Forest Health Monitoring

Program Overview

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National Program Manager

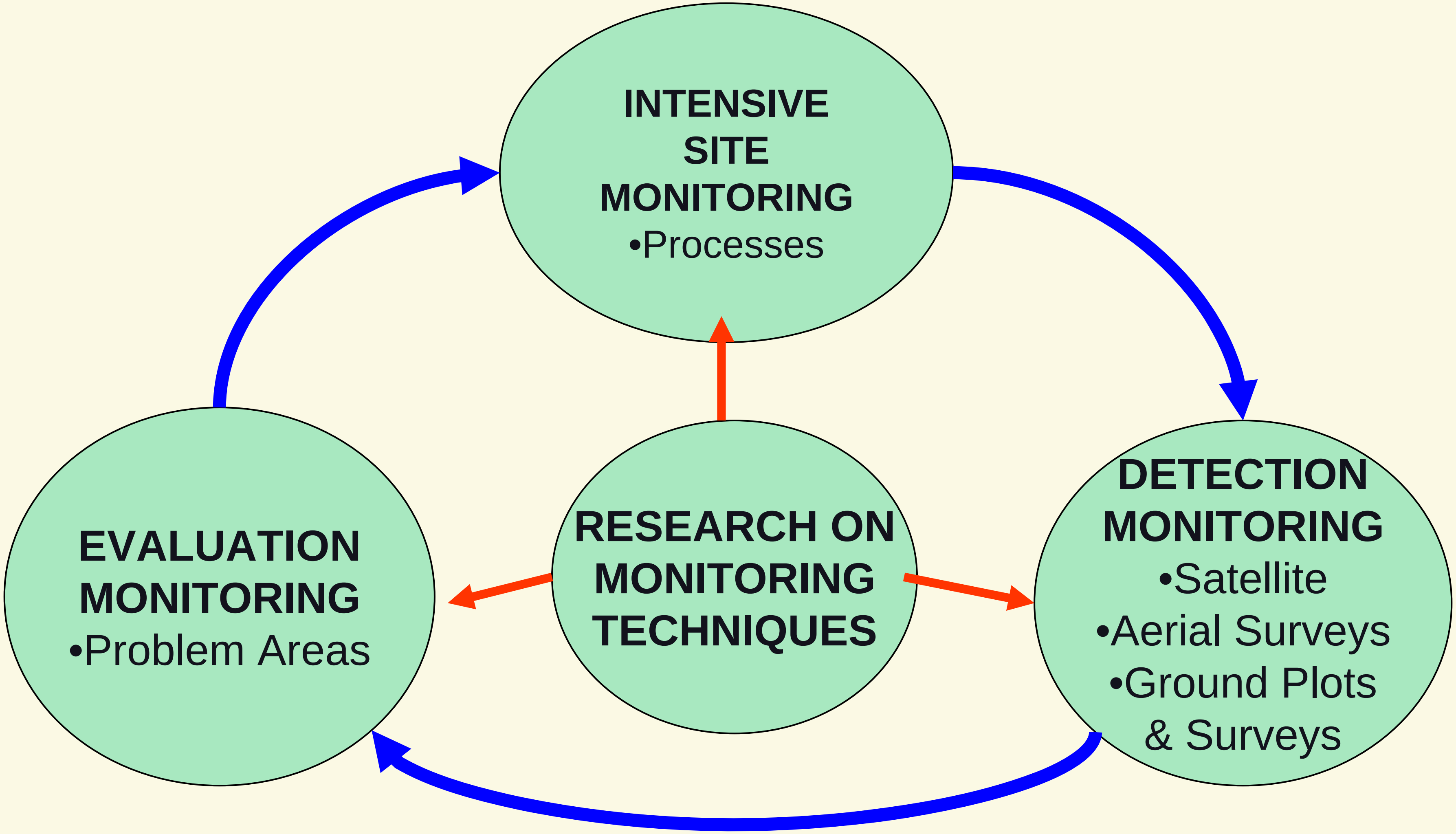
Forest Health Monitoring Program

- 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.

FHM Objectives:

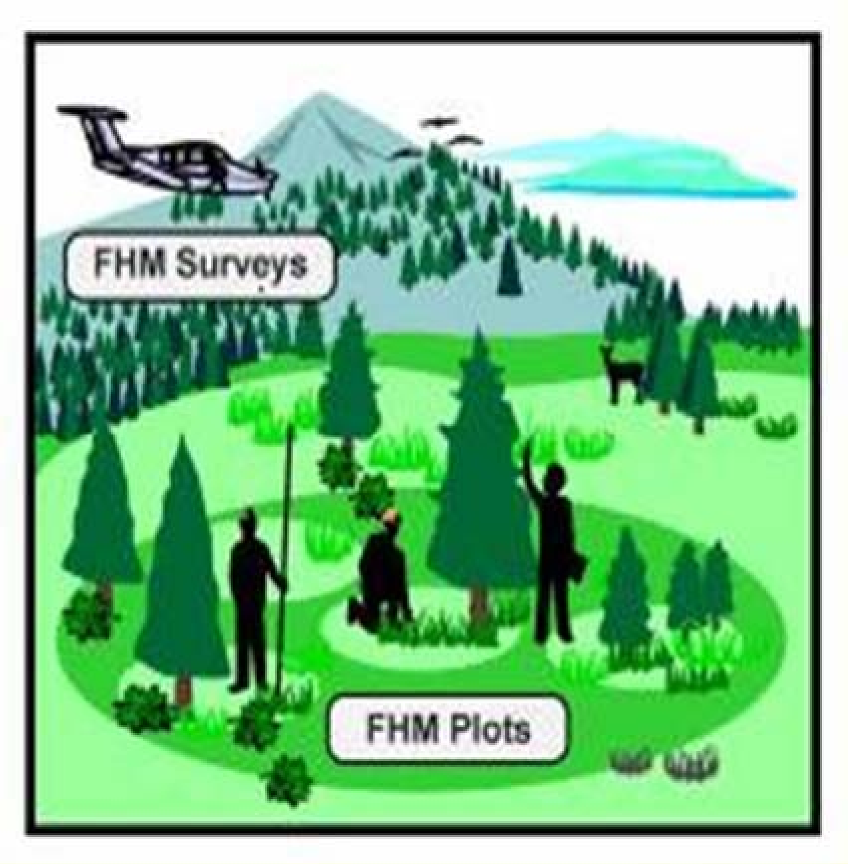
- Establish a monitoring system throughout the forests of the United States to determine detrimental changes or improvements that occur over time.
- Provide baseline and health trend information that is statistically precise and accurate.
- Report annually on status and changes to forest health.

Major Program Components

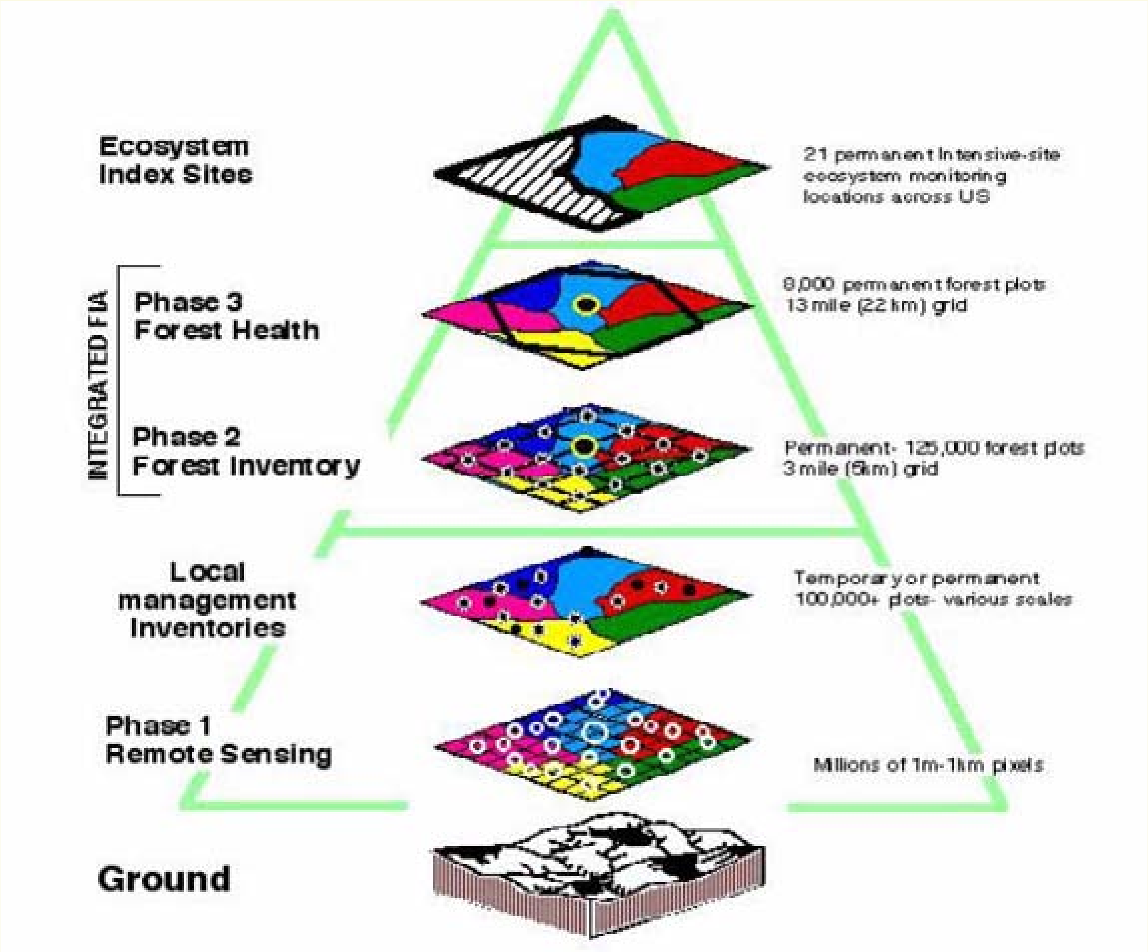


Detection Monitoring

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

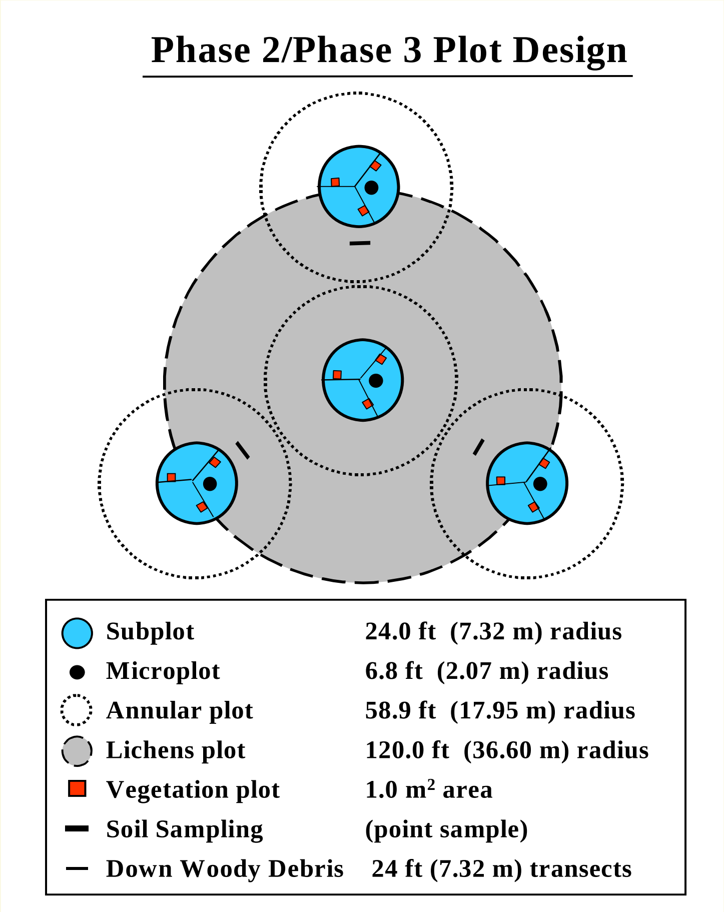


Integrated Monitoring Framework

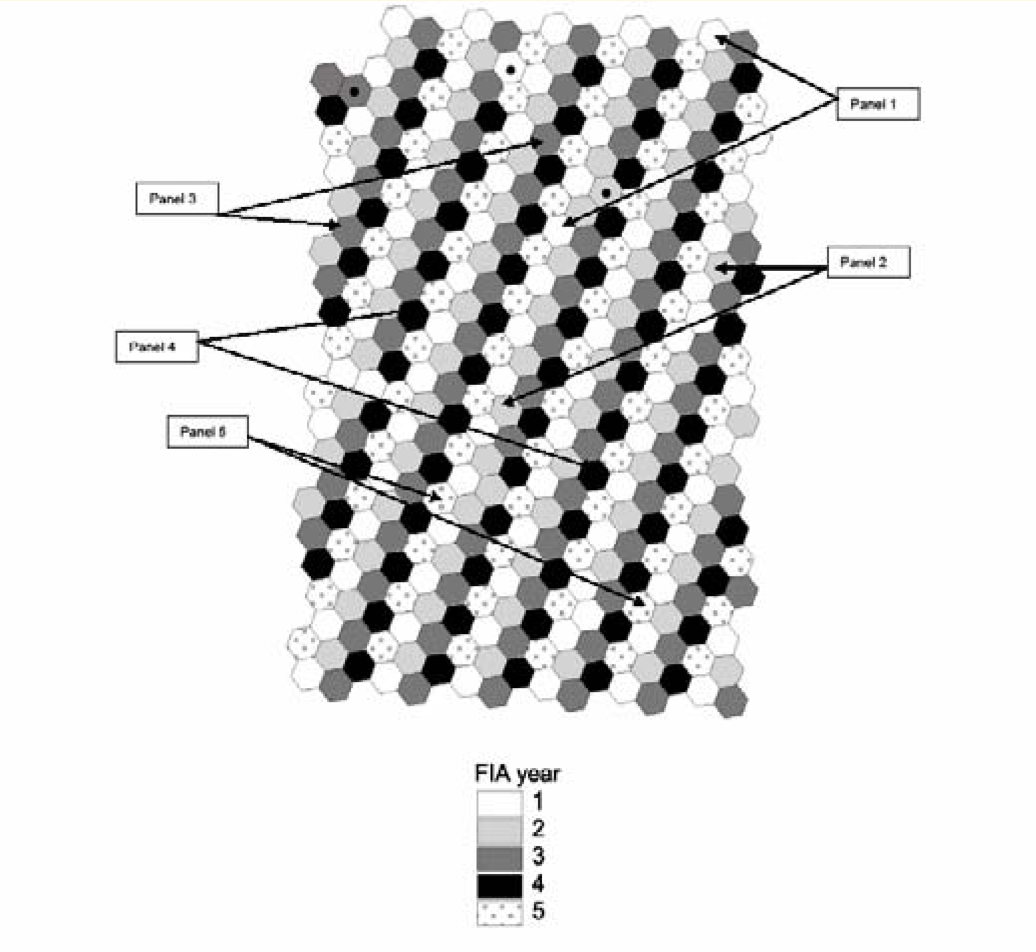


FHM/FIA Plot Integration

- 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

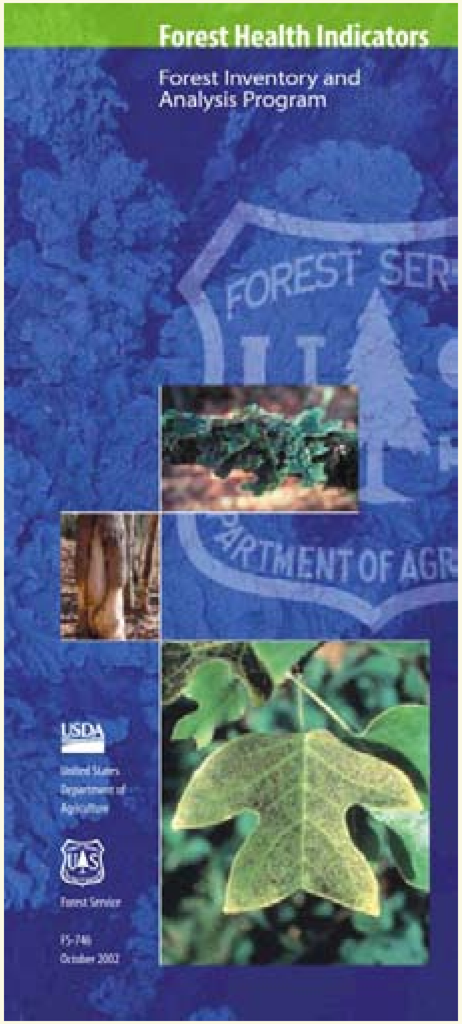


Rotating Panel Design



Forest Health Indicators

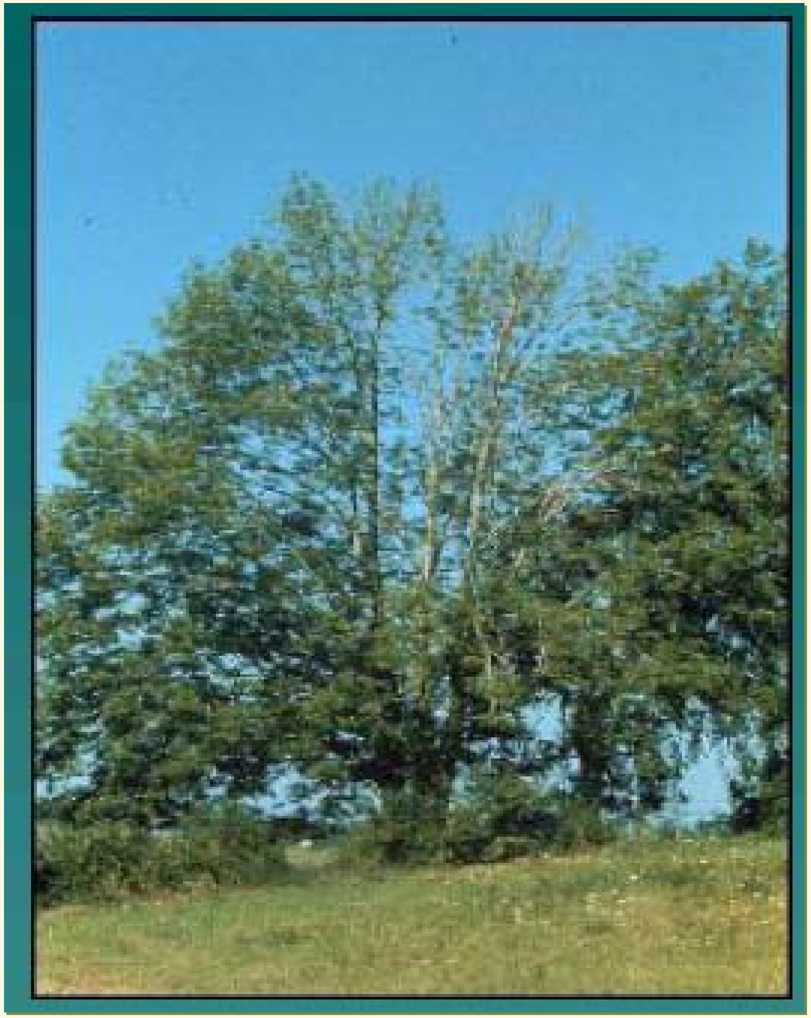
- Tree Growth
- Tree Regeneration
- Tree Crown Condition
- Tree Damage
- Tree Mortality
- Lichen Communities
- Ozone Bioindicator Plants
- Soil Morphology and Chemistry
- Vegetation Structure
- Plant Diversity



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

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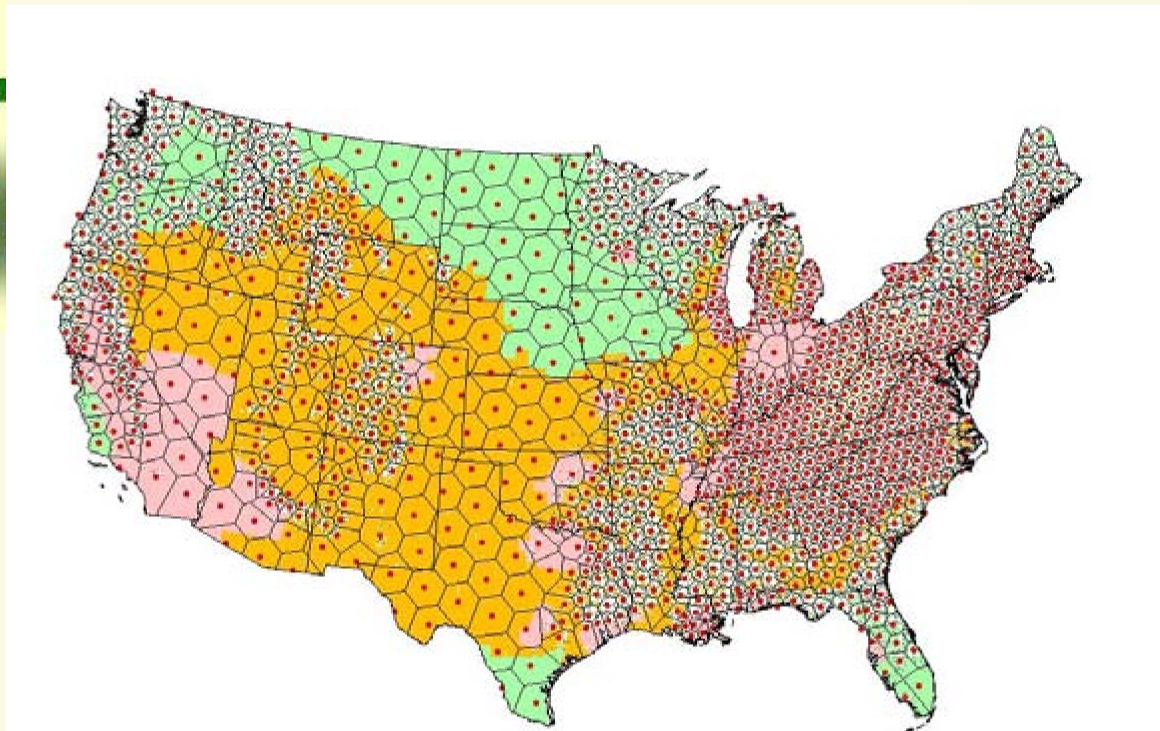


Down Woody Material

- 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

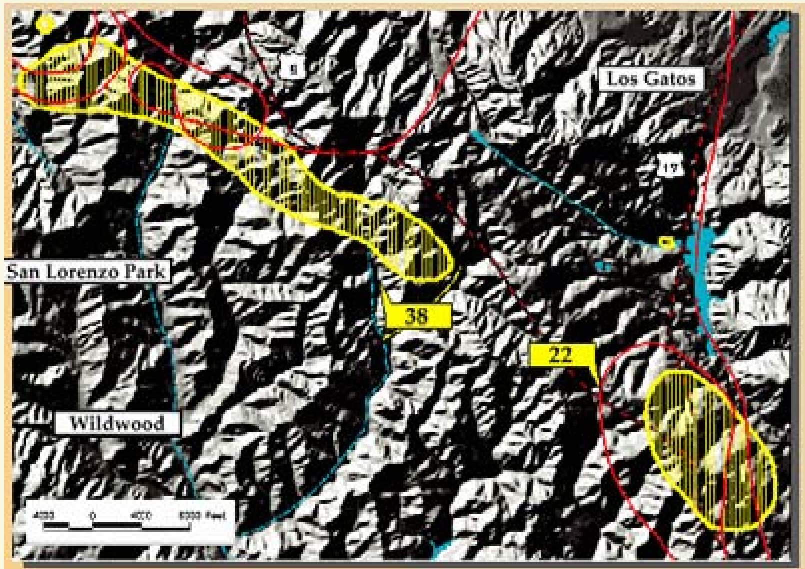
Photo by Will McWilliams

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



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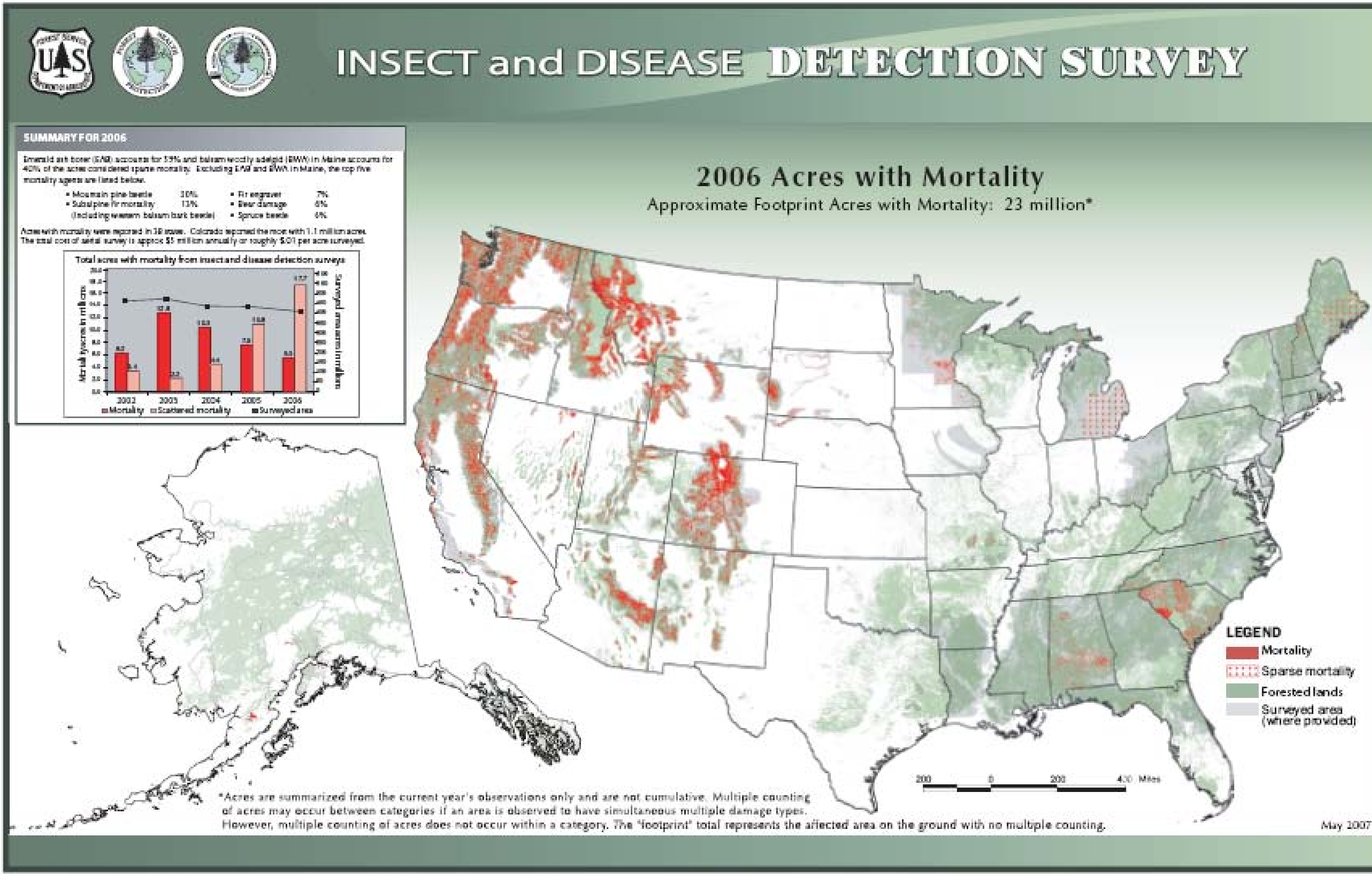
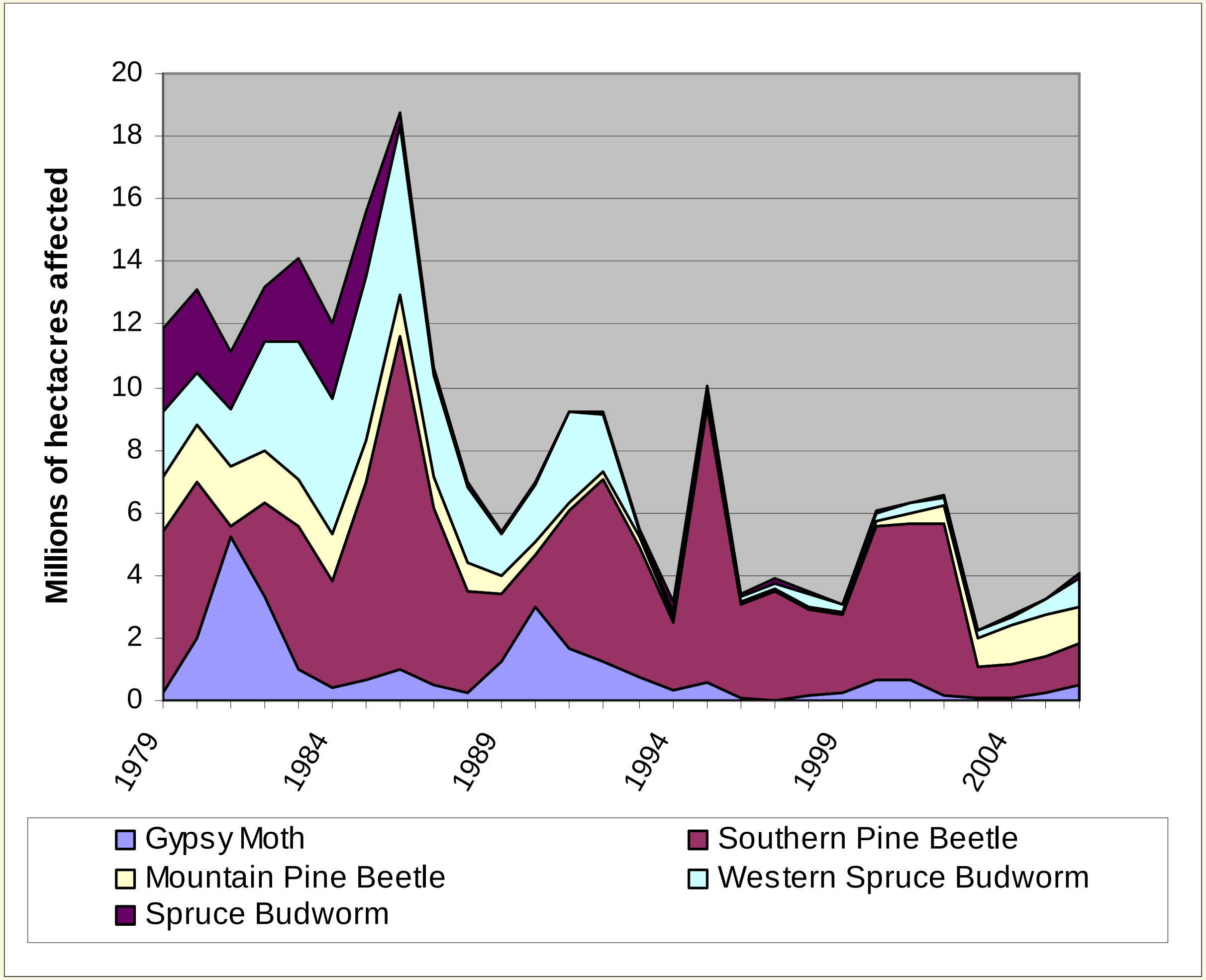
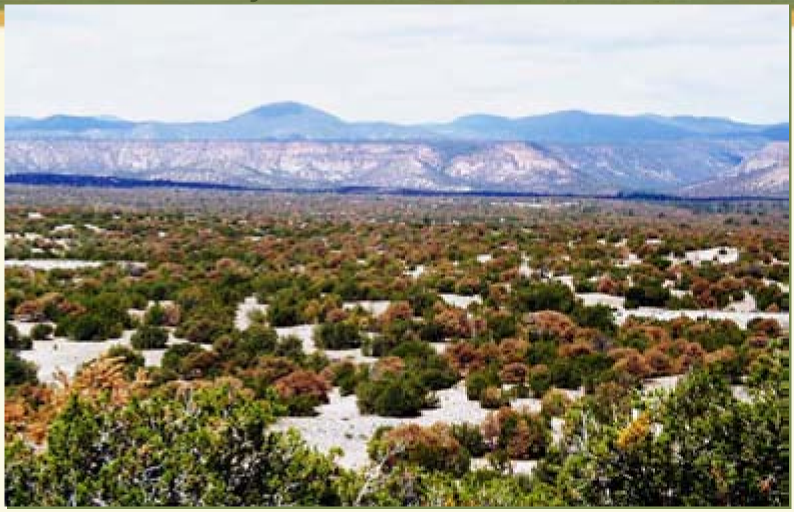


Major Forest Pest Trends US



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



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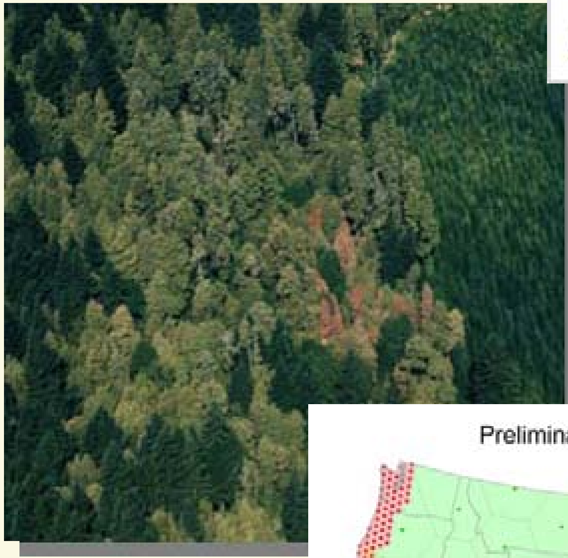
Sudden Oak Death Detection and Monitoring

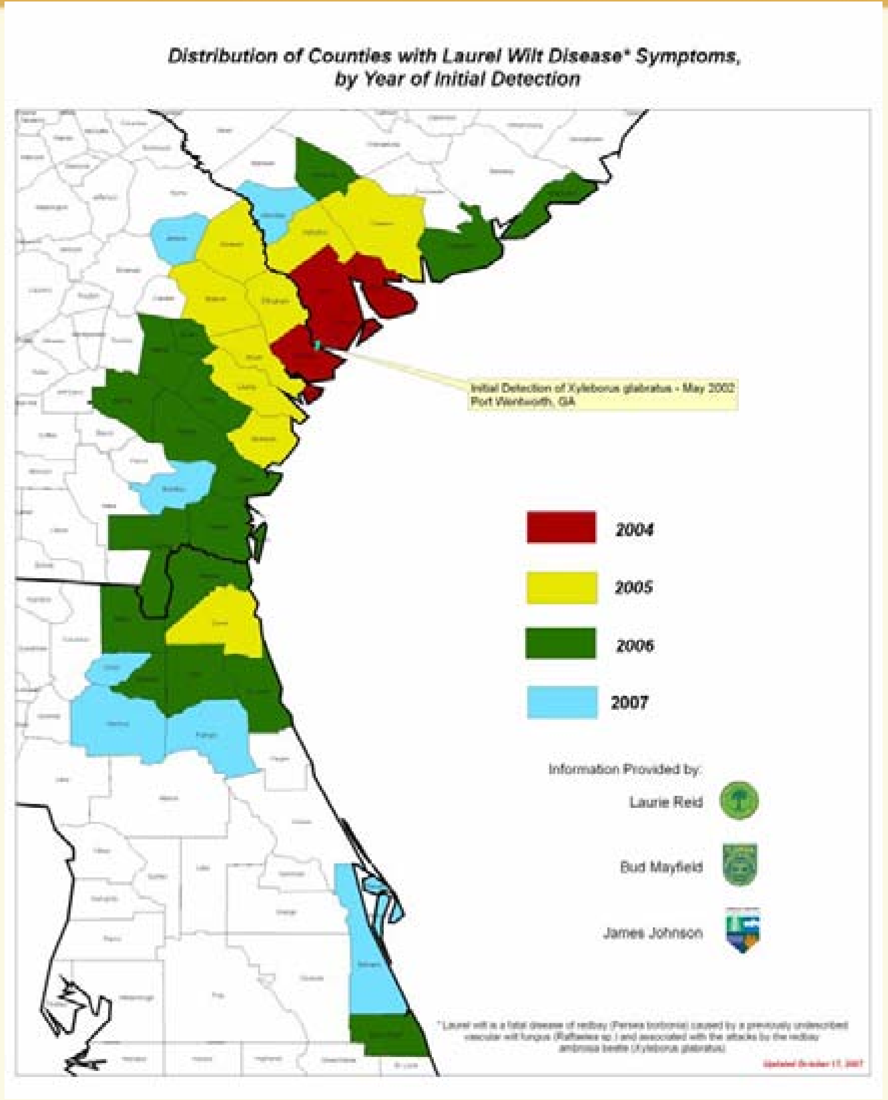
- Objectives:
  - Multi-scale approach to distribution, incidence, and impact of SOD in CA
  - Detection, effectiveness of eradication in OR
  - Detection outside infested areas in CA and OR



Maps and photos
Courtesy R5, ODF, SRS

Special Detection Surveys

Red Bay mortality –
exotic ambrosia beetle *Xyleborus glabratus* vectoring *Ophiostoma sp.* in Southeastern coastal states, killing red bay, sassafras, and other Lauraceae

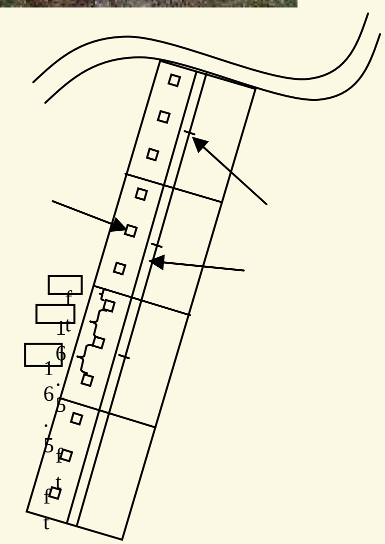


Evaluation Monitoring

- 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.

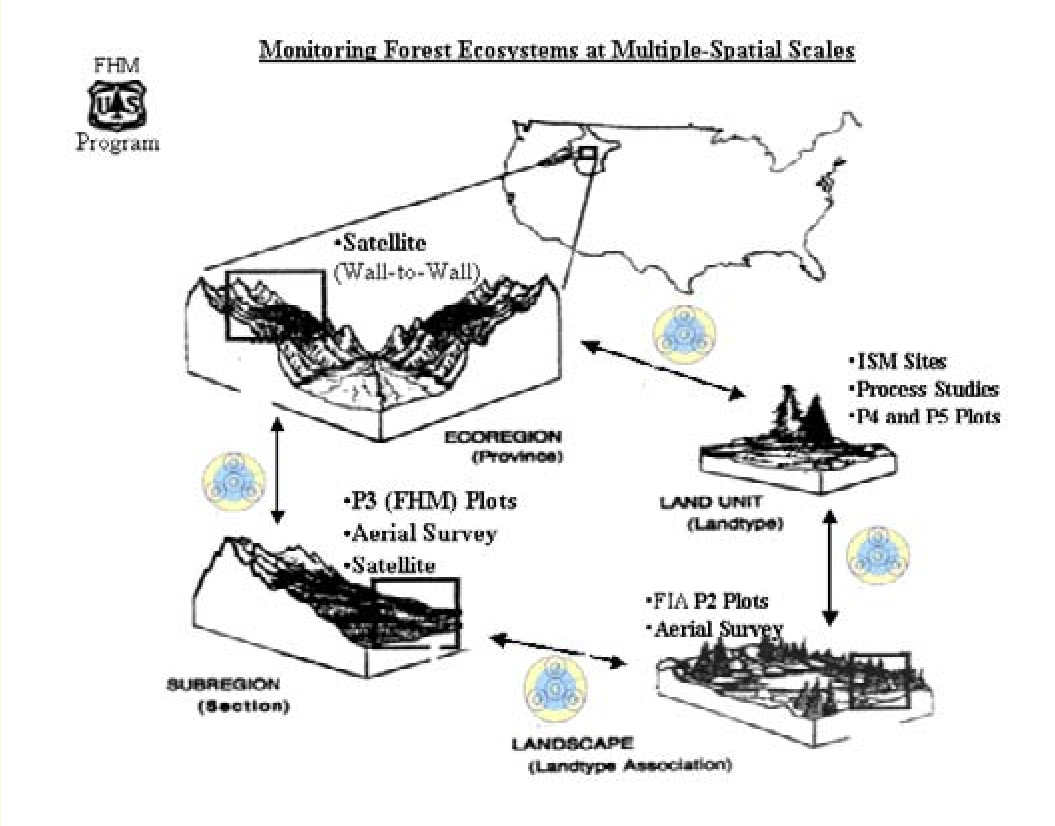
Research on Monitoring Techniques

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



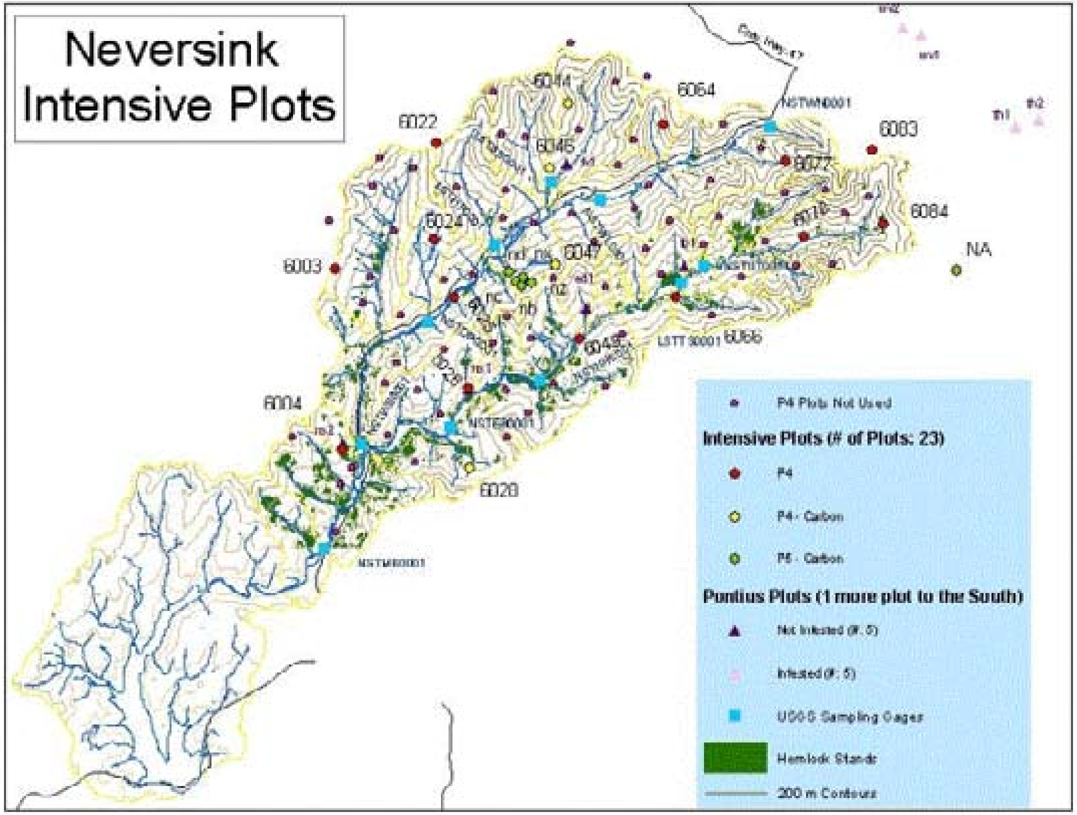
Intensive Site Monitoring
– Linking Multiple Scales

- 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



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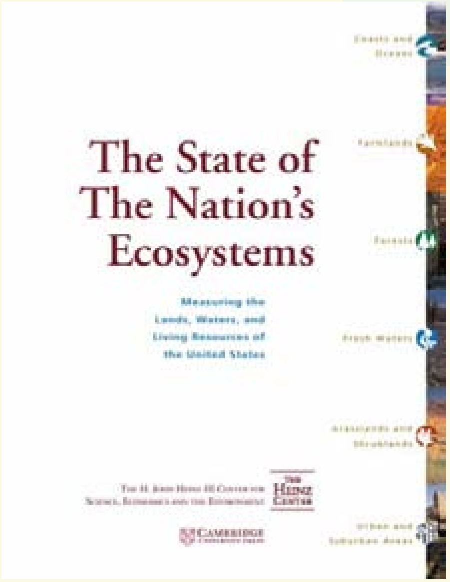
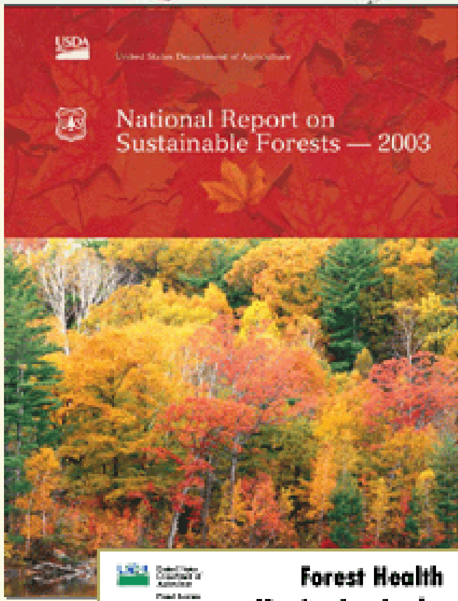
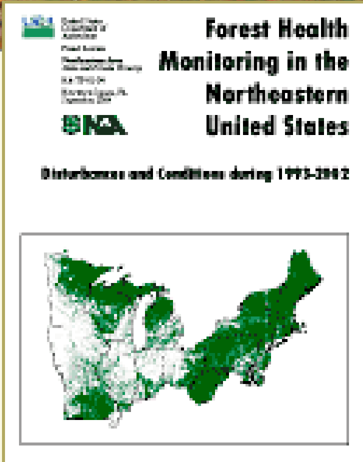
Reporting Highlights

- 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

http://www.fhm.fs.fed.us





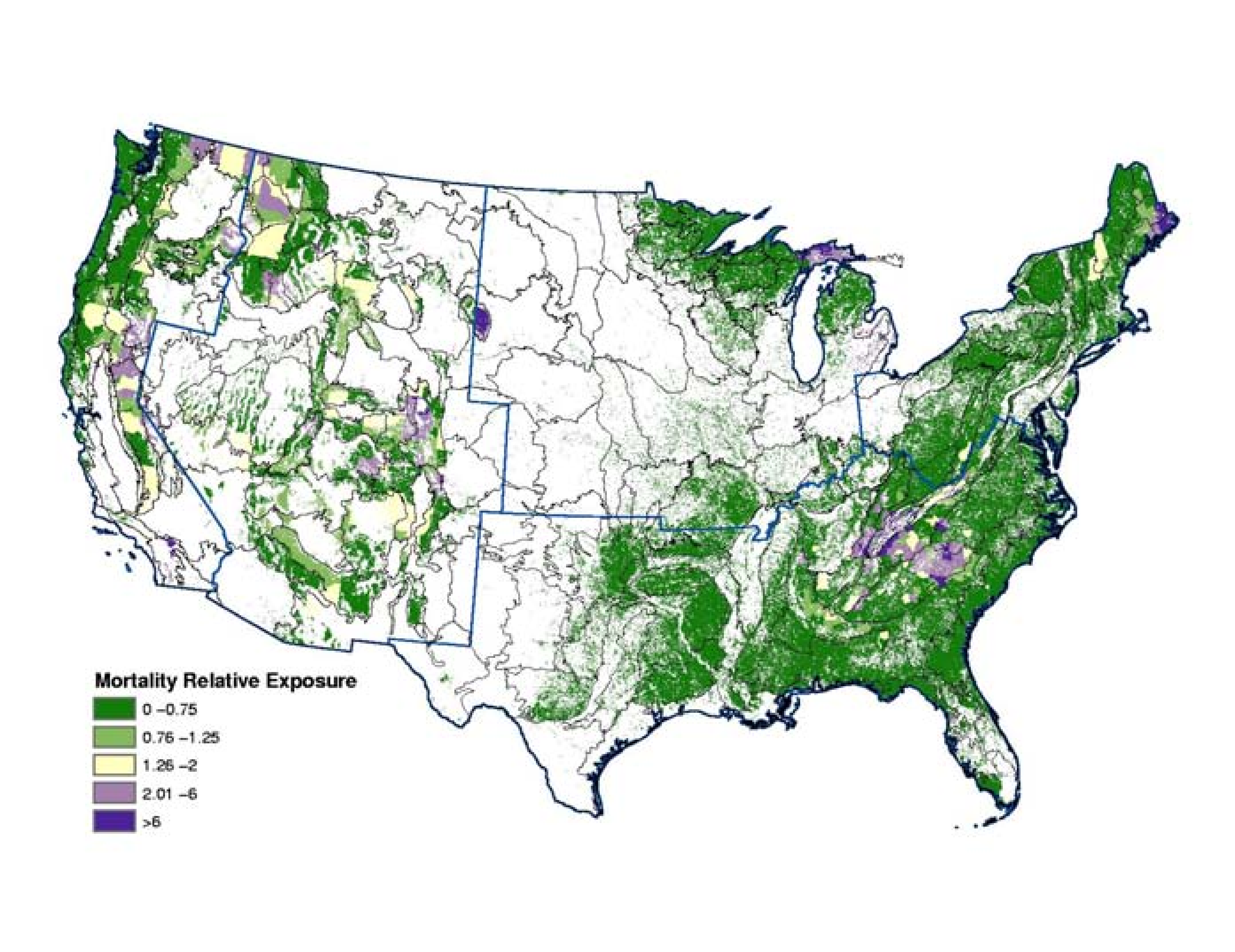


Analysis by Ecoregion Sections

- National hierarchical system of ecological units
  - Climate
  - Vegetation
  - Soils

R.G. Bailey, 1995

Mortality from Aerial Surveys 1998-2004



Mortality from Plots

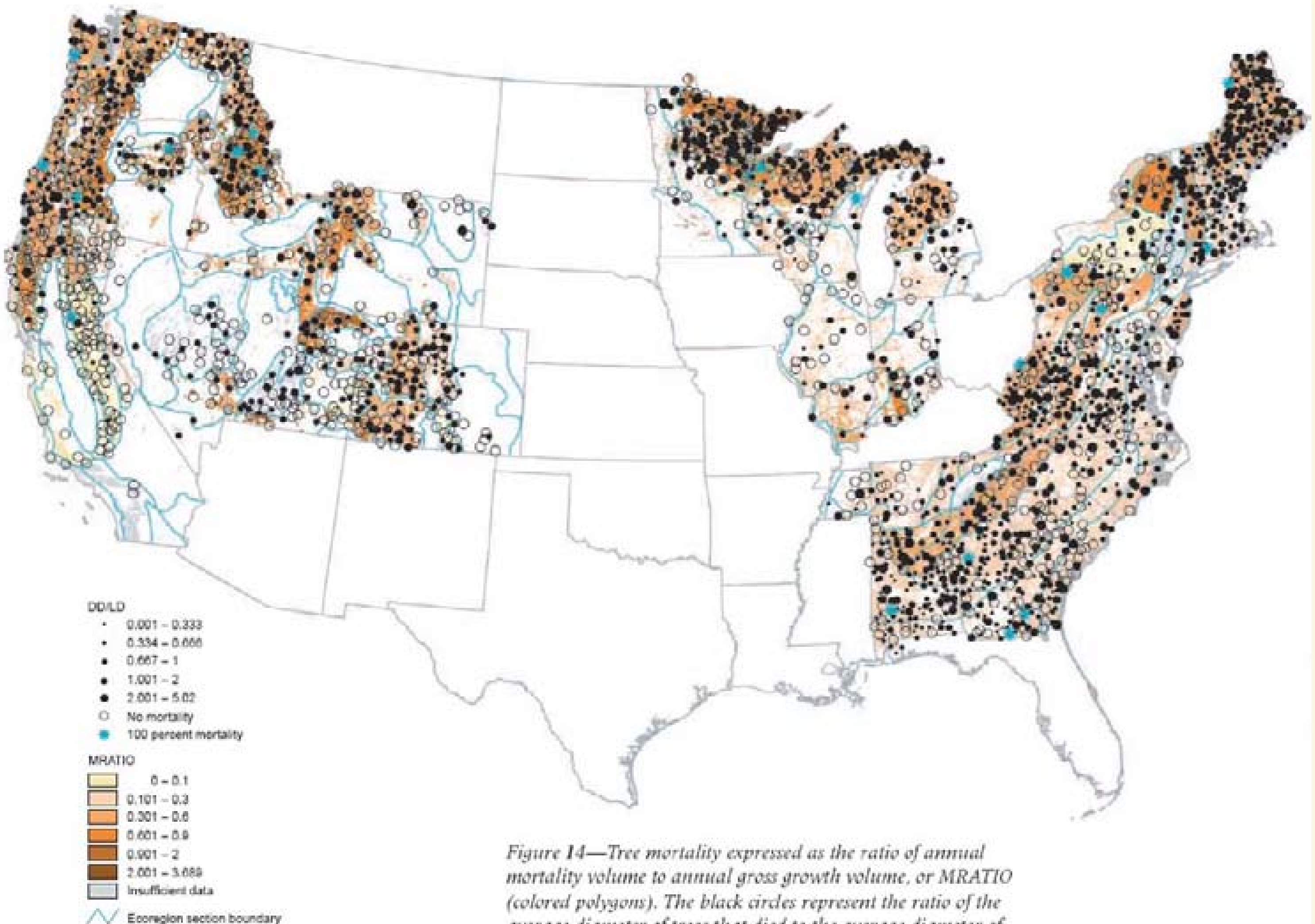
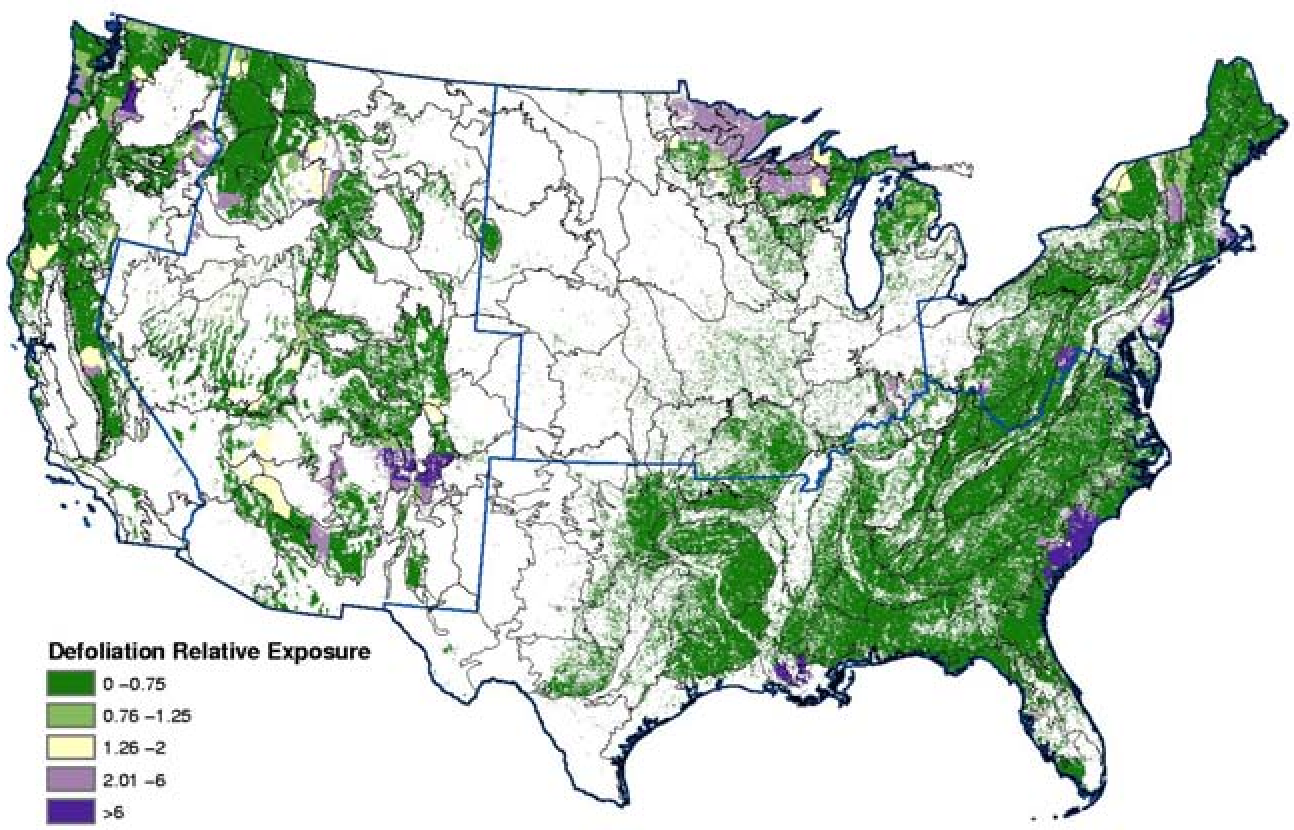


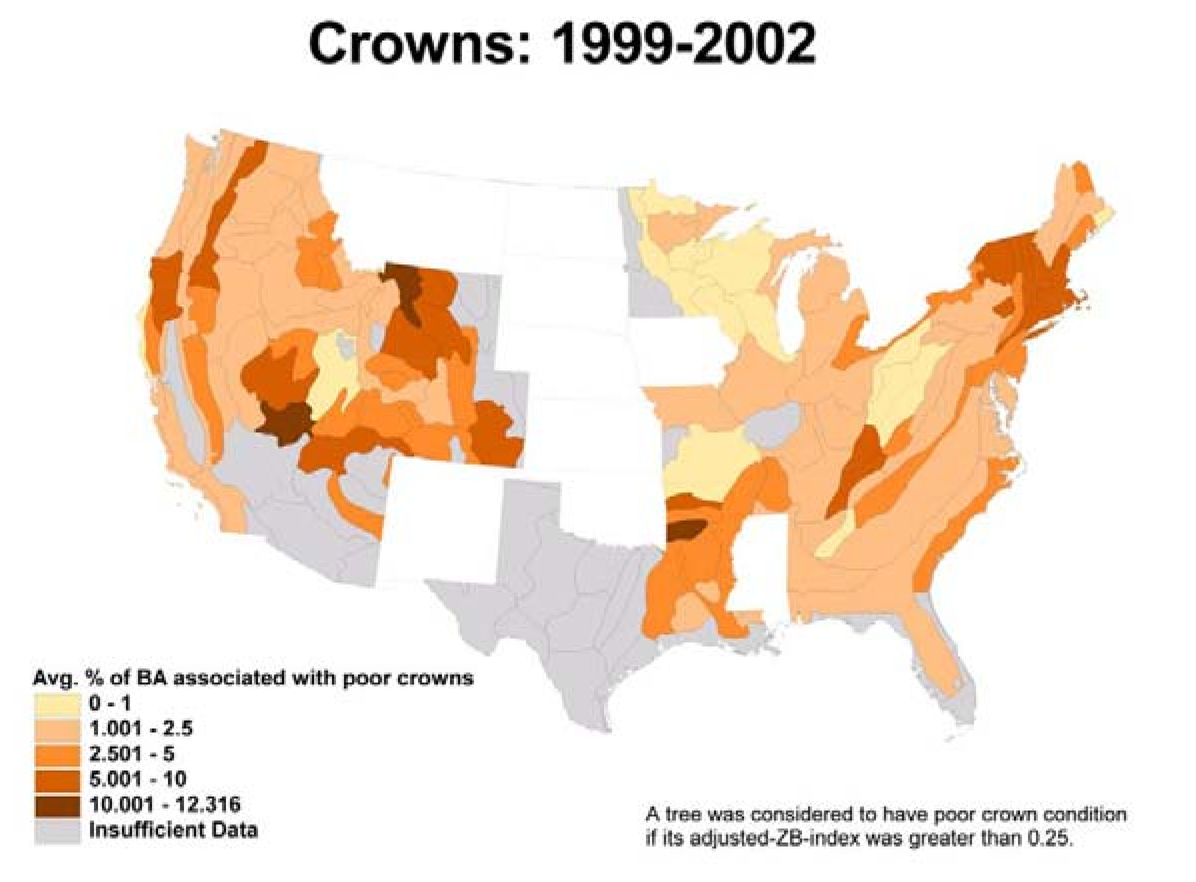
Figure 14—Tree mortality expressed as the ratio of annual mortality volume to annual gross growth volume, or MRATIO (colored polygons). The black circles represent the ratio of the average diameter of trees that died to the average diameter of surviving trees as of the most recent measurement of each plot, or DDLD. Plot locations are approximate.

Defoliation from Aerial Surveys 1998-2004



Crown Conditions

- Crown dieback and foliar transparency were used to calculate a crown index
- Overall, < 15 percent of the basal area was associated with unhealthy crowns
- Ecoregion sections having > 10 percent average basal area associated with unhealthy crowns were mostly located in the Interior West



Wet Sulfur Deposition

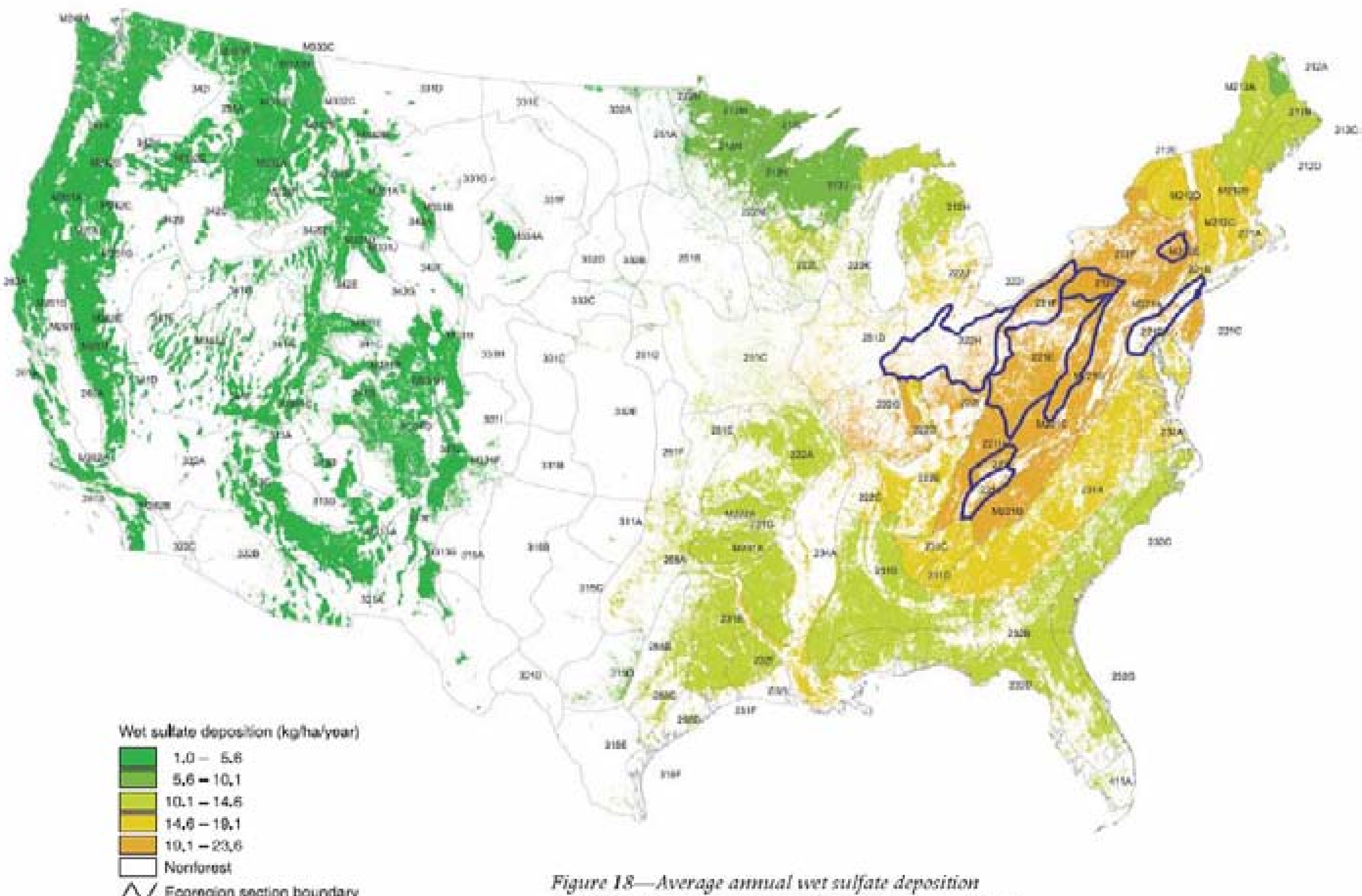


Figure 18—Average annual wet sulfate deposition (1994 to 2001) by ecoregion section. The areas outlined in blue highlight ecoregion sections whose deposition rates exceed the 95th percentile.

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Wet Nitrogen Deposition

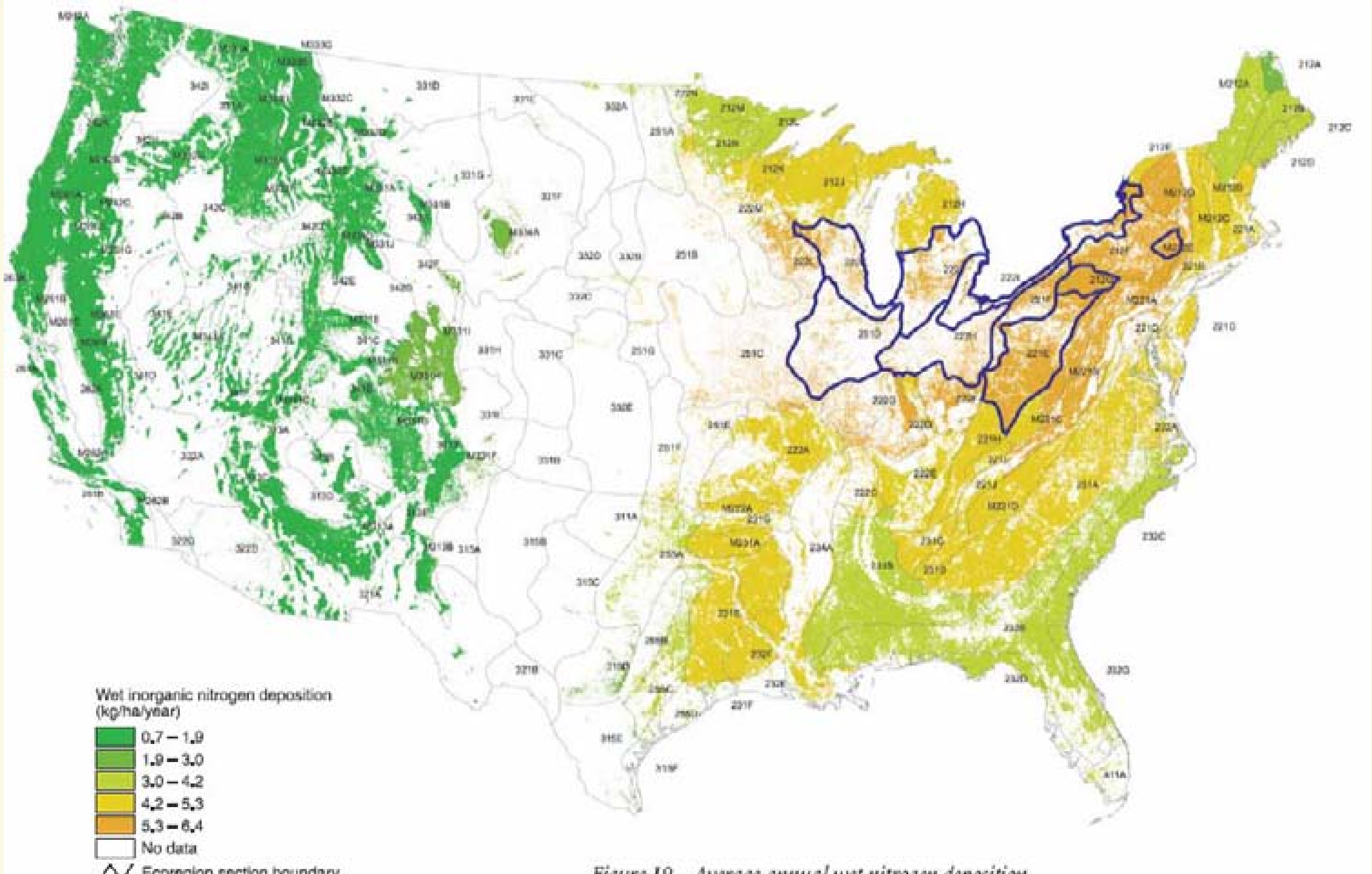
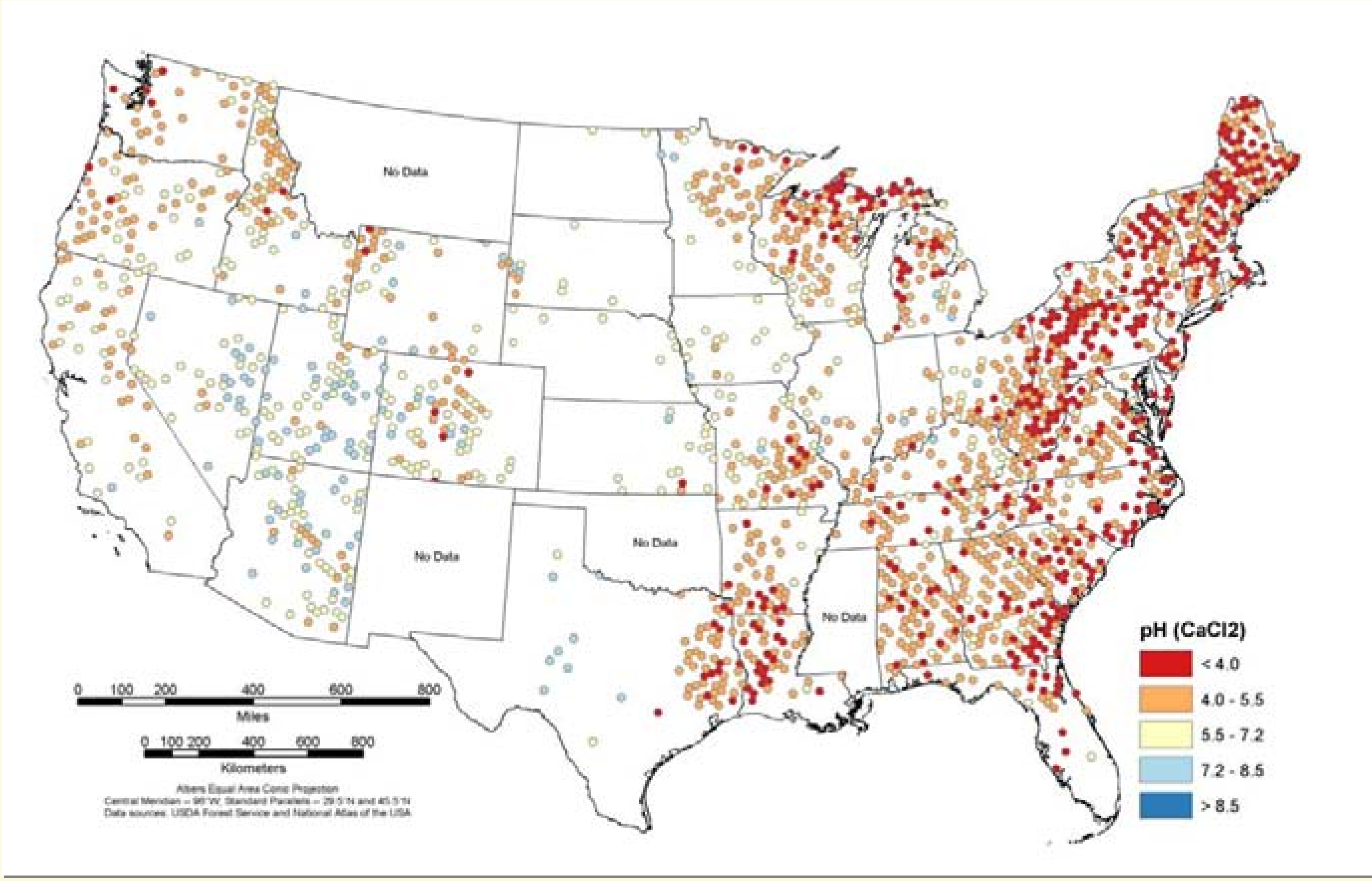


Figure 19—Average annual wet nitrogen deposition (1994 to 2001) by ecoregion section. The areas outlined in blue highlight ecoregion sections whose deposition rates exceed the 95th percentile.

Soil pH

- Mean soil pH value is 4.8
- Acidic tendency of soil pH is most clear east of the Mississippi River

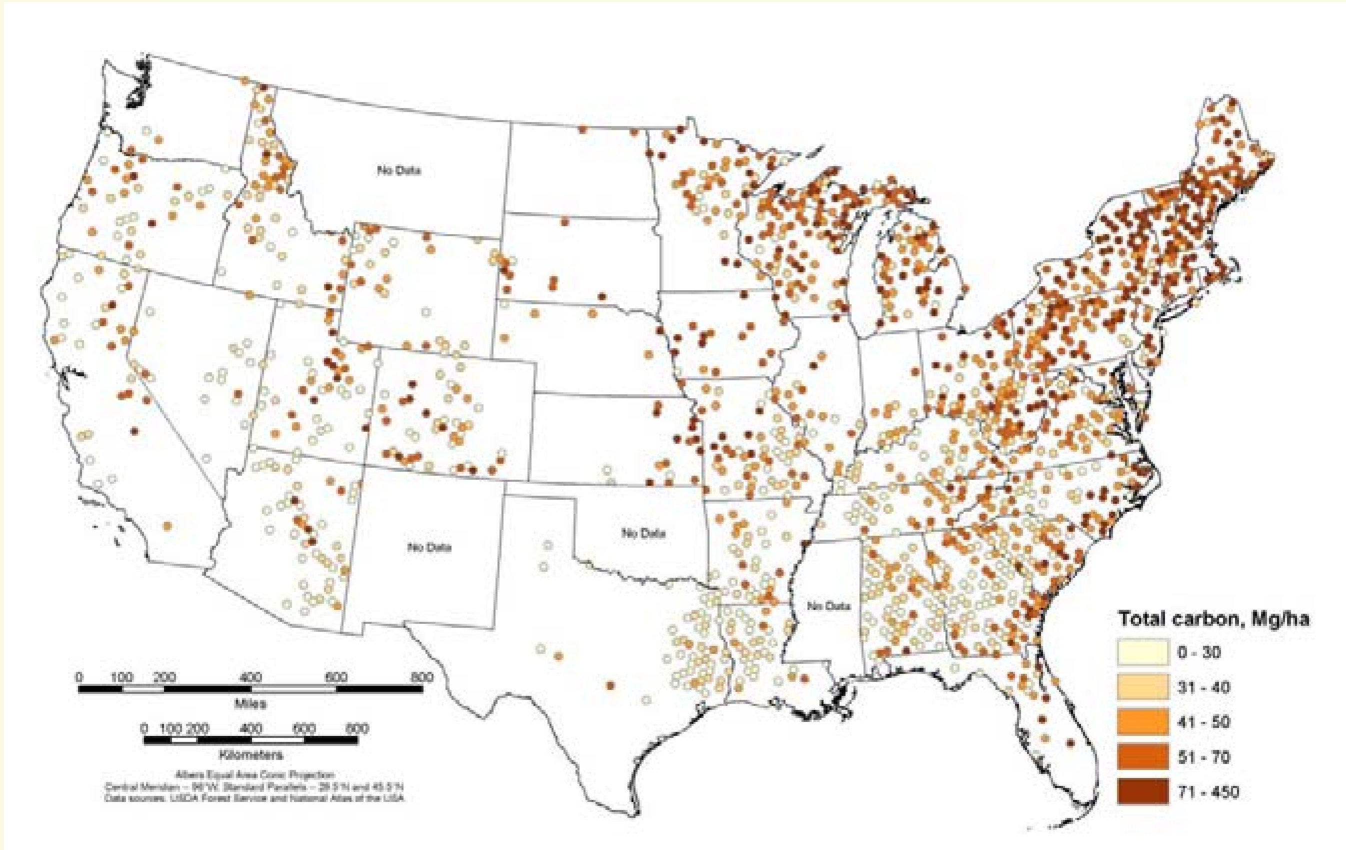


Effective Cation Exchange Capacity

- Southeastern United States tended to have the greater proportion of forest soils with low ECEC levels.

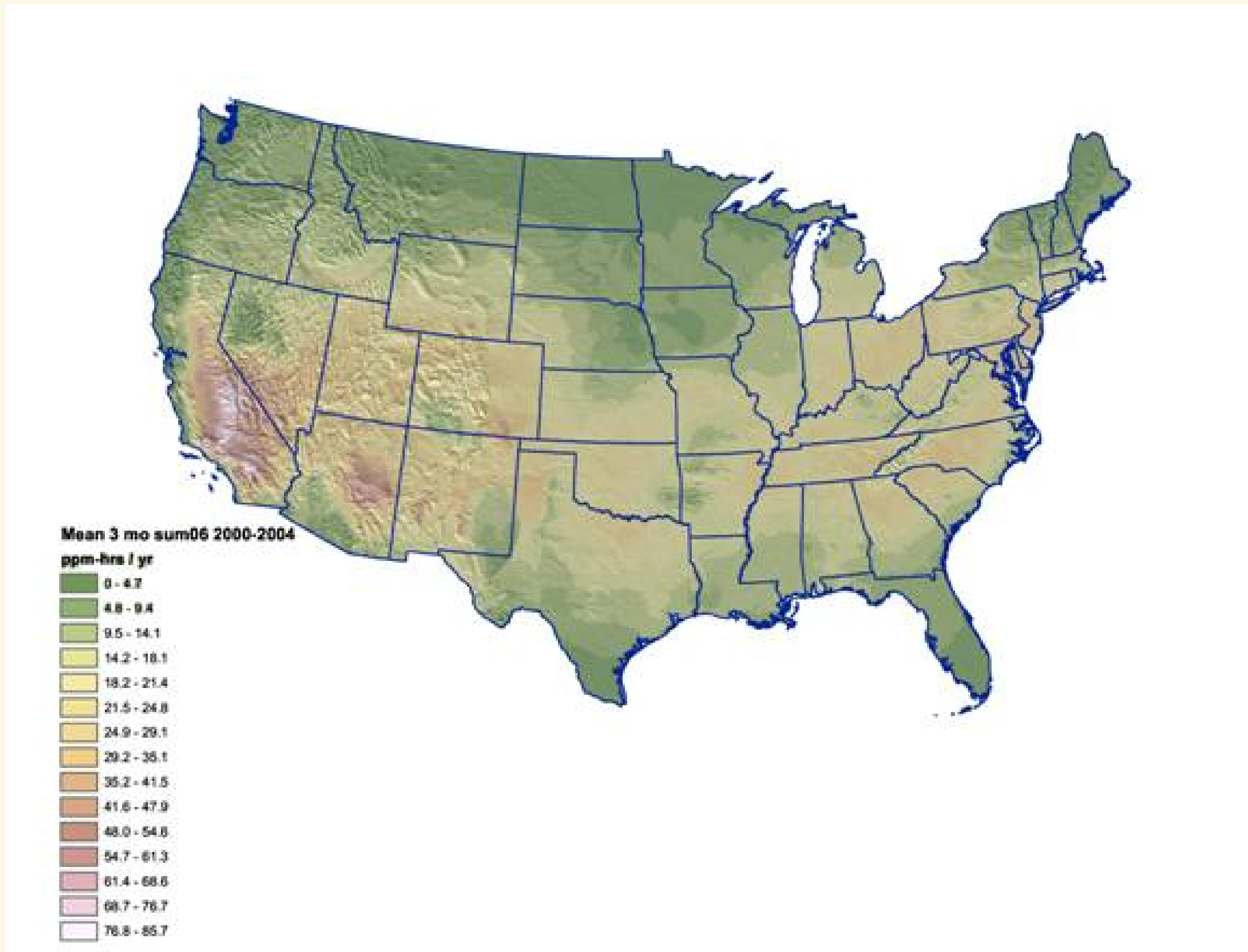
Total Soil Carbon

- Total soil carbon content is generally the highest in the Northeastern and Northern United States where decay rates are very low



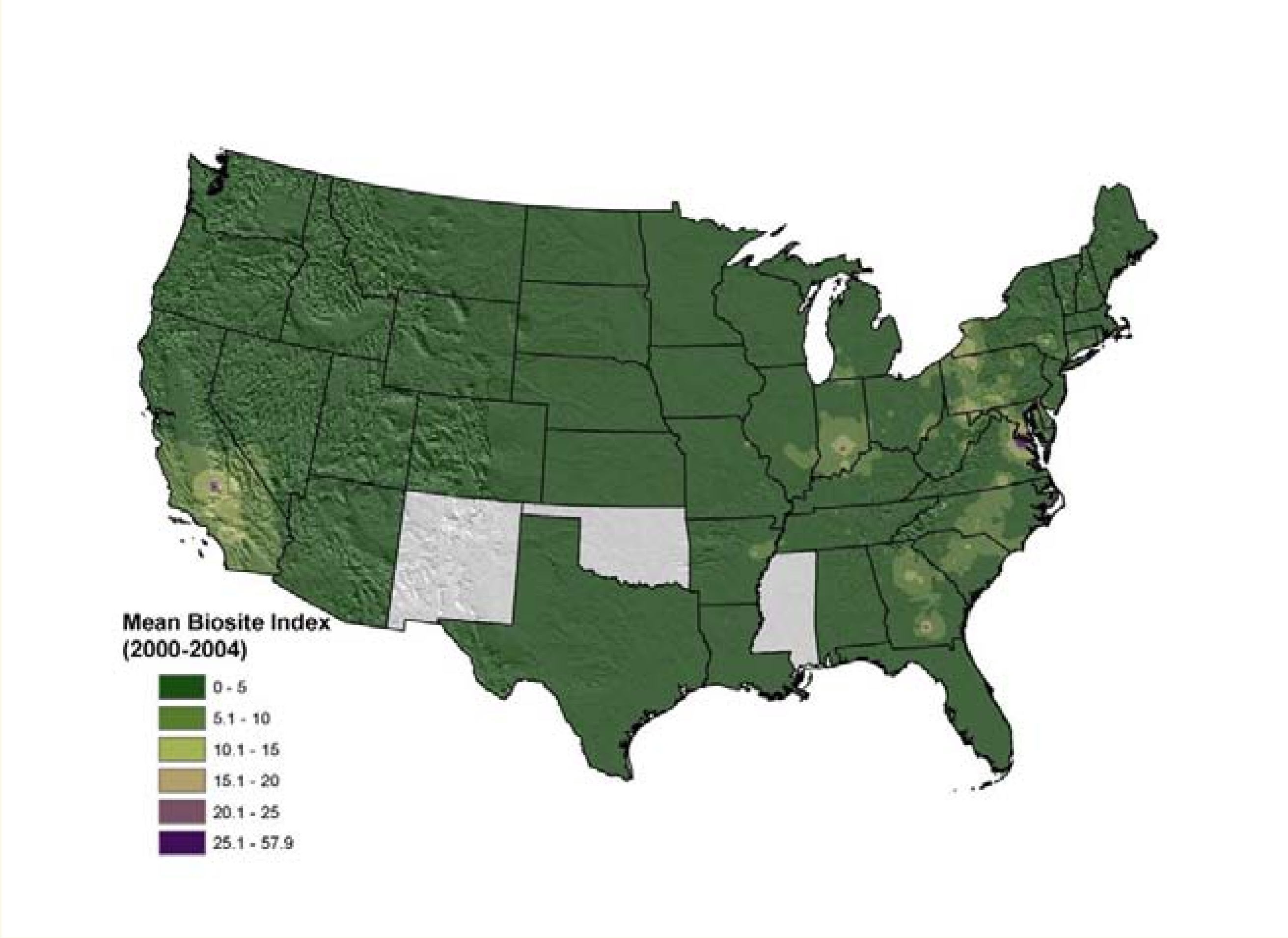
Ozone Exposure

- **Ozone concentrations highest in Sierra Nevada, southwest, Appalachian piedmont, along east coast and Great Lakes**



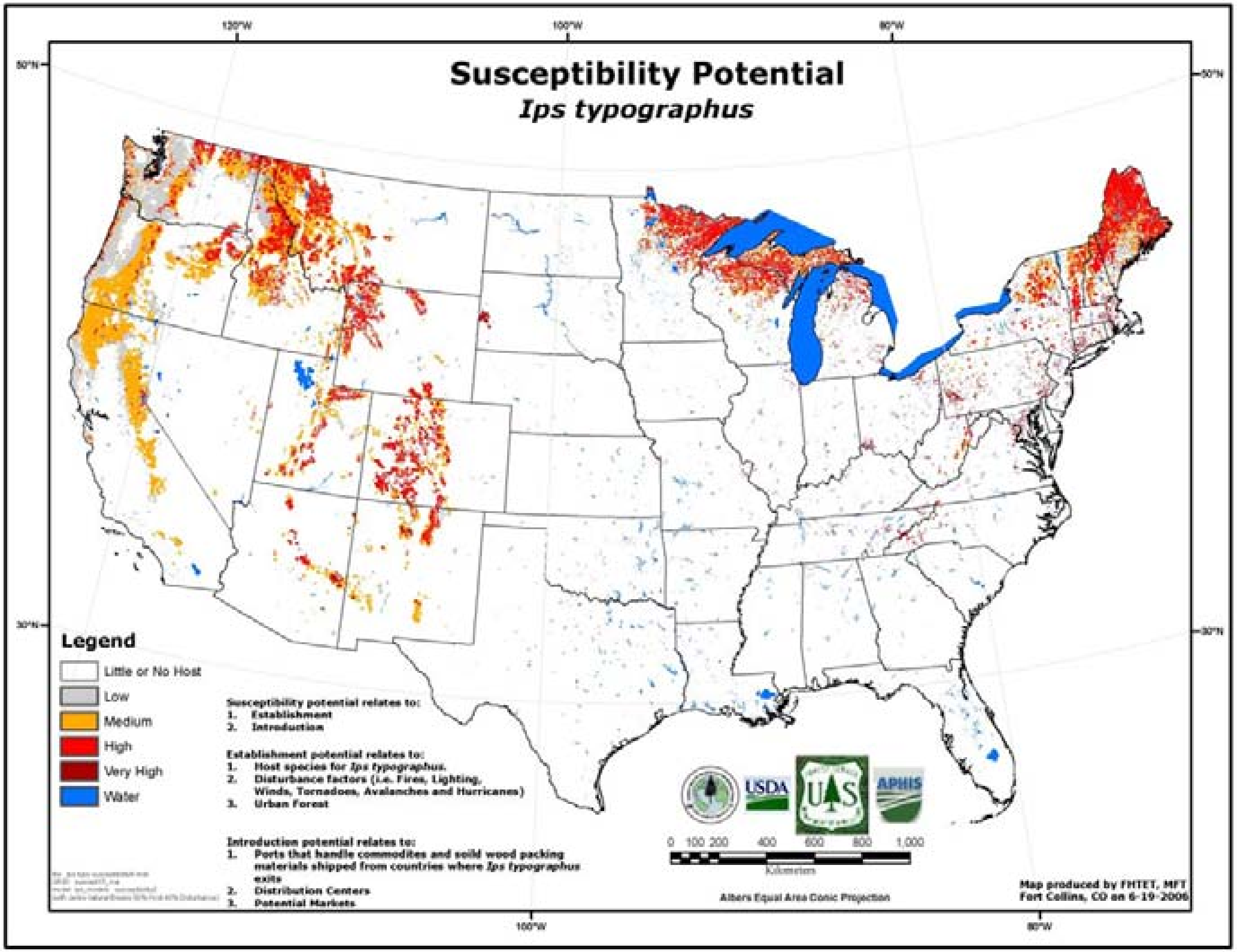
Ozone Biosite Index

- Foliar injury on ozone plots showed similar trends
- The highest occurrences in the Sierra Nevada, the southeast, and near Washington, DC



Risk Mapping

Risk of Invasive Forest Pests



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