Phytophthora ramorum Modelers' Meeting

November 1, 2005
Asheville, North Carolina

USDA Forest Service, National Risk Model for *Phytophthora ramorum*

Data Mining and Mind Mining: Principles and Limitations of National Risk Mapping for Exotic Insects and Diseases

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1. Do models provide similar results? How can they be compared?

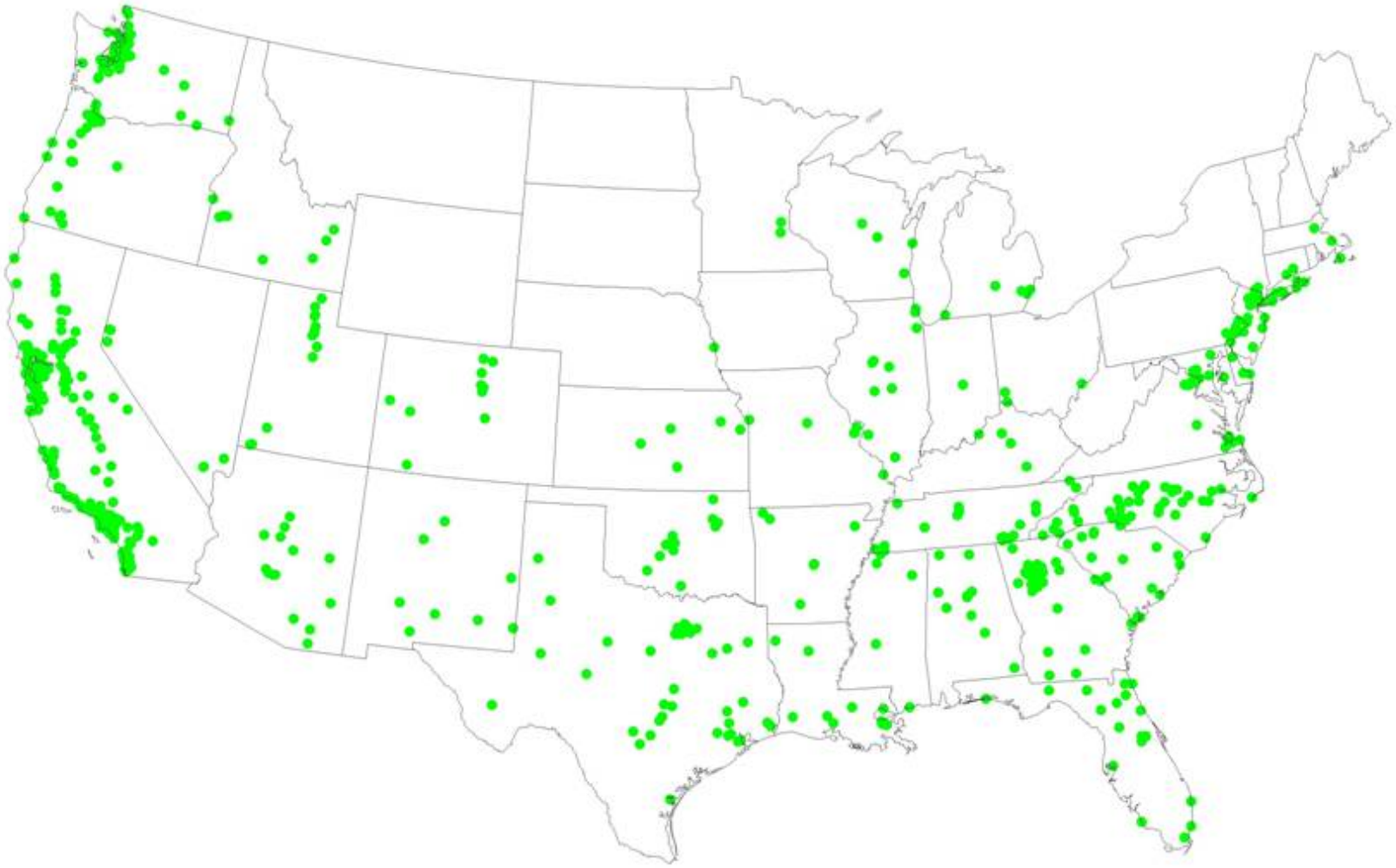
Risk Mapping

Definitions

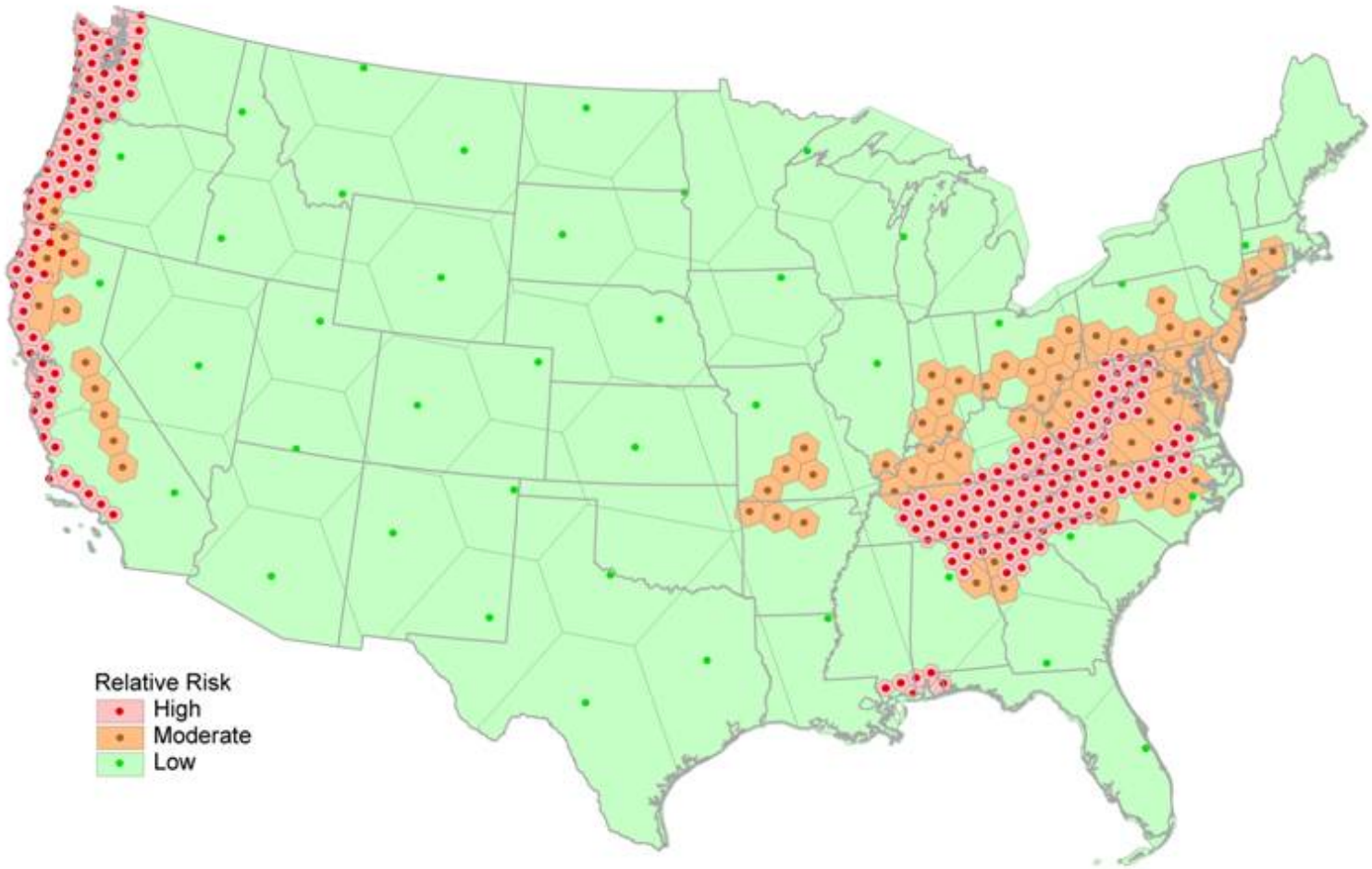
- **Risk** – Likelihood of an undesirable event
- **Hazard** – Undesirable effect | Undesirable event

Risk

Nursery Trace Forwards



Preliminary SOD Risk/Hazard Map



WDS/10Oct02

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2. Are there needs for models at different geographic or time scales?

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Approaches

- **Empirical** (Data Fitting – Statistical Inference – Statistical Model)
- **Modeling** (Conceptual – Process – Mechanistic)
- **Mind Mining** (Overlay Analysis)

Modeling

- Models are developed from theory, scientific insight, via mathematics (geometry, probability)

- Statistics is used to estimate parameters, tests of significance and repeatability, and interpolate between data points

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‘Whoever wishes to **investigate** medicine **properly**, should **proceed thus**: in the first place to consider the **seasons** of the year, and what effects each of them produces for they are not at all alike. …Then the winds, the **hot** and the **cold**, especially such as are common to all countries, and then such as are peculiar to each locality, … In the same manner, when one comes into a city to which he is a **stranger**, he ought to **consider its situation**, how it lies as to the winds and the rising of the sun; for its influence is not the same whether it lies to the north or the south, to the rising or the setting sun. … and the ground, whether it be **naked** and **deficient in water**, or **wooded** and **well watered**, and lies in a hollow, confined situation, or is elevated and cold…

Hippocrates 400 B.C.E.
On Airs, Waters, and Places
Translated by Francis Adams 1849

PROCEDURES

1. Determine the distribution of known and suspected host species

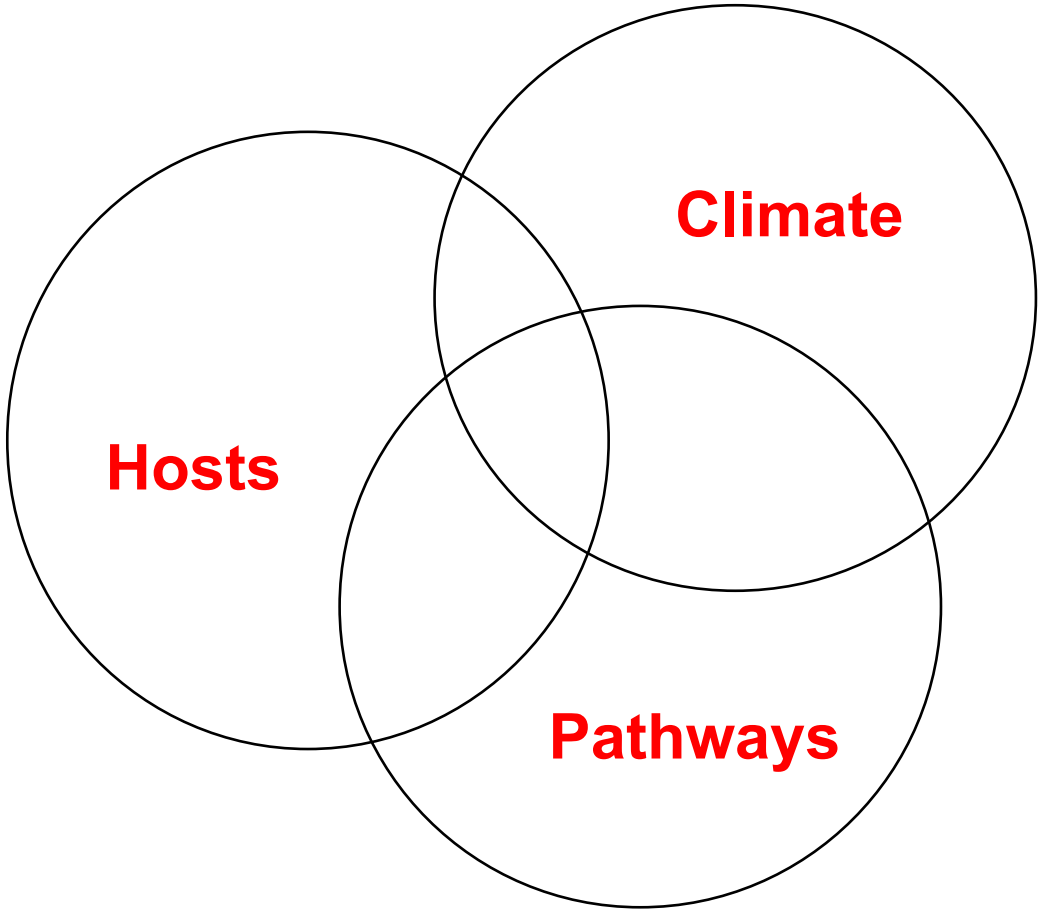
2. Identify Climatic Conditions that favor or limit the development of the pathogen.

3. Identify pathways of introduction to new areas.

4. Define Risk Strata

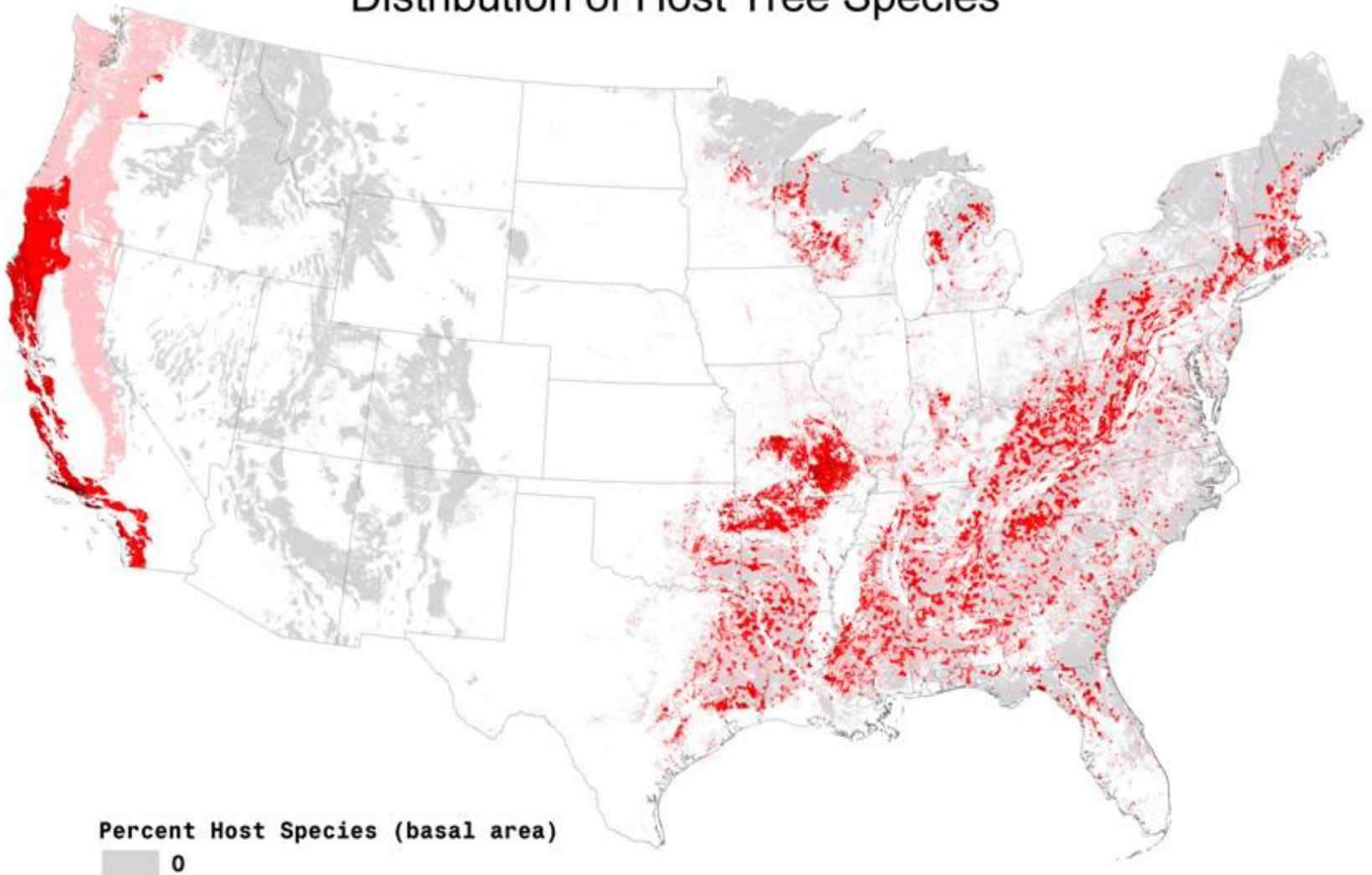
5. Evaluate the Veracity of the Risk Strata

Overlay Analysis



If present value=1, If not present value= 0

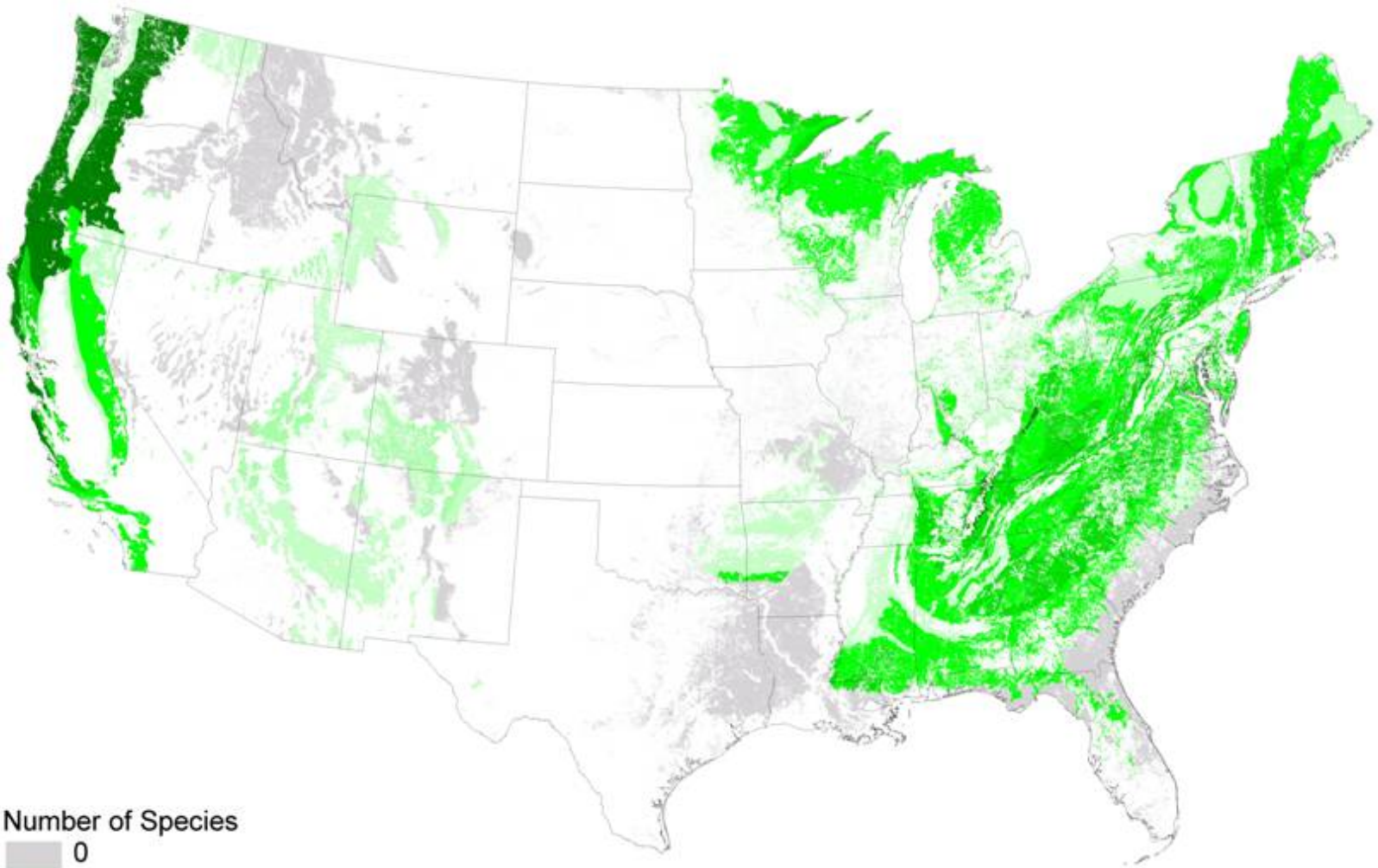
Distribution of Host Tree Species



Western Distribution developed from FIA P3 data by the plot mean value by Bailey's EcoSection

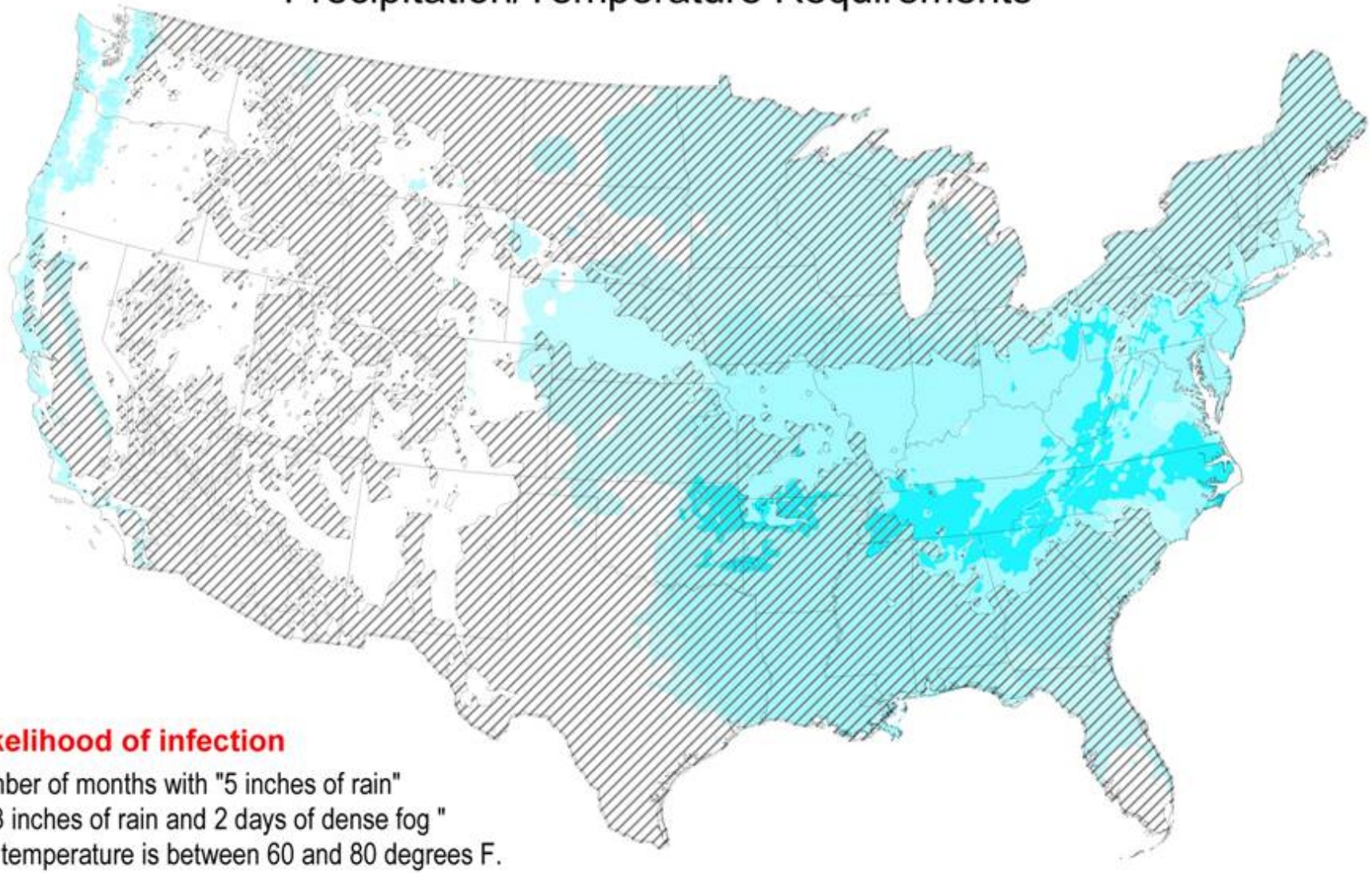
Eastern Distribution developed from FIA P2 data by spatial interpolation

Distribution of Host Shrub Species



Number of Species by Baileys Ecoregion Section (West) or Subsection (East) from the NatureServe and Calflora Data Bases

Precipitation/Temperature Requirements



Likelihood of infection

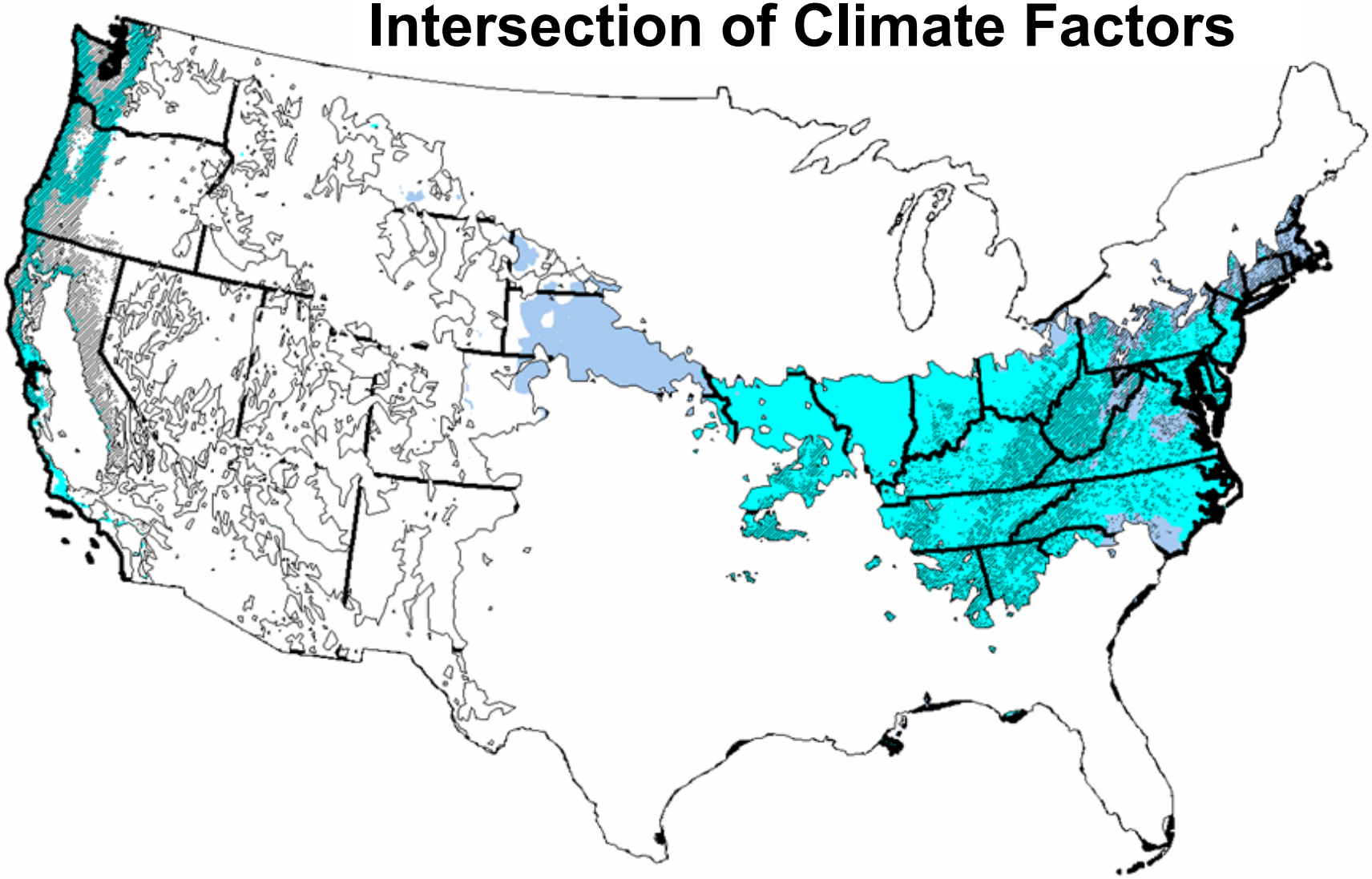
Number of months with "5 inches of rain"
or "3 inches of rain and 2 days of dense fog "
and temperature is between 60 and 80 degrees F.

0
1
2
3

Likelihood of Pathogen Survival

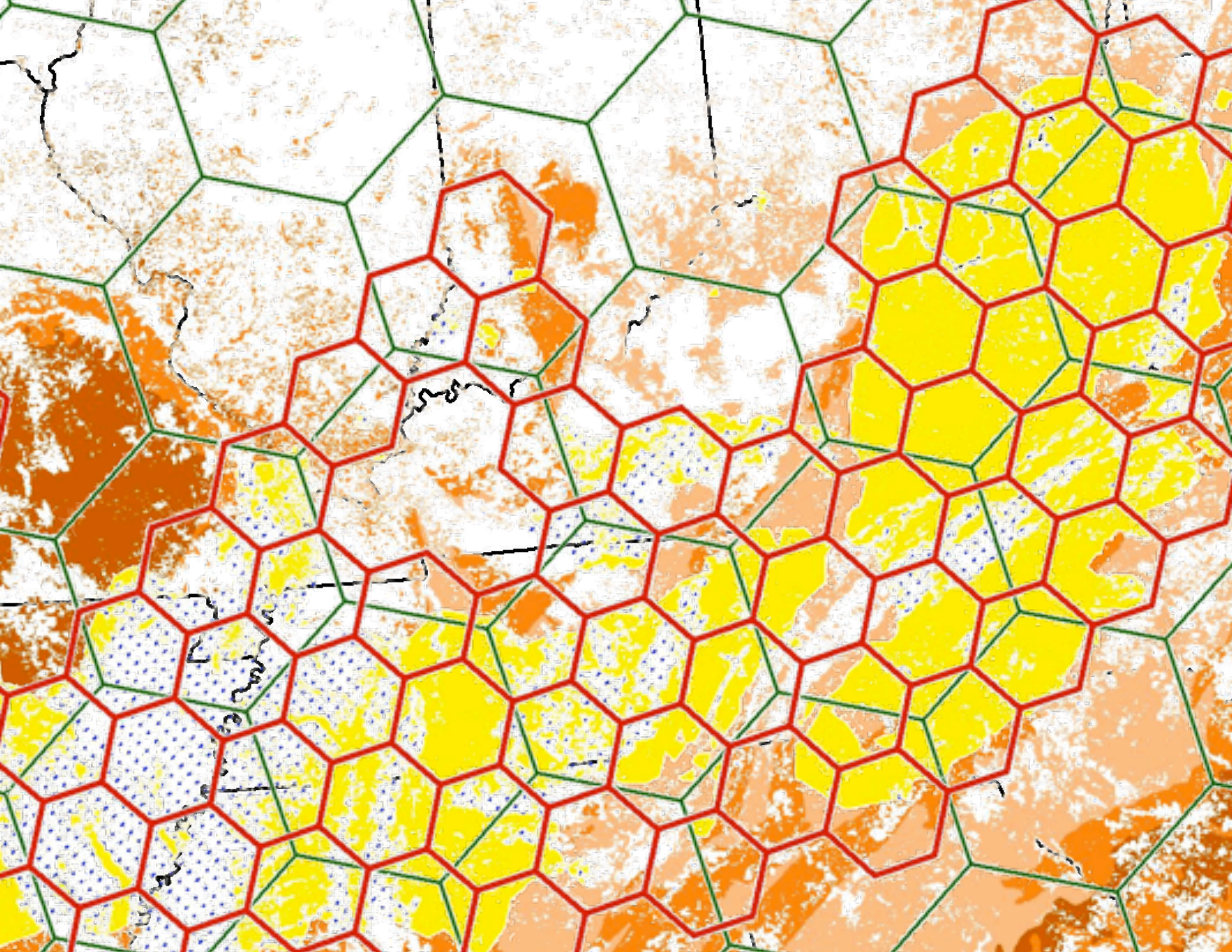
One month with winter maximum <32 F.
or Summer Maximum > 90 F.

Intersection of Climate Factors



Rhododendron Nurseries

* Rhododendron Nurseries (Rhododendron Growers Association Database)



Are there needs for models at different geographic or time scales?

1. What scale do we need?
2. What scale can we honestly present?

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Scale

- **Spatial** (large, small)
- **Measurement** (interval, ordinal, nominal)

Objective

- Monitoring for Detection
- versus Population Estimation
- versus Epidemiology

Sampling

Objective '**begats**' design '**begats**' statistical rigour '**begats**' analysis

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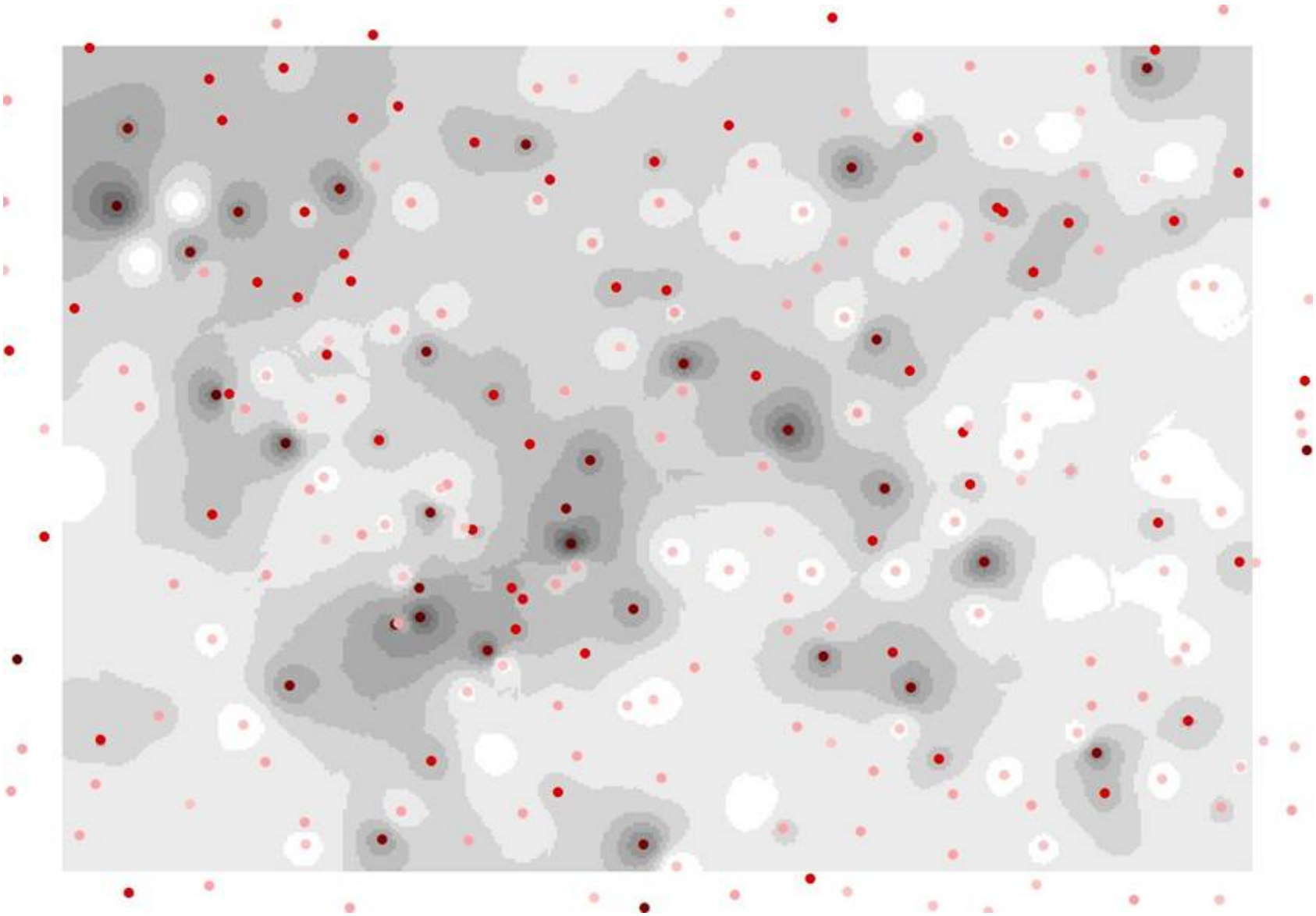
High Frequency Data



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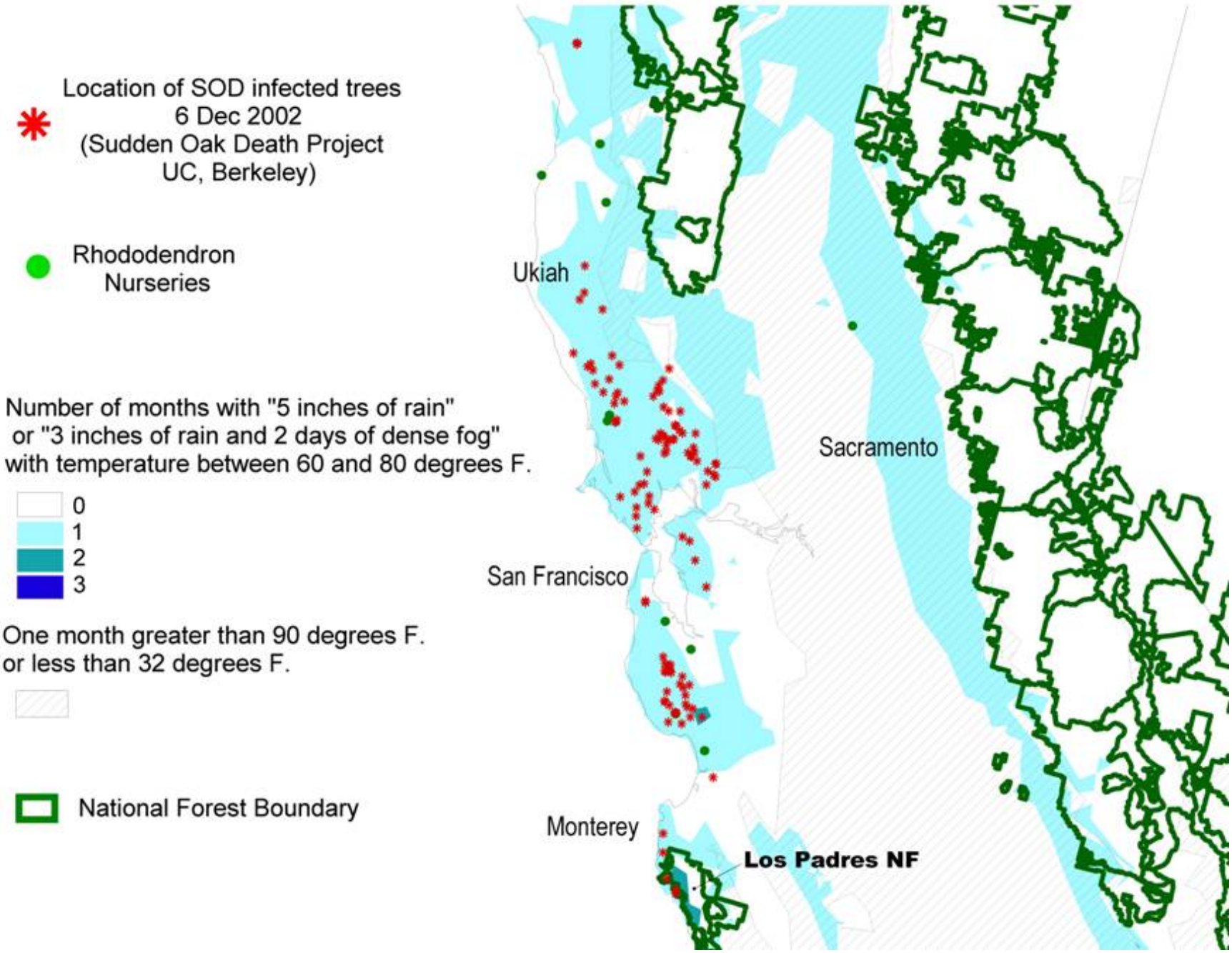
3. Have the models been validated?

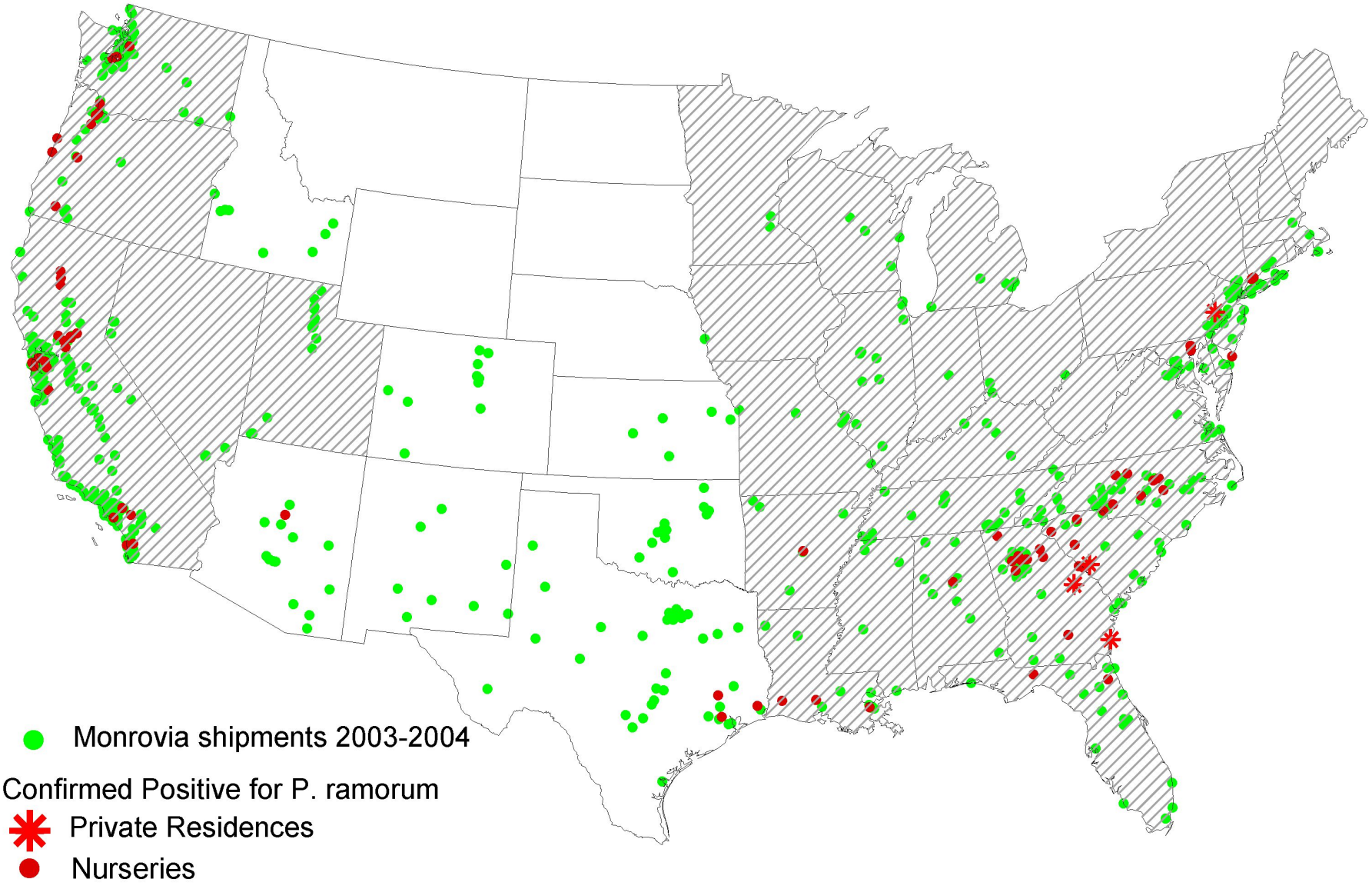
Location of Confirmed SOD Infections



As of June 30, P. ramorum has been confirmed in plants at 118 locations in16 states. The numbers of nurseries or garden centers with positive trace forward samples from the wholesaler by state are:

- **California (43)**
- **Alabama (3)**
- **Arkansas (1)**
- **Florida (6)**
- **Washington (11)**
- **Oregon (9)**
- **Texas (10)**
- **Colorado (1)**
- **Georgia (13)**
- **Louisiana (5)**
- **Maryland (1)**
- **North Carolina (9)**
- **New Mexico (1)**
- **Tennessee (2)**
- **Virginia (1)**

States in 2005 Survey



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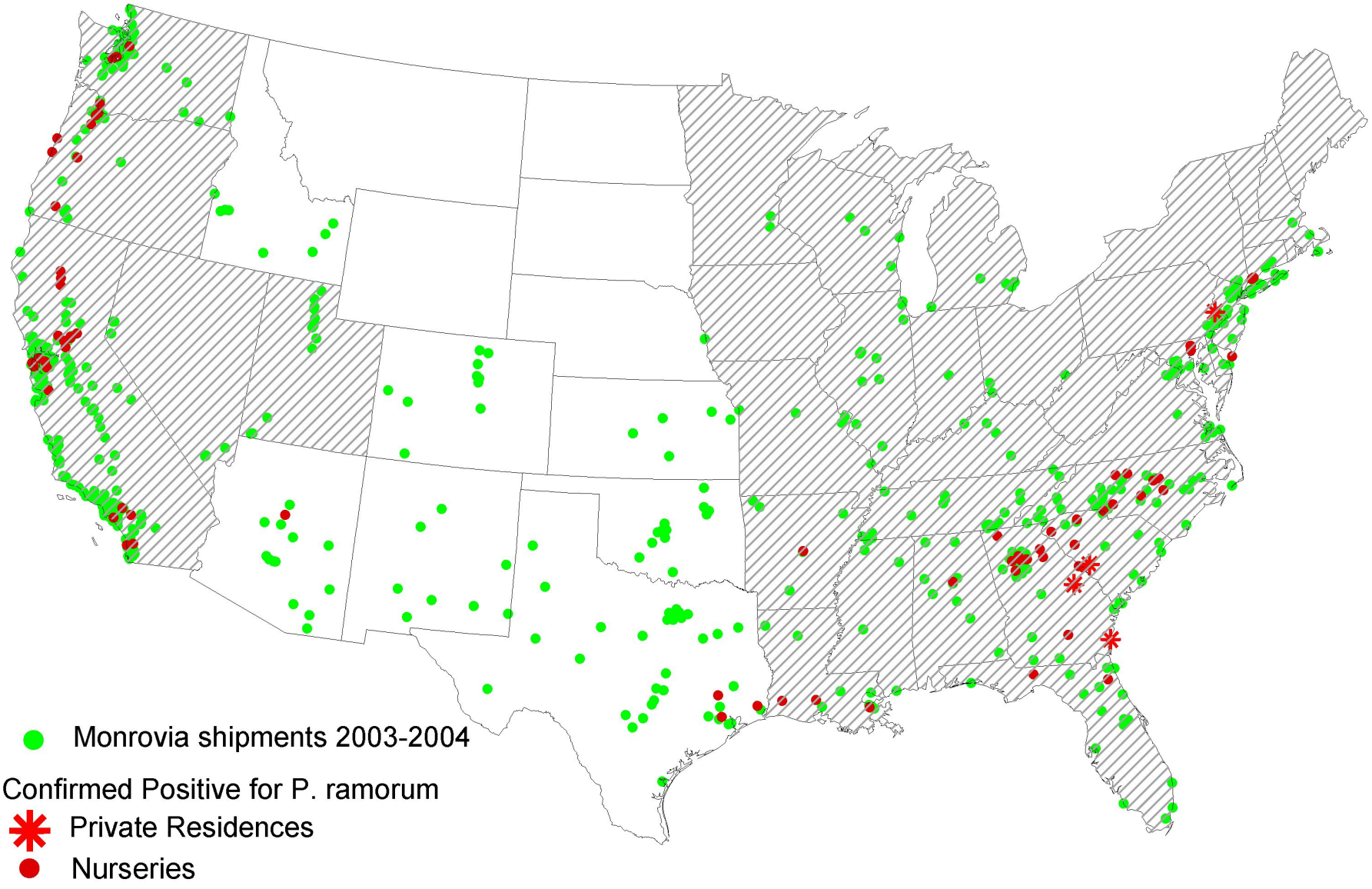

Private Residence in Georgia

total homeowners 166
total plants 221
positive for ramorum 3
1.4 percent

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5. Data and research needs: What information is needed to improve models?

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- Urban Forest Inventory
- Understory vegetation

Data and research needs: What information is needed to improve models?

- Longevity of resting spores, particularly in soil
- Conditions for spore germination
- Mode of transport from resting stage to leaf
- Transport from bay to oak – water splash?, - wind?
- Understanding known artificial pathways
- Understanding unknown artificial pathways
- Natural pathways
- Interaction with hypoxylon and other “final” mortality agents
- Genetic resistance
- Tree defenses
- Climate effects on disease progression
- Other biotic interactions
- Other abiotic interactions
- Role of foliar hosts in disease progression
- …