Annual Gypsy Moth Review, 7-9 November 2017, Savannah, GA

Three hundred million dead trees and counting: the worsening impact of laurel wilt on redbay

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Background: Redbay Ambrosia Beetle

- *Xyleborus glabratus*
- Native to Asia
- Discovered near Savannah in 2002
- Attacks plants from Lauraceae family
- Prominent North American hosts:
  - Redbay (*Persea borbonia*)
  - Sassafras (*Sassafras albidum*)

Michael C. Thomas, Florida Department of Agriculture and Consumer Services, Bugwood.org

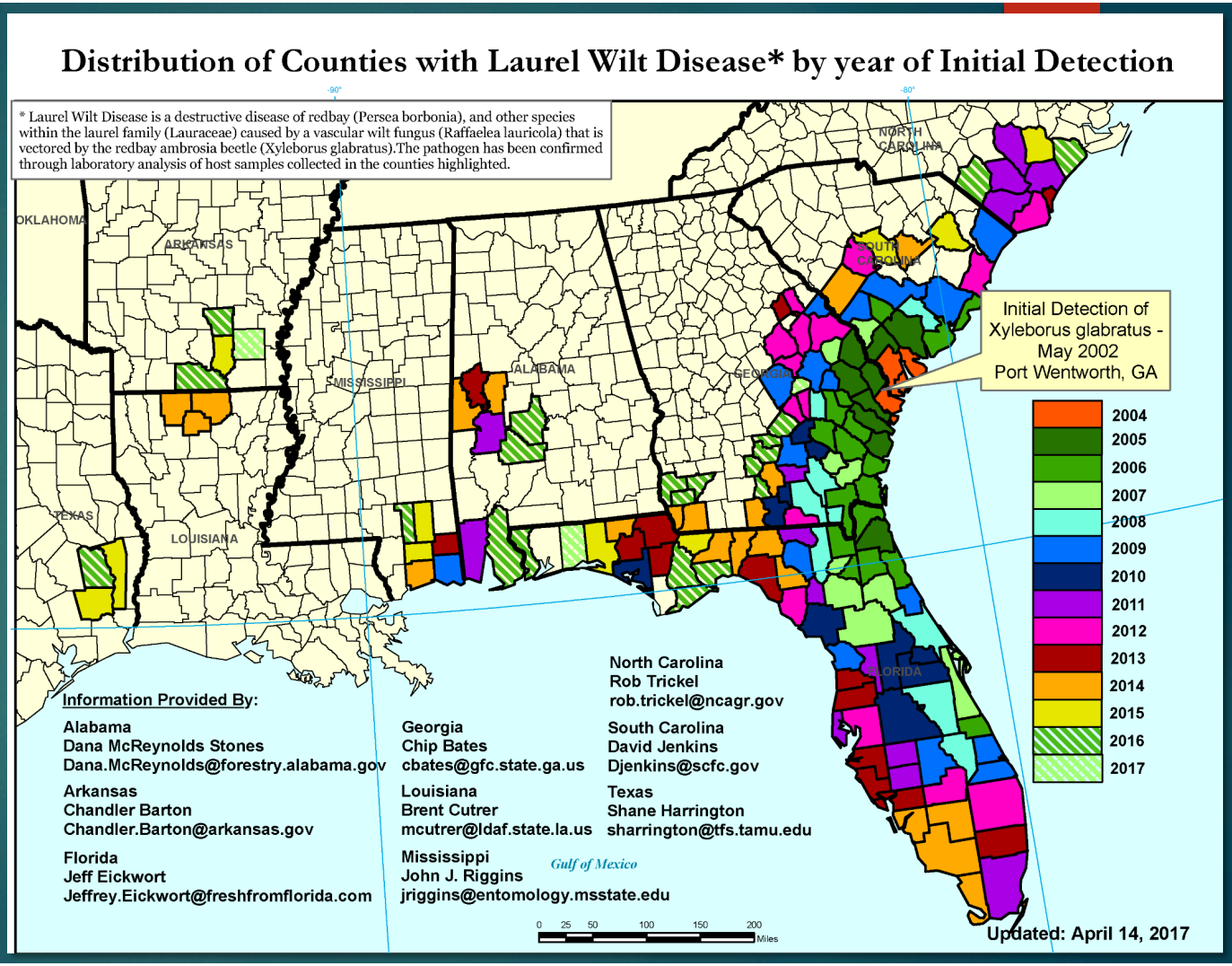
Background: Laurel Wilt

- Vascular wilt disease
- Caused by fungal symbiont, *Raffaelea lauricola*
- Rapid host mortality
- Has been particularly devastating to redbay

www.dontmovefirewood.org

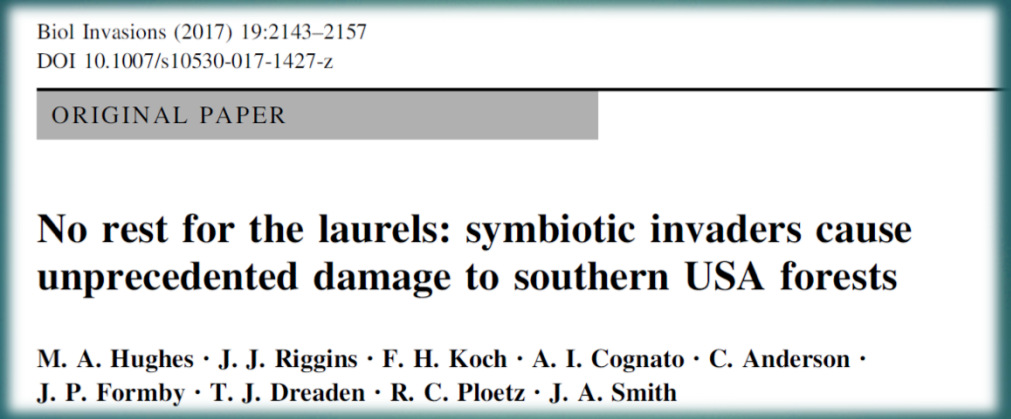
Albert (Bud) Mayfield, USDA Forest Service, Bugwood.org

…and has spread widely since 2002…



Quantifying Laurel Wilt Impact

- First addressed topic for recent journal article



Biol Invasions (2017) 19:2143–2157
DOI 10.1007/s10530-017-1427-z

ORIGINAL PAPER

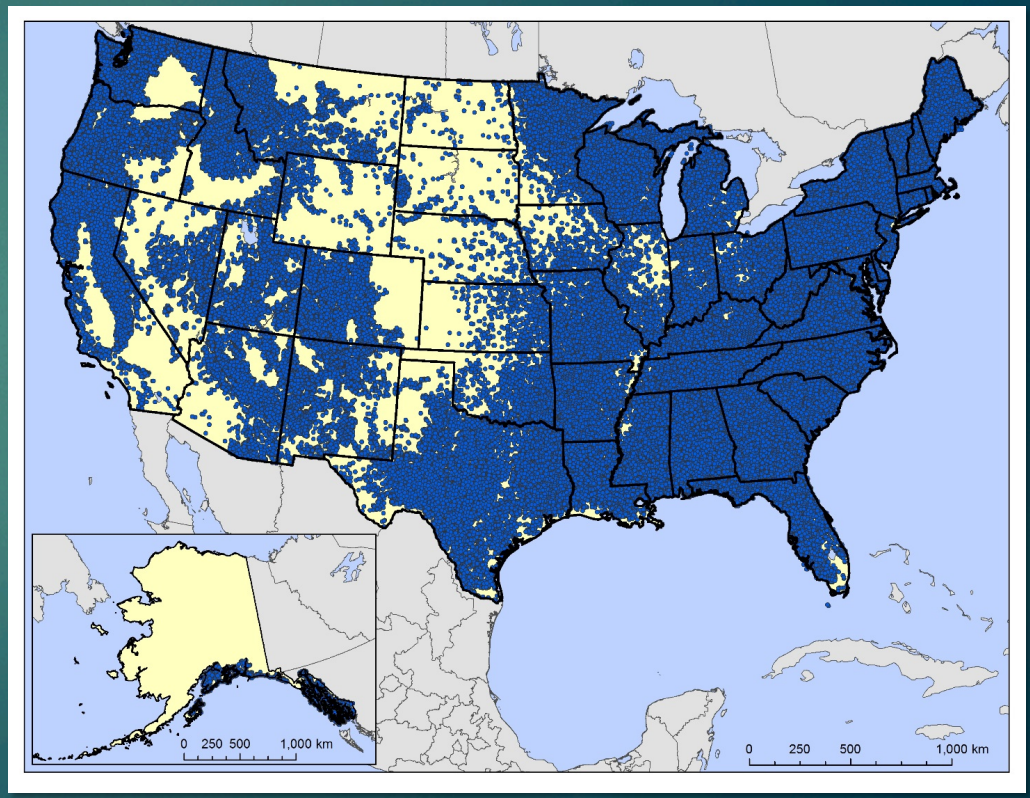
No rest for the laurels: symbiotic invaders cause unprecedented damage to southern USA forests

M. A. Hughes · J. J. Riggins · F. H. Koch · A. I. Cognato · C. Anderson · J. P. Formby · T. J. Dreaden · R. C. Ploetz · J. A. Smith

- Q: How many trees killed?
  - Never quantified for redbay or any other host
- Answered using Forest Inventory and Analysis data

Forest Inventory and Analysis (FIA)

- Nationwide plot system
- "Annualized" surveys, by state
  - Percentage of plots surveyed each year
- Full inventory cycle every 5-7 years
- 1 plot per ~6000 acres
  - Expansion factors to generate regional estimates



Impact Estimation Methods

- Redbay trees on FIA plots
- Compare plots between two inventory periods
  - Pre-invasion
  - "Current" = most recent inventory cycle(s)
- Estimate at state level
  - Current live and dead redbay populations
  - How much of current live population = new growth since pre-invasion period

Impact Estimation Methods

- Complication: not all dead trees killed by laurel wilt
- How to determine cause of death?
  - Filter using FIA attribute field *agentcd*
  - Adjust estimates accordingly

agentcd labels:

- Insect
- Disease

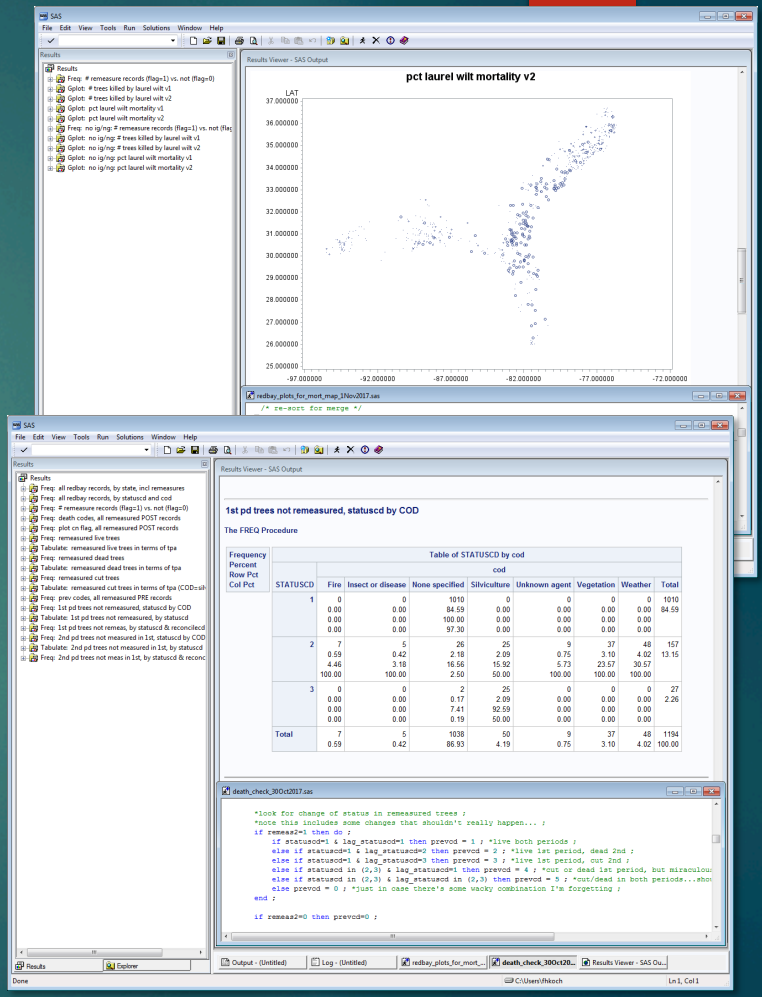
Assume all killed by laurel wilt

- Animal
- Weather
- Vegetation
- Fire
- Silviculture / land clearing
- Uncertain

Assume some actually killed by laurel wilt

New Impact Analysis

- Redid analysis from *Biological Invasions* article
- Included recent FIA data for each state in redbay range
  - Shifted current inventory period forward 1-2 years
- Evaluated differences in results
  - Changes in mortality per state
  - Changes in geographic pattern



State	Laurel wilt first reported	Pre-invasion inventory period	Current inventory period
AL	2011	2001-2005	2011-2017
FL	2005	2002-2004	2011-2015
GA	2004	2001-2004	2011-2015
LA	2014	2001-2005	**2009-2015**
MS	2009	**2006**	2010-2016
NC	2011	2003-2007	2011-2016
SC	2004	2002-2004	2012-2016
TX	2015	2004-2008	**2012-2016**
VA	n/a	2002-2003, 2005, 2007	**2011-2015**

Current inventory period shifted 2 years forward from previous analysis

Current inventory period shifted 1 year forward from previous analysis

Results

State	Total Live Redbay Trees × 1 M (SD)	Total Dead Redbay Trees × 1 M (SD)	Redbay Likely Killed by Laurel Wilt × 1 M (SD)
AL	36.1 (7.2)	23.4 (5.8)	0.5 (0.1)
FL	122.9 (11.3)	111.2 (12.7)	87.4 (10.8)
GA	97.1 (11.7)	147.9 (18.7)	134.8 (17.3)
LA	10.8 (3.2)	8.9 (3.3)	0.0 (0)
MS	61.5 (11.9)	14.3 (3.8)	3.9 (1.5)
NC	261.3 (23.3)	143.5 (15.8)	23.1 (3.8)

Regional totals from previous analysis:

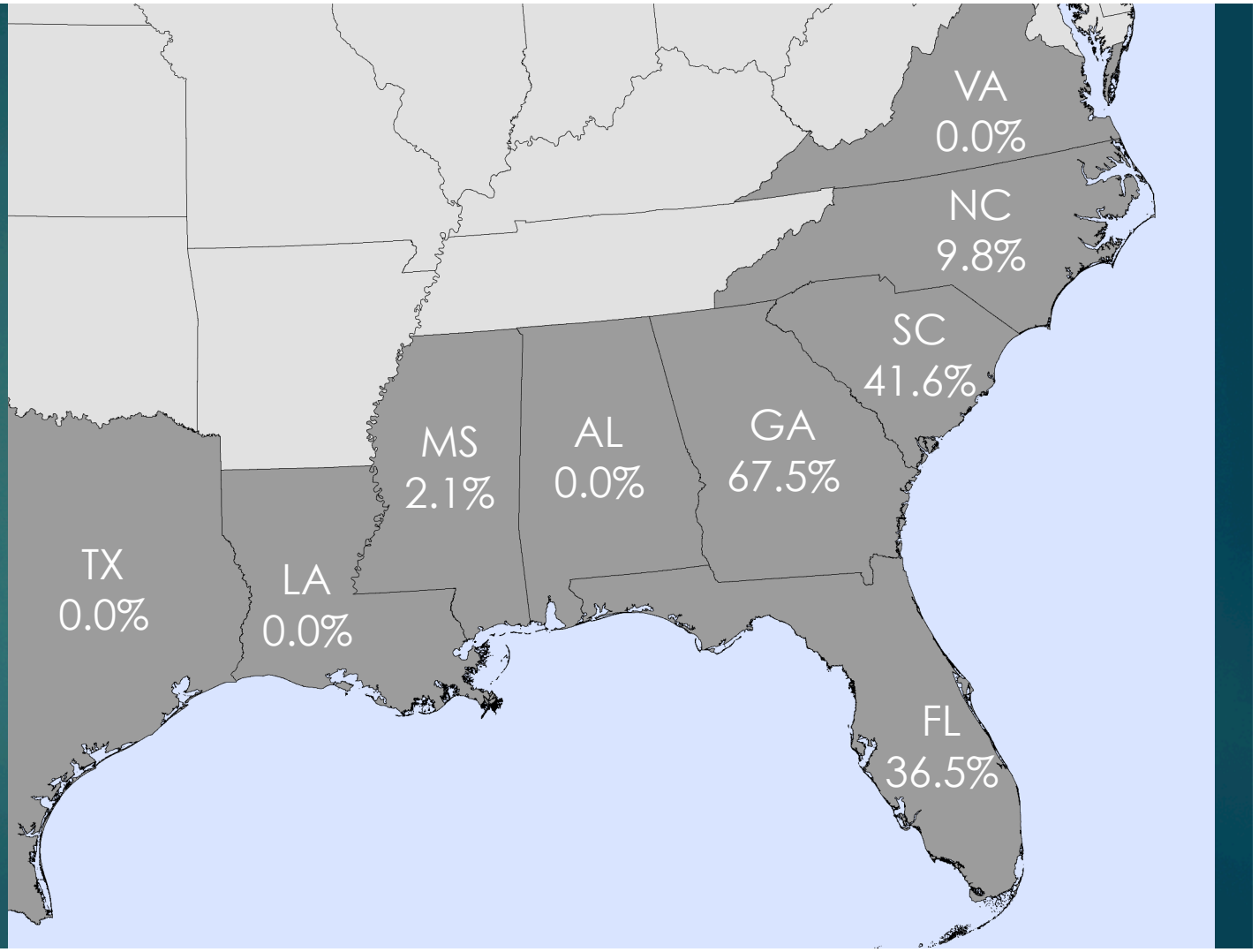
Total	***779.7 (37.8)***	***560.7 (32.8)***	***316.3 (23.1)***
Total	***742.8 (35.2)***	***591.9 (31.7)***	***330.9 (22.8)***

Current inventory period, live tree totals include new growth

Previous Analysis

Percent laurel wilt mortality of pre-invasion redbay (i.e., excluding new growth)

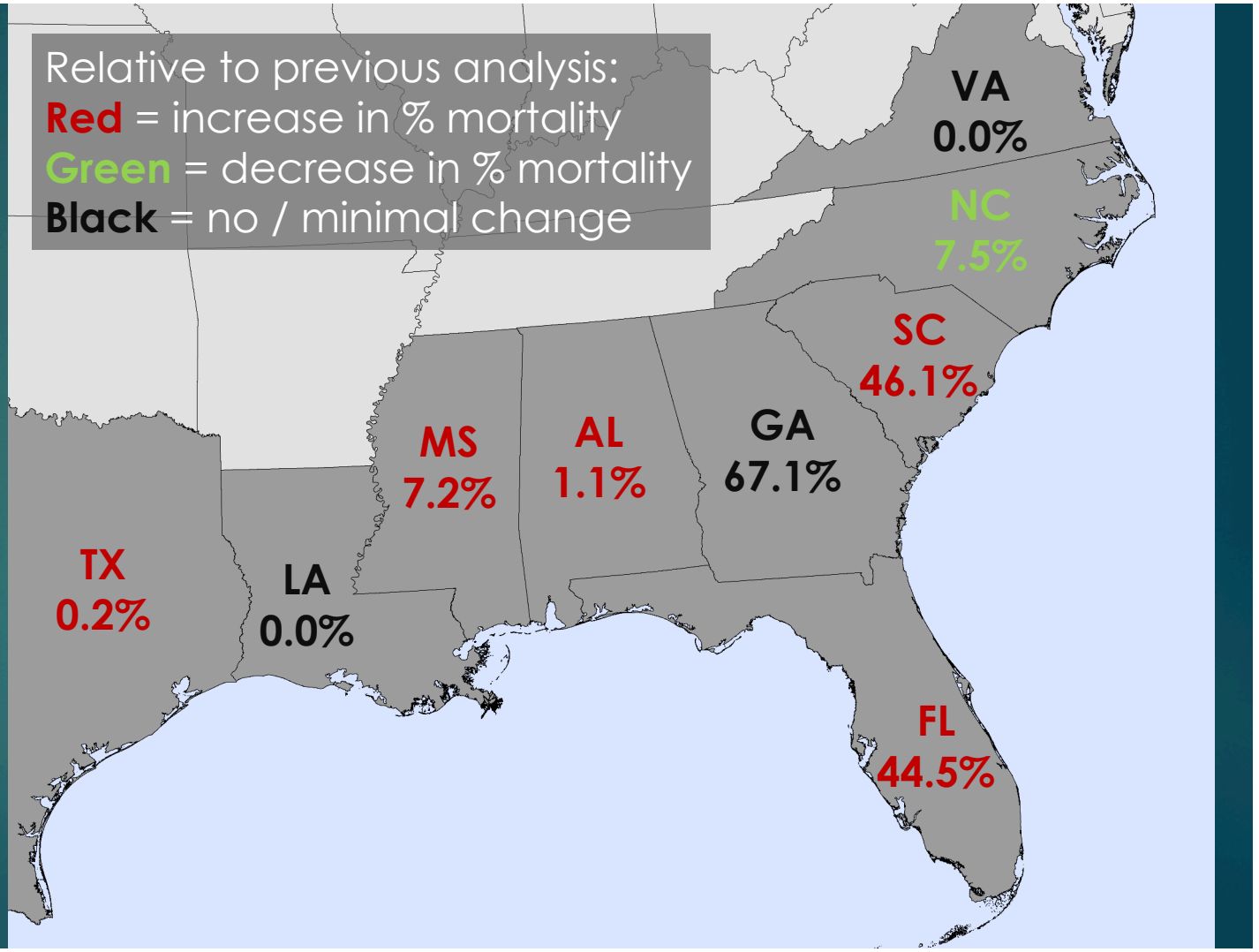
Range-wide: **29.9%**



New Analysis

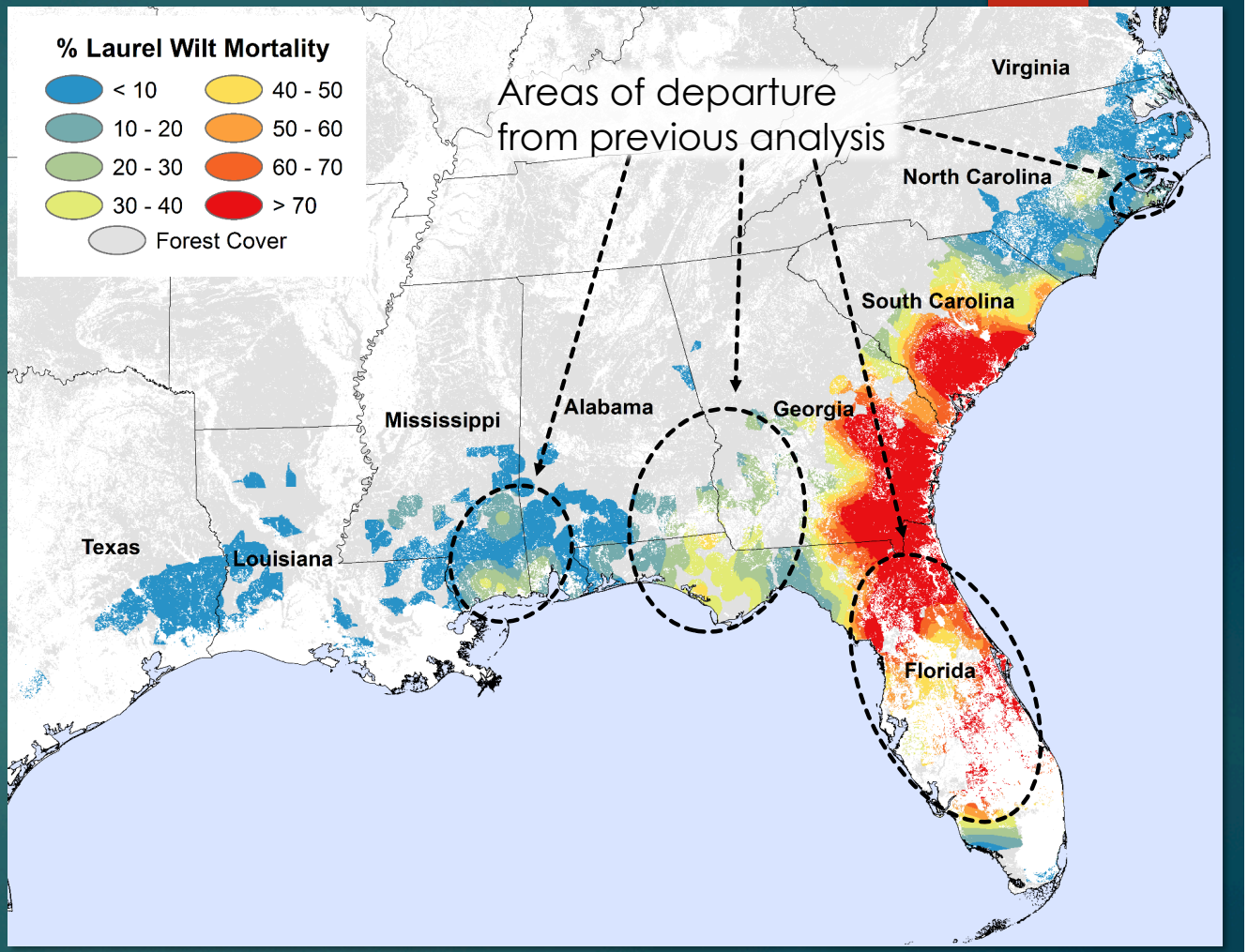
Percent laurel wilt mortality of pre-invasion redbay (i.e., excluding new growth)

Range-wide: **31.2%**



Interpolated Maps

- Ordinary kriging of plots with redbay
  - Only plots measured in both inventory periods
    - *N* = 620
- 2nd-order polynomial trend removed
- Spherical semivariogram
- Minimum 10, maximum 20 neighbors



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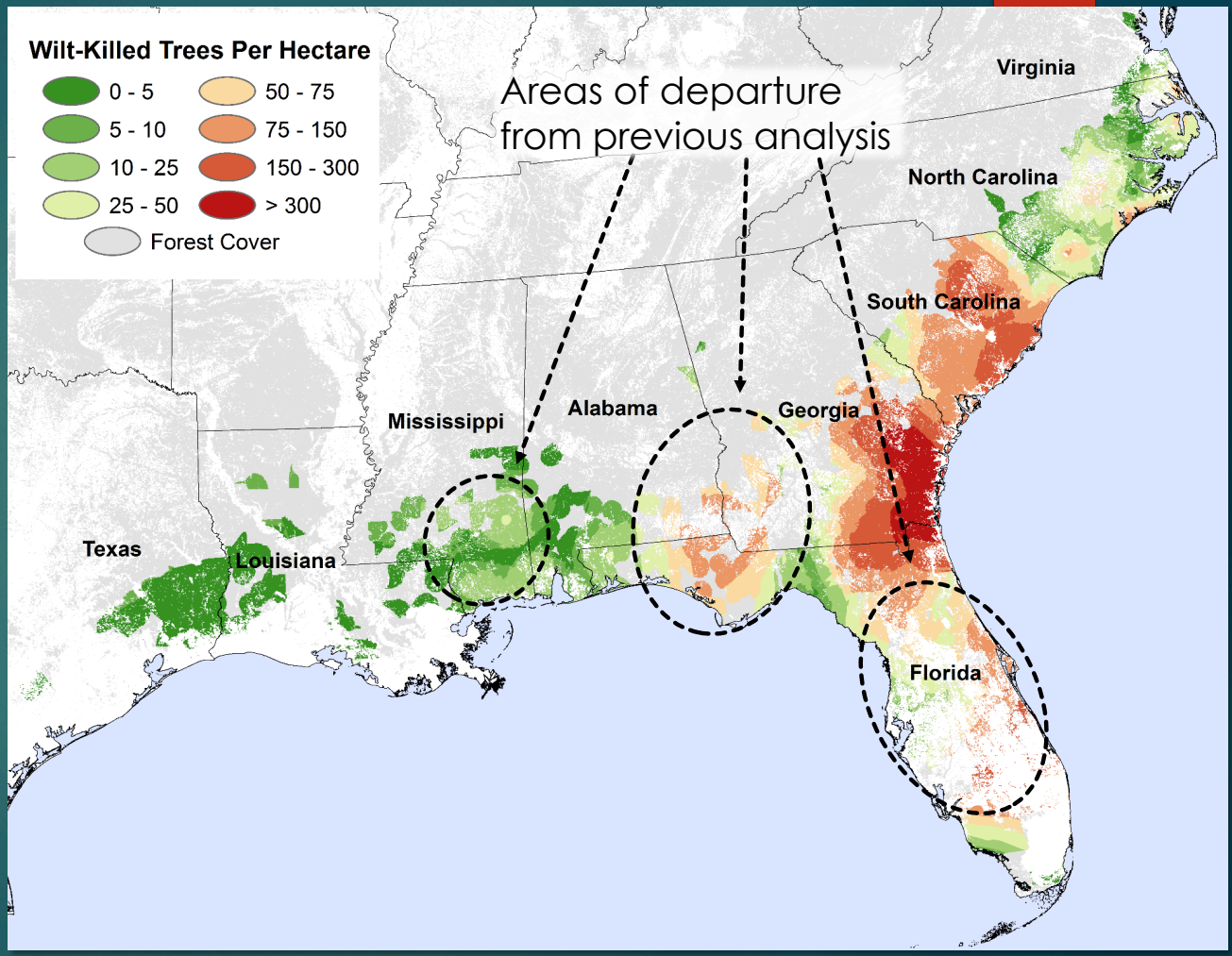
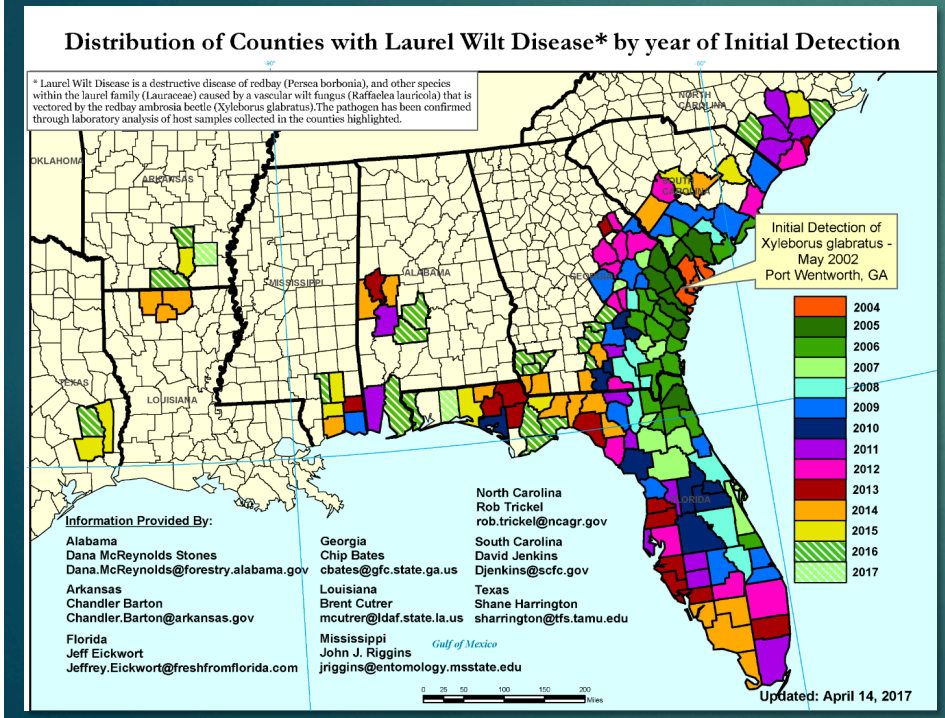
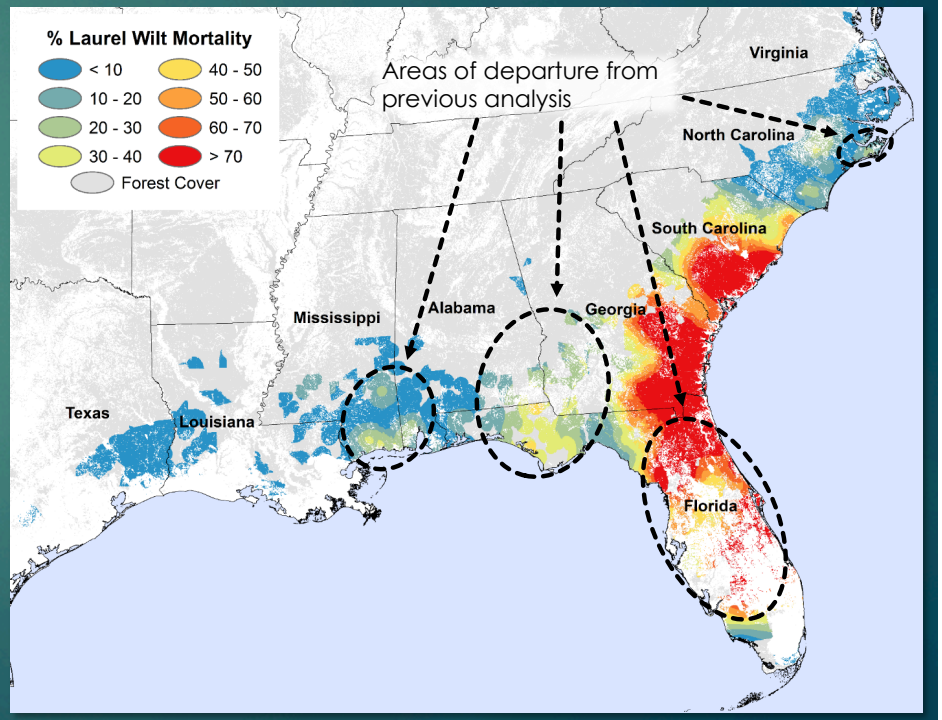


Parallels / Differences Between FIA Results and Initial Detection Map





Take-Home Points

- Re-emphasizes that FIA data can be used for impact analysis
  - Comes with some caveats
- Data show that redbay loss has been severe, extensive, and rapid
  - Roughly 330 million trees killed
  - Nearly1/3 of pre-invasion redbay population
- Shifting analysis window forward just 1-2 years reveals worsening impacts