

Risk Mapping for Forest Pests



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Gypsy Moth Management
in the United States:
a cooperative approach

Final

Environmental Impact Statement

Volume II of V
Chapters 1-9 and Appendixes A-E

November 1995



United States
Department
of Agriculture



Forest Service



Animal and Plant
Health Inspection
Service

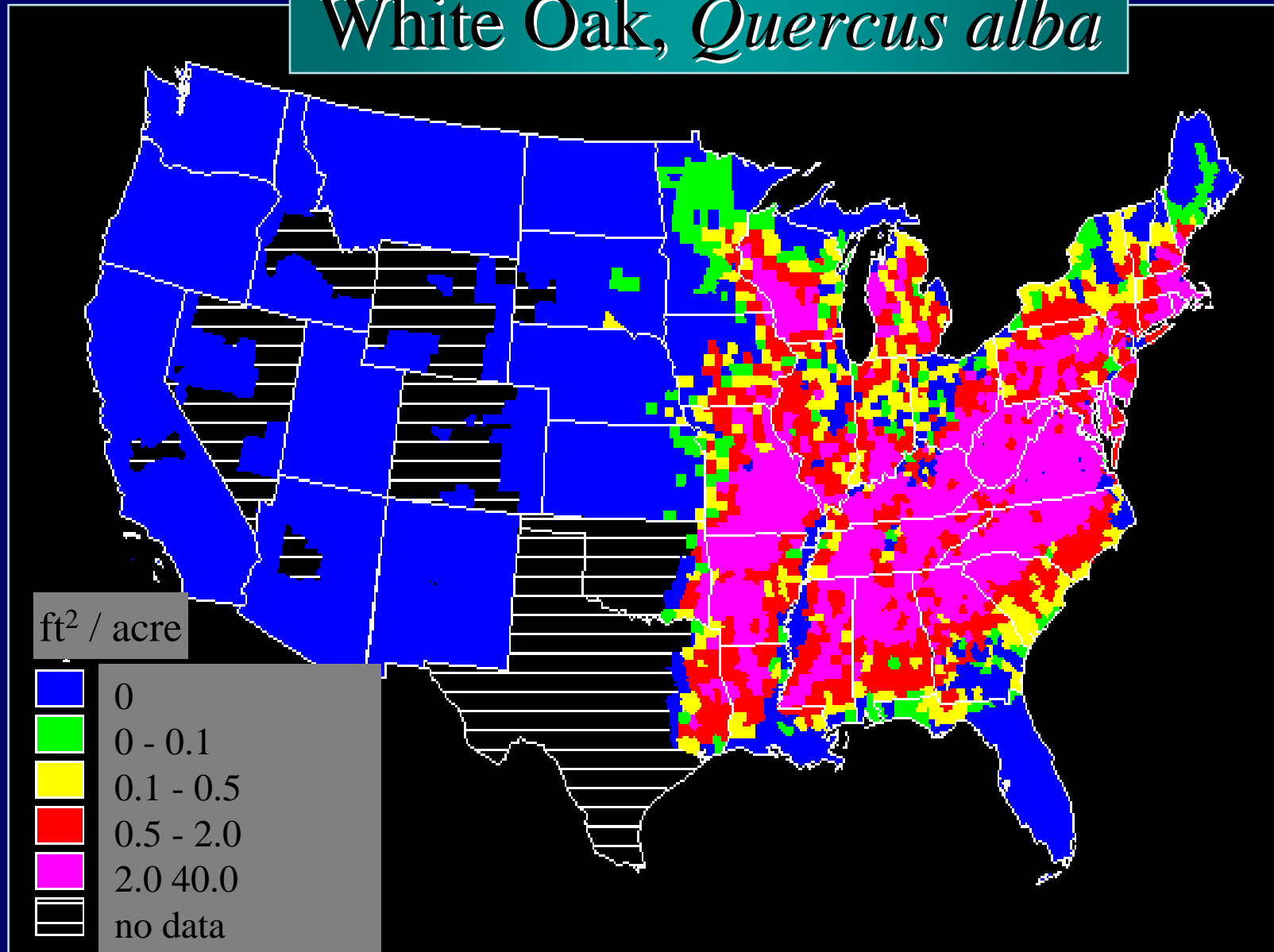
JOURNAL OF
FORESTRY

MAY 1997 VOLUME 95, NUMBER 5

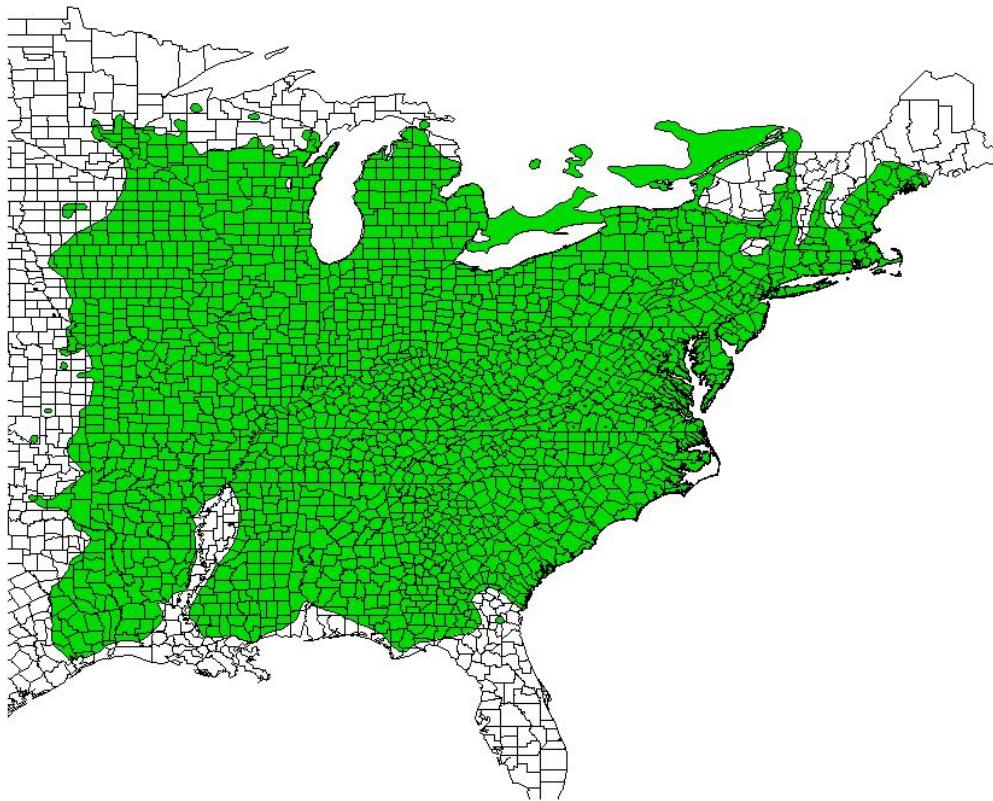
**When the
GYPSY MOTH
Moves WEST**

Also:
Aspen in Decline
Roundup Ready®
Cottonwoods
Working Together to
Manage the Forest

White Oak, *Quercus alba*

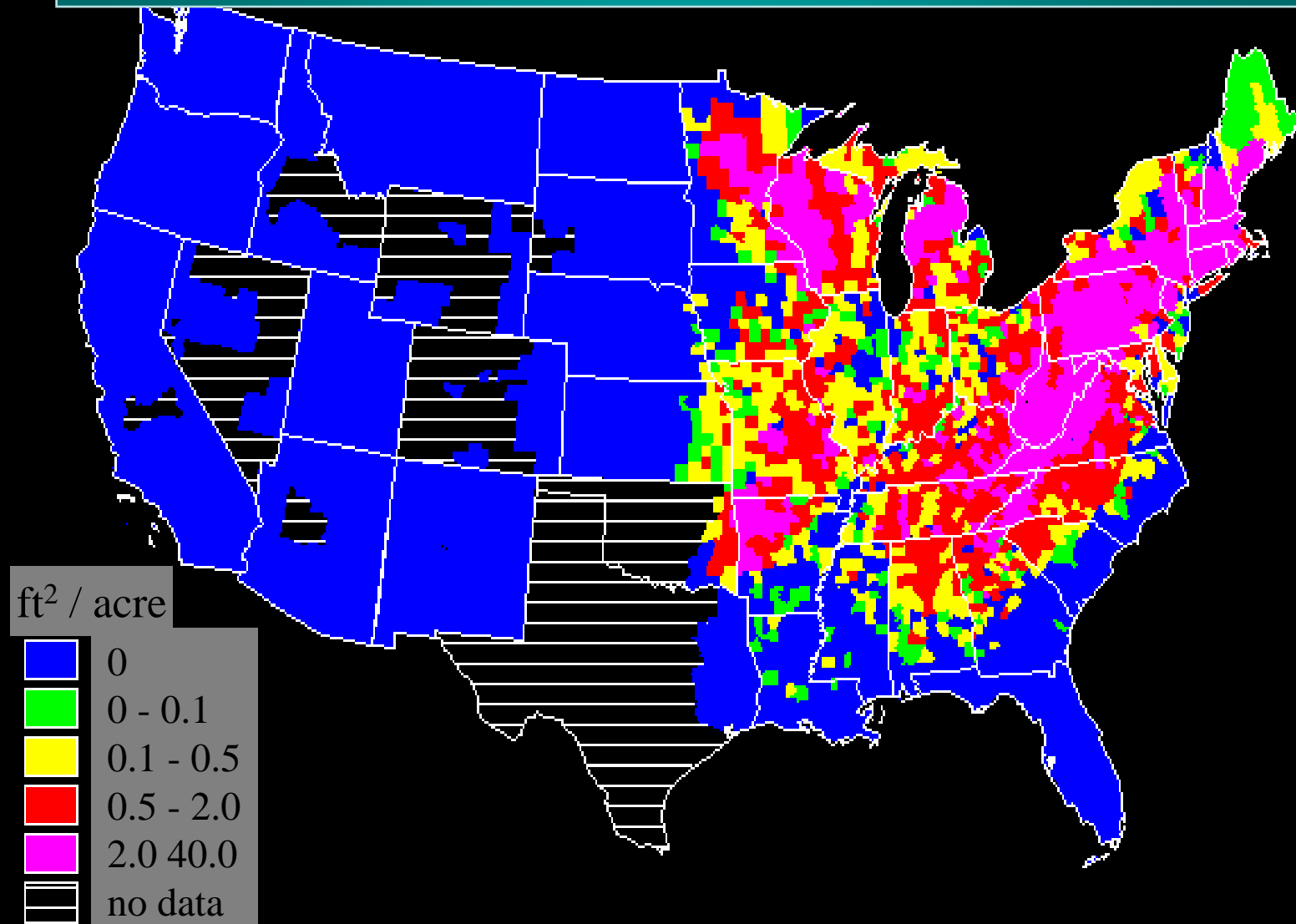


The Native Range of White Oak

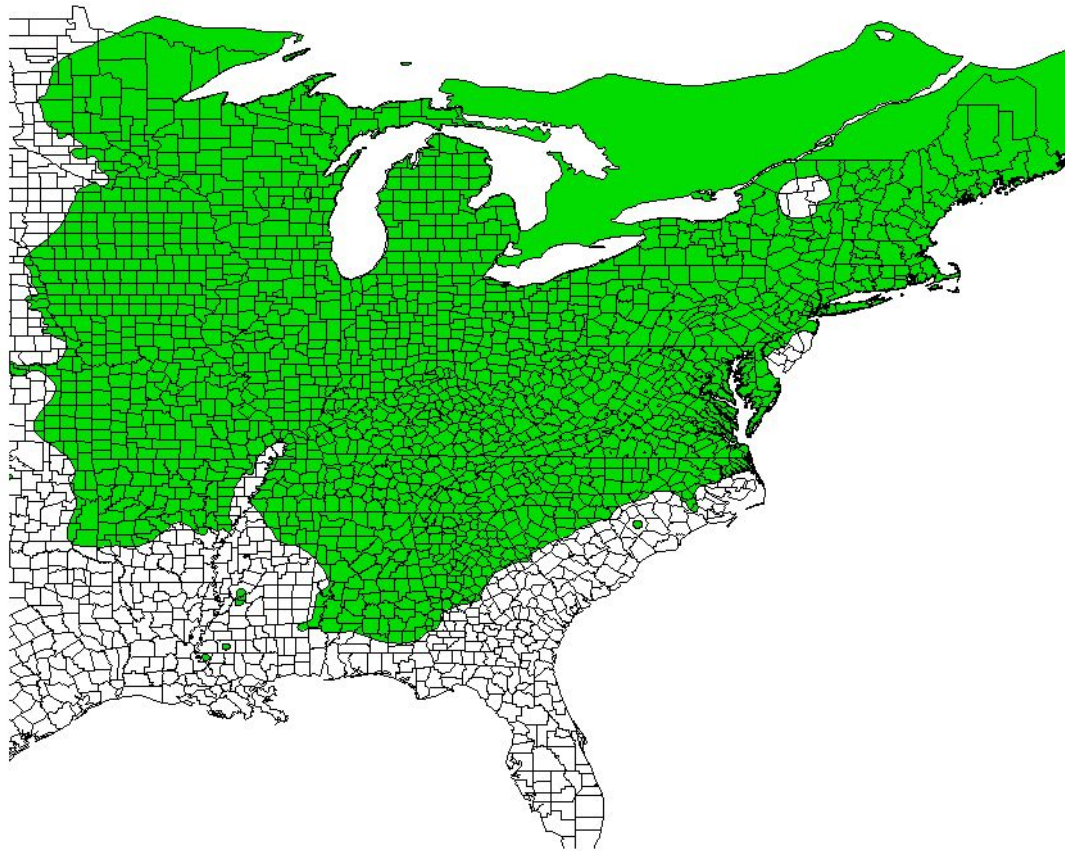


(Burns &
Honkala
1990)

Northern Red Oak, *Quercus rubra*

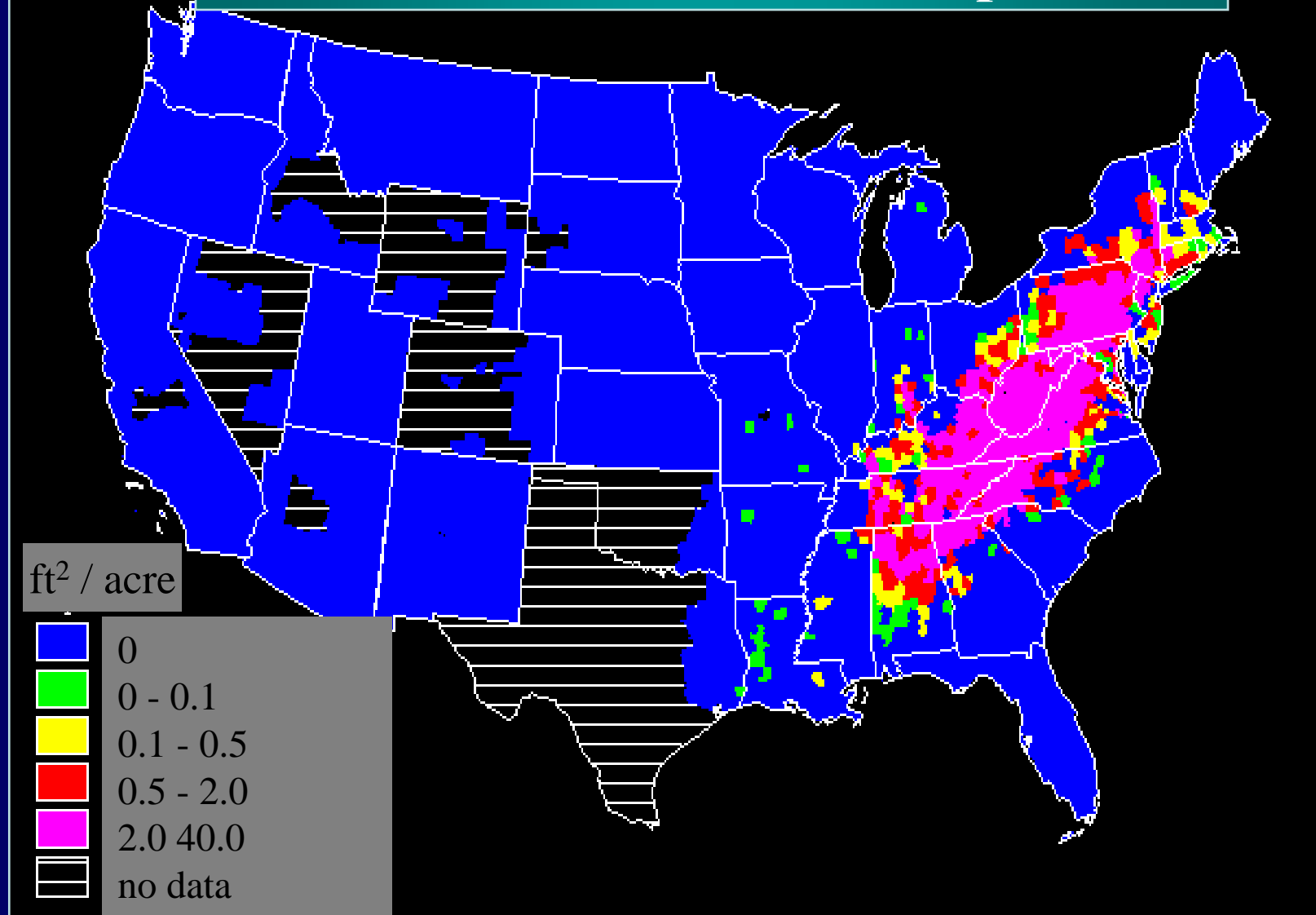


The Native Range of Northern Red Oak



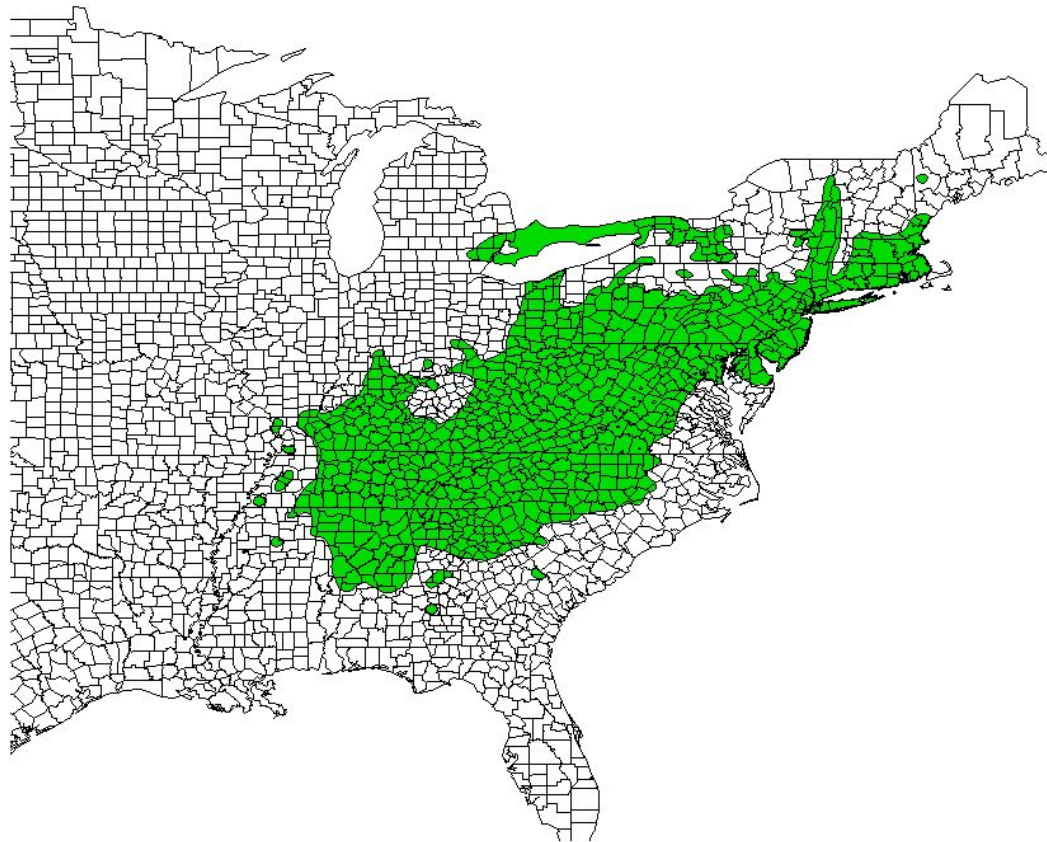
(Burns &
Honkala
1990)

Chestnut oak, *Quercus prinus*



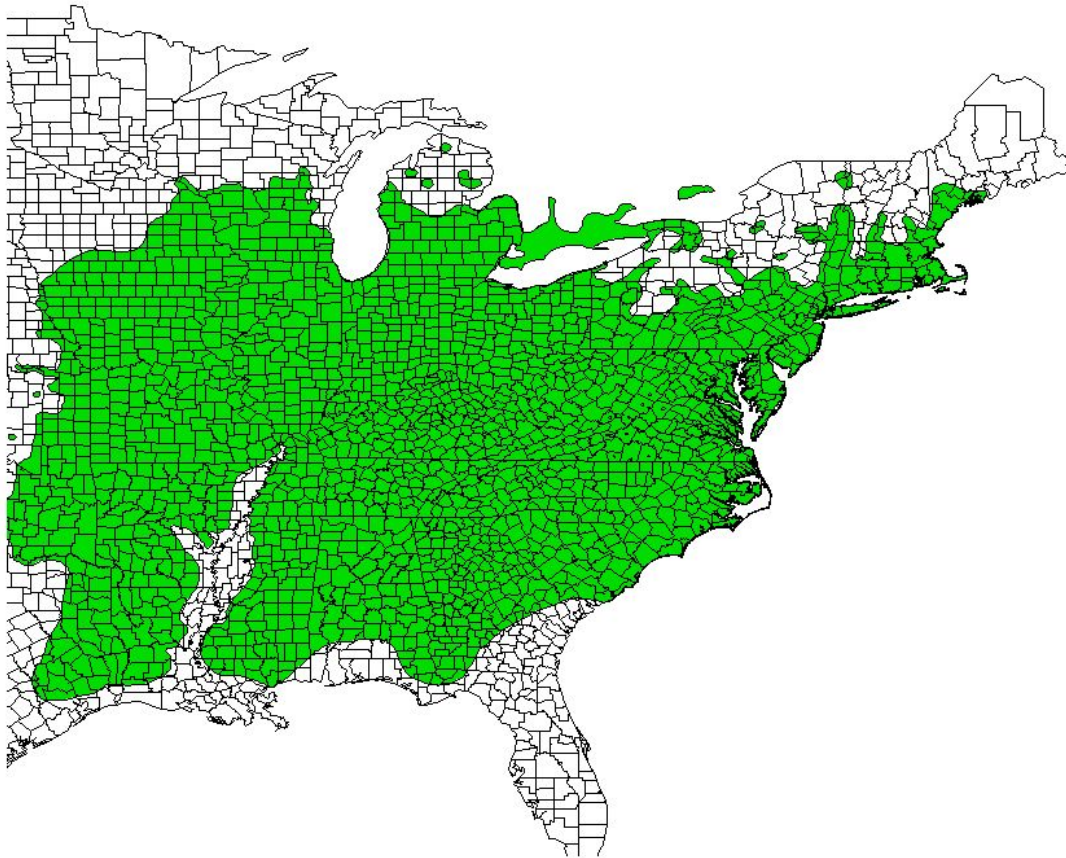
(Liebhold et al. 1997)

The Native Range of Chestnut Oak



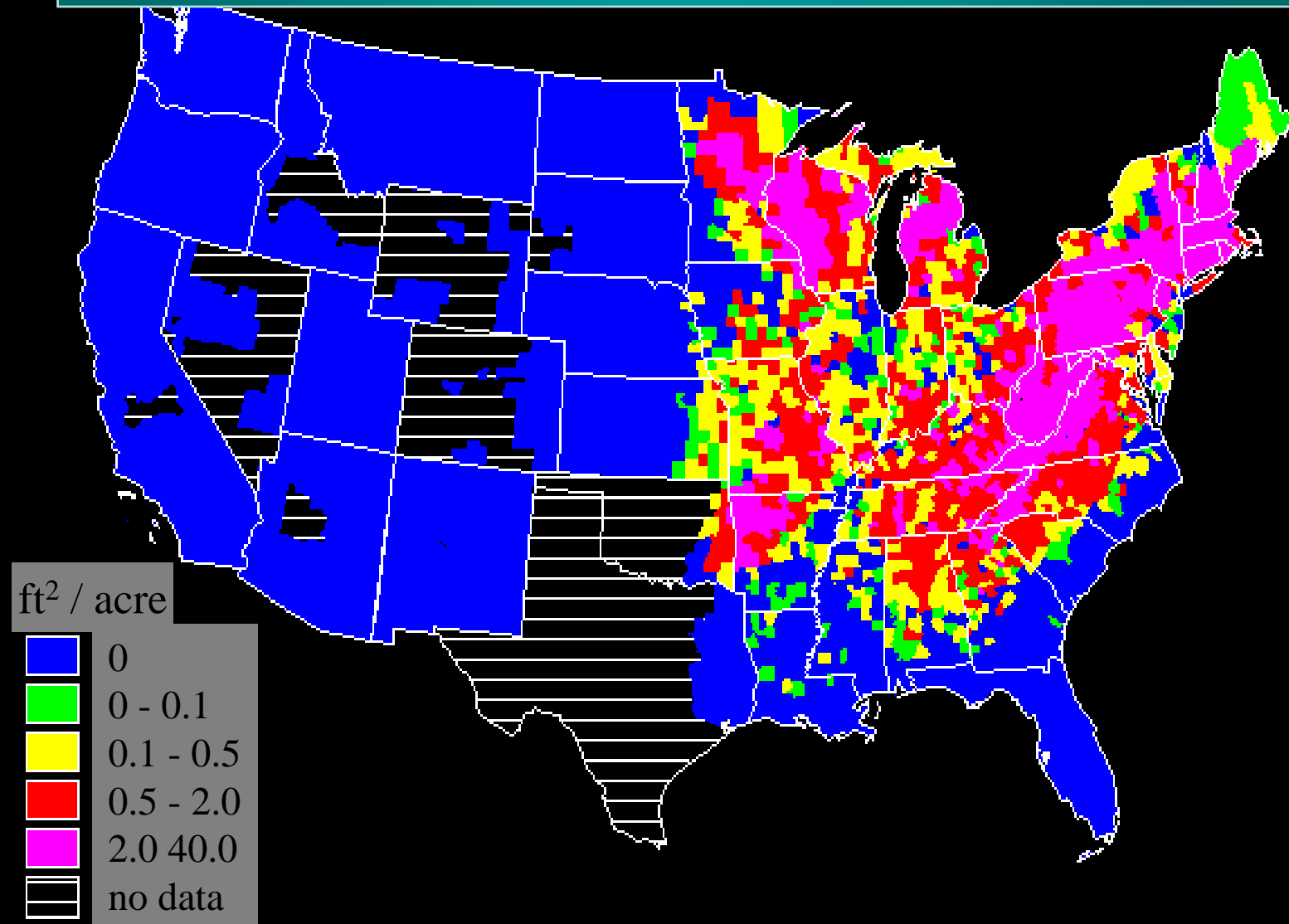
(Burns &
Honkala
1990)

The Native Range of Black Oak



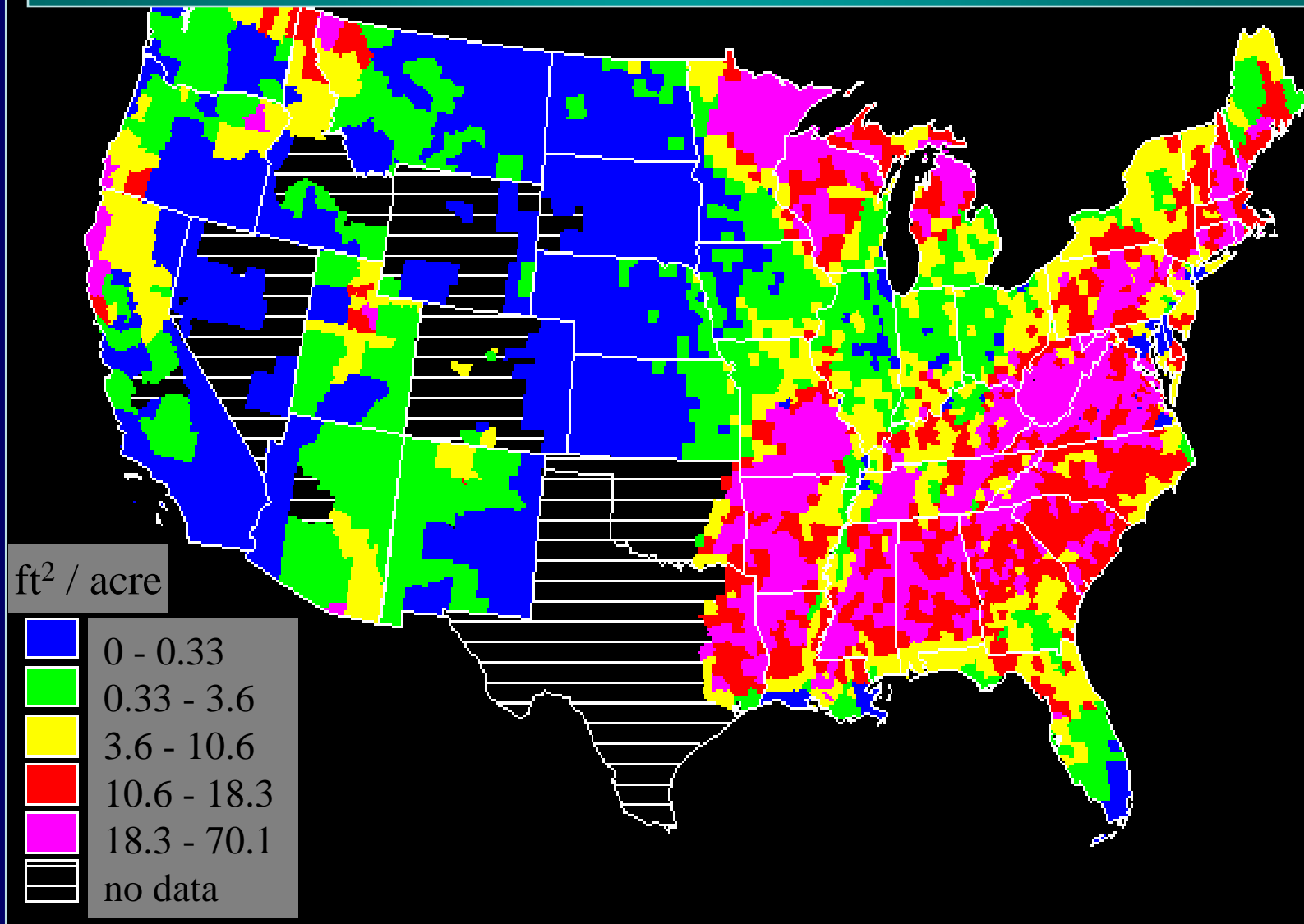
(Burns &
Honkala
1990)

Northern Red Oak, *Quercus rubra*

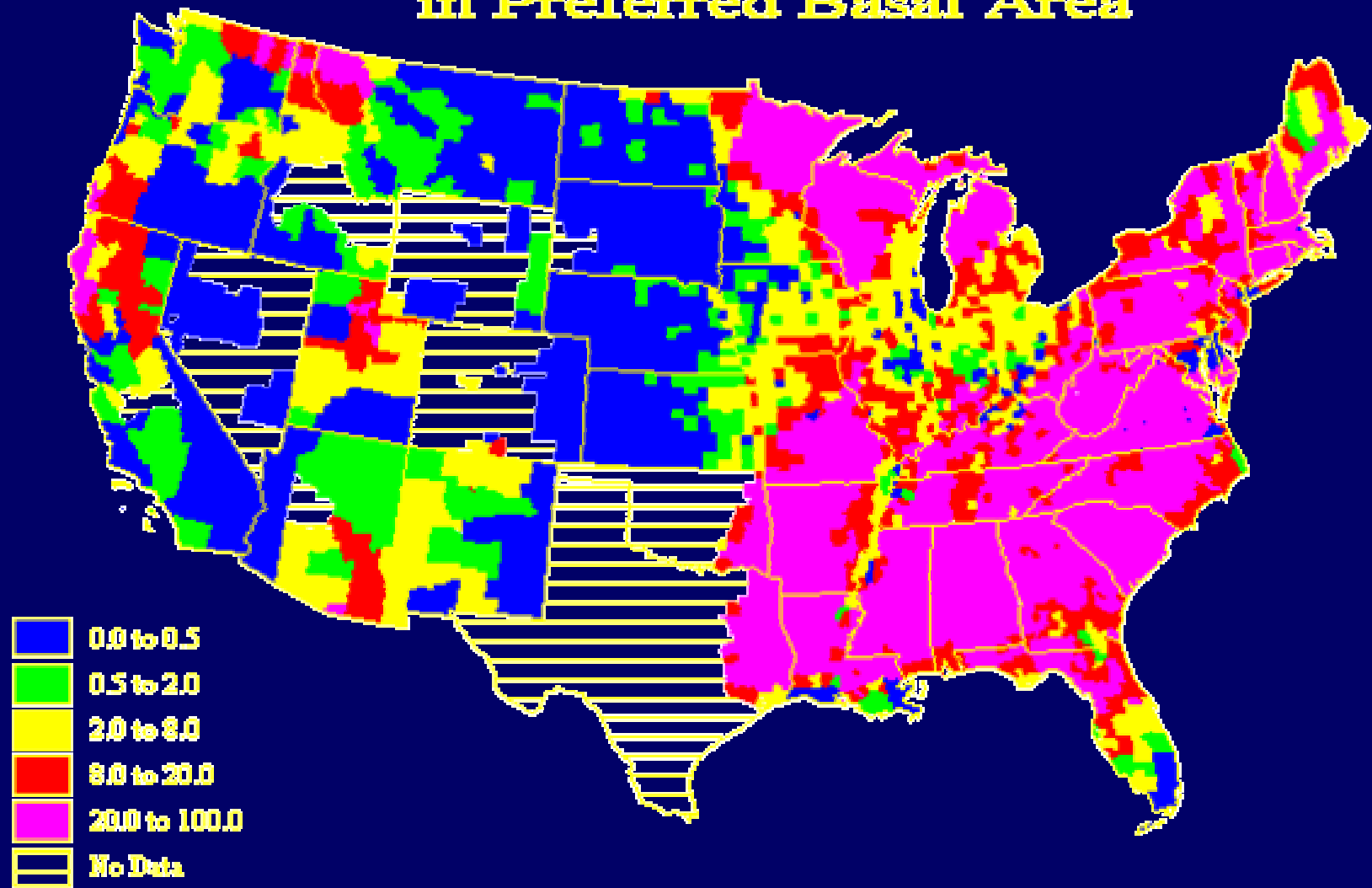


(Liebhold et al. 1997)

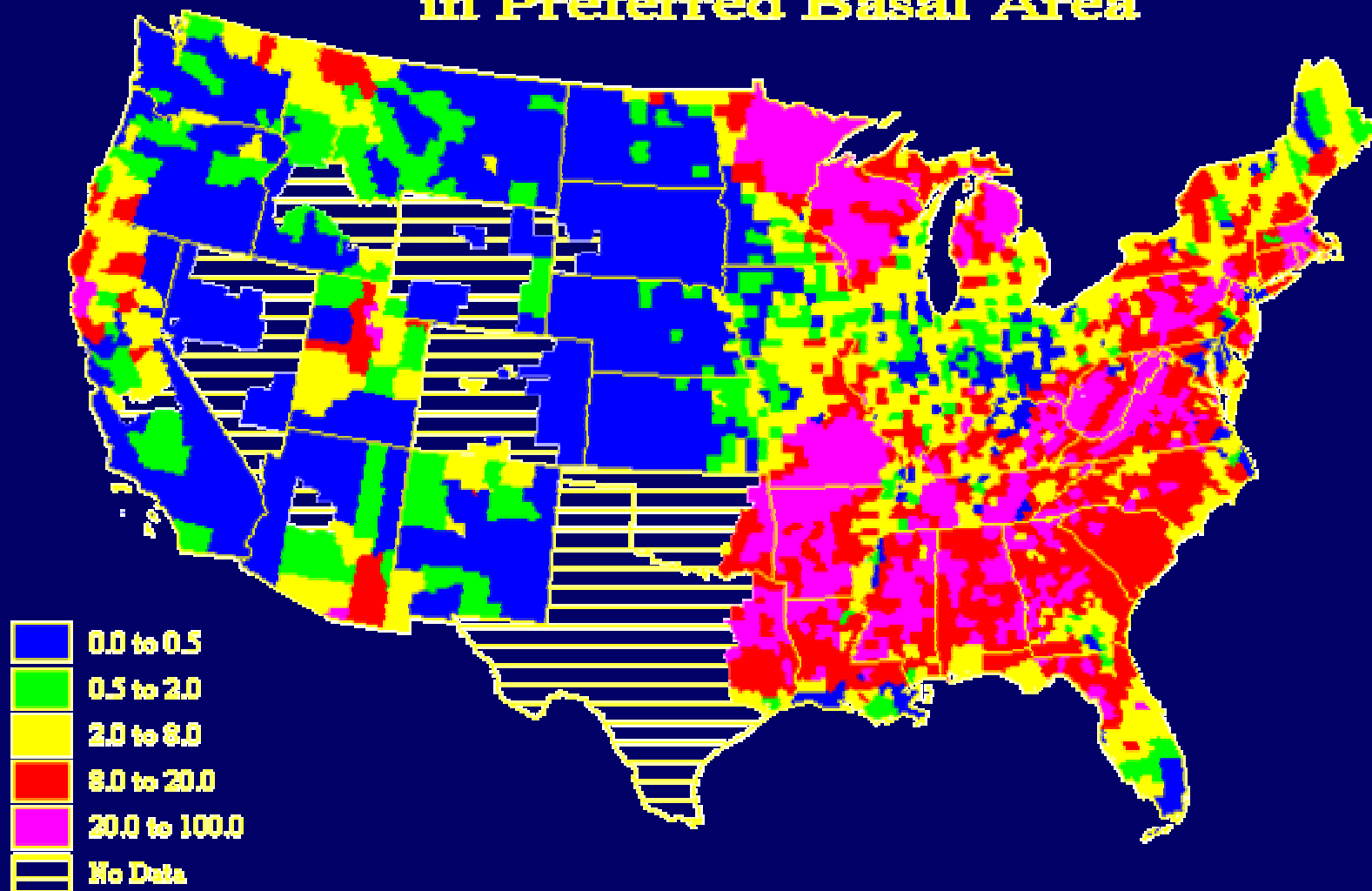
Total Basal Area of Preferred Species



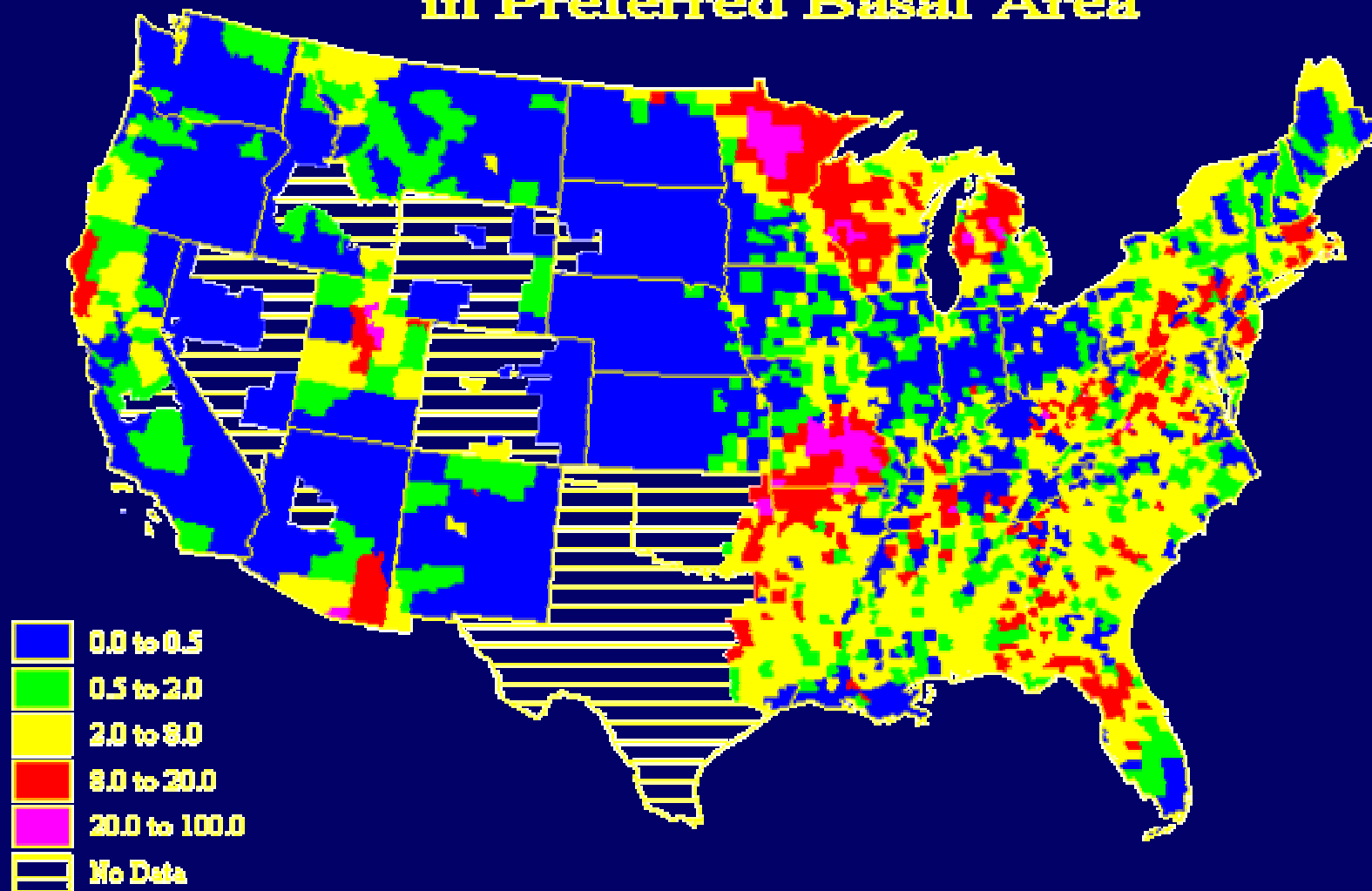
Percent Land Area Above 20% in Preferred Basal Area



Percent Land Area Above 50% in Preferred Basal Area



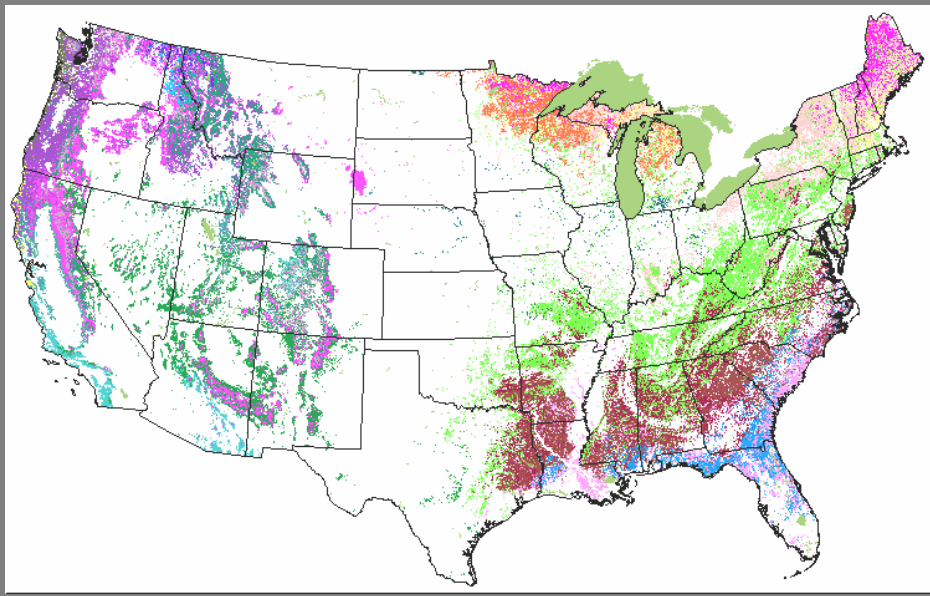
Percent Land Area Above 80% in Preferred Basal Area



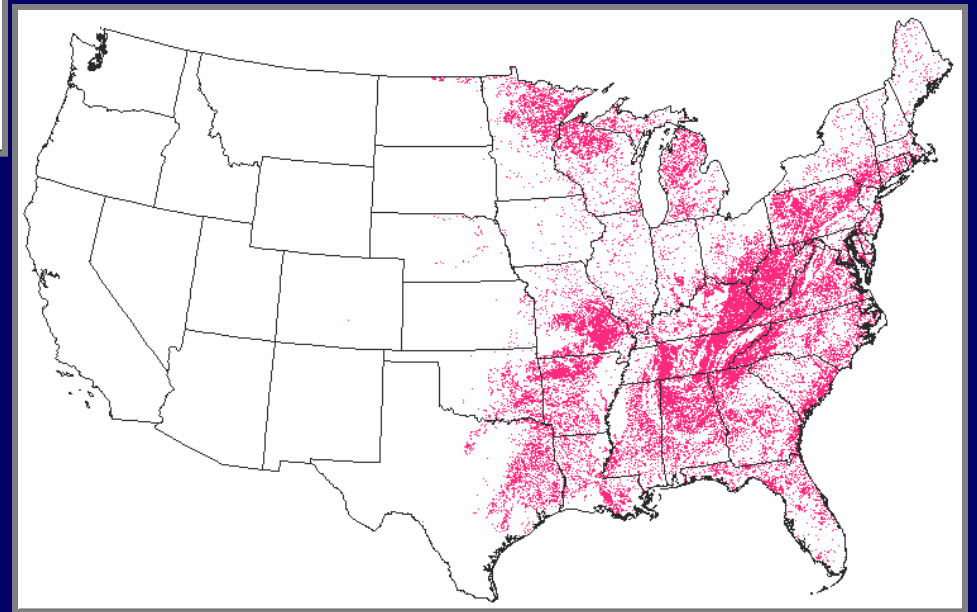
Second Effort....

- In round two, S&PF was interested in making a national forest pest risk map
- Sandy and I were approached about revising our gypsy moth effort
- For this effort, we started with the FIA AVHRR forest type map
- GM rate of spread was added into this effort as well

FIA forest type group map



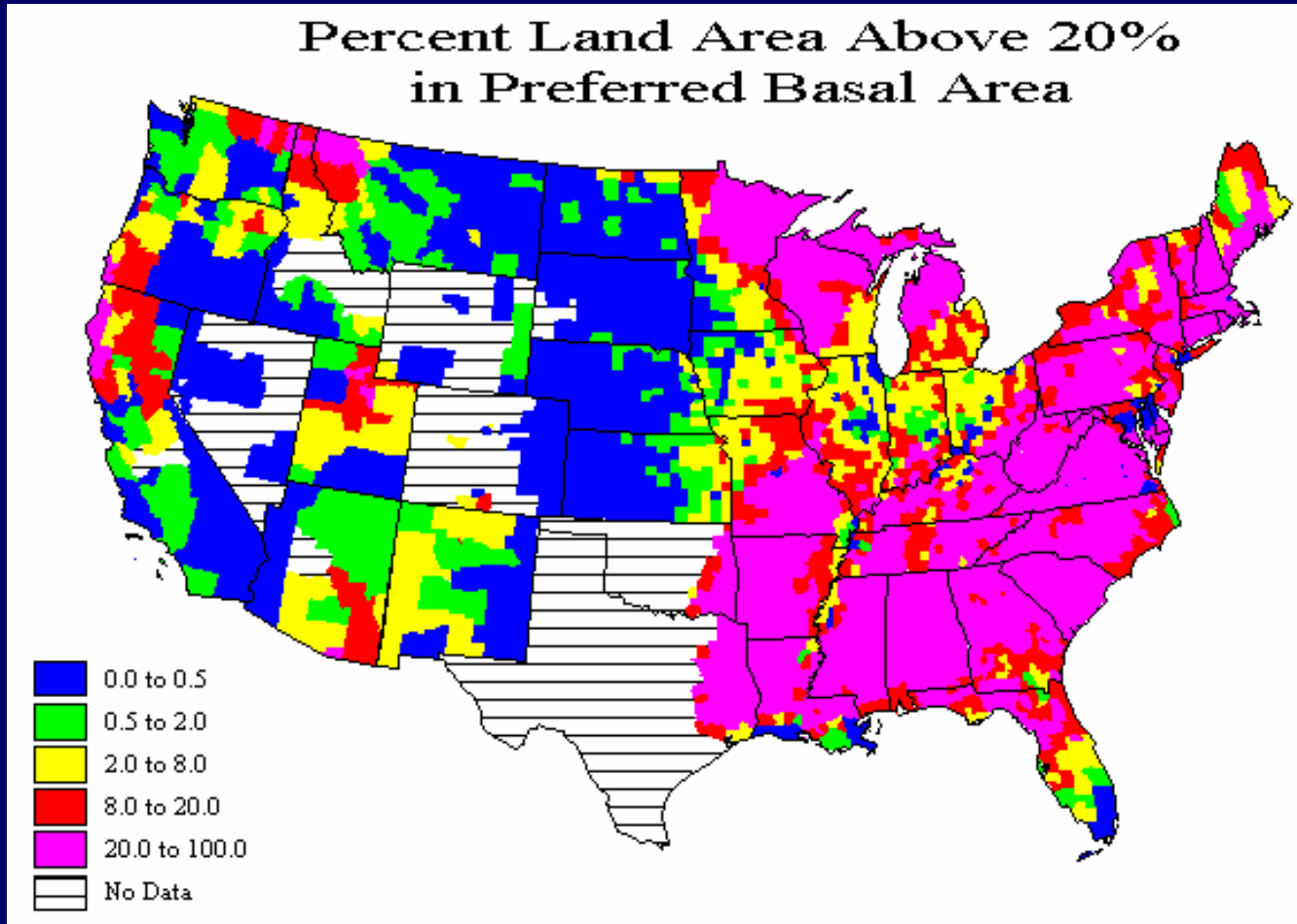
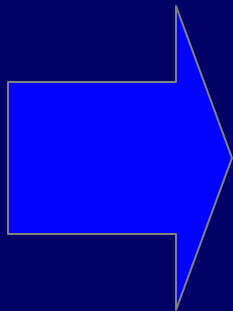
Subset for forest type groups that contain susceptible forest types (Oak-pine, Oak-hickory, Oak-gum-cypress, Elm-ash-cottonwood, and Aspen-birch):



Susceptible types

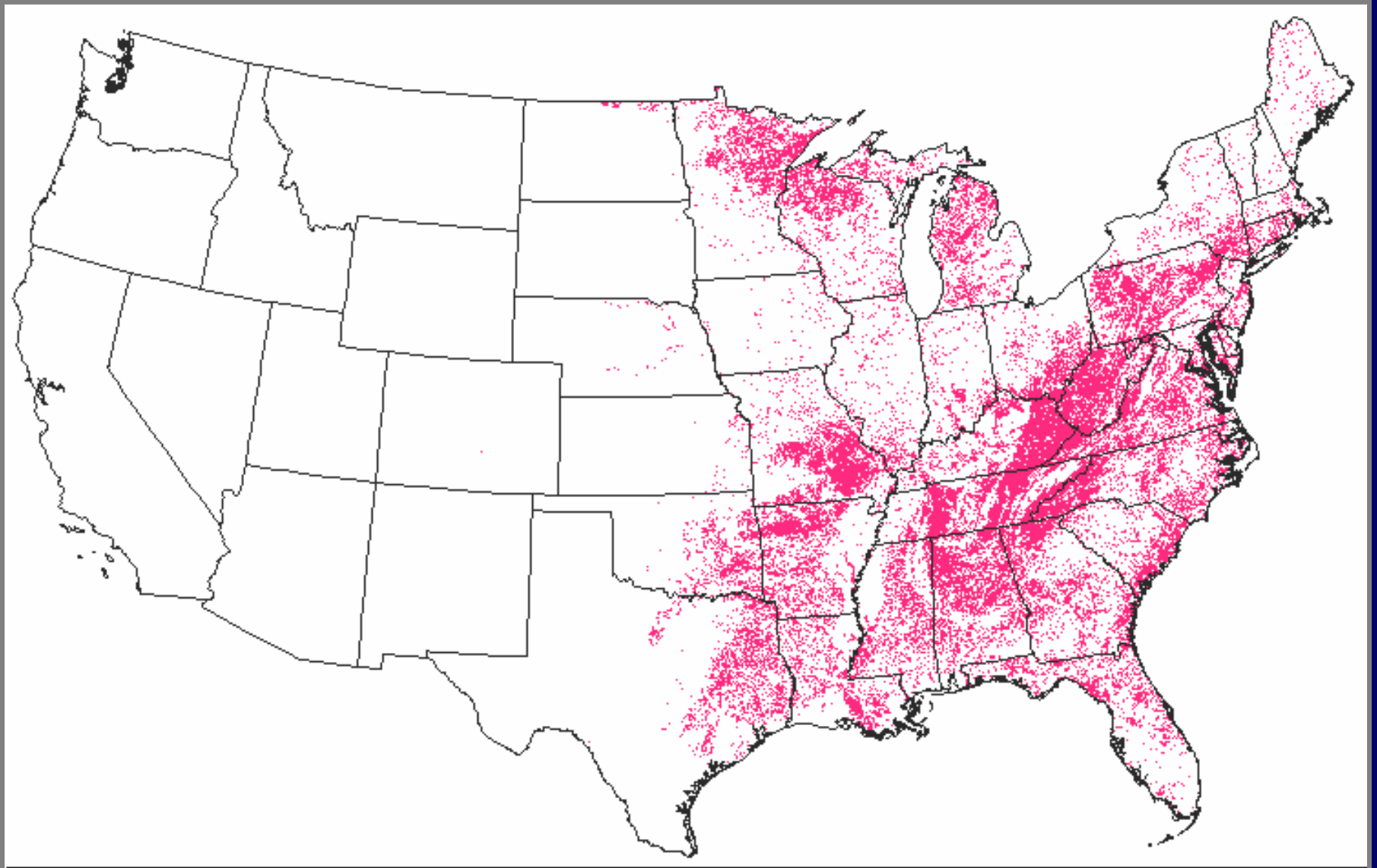
... excluded any counties where less than 10% of land area was covered by forests that have > 20% BA preferred species...

FIA
Plot
Data



(from: Liebhold et al. J. Forestry 95: 20-24)

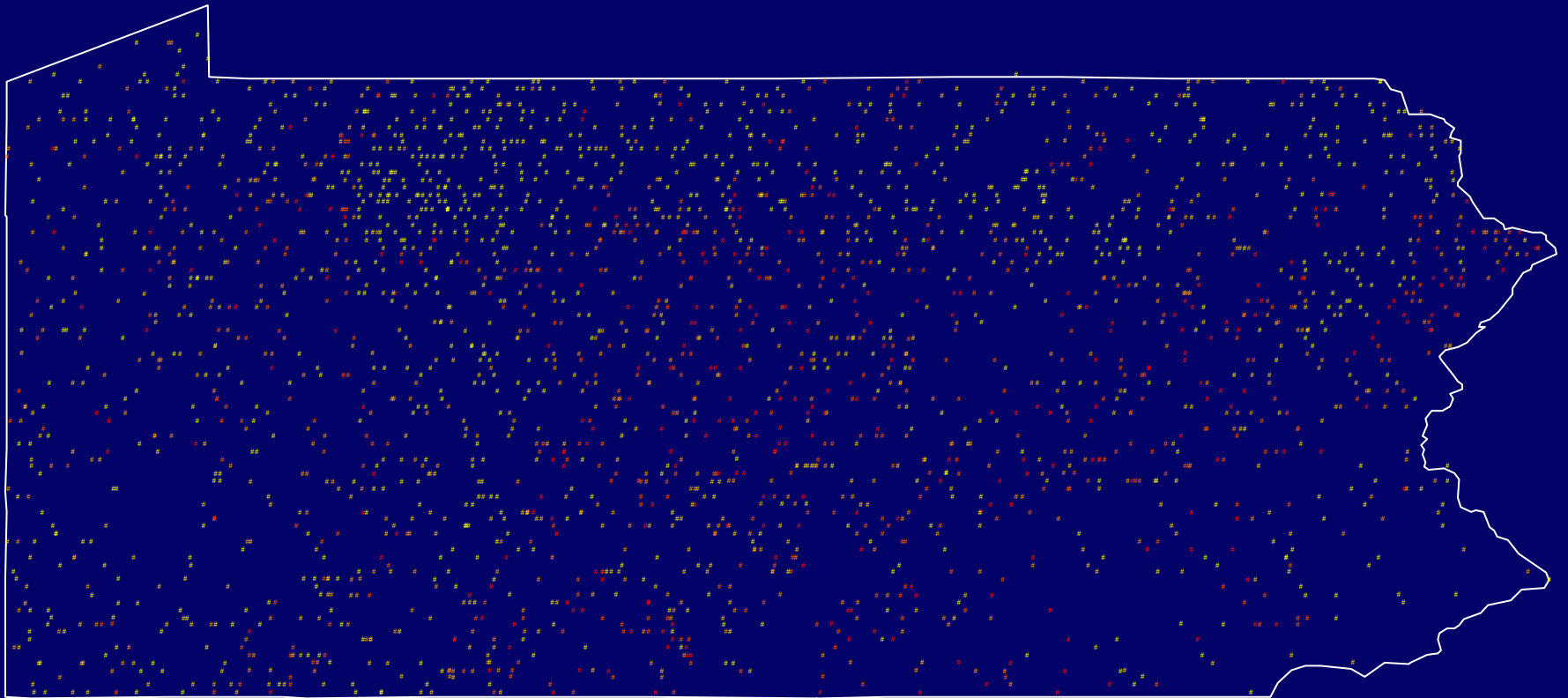
Susceptible forest types



Third effort...

- Sandy had been introduced to geostatistics, so the availability of actual GPSed plot locations allowed us to use kriging as a new approach

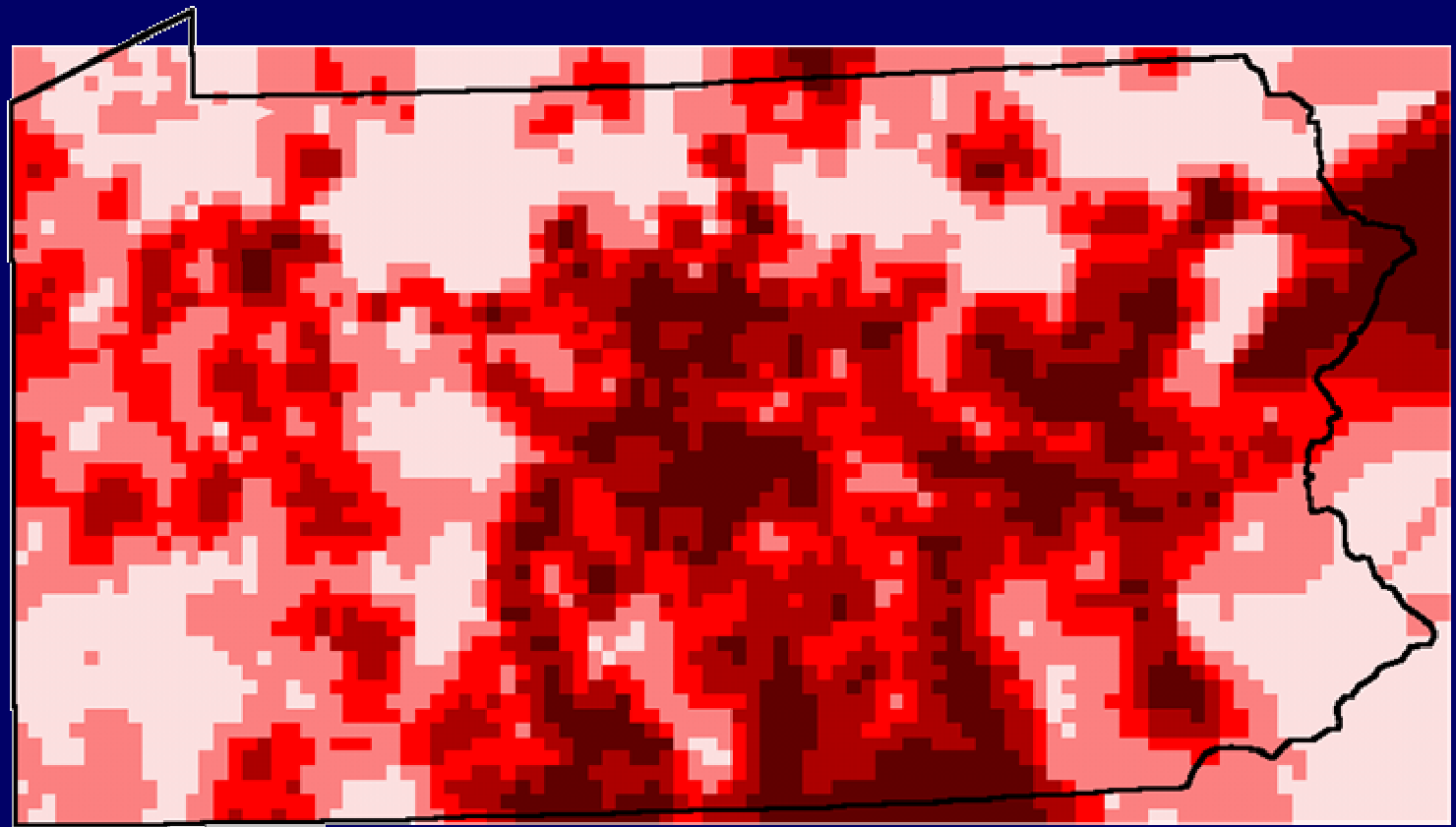
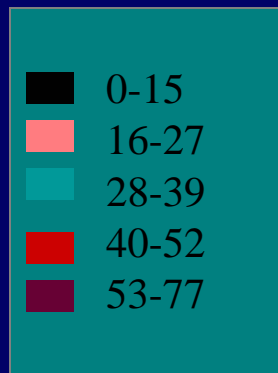
1989 Pennsylvania FIA data % basal area: Preferred by gypsy moth



% BA in Preferred Species

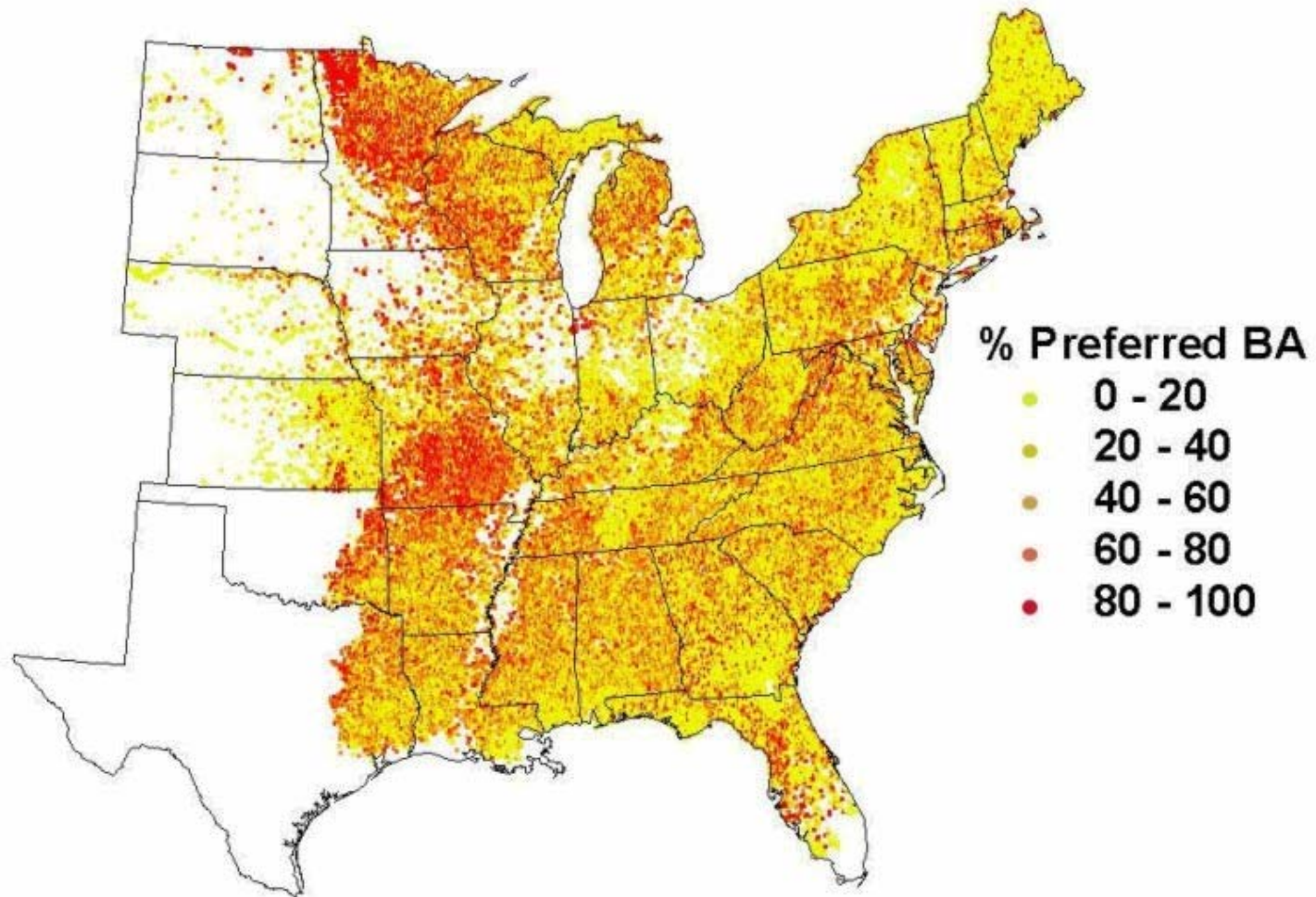
#	0 - 10.5
#	10.5 - 27.6
#	27.6 - 47.7
#	47.7 - 70.8
#	70.8 - 100

% BA Preferred by the Gypsy Moth Kriged from 1989 PA FIA Plot Data



Final kriged map for east

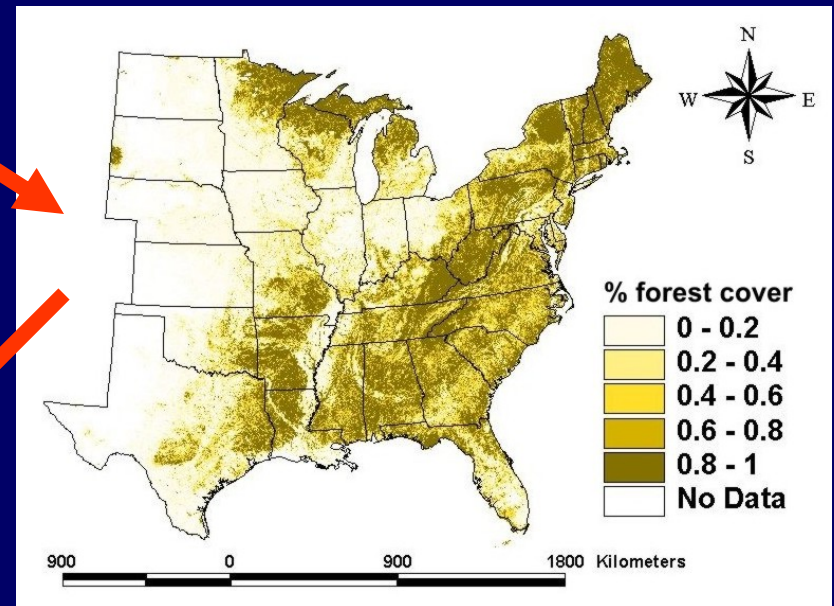
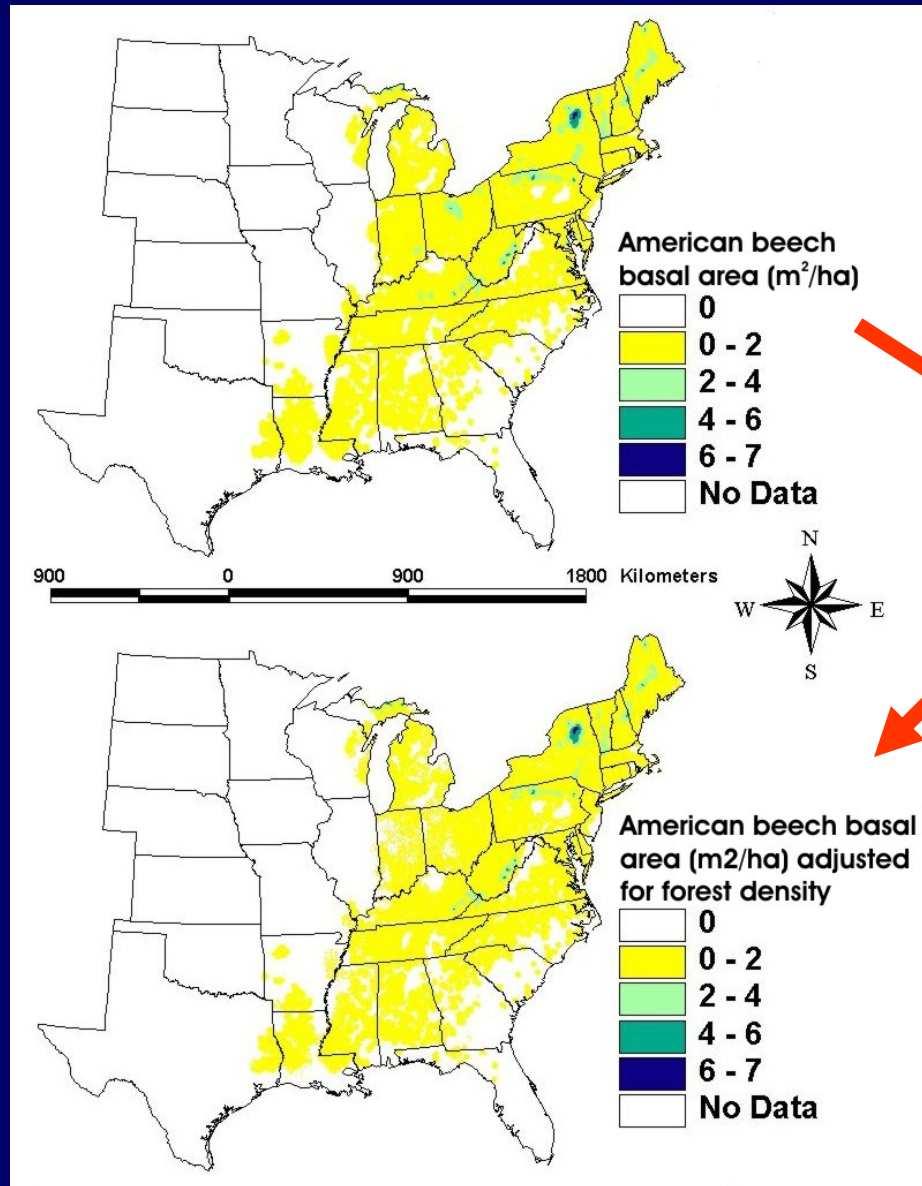
% BA in Species Preferred by Gypsy Moth



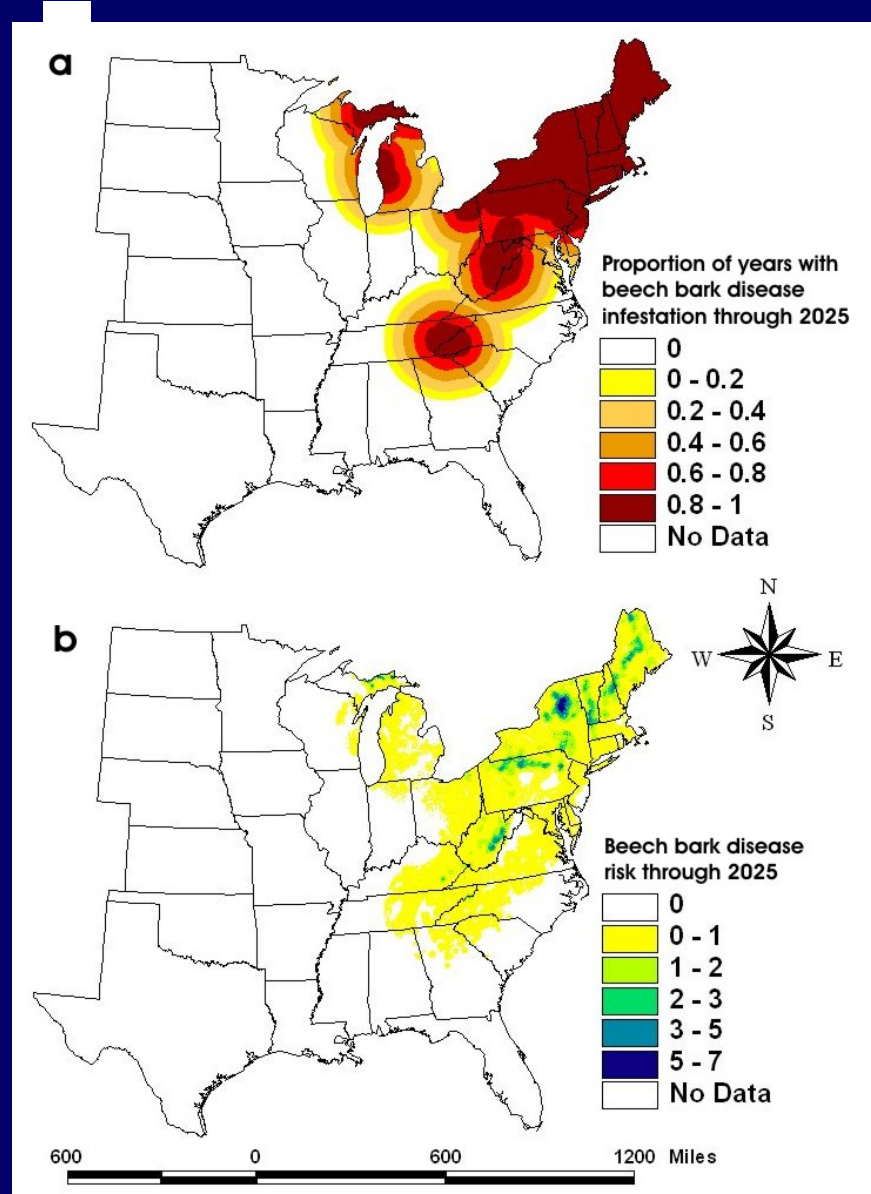
STDP Proposal for Risk Mapping Technology

- Armed with actual plot locations and our new geostatistical tools, we got funded to develop this technology along with rate of spread into a prototype for the National Pest Risk Map

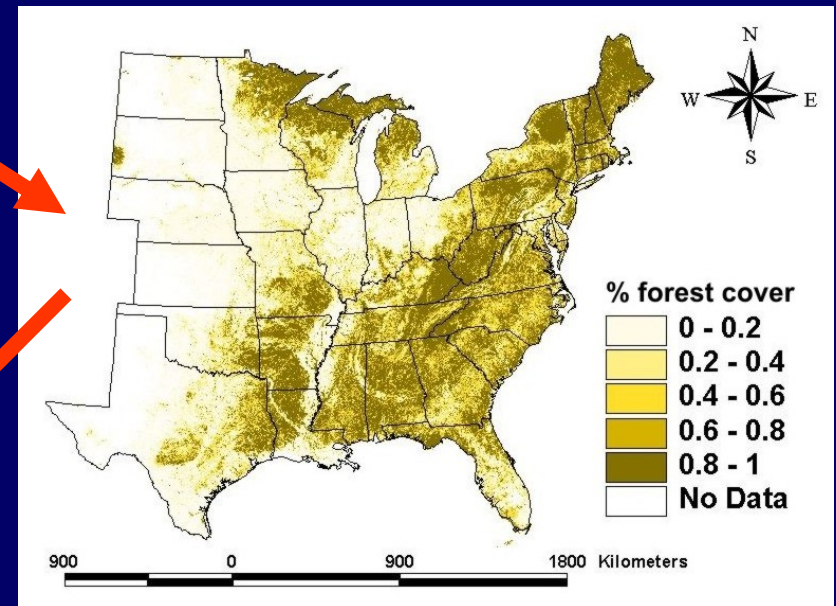
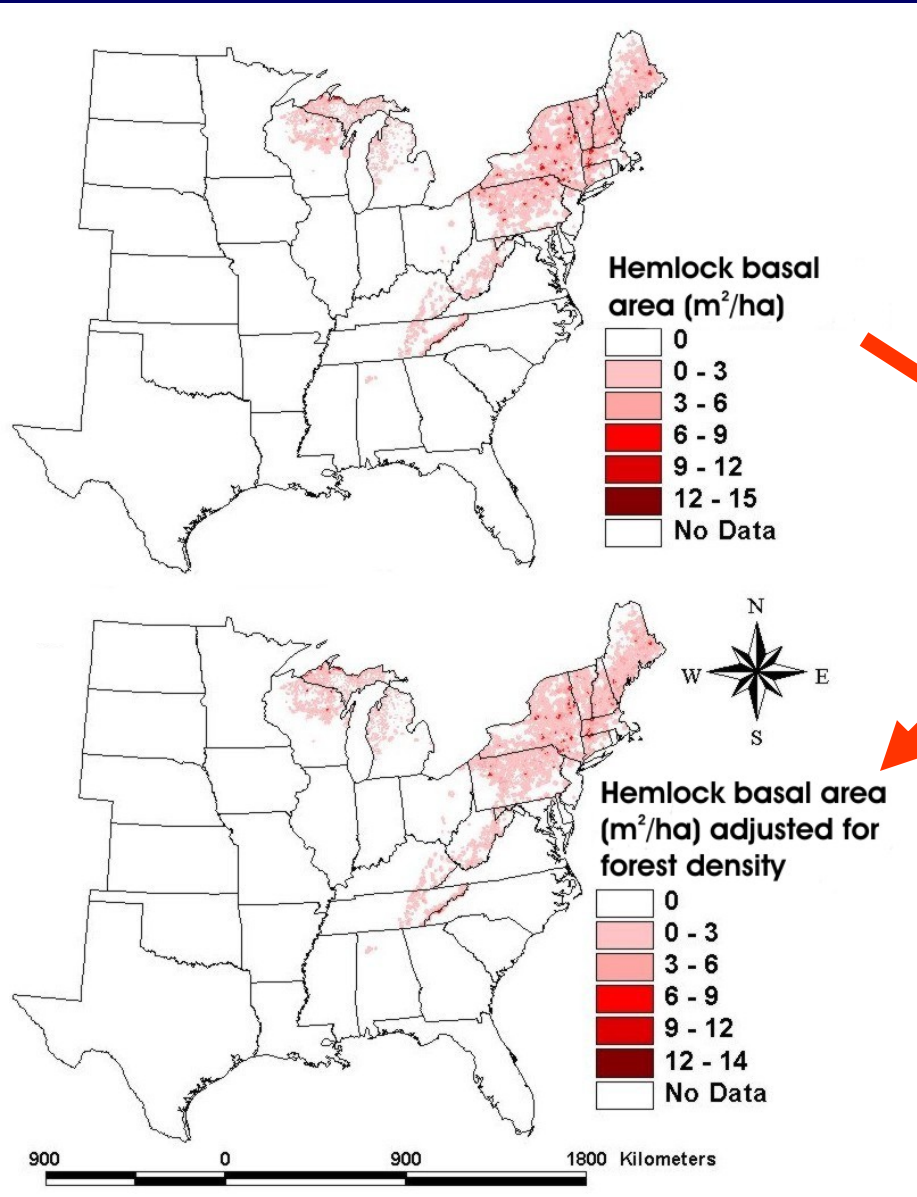
RESULTS – Beech bark disease



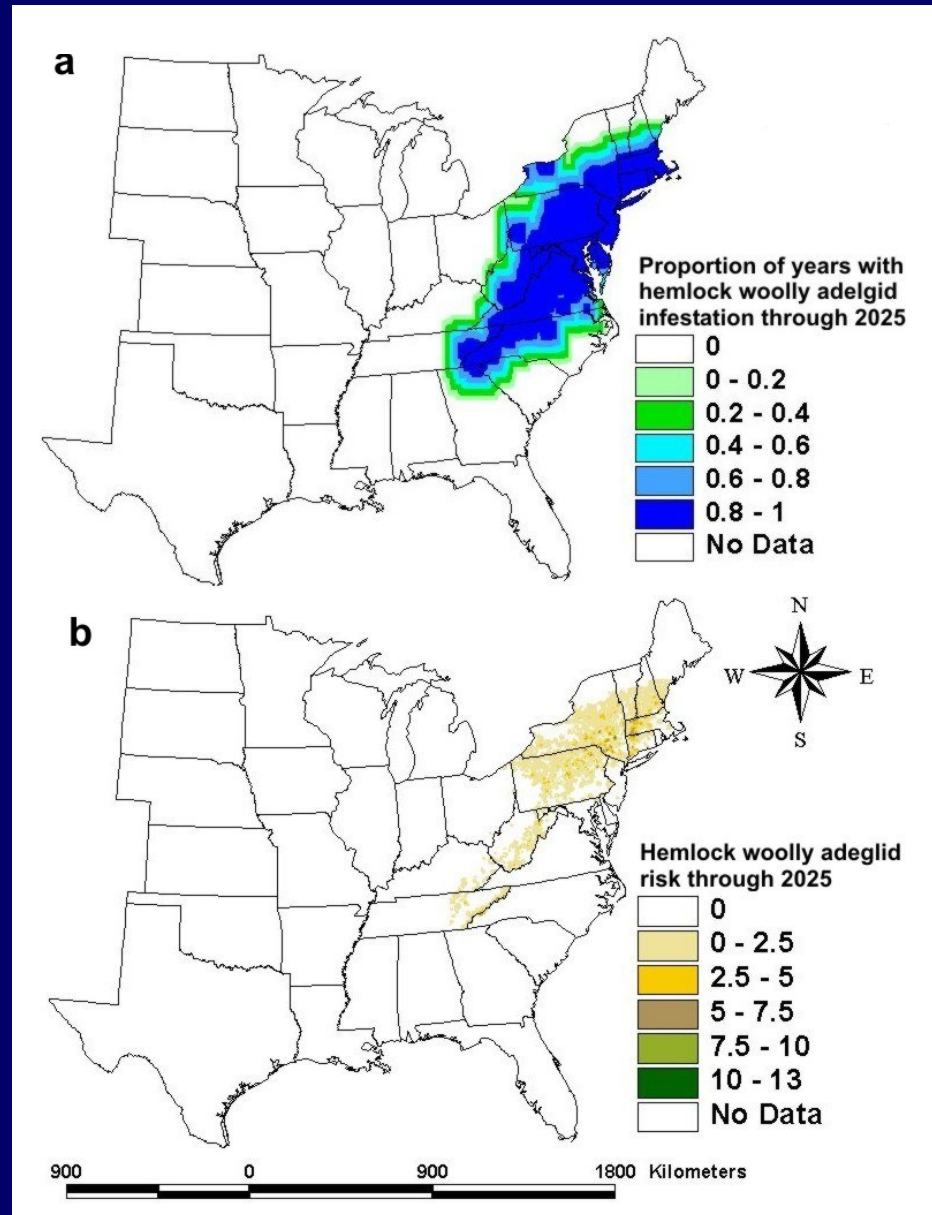
RESULTS – Beech bark disease



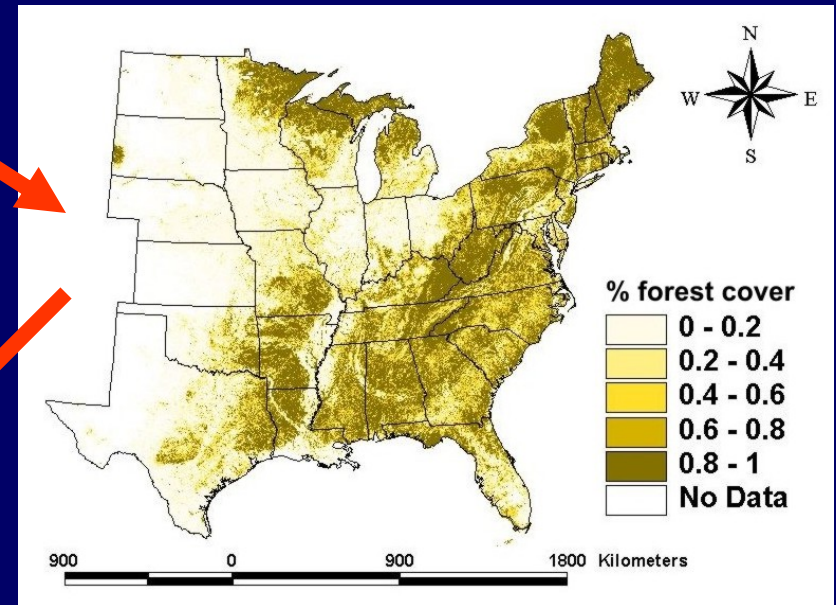
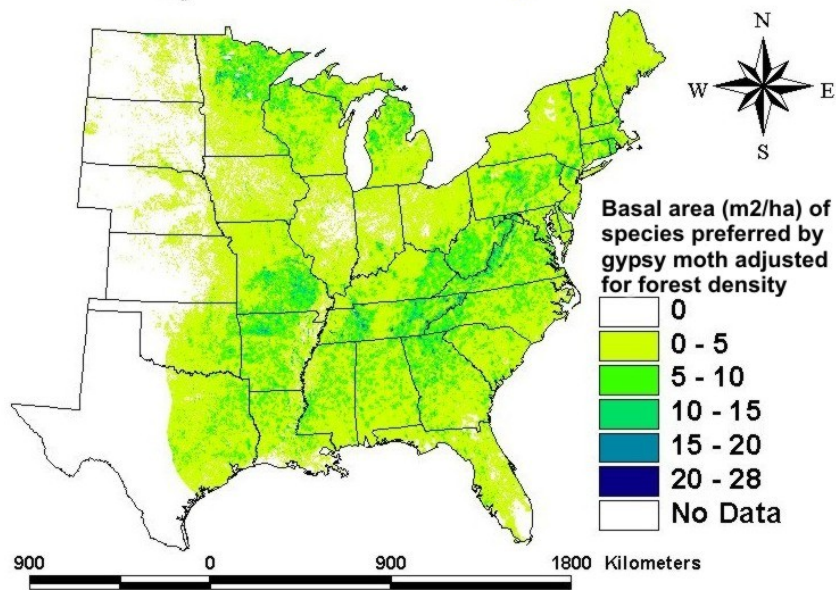
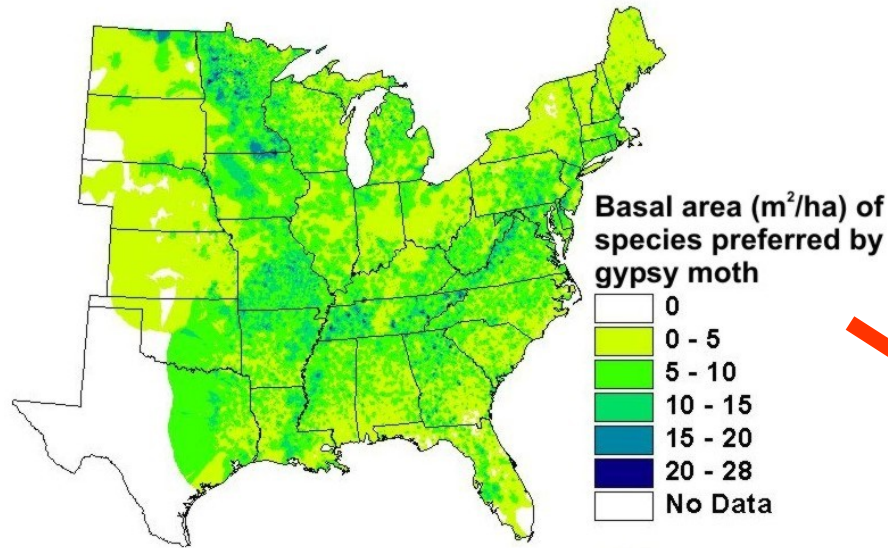
RESULTS – Hemlock Woolly Adelgid



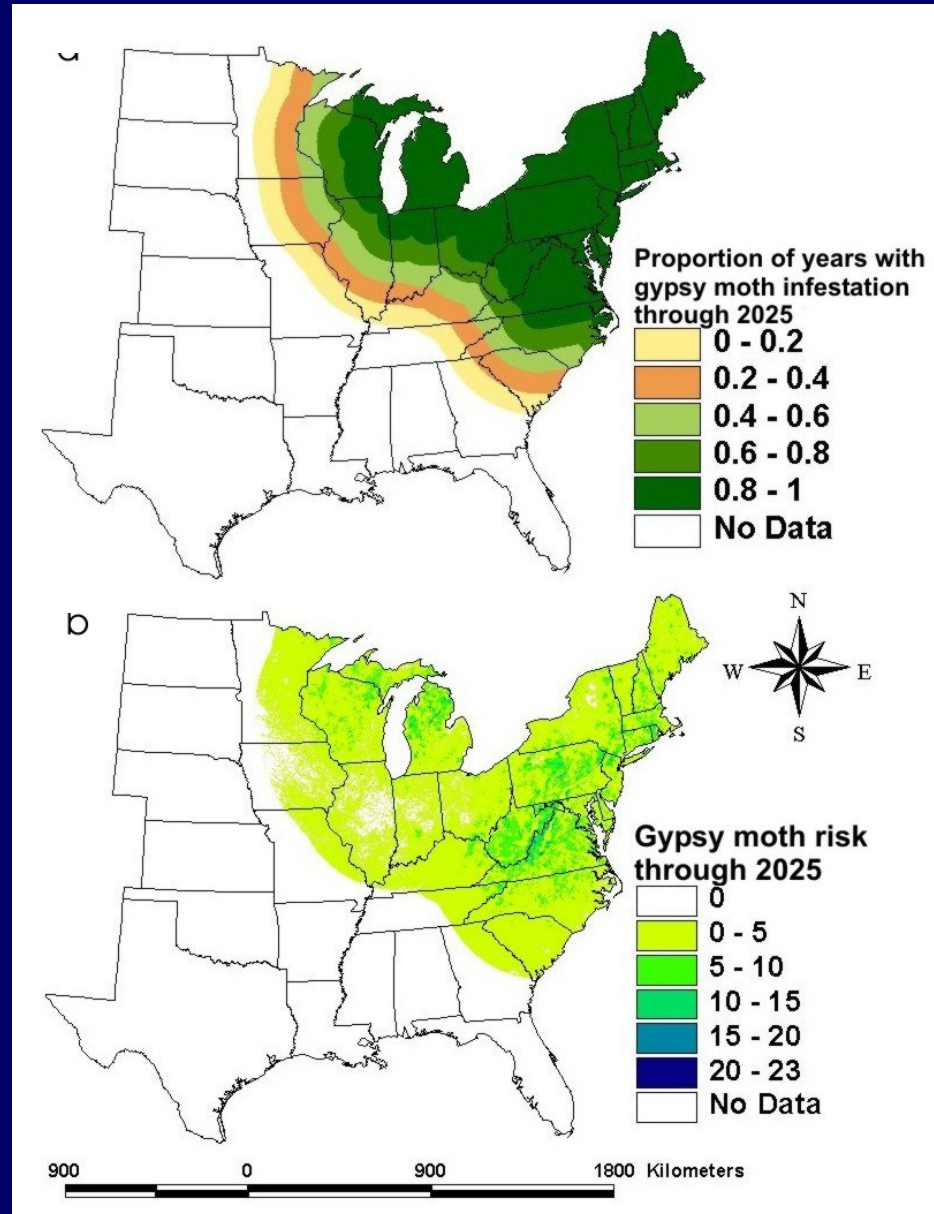
RESULTS – Hemlock Woolly Adelgid



RESULTS – Gypsy Moth

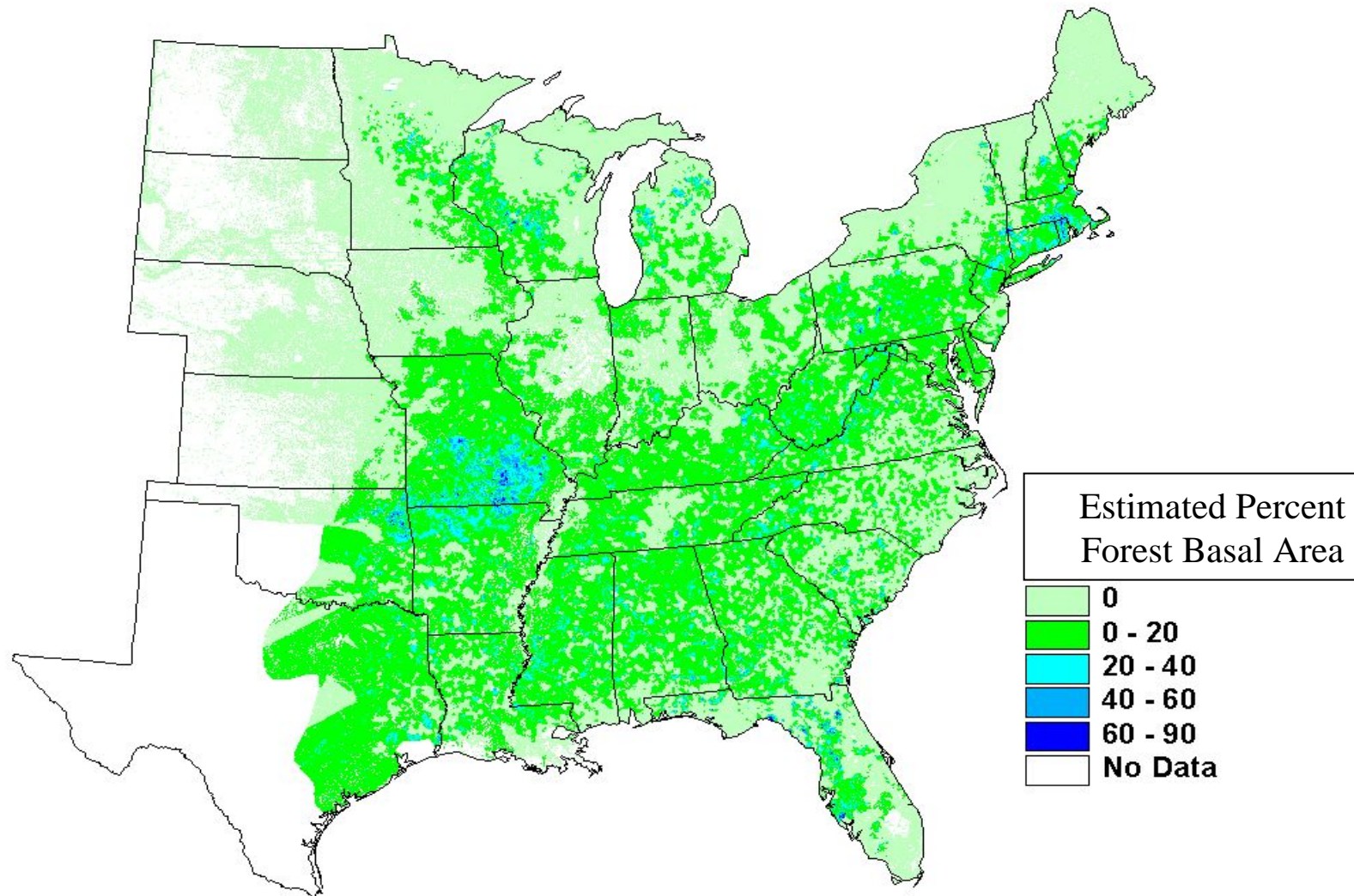


RESULTS – Gypsy Moth



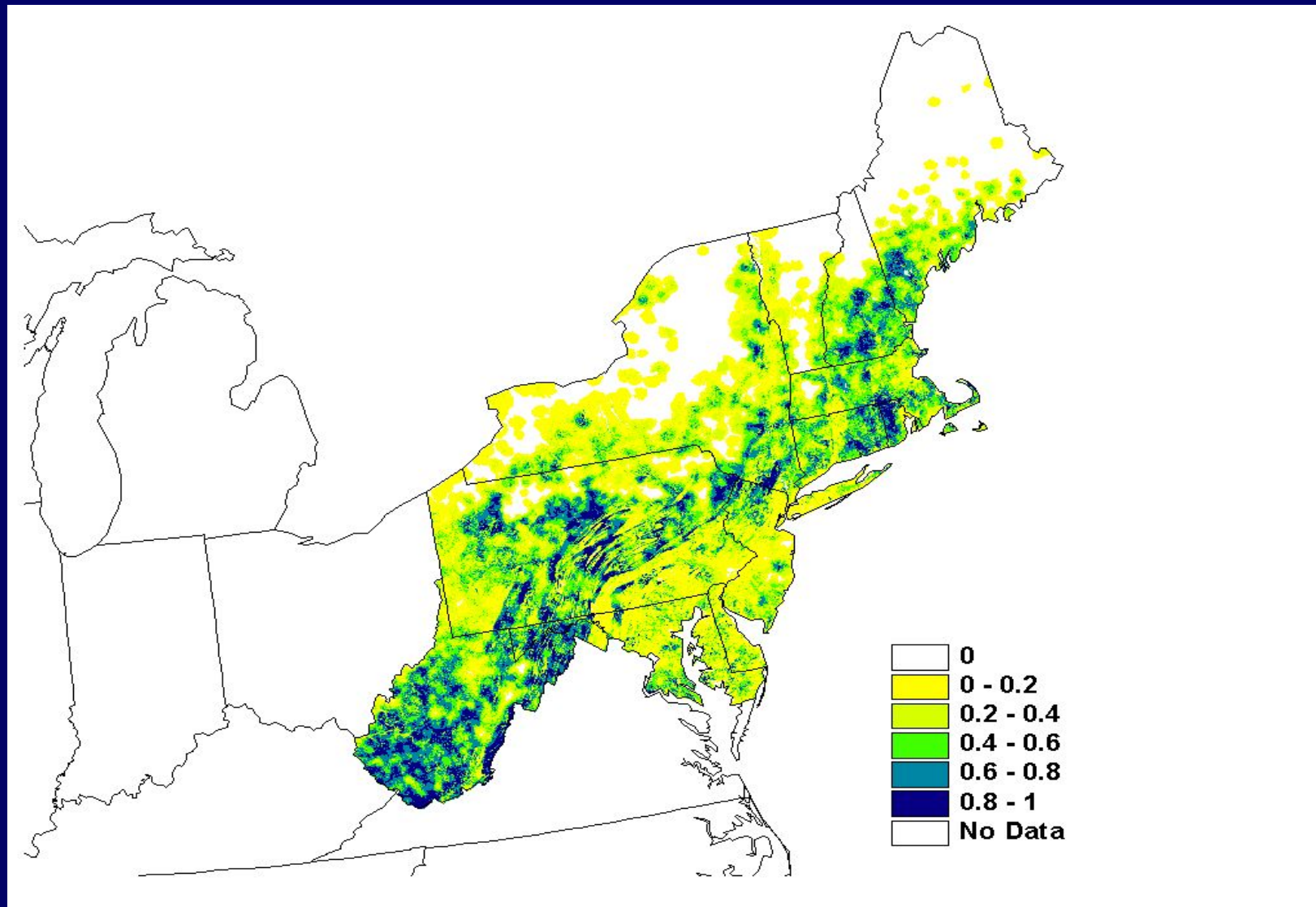
About this time, Sudden Oak Death hit the scene

- I heard a talk by David Rizzo on his tests of northern red oak and black oak
- I decided to use this approach to determine the risk to the East from SOD
- Our risk map went on to be used as the basis of the national SOD risk map
- We then added in the NE shrub data as an additional risk factor

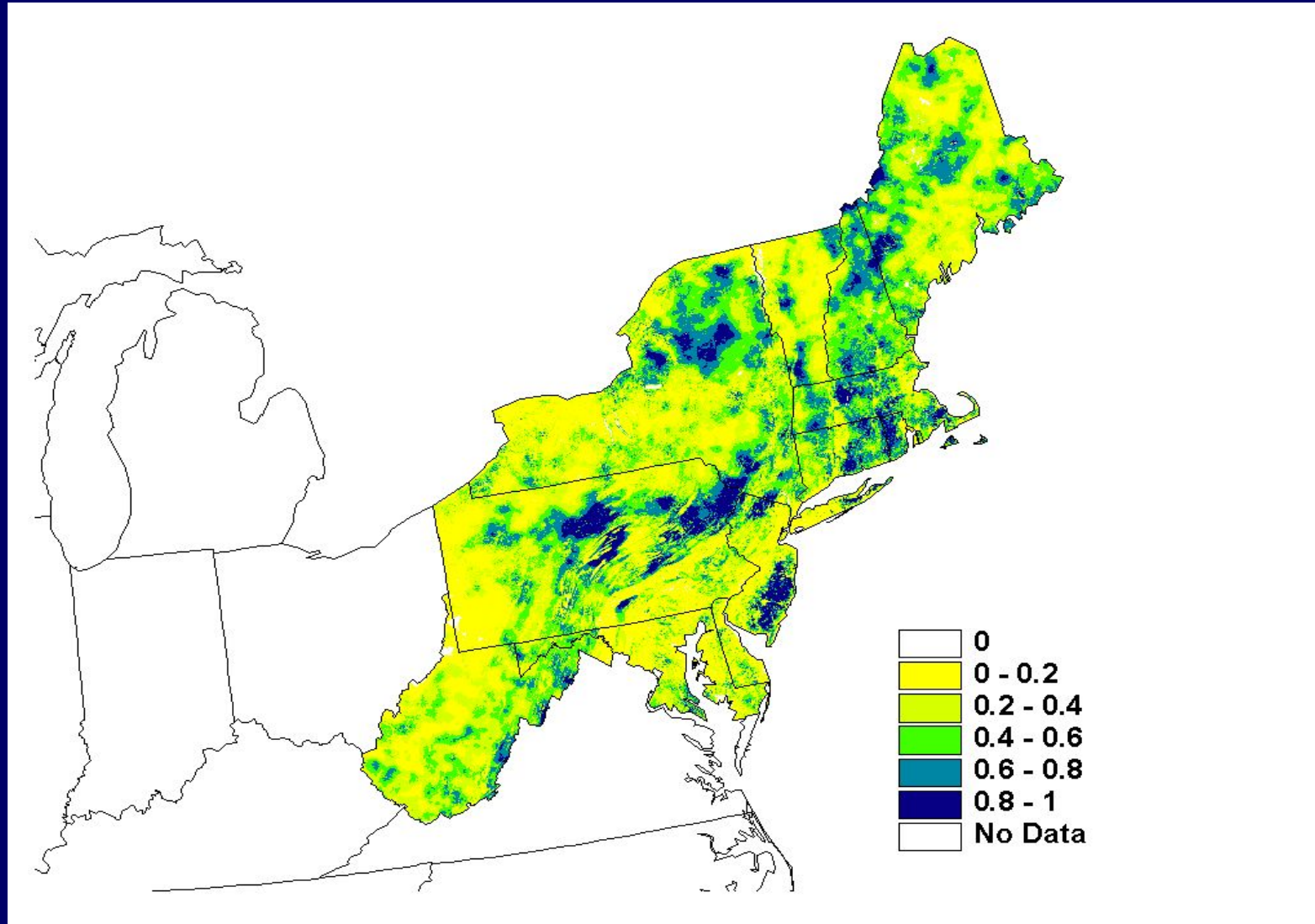


Kriged map of the estimated percent forest basal area for the red and live oak groups adjusted for forest density.

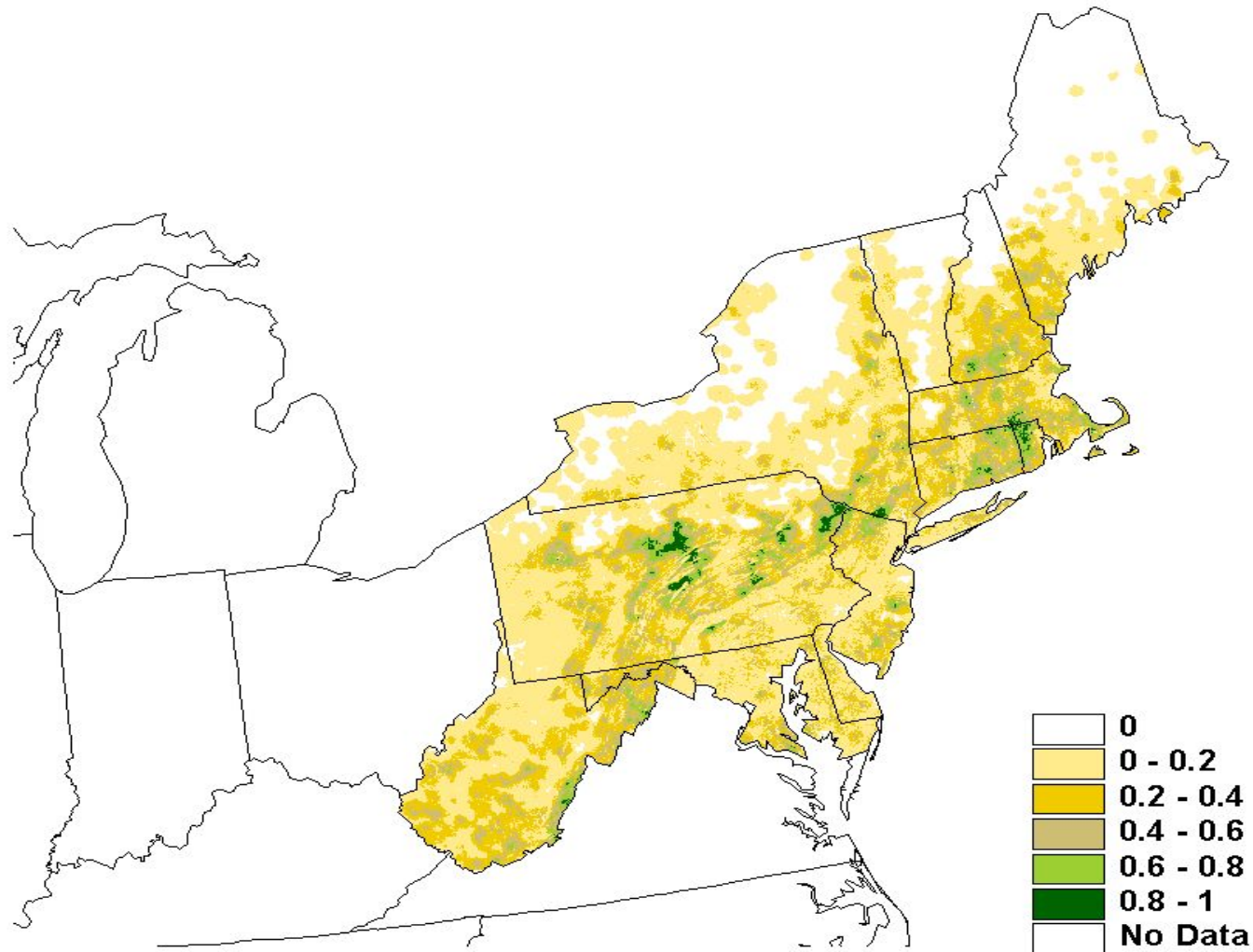
Kriged probability of overstory hosts of *Phytophthora ramorum*



Kriged probability of understory hosts of *Phytophthora ramorum*



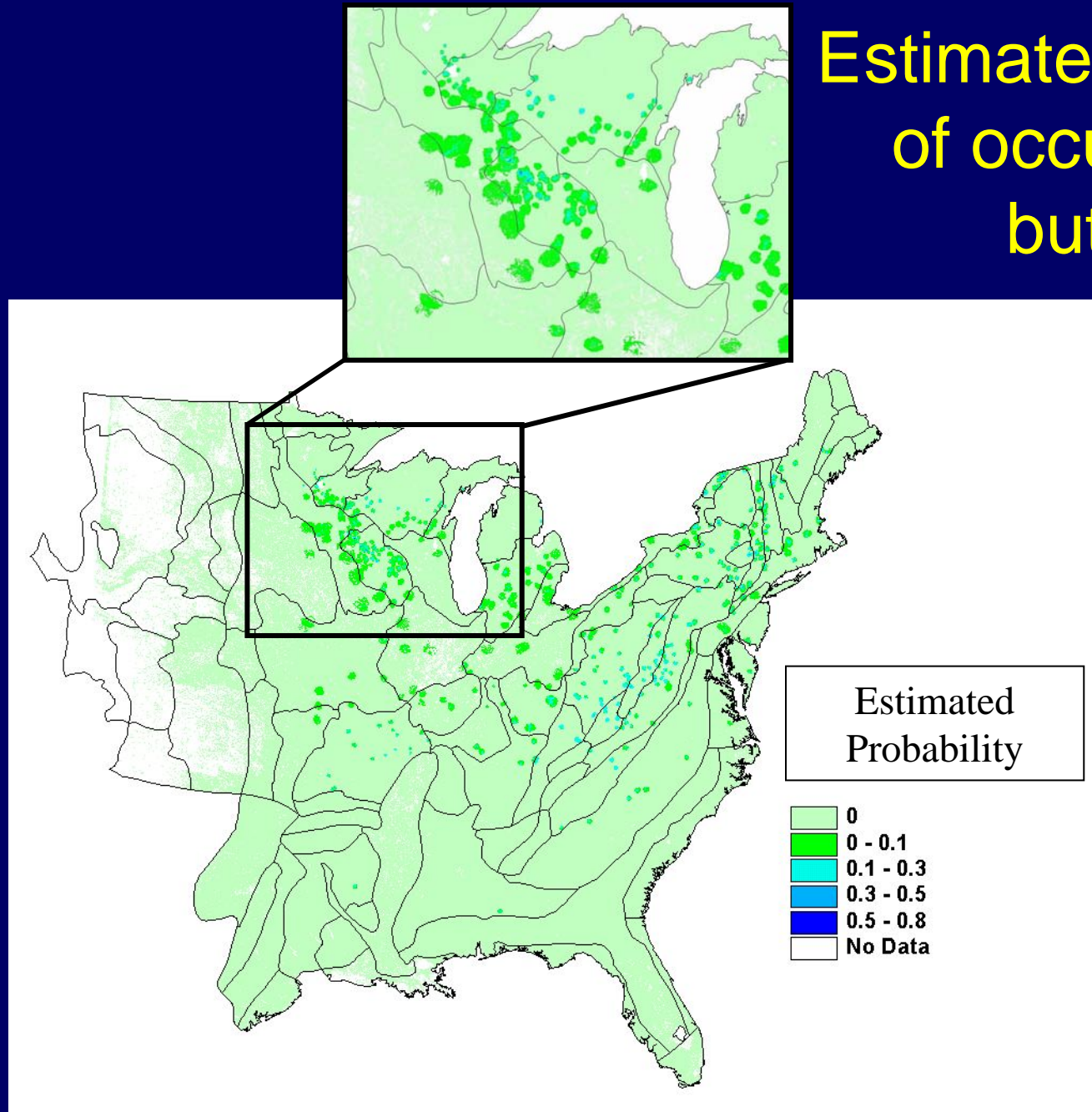
Probability of presence of overstory and understory hosts of *Phytophthora ramorum*



Forest Health Monitoring, Evaluation Monitoring Proposal on Butternut

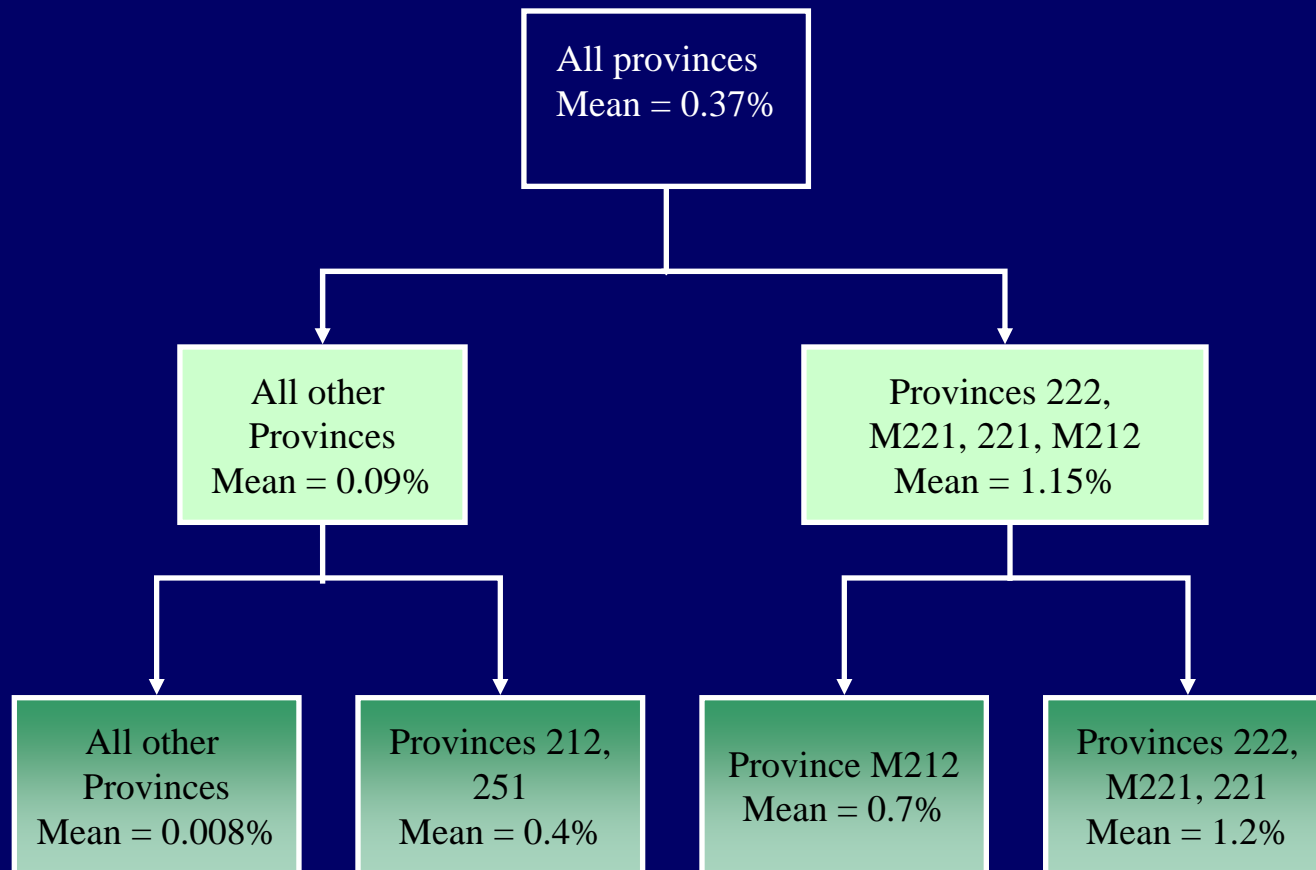
- Butternut canker has been devastating butternut
- However, Mike Ostry has some putative resistant genotypes
- If true resistance exists, then knowledge on where to restore butternut is needed
- We mapped the occurrence of all butternut (live and dead) and also analyzed by ecoregions and found out some interesting things

Estimated probability of occurrence of butternut



Butternut occurrence by ecoregion province.

Province	# of FIA Plots with Butternut	Total # of FIA Plots	% of Plots w/ Butternut
222	290	13862	2.09
221	88	6318	1.39
M221	74	5614	1.32
M212	28	2915	0.96
251	26	4156	0.63
212	142	24321	0.58
231	8	14064	0.06
232	2	13659	0.01
234	0	1267	0.00
255	0	615	0.00
331	0	158	0.00
332	0	461	0.00
411	0	50	0.00
M222	0	474	0.00
M231	0	753	0.00



A CART analysis of province-level proportion of plots with butternut produced four significantly different groups.

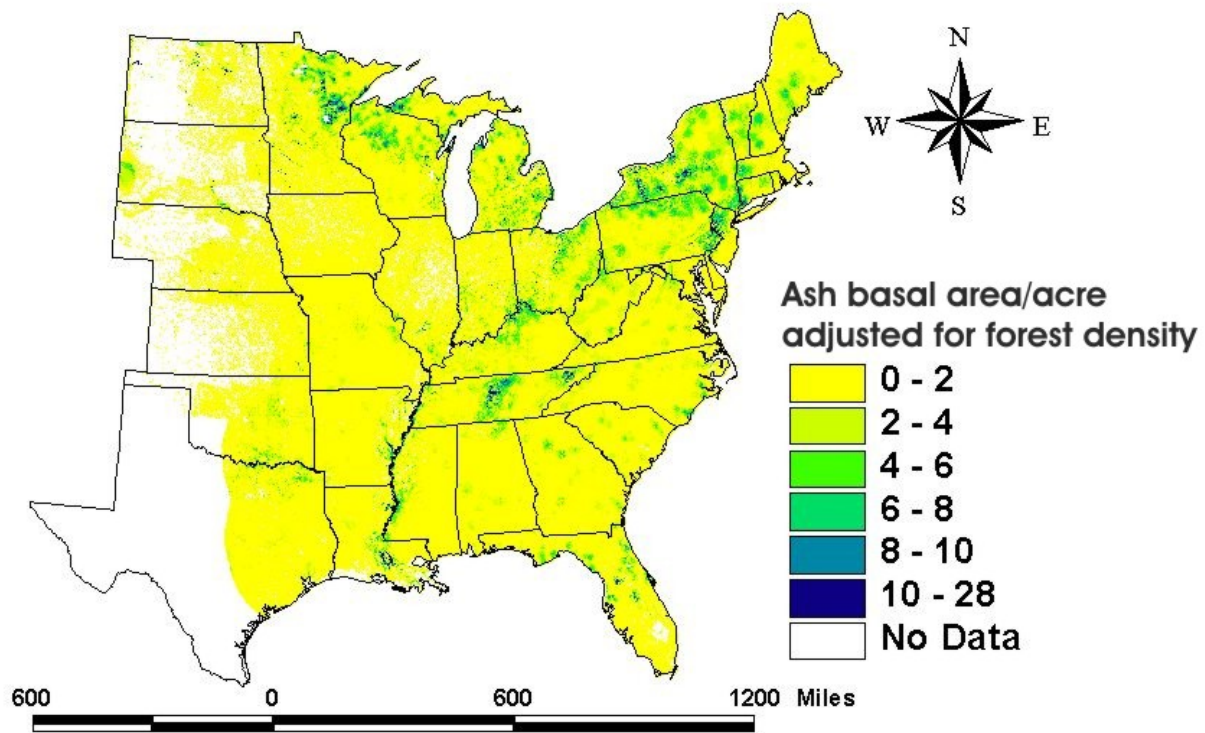
Butternut occurrence by ecoregion section.

Section	# of FIA Plots with Butternut	Total # of FIA Plots	% of Plots w/ Butternut
222L	132	1211	10.90
212E	14	219	6.39
221B	15	343	4.37
222M	46	1342	3.43
222H	15	514	2.92
222I	16	563	2.84
222J	28	1006	2.78
212F	32	1330	2.41
212K	33	1428	2.31
251B	5	226	2.21
M212C	10	484	2.07
221F	10	485	2.06
M221B	18	919	1.96
M221C	10	559	1.79
M221A	40	2387	1.68

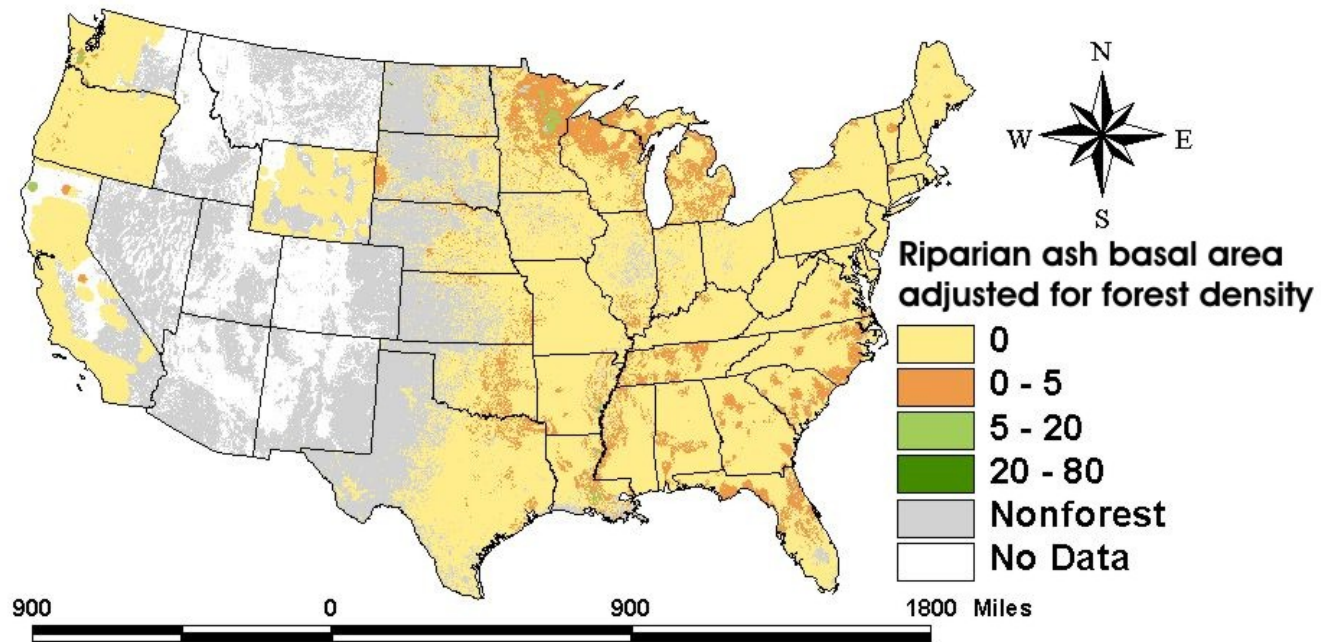
State & Private wanted an Emerald Ash Borer Risk Map

- Based on our success creating the SOD risk map, an EAB risk map was requested
- We did two different host layers for this map – an upland ash layer based primarily on FIA plots and a lowland ash layer based on FIA plots and other factors

Risk to Emerald Ash Borer based on Forests



Riparian ash host risk to EAB



Summary

- Over time, we have increased our ability to create realistic estimates of species occurrences that allows us to estimate invasive pest risk
- Given the host species range, we can produce a host risk map for almost any forest pest
- We have used only periodic FIA data so far – the challenge ahead is to figure out how to incorporate annual FIA data into this system