Strategies for Monitoring and Managing Impacts of Climate Change on Forest Health

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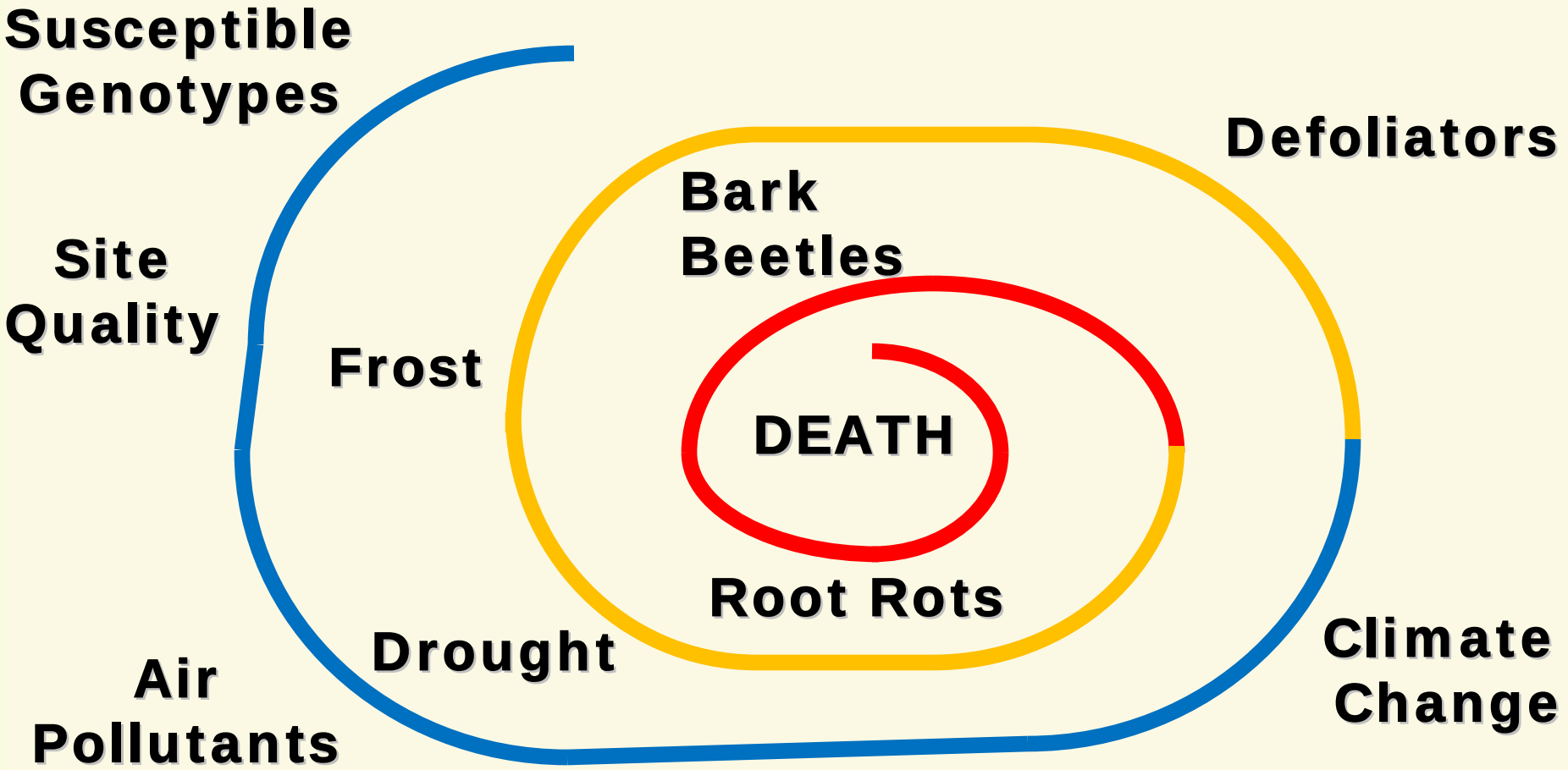
Climate Change Impacts on Forests

- Potential effects of:
  - Shifts in native species distributions,
  - Increased spread of invasive species,
  - Increased disturbances (drought, fire)
  - Eventual local or range-wide extinctions
- Much uncertainty because
  - Current empirical data are limited
  - Complexity of interacting factors
  - Predictive models sensitive to input values

Complex Factors

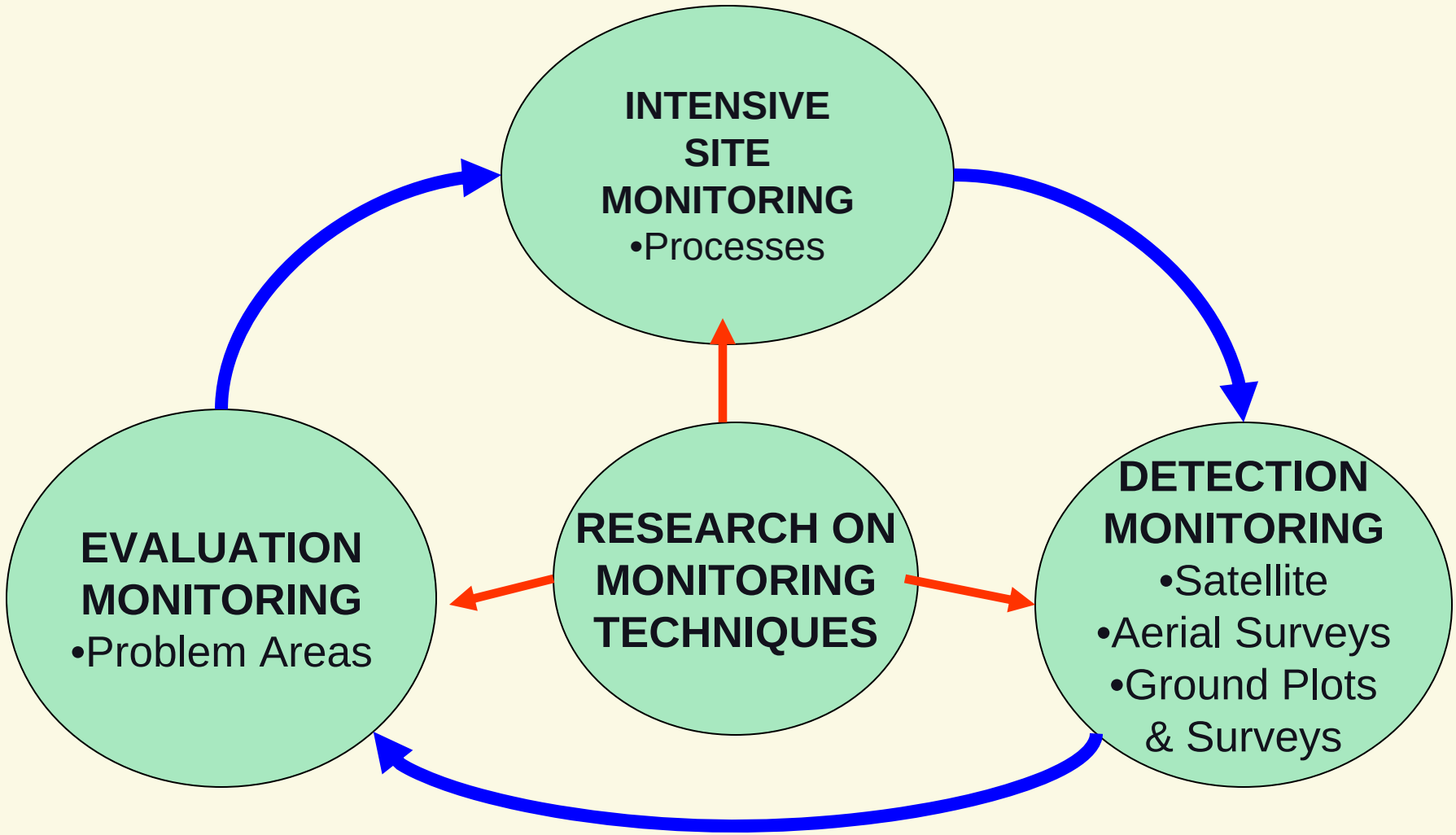
Spiral Decline Concept (Manion, 1981)



Forest Health Monitoring

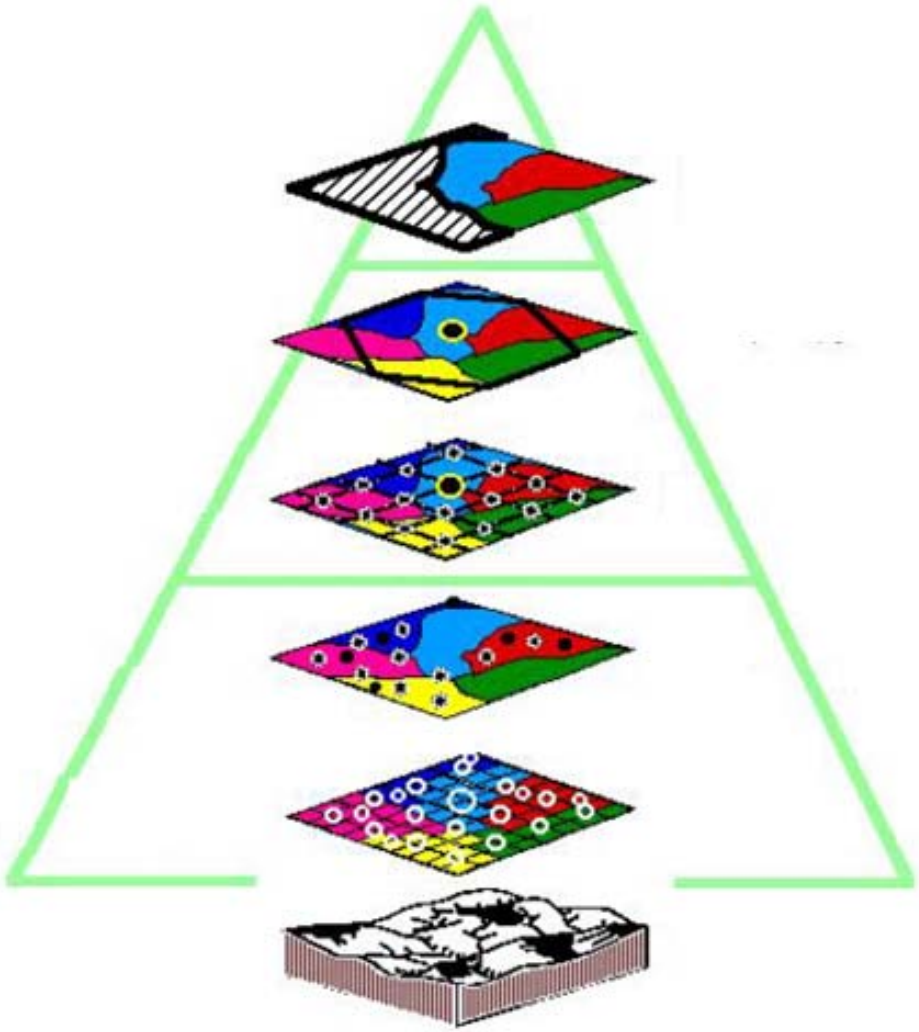
- Implement a monitoring system throughout the forests of the United States to determine detrimental changes or improvements that occur over time.
- Provide baseline and trend information that is statistically precise and accurate.
- Report annually on status and changes to forest health.

FHM Components



Integrated Monitoring Framework

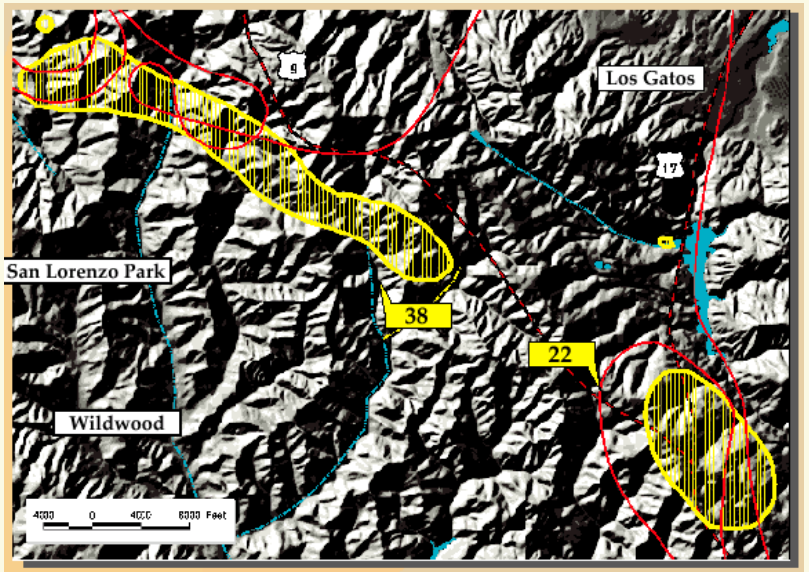
- Satellite Imagery
- Aerial Surveys
- Ground Surveys
- FIA Inventories
- Data from Other Agencies



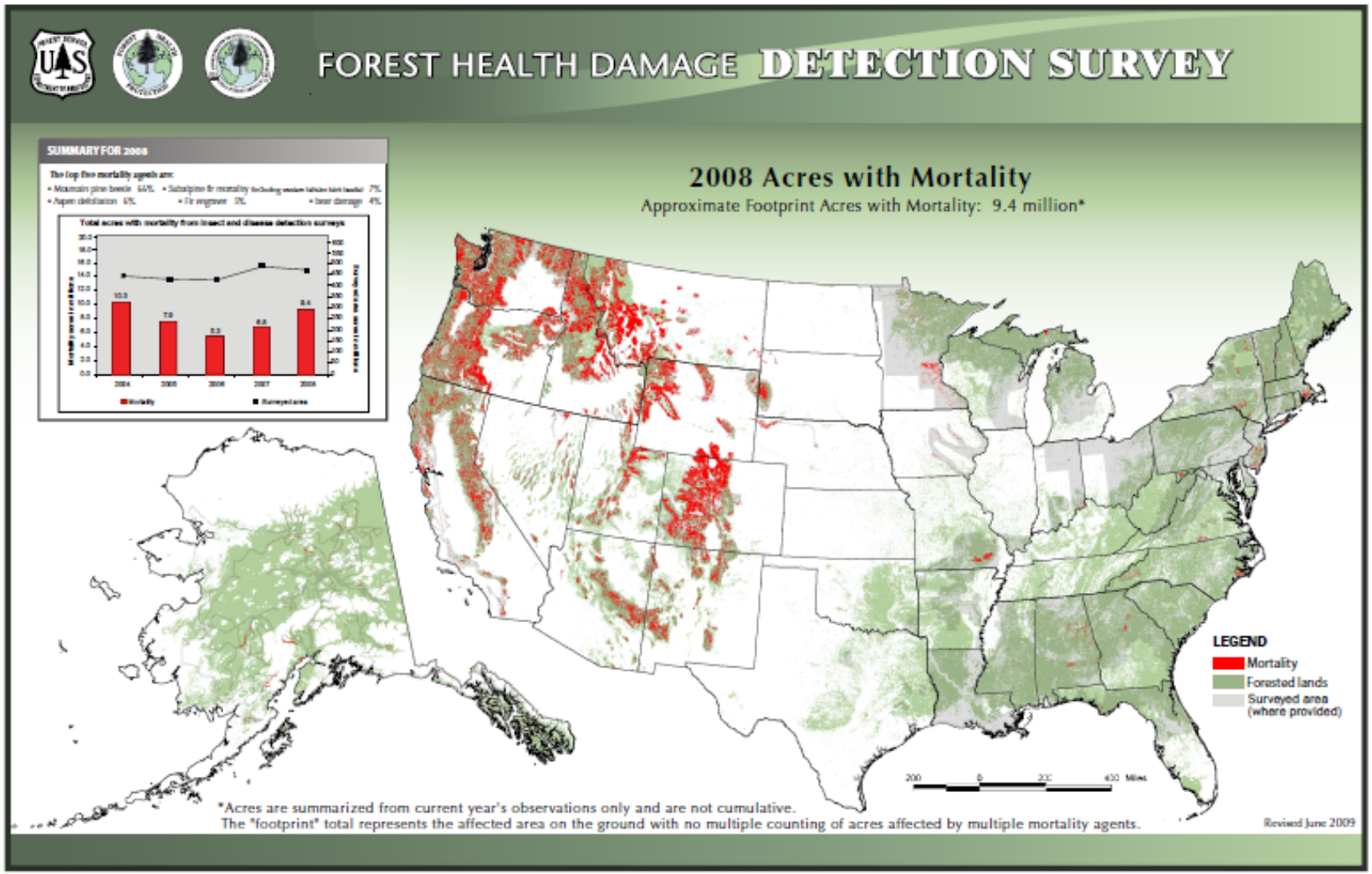
Detection Monitoring

Aerial Detection Surveys

- Observers at 400-800 m
- Create maps of visible damage
- Digital Aerial Sketch Mapping

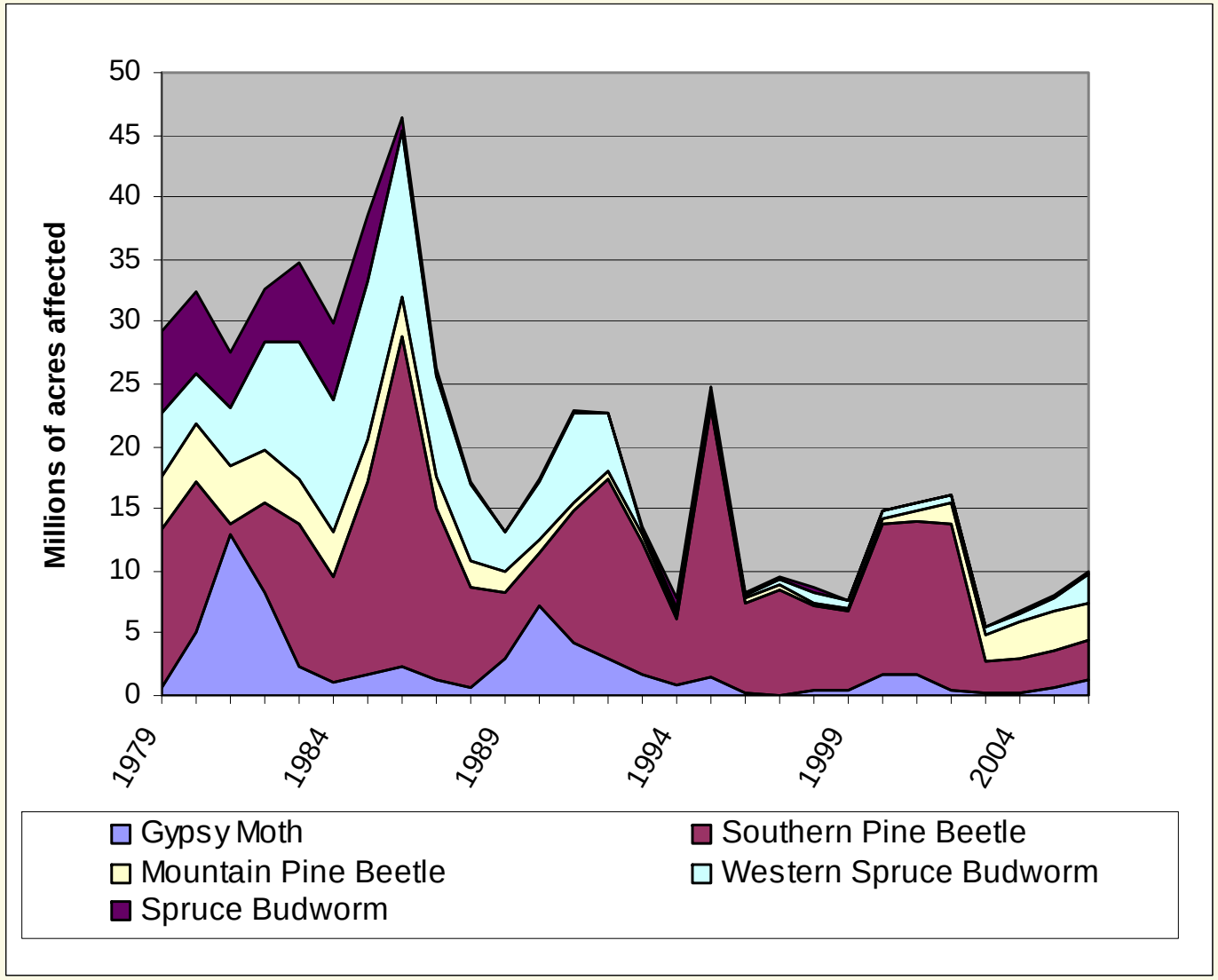


Detection Monitoring



http://www.fs.fed.us/foresthealth/technology/adsm.shtml

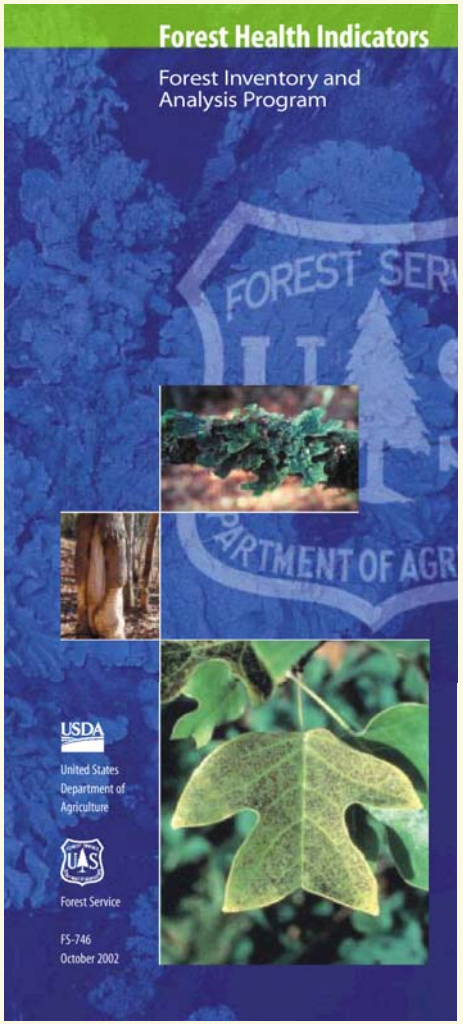
Detection Monitoring



Detection Monitoring

FIA Ground-based 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

Evaluation Monitoring

- Designed to determine the extent, severity, and causes of undesirable changes in forest health identified through Detection Monitoring
- Various projects have been supported related to the potential impacts of climate change

Evaluation Monitoring

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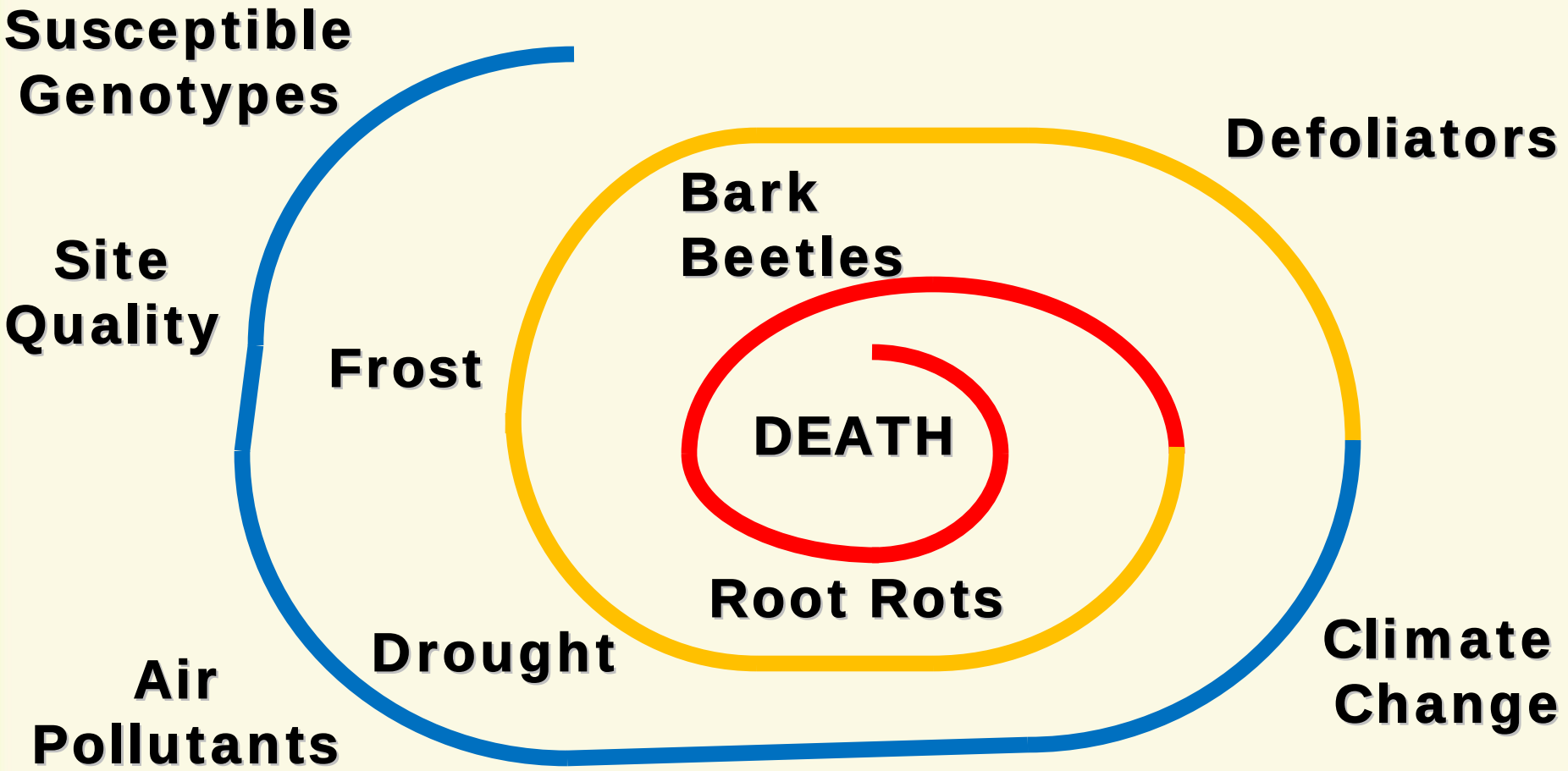


Evaluation Monitoring

Links to Climate Change

Interior West

Pine Declines

- Ponderosa Pine
- Pinon Pine
- Whitebark Pine
- Lodgepole Pine

Sudden Aspen Decline

Alaska

Yellow-cedar Decline

Evaluation Monitoring

Links to Climate Change

Northeast U.S.

What is the threshold of perception?

Less extreme droughts
Mixed forest compositions
Confounding disturbances

- Development
- High-grade logging
- Invasive pests

Climate Change & Invasives

Mid-Atlantic Invasive Insects and Diseases

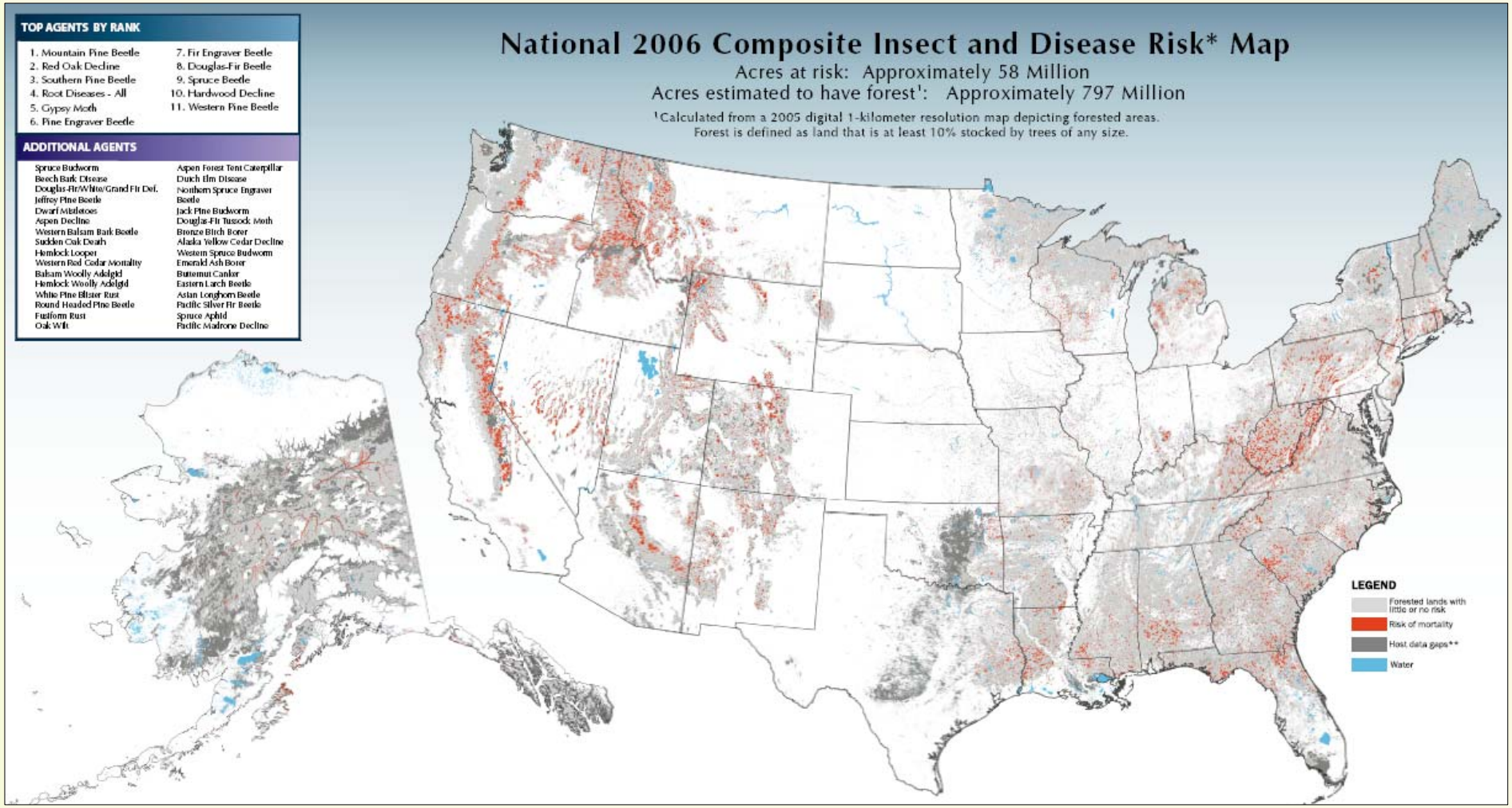
Date	Pest
1869	Gypsy Moth
1890s	Beech Bark Disease
1904	Chestnut Blight
1933	Dutch Elm Disease
1950s	Hemlock Woolly Adelgid
1967	Butternut Canker
1978	Dogwood Anthracnose
1986	Bacterial Leaf Scorch
1996	Asian Longhorn Beetle
2002	Emerald Ash Borer
2004	Sirex Woodwasp

USDA FOREST SERVICE
Caring for the Land and Serving People

National Forest Health Monitoring

USDA

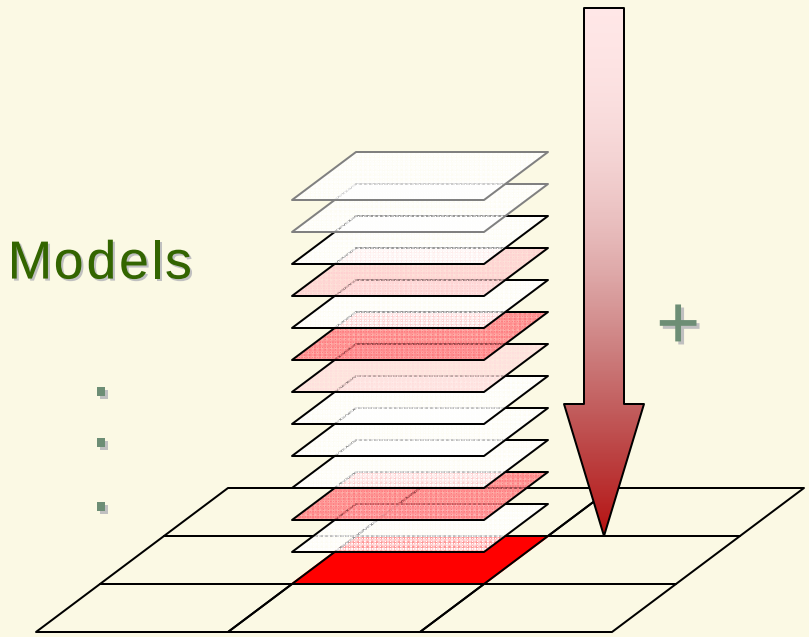
National Insect & Disease Risk Map



http://www.fs.fed.us/foresthealth/technology/nidrm.shtml

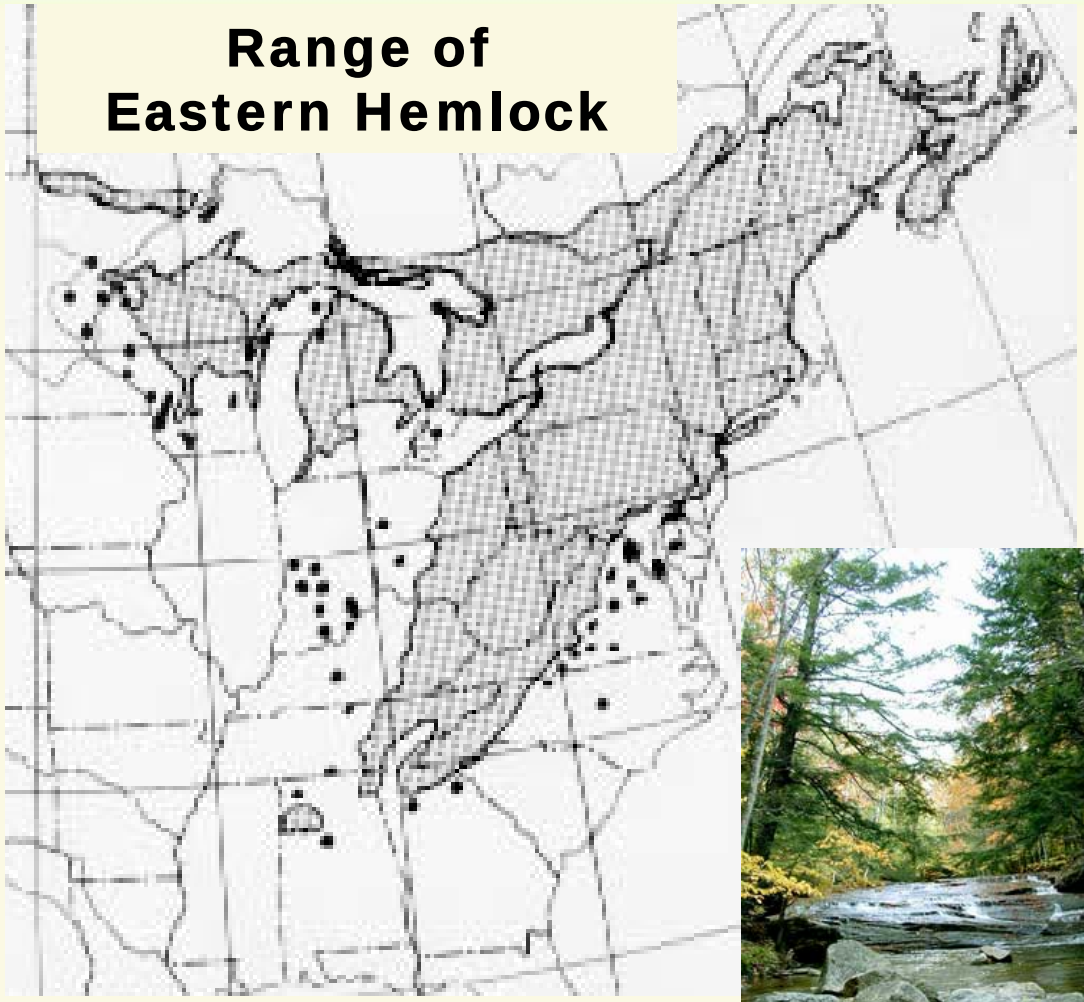
National Insect & Disease Risk Map

- 190 specific models
- Over 50 insects and diseases
- 61 tree species
- Includes climate & soil moisture factors
- Identified 23.5 million hectares of potential risk



Monitoring on the Margins

- First Impacts likely on edges of species ranges
- Focused monitoring on these margins
- Both southern & northern edges of special concern
- Higher elevations



Understanding Complexity

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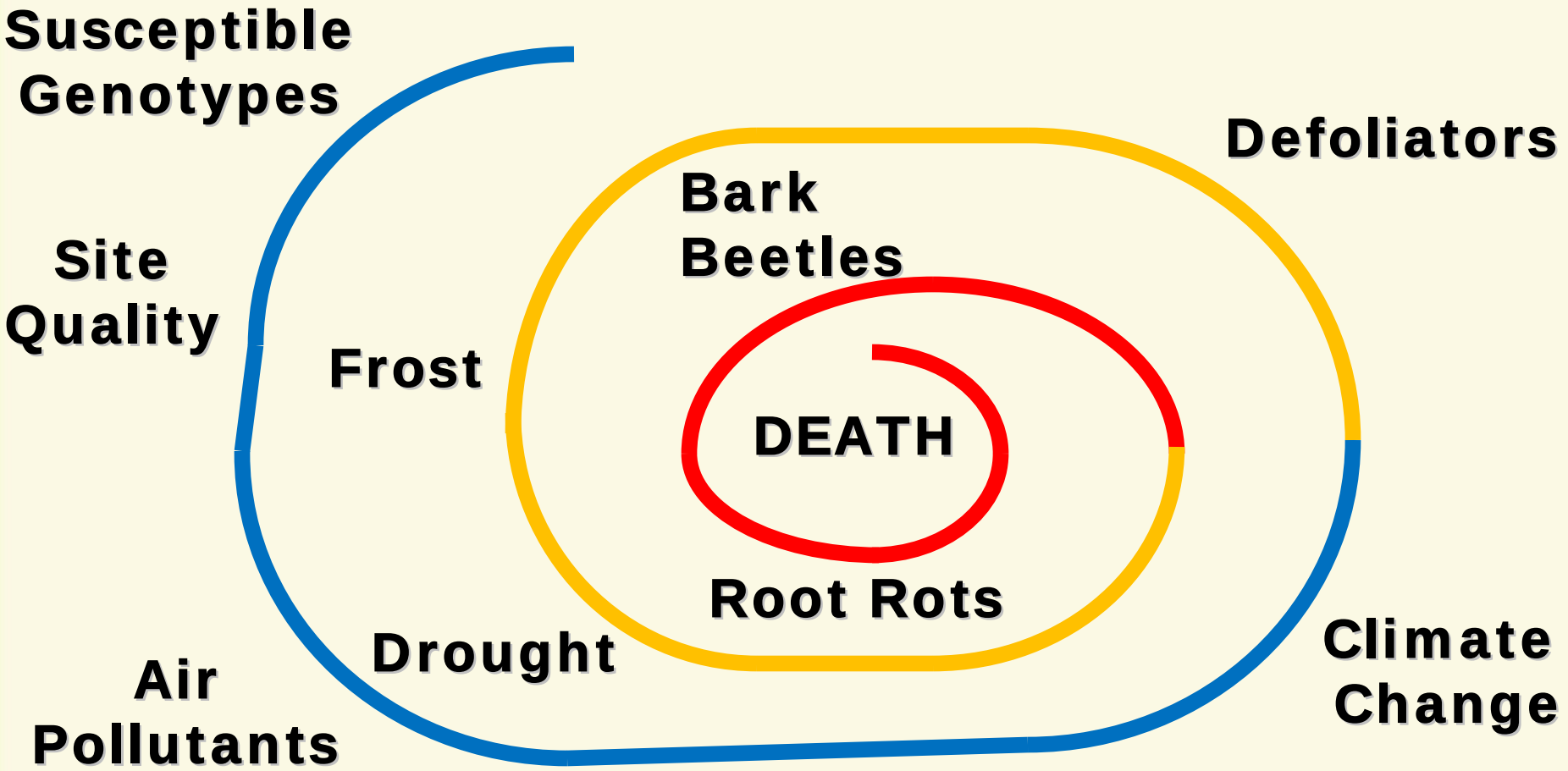

Conclusions

Monitoring

- Long-term commitments are essential
- Need to detect deviations from historic trends
- Early detection using monitoring on the margins
- Risk models can help identify future risks

Adaptation Strategies

- Strong reliance on findings from monitoring
- Compare what is at risk with what is manageable
- Be diligent against invasive pests
- Promote within-species diversity of gene pools
- Promote diverse forest species compositions

Managing Uncertainty