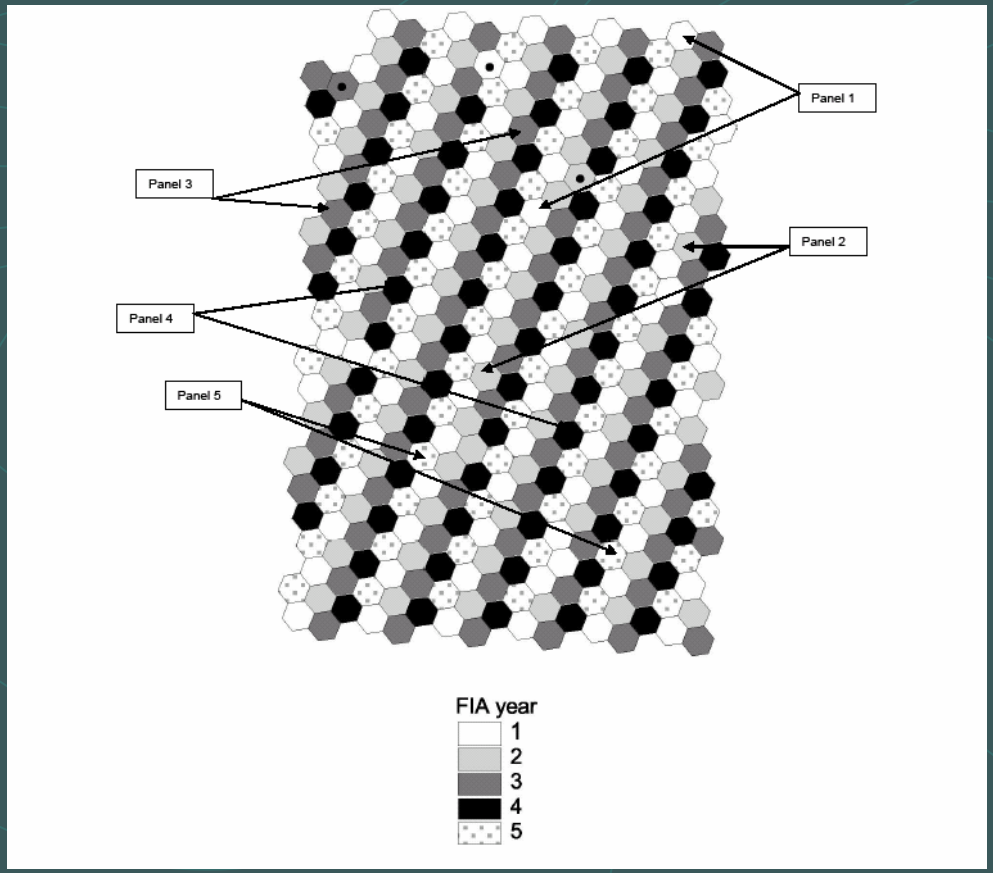


FHM/FIA Plot Integration

- Since 1999 FHM ground plots have been integrated with Forest Inventory and Analysis (FIA) plots
- Phase 2 – Tree Measurements (~125,000 plots, each representing ~6,000 ac.)
- Phase 3 – Health Indicators (~8,000 plots, each representing ~96,000 ac.)
- Each plot measured once every 5 to 10 years

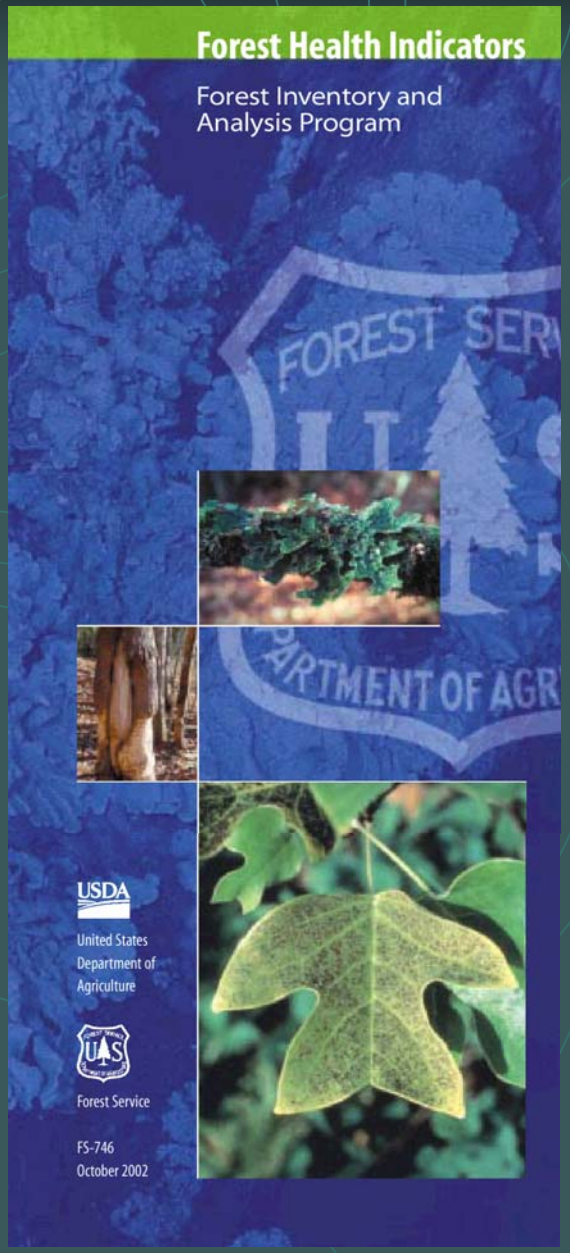


Rotating Panel Design



Forest Health Indicators

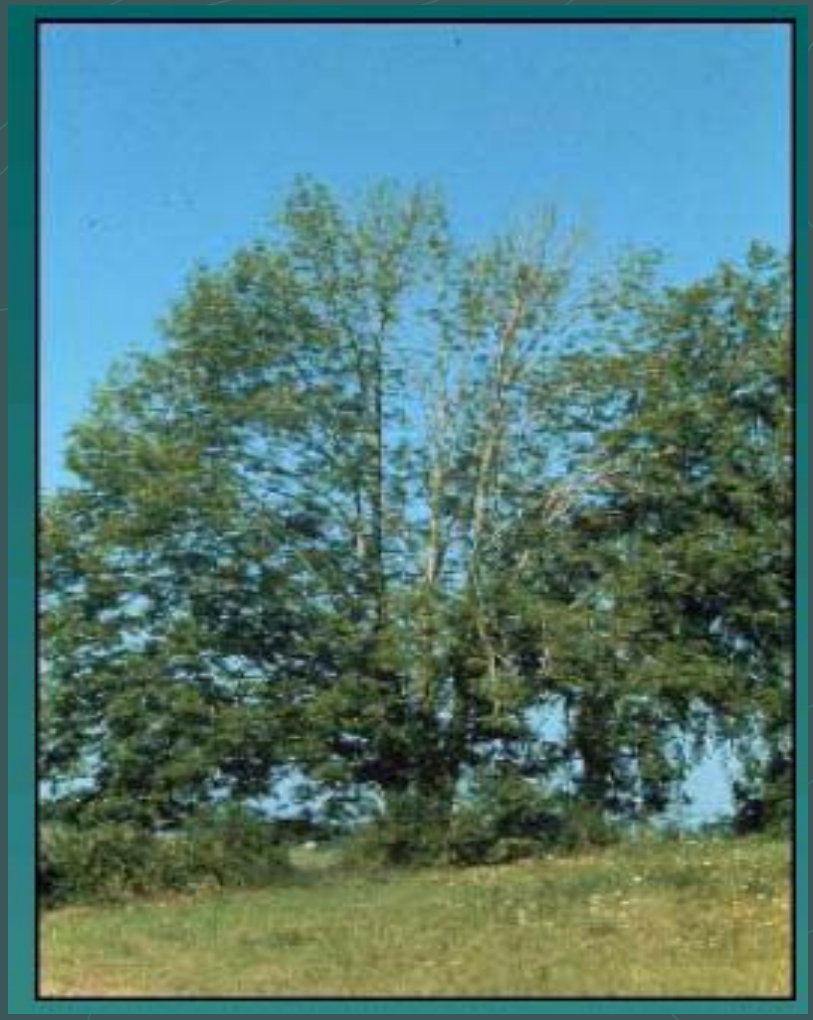
- Tree Growth
- Tree Regeneration
- Tree Crown Condition
- Tree Damage
- Tree Mortality
- Lichen Communities
- Ozone Bioindicator Plants
- Soil Morphology and Chemistry
- Vegetation Structure
- Plant Diversity



http://fia.fs.fed.us

Crown Condition

- Live crown ratio
- Density
- Foliage transparency
- Dieback
- Diameter



Lichen Communities

- Fungi that live in association with algae
- Sensitive to environmental stresses such as air pollution or climate change
- Indicators of forest biodiversity
- Biotic indexes are developed based on pollution and climate gradients

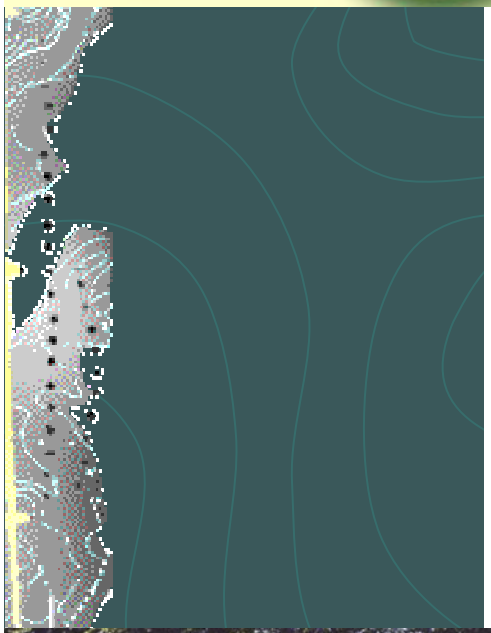
Photo by Stephen Sharnoff

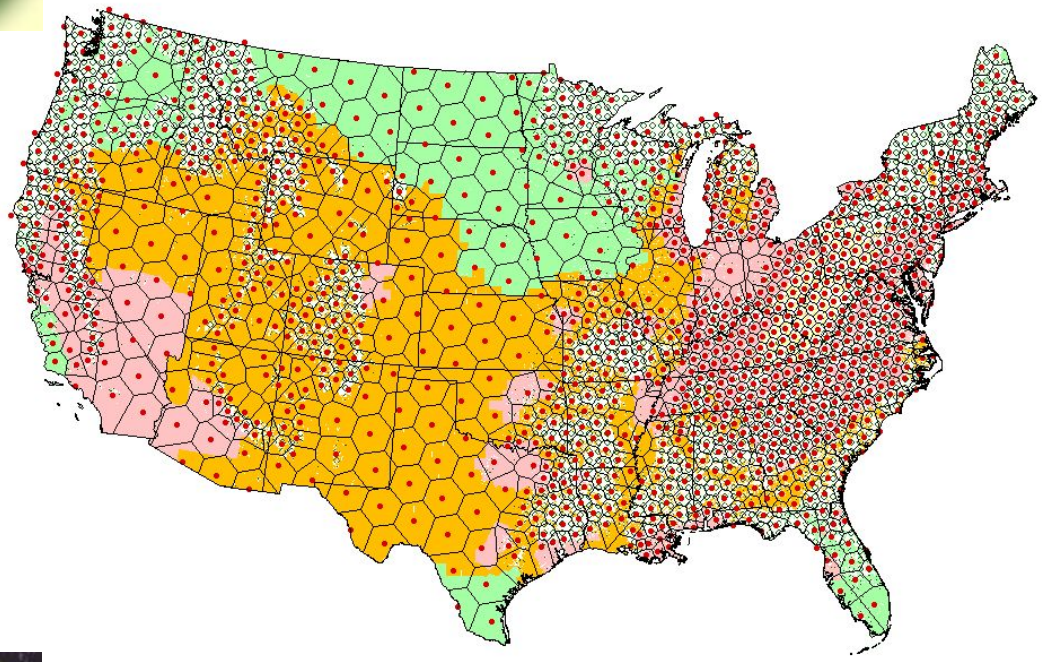
Ozone Injury

- Ozone causes direct foliar injury to many species
- Bio-indicator plants are evaluated for severity of foliar injury
- Sampled on separate plots

Photo by Gretchen Smith

Ozone Biomonitoring





Down Woody Material

- Measurement of fallen trees, dead branches along transects
  - Diameter
  - Length
  - Stage of decay
  - Species
  - Cavities
- Assess fire risk, wildlife habitat, carbon

Photo by Chris Woodall

Vegetation Diversity and Structure

- Type, abundance, and arrangement of plants on plots
- Allows reporting on diversity of native and introduced species
- Monitoring for change over time will be possible by re-measurement

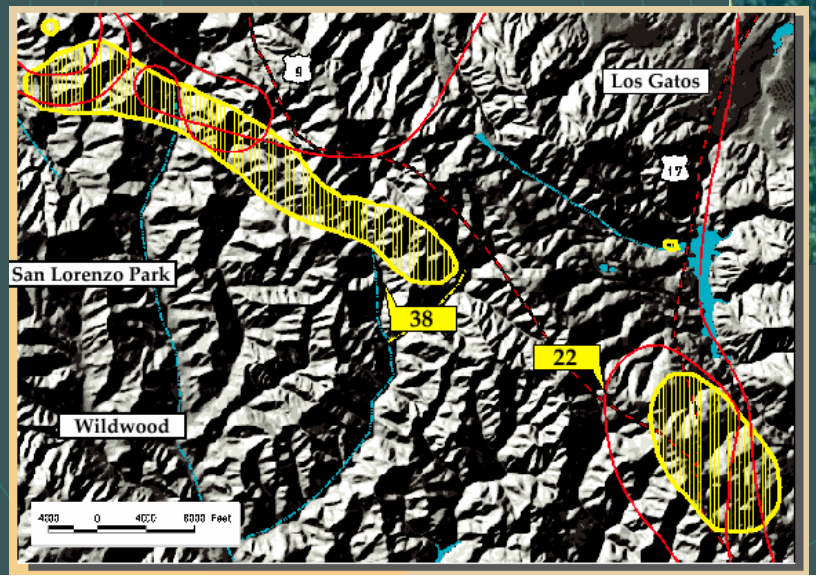
Photo by Will McWilliams

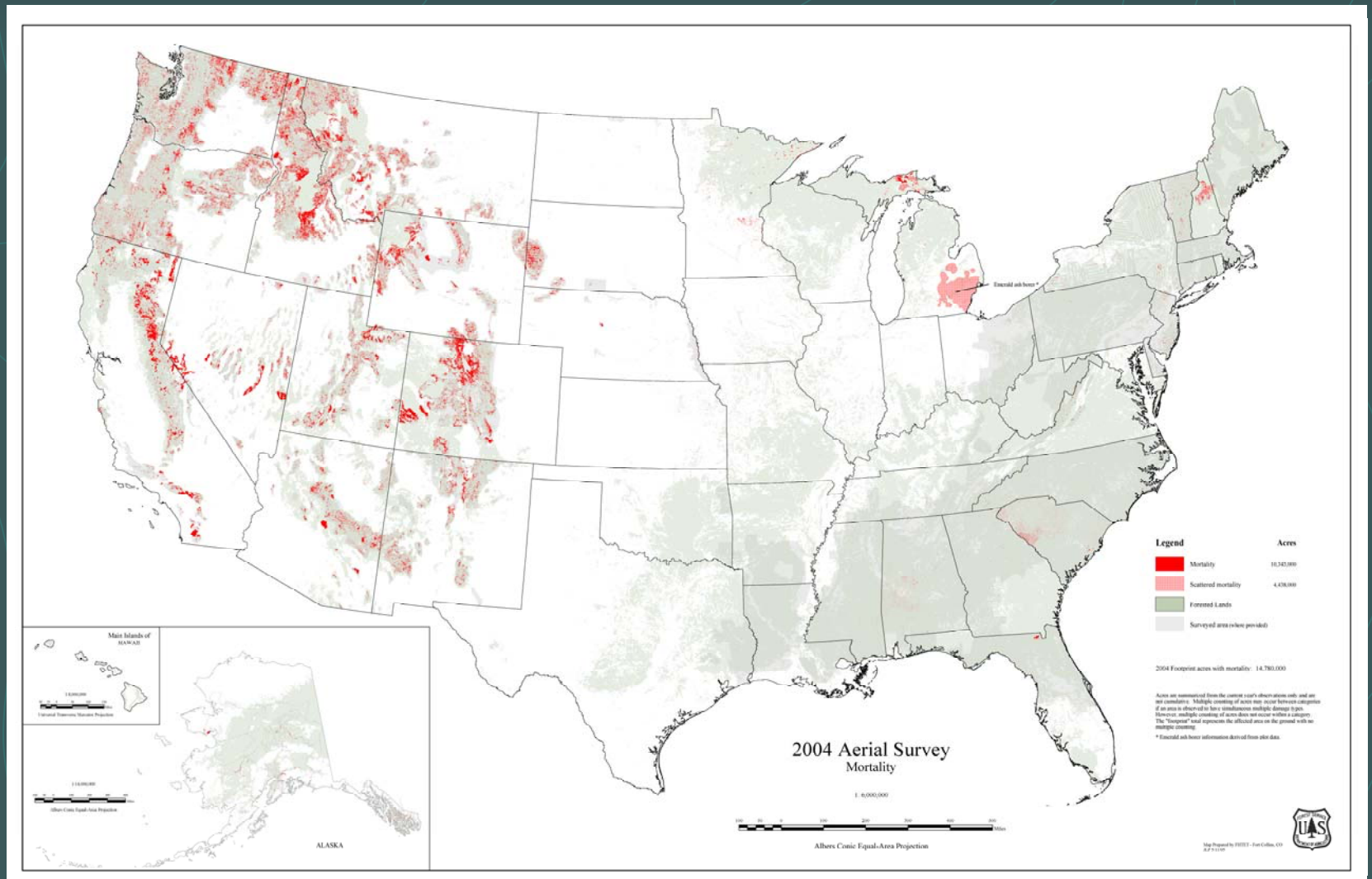
Soil Condition

- Measurement of soil physical properties, compaction, erosion potential
- Soil samples collected for chemical analyses
  - Acidity
  - Exchangeable cations
  - Nitrogen and carbon
  - Toxics
  - Bulk density

Detection Monitoring

- Aerial Detection Surveys
  - Observers in aircraft at 1,000 to 2,000 ft. elevation
  - Create maps visible damage




Emerald ash borer *
Main Islands of HAWAII
ALASKA
Legend
Acres
Mortality
10,345,000
Scattered mortality
4,436,000
Forested Lands
Surveyed area (where provided)
2004 Footprint acres with mortality: 14,780,000
Acres are summarized from the current year's observations only and are not cumulative. Multiple counting of acres may occur between categories if an area is observed to have simultaneous multiple damage types. However, multiple counting of acres does not occur within a category. The "footprint" total represents the affected area on the ground with no multiple counting.
* Emerald ash borer information derived from plot data.
2004 Aerial Survey
Mortality
1: 6,000,000
Albers Conic Equal-Area Projection

Special Detection Surveys

Pine mortality in the Southwest

Piñon pine in New Mexico - 2003

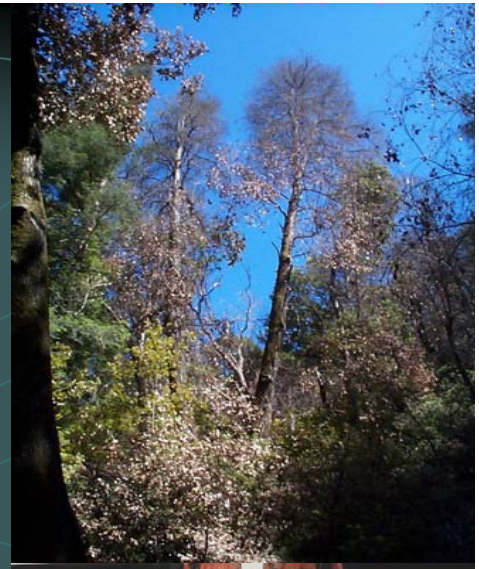
Ponderosa pine in Arizona - 2003

Photos – FHP R3

Special aerial and ground surveys conducted in 2003 covering 15 million acres in AZ, NM, CO, UT, NV

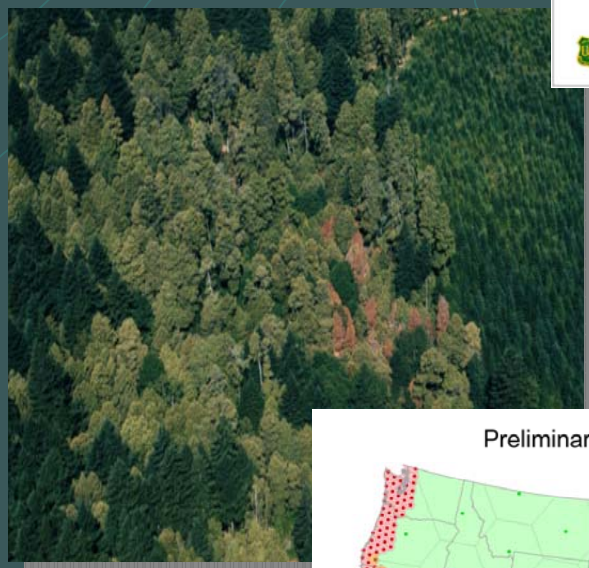
Special Detection Surveys
Sudden Oak Death

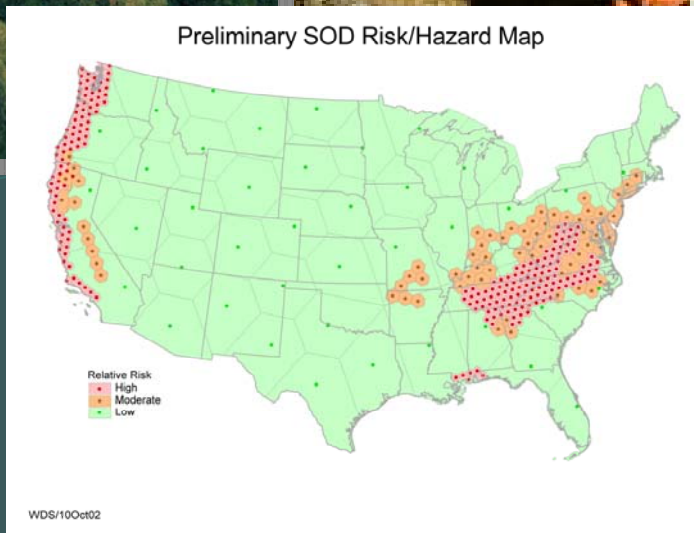
- Accelerated mortality of tanoak (*Lithocarpus densiflorus*) has been noted in California since 1995
- Extensive mortality of coast live oak (*Quercus agrifolia*) and CA black oak (*Q. kelloggii)* occurs in coastal areas of California
- Causal agent of disease identified as *Phytophthora ramorum* in 2000 by researchers at Univ. of California



Sudden Oak Death Detection and Monitoring

- Objectives:
  - Multi-scale approach to distribution, incidence, and impact of SOD in CA
  - Detection, effectiveness of eradication in OR
  - Detection outside infested areas in CA and OR





Maps and photos
Courtesy R5, ODF, SRS

Evaluation Monitoring

- Determine the extent, severity, and causes of undesirable forest health changes.
- Address likely cause-and-effect relationships, identify associations between forest health and forest stress indicators.
- Identify management consequences and alternatives for reducing the effects of forest stress.
- Identify research needs.

Ozone-induced foliar injury in the South

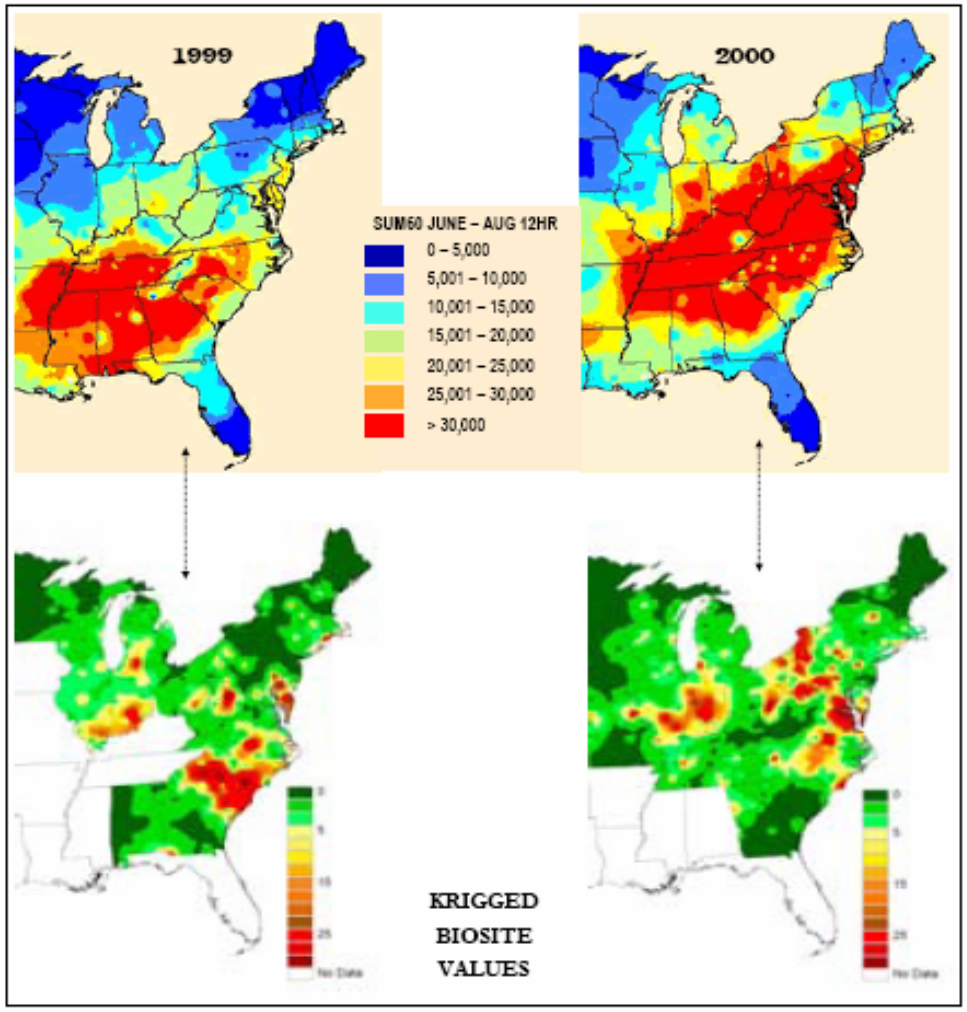


Figure 6. SUM60 O_3 exposures (top), based on monitoring data, and krigged Biosite Indices (bottom), based on plot-level data.

http://fhm.fs.fed.us

Lichen Distribution on Allegheny NF

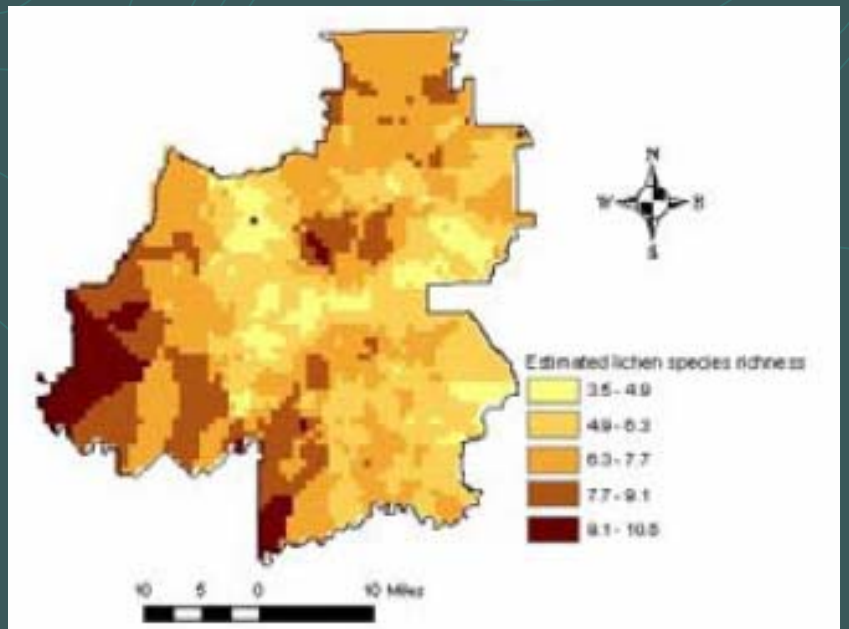


Figure 2. Kriged surface of lichen species richness on the ANF .

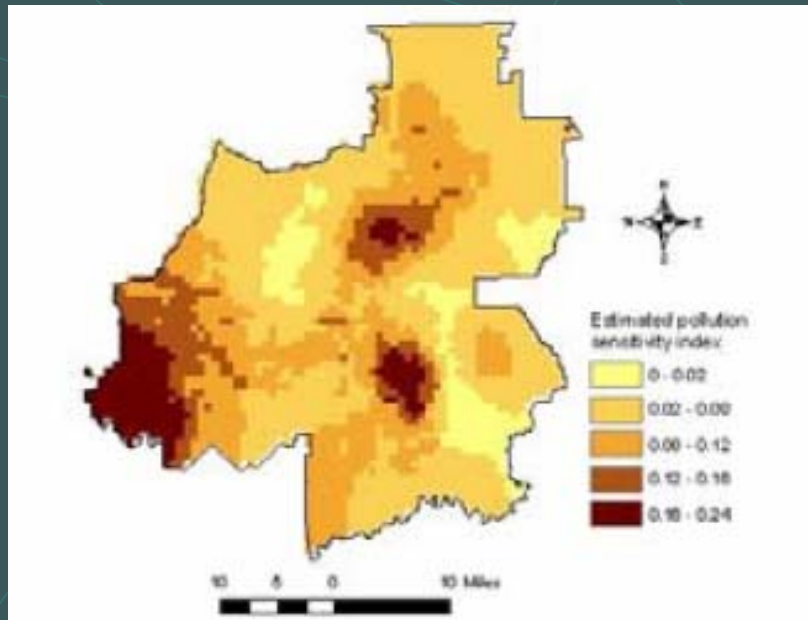


Figure 3. Kriged surface of the lichen pollution sensitivity index.

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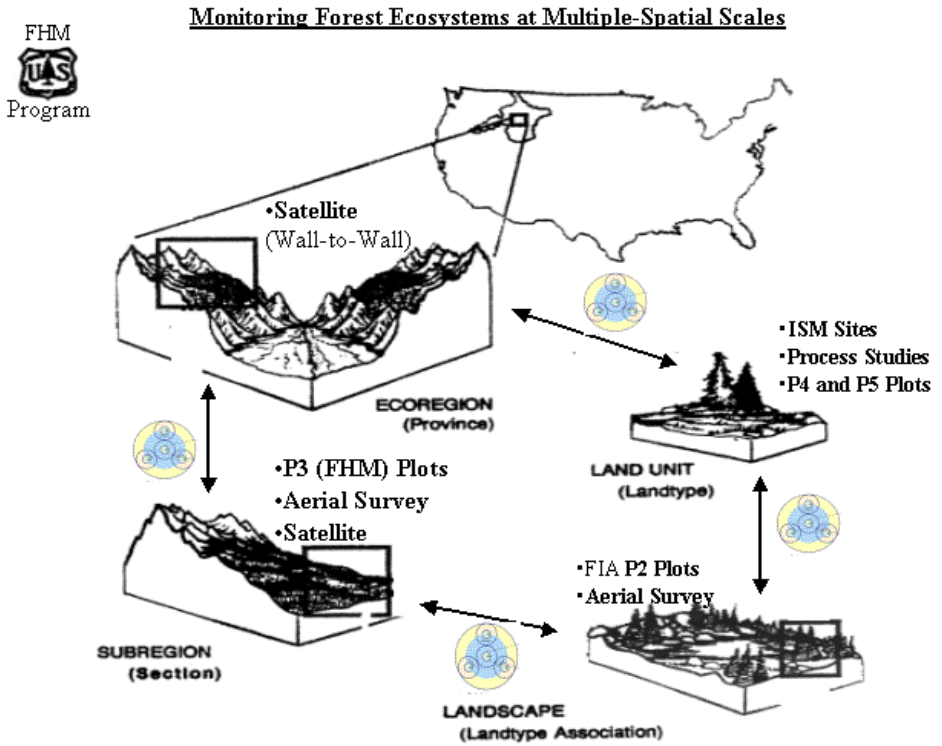
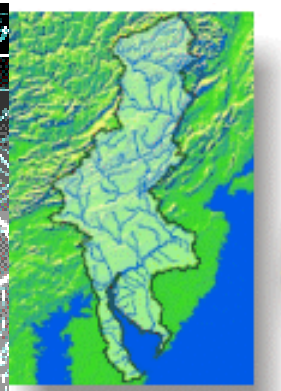
Research on Monitoring Techniques

- Urban Monitoring – design sampling strategies for urban forests and street trees
- Riparian Monitoring – design sampling strategies for riparian forests

Intensive Site Monitoring – Linking Multiple Scales

- In depth monitoring of indicators to determine detailed information on key components and processes of selected forest ecosystems

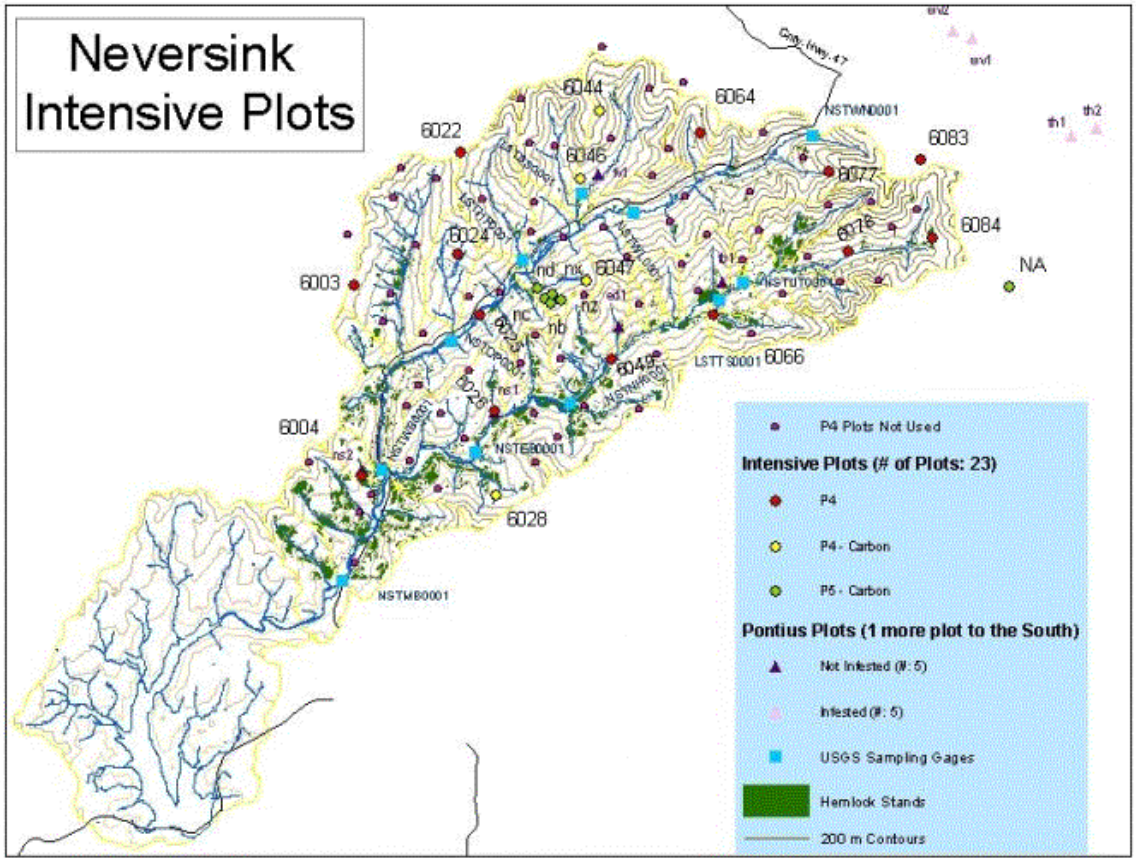




Delaware River Basin Collaborative Environmental Monitoring & Research Initiative

CEMRI

- Water quality
- Total Carbon
- Calcium Depletion
- Invasive Species



Reporting Highlights

- National Reports
  - FHM National Technical Reports
  - 2003 Sustainability Report – Montreal Process Criteria and Indicators for Sustainable Forests
  - Heinz Center – The State of the Nation's Ecosystems
  - EPA – US/Canada Air Quality Agreement Progress Reports
- Regional Reports
  - Northeast Forest Stressor Report
  - Aspen Forest Cover Change in Rockies
- State Reports
  - Utah Baseline Report
  - Forest Health Highlights

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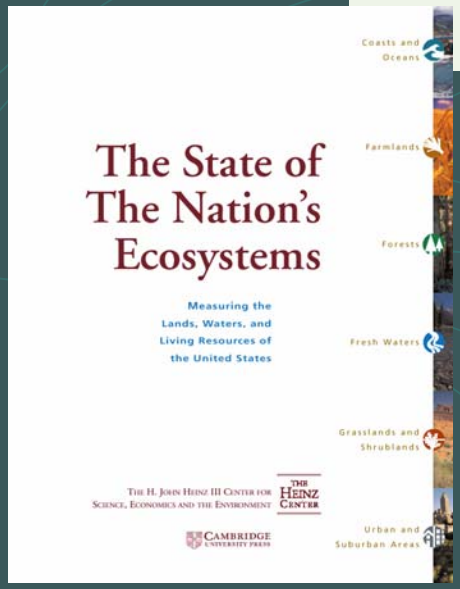
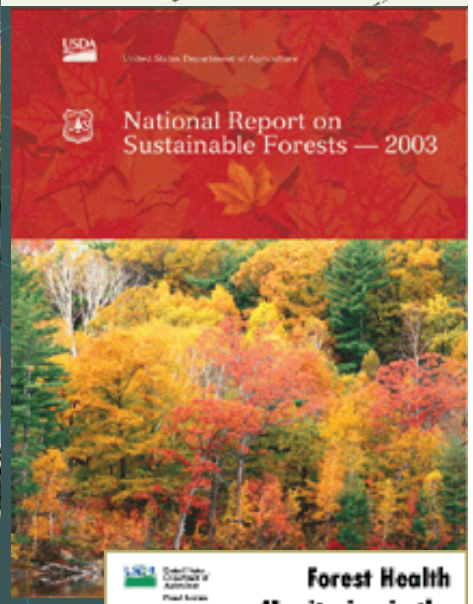
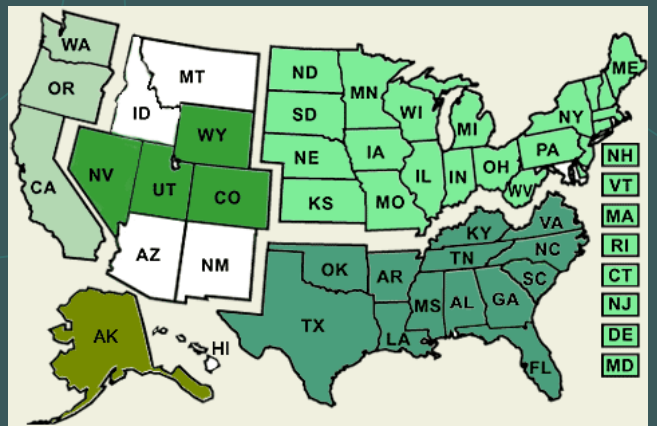
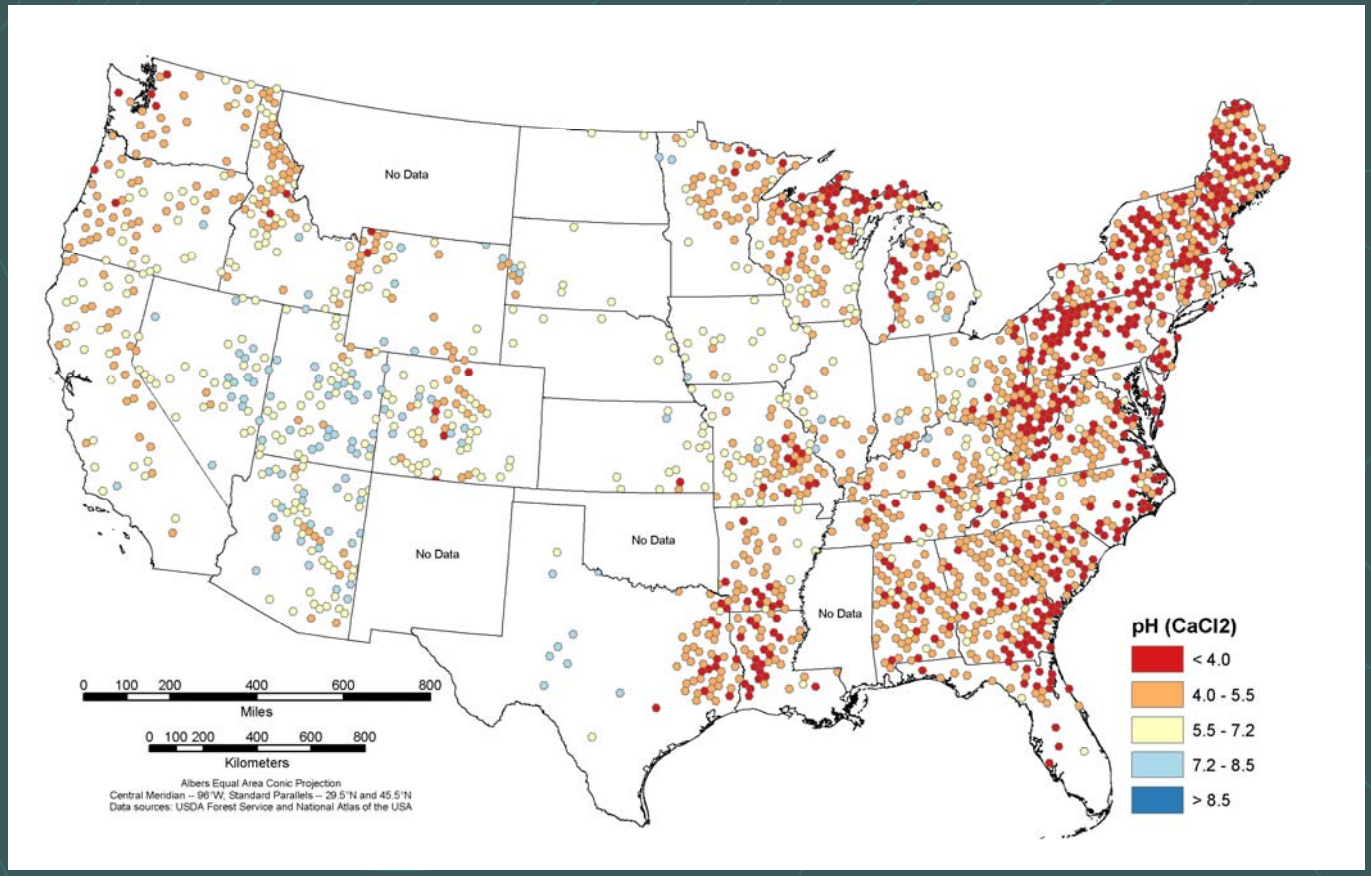







Ecoregion Province
Adirondack New England Mixed Forest-Coniferous Forest-Alpine Meadow Province
American Semi-Desert and Desert Province
Arizona-New Mexico Mountains Semi-Desert-Open Woodland-Coniferous Forest-Alpine Meadow Province
Black Hills Coniferous Forest Province
California Coastal Chapparral Forest and Shrub Province
California Coastal Range Open Woodland-Shrub-Coniferous Forest-Meadow Province
California Dry Steppe Province
Cascade Mixed Forest-Coniferous Forest-Alpine Meadow Province
Central Appalachian Broadleaf Forest-Coniferous Forest-Meadow Province
Chihuahuan Semi-Desert Province
Colorado Plateau Semi-Desert Province
Eastern Broadleaf Forest (Continental) Province
Eastern Broadleaf Forest (Oceanic) Province
Everglades Province
Great Plains Steppe Province
Great Plains Steppe and Shrub Province
Great Plains-Palouse Dry Steppe Province
Intermountain Semi-Desert Province
Intermountain Semi-Desert and Desert Province
Laurentian Mixed Forest Province
Lower Mississippi Riverine Forest Province
Middle Rocky Mountain Steppe-Coniferous Forest-Alpine Meadow Province
Nevada-Utah Mountains-Semi-Desert-Coniferous Forest-Alpine Meadow Province
Northern Rocky Mountain Forest-Steppe-Coniferous Forest-Alpine Meadow Province
Ouachita Mixed Forest - Meadow Province
Outer Coastal Plain Mixed Forest Province
Ozark Broadleaf Forest - Meadow Province
Pacific Lowland Mixed Forest Province
Prairie Parkland (Subtropical) Province
Prairie Parkland (Temperate) Province
Sierran Steppe-Mixed Forest-Coniferous Forest-Alpine Meadow Province
Southeastern Mixed Forest Province
Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest-Alpine Meadow Province
Southwest Plateau and Plains Dry Steppe and Shrub Province

National map of observations of soil pH in the top 10 cm of soil (2001-2003)



National map of effective cation exchange capacity in the top 10 cm of soil (2001-2003)

Percent of plot basal area (BA) associated with poor crown condition.

Wet Sulfur Deposition

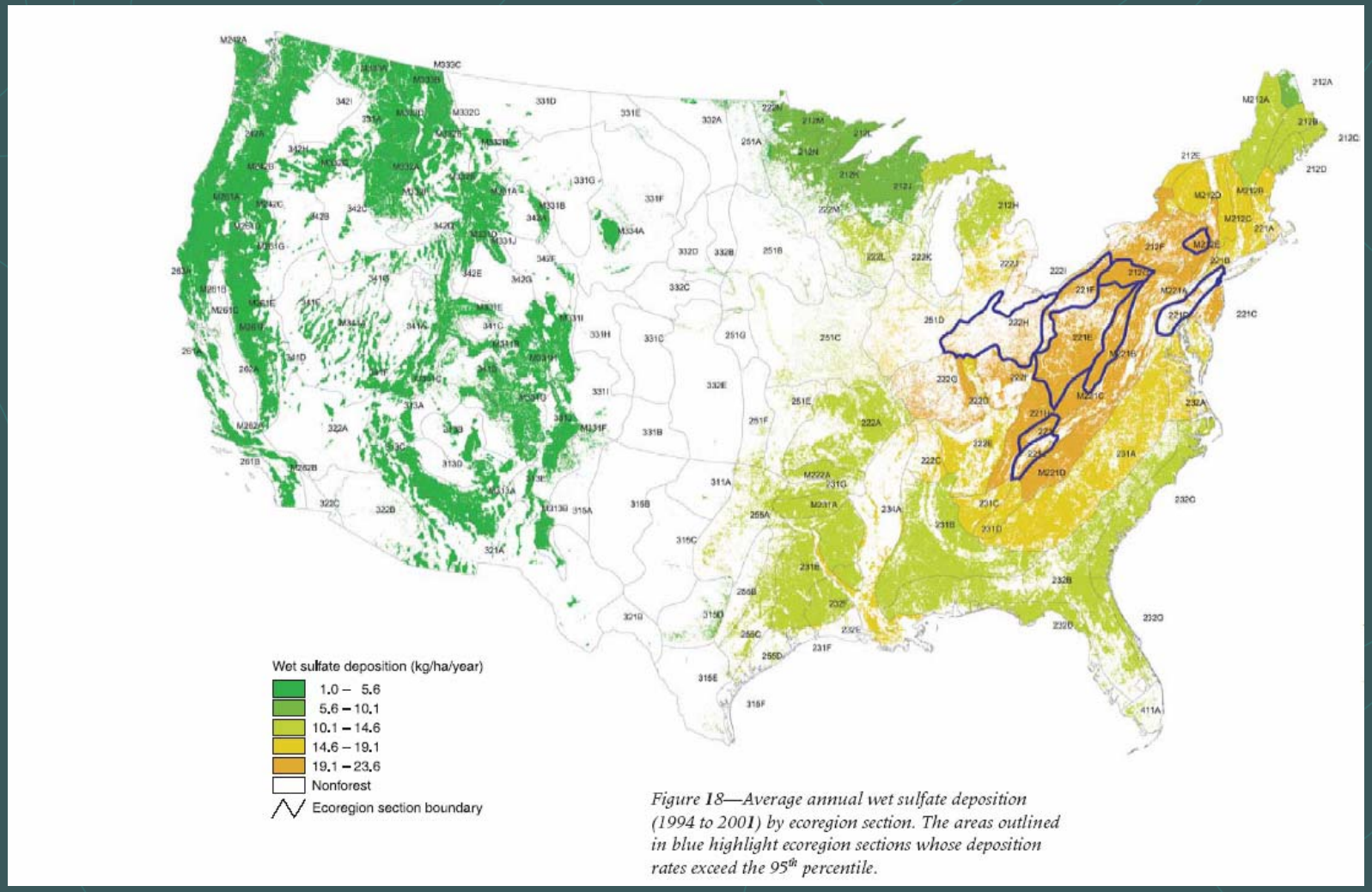


Figure 18—Average annual wet sulfate deposition (1994 to 2001) by ecoregion section. The areas outlined in blue highlight ecoregion sections whose deposition rates exceed the 95th percentile.

Wet Nitrogen Deposition

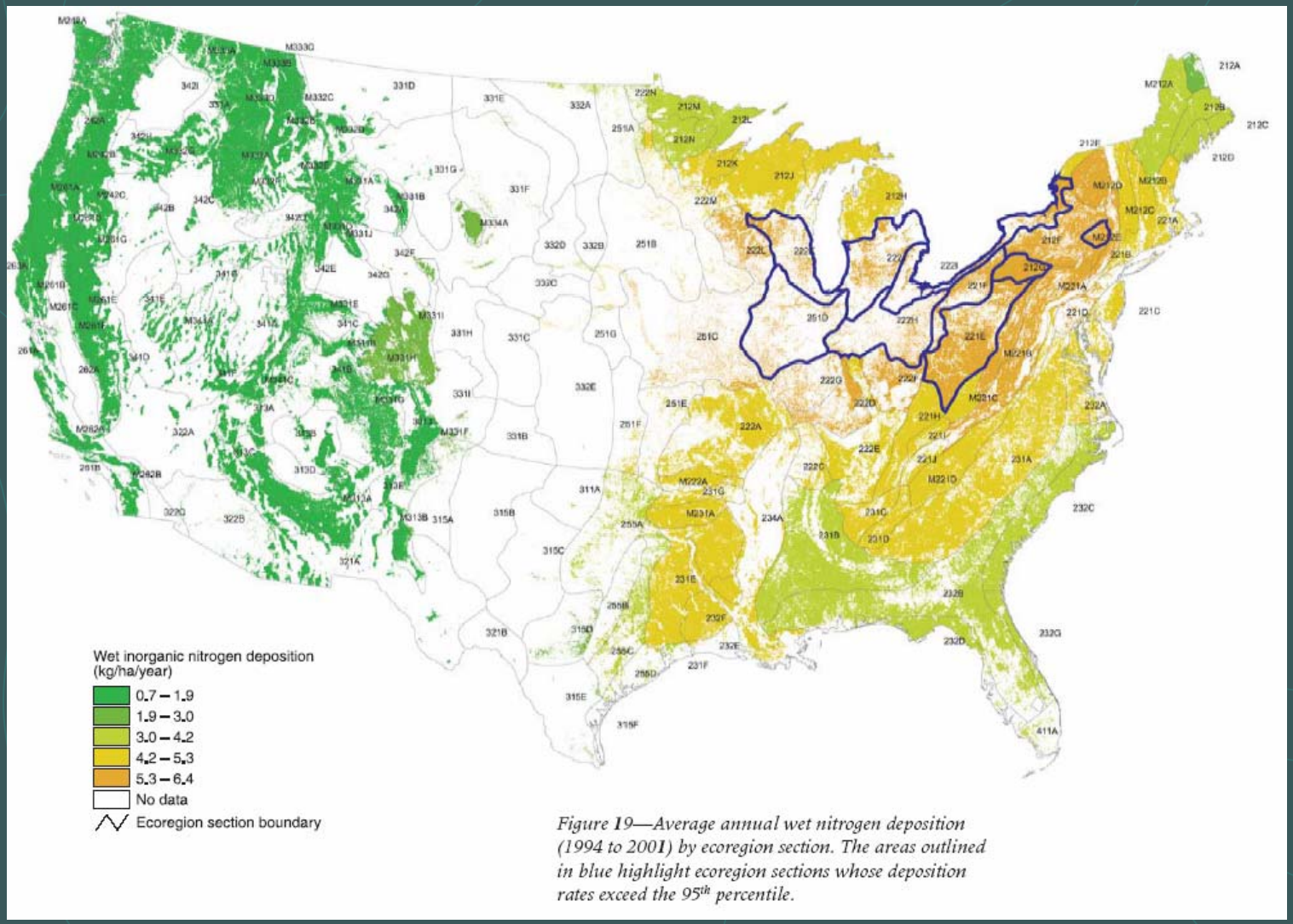
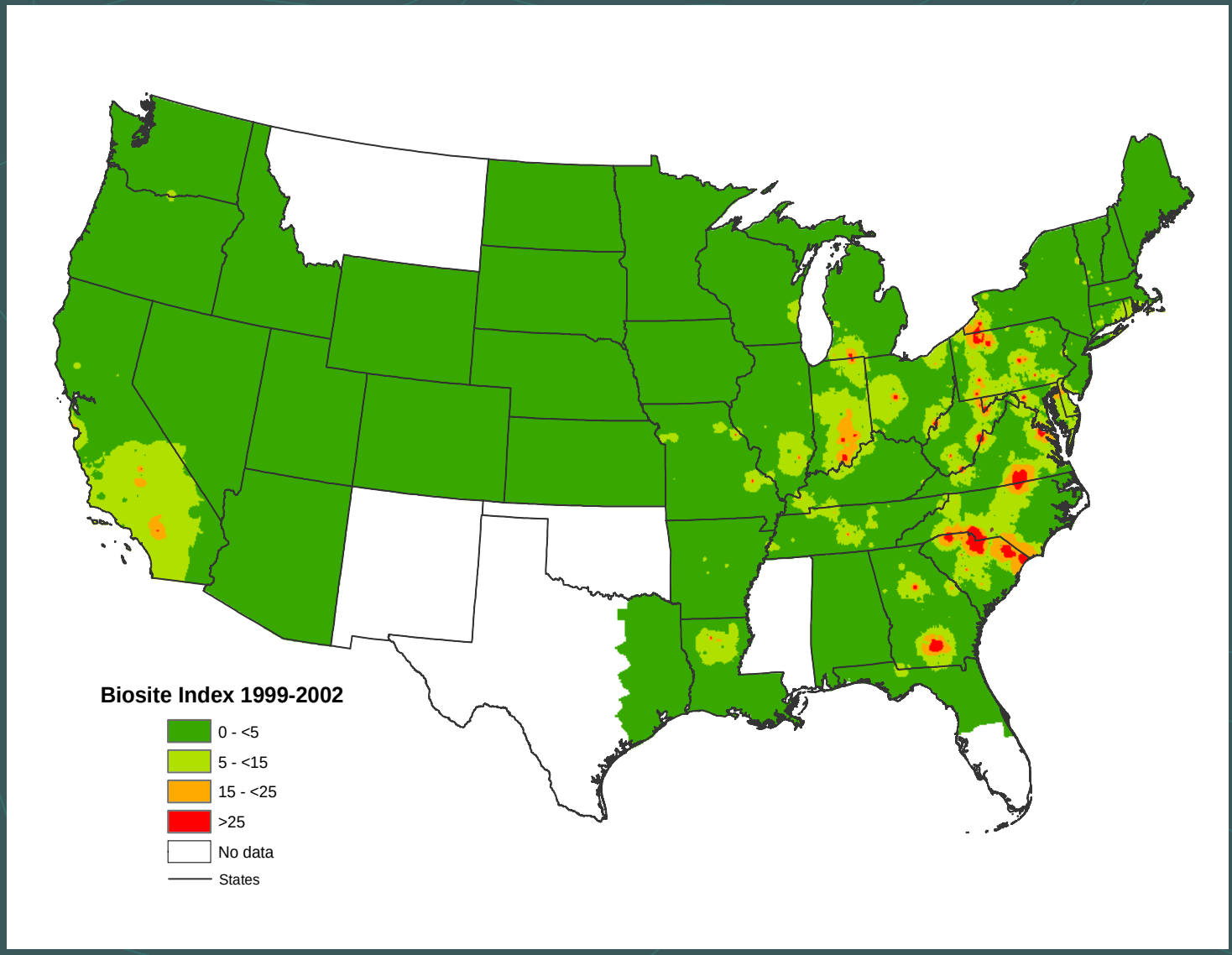
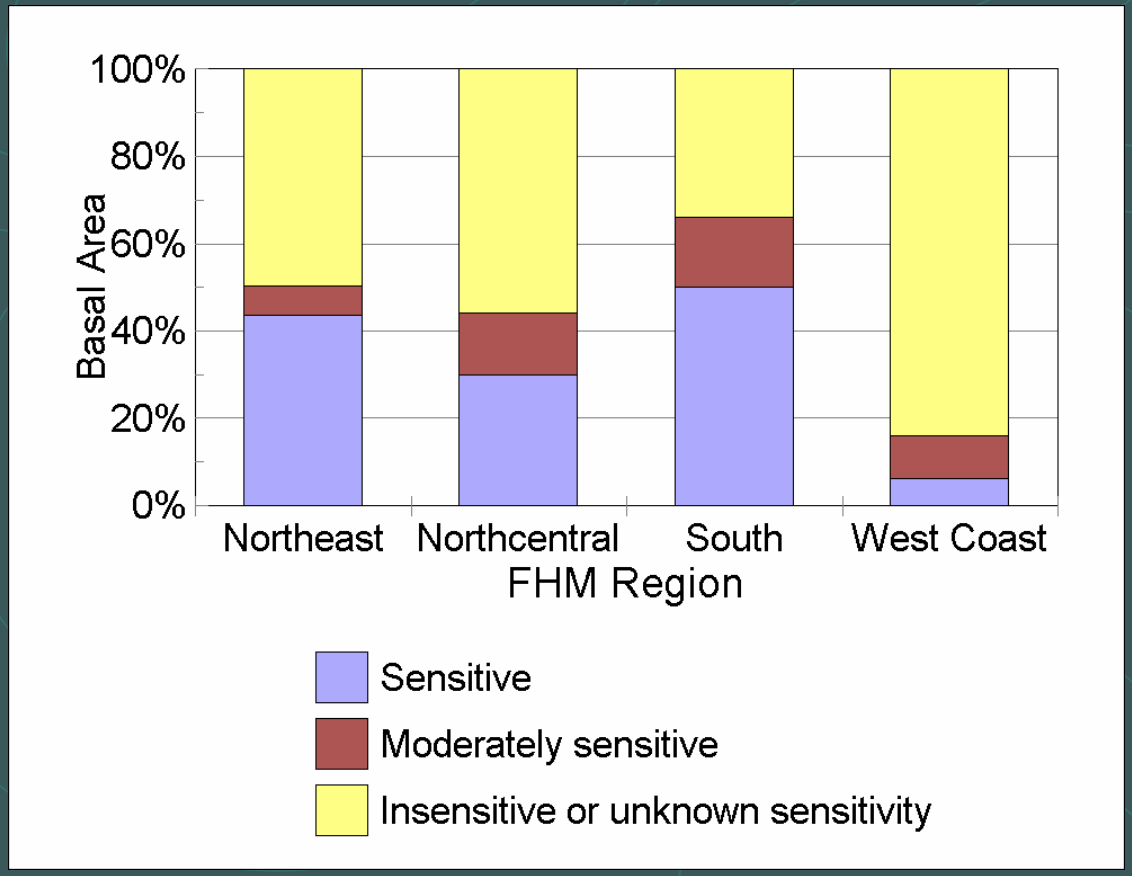


Figure 19—Average annual wet nitrogen deposition (1994 to 2001) by ecoregion section. The areas outlined in blue highlight ecoregion sections whose deposition rates exceed the 95th percentile.

Interpolated ozone biosite index value (1999-2002).



Sensitivity of tree species in the high and moderate ozone risk areas of the conterminous United States



Future Challenges

- Stress key strengths of FHM
  - Partnership-based
  - Innovative
  - Comprehensive
  - Science-based
- Be “Real Time”
  - Timely detection, analysis, and reporting of adverse changes in forest health to facilitate effective management response
- Look Beyond the Grid
  - Look back – analyze trends, integrate diverse data sources
  - Look forward – forecast future conditions, analyze risks
  - Design new approaches for detection of invasives