Leveraging high resolution data to develop insight about urban forests

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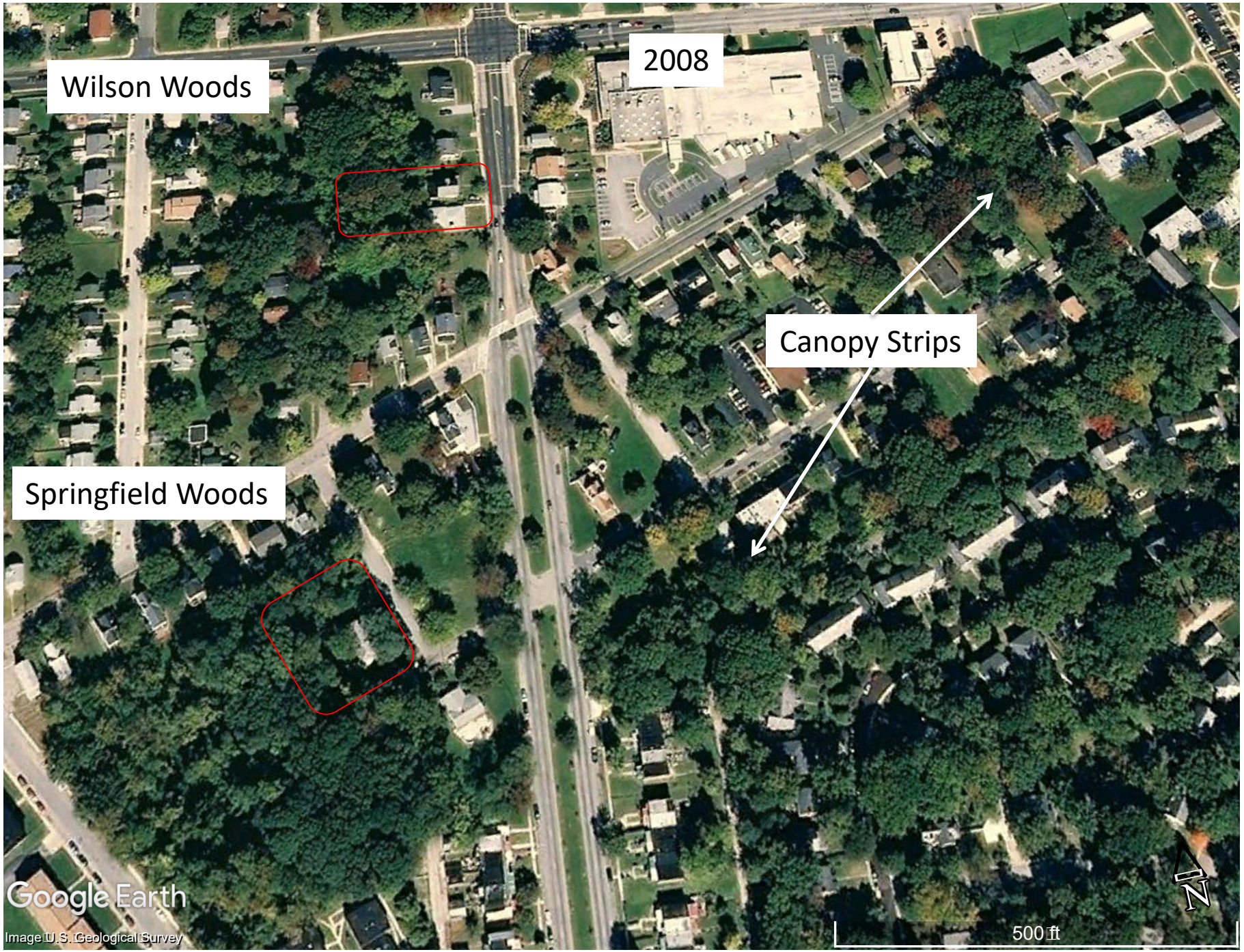
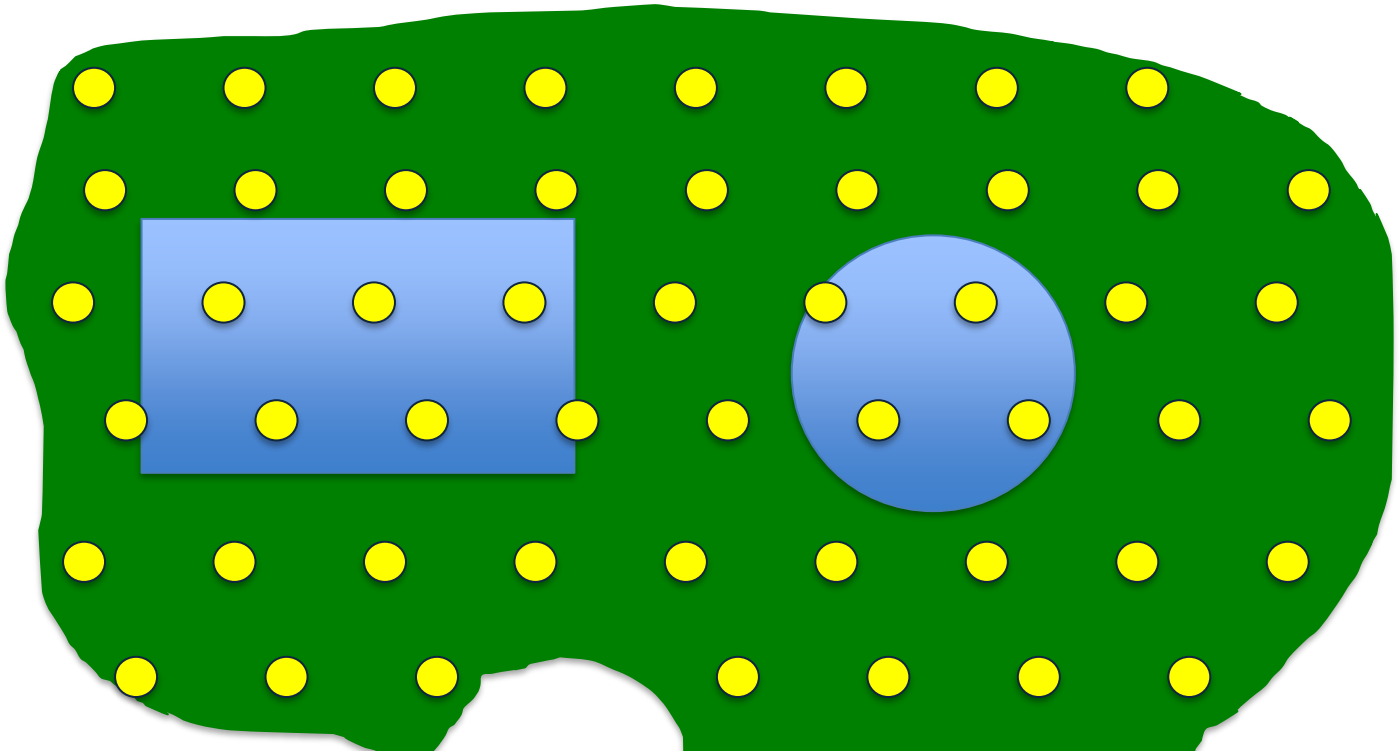

Wilson Woods
2008
Canopy Strips
Springfield Woods
Google Earth
Image U.S. Geological Survey
500 ft
N


2008
Wilson Woods
Canopy Strips
Springfield Woods
Google Earth
Image U.S. Geological Survey
500 ft
N


2018
Wilson Woods
Canopy Strips
Springfield Woods
Google Earth
500 ft
N

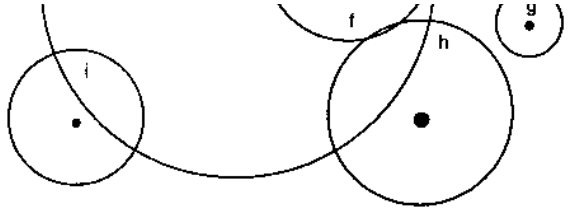
Distributed Sampling information needed for management



Geo-located sampling points
Relative dominance of overstory (10 BAF prism)
Groundcover composition
Vine Encroachment Index
Soil bulk density, penetrometer, abbreviated description

Prism Point Sampling

- Size-based selection rather than occurrence frequency
- Wedge prisms refract light
- Each sampled tree represents a fixed amount of basal area per acre
- Integrates size ad density for relative dominance estimate
- SD is higher for single prism vs plot samples, so minimum of 3-5 points are necessary to stabilize estimate



. Imaginary plots of trees with various diame
Letters refer to individual trees and assoc
In this example, only trees c, d, e, and f
measured at the sample point, which is repr
the black triangle (from Hovind and Rieck 1

portional to the diameter of its stem; therefor
rs of the forest community are emphasized in a
prism is a ground glass sighting device used to
This instrument creates a sighting angle that

Use a systematic approach to sighting trees. For example, you may
due north to start and rotate clockwise until you have returned t
first tree sighted. Be careful to keep the prism over the sa
point as you change your body position.

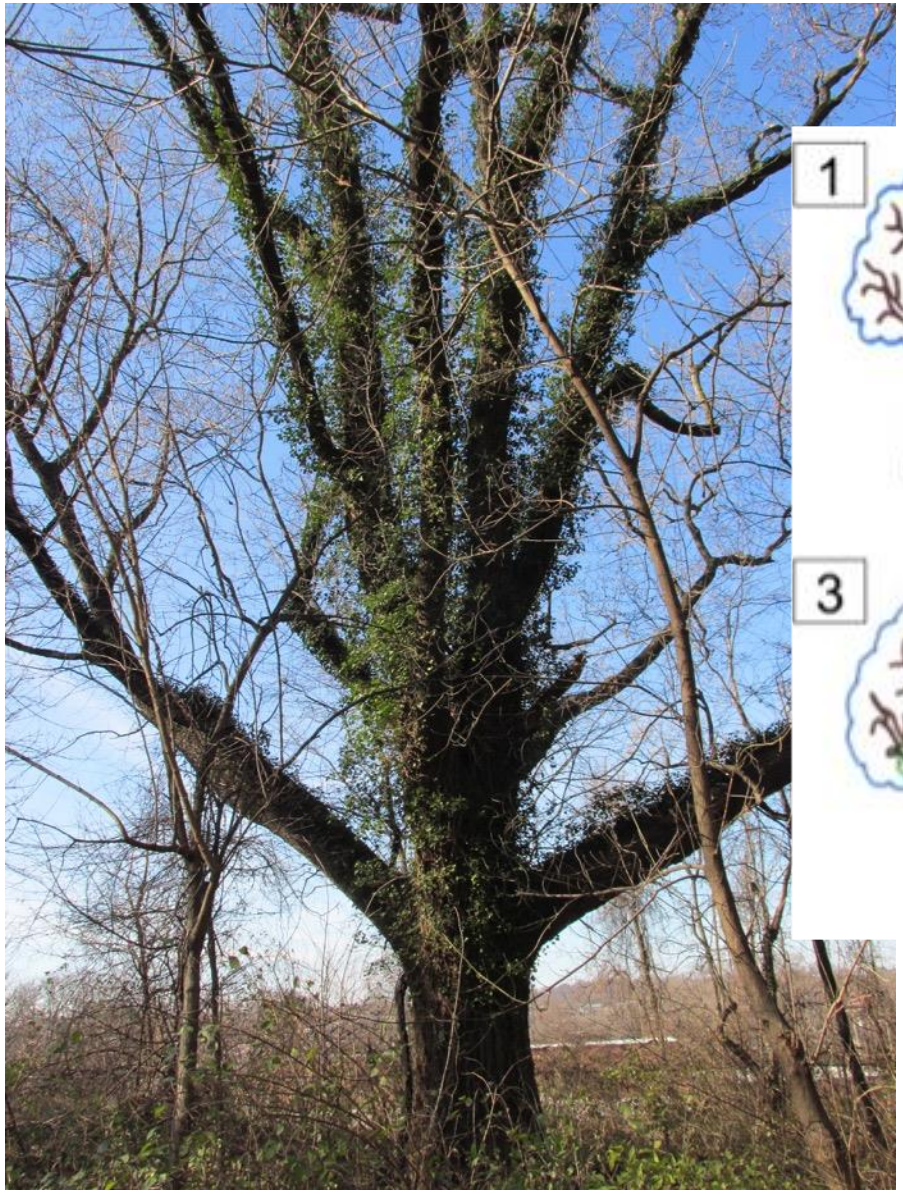
Determine the trees to sample:

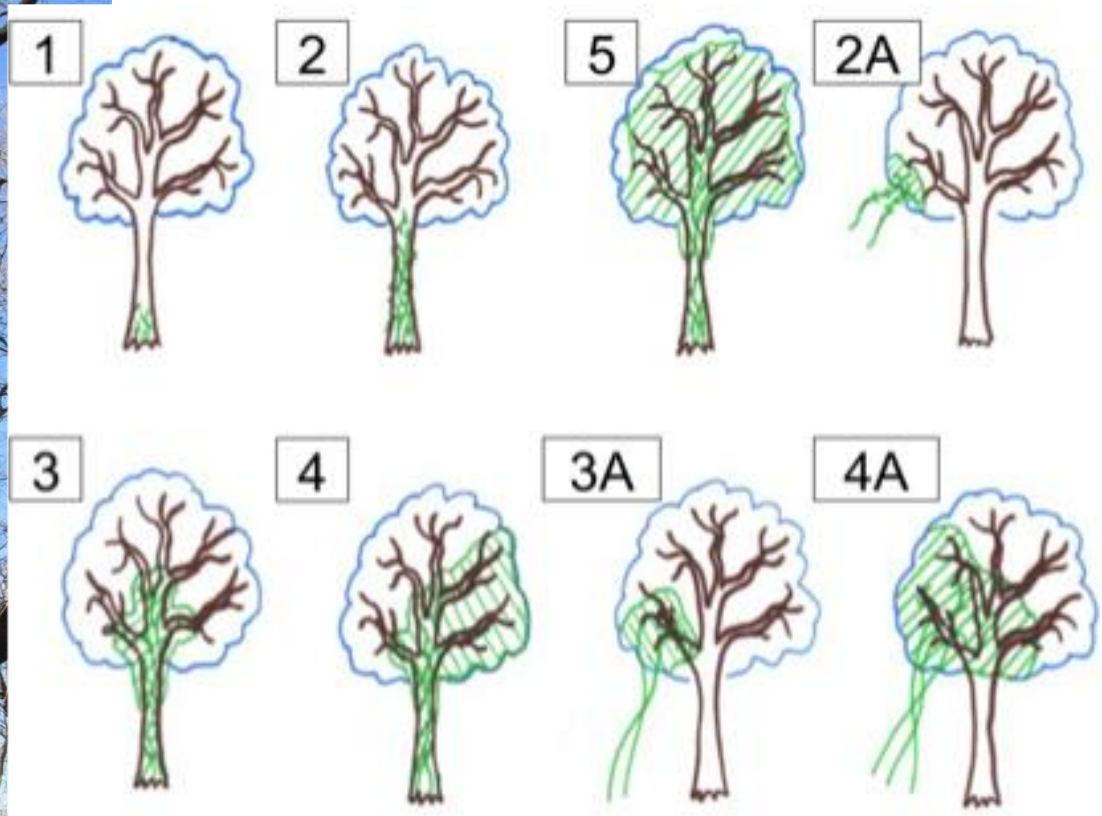
a. A tree is sampled if the image of the tree viewed through
prism is not completely offset (Fig. 3b). This means that
sample point is inside the tree's plot.

b. A tree is not sampled (the point is outside the plot) if the i
is completely offset (Fig. 3a).

c. A borderline tree is one in which the image is not defini
overlapping or offset (neither inside nor out of the p
(Fig. 3c). Whether this tree is sampled or not depends upor

Shumacher Scores





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A Baltimore Sample

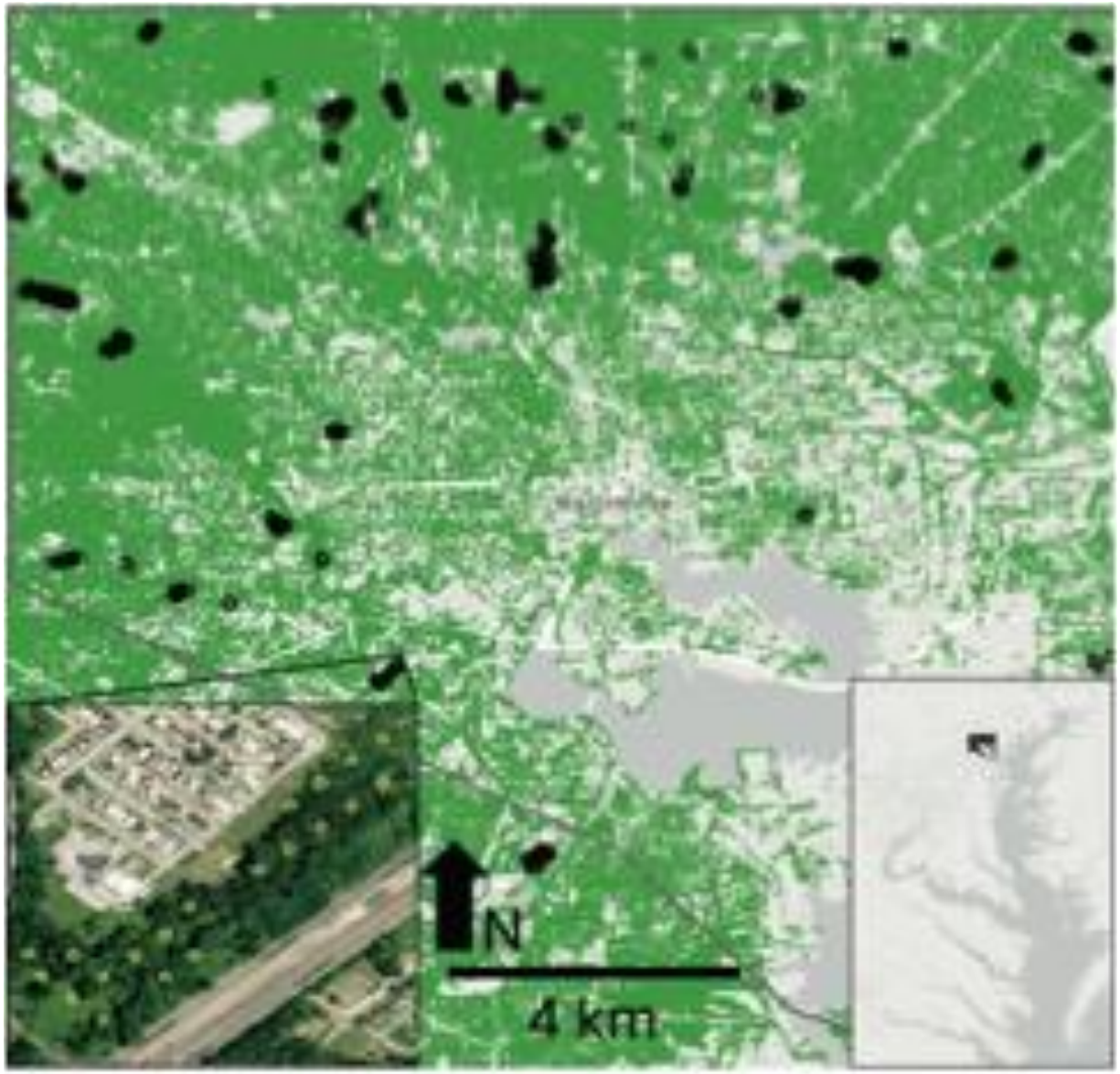
Began with survey of eased woodlands in 2015

Subsequent sampling focused on expanding the sample to encompass public and private lands

Spatially balanced, proportionate

47 woodland samples

895 sampled points



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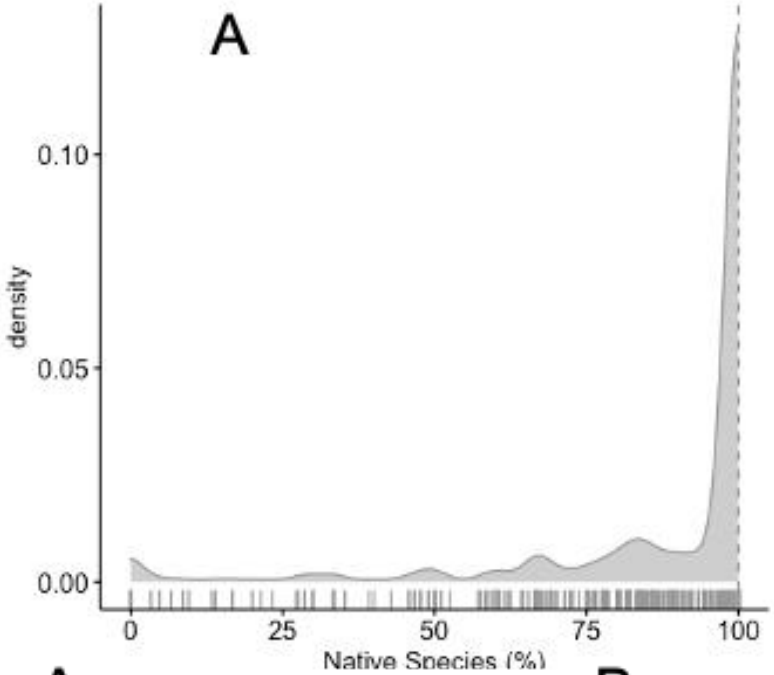
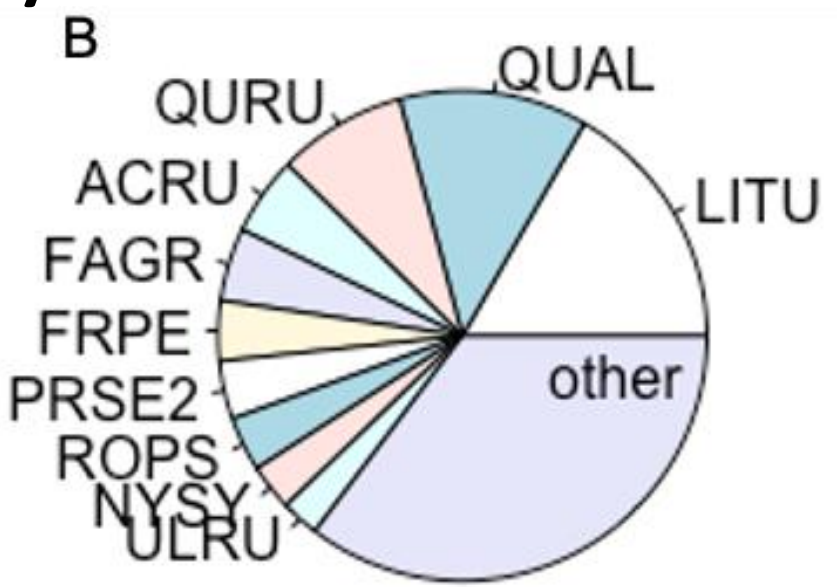
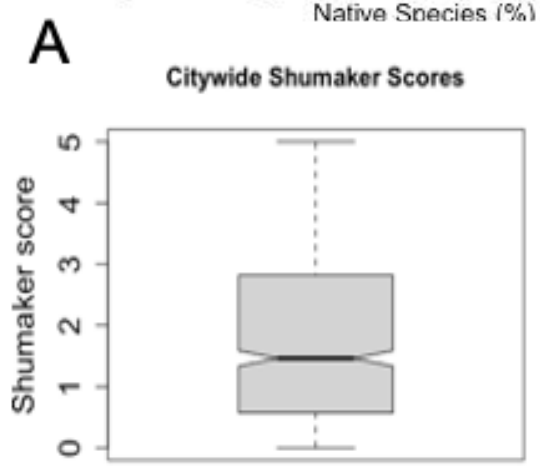
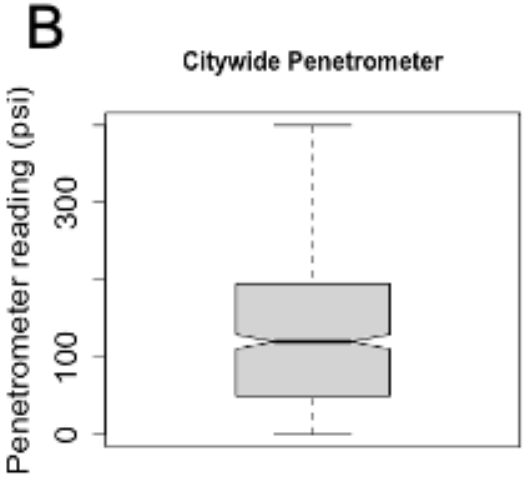
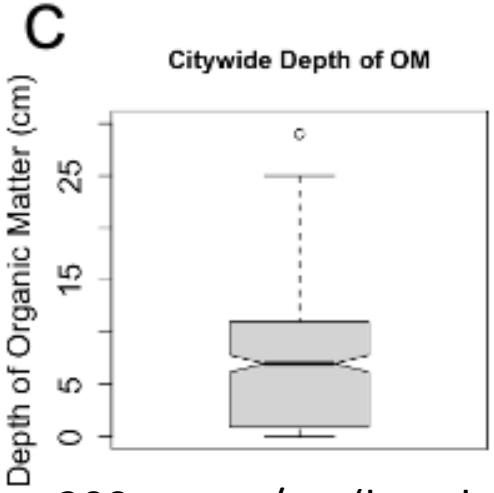
Overstory Results











Overstories are largely native, soils uncompacted, many samples <200 stems / ac (low density), most points 3 more spp, nearly every point has vines on trunks

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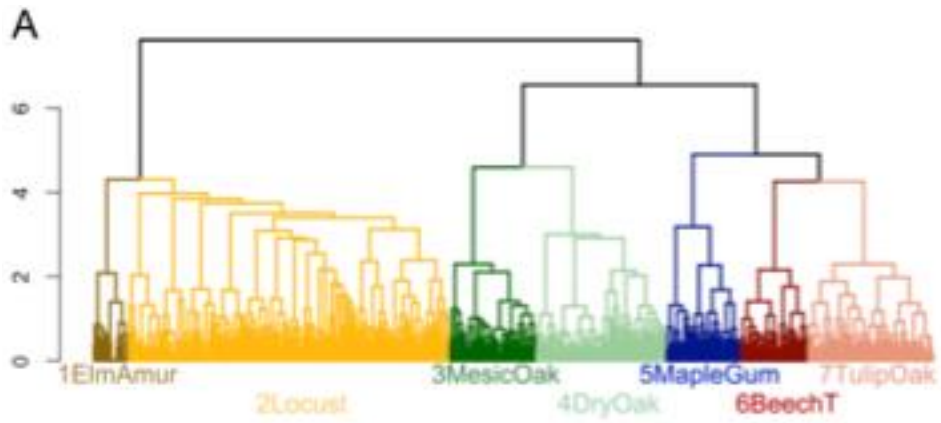
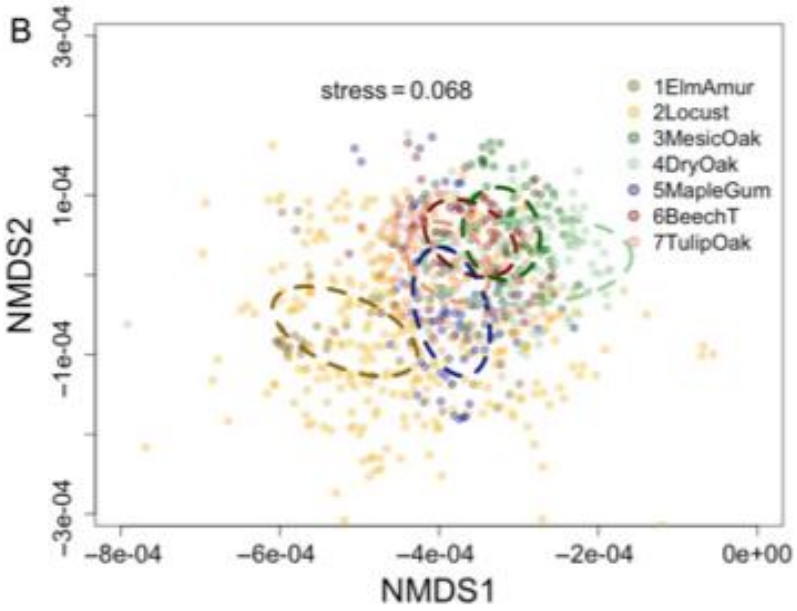
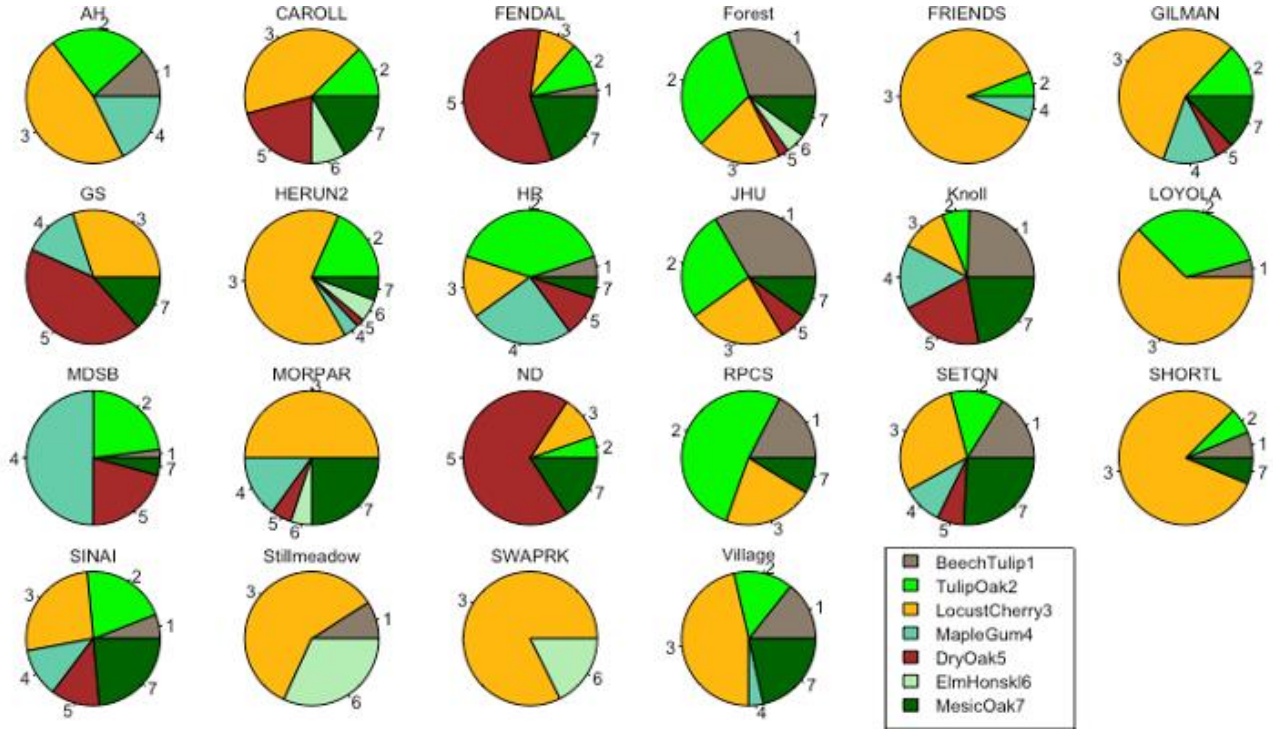




Dry oak woodlands, mesic hardwoods, wetland/riparian canopies, disturbed types



Individual patches can be classified and described as a combination of different types to inform expectations for management and guide planting

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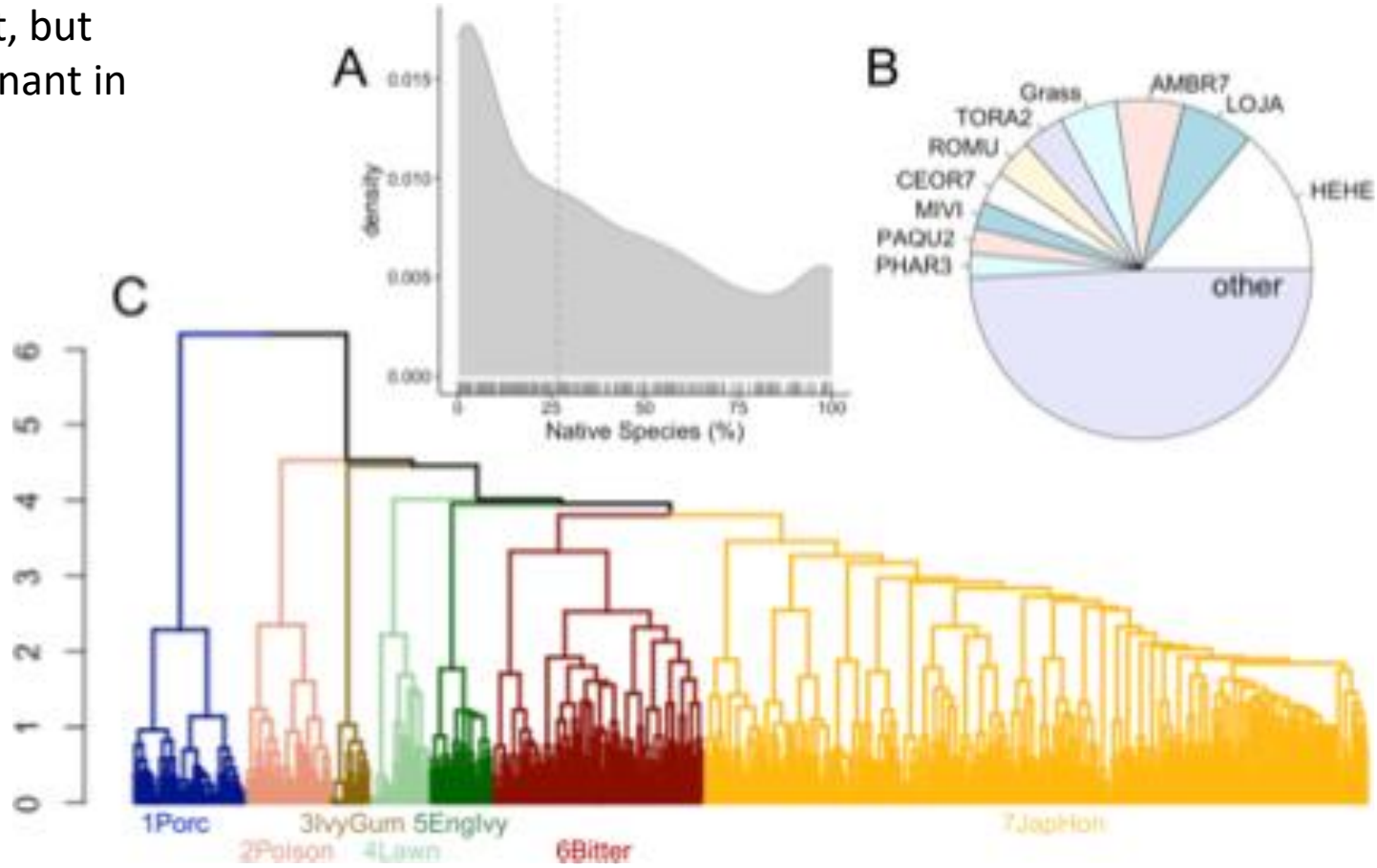
Groundcover Results

Many samples, all clusters dominated by exotics

Some natives exist, but they are not dominant in nearly any cluster



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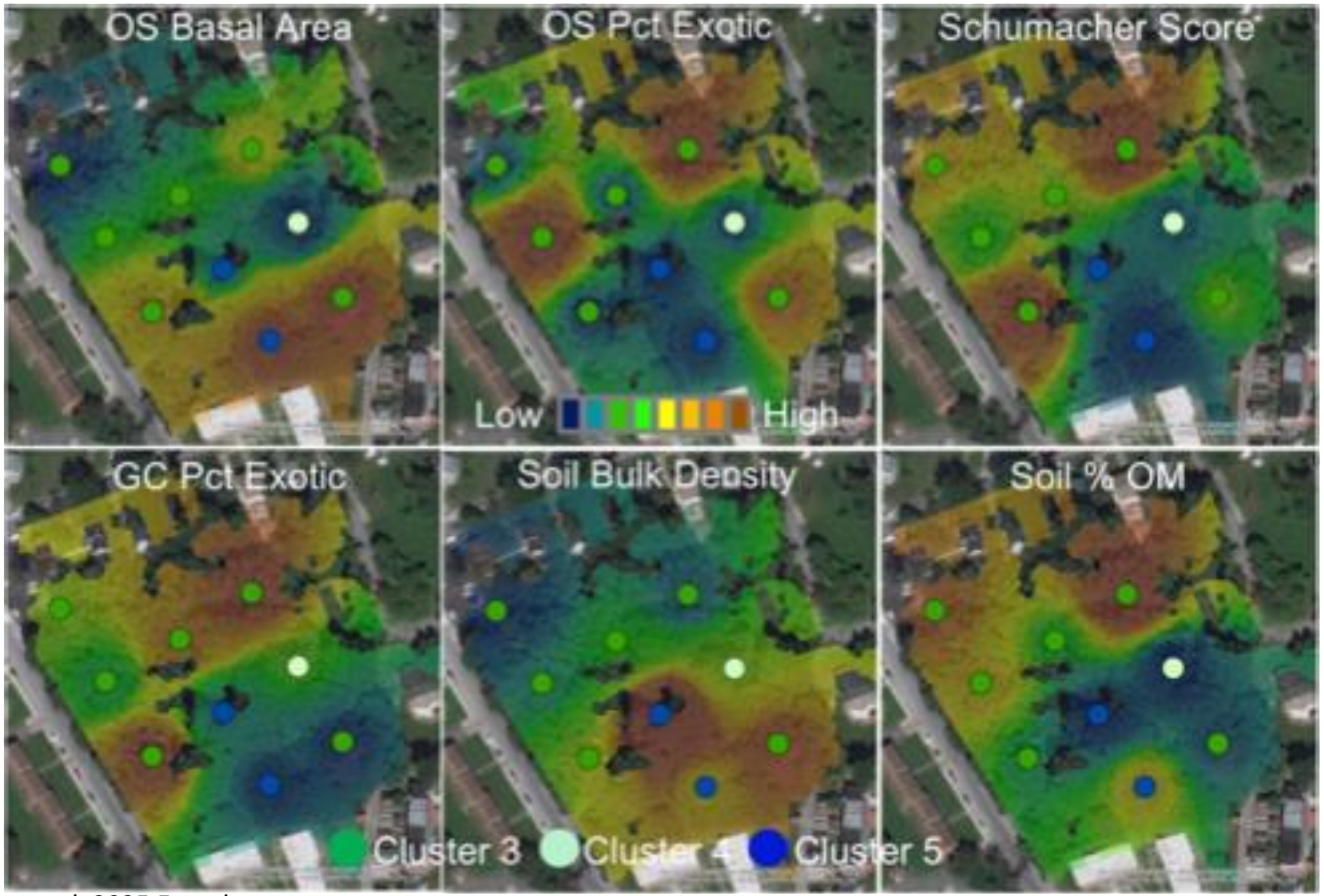
Spatially-explicit Information



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Sampling at Stillmeadow Woods helps guide restoration and visioning

https://www.baltimoresun.com/.../bs-fe-stillmeadow-church...

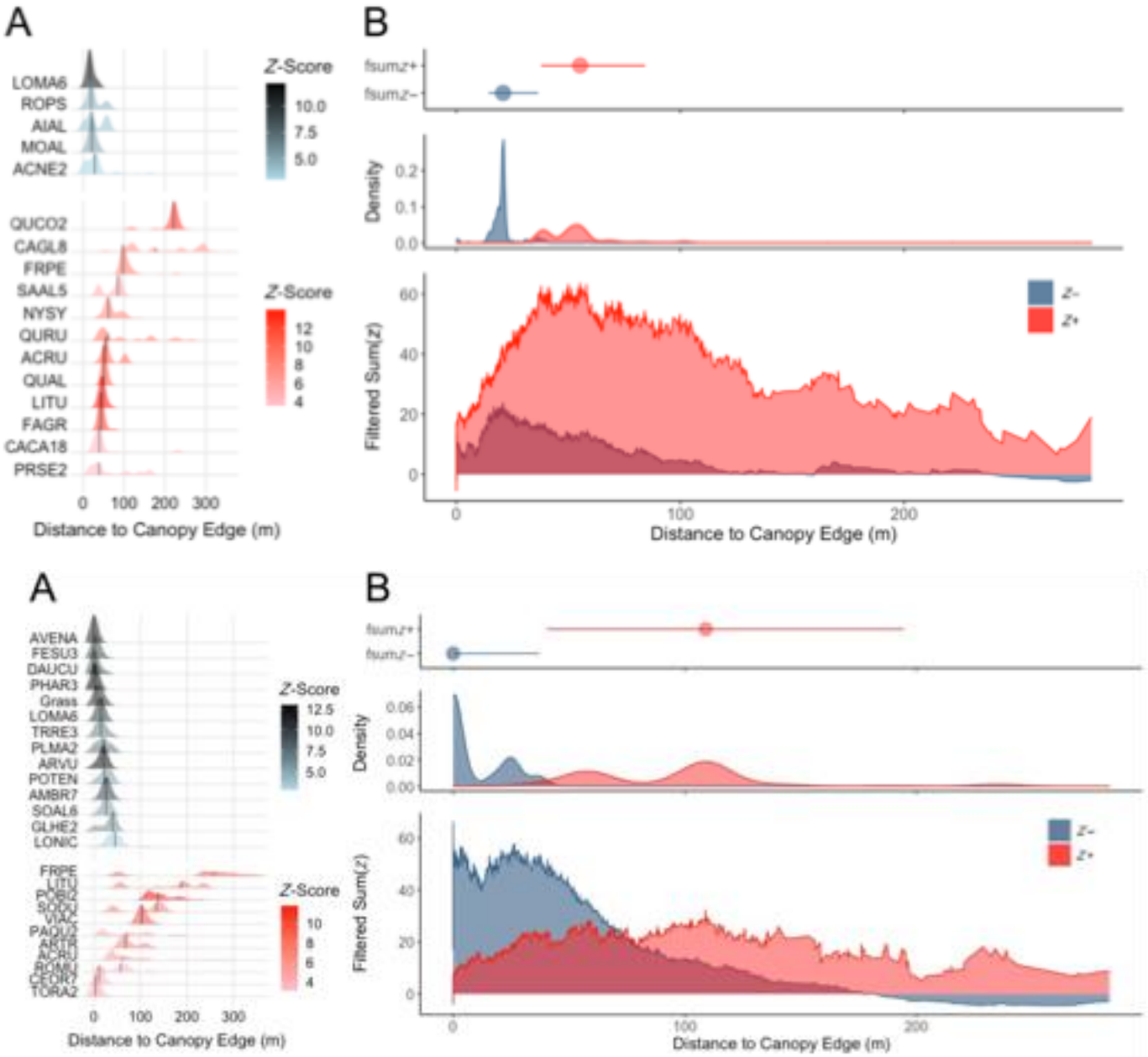
Detecting Edge Effects

TITAN uses changes in individual species abundances to detect point of maximum community change

OS and GC as well as forest structural metrics pointed towards changes within 15-18 m of edge

Secondary changes were detected 40-45m from edge

More edge loving GC than OS



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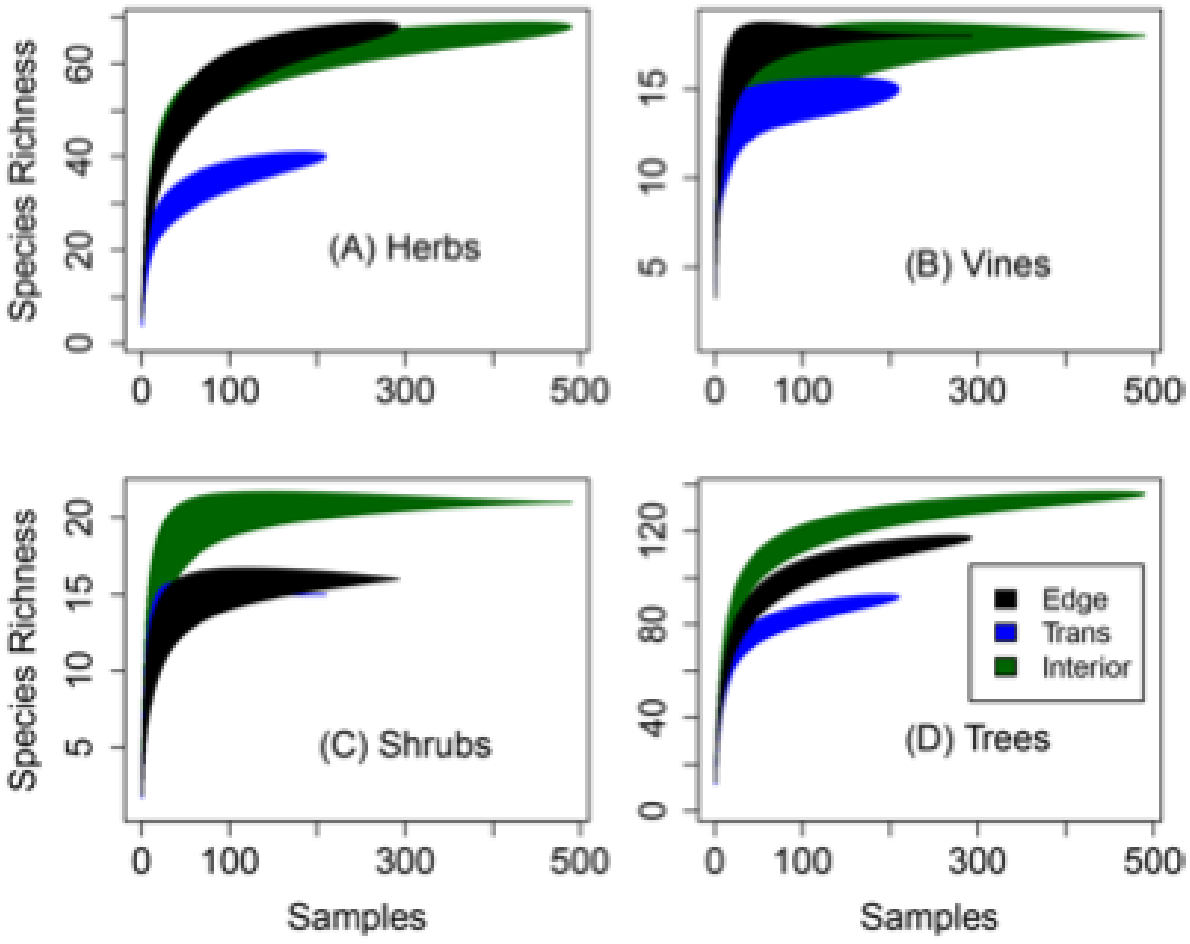
Urban Forests Have Edges

- OS forests remain native
- Dry oak and Mesic hardwoods, riparian zones
- Other, disorganized woods
- Exotic GC, but some natives remain
- Distributed sampling allows perception of patches as gradients
- Edges are different than interiors, less native, less rich, more variable



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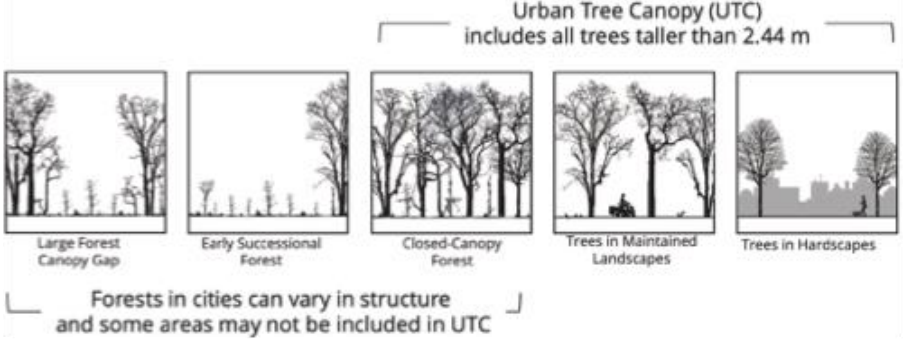
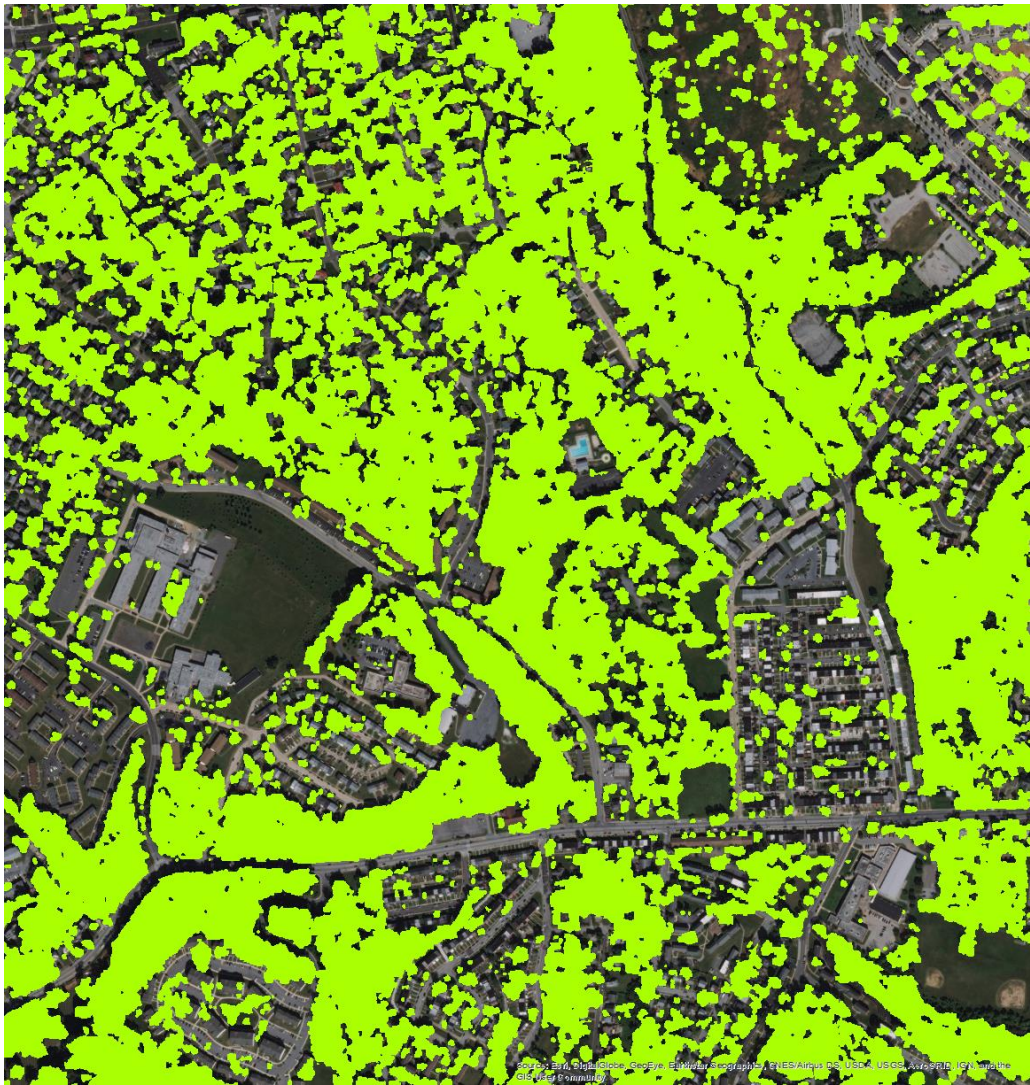
Urban Tree Canopy



- Derived from aerial imagery (2ft) and lidar canopy height model
- Includes street trees, yards, parks, and woodland remnants
- Does not reflect soils with greater water holding capacity



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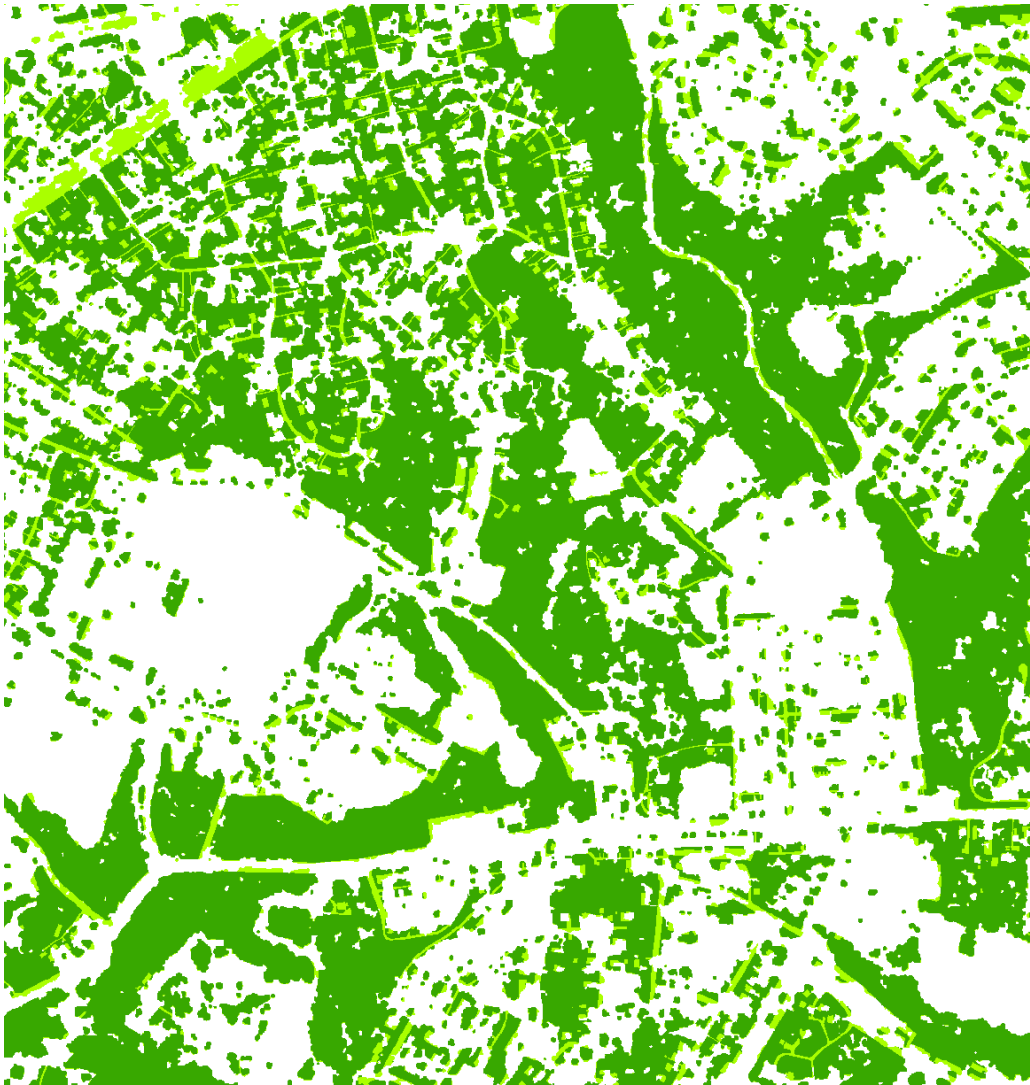
Soft Canopy

- Removes UTC over streets, sidewalks, buildings (i.e., ‘hard’ canopy)
- Accounts for continuity not reflected by canopy
- May reflect canopy with greater water holding capacity, but typically this requires interior woodland spaces



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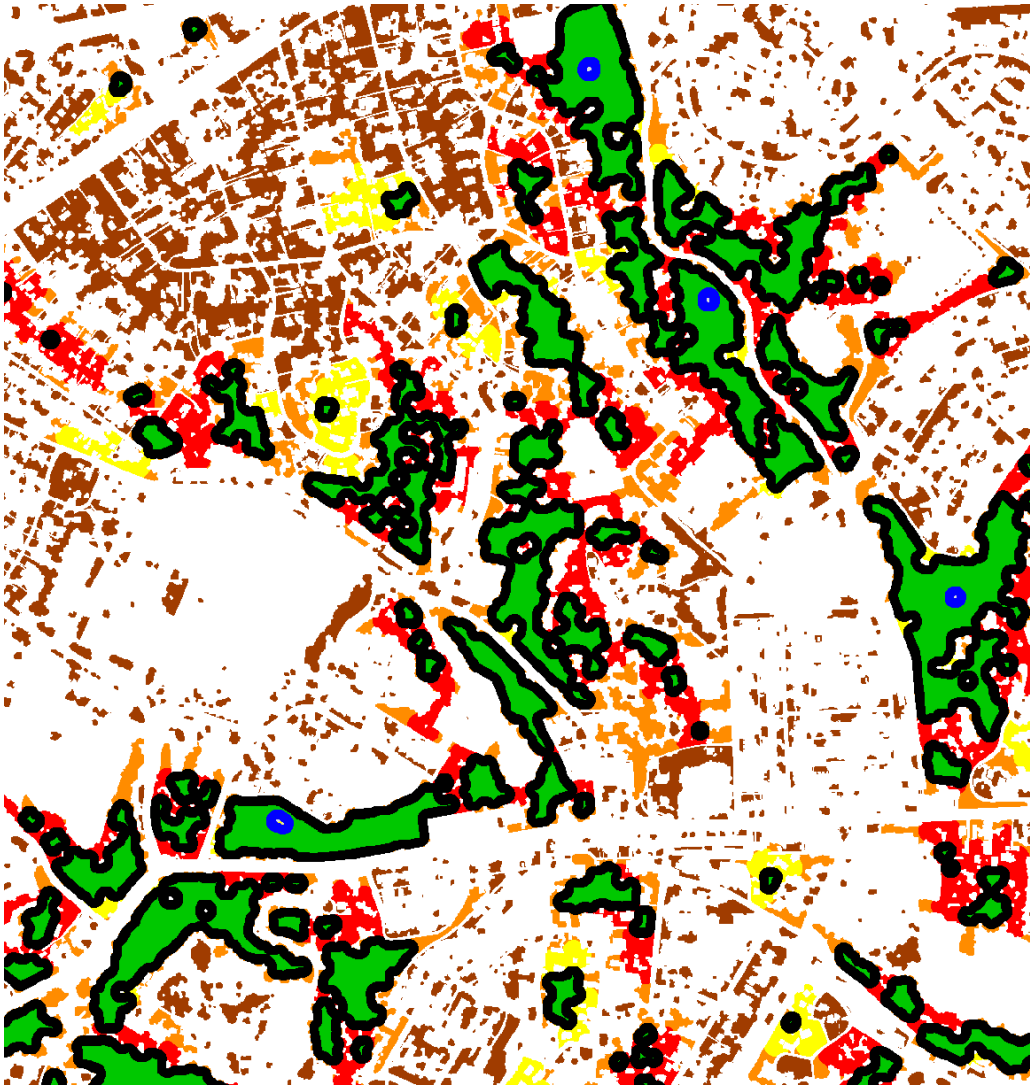
Morphometric Spatial Pattern Analysis (MSPA)

- Classifies pixels based on landscape structure
- Connected and Unconnected **islets**
- Interior **cores** and 15 m **edges** and **perforations**
- Cores fundamentally different spaces
- Other connected canopy includes **branches**, **loops**, and **bridges**



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Forest Patches

- Woodlands with core area
- Can further subdivide patches based on size and minimum width of core area
- Forest Natural Areas
  - >100 m2 core area
  - > 22 m minimum width
- Groves
  - Less substantial core area

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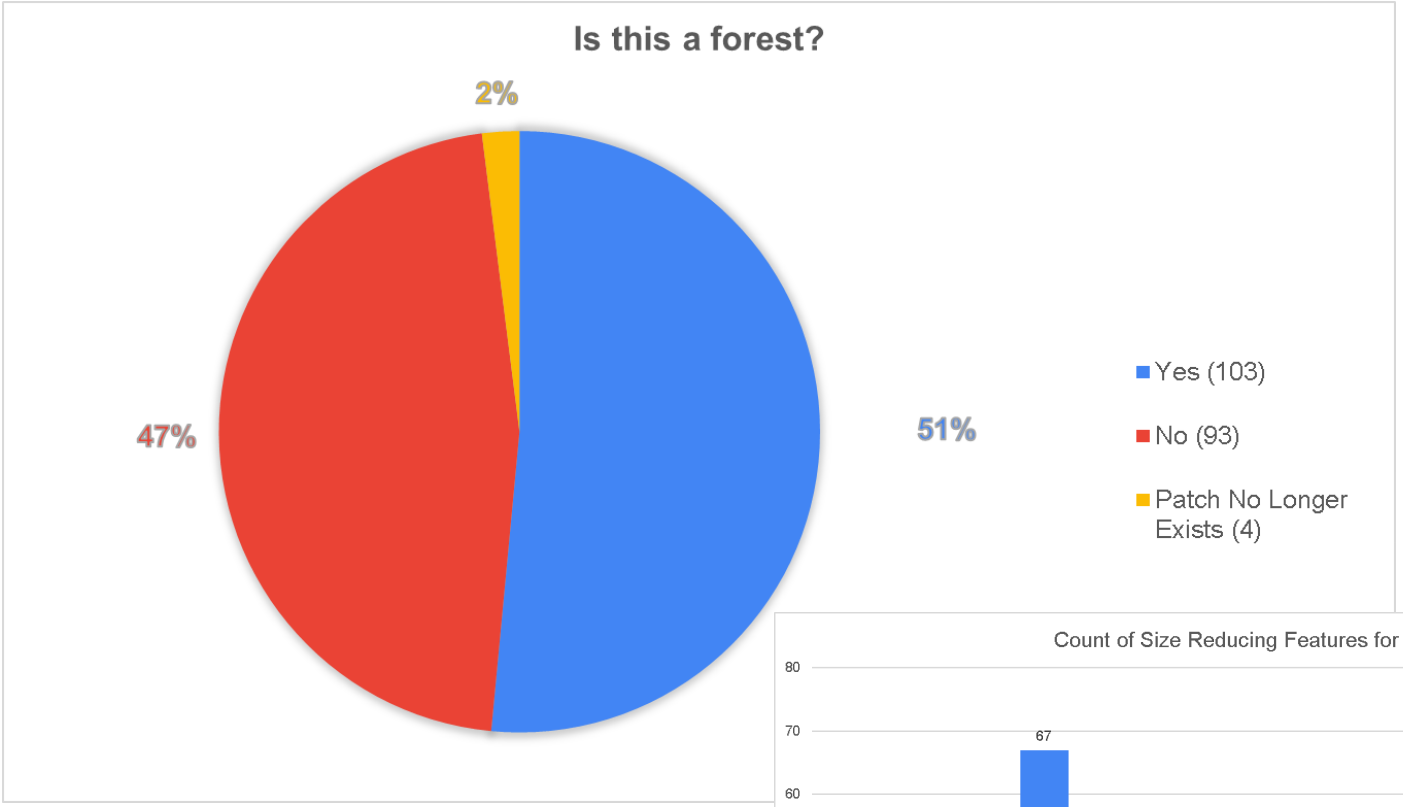
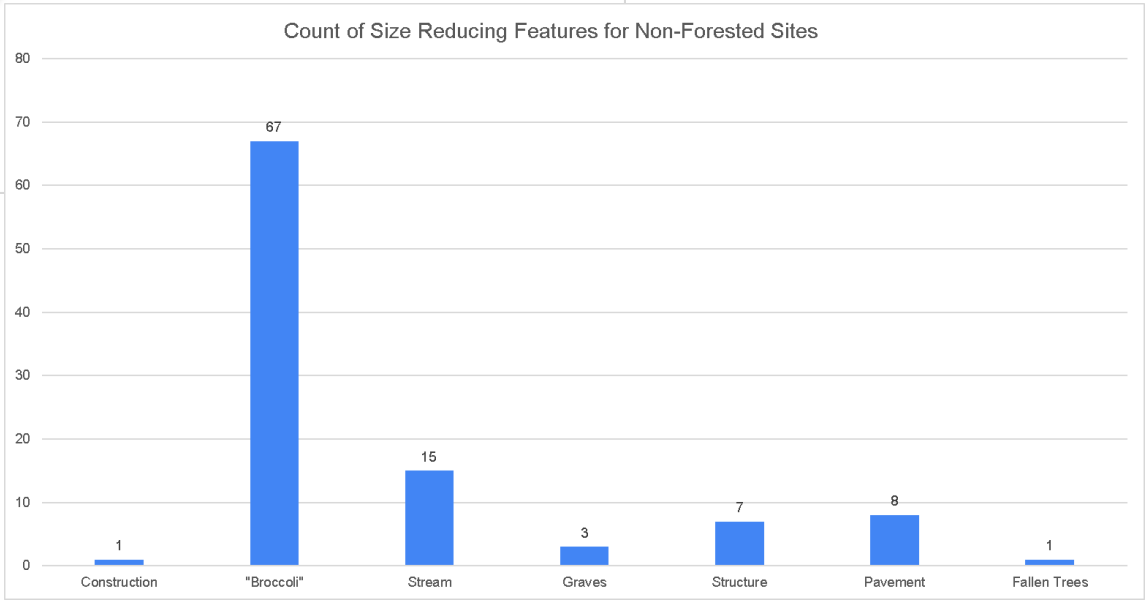
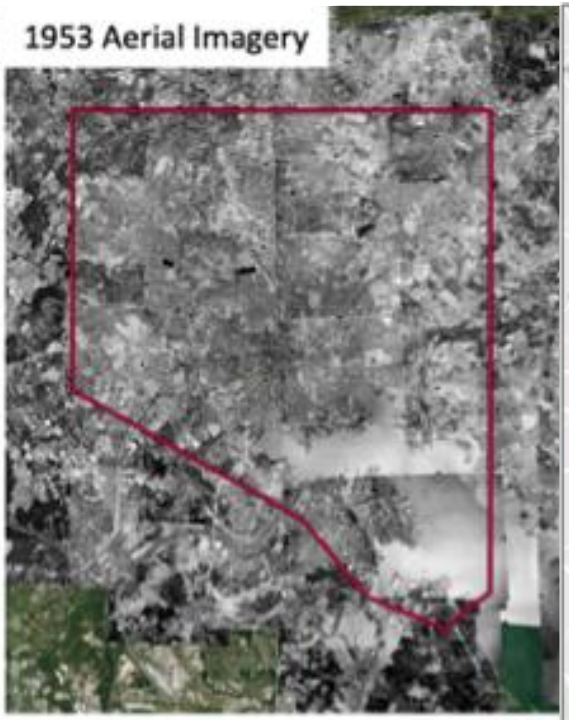
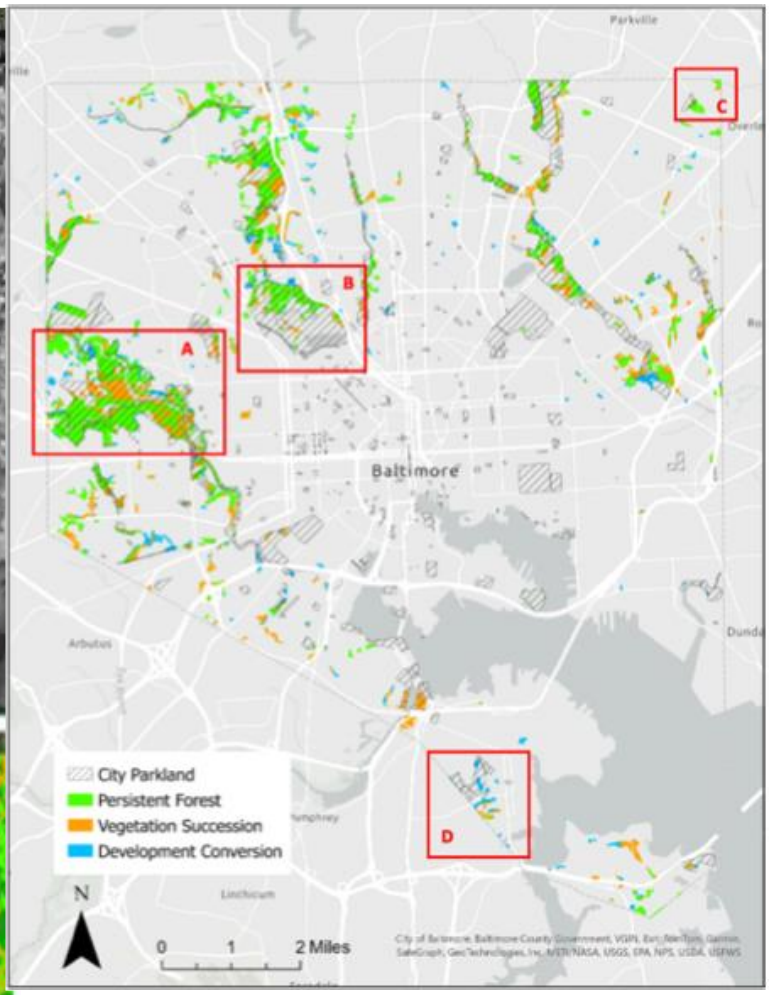
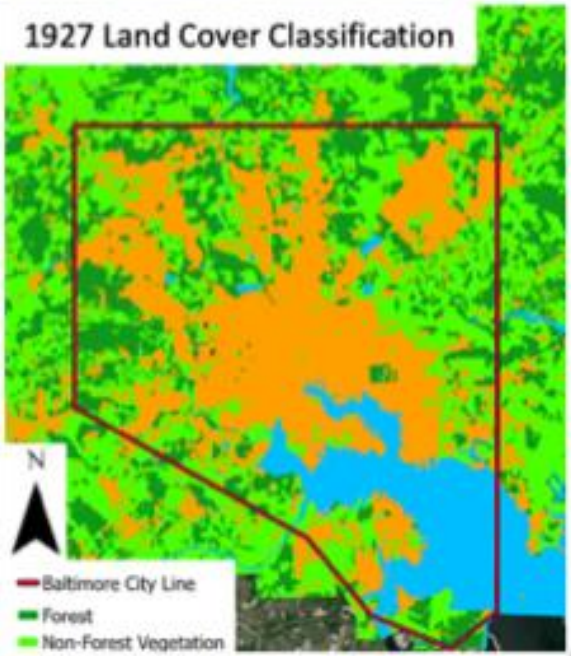
103 / 200 **groves** visited in random sample met both size and composition requirements to be considered forest patch. Remaining sites either did not meet these criteria (93 sites) or no longer existed (4 sites).

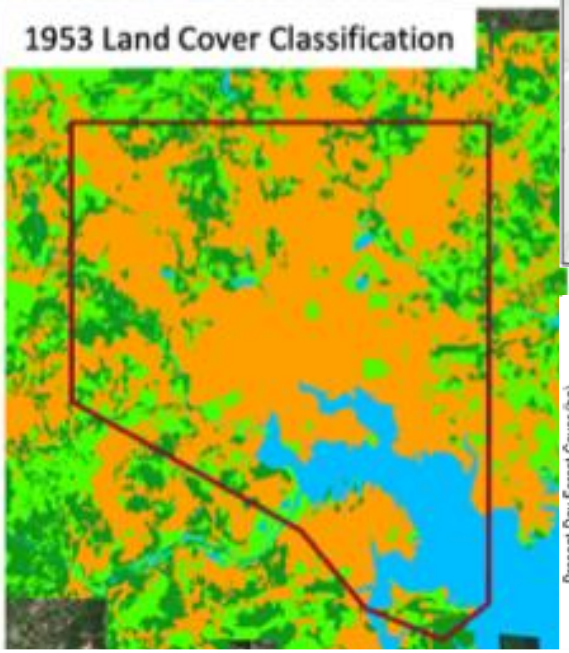


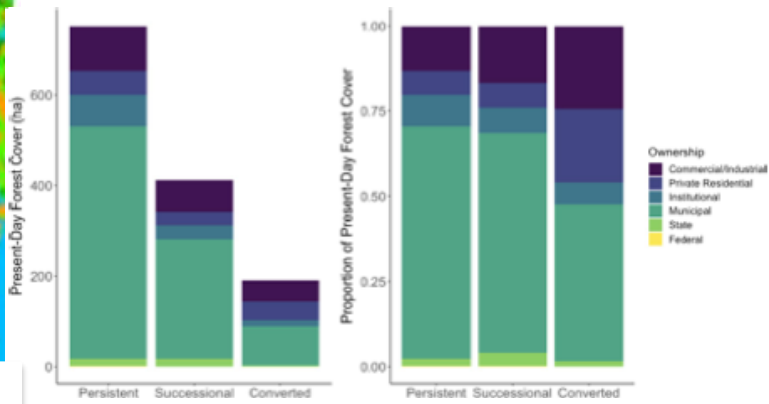












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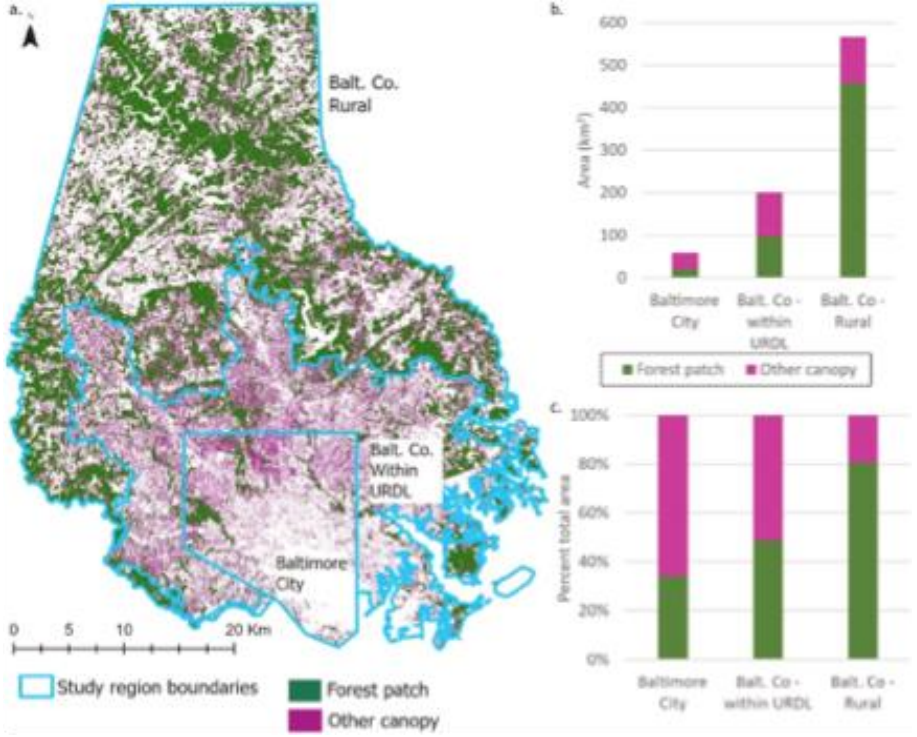
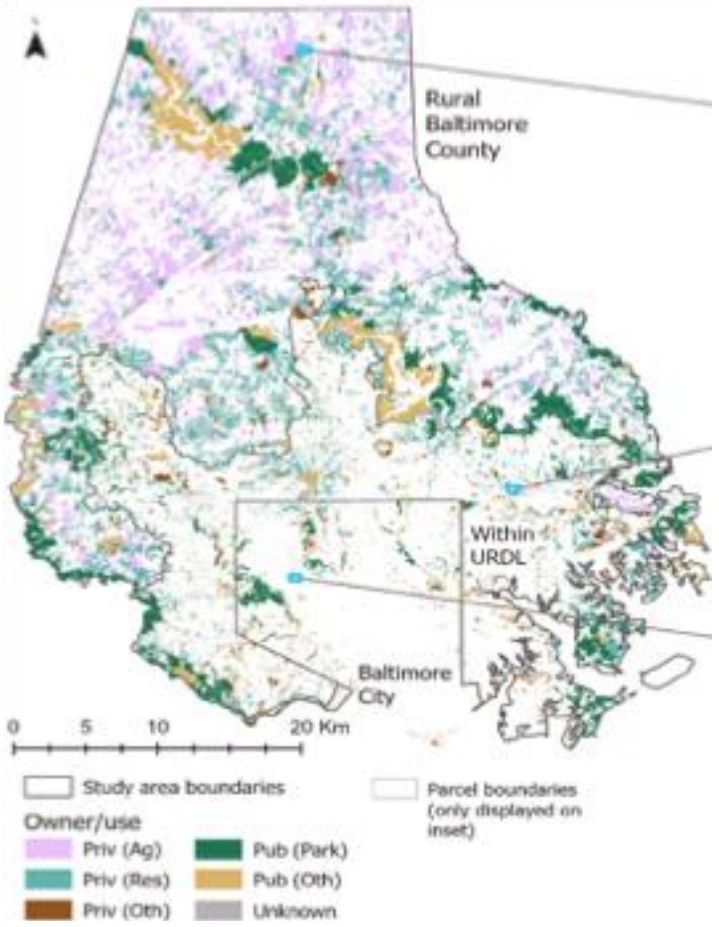
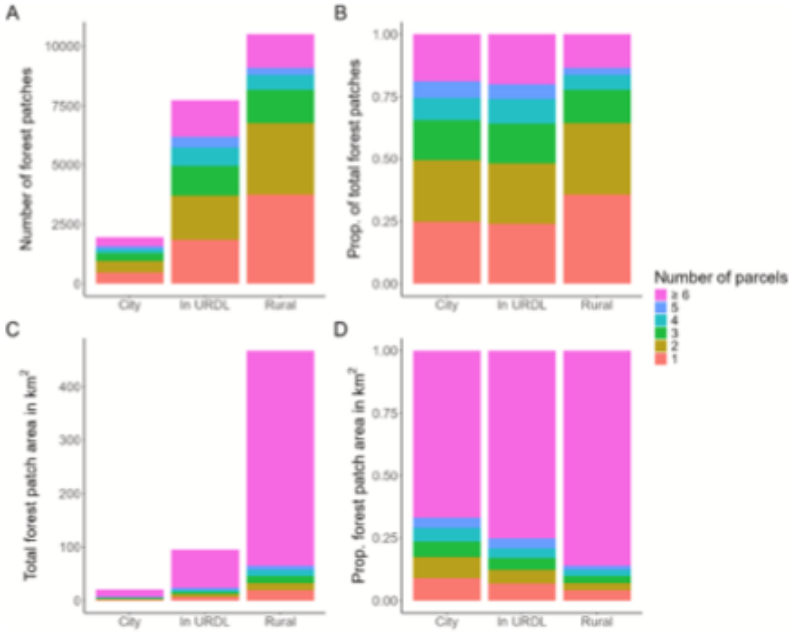


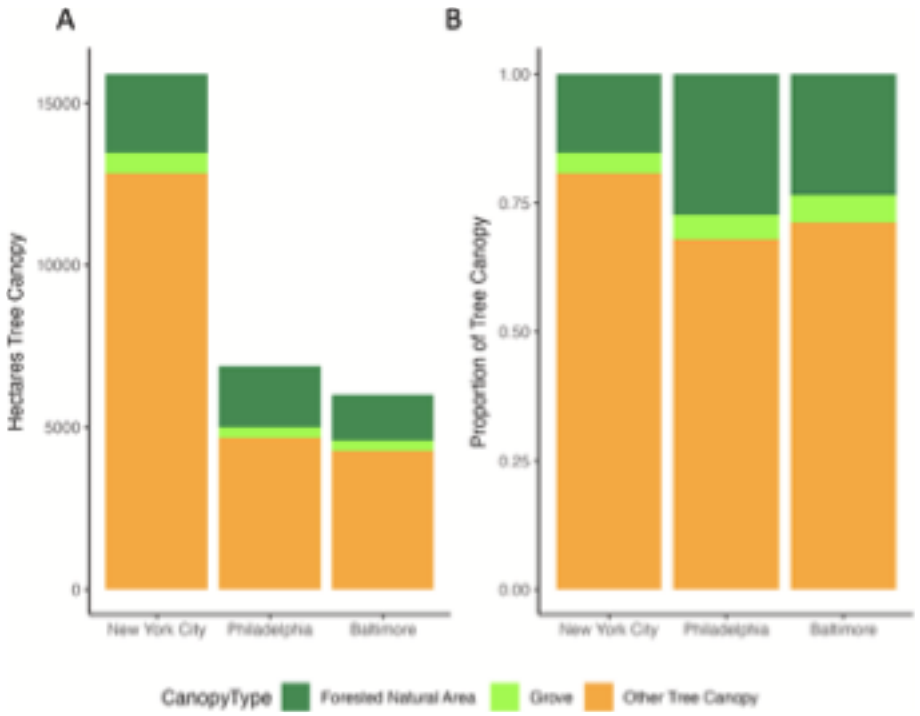


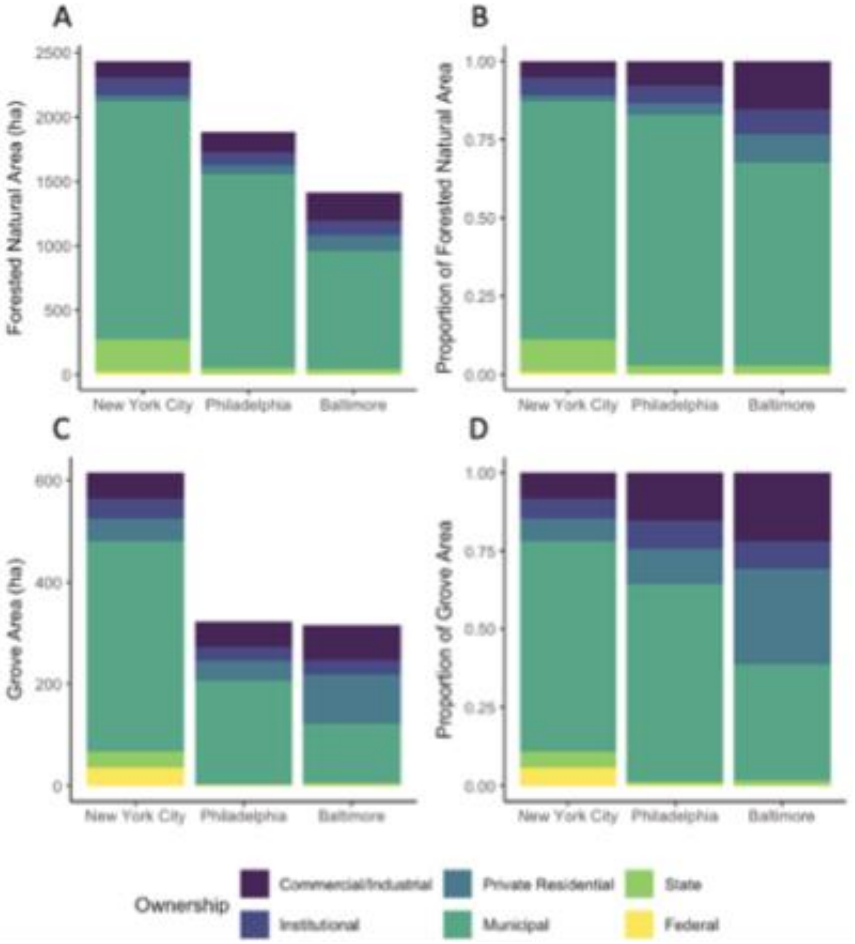


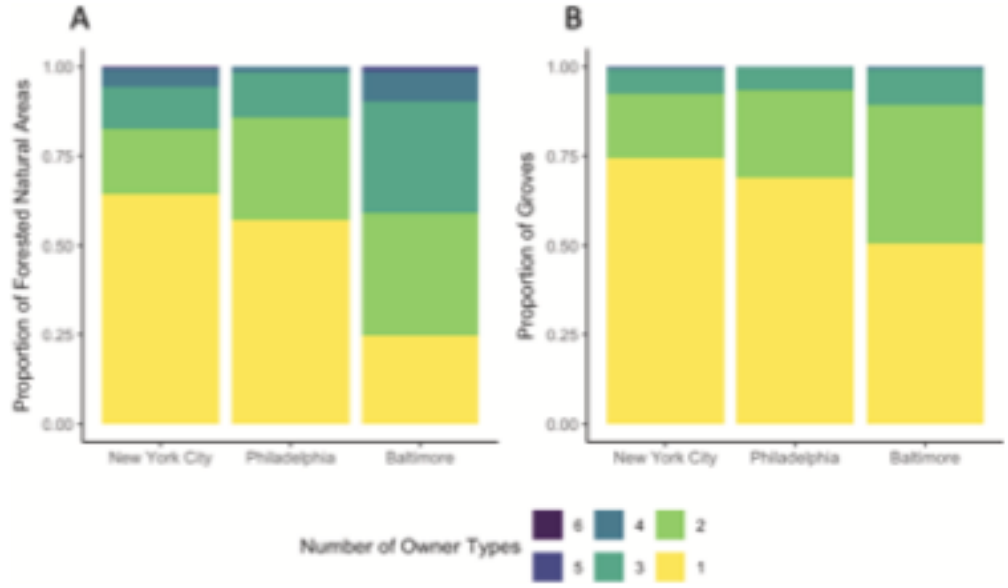
Ownership and use of forest patch area by region, in total area (km^2) and percent of all forest patch area in the region.

	City		County – In URDL		County – Rural	
Owner (Use)	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Public (Park)	7.6	37.4	12.6	13.3	85.6	18.3
Public (Other)	3.5	17.2	14.8	15.7	49.1	10.5
Private (Ag.)	0	0	1.4	1.5	159.3	34.1
Private (Res.)	4.2	20.7	36.9	39.0	143.3	30.7
Priv (Other)	4.1	20.2	18.8	19.9	14.2	3
Unknown	0.9	4.4	10.0	10.6	15.1	3.2
Total	**20.3**	**100**	**94.5**	**100**	**466.5**	**100**

Mockrin et al. 2025 UFUG







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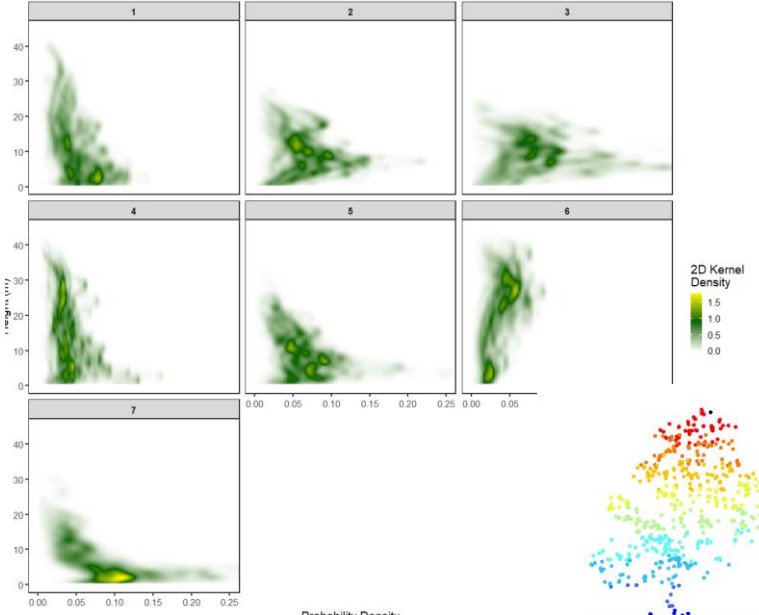
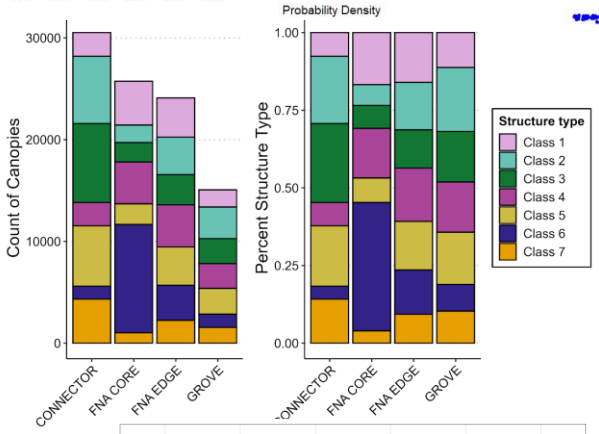
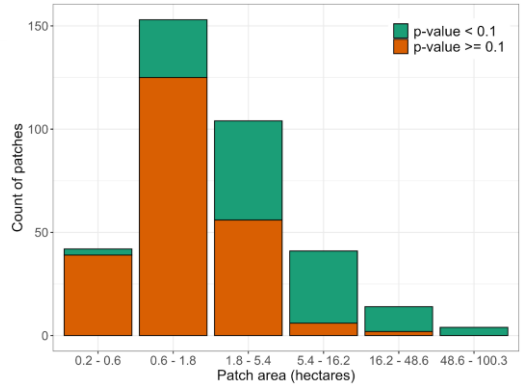
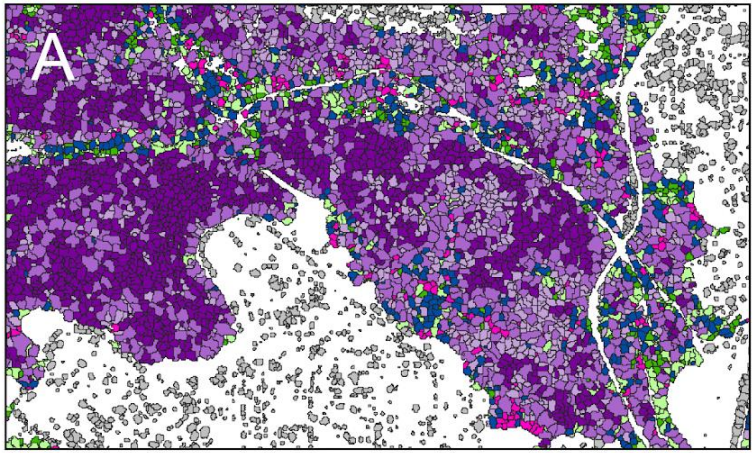
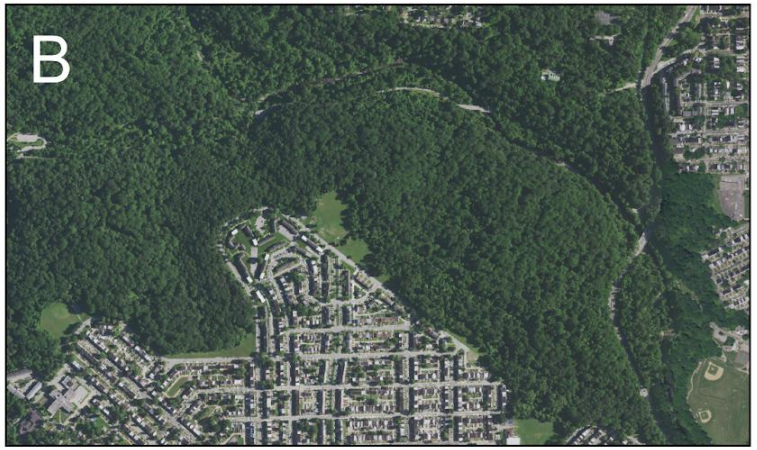
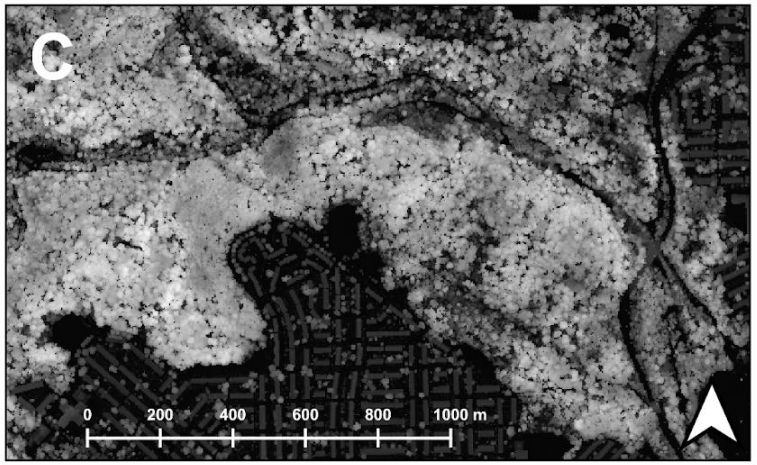

1
2
3
4
5
6
7
2D Kernel Density
1.5
1.0
0.5
0.0


Count of Canopies
Probability Density
Percent Structure Type
Structure type
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
CONNECTOR
FNA CORE
FNA EDGE
GROVE


p-value < 0.1
p-value >= 0.1
Count of patches
0.2 - 0.6
0.6 - 1.8
1.8 - 5.4
5.4 - 16.2
16.2 - 48.6
48.6 - 100.3
Patch area (hectares)


A
Cluster Class
Excluded canopy
1
2
3
4
5
6
7


B


C
0
200
400
600
800
1000 m
Surface Height (m)
49.1
0

High resolution data has transformed the way we deal with urban woodlands

- Characterize woodland structure and composition using a combination of field and geographic data sources
- Map the distribution of Baltimore's and other cities woodlands
- Link woodland characteristics and their impacts to ownership, stewardship, and management regimes
- To develop a system that can organize and facilitate information sharing within Baltimore and with other regions
- Mapping and monitoring condition and ecosystem services

Forest Semantics

- *Forest*, *Grove*, *Wood* all refer to areas covered with trees

- A **forest** is an extensive area, preserving some primitive wildness and usually having game or wild animals. e.g., Sherwood Forest; Black Forest

- A **grove** is a cluster of trees, usually not very large in area and cleared of underbrush, often tended or cultivated. e.g., shady grove; grove of pines; orange grove; walnut grove

- A **wood** resembles a forest but is a smaller tract of land, less wild in character, and generally closer to civilization. e.g., lost in the woods; a wood covering several acres.

- **Forest patch** is a wood, possibly remnant of larger forest