An Ecological Condition Model for the Apalachicola National Forest

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National Forests in Florida

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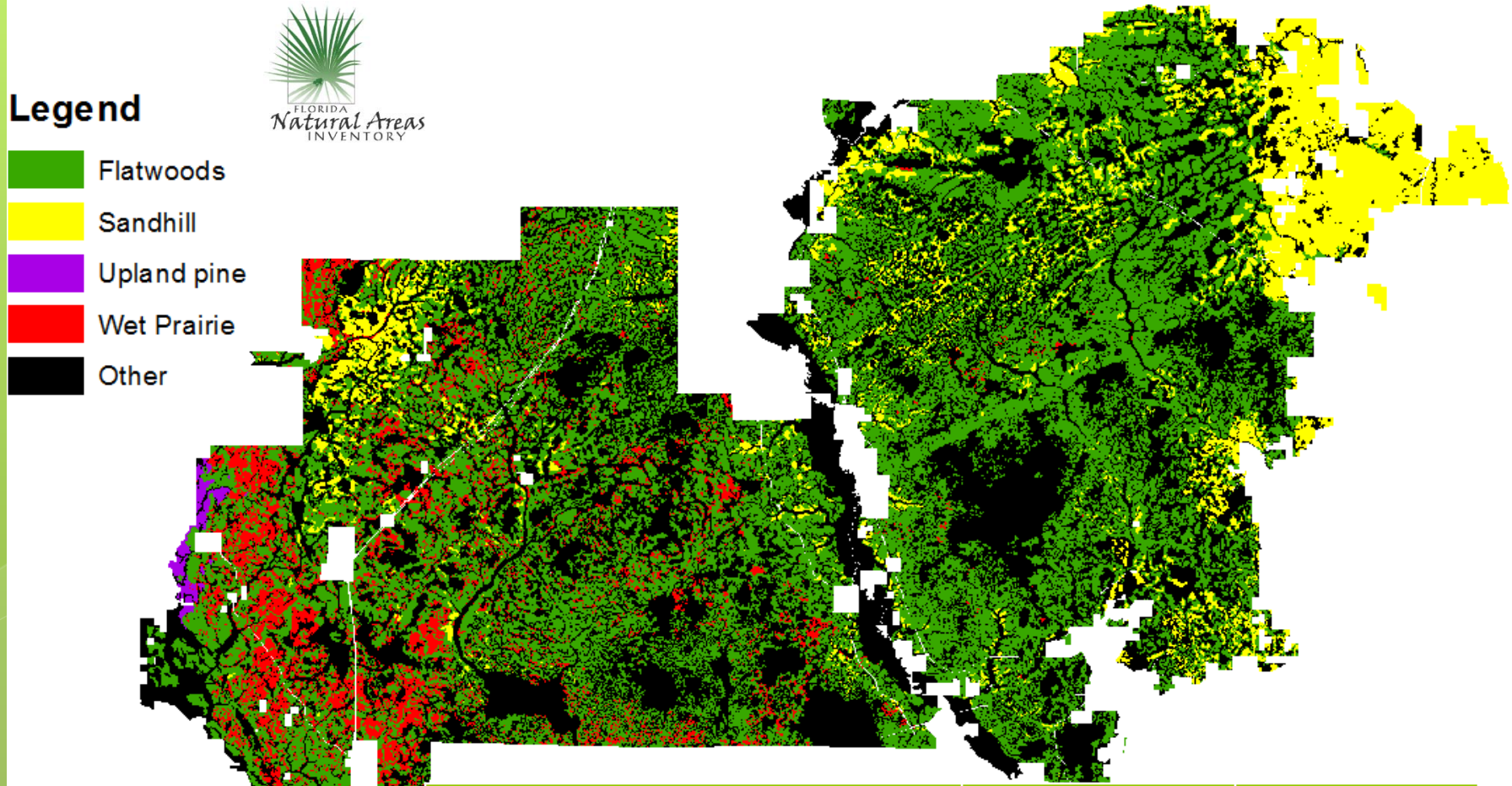
- Approximately 1.2 million acres
- Over 500,000 acres of longleaf pine (current or historical natural communities)

Management priorities

Historical natural communities



Historical Natural Community	Area (acres)	Percent
Flatwoods (includes wet and mesic flatwoods)	247,156	43.2%
Sandhill	54,289	9.5%
Wet savanna	36,705	6.4%
Upland pine	1,631	0.3%
Freshwater forested wetlands	230,849	40.4%
Other	<1,000	0.2%

Ecological condition model (ECM)

- Geospatial model developed to quantify current ecological condition of the forest's longleaf natural communities
  - Integrates best available information from GIS, remote sensing and field sources
  - Combines data to generate a simple condition score (1-5) for ~0.5ac map cells across the forest

- Potential applications of the model:
  - Inform strategic management decisions
  - Identify specific restoration needs for species or ecological integrity (i.e., structure, composition, function, connectivity)

Evaluating condition

- Condition Class
  - Tier 1: Established vegetation (often old growth) in desired conditions, maintained with prescribed fire
  - Tier 2: Good condition, maintained with prescribed fire
  - Tier 3: Fair condition, transitional, some restoration followed by prescribed fire
  - Tier 4: Poor condition, multiple restoration activities required
  - Tier 5: Very poor condition, substantial restoration required

- Specific for each historic natural community type
  - e.g., 40-80 BA is within NRV for flatwoods, but not for wet prairie/savanna

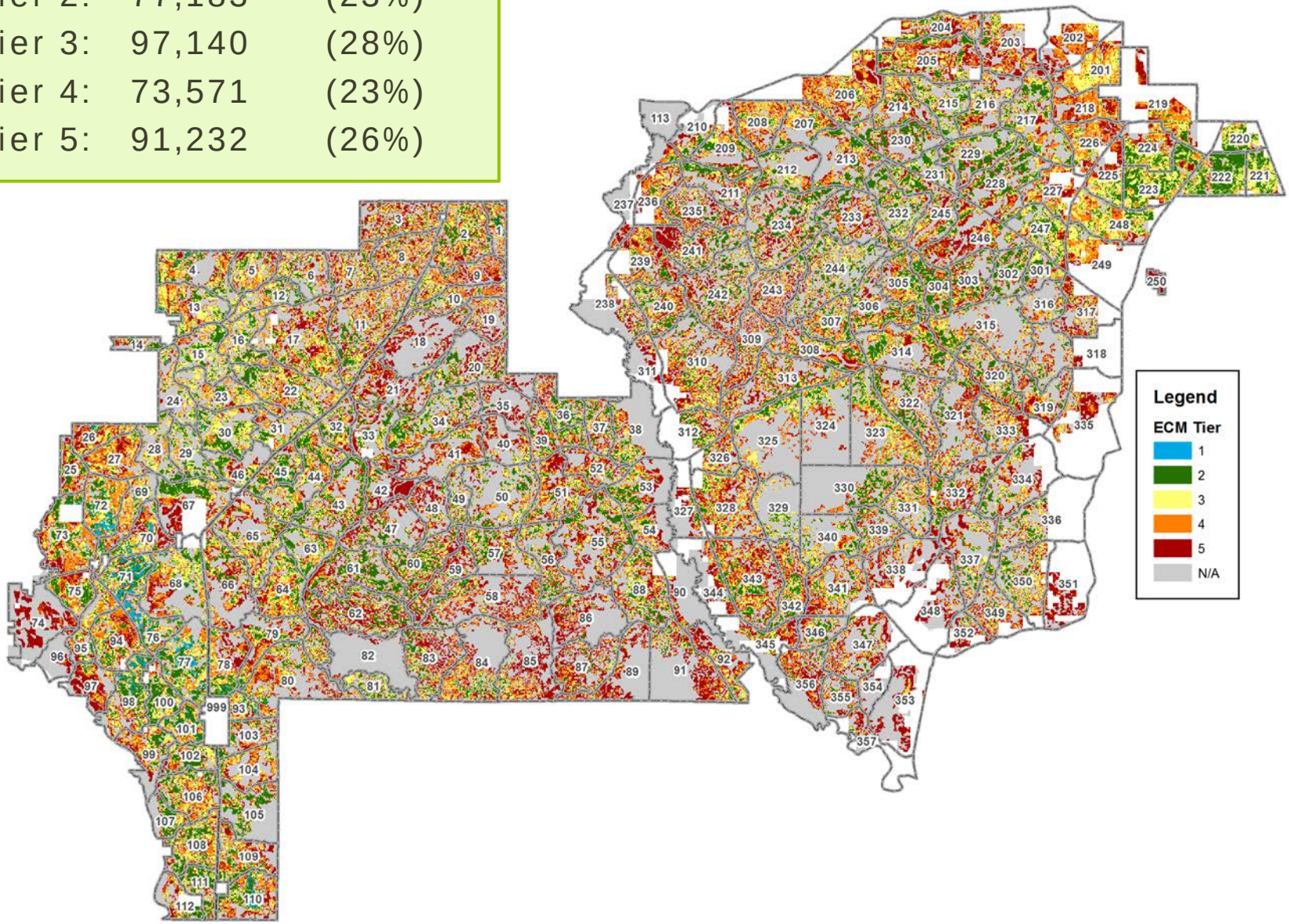
Condition scores for flatwoods

Condition scores for sandhills

Condition scores for wet prairies

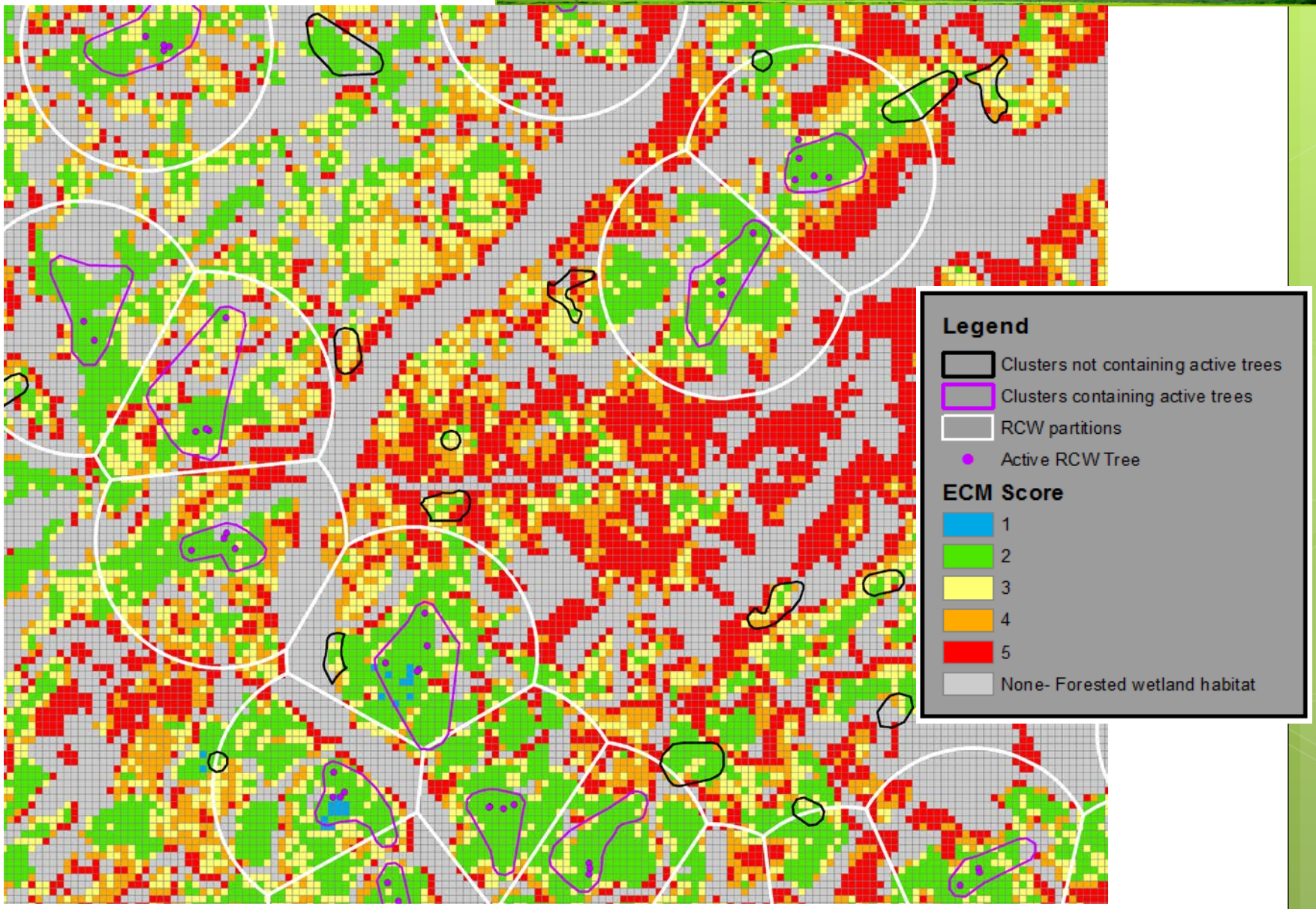
Condition scores

Tier 1:	1,952 ac	(0.6%)
Tier 2:	77,183	(23%)
Tier 3:	97,140	(28%)
Tier 4:	73,571	(23%)
Tier 5:	91,232	(26%)

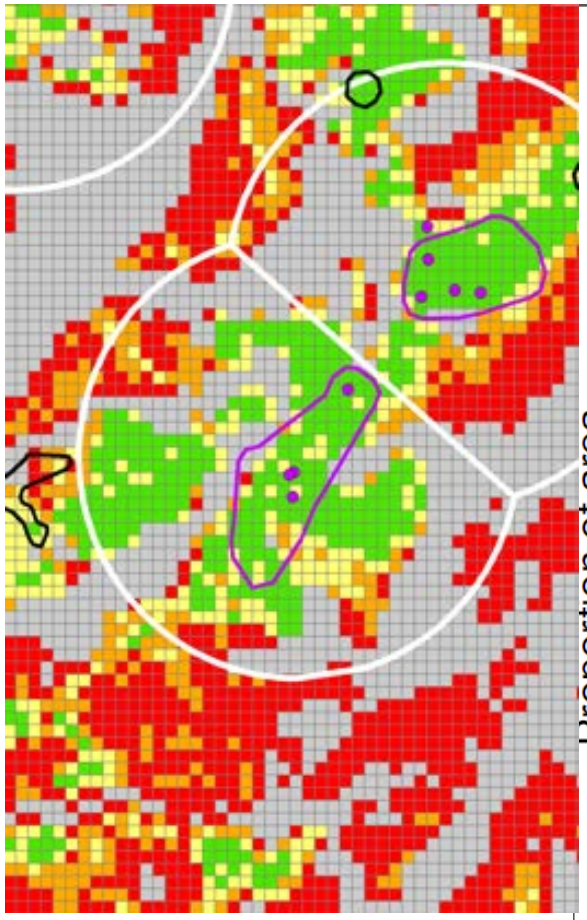


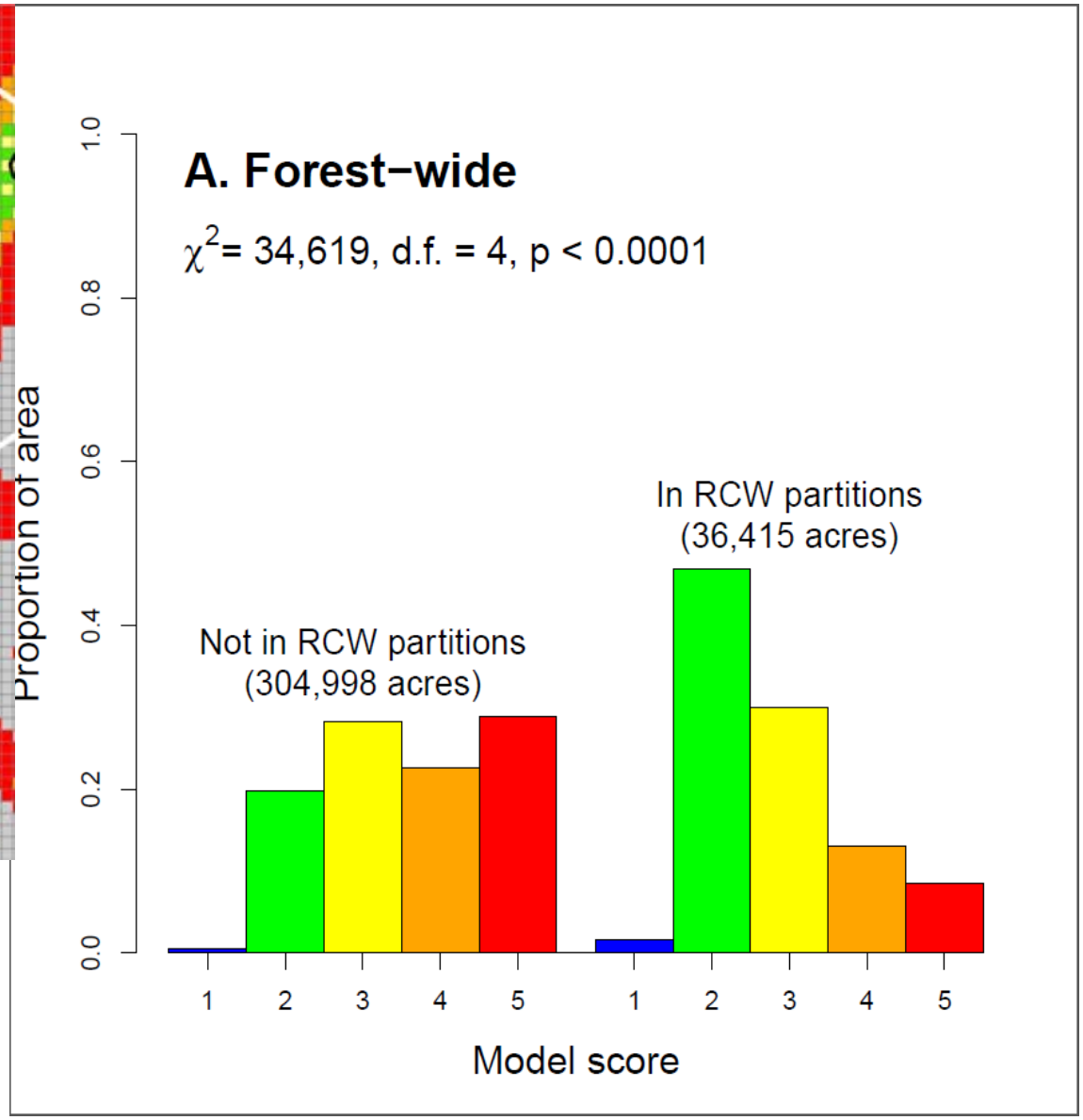
Red-cockaded woodpecker habitat use

Spatial structure of territories

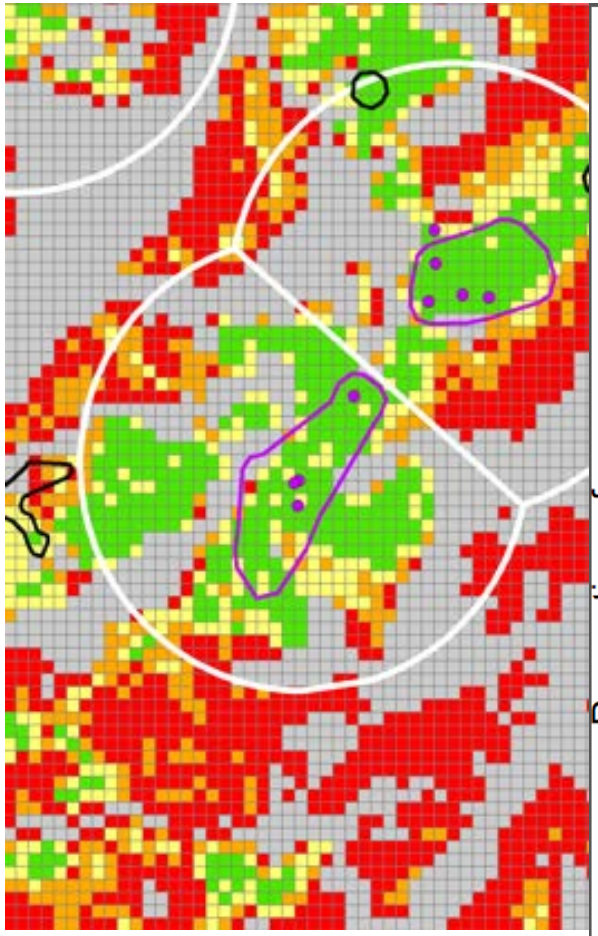


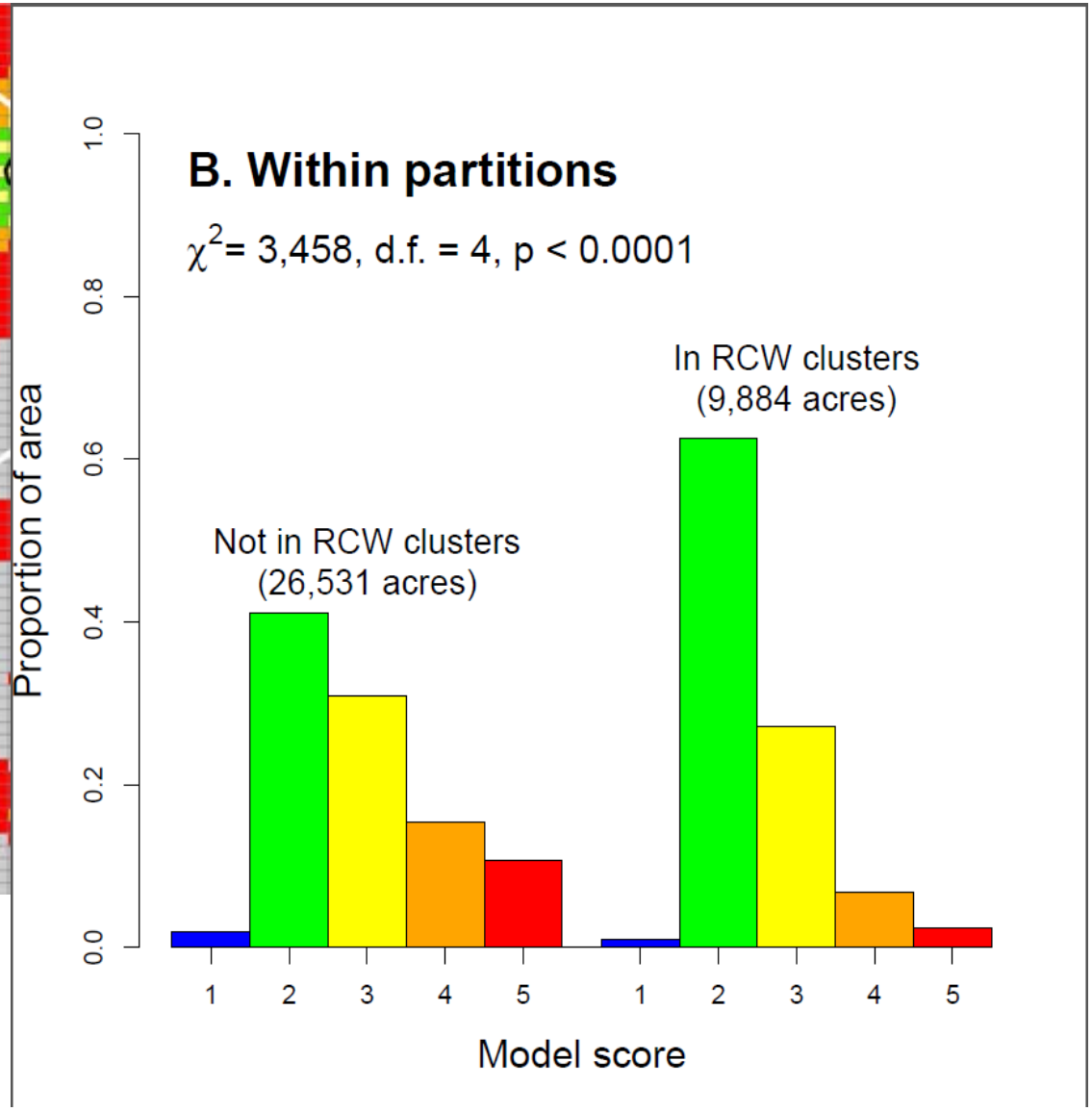
Foraging partitions



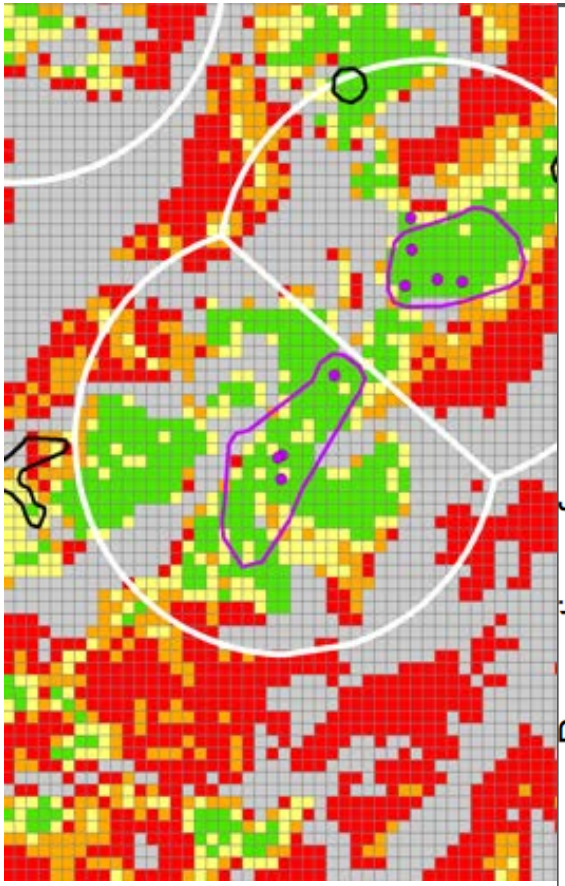


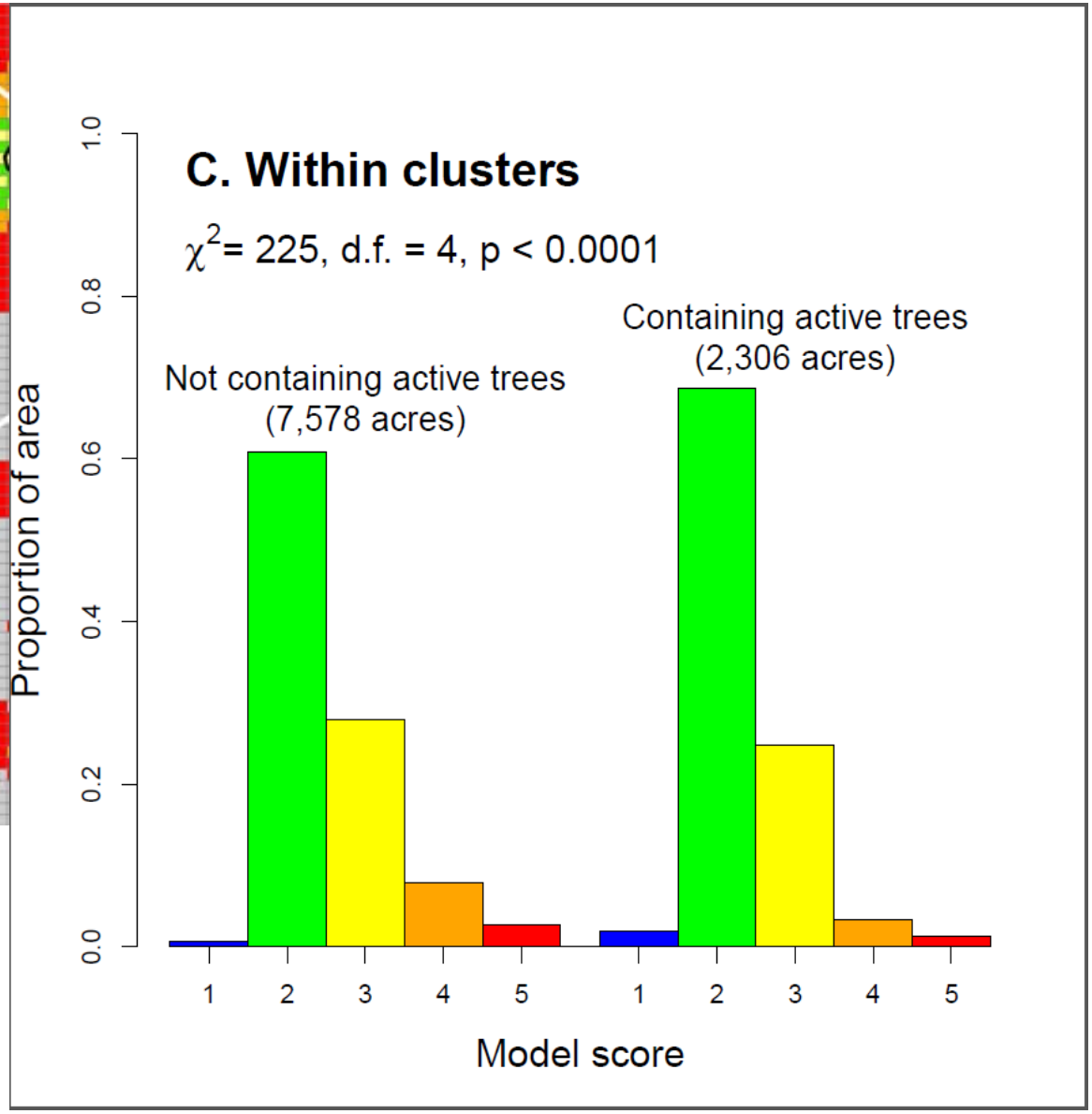
Clusters




B. Within partitions
χ^2= 3,458, d.f. = 4, p < 0.0001
Not in RCW clusters
(26,531 acres)
In RCW clusters
(9,884 acres)
Proportion of area
0.0
0.2
0.4
0.6
0.8
1.0
1
2
3
4
5
1
2
3
4
5
Model score

Active cavity trees





What the woodpeckers say

- ECM scores align well with habitat characteristics important for RCW
- Practical applications for RCW management:
  - Identify areas where unknown clusters are most likely to be present
  - Identify areas where recruitment clusters are most likely to be successful
  - Identify areas where restoration (thinning or fire) would improve and connect RCW territories
- Because RCW are considered representative of many other longleaf pine species, results suggest that ECM is a useful tool for evaluating overall ecosystem condition

Building an ecological condition model

- Identifying reference conditions is a critical first step
  - If you don’t know what was there, how do you know your actions are restoration?
- Condition scores should be scalable from landscape to project (or smaller)
- Methods may be complex, but results should be simple to provide common ground for stakeholders to understand the current conditions and rationale for management actions
- The most useful models will be robust to ground-truthed data and can accommodate changes due to management or other processes that affect conditioon.

Questions?

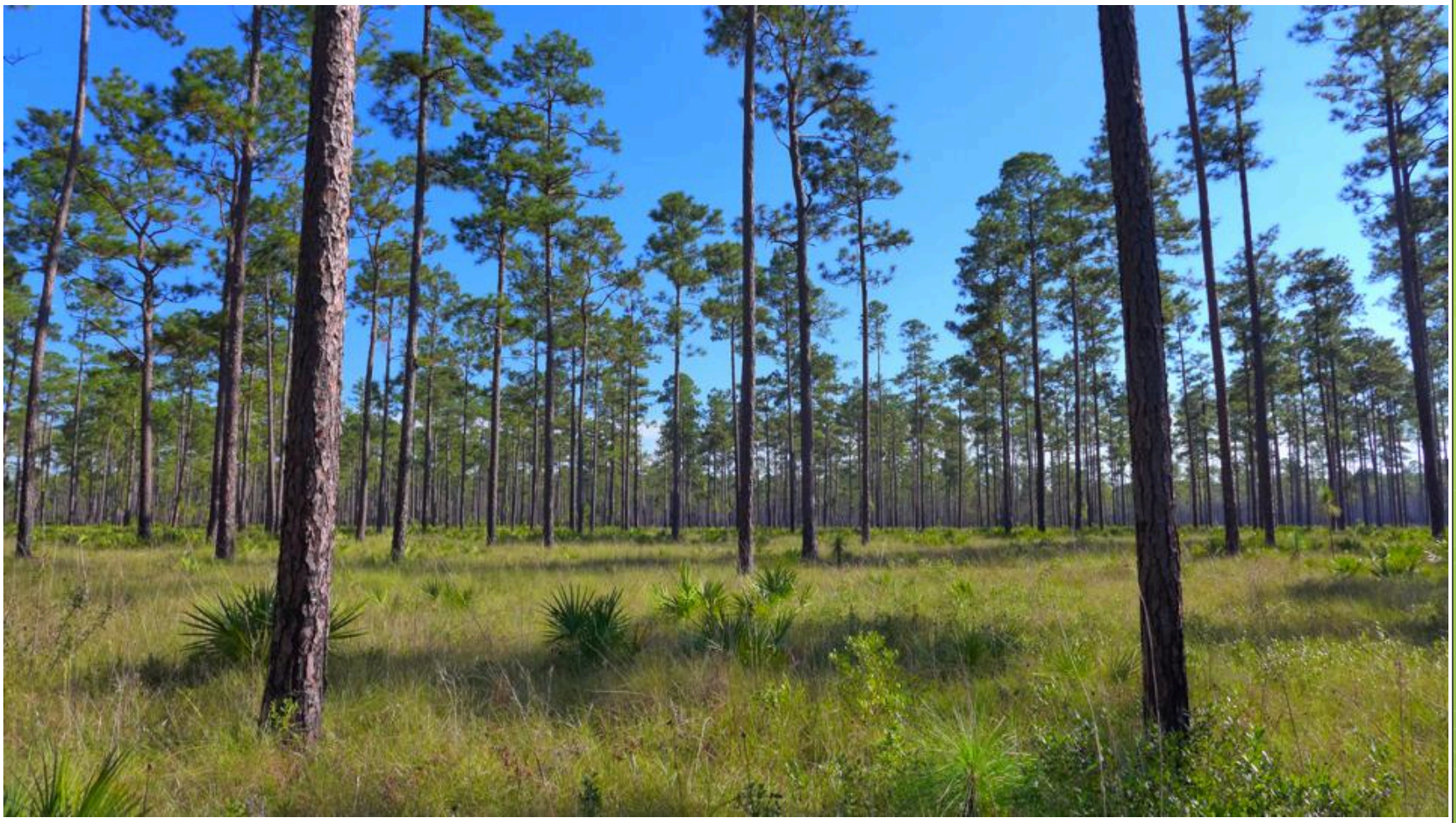
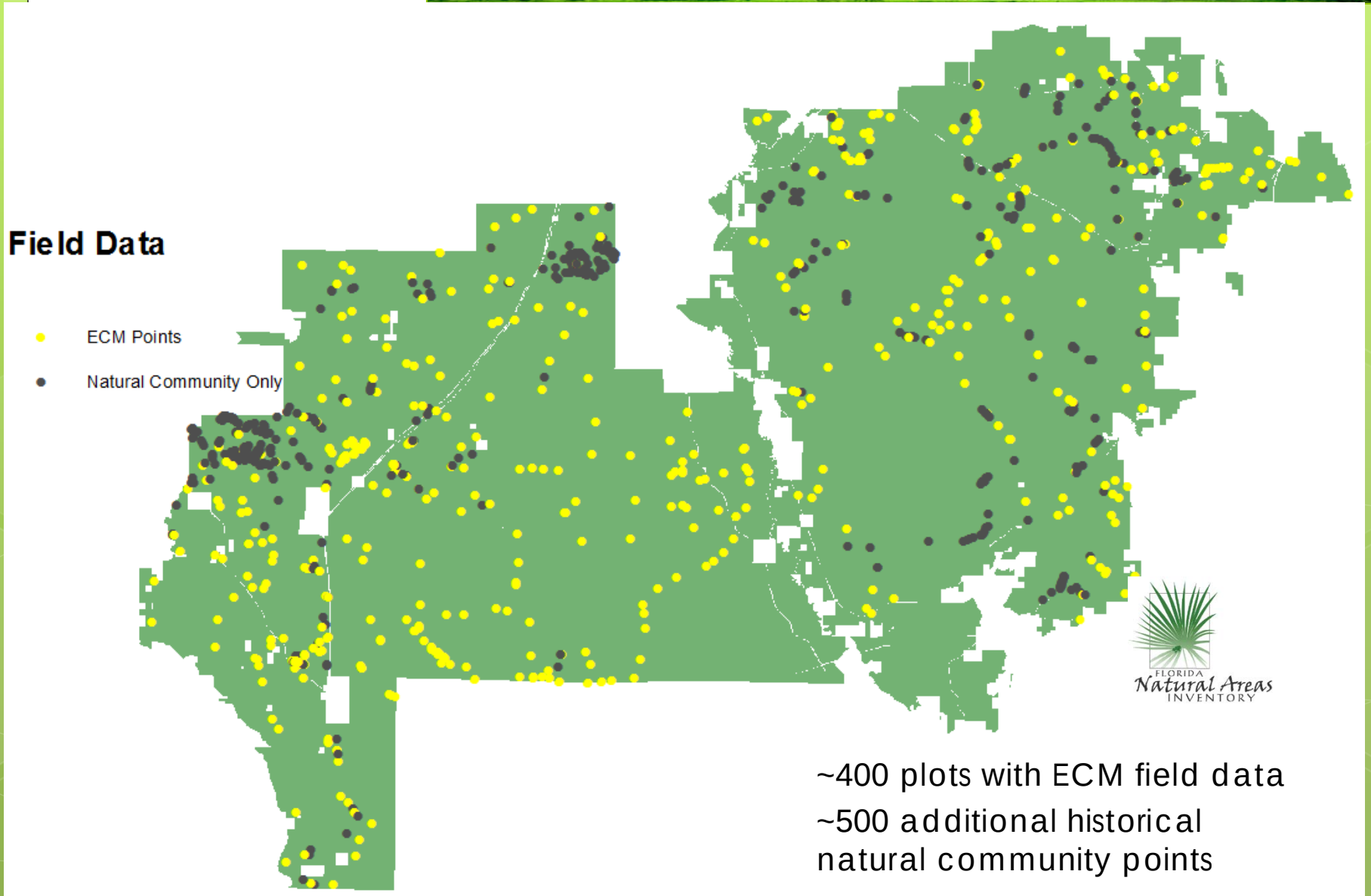


Photo courtesy of Amy Jenkins, FNAI

Field data collection

- Longleaf Rapid Assessment protocol (R8, Nature Serve, FNAI)
  - 20 m (66 ft, 1 chain) radius plot
  - Natural community type, Overall condition
  - Canopy
    - species, basal area, cover, height, etc.
  - Midstory
    - species, Density, Cover
  - Shrub
    - species, cover, herbaceous
  - Groundcover
    - species, cover, rare plants
  - Photo

Field data collection

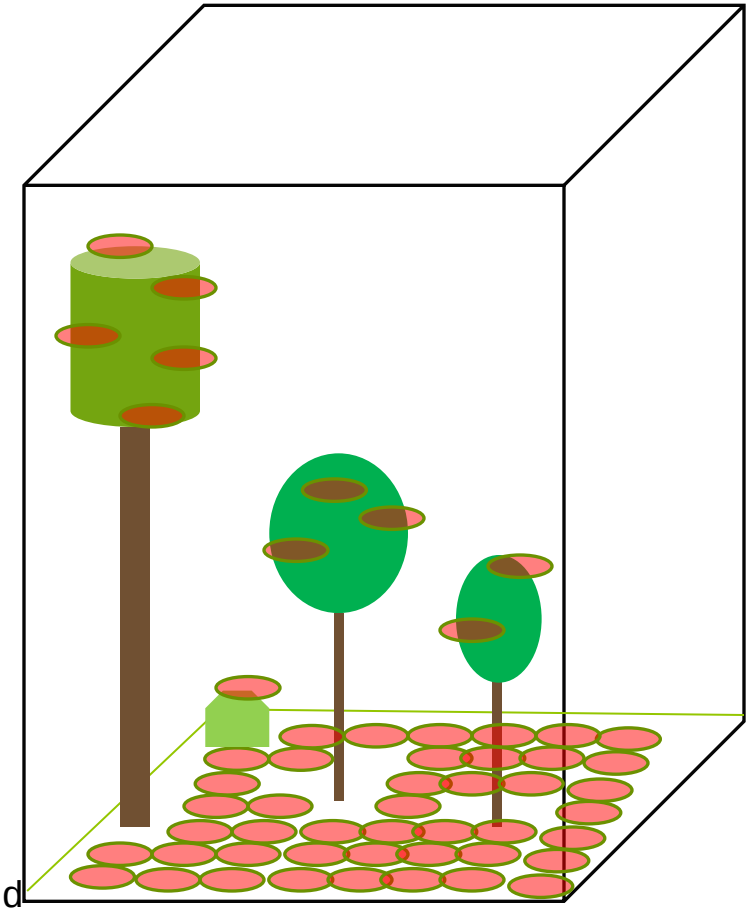


~400 plots with ECM field data

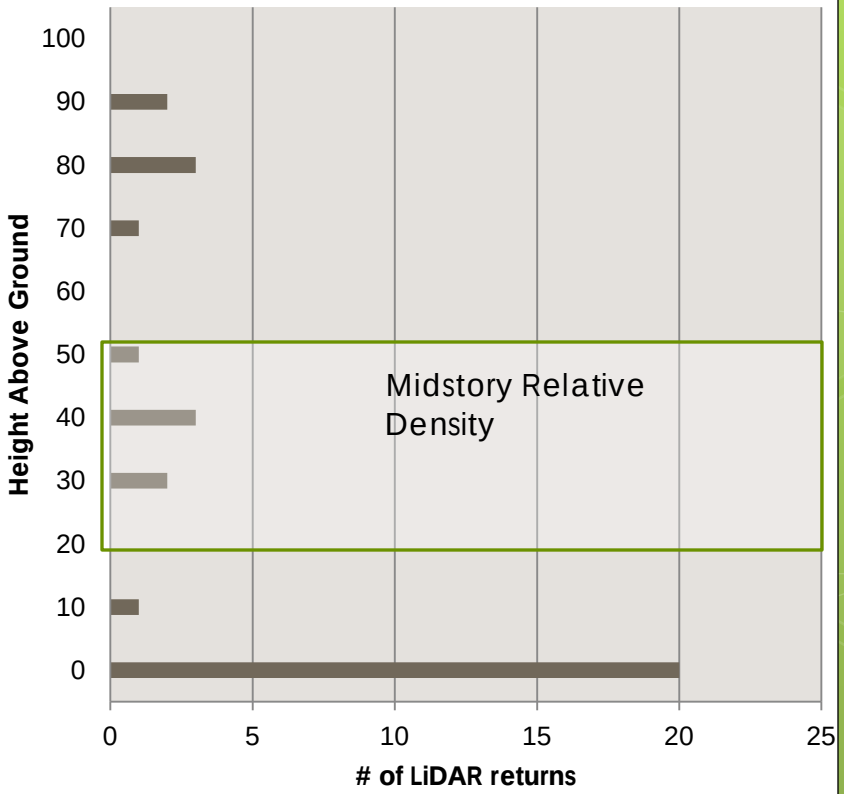
~500 additional historical natural community points

Step 4: Airborne LiDAR data

- 9 separate flights from 2007-2010

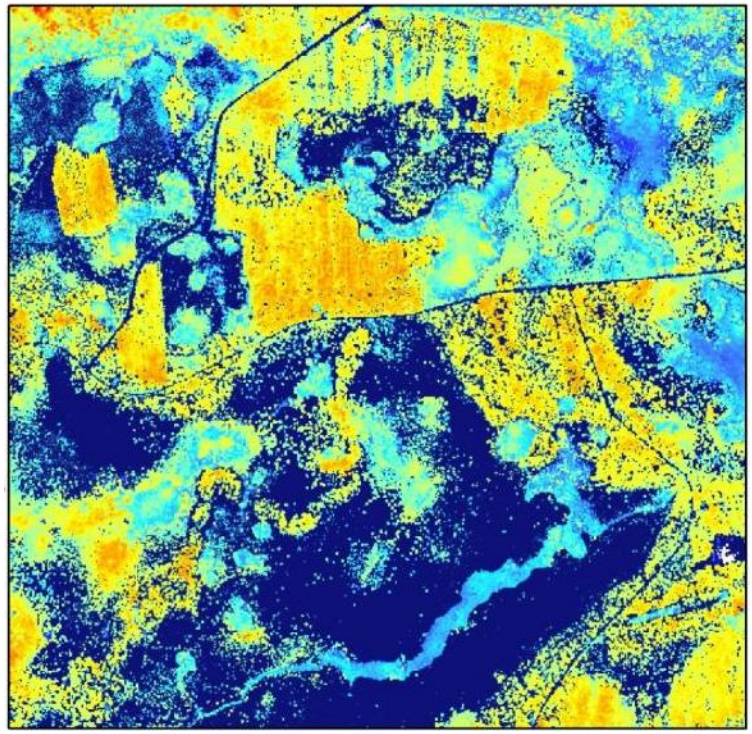


Ground
(DEM)



http://www.fs.fed.us/eng/rsac/fusion

Vegetation structure

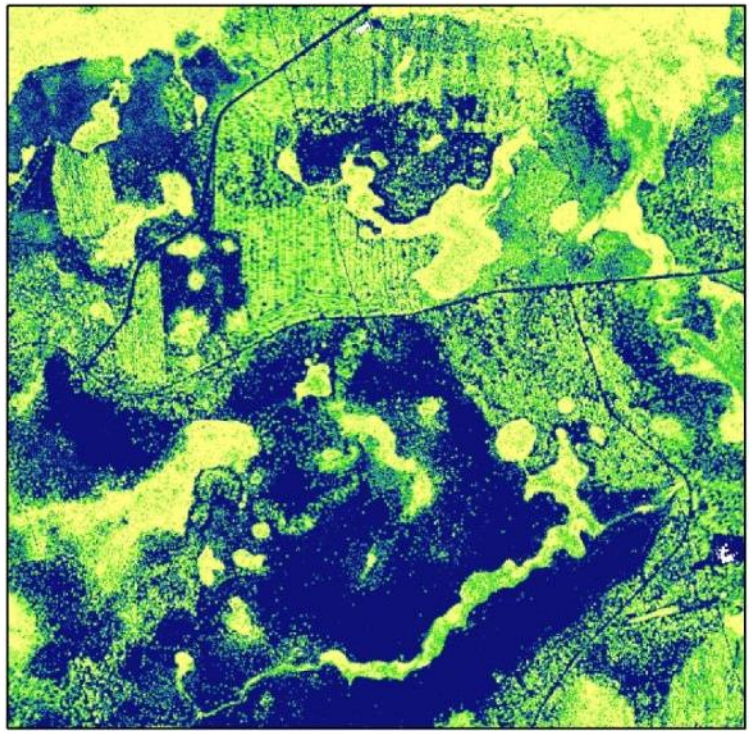


Max Canopy Height

Value

High : 115 ft

Low : 2 ft



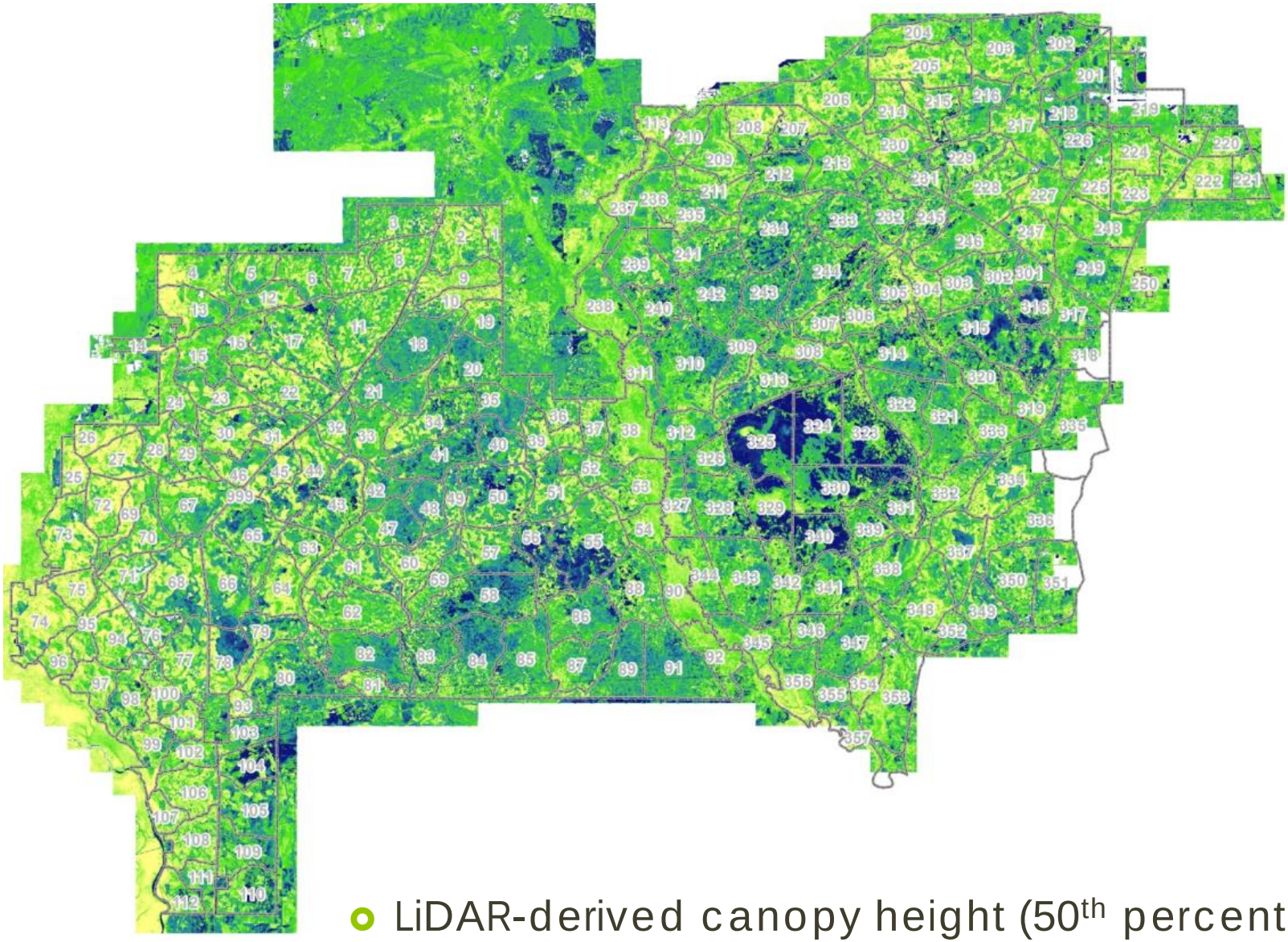
Canopy Cover (5m)

Value

High : 100

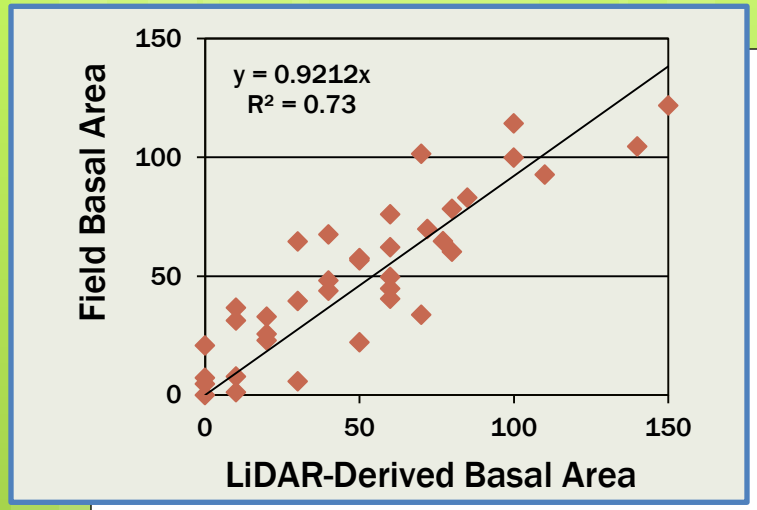
Low : 0

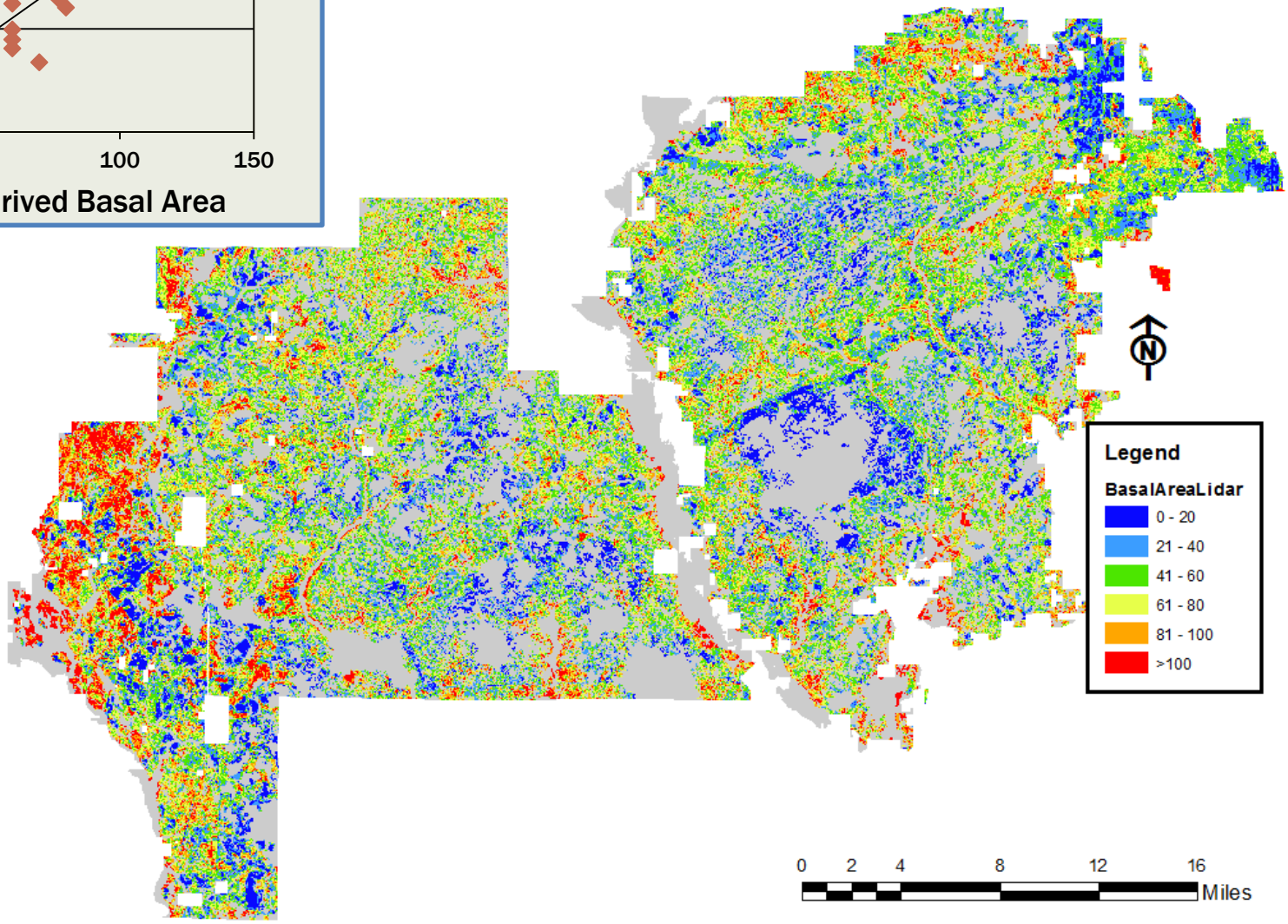
Step 4: Airborne LiDAR data



- LiDAR-derived canopy height (50th percentile)

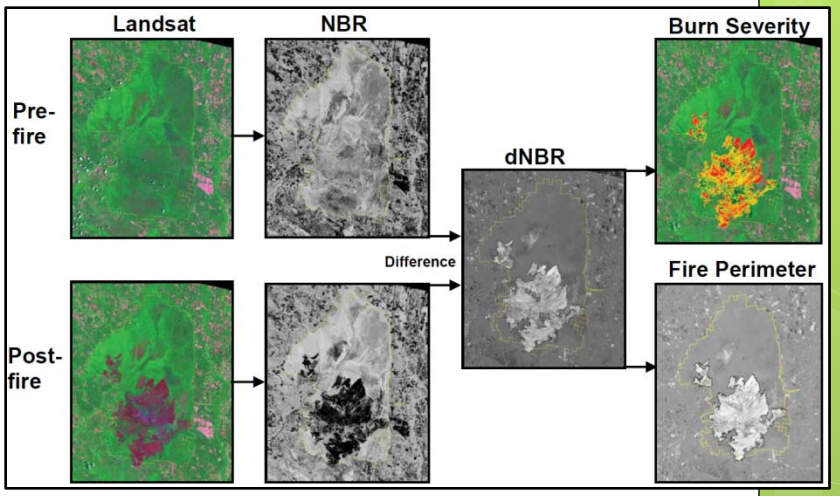
Canopy conditions



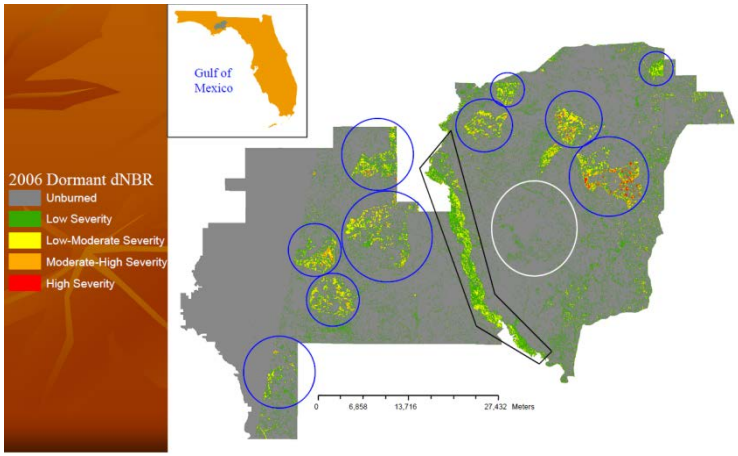


Burn history- Landsat data

- Burn Severity Mapping (Key and Benson 1996)
  - Normalized Burn Ratio from Landsat
    - NBR = $(R_4 - R_7)/(R_4 + R_7)$
    - dNBR = NBR prefire – NBR postfire
    - More info at: www.mtbs.gov

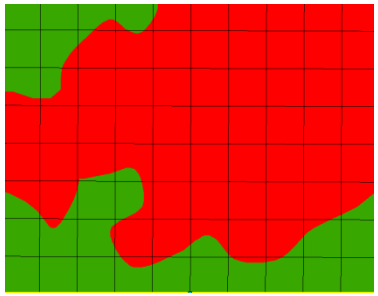


- Robertson and Picotte (2011)
  - Apalachicola and Osceola NFs



Step 5: Integrate layers

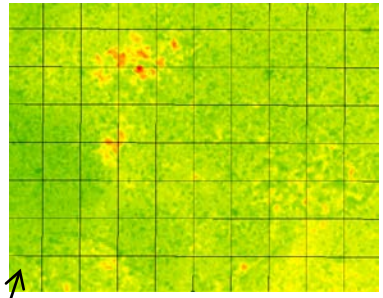
Categorical Data



Example: Historic Natural Community

Majority value assigned to cell

Continuous Data



Example: Lidar Shrub Density

1/2 acre cell

Summary stats (e.g., mean, median) assigned to cell

Final, forest-wide product contains these summary values for all input datasets

(0.5 ac cells)

Canopy Tiers

- Predominant Canopy Species
  - GIS - Stands: Forest Type
- Age
  - GIS - Stands: Age_Year
- Canopy Cover and Canopy Relative Density
  - LiDAR- RDgt45ft
  - Tier "break points" based on subset of ECM field plot data of predefined Tier classes
- Basal Area
  - LiDAR- Canopy Cover, Canopy Height percentiles
  - Relationship based on field data from FSVeg plots in sandhills and flatwoods

Midstory Tiers

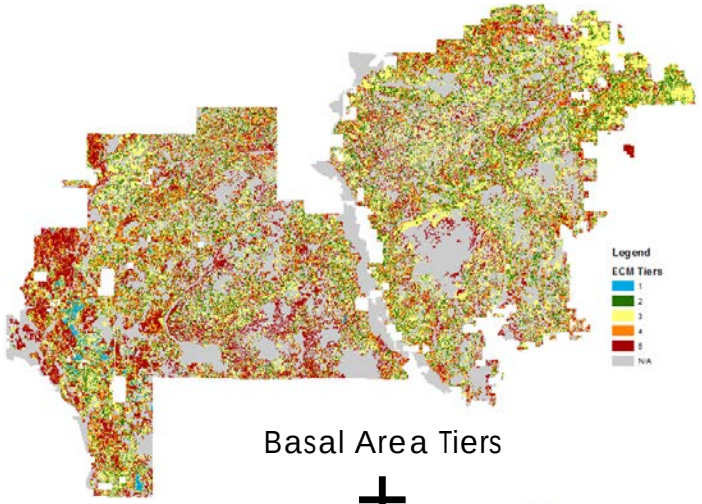
- Midstory relative density
  - LiDAR - RD20to45ft (*only for canopies > 45 ft*)
  - LiDAR - RD6to20ft
  - Tier “break points” based on subset of ECM field plot data

- Landsat derived hardwood estimate
  - Landfire Existing Veg Type (EVT)- Live Oak and all other hardwood types in historic LLP communities

Shrub/Ground Cover Tiers

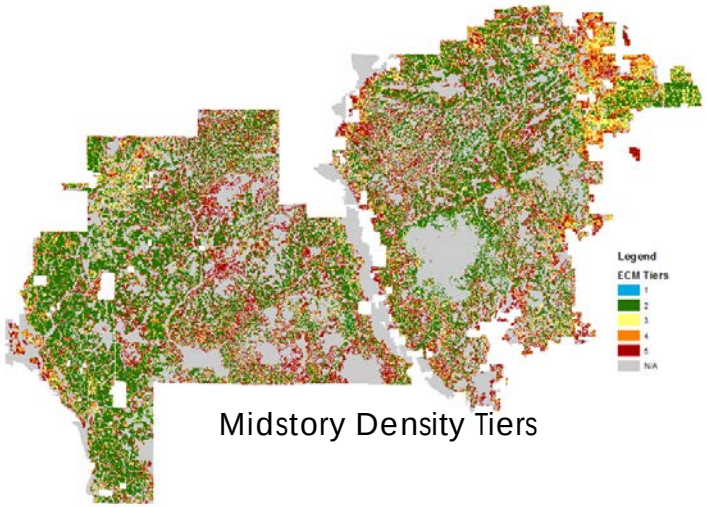
- Shrub relative density
  - LiDAR - RD2to6ft
  - Tier “break points” based on subset of ECM field plot data
- Number of burns
  - At Burn unit level
- Years since last fire
  - At Burn unit level
- Remotely sensed total burn severity
  - From 1995-2010 Landsat data following MTBS (Picotte) methods
- Canopy Cover
  - LiDAR - CCgt2ft
  - Tier “break points” based on subset of ECM field plot data
- Site preparation (Activities)
  - Mechanical site prep for planting/seeding

Step 6: Calculate overall ECM score



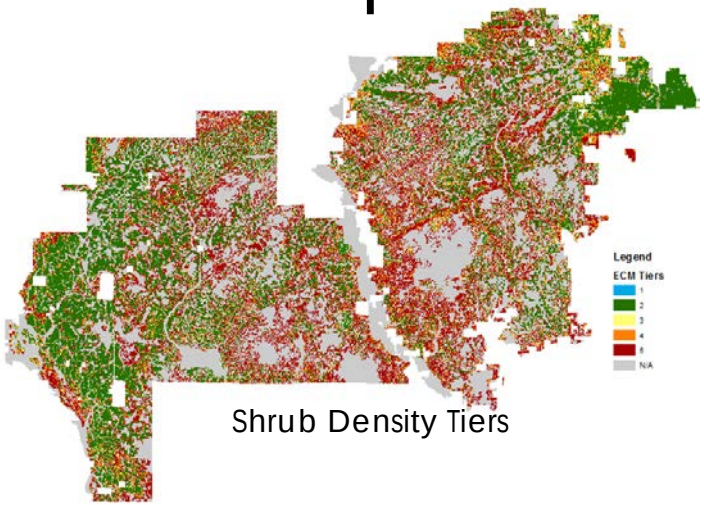
Basal Area Tiers

+



Midstory Density Tiers

+



Shrub Density Tiers

+ …all other input layers