



National Insect and Disease Risk Map Status, Results, and Future

Presented by:

Frank Krist

And Jim Ellenwood

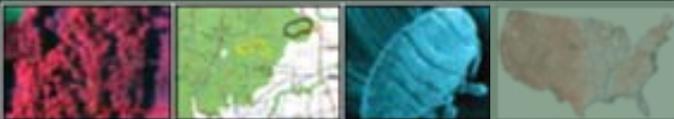
Forest Health Technology Enterprise Team

Fort Collins, Co

Overview

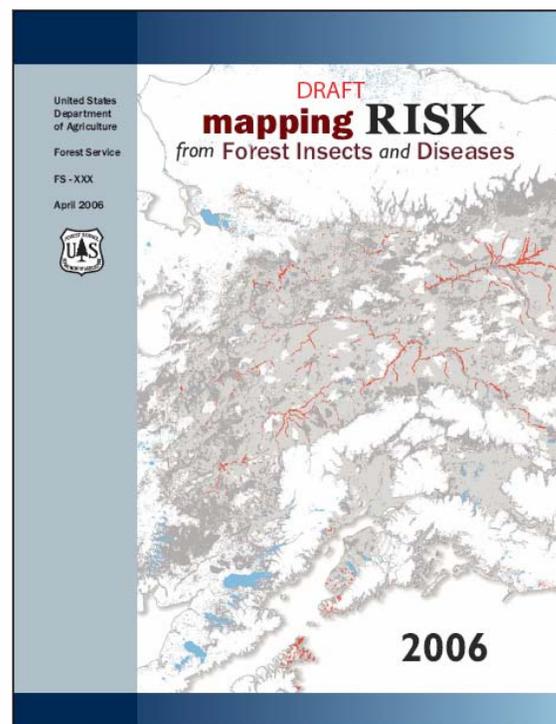
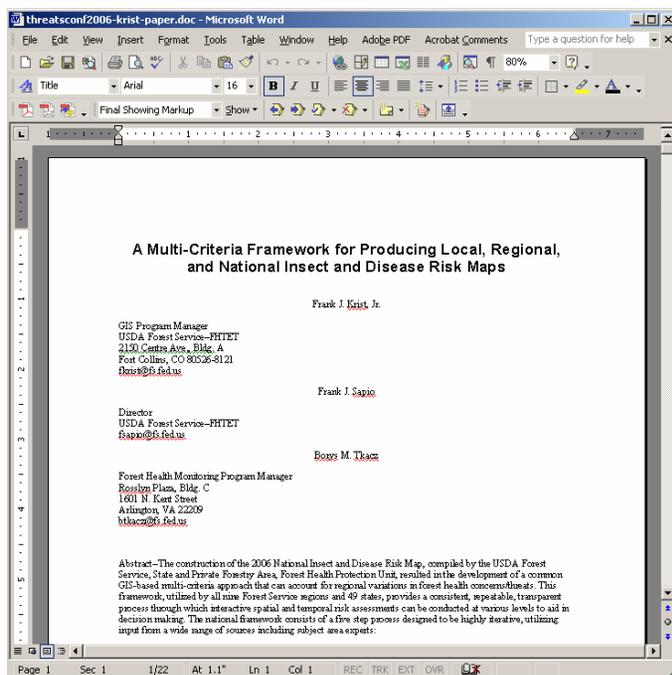
2006 National Insect and Disease Risk (**NIDRM**) Map

- **Status**
 - Models, maps, paper, report...
- **Results**
- **Briefings**
- **Future Directions...**
- **Accessing Data**
 - Portal



NIDRM Status

- **Peer-Reviewed Paper Completed**
 - Details methods
 - GTR Publication (Threats Conf. Boulder July 06)
- **Report: Currently Working on Final Edits, Layout, and Design**





NIDRM Status

- **Maps and Models: Final Edits Complete Fall 2006**

The screenshot displays the ArcView GIS 3.3 interface with a Model Builder workflow for 'Risk Agent X for Aspen'. The workflow includes several input themes, reclassification steps, weighted overlays, and an arithmetic overlay leading to a mortality risk output. A 'Weighted Overlay' dialog box is open, showing the evaluation scale and table for the 'Aspen BA Rcl.' input theme.

Model Builder Workflow:

- Extrem. Annual Min. Temps → Reclass → Extrem. Annual Min. Temps Rcl.
- Dist. To Know Infestations → Reclass → Dist. To Know Infestations Rcl.
- Aspen BA → Reclass → Aspen BA Rcl.
- Soil Dryness/Wetness → Reclass → Soil Dryness/Wetness Rcl.
- Aspen QMD → Reclass → Aspen QMD Rcl.
- Extrem. Annual Min. Temps Rcl. and Dist. To Know Infestations Rcl. → Weighted Overlay → Susceptibility
- Aspen BA Rcl. and Soil Dryness/Wetness Rcl. → Weighted Overlay → Vulnerability
- Susceptibility and Vulnerability → Arithmetic Overlay → Mortality Risk

Weighted Overlay Dialog - Evaluation Scale:

Input Theme	% Inf	Input Field	Input Label	Scale Value
Aspen BA Rcl.	100	Value		Restricted
		1	0 - 1	0
		2	1 - 20	0
		3	20 - 30	1
		4	30 - 40	2
		5	40 - 50	3
		6	50 - 60	4
		7	60 - 70	5
		8	70 - 80	6
Sum of influences (must equal 100%)				100



NIDRM Results

- NIDRIM Summary:**
 - Assembled, ran, and integrated 190 models representing over 50 agents acting on 61 tree species
 - Identified approx. 58 million acres of potential risk

TOP AGENTS BY RANK		AREA AT RISK (ACRES x 1000)		PERCENT OF FORESTED LAND AT RISK			
1. Mountain Pine Beetle	7. Fir Engraver Beetle	California 4,919	Missouri 872	Rhode Island 25.94	Michigan 7.27	West Virginia 22.38	Georgia 7.17
California 4,919	Missouri 872	Montana 4,222	New York 801	West Virginia 22.38	Georgia 7.17	Nevada 19.60	North Carolina 6.95
Idaho 3,709	Arkansas 733	Idaho 3,709	Texas 689	Montana 17.99	Alabama 6.07	West Virginia 17.11	Utah 5.95
West Virginia 2,985	Texas 689	Alaska 2,772	Ohio 475	Connecticut 17.11	Utah 5.95	Oregon 16.82	Missouri 5.95
Alaska 2,772	Ohio 475	Oregon 2,765	Minnesota 450	California 16.82	Missouri 5.95	Wyoming 16.72	Wisconsin 5.80
Oregon 2,765	Minnesota 450	Georgia 2,062	Tennessee 423	Wyoming 16.72	Wisconsin 5.80	Jeffrey Pine Beetle	Beetle
Georgia 2,062	Tennessee 423	Wyoming 1,756	New Hampshire 214	Oregon 9.06	Iowa 3.56	Dwarf Mistletoes	Jack Pine Budworm
Jeffrey Pine Beetle	Beetle	Arizona 1,743	Illinois 202	Louisiana 8.93	North Dakota 3.42	Aspen Decline	Douglas-Fir Tussock Moth
Dwarf Mistletoes	Jack Pine Budworm	North Carolina 1,623	Maryland 184	Indiana 8.63	Tennessee 2.99	Western Red Cedar Mortality	Bronze Birch Borer
Aspen Decline	Douglas-Fir Tussock Moth	Florida 1,600	South Dakota 116	Colorado 8.54	Texas 2.89	Western Balsam Bark Beetle	Alaska Yellow Cedar Decline
Western Balsam Bark Beetle	Bronze Birch Borer	Alabama 1,491	Rhode Island 106	Florida 8.38	Minnesota 2.63	Sudden Oak Death	Western Spruce Budworm
Sudden Oak Death	Alaska Yellow Cedar Decline	Michigan 1,391	Vermont 106	New Mexico 8.33	Oklahoma 2.53	Hemlock Looper	Emerald Ash Borer
Hemlock Looper	Western Spruce Budworm	New Mexico 1,353	Iowa 85	Maryland 7.88	Vermont 2.18	Western Red Cedar Mortality	Butternut Canker
Western Red Cedar Mortality	Emerald Ash Borer	Louisiana 1,349	Delaware 16	Washington 7.78	Alaska 1.88	Balsam Woolly Adelgid	Eastern Larch Beetle
Balsam Woolly Adelgid	Butternut Canker	Mississippi 1,016	Kansas 14	Massachusetts 7.61	Maine 1.67	Hemlock Woolly Adelgid	Asian Longhorn Beetle
Hemlock Woolly Adelgid	Eastern Larch Beetle	Utah 970	Nebraska 10	Kentucky 7.54	Nebraska 0.90	White Pine Blister Rust	Pacific Silver Fir Beetle
White Pine Blister Rust	Asian Longhorn Beetle	Kentucky 962	North Dakota 9	South Dakota 7.37	Kansas 0.81	Round Headed Pine Beetle	Spruce Aphid
Round Headed Pine Beetle	Pacific Silver Fir Beetle	Wisconsin 923	DC 0	Ohio 7.31	DC 0.00	Fusiform Rust	Pacific Madrone Decline
Fusiform Rust	Spruce Aphid					Oak Wilt	
Oak Wilt	Pacific Madrone Decline						

NIDRM Results

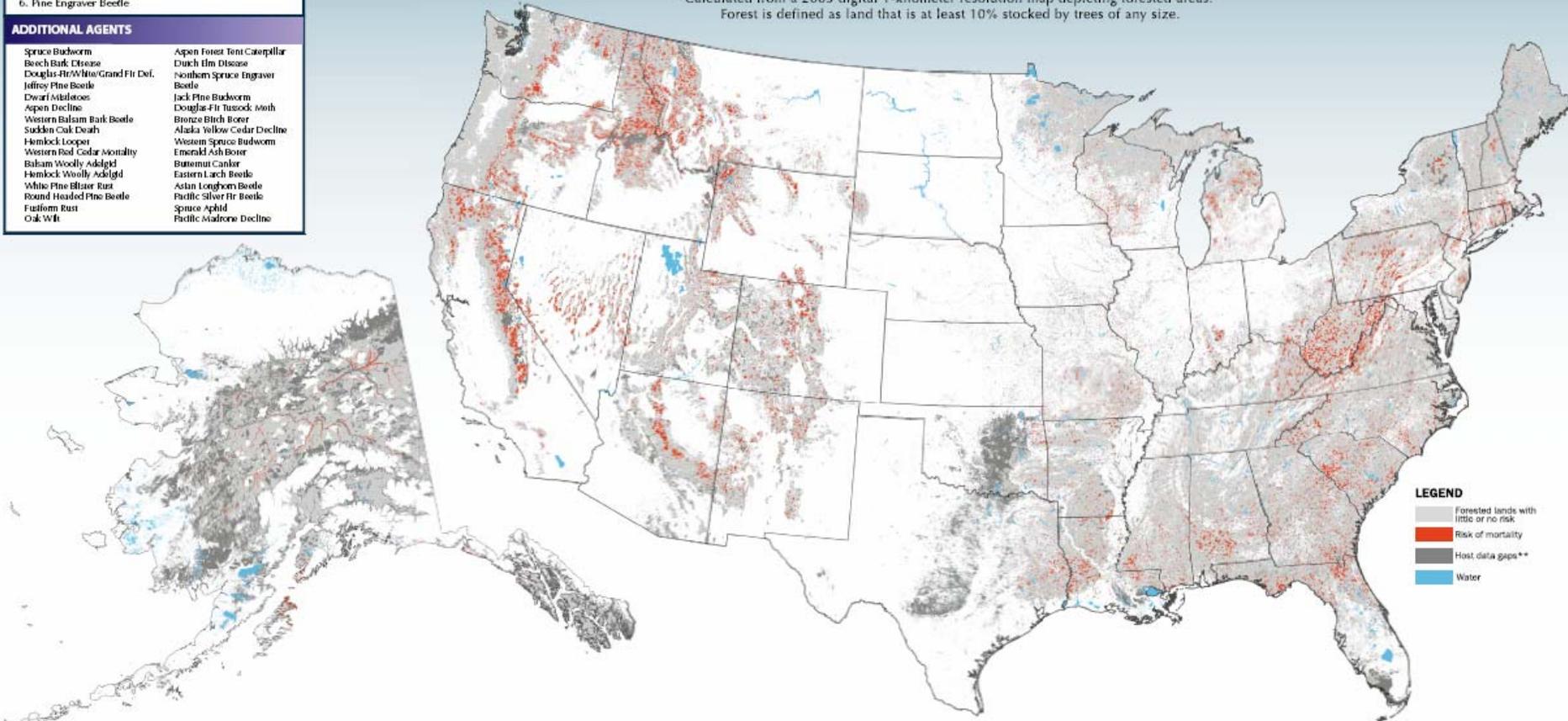
TOP AGENTS BY RANK	
1. Mountain Pine Beetle	7. Fir Engraver Beetle
2. Red Oak Decline	8. Douglas-Fir Beetle
3. Southern Pine Beetle	9. Spruce Beetle
4. Root Diseases - All	10. Hardwood Decline
5. Gypsy Moth	11. Western Fine Beetle
6. Pine Engraver Beetle	

ADDITIONAL AGENTS	
Spruce Budworm	Aspen Forest Tent Caterpillar
Beech Bark Disease	Dutch Elm Disease
Douglas-Fir/Water Grand Fir Def.	Northern Spruce Engraver Beetle
Jeffrey Pine Beetle	Jack Pine Budworm
Dwarf Mistletoes	Douglas-Fir Tussock Moth
Aspen Decline	Bronze Birch Borer
Western Balsam Bark Beetle	Alaska Yellow Cedar Decline
Sudden Oak Death	Western Spruce Budworm
Hemlock Looper	Emerald Ash Borer
Western Red Cedar Mortality	Burramut Cankers
Balsam Woolly Adelgid	Eastern Larch Beetle
Hemlock Woolly Adelgid	Asian Longhorn Beetle
White Pine Blister Rust	Pacific Silver Fir Beetle
Round Headed Pine Beetle	Spruce Aphid
Fusiform Rust	Pacific Madrone Decline
Oak Wilt	

National 2006 Composite Insect and Disease Risk* Map

Acres at risk: Approximately 58 Million
 Acres estimated to have forest¹: Approximately 797 Million

¹Calculated from a 2005 digital 1-kilometer resolution map depicting forested areas. Forest is defined as land that is at least 10% stocked by trees of any size.



LEGEND

- Forested lands with little or no risk
- Risk of mortality
- Host data gaps**
- Water



NIDRM Results

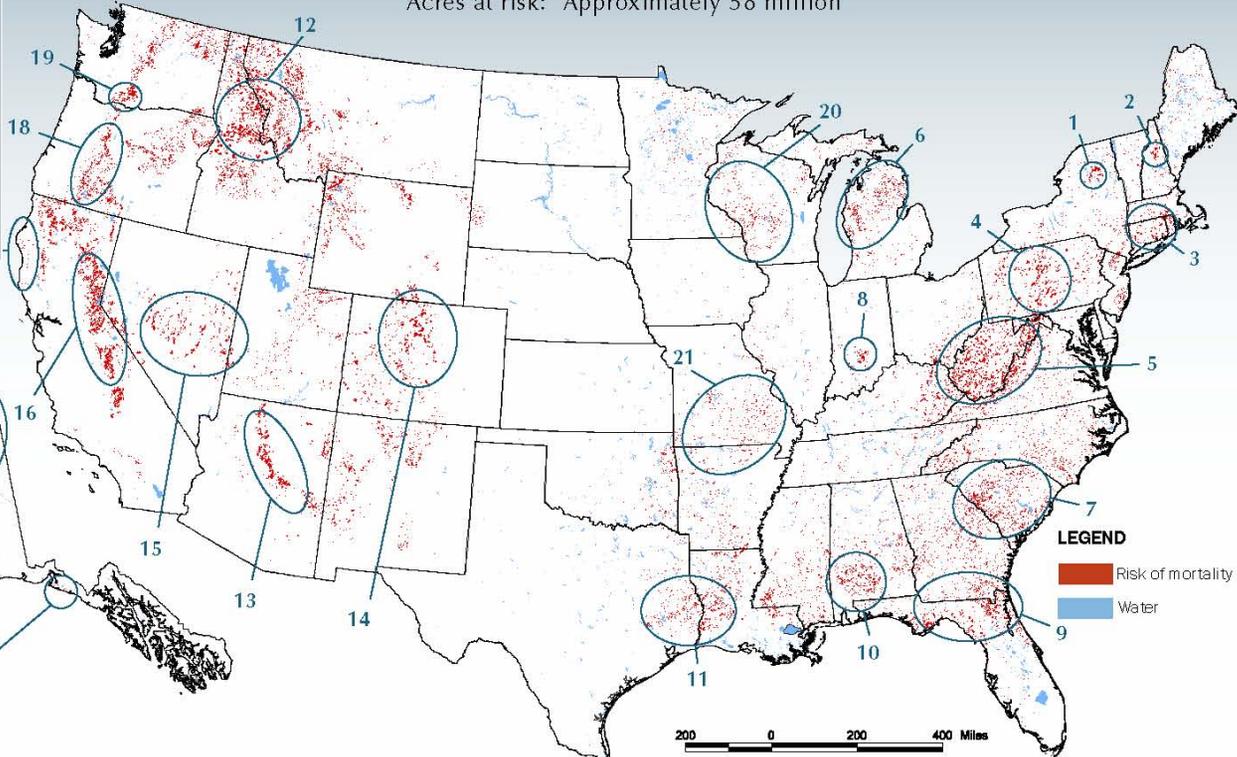
PREDOMINANT AGENT(S) BY AREA OF INTEREST

1. Beech Bark Disease, some Hardwood Decline
2. Balsam Woolly Adelgid, Spruce Budworm
3. Red Oak Decline, Gypsy Moth
4. Red Oak Decline, Gypsy Moth
5. Gypsy Moth, Red Oak Decline
6. Red Oak Decline, Gypsy Moth
7. Southern Pine Beetle, Root Disease
8. Red Oak Decline, Gypsy Moth
9. Southern Pine Beetle
10. Southern Pine Beetle, Root Disease
11. Southern Pine Beetle
12. Mountain Pine Beetle, Root Disease
13. Western Pine Beetle, Pine Engraver Beetle (Ips), Round Headed Pine Beetle
14. Mountain Pine Beetle
15. Pine Engraver Beetle (Ips)
16. Mountain Pine Beetle, Fir Engraver Beetle, Root Disease
17. Sudden Oak Death
18. Pine Engraver Beetle (Ips), Fir Engraver Beetle, Root Disease
19. Mountain Pine Beetle, Pine Engraver Beetle (Ips)
20. Red Oak Decline, Gypsy Moth
21. Red Oak Decline, some Oak Wilt
22. Birch Heart/Root Rot
23. Spruce Beetle
24. Northern Spruce Engraver Beetle, Spruce Beetle
25. Northern Spruce Engraver Beetle

NATIONAL INSECT and DISEASE RISK MAP

Major Risk Agents Contributing to the 2006 National Composite Insect and Disease Risk* Map

Acres at risk: Approximately 58 million



LEGEND

- Risk of mortality
- Water

*The expectation that 25% or more of the standing live volume of trees greater than 1" in diameter will die over the next 15 years.

NIDRM Results



NATIONAL INSECT and DISEASE RISK MAP

Bark Beetle Risk*

Acres at risk: Approximately 29 million

AREA AT RISK (THOUSAND ACRES)

California	3,571
Montana	3,026
Alaska	2,730
Idaho	2,341
Nevada	1,725
Arizona	1,692
Wyoming	1,647
Colorado	1,628
Florida	1,544
New Mexico	1,301
South Carolina	1,146
Louisiana	1,145
Oregon	1,123
Georgia	1,029
Alabama	977
Mississippi	859
Utah	735
North Carolina	608
Washington	553
Texas	536
Arkansas	376
New Jersey	114
South Dakota	111
Virginia	83
Oklahoma	83

BARK BEETLES

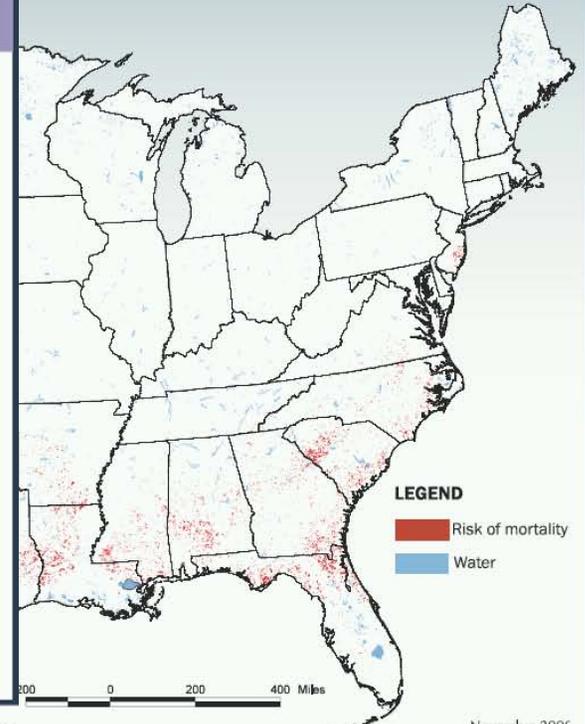
- Douglas Fir Beetle
- Fir Engraver Beetle
- Jeffrey Pine Beetle
- Mountain Pine Beetle
- Northern Spruce Engraver Beetle

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BARK BEETLES

- Douglas Fir Beetle
- Fir Engraver Beetle
- Jeffrey Pine Beetle
- Mountain Pine Beetle
- Northern Spruce Engraver Beetle
- Pacific Silver Fir Beetle
- Pine Engraver Beetle
- Roundheaded Pine Beetle
- Southern Pine Beetle
- Spruce Beetle
- Western Balsam Bark Beetle
- Western Pine Beetle



*The expectation that 25% or more of the standing live volume of trees greater than 1" in diameter will die over the next 15 years.

NIDRM Results



NATIONAL INSECT and DISEASE RISK MAP

AREA AT RISK (THOUSAND ACRES)

West Virginia	651
Virginia	389
Michigan	208
New York	192
Pennsylvania	171
Kentucky	166
Ohio	109
Wyoming	103
California	64
North Carolina	58
New Jersey	44
Indiana	42
Maine	35
Tennessee	26
Illinois	22
New Hampshire	19
Maryland	16
Oregon	16
Minnesota	15
Missouri	14
Texas	12
Iowa	12
Oklahoma	10
Massachusetts	9
Vermont	9

EXOTIC INSECTS AND DISEASES

Asian Longhorned Beetle
Balsam Woolly Adelgid
Beech Bark Disease
Butternut Canker
Dutch Elm Disease

Exotic Insect and Disease Risk*

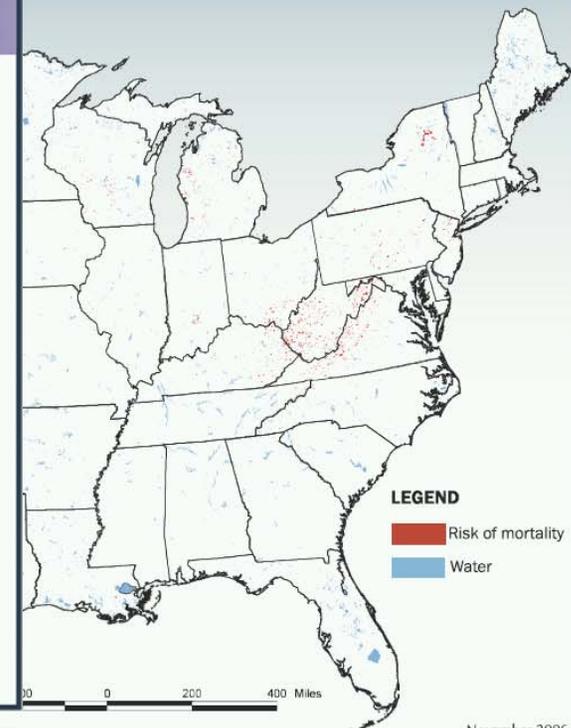
Acres at risk: Approximately 2.4 million

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Massachusetts	9
Vermont	9

EXOTIC INSECTS AND DISEASES

Asian Longhorned Beetle
Balsam Woolly Adelgid
Beech Bark Disease
Butternut Canker
Dutch Elm Disease
Emerald Ash Borer
Gypsy Moth
Hemlock Woolly Adelgid
Oak Wilt
Port-Orford Cedar Root Disease
Spruce Aphid
Sudden Oak Death
White Pine Blister Rust
White Pine Blister Rust



*The expectation that 25% or more of the standing live volume of trees greater than 1" in diameter will die over the next 15 years.



NIDRM Results



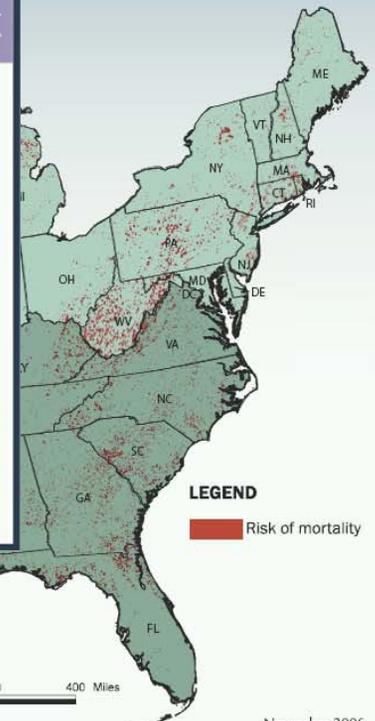
NATIONAL INSECT and DISEASE RISK MAP

Risk* by Forest Service Region

Acres at risk: Approximately 58 million

AREA AT RISK (THOUSAND ACRES)		PERCENT OF FORESTED LAND AT RISK	
Region 8	15,934	Region 1	18.95
Region 9/NA	12,095	Region 5	16.77
Region 1	6,684	Region 4	11.95
Region 4	5,028	Region 2	9.01
Region 5	4,801	Region 3	8.86
Region 6	4,635	Region 6	8.46
Region 3	3,097	Region 9/NA	7.09
Region 2	2,949	Region 8	6.37
Region 10	2,772	Region 10	1.88

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NIDRM Results



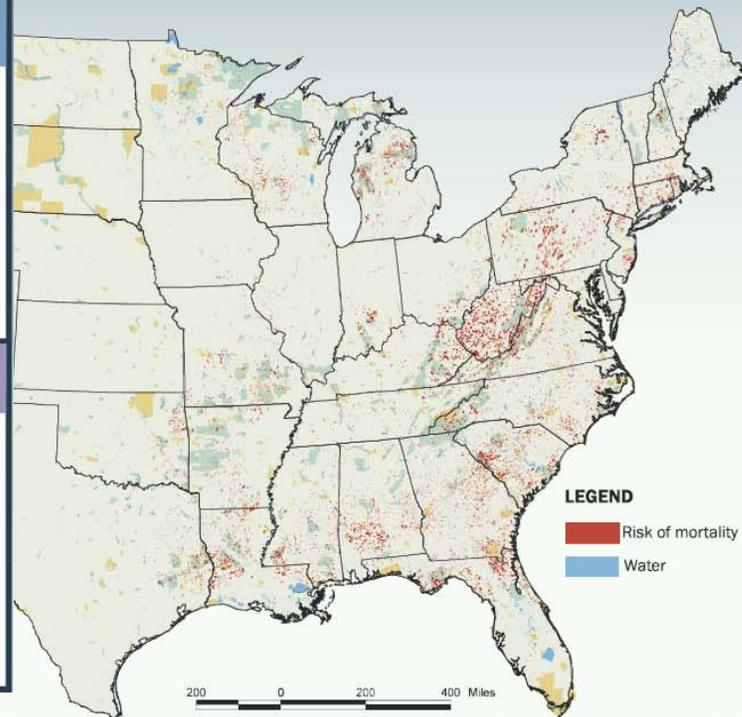
NATIONAL INSECT and DISEASE RISK MAP

AREA AT RISK (THOUSAND ACRES)	
National Forest System	25,026
Other Federal	5,861
State, County and Private	27,107

Risk* by Ownership Class
 Acres at risk: Approximately 58 million

AREA AT RISK (THOUSAND ACRES)	
National Forest System	25,026
Other Federal	5,861
State, County and Private	27,107

PERCENT OF FORESTED LAND AT RISK	
National Forest System	14.16
Other Federal	4.34
State, County and Private	5.59



LEGEND
■ Risk of mortality
■ Water

*The expectation that 25% or more of the standing live volume of trees greater than 1" in diameter will die over the next 15 years.



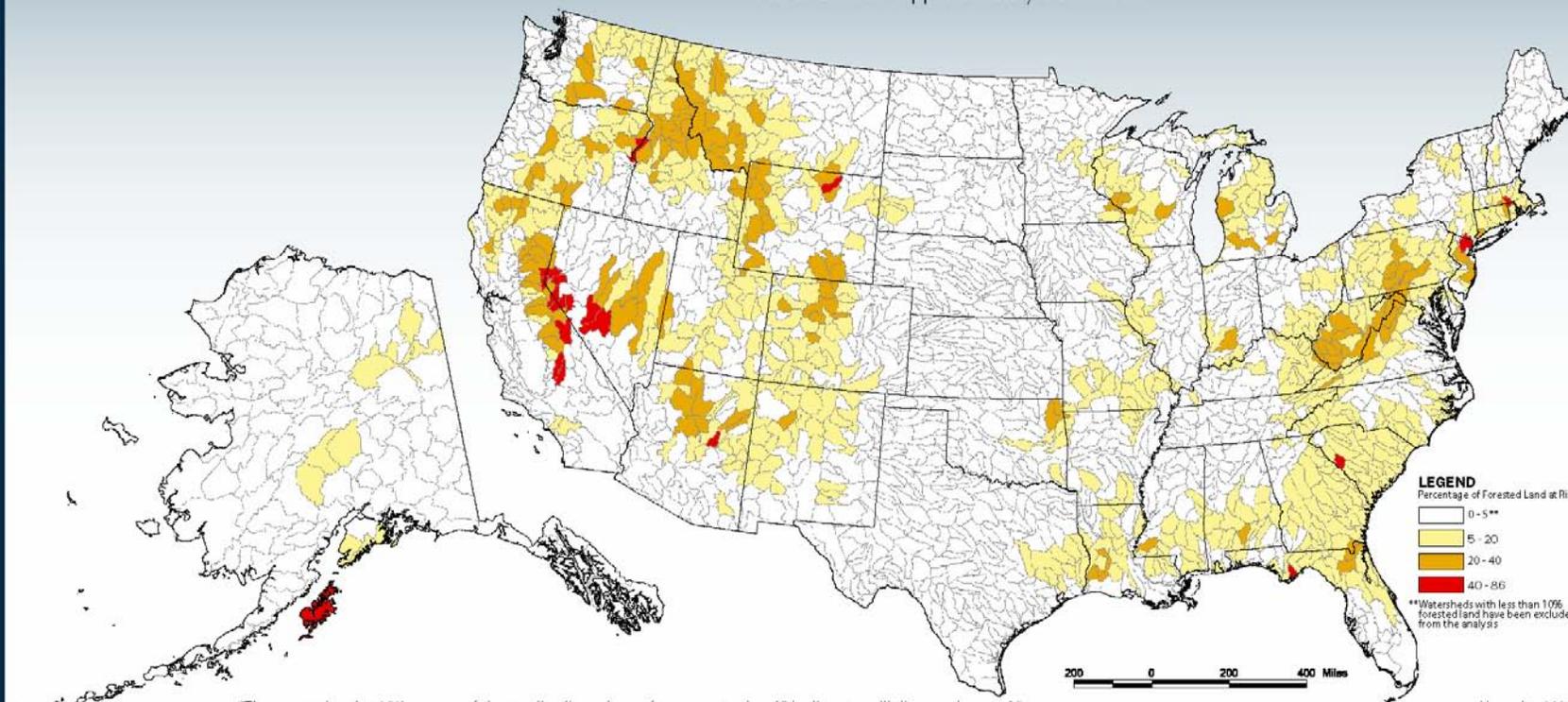
NIDRM Results



NATIONAL INSECT and DISEASE RISK MAP

Watersheds Most at Risk*

Acres at risk: Approximately 58 million



LEGEND
Percentage of Forested Land at Risk*

White	0 - 5**
Light Yellow	5 - 20
Orange	20 - 40
Red	40 - 86

**Watersheds with less than 10% forested land have been excluded from the analysis

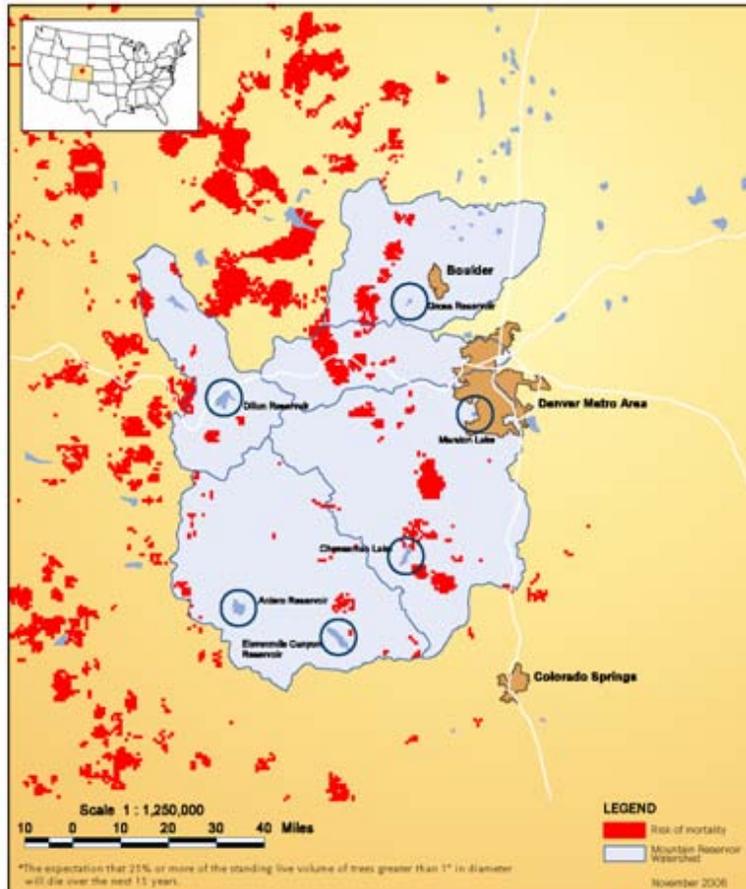
*The expectation that 25% or more of the standing live volume of trees greater than 1" in diameter will die over the next 15 years.



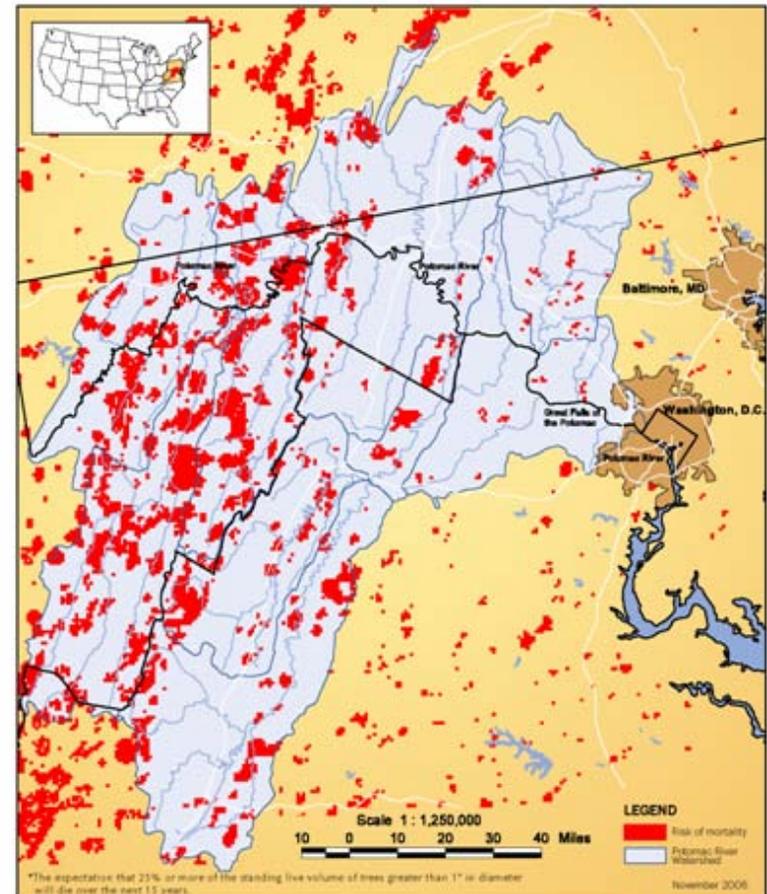
NIDRM Results



Mortality Risk*: Mountain Reservoir Watersheds
(Denver, CO Water Supply)

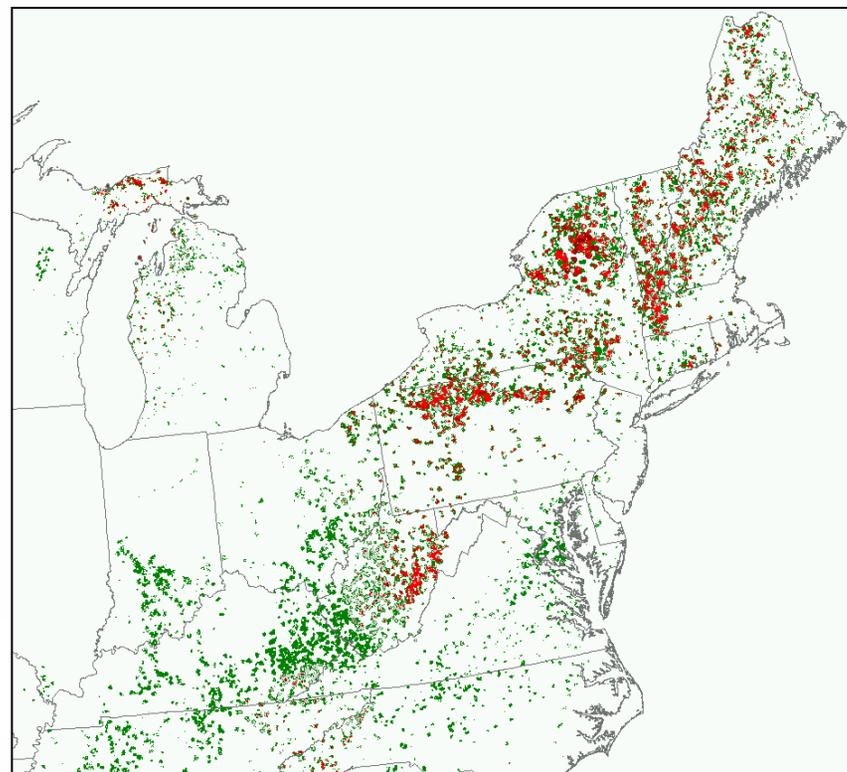


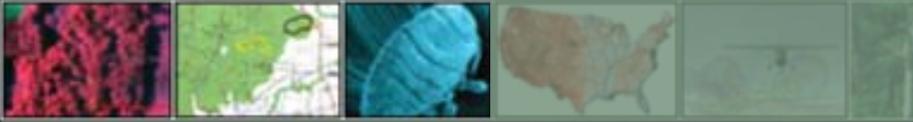
Mortality Risk*: Potomac River Watersheds
(Washington, D.C. Water Supply)



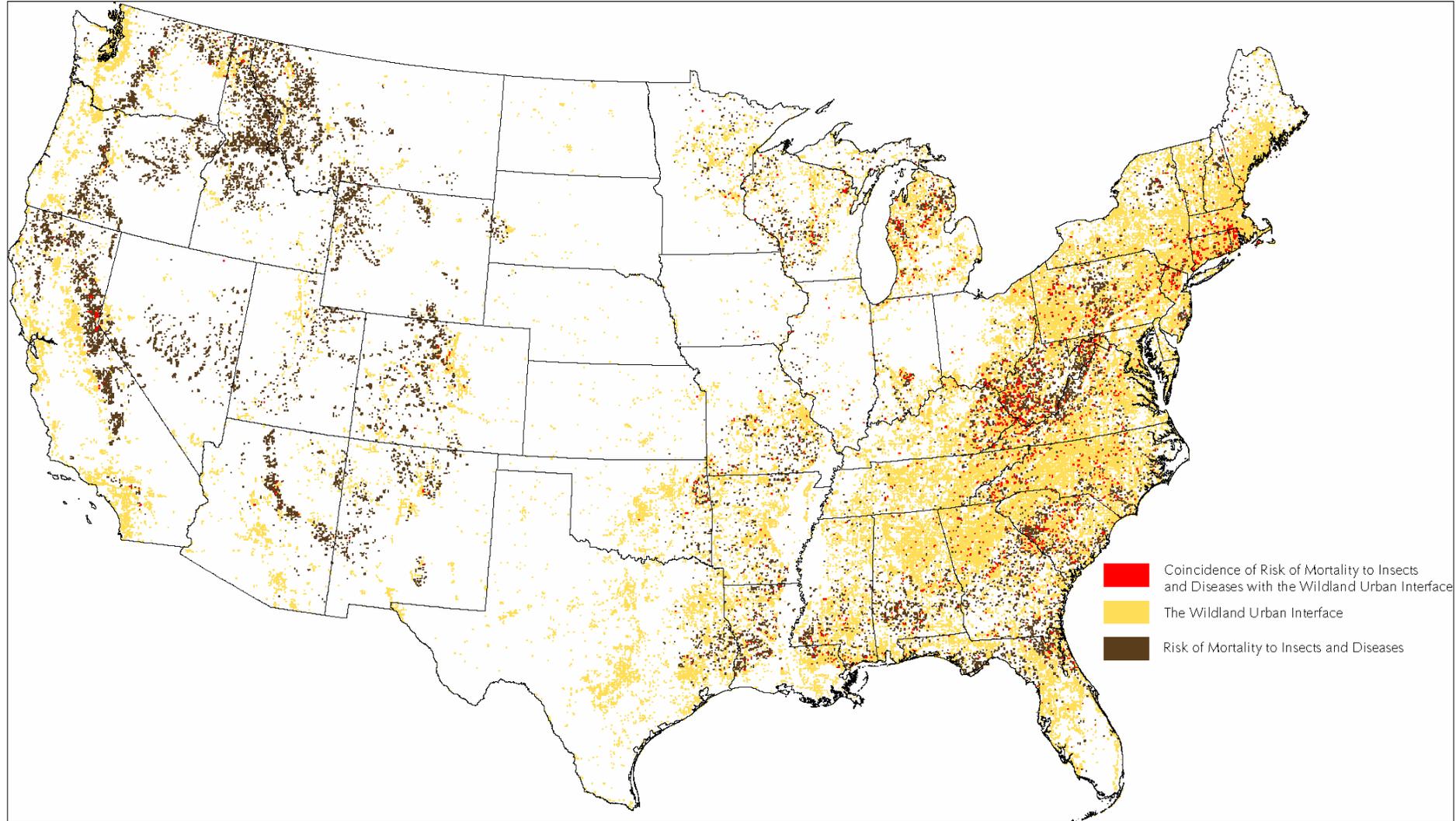
NIDRM Results

- **Percent Host...**
- **Beech Bark Disease**
 - Beech is usually a minor component in many northern hardwood stands
 - **Won't flag too many pixels in NIDRM (Definition of Risk)**
 - Look at % of Host
 - **Impact on wildlife**
 - Mast production threatened



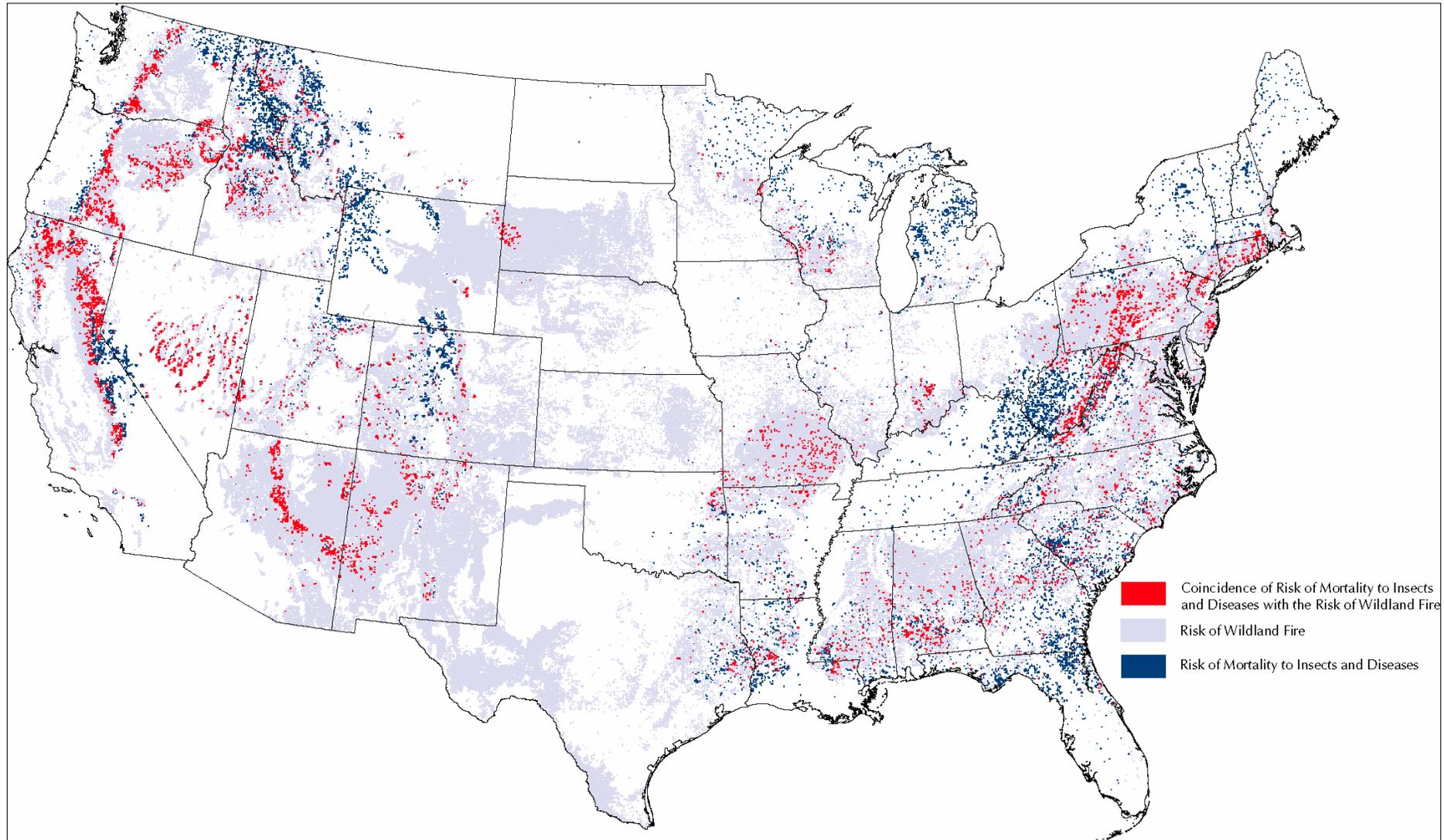


NIDRM Results





NIDRM Results



Briefings

- Began in late October
- S&P Deputy Chief
- Legislative Affairs
- Under Secretary of Ag.
- Still to go...
 - Congressional Staffers



USDA Forest Service
State and Private Forestry
Forest Health Protection

November 28, 2006



Chief and Staff Briefing Paper

ISSUE NAME	2006 National Insect and Disease Risk Map
LEAD EXECUTIVE	Jim Hubbard
PRESENTER	Robert Mangold, Frank Sapio

BACKGROUND The primary goal of the National Insect and Disease Risk Map (NIDRM) is to provide Congress, USDA officials, and federal and state land managers with a periodic strategic assessment of risk of tree mortality due to major insects and diseases. While the database behind the map is capable of displaying risk many ways, the definition of risk depicted in the standard map is as follows: The expectation that 25% or more of the standing live volume of trees greater than 1" in diameter will die over the next 15 years.

STATUS NIDRM is more than "just a map", it represents a compilation of nearly 190 individual risk models, all constructed within a common GIS-based multi-criteria framework that can account for regional variations in forest health concerns. The 2006 risk map process, utilized within 49 states, provides a consistent, repeatable, transparent and science-based process through which interactive spatial and temporal risk assessments can be conducted. This new modeling process will allow for flexible analysis to produce specific risk assessments for specific insects and diseases that can be tied to other agency assessments. The production of the 2006 risk map has been a highly collaborative process led by the Forest Health Monitoring Program of Forest Health Protection (FHP). Entomologists and pathologists from all states and every FHP Region were invited to take part in the process of developing the risk map. Other partners include: Forest Inventory and Analysis (FIA), Remote Sensing Applications Center (RSAC) and the Western Wildlands Environmental Threat Assessments Center (WWETAC).

Future Directions...2010 Risk Map?

2010 Risk Map.....

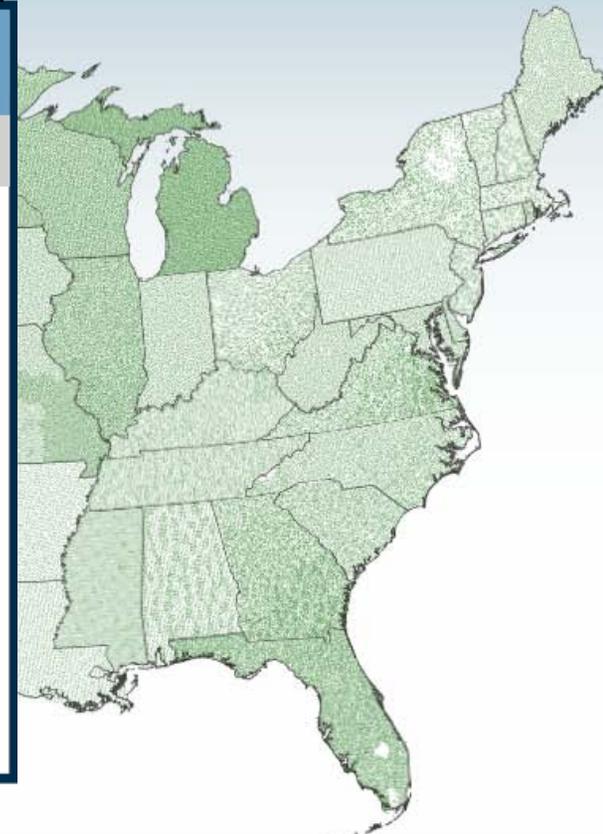
- **Improving Data – National BA, QMD, etc. Layers**
- **Improving Models – Using Risk Map to Prioritize Research**
- **Multi-Resolution Risk Models (30 Meter – 1KM)**
- **Model Validation/Confidence Limits**
- **Multi-Date (Scenario) Predictions**
 - Using FVS to grow tree data
 - Climate Change
- **Developing Tools To Aid Model Construction and Provide Access To Results**
 - Web-based ArcGIS Server app.
 - Portal Demo



Improving Data

Identified Several Key GIS Layers...
Generating Multi-Scale Forest Attribute Layers is a Huge Challenge...

Distribution of FIA Plot Data Used
 to Create Surfaces of Forest Parameters



KEY CRITERIA OF TOP 11 AGENTS OF MORTALITY

Criterion	Times Used (Percent)
Basal Area/Stand Density	31.51
Diameter	31.05
Percent Host	14.61
Soil Characteristics	7.76
Climate	5.48
Topography	3.65
Other	3.20
Proximity to Infestations	2.74

KEY CRITERIA OF TOP 11 AGENTS OF MORTALITY

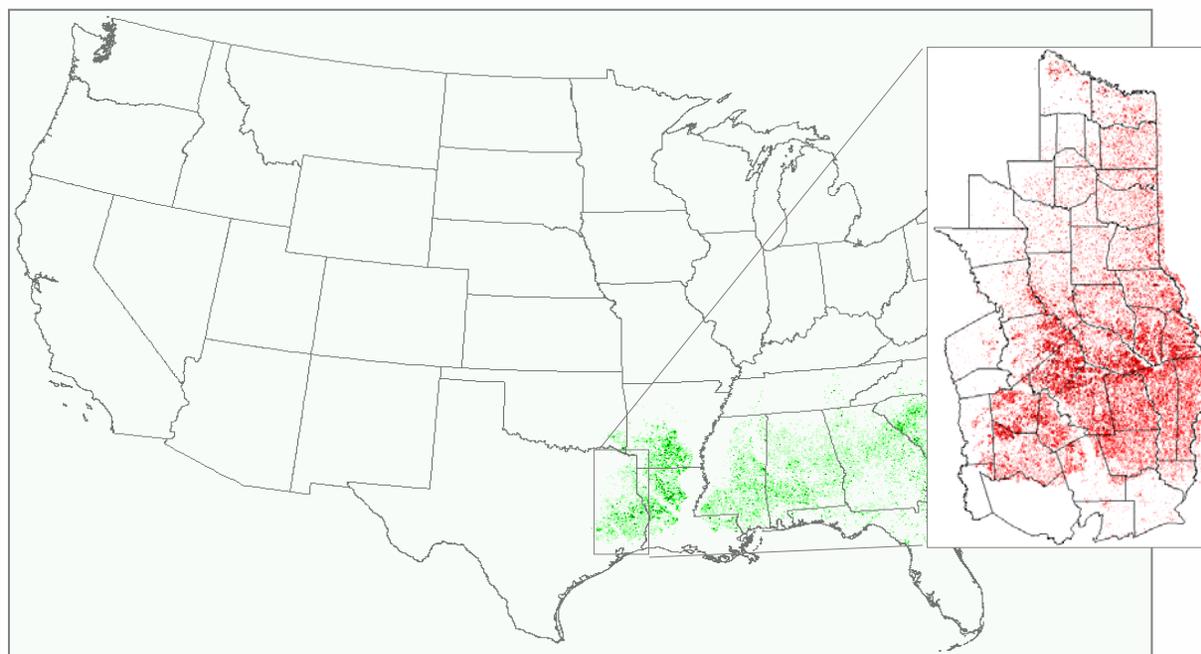
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Improving Data

- **Produce Standard GIS layers to Depict Criteria**
- **Model Forest Attributes Nationally**
 - BA, Diameter, etc.

Much More Detail...Using Modeling Techniques (30-meter)

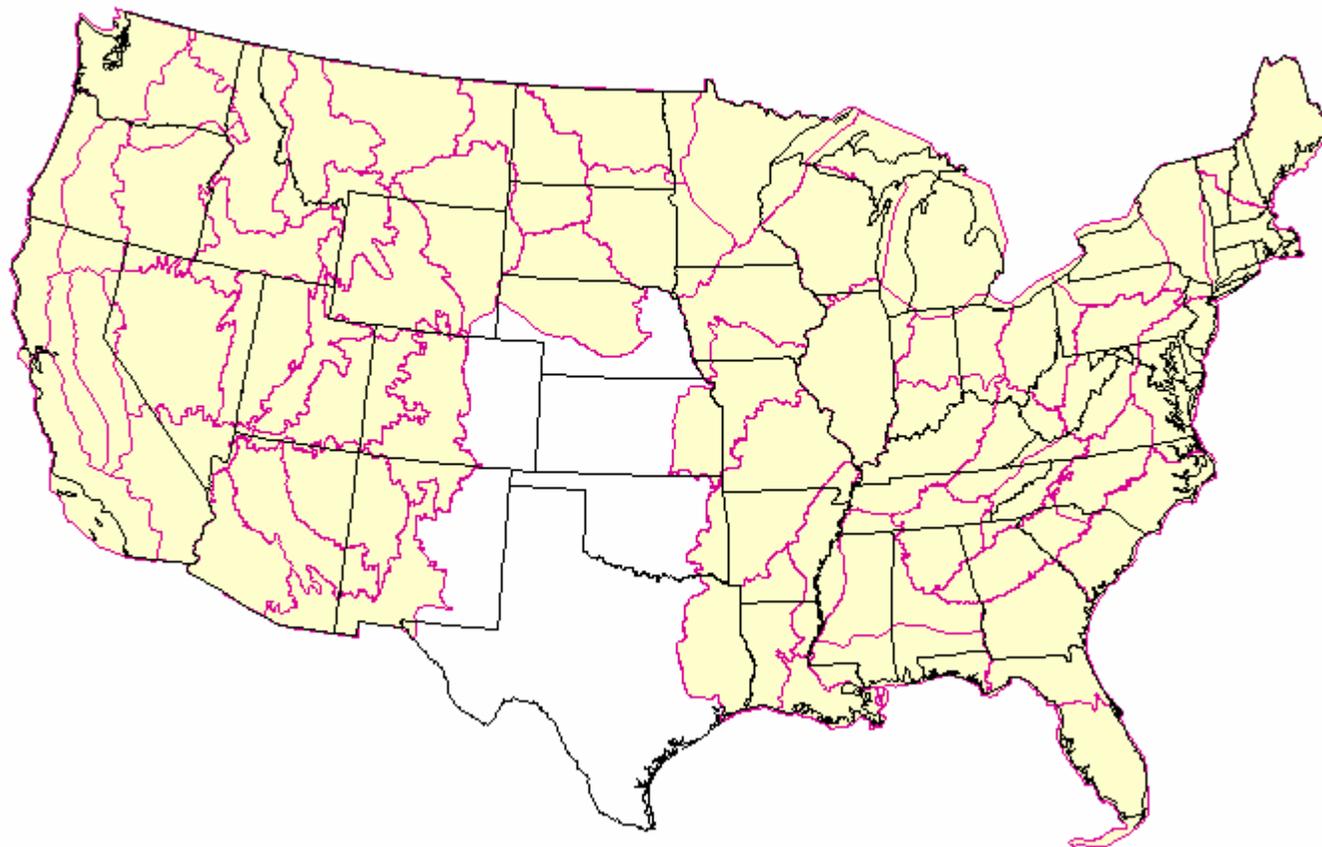


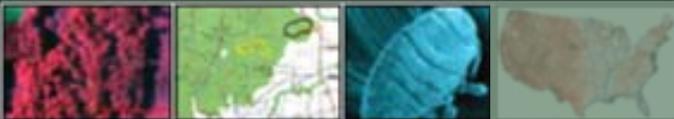
**Surfaced
Loblolly Pine BA (30m)**

Surfaced Loblolly Pine BA (1km)

65 USGS Mapping Zones

- **30-m NLCD 2001 3-season intermediate dataset**

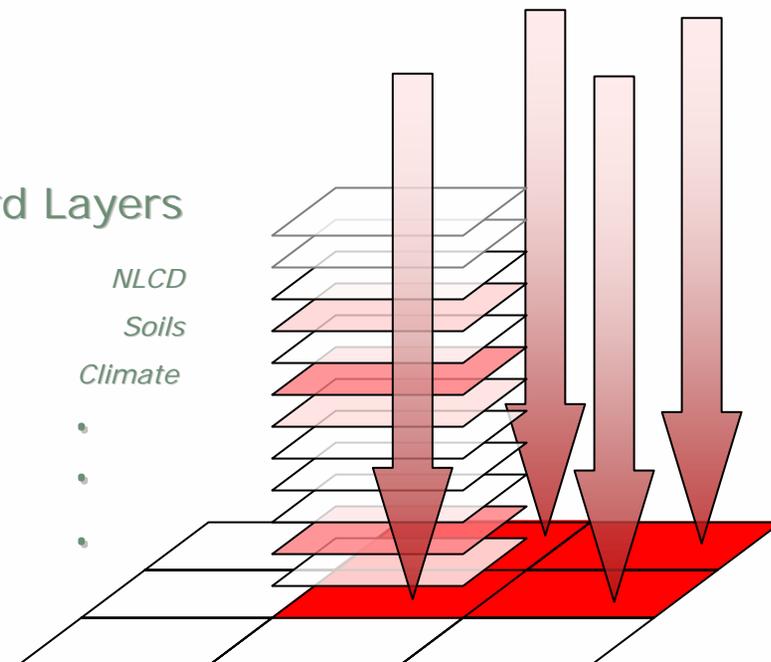




Standard 30-meter Layers

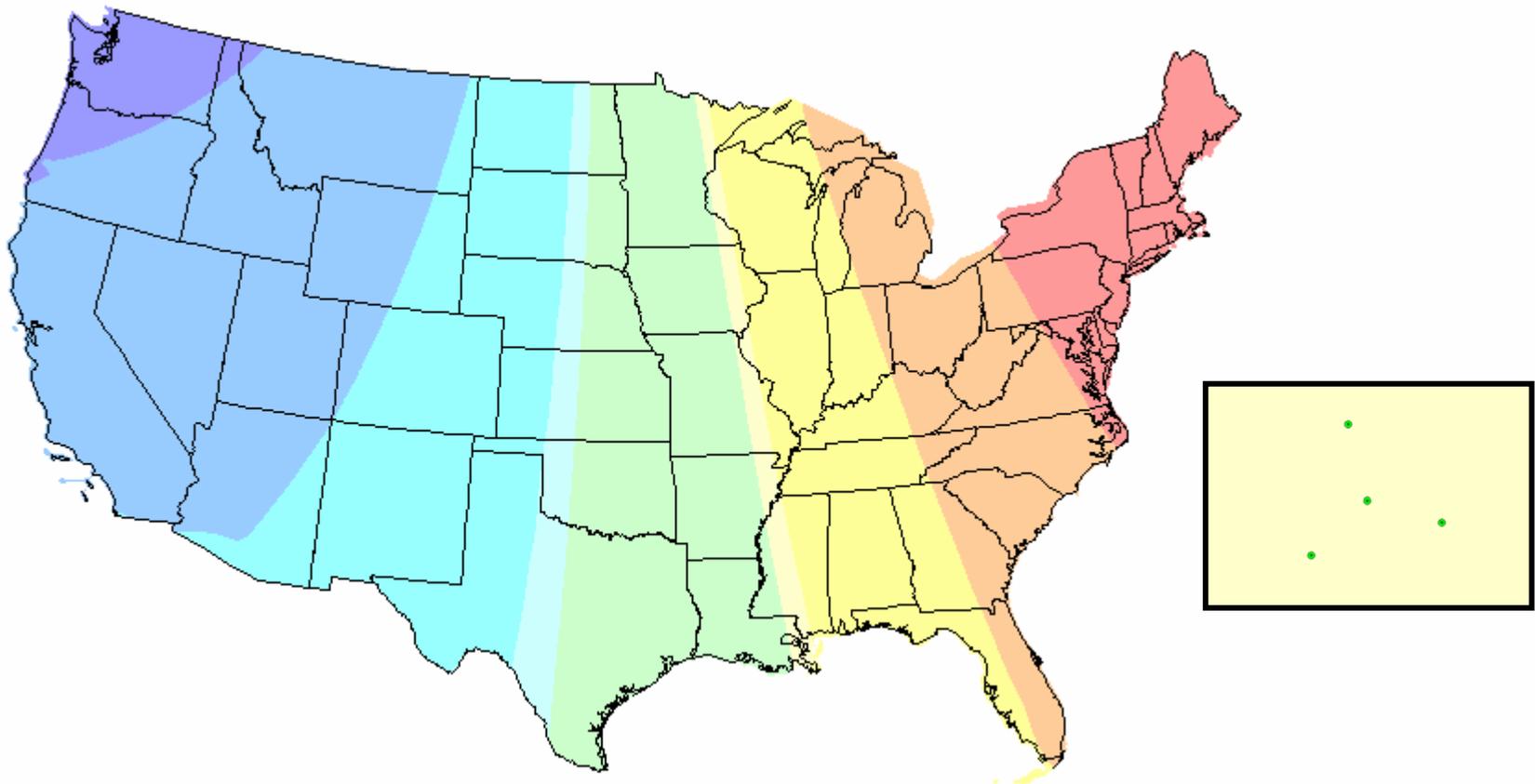
- **NLCD 2001 3-season Landsat dataset**
- **SSURGO/STATSGO Soils Data** → drainage index
- **Climate – PRISM** → topogrid to 30m
- **Terrain data** → dem, posindex, curvature, aspect phases
- **FIA Phase 2 inventory** – corresponding 2002 cycle
- **Bilinear Sampling**

Standard Layers



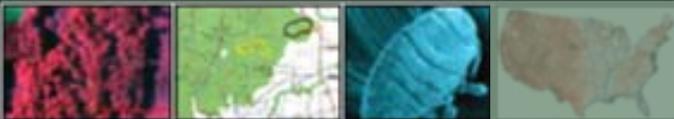
Magnetic Declination and Secular Variation

- **FIA subplot locations “with a twist”**



January 31, 2007

Annual Forest Health Monitoring Meeting, San Diego, CA



National 30-meter Host Type

- **57 mapping zones**
- **50-200 species per mapping zone**
- **2 parameters per species to model (basal area, trees/ac)**
- **“negative” runs**
- **57 x 100 x 2 x 2 = 22,800 cubist models**
- **Building geospatial dataset from models**
 - Python script – aml generator
 - Imagine cubist sampler
 - ArcGIS Sampler
- **4 hrs minimum per dataset**
- **4 hrs x 11,400 models = 45,600 computing hours**
- **Jim Ellenwood minimum retirement date 7/31/2016**
- **Jim Ellenwood MANDATORY retirement date 7/31/2030**
- **Dataset complete 7/31/2030**
- **Rob wants it when??????????????????**

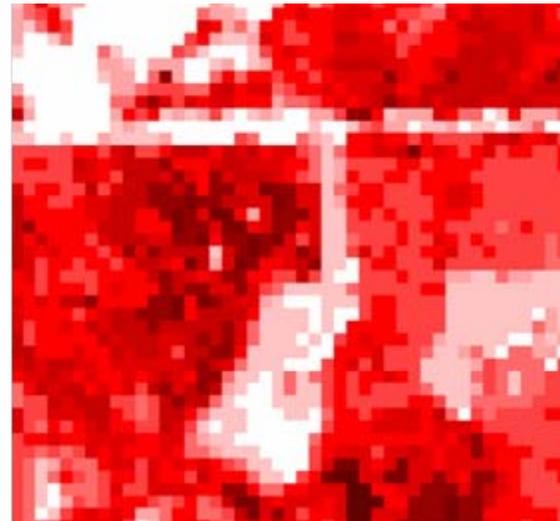


ETX Field Test

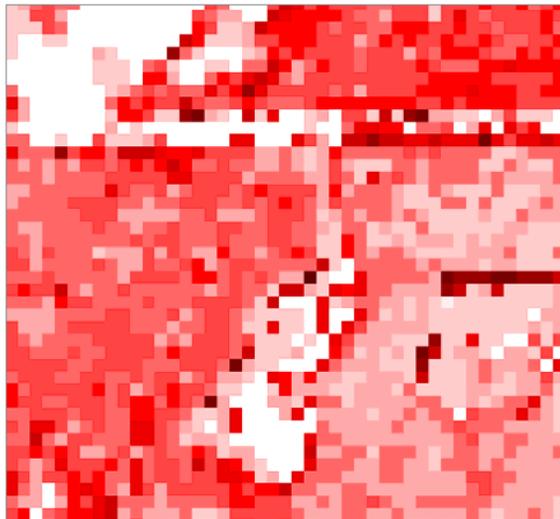
NAIP



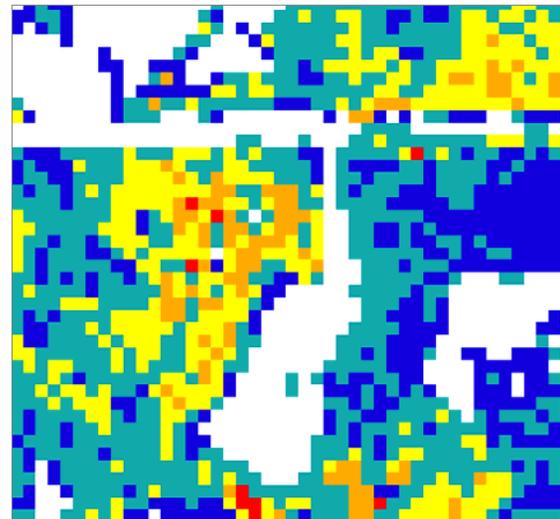
Loblolly BA



Loblolly QMD

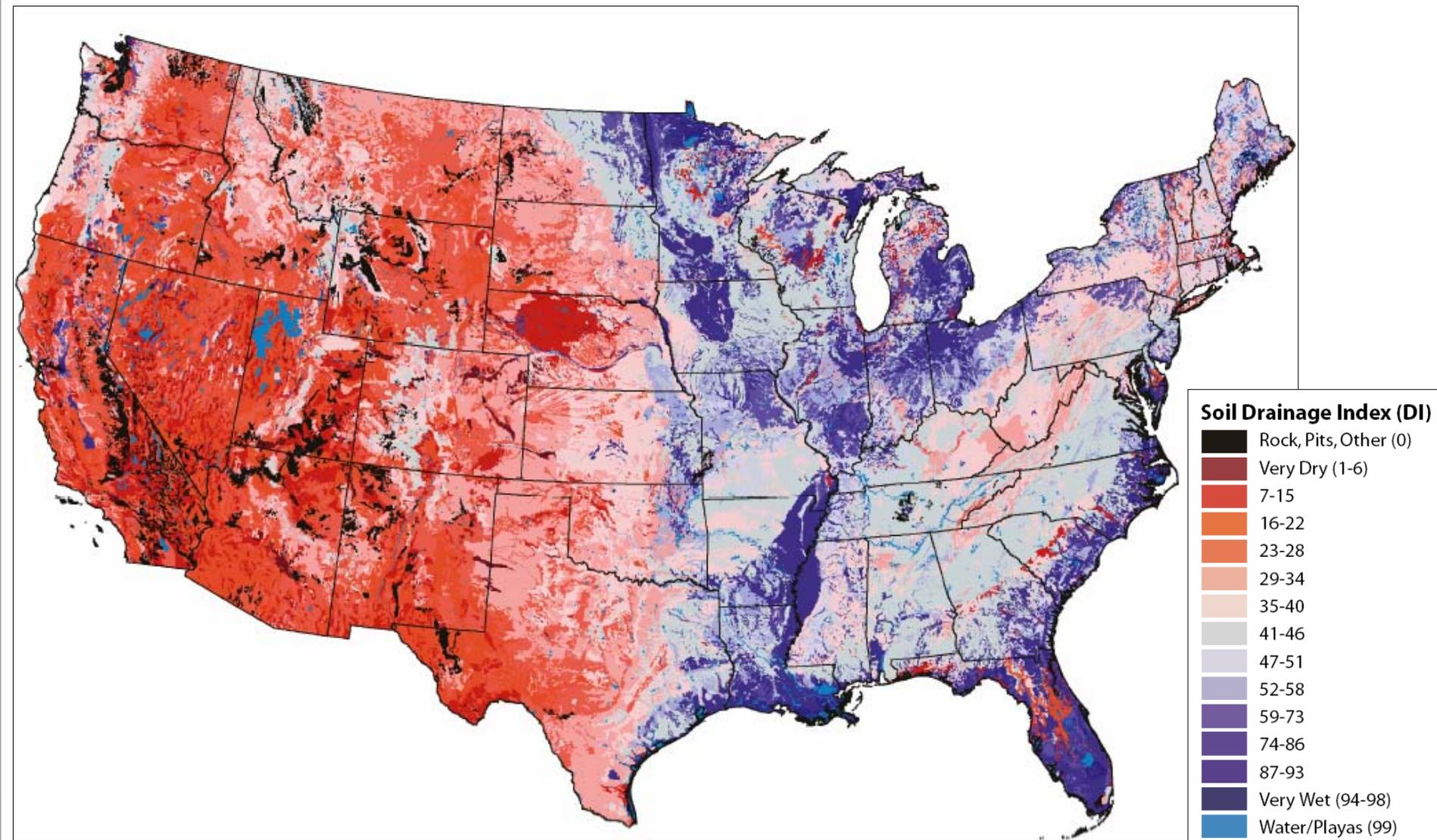


SPB Hazard





Improving Data





Improving Models

- **Continued Model Development and Improvement Is Critical For Future Risk Mapping Efforts**
- **There are many holes in our knowledge base**
 - Eric Smith is developing a database of published risk rating systems
 - This type of work could really streamline our efforts to identify and access models for inclusion in NIDRM
 - Identify research gaps...

Agent	# of Published Models
western bark beetles	105
southern pine beetle	45
spruce budworm	39
gypsy moth	35
western spruce budworm	28
dwarf mistletoes	23
root diseases	21
Douglas-fir tussock moth	13
white pine blister rust	12
other stem rusts	5
littleleaf disease	3
oak decline	3

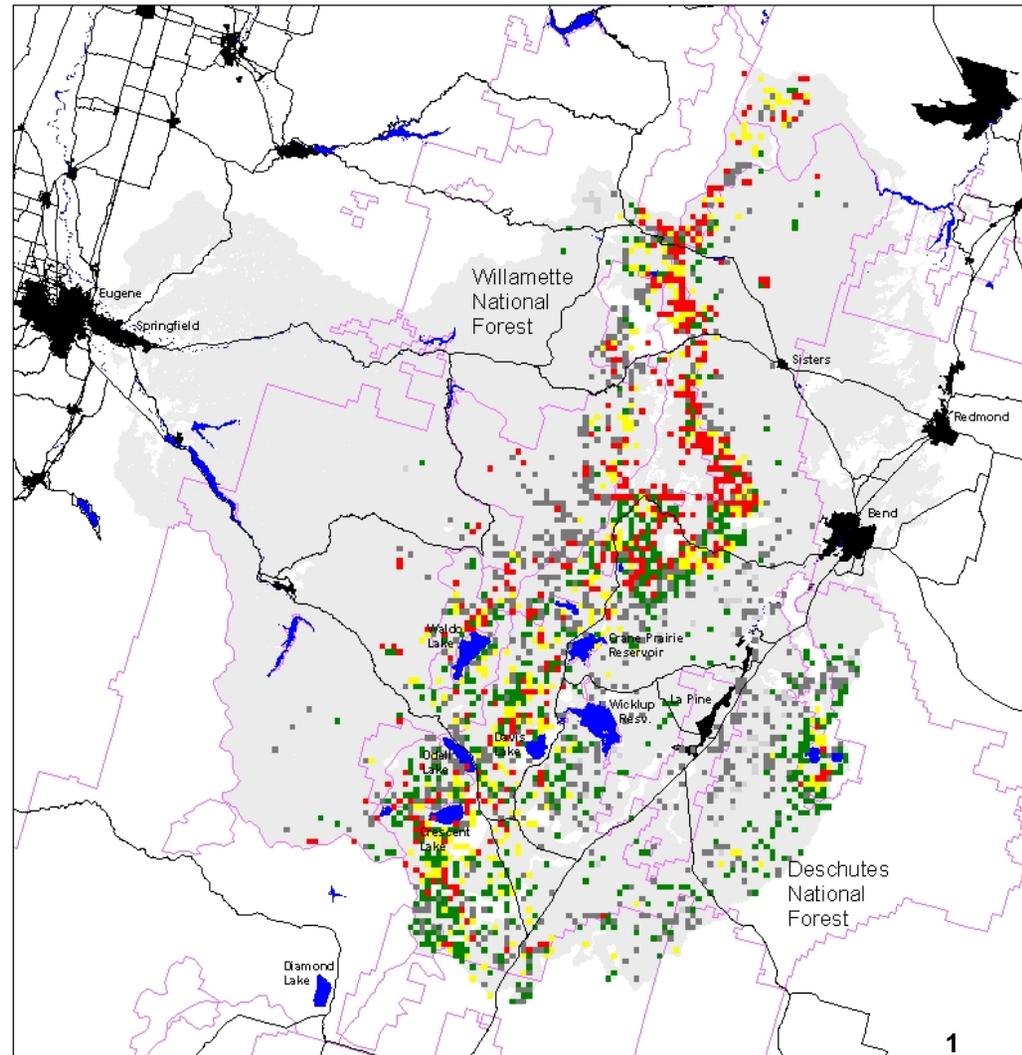
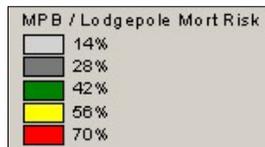
Oak Decline was the primary contributor to NIDRM and yet little work has been done on this issue (according to Smith)



Multi-Resolution Risk Models

High Res. Lodgepole Mountain Pine Beetle Risk Model

Resampled to Various
Resolutions for Regional
and National Use



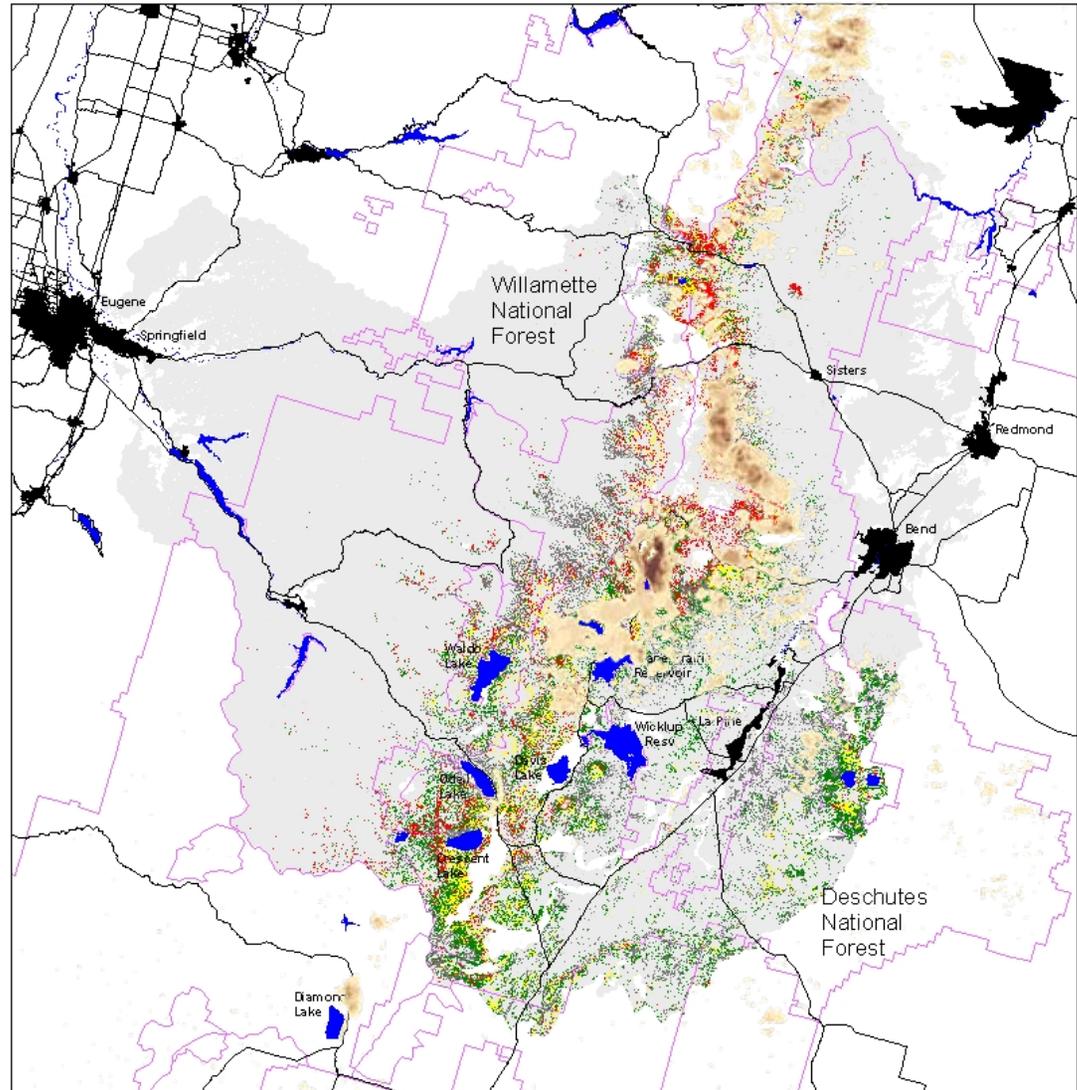
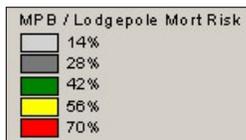
1
Kilomete
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Model Validation

High Res. Lodgepole Mountain Pine Beetle Risk Model

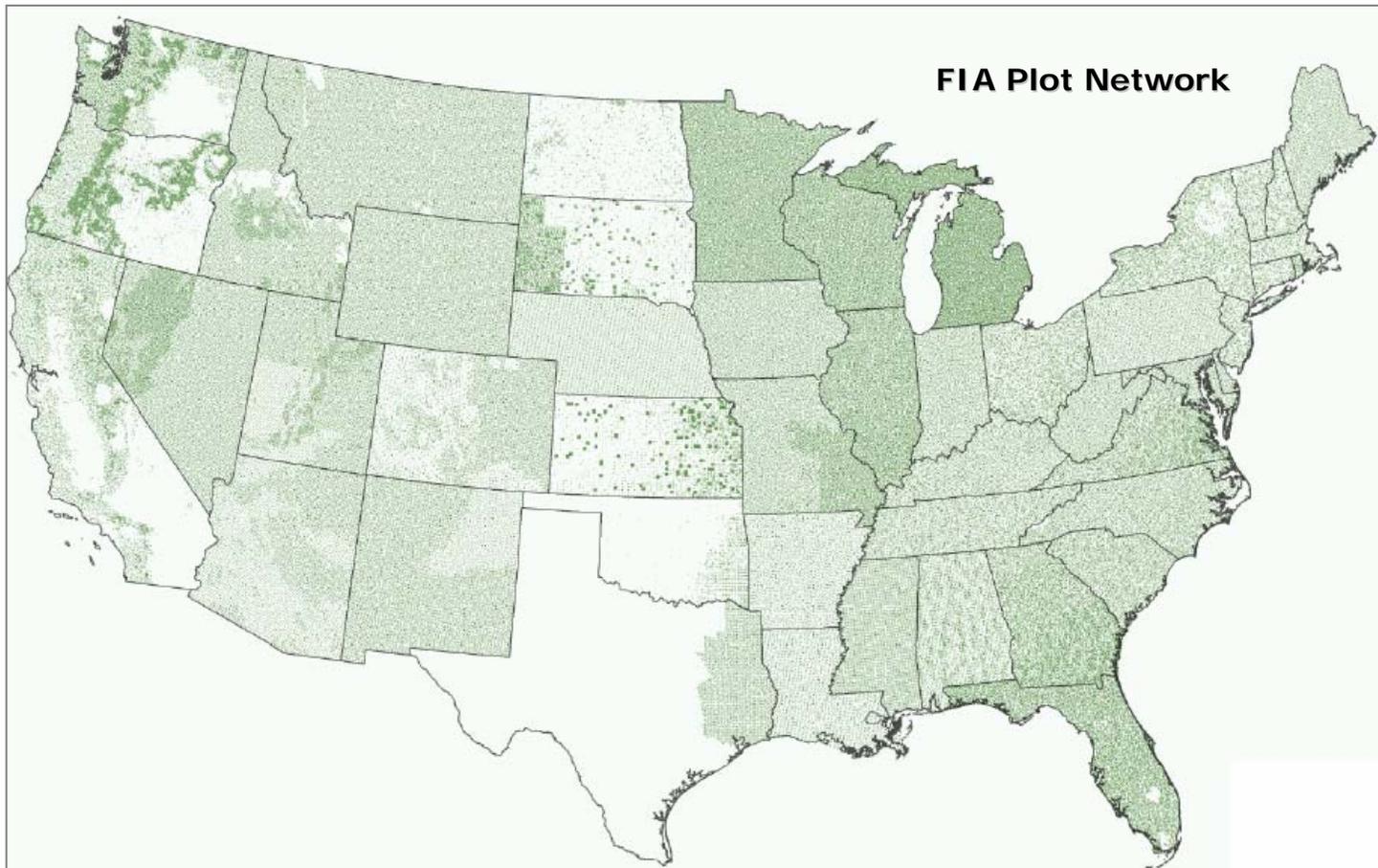
Risk Expressed as % BA Loss
Since 1996
Compared with 9 yrs. of ADS
Data





Scenarios

Growing Tree Data From FIA...Examining Climate Change Running Risk Models at 20 Year Intervals





Tools

**FHTET is Working on
 A Tool That Will
 Help The Field
 Create Local Risk
 Maps**

Form1
_ □ ×

AD1/Agent/Host
Susceptibility
Vulnerability
Constraints
Metadata

Resolution:

General Area of Interest:

Select AD1 from the following ecoregions or from the map:

M32G
M32H
N331A
N331B

Risk Agent(s):

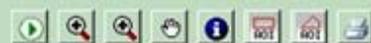
Fir Engraver Beetle
Mountain Pine Beetle
Root Disease
Western Balsam Bark Beetle

Host(s):

Mountain Hemlock
Southwestern White Pine
Subalpine Fir
Western Larch

Max Percent Mortality:





	Column1	Column2	Column3	Column4	Column5
*					
<i>Identify Results Here...</i>					

Tools

<http://svinetfc8.fs.fed.us/aerialsurvey/>

**FHTET is Developing
an ArcIMS-Based
Portal to Provide
Access to Risk
Assessments and
Other Forest
Health Data**

The screenshot shows the web application interface for the National Aerial Survey Data - Lower 48 States. The header includes the USDA logo and the Forest Health Technology Enterprise Team logo. The main content area features a map of the United States with red and green patches indicating survey data. A layer list on the right side of the map shows the following layers:

ON	A	DL	NAME
<input checked="" type="checkbox"/>			Damage categories
<input checked="" type="checkbox"/>			State boundaries
<input checked="" type="checkbox"/>			National Overview
<input checked="" type="checkbox"/>			Nat'l Aerial Survey Database - 2004
<input checked="" type="checkbox"/>			Damage agent category
<input checked="" type="checkbox"/>			Surveyed Area 2004
<input checked="" type="checkbox"/>			Counties
<input checked="" type="checkbox"/>			Federal Lands

Below the map, a message states: "There are no selected features. Please use one of the feature selection tools to display data."



Acknowledgements

We would like to thank all the local land managers and regional GIS staff....

Without *you* the National Insect and Disease Risk Map *Would Have Been*
"Just a Map"

