Mapping forest structure along the southern Blue Ridge Parkway from LiDAR

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Blue Ridge Parkway
Research and Science Symposium
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Focus

(1) Motivating questions:

- How different is the BRP from surrounding lands?
- Can we see *edge effects* to structure that are important for management?

(2) The dataset:

- 2005-06 North Carolina LiDAR for western NC including 13 counties; roughly 14.5 million 60 foot grid cells (~1,800 mi^2)

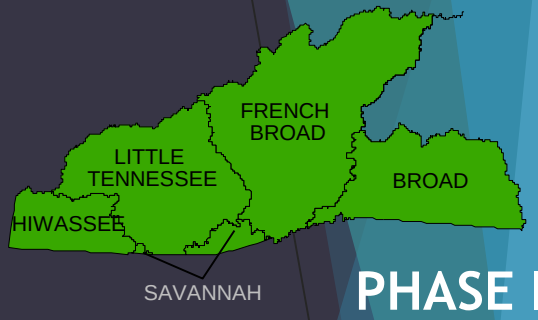
(3) LiDAR products used in analysis:

- Maximum vegetation height
- A full above-ground structural classification involving ~479 million gridded 5’ height band values and billions of LiDAR returns

NC Airborne LiDAR dataset and processing

Phase III data collected for flood hazard mapping (leaf off, 2005-2006). Use of above ground aspects (veg.), an after thought.

Max canopy height at 60' grid resolution was calculated from a high-resolution LiDAR DEM from same effort.



PHASE III

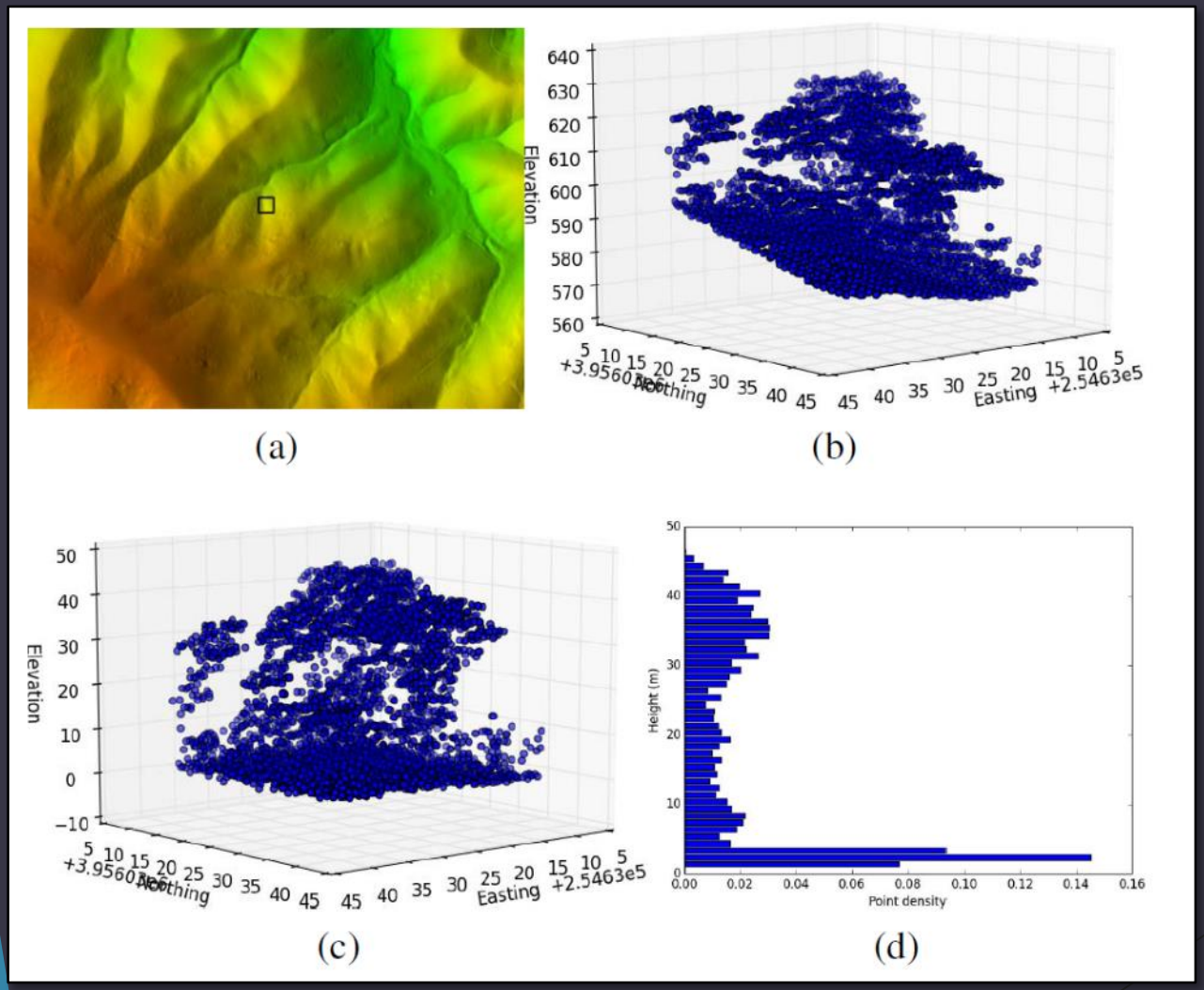
Classification of vertical structures:

(1) Point height calculated from high res DEM
(2) Extreme values removed
(3) Density calculated across 5 ft. height bands
(4) Relative density calculated as % of above ground points in each band
(5) Non-hierarchical K-means clustering reiteratively identified 10, 20, 40, 75 and 200 unique structural types

The processing was conducted using a supercomputer at Oak Ridge NL

Subsequent landscape analysis used a 250,000 random point sample of various rasters for jurisdictional, land use history, vegetation compositional and topographic gradient analysis.

LiDAR data preparation



(a) Location of a cove grid cell.

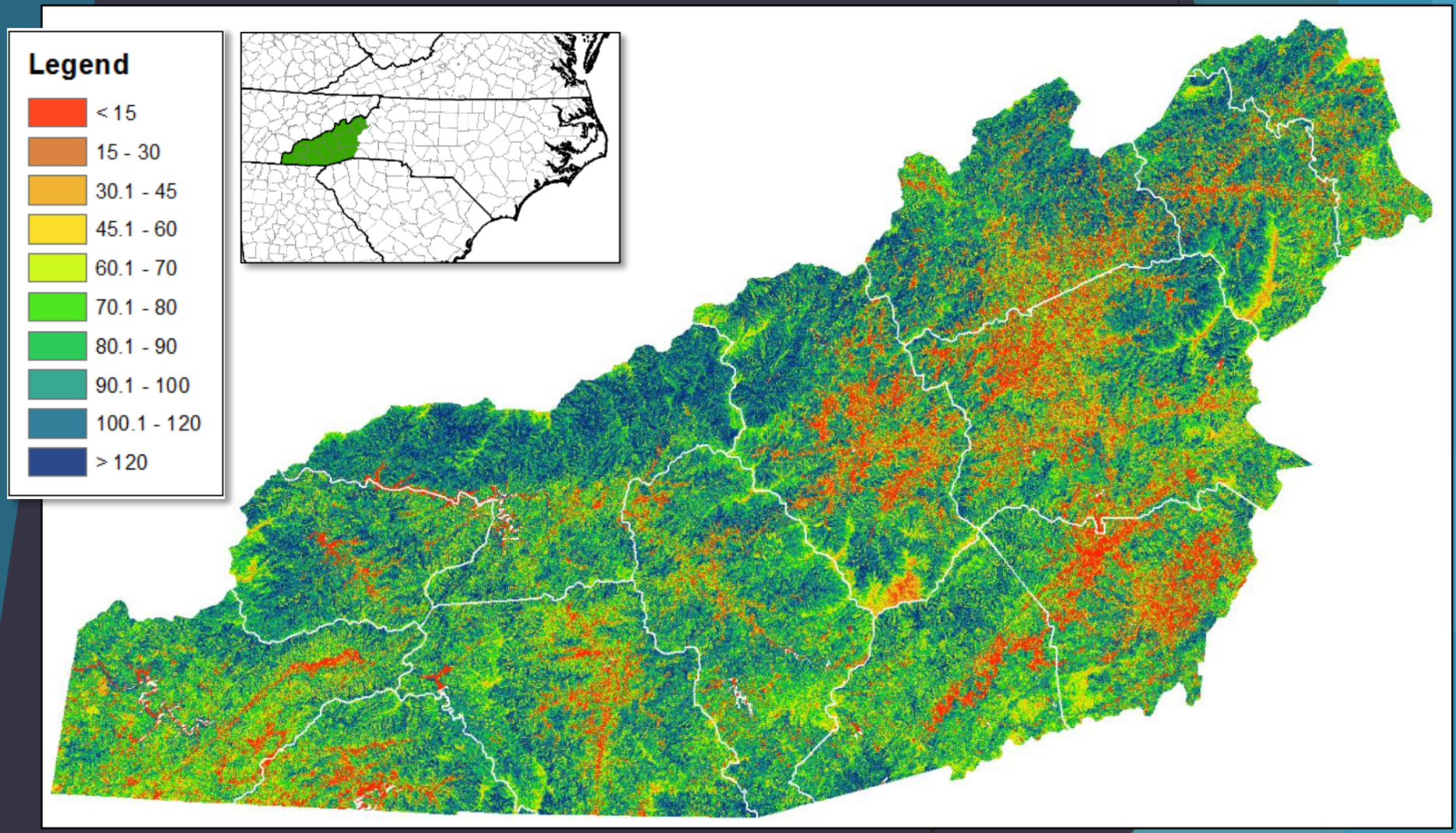
(b) The raw LiDAR point cloud.

(c) LiDAR cloud after slope detrending.

(d) Vertical density profile

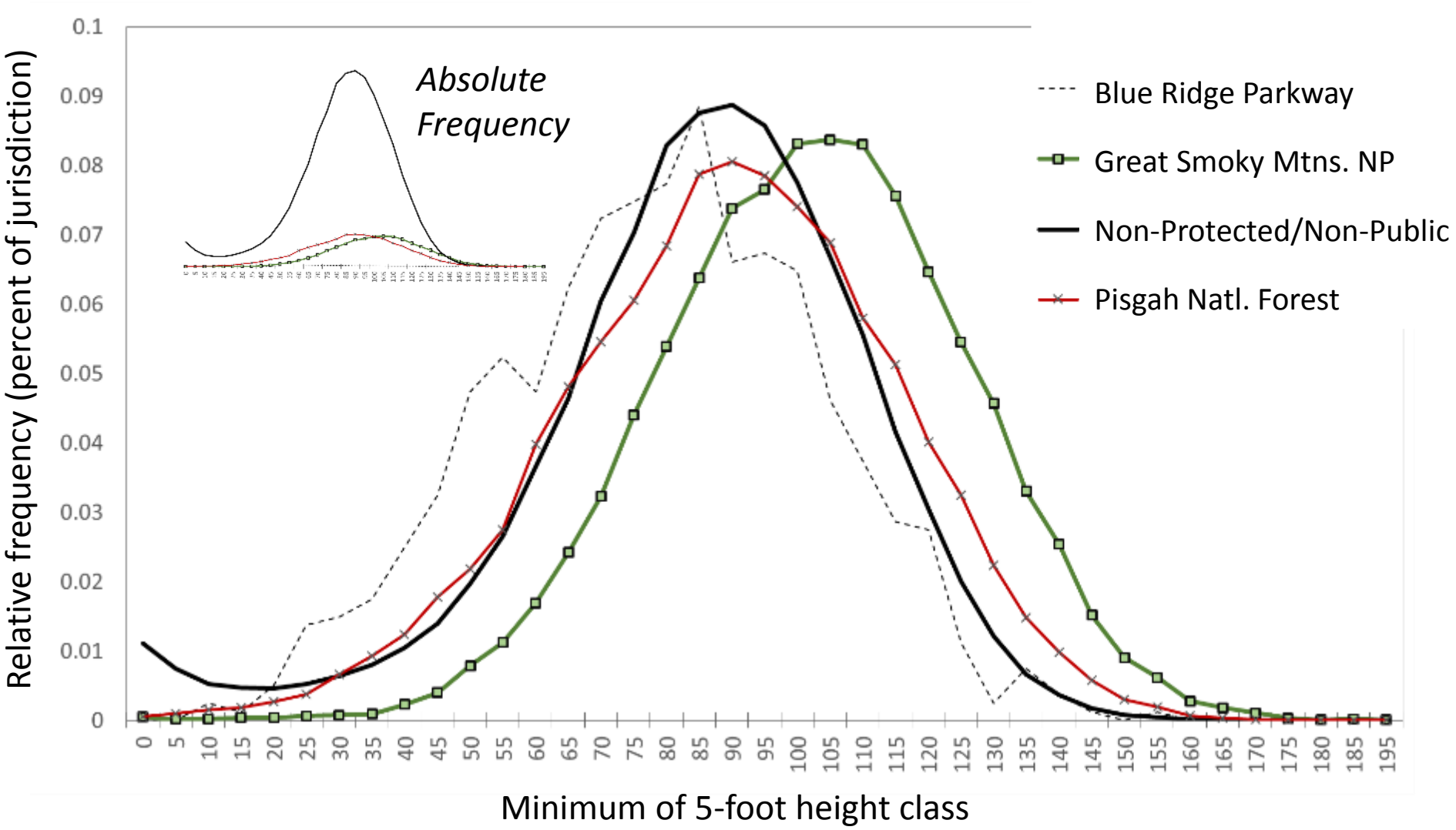
Maximum vegetation height from LiDAR

Across a 13-county area of western NC



Distributions of max. height by jurisdiction

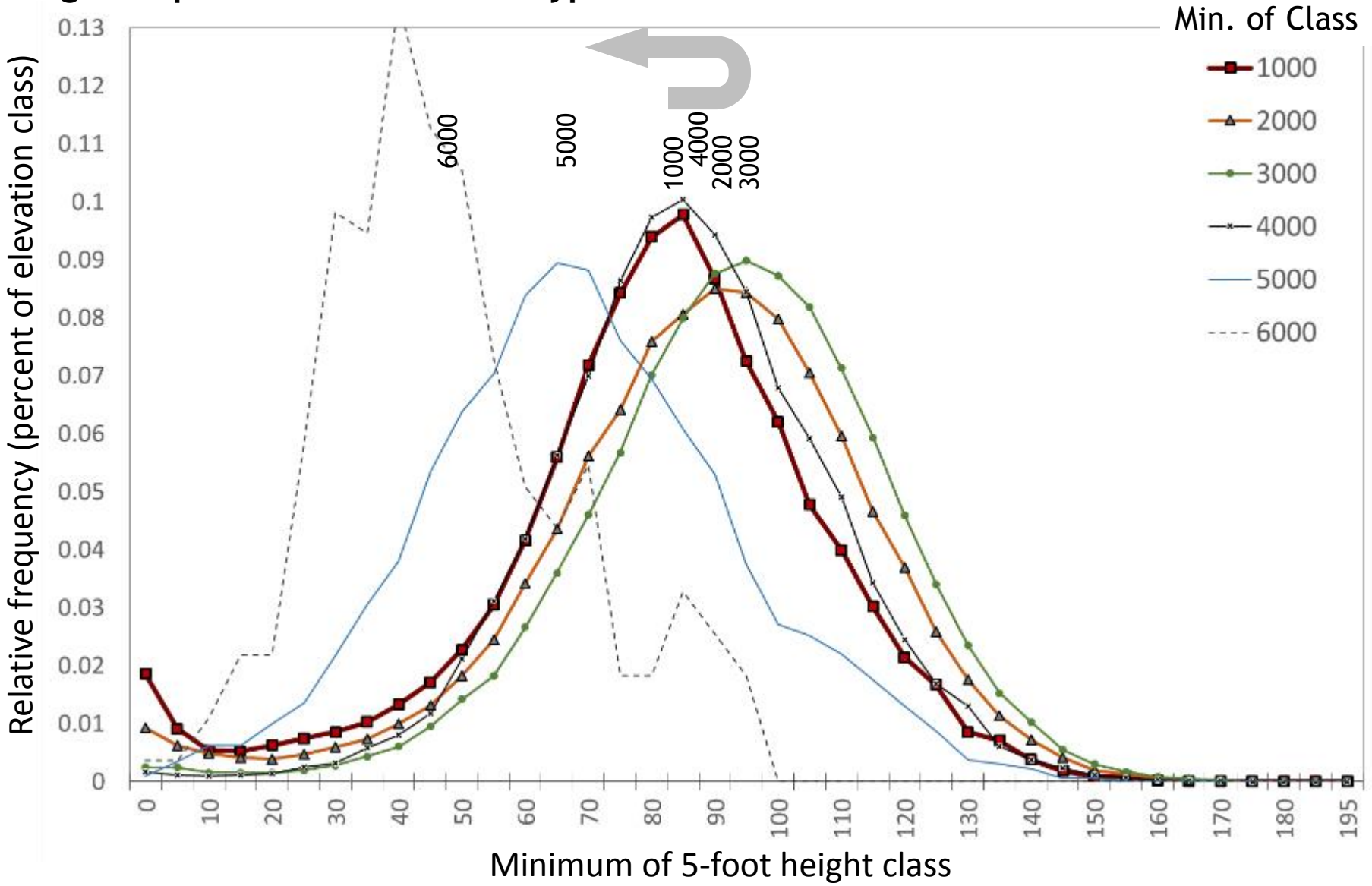
Regional pattern of "Natural" types



N= BRP: 802; GSMNP: 19,839; Non: 120,514; Pisgah NF: 21,991 (Sum: 163,146)

Distributions of max. height by elevation

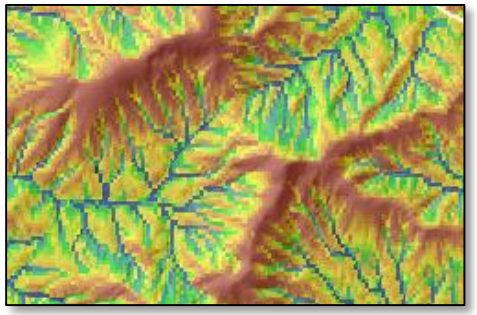
Regional pattern of “Natural” types



N=210,248 randomly sampled 20x20m LiDAR grid cells

Distributions of max. height by moisture index

Regional pattern of "Natural" types



Moisture Index

1 2 3 4 5

1_Very dry
2_Dry
3_Moderate
4_Moist
5_Very Moist

Relative frequency (percent of moisture class

0.11 0.1 0.09 0.08 0.07 0.06 0.05 0.04 0.03 0.02 0.01 0

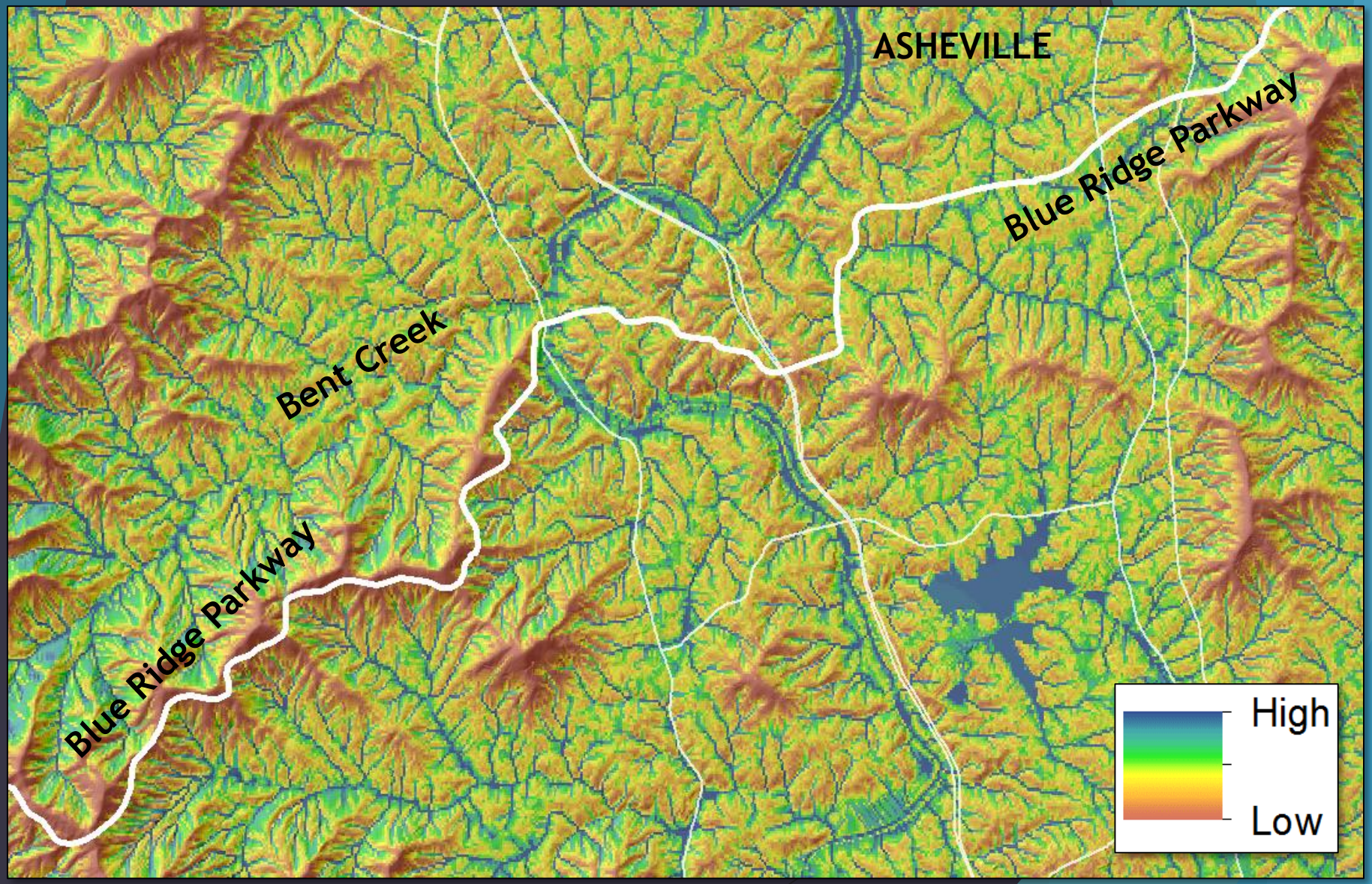
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 195

Minimum of 5-foot height class

N=210,248 randomly sampled 20x20m LiDAR grid cells

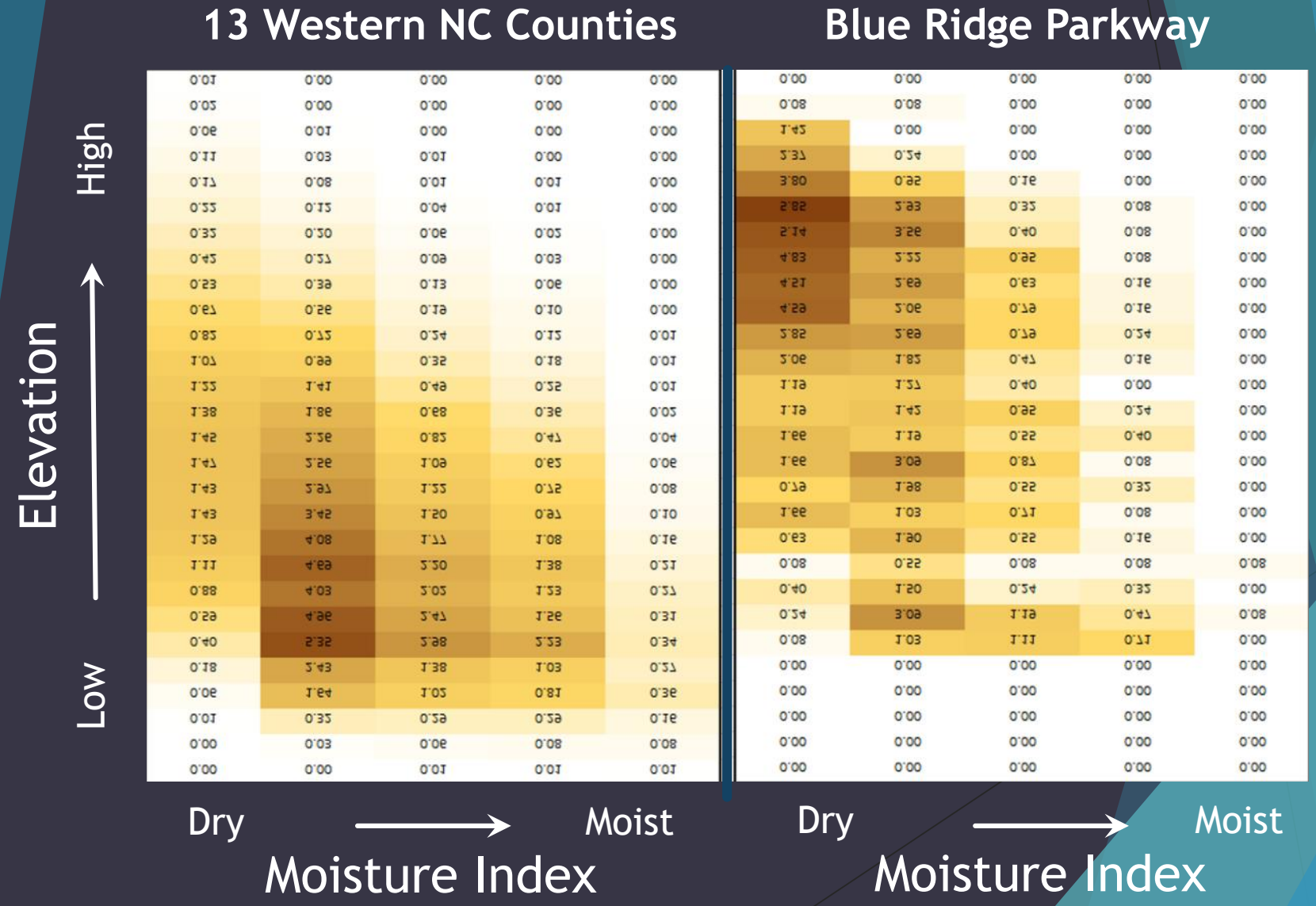
The Parkway's preference for high and dry sites

Topographic Moisture Index (TIMI)



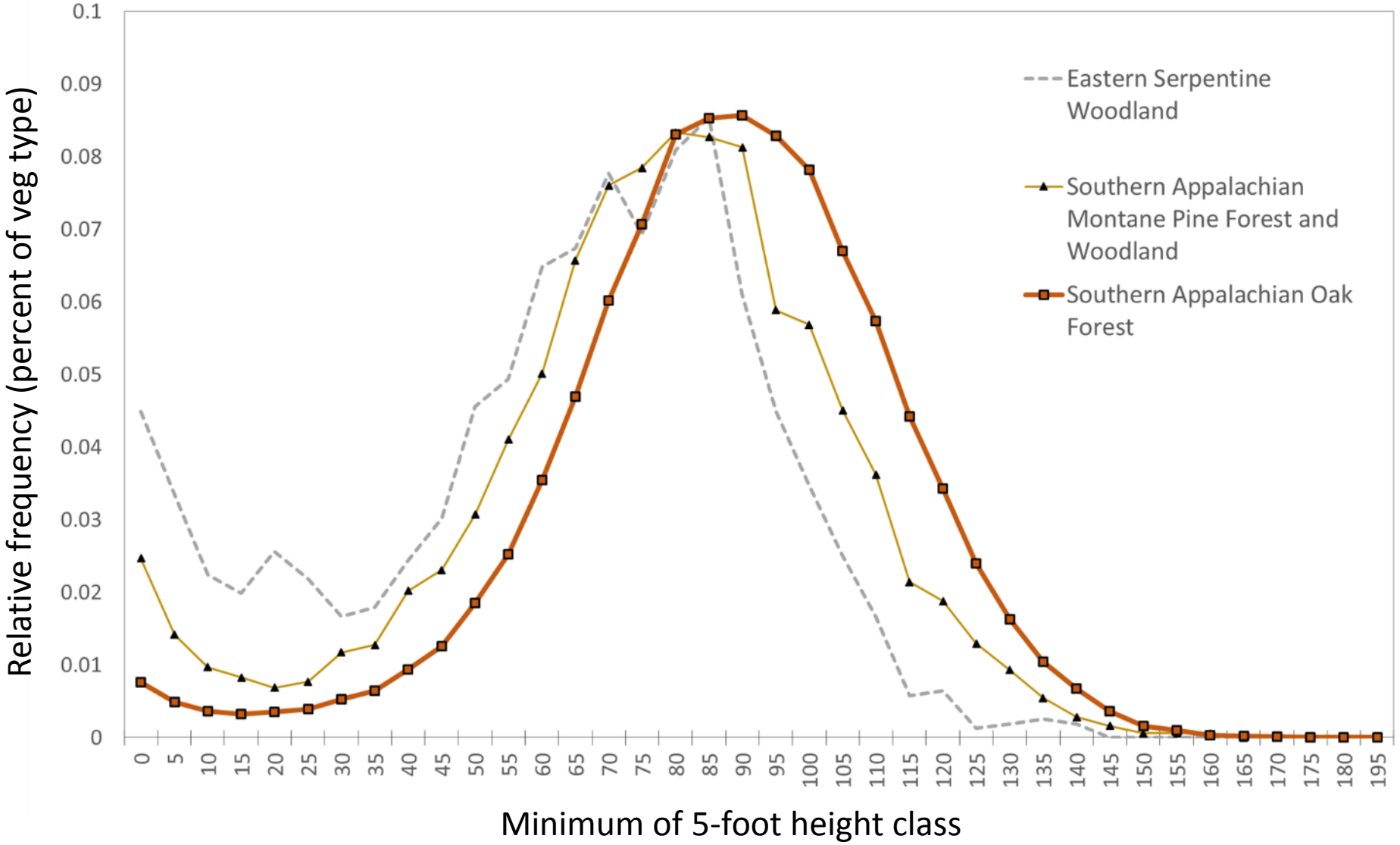
The NC Blue Ridge Parkway's "topographic niches"

As compared to "Natural" lands of the surrounding region



Distributions of max. height by compositional type

Regional pattern for selected xeric Landfire eVeg types



N= Serpentine woodland: 1,558; Pine forest-woodland: 4,945; Oak forest: 81,786

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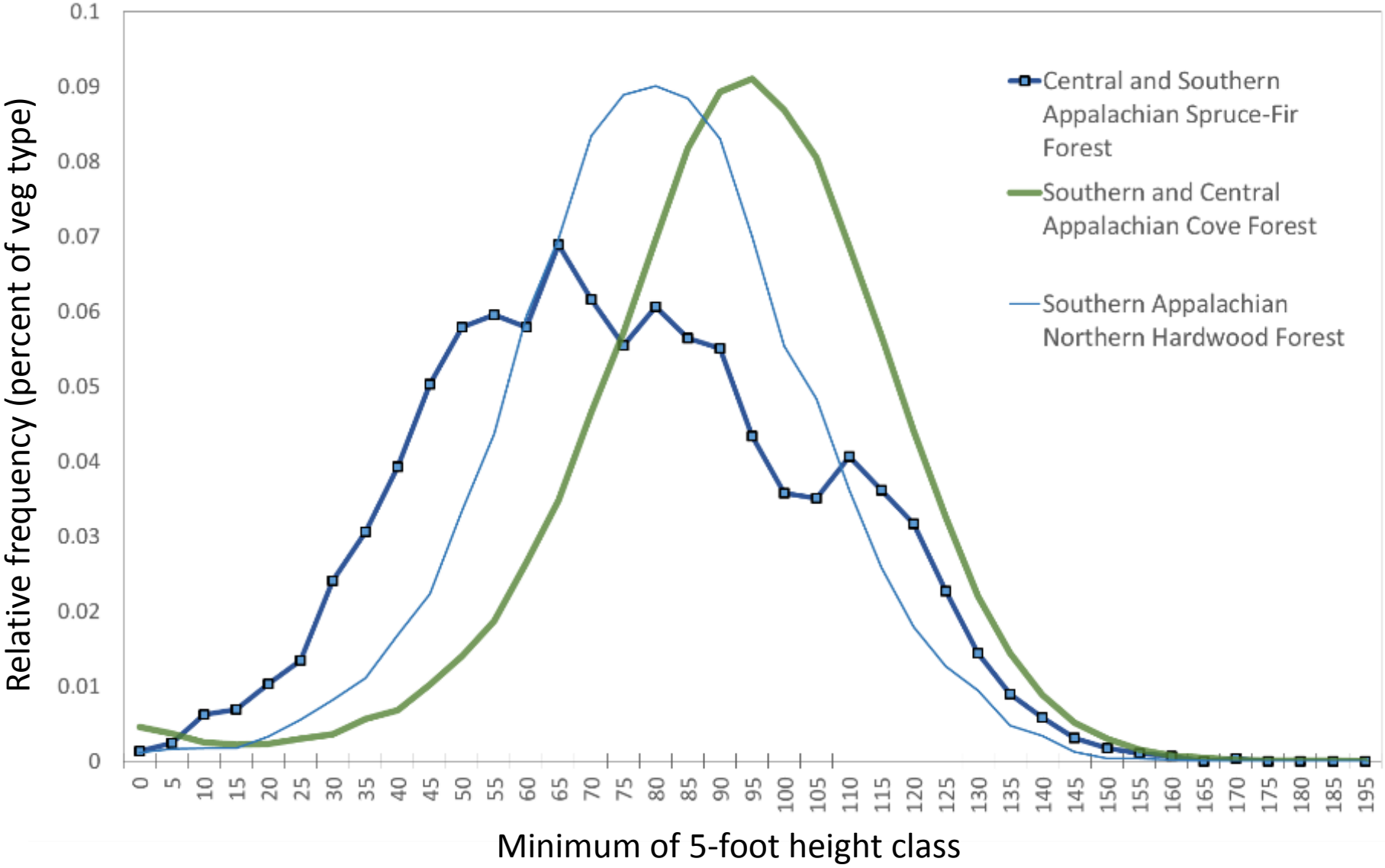
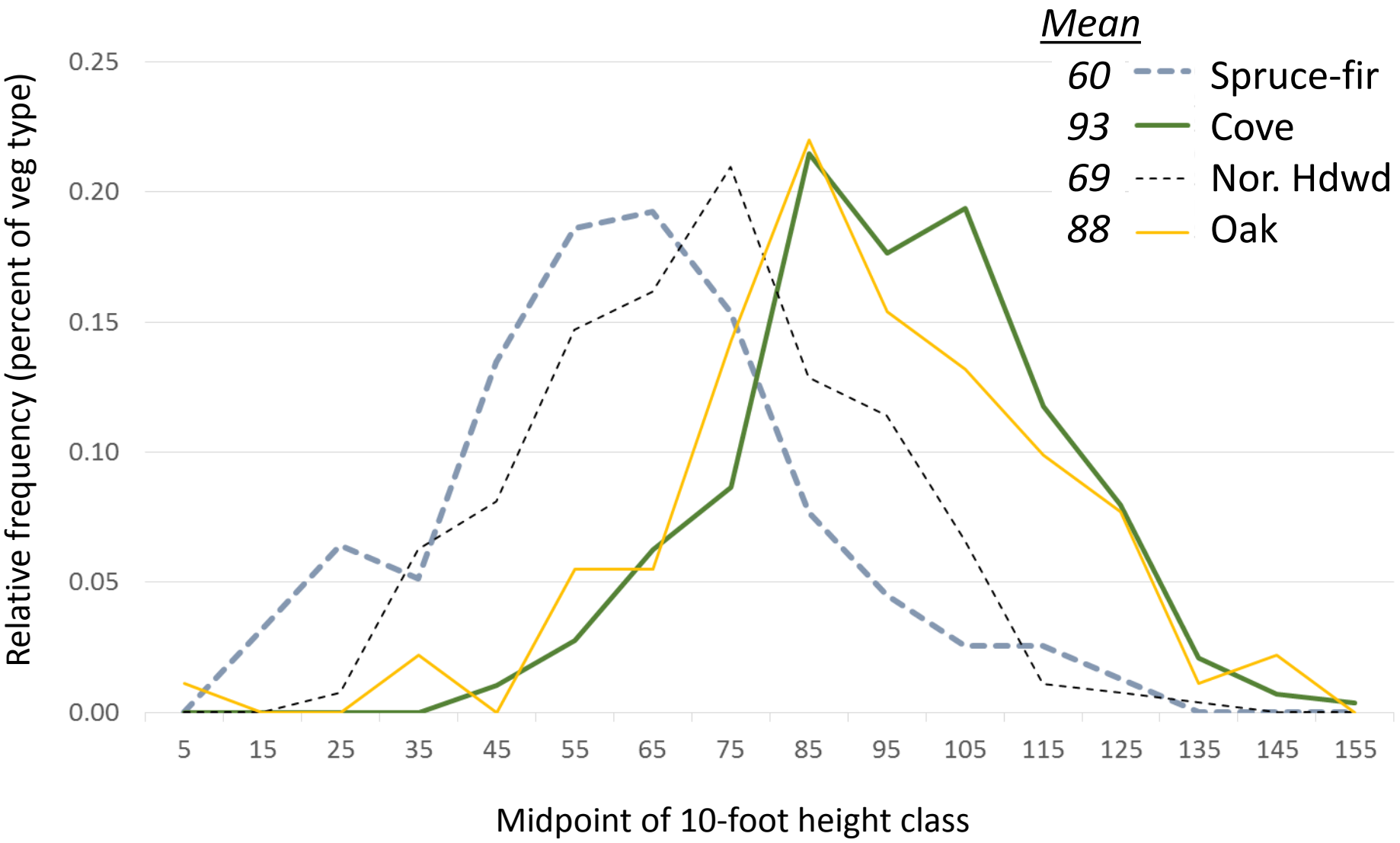
Regional pattern for selected mesic Landfire eVeg types



N= Spruce-fir forests: 2,904; Cove forests: 77,956; Northern Hardwood: 11,802

Distributions of max. height by compositional type

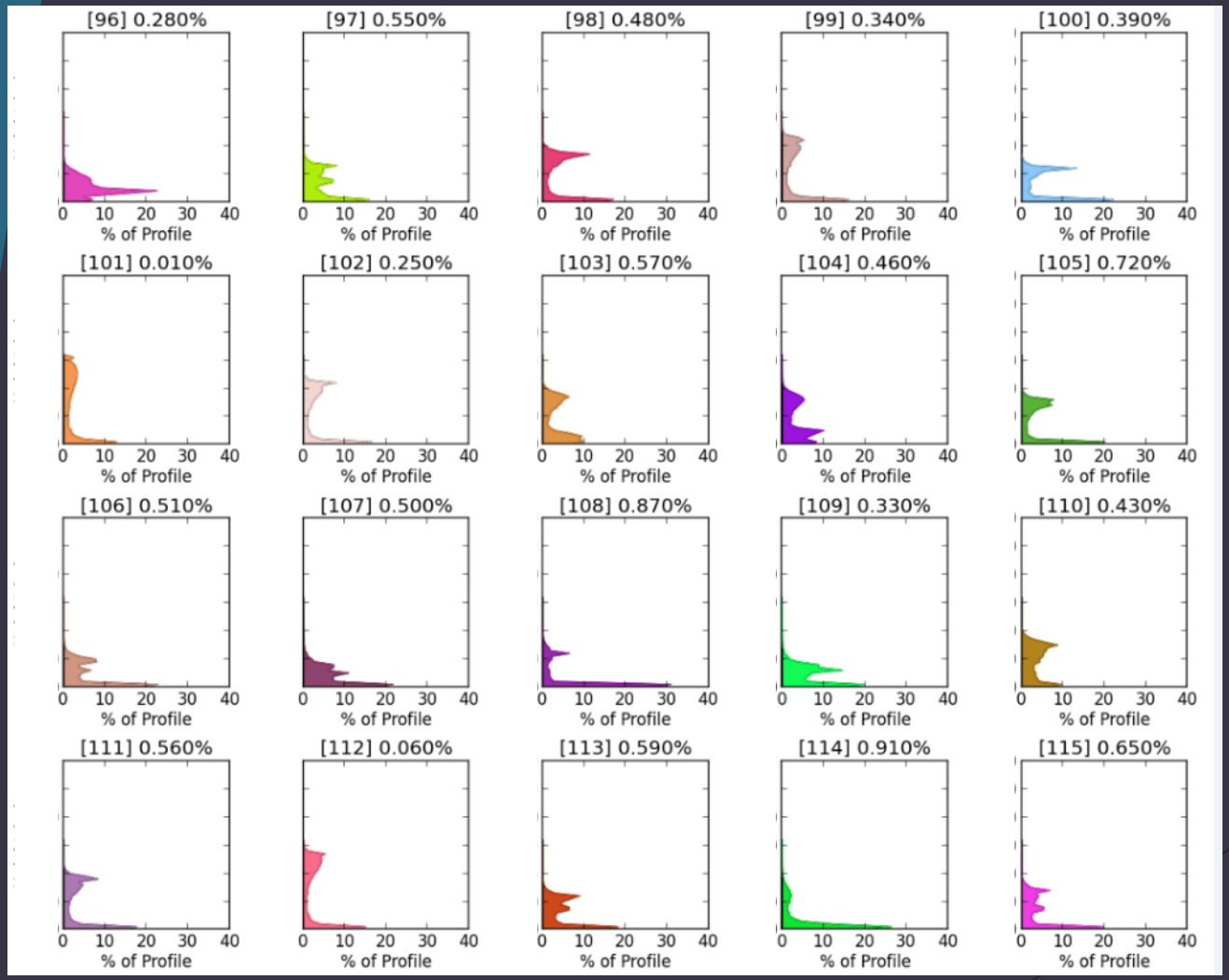
Blue Ridge Parkway for selected Landfire eVeg types

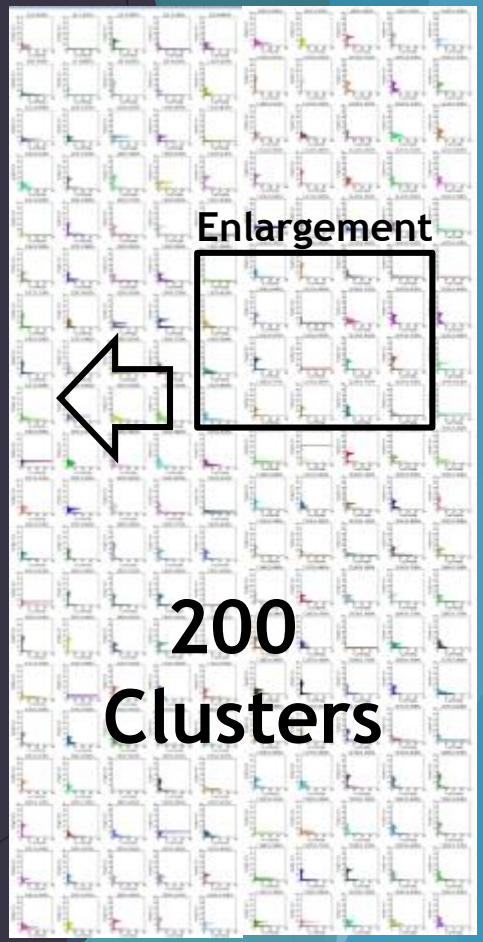


N= Spruce-fir: 156; Cove: 289; Northern Hardwood: 272; Oak: 91

The Structural Classification

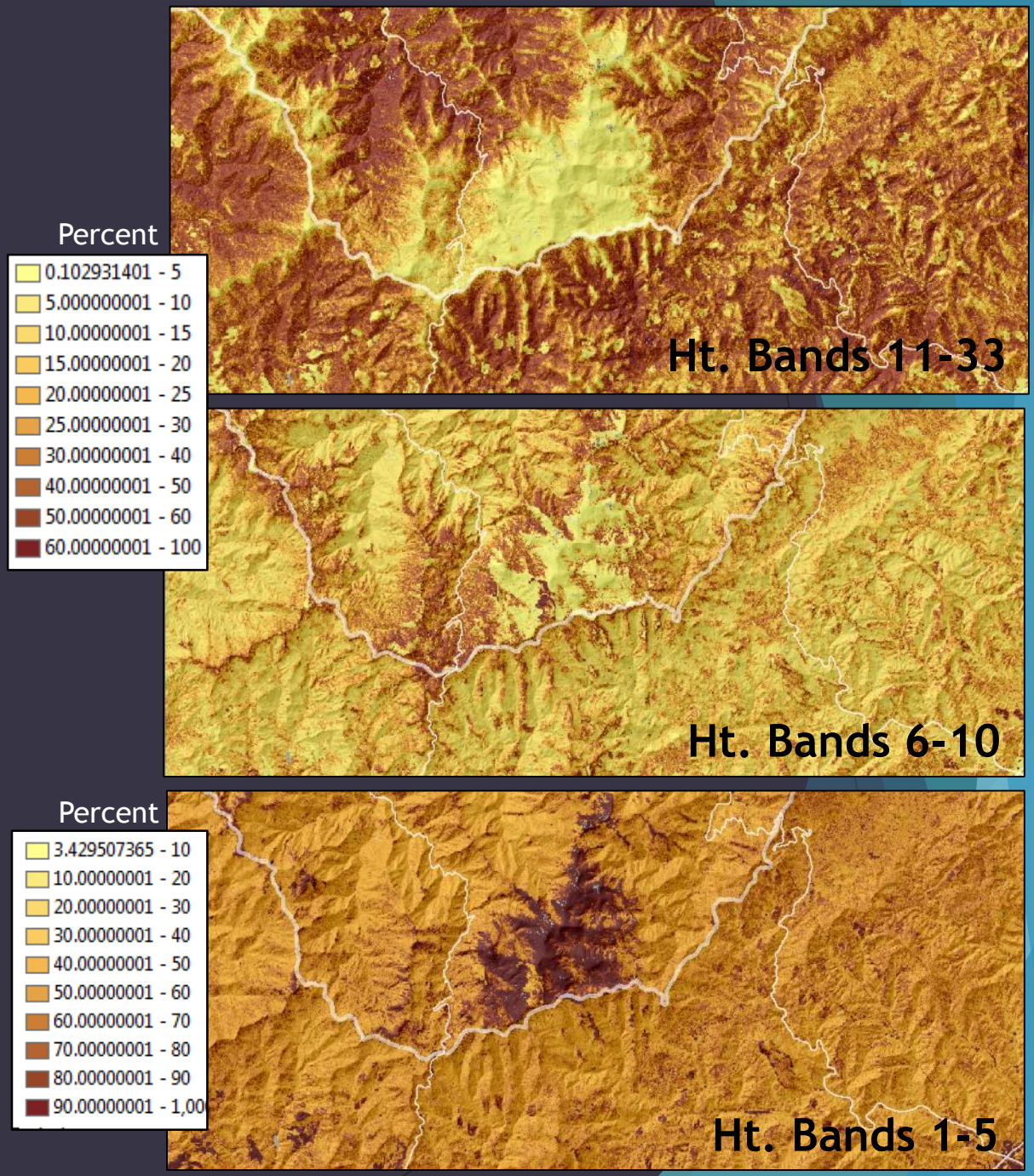
LiDAR relative density profiles for clusters





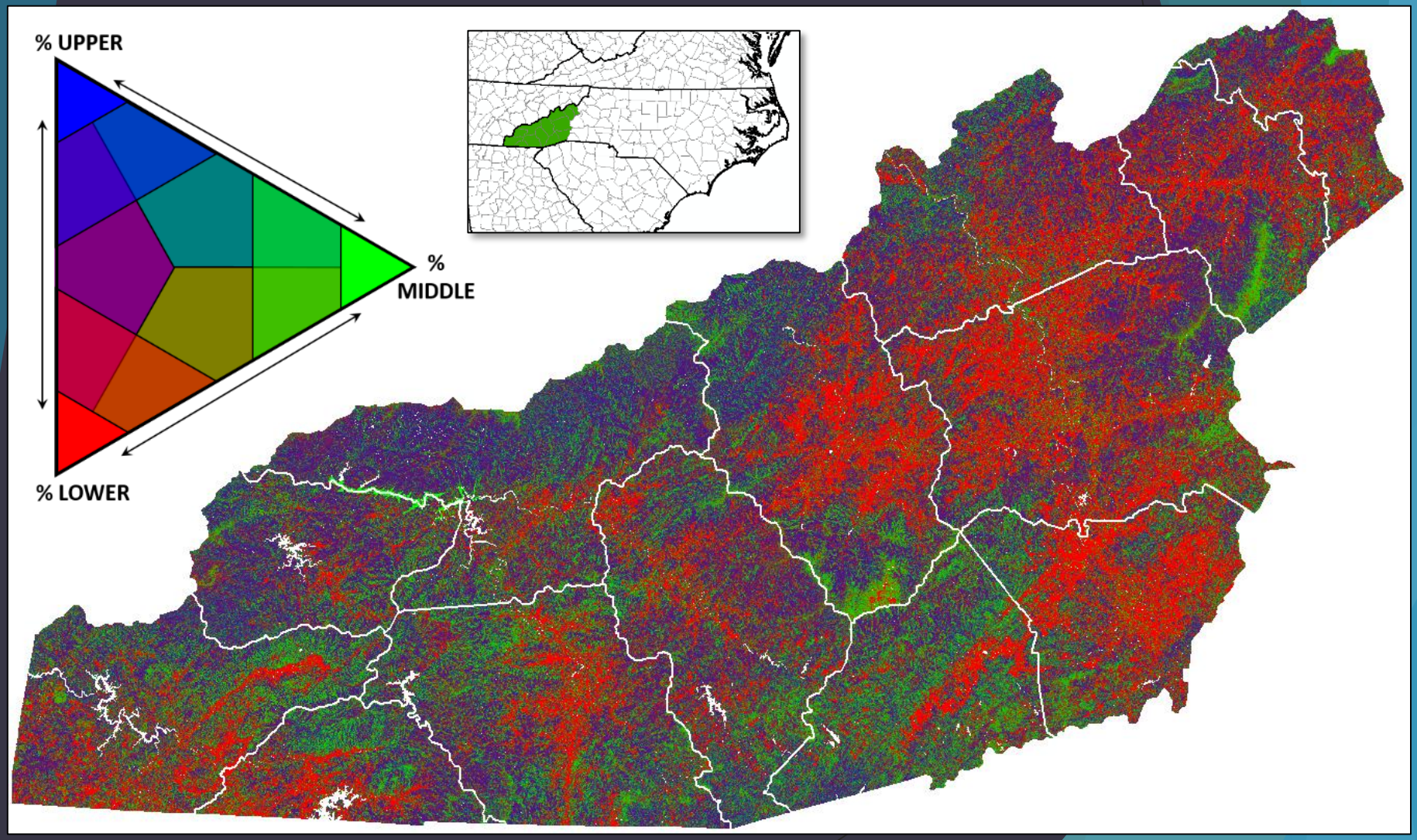
The Structural Classification

Relative proportion of LiDAR returns in Upper (bands 11-33), mid (6-10) and lower (1-5) fixed five-foot height bands for the greater Shining Rock Wilderness Area, Pisgah NF and Blue Ridge Parkway



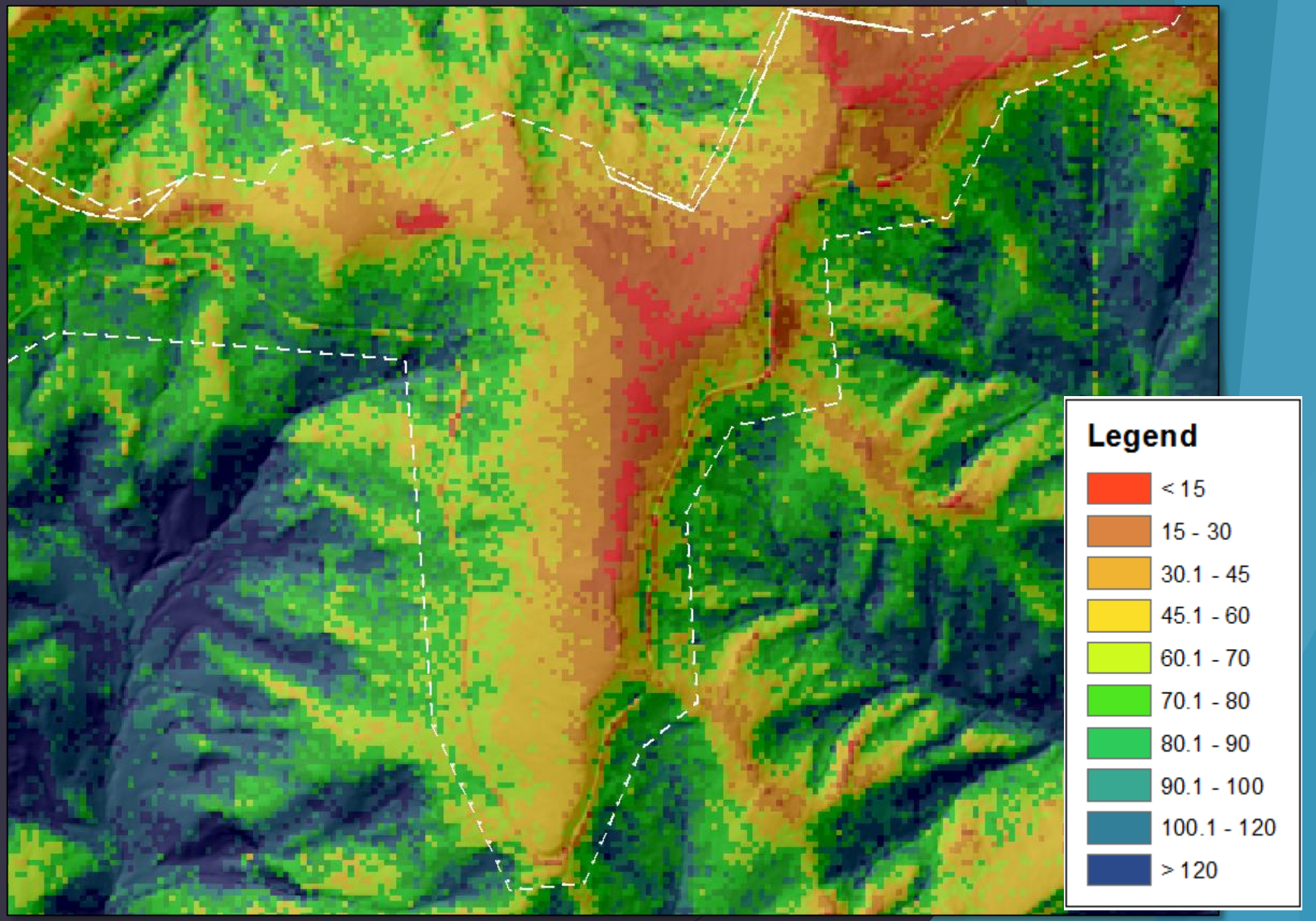
The Structural Classification

The relative importance of the three height zones in tri-polar (R-G-B) colors



Edge effects along the Blue Ridge Parkway

Craggy Mountains: Structural impacts of Parkway fragmentation



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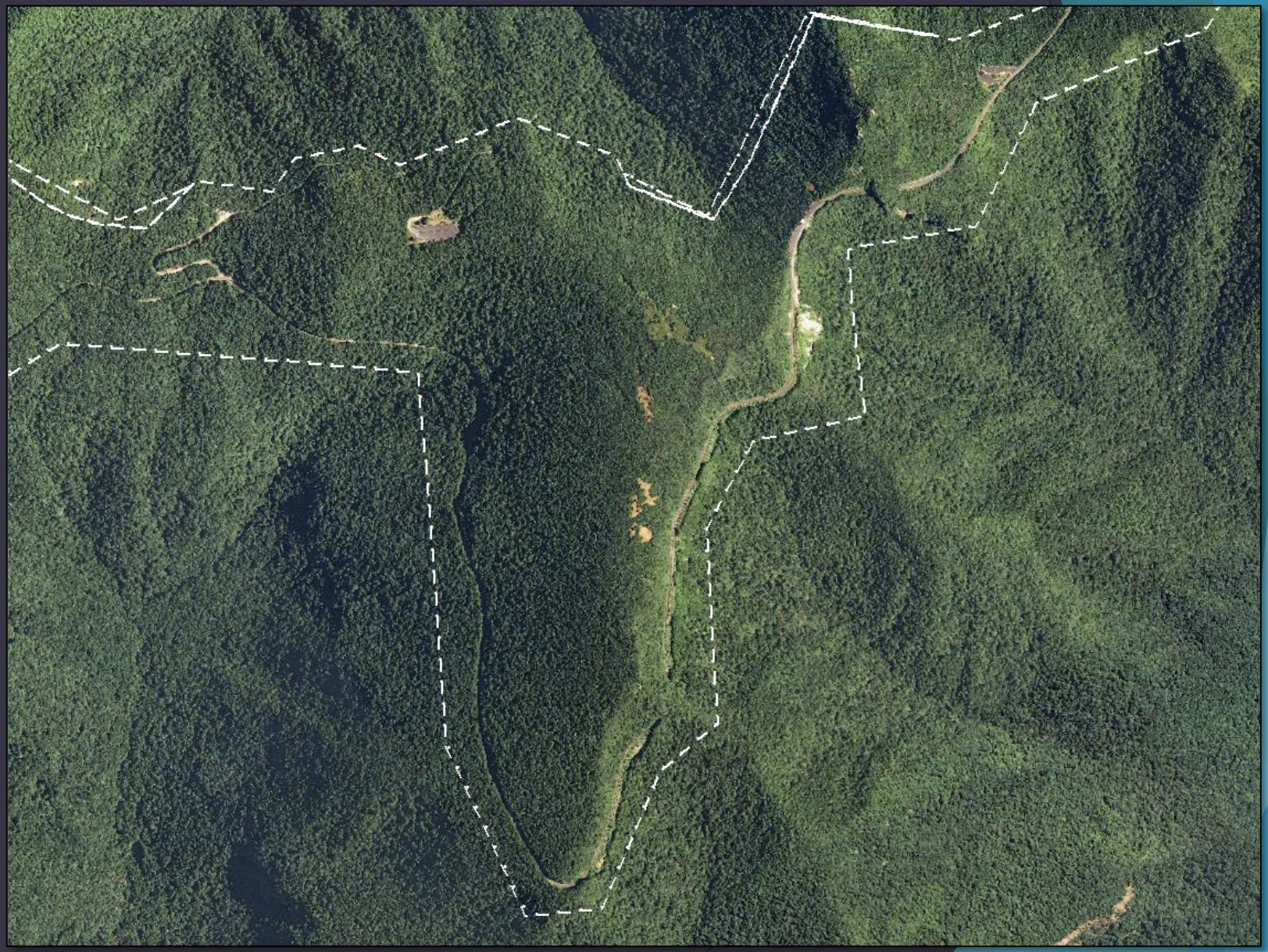

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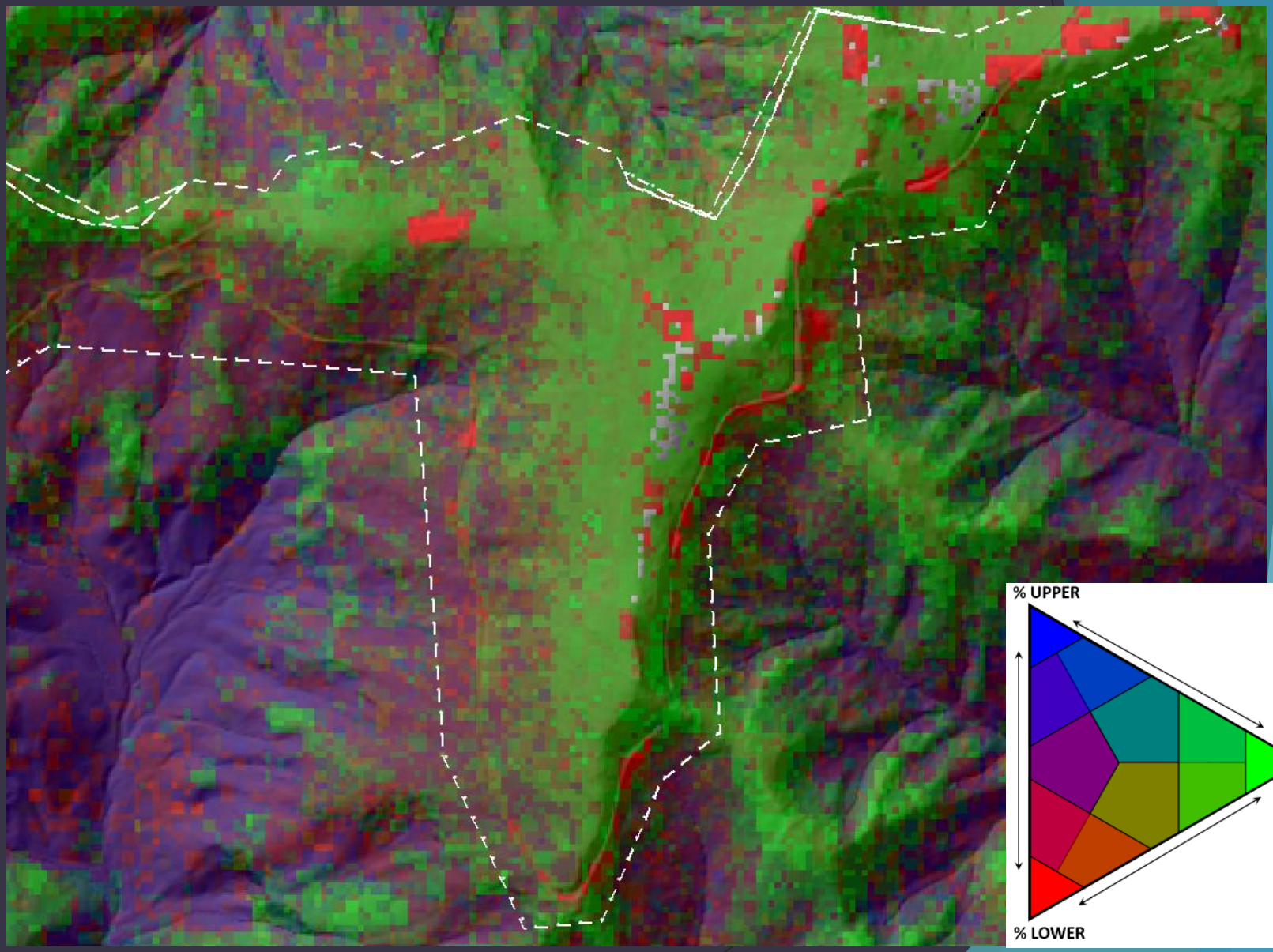
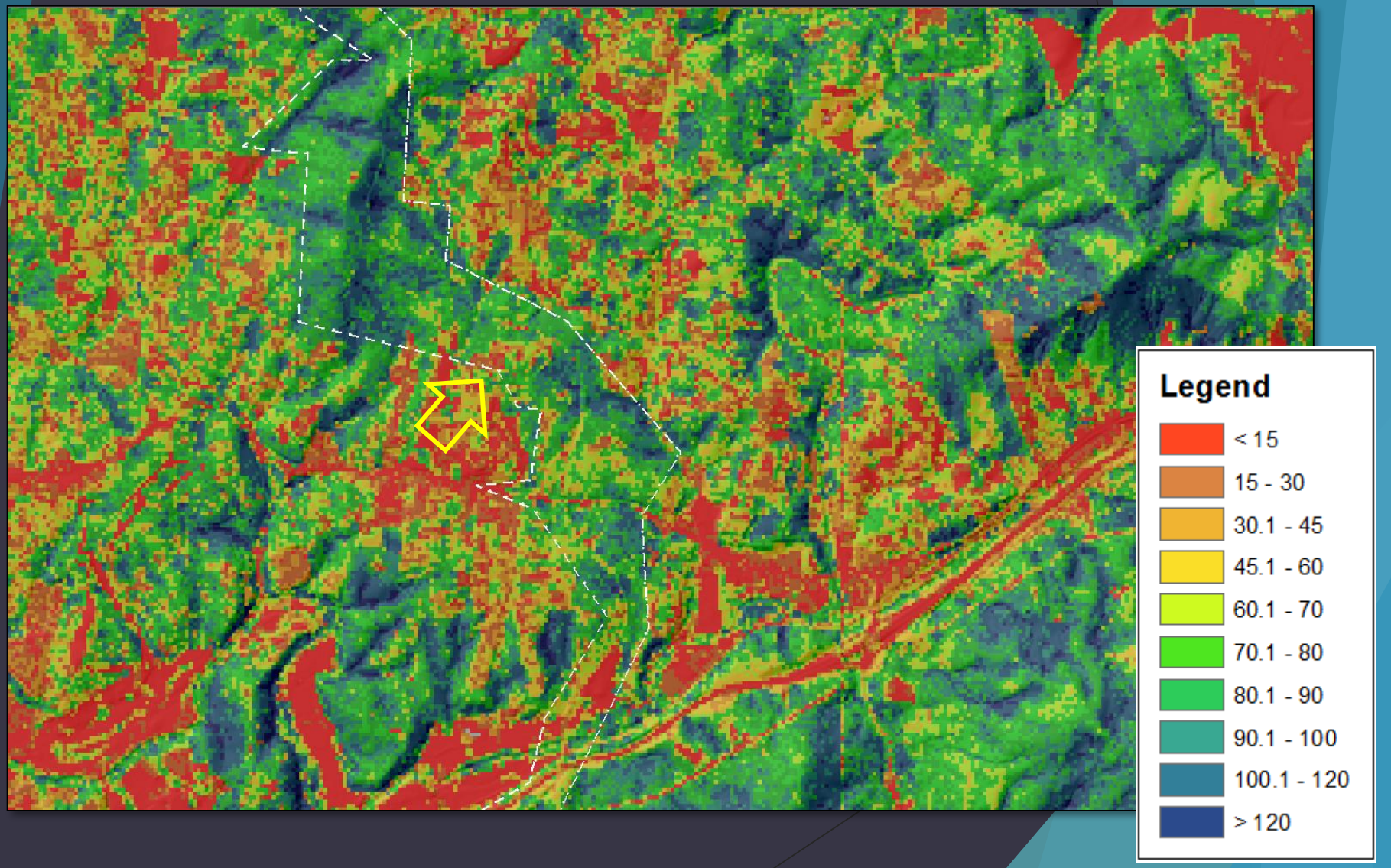


Edge effects along the Blue Ridge Parkway

Folk Arts Center: Structural condition when surrounded by private lots



Edge effects along the Blue Ridge Parkway

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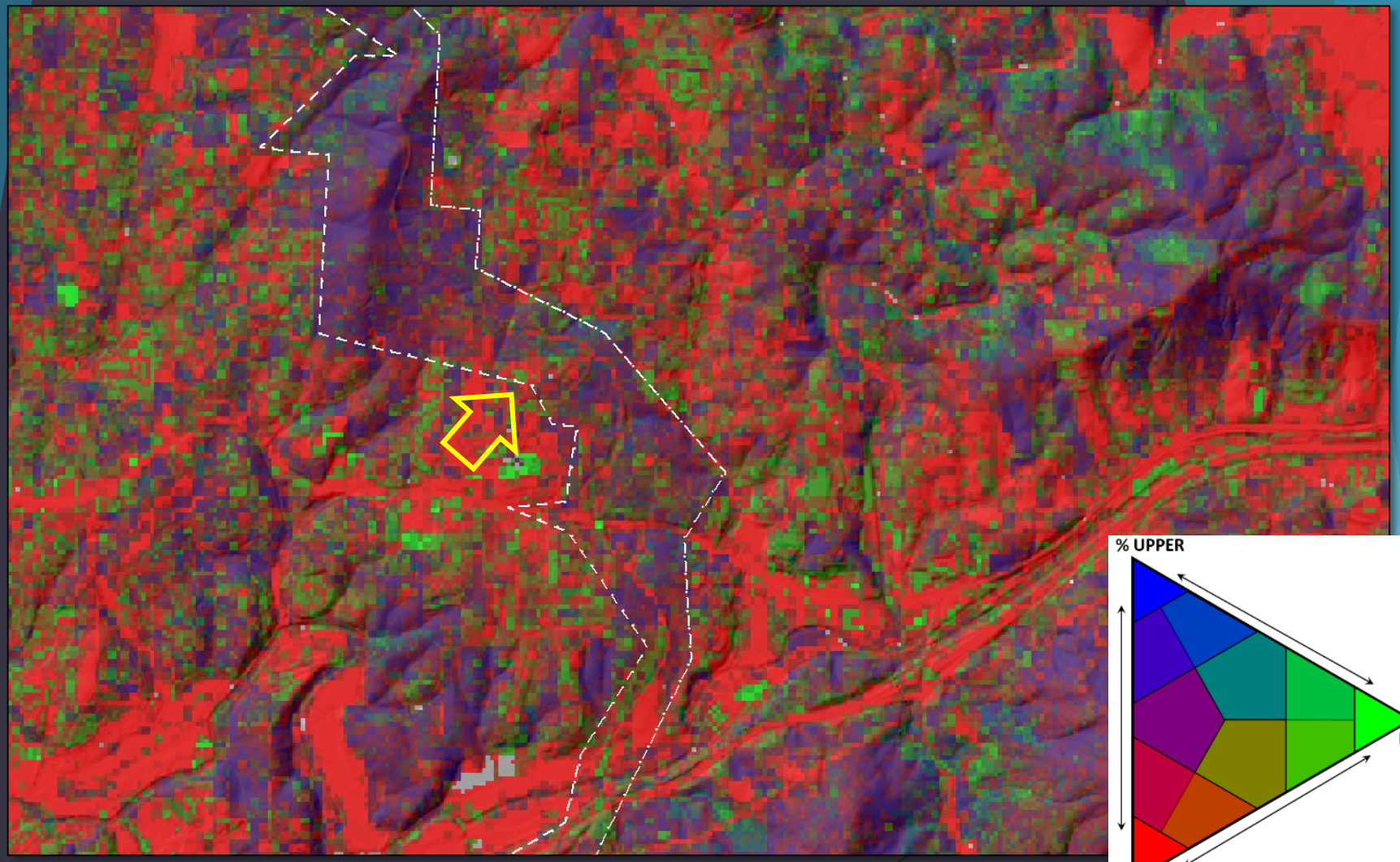
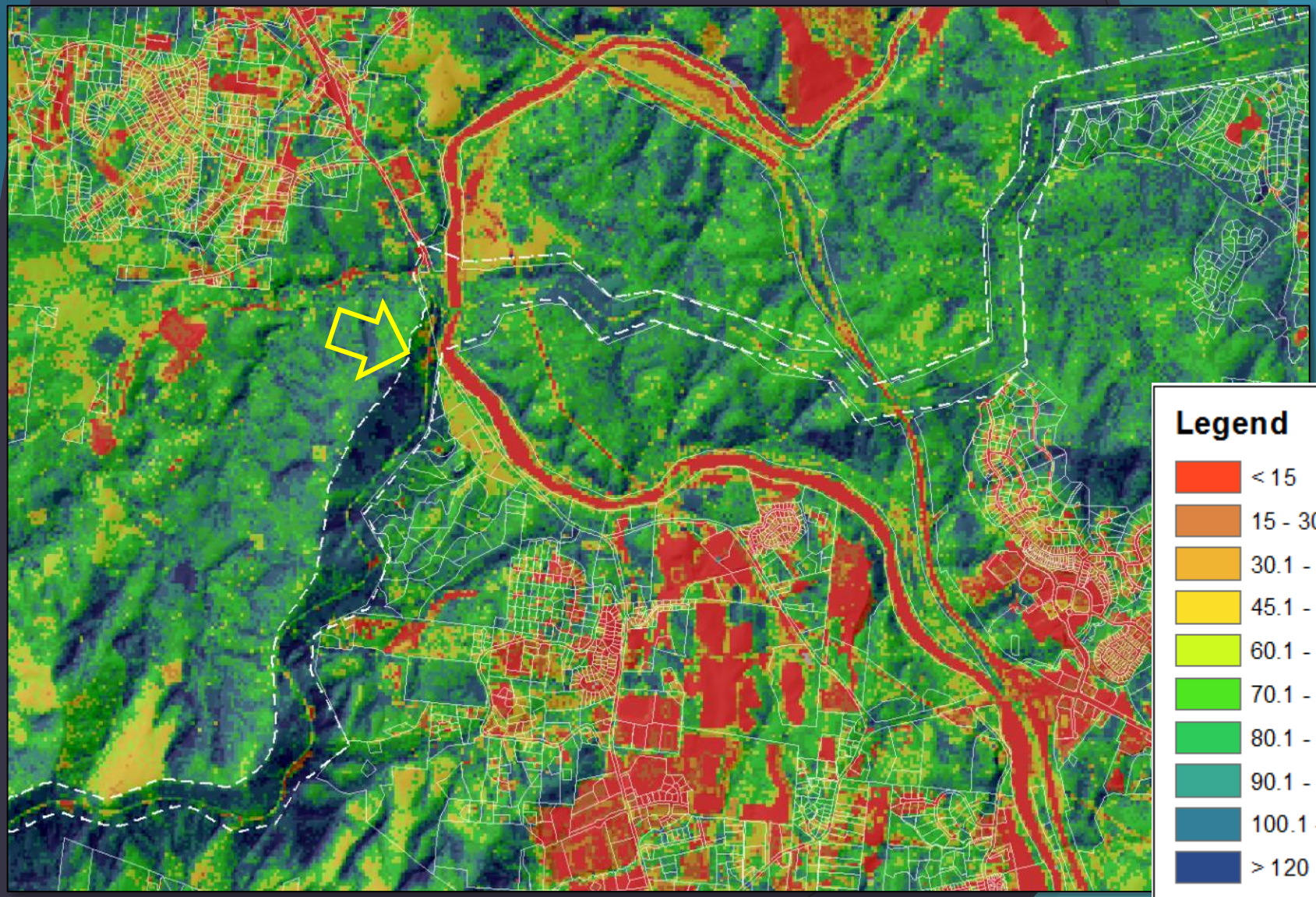


Edge effects along the Blue Ridge Parkway

French Broad Overlook: Structural impacts at the Wildland-Urban Interface (WUI)



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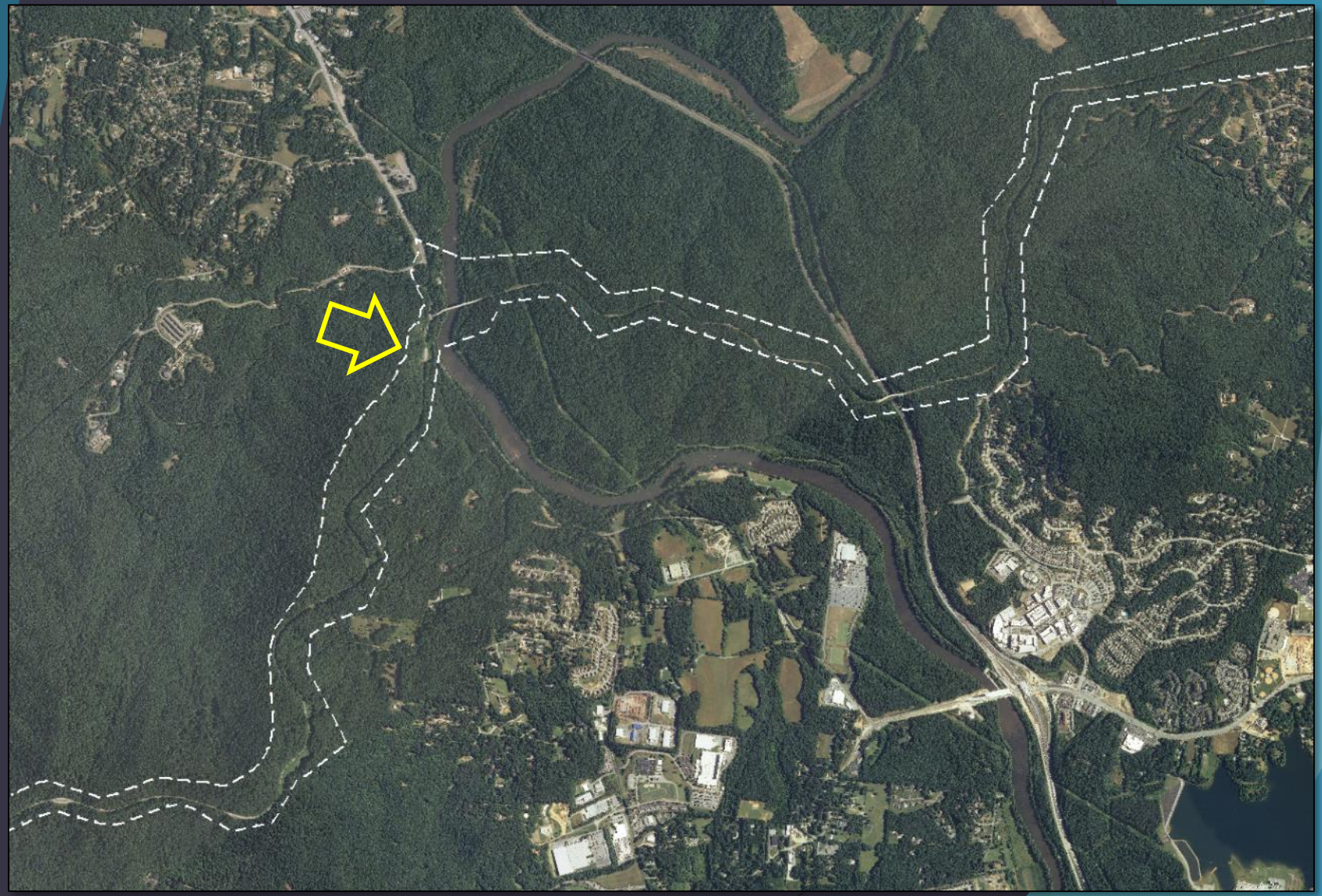

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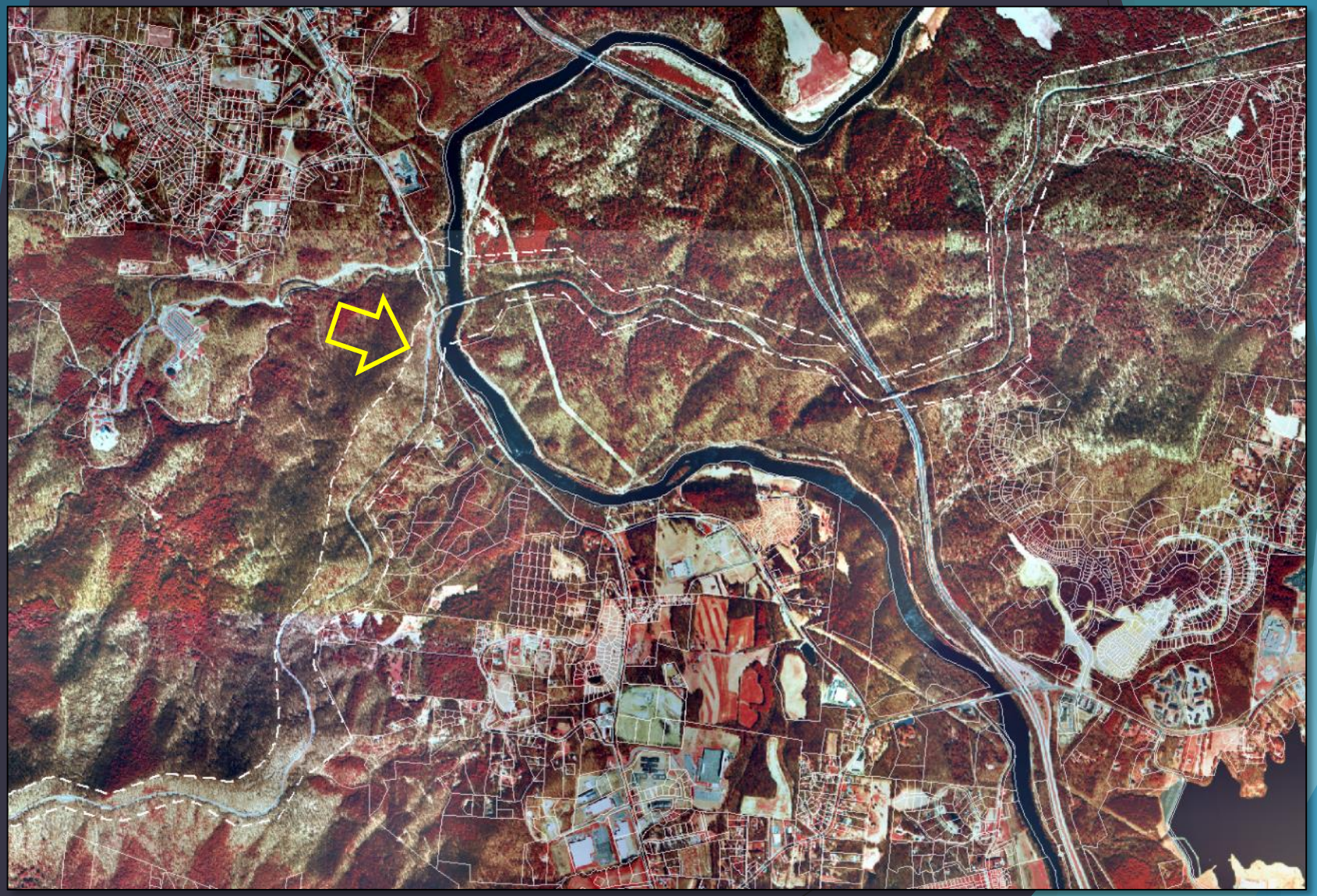

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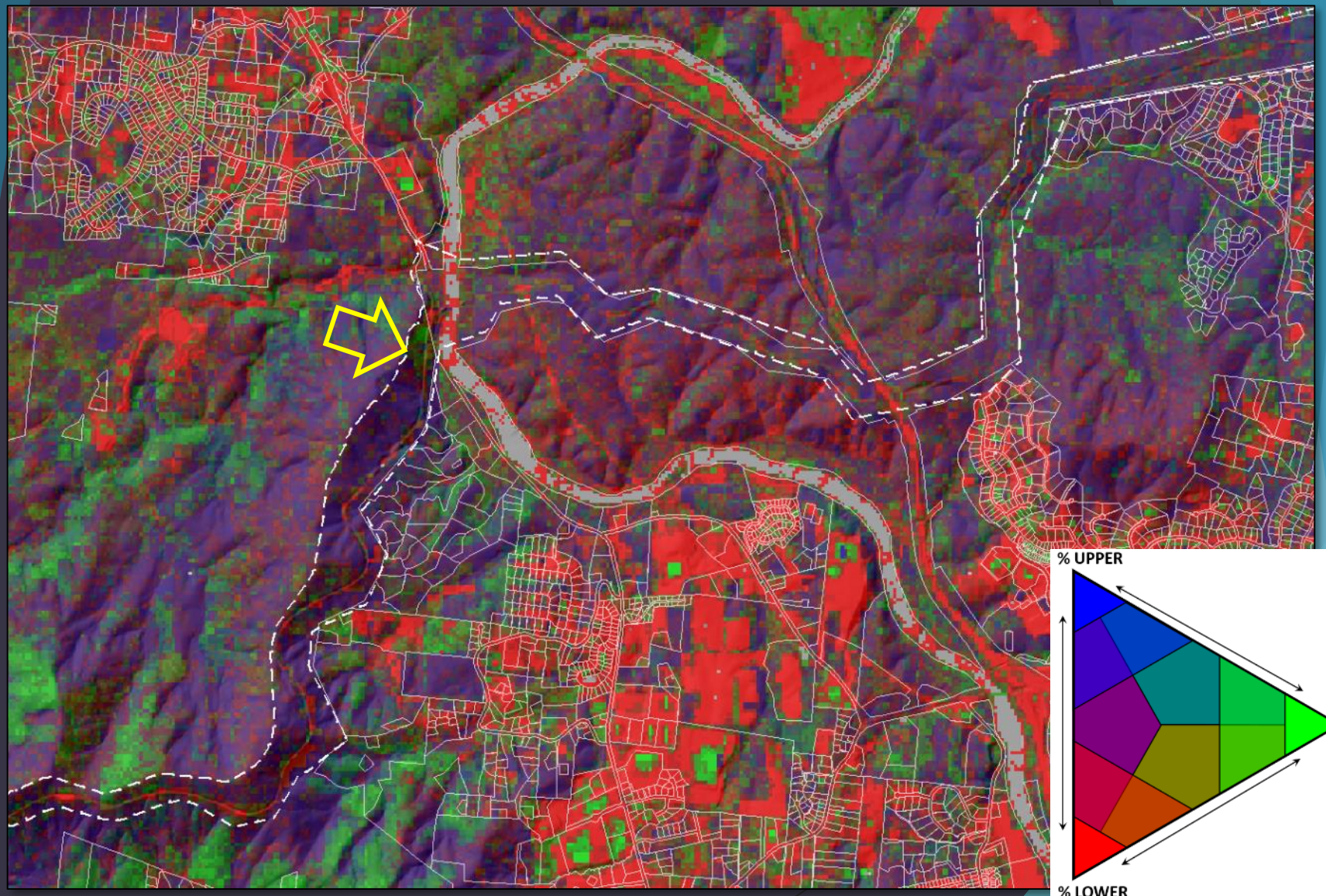

Summary

(1) Across North Carolina's Appalachians, vegetation height is predominantly explained by elevation and moisture gradients, with disturbance history of local significance.

(2) The NC Blue Ridge Parkway's forests are of lower stature than surrounding jurisdictions due to the Parkway's preference for higher and dry slopes. This "niche" may present different management challenges and opportunities.

(3) Casual inspection of the Parkway's edge effects using both max canopy and the full classification finds complex and ambiguous patterns. While hard roadside edges are common, the Parkway's natural structure is highly variable, and this nuances impacts along the Parkway's course.

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Thank You