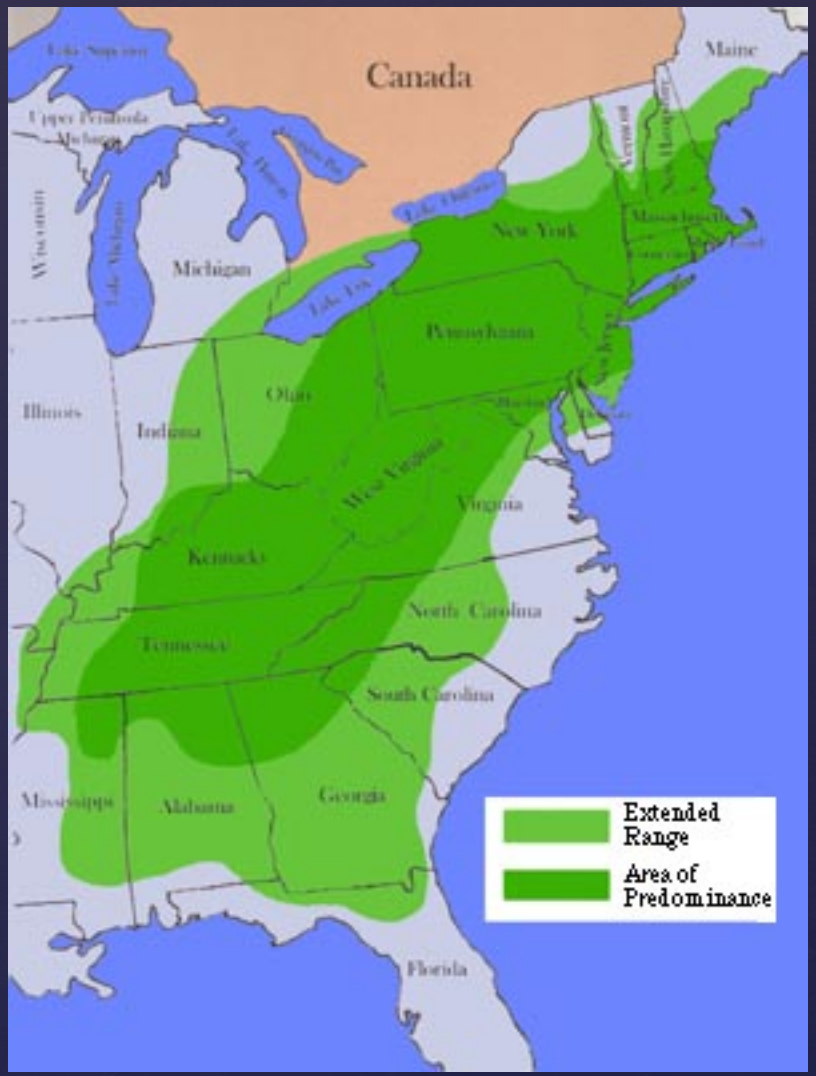
Early European explorers reported : "Where there be mountains, there be chestnuts."

Chestnuts were the dominant tree of the Appalachians

Courtesy – American Chestnut Foundation



Diversity in systems in general is undeniably a good thing. But as with most "good things" in the real world there can be too much of it as well as too little.

-Eugene P. Odum

Managing for Ecosystem Integrity and Ecosystem Diversity

“The plan must include plan components,

- including standards or guidelines,
- designed to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area,
- including plan components to maintain or restore structure, function, composition, and connectivity . . . .”

- 2012 Planning Rule (36 CFR 219)

1776

". . . A vast country of forests, meadows, groves, expansive savanna, fields, and swelling hills. . . .forests, fields, meadows, and lawns."

- William Bartram, 1776, literary description of WNC in *Travels*

110th Anniversary – 1904
At the Bronx Zoo

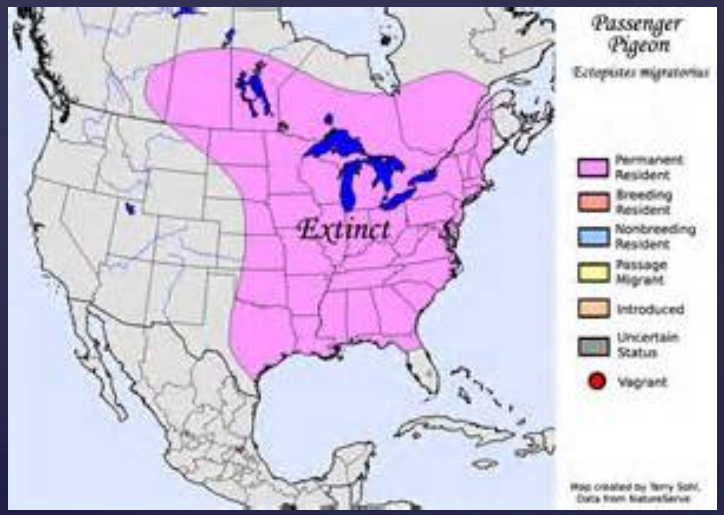
A fungus on
Chinese chestnut
transfers to
American chestnut

100th Anniversary – 9/1/1914 –
At the Cincinnati Zoo

The last known
passenger pigeon
– Martha - dies

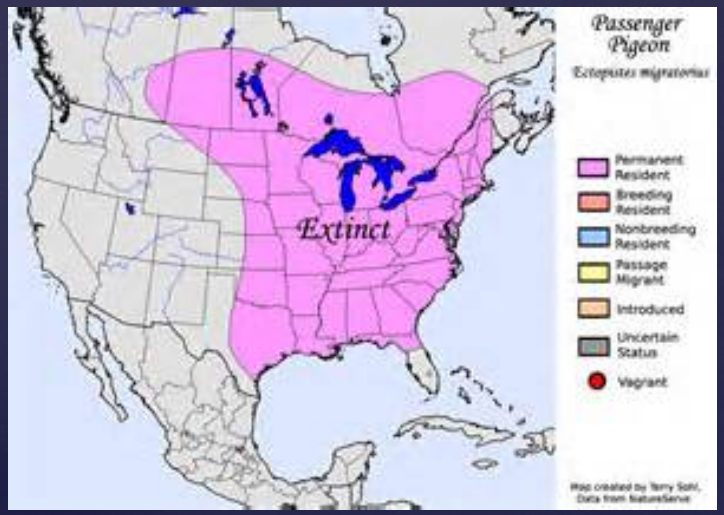
In general the great oak-chestnut communities are characteristic of all the main types of habitat within the altitudinal confines of the hardwood forest; and chestnut, occurring from ridge to cove, is the most abundant species.

- Frothingham, 1917



"[W]e went to shoot pigeons which were so numerous in these parts that you might see many millions in a flock; they sometimes split off the limbs of stout oaks and other trees upon which they roost of nights. . . You must understand that these birds do not breed amongst us but come down (especially in hard winters) amongst the inhabitants in great flocks." John Lawson writing about the early 1700s near Sapona, Davidson County.

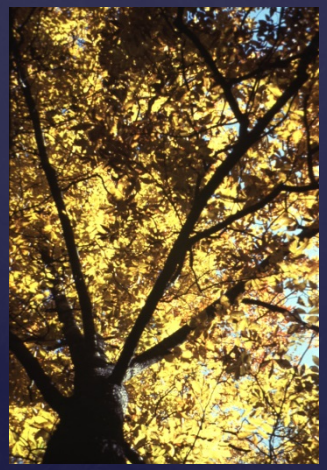
"Dr. K.P. Battle of Raleigh,, a careful observer of birds, states that when at Bingham School between 1871 and 1872 he saw a flock about a mile in width." T. Gilbert Pearson, Birds of North Carolina, 1919.



Local Place Names:

- Pigeon River in Haywood County
- Pigeon Township in Haywood County
- There are two Pigeon Gaps (gap) in Haywood County
- Pigeonroost (populated place) in Mitchell County
- Pigeonroost Creeks (stream) in Mitchell County and, Wautaga County
- Pigeon Mountain (rise) in Rutherford County
- There are two Pigeon Creeks (stream) in Swain County
- Pigeon Branch (stream) in Transylvania County

Last known occurrence in NC – 1894 in Buncombe County



The oaks . . . constitute by far the greater portion of the timber . . Next in abundance is the chestnut, constituting over 17 percent of the forest . . . Hemlock lines many of the ravines . . White pine is found . . . over the entire area . . .Poplar has wide distribution, but few timber trees of this species are found together . . . Shortleaf and pitch, or black pine, and the hickories are most prevalent southward along the lower slopes of the Blue Ridge.

- Ayres and Ashe, 1905

WNC Forest Factoids

- Railroads opened WNC to industrial logging and mining in the 1880's, with an explosion of activity after 1900.
- 1901 – Ashe and Ayers estimate 75% of Southern Appalachians are forested and 10% in "virgin growth."
- 1900-1910 timber boom.
- First national forest purchases 1911 and 1912, 70% was cutover and has subsequently regrown.
- 1924 Clarke-McNary Act allowed the purchase of land for growing timber.
- 1938 – first Forest Service "Forest Inventory and Analysis" Inventory - +/-66% of WNC is forested
- 2012 – FIA Inventory – 77% of WNC is forested

Why this talk about the Past?

The forests of WNC, including Nantahala and Pisgah National Forests, are largely second – or third – or fourth generation forests that have grown up following great disturbances:

- Loss of the predominant tree species
- Loss of a number of animal species by the early 1900's; (some have been successfully reestablished)
- Widespread land clearing for agriculture; subsequent abandonment and regrowth into forest
- Widespread burning before WWII
- Widespread logging 1880-1920

Why this talk about the Past?

Ecosystem Integrity:

- Is the forest " resilient" ?
- Can it adapt or recover from large scale disturbance?
- What can we learn from past disturbances and the resulting forest conditions that may help inform us about managing to ensure ecosystem integrity and ecosystem diversity as we go forward?

The Plan for this afternoon

- Requirements for the revised plan (why we are discussing “ecosystem integrity and ecosystem diversity)
- Tools useful for evaluating ecosystem integrity

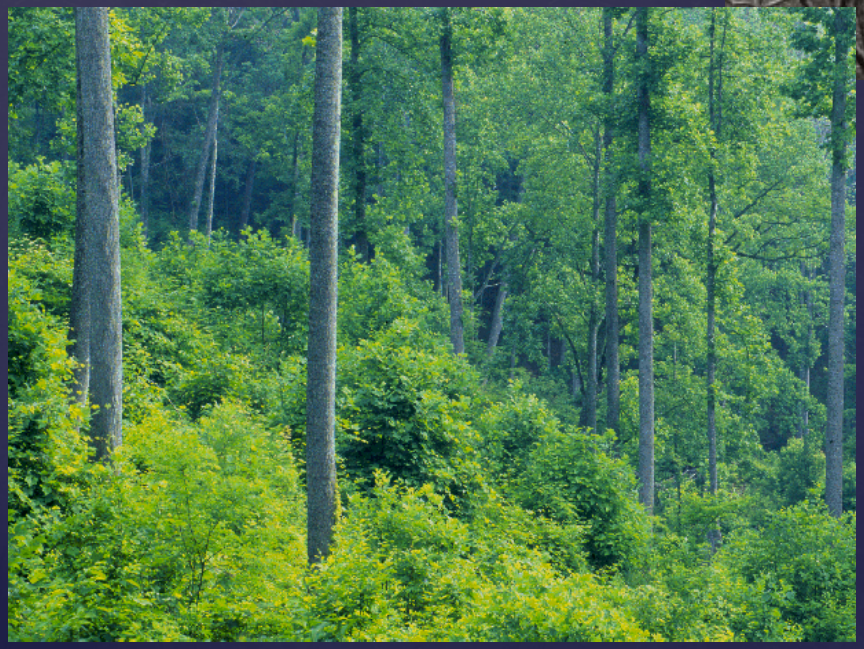
The Plan for this afternoon

Watershed Scenario: Gary and Jason will describe the possible past conditions and the current conditions of a forested watershed

Then they will discuss some potential management actions to implement to promote ecosystem integrity and ecosystem diversity

Finally we will open it up for ideas from you all about management actions to promote ecosystem integrity and ecosystem diversity

How does this fit within the plan revision process?

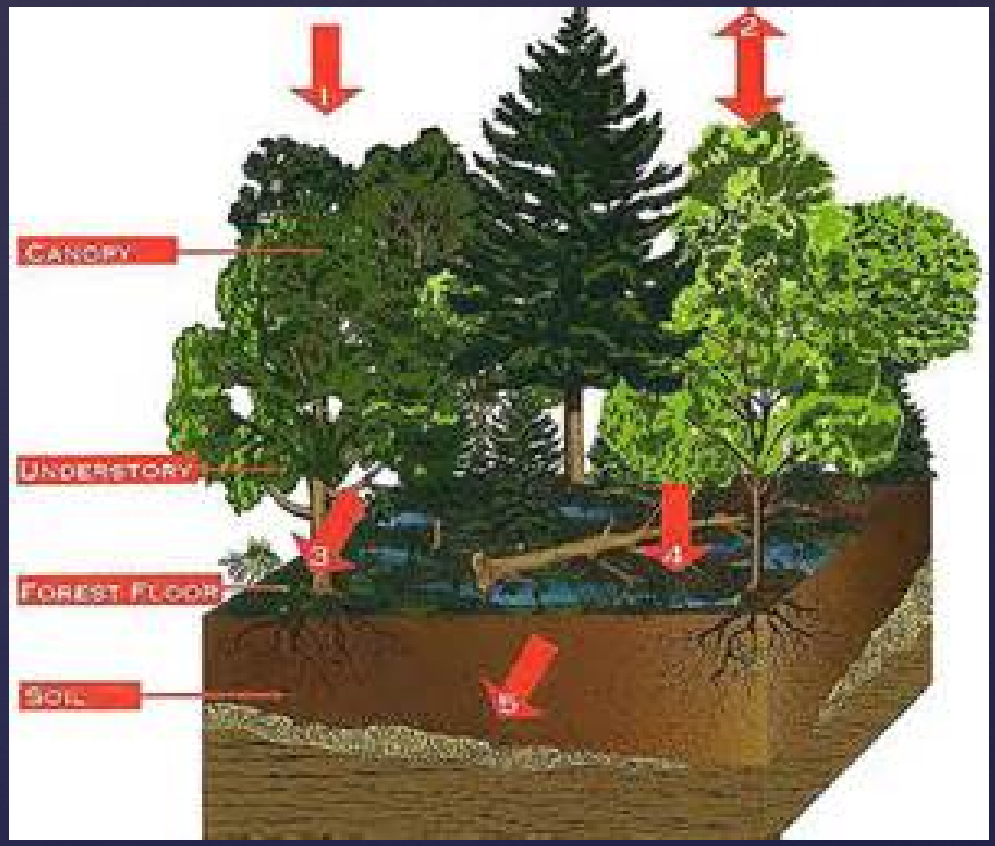


Ecosystem Integrity. The plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity….

- 2012 Planning Rule

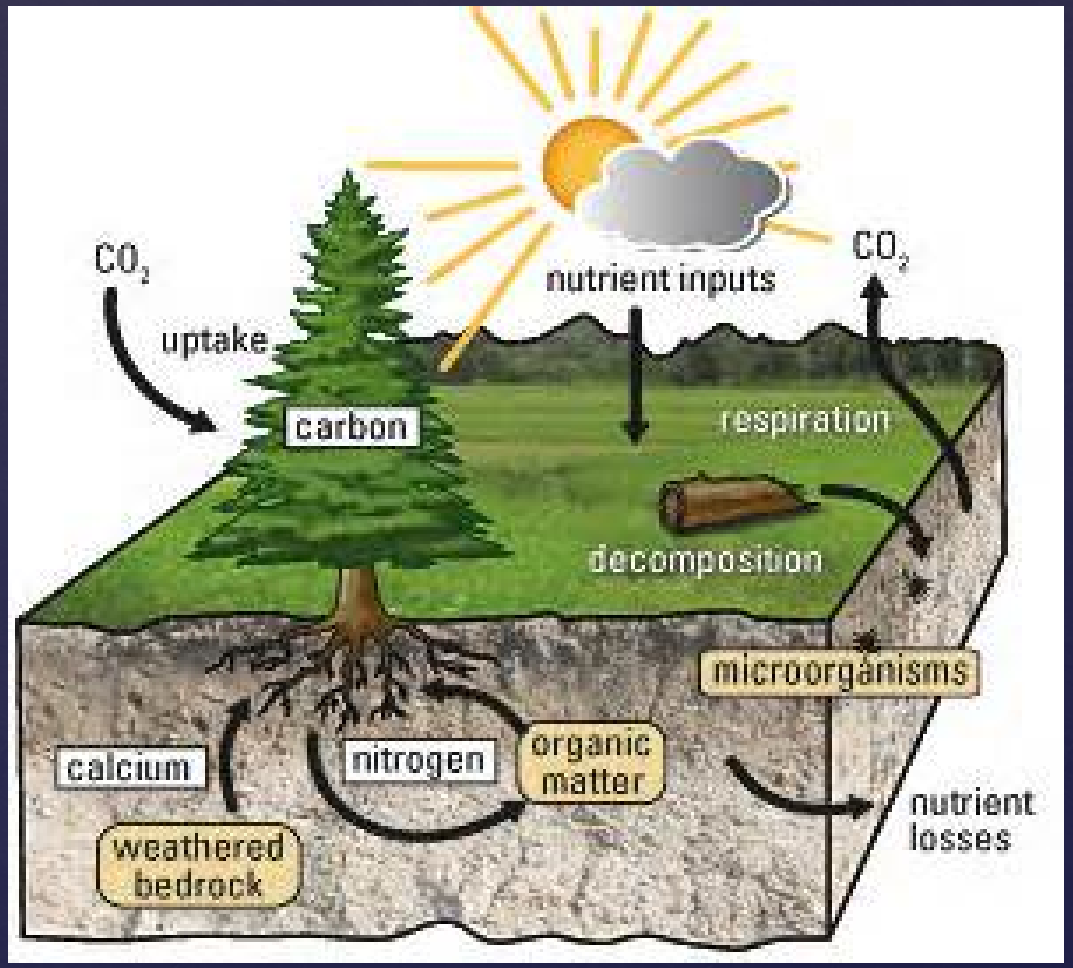
Structure

Canopy (open or closed)
Density of layers
(sub-canopy, shrubs, grasses and forbs),
Food Chain
(producers, consumers, decomposers)



Function

Photosynthesis
Biomass accumulation
Carbon sequestration
Nutrient cycling
Soil formation



Composition

Diversity and extent of species
Diversity and extent of plant and animal communities.
Status of non-native invasive species (NNIS)
Status of key species

Connectivity

Distribution of habitats are such that movement and potential expansion of native species populations, successful reproduction and growth, and the interchange of genetic material can occur.

"Plan Components"

Desired Conditions: What do we want the forest to be like

Objectives: What management actions will move us toward the desired conditions. [How many widgets over what time period?]

Standards and Guidelines: Sideboards for implementing management activities designed to protect various forest resources

Desired Conditions: What do we want the forest to be like

- Composition: Mix of species present
- Structure: Range of percentages of various ages and conditions or trees; patch sizes
- Function: Tree growth exceeds combined harvest plus mortality
- Connectivity: Minimum or maximum distance between patches of certain conditions (young forest, old forest); how or if patches might be connected; migration corridors

TOOLS, or information sources to help design plan components for maintaining or restoring "ecological integrity"

- Natural Range of Variation
- Other sources of scientific information plus public involvement

Natural Range of Variation (NRV)

Past disturbance histories are modeled to give an idea of the range of forest structural conditions that occurred over some span of time in the past (fire-ice-wind-water-insects, etc.)

Premise:

> A forest that is maintained within the range of conditions that existed over a span of centuries before European influence . . .
>
> . . . is likely to be resilient to future disturbances
>
> . . . and therefore maintain "ecological integrity."

Natural Range of Variation (NRV)

- Strong Western US influence in original application of NRV: not as developed or as accepted as appropriate in the East
- The Forest Service's presumption is that maintaining or restoring areas to NRV condition will result in some products:
  - Commercial timber products
  - Wildlife habitat improvement
- Range of opinions on NRV from revision participants

"If NRV is not appropriate, practical, possible, or desirable, Use Best Available Scientific Information (BASI) and public input."

FACA recommended draft FSH 1909.12

Comments we've heard:

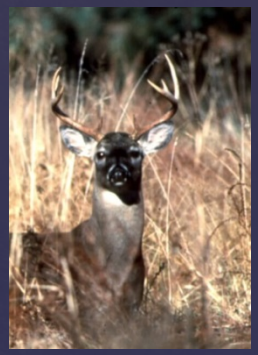
- The BASI for some wildlife species indicates NRV modeled conditions are insufficient in providing habitat to maintain or restore species diversity

- Absence of American chestnut makes NRV inappropriate

- The past structure isn't relevant to ensuring resilience for a very different future with different disturbances and threats

Question: Does it have to be all one way or the other? NO

We will use a variety of tools and information sources to establish plan components for Ecological Integrity



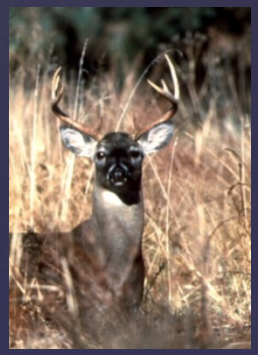
"Natural Range of Variation" NRV

Tools

"Best Available Scientific Information" BASI

Public Involvement

We will use a variety of information sources to establish plan components for Ecological Integrity



Which sources may be the "best" depend on what questions are being asked

WHEN . . . WHERE . . IN WHAT CIRCUMSTANCES

Before we set up the watershed scenario….

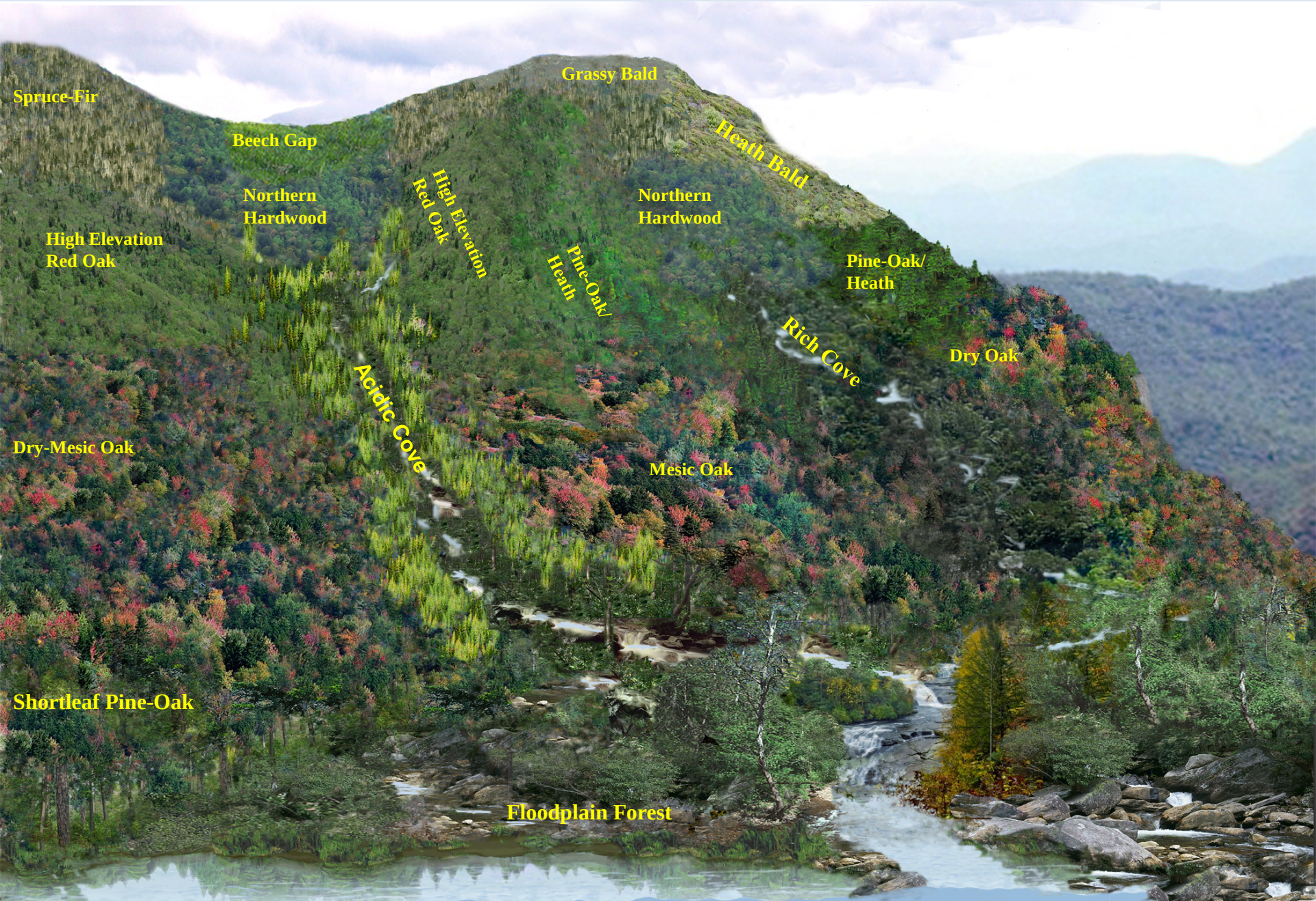
An “ECOZONE” refresher

With Gary

Existing Conditions and Natural Range of Variation:

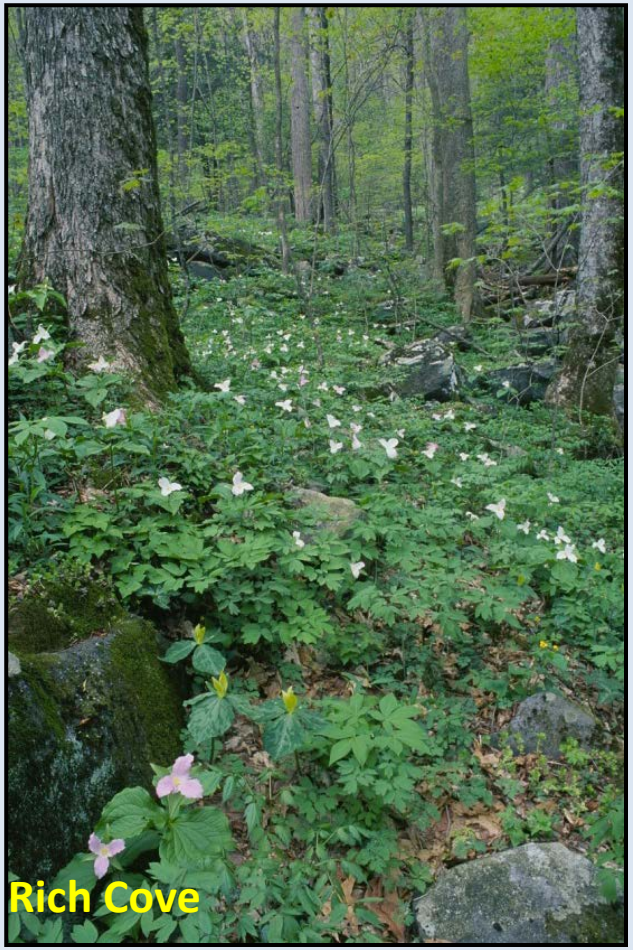
A visit to a hypothetical watershed on the Nantahala and Pisgah NFs

Ecozones on the Landscape



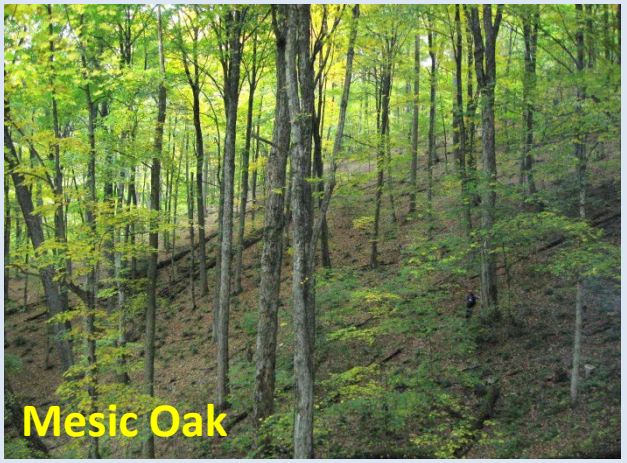
High Elevation > 4200 Feet

10% of Nantahala & Pisgah NFs



Mid Elevation: 2300- 4200 Feet

85% of Nantahala & Pisgah NFs



Low Elevation < 2300 Feet

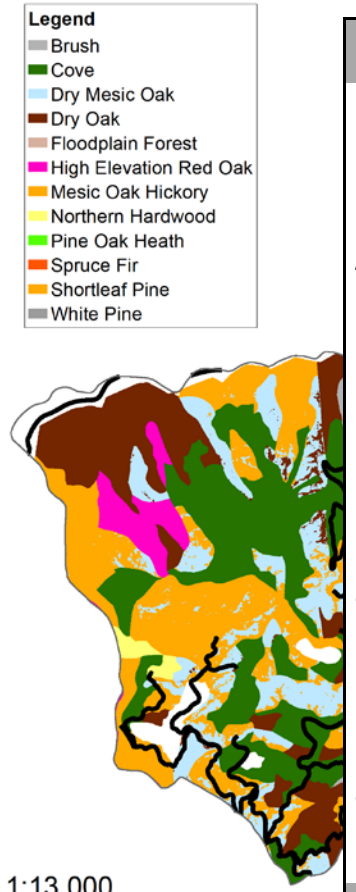
5% of Nantahala & Pisgah NFs

Let’s take a look at how this all comes together on a hypothetical watershed on the Nantahala and Pisgah NFs

Forest Community Composition

Existing Community Composition

Sample Watershed Study Area
Example National Forest

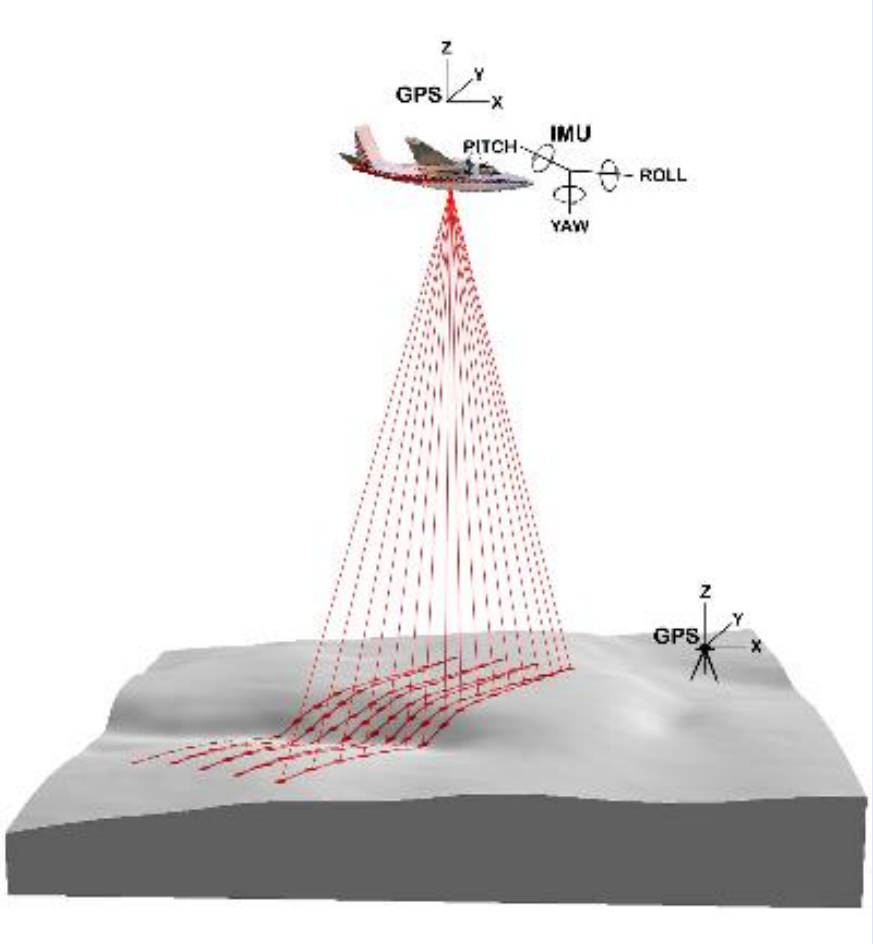


Communities	Acres	Percent
Dry Oak	6,396	35
Rich Cove	5,088	20
Acidic Cove	4,484	17
Dry/Mesic Oak	4,226	16
Mesic Oak Hickory	4,216	16
High Elevation Red Oak	517	2
Pine/Oak Heath	391	2
Spruce Fir	265	1
N. Hardwood	59	0
Flood Plain	54	0
Shortleaf Pine	144	1
Other	1,716	6
Grand Total	27,166	100

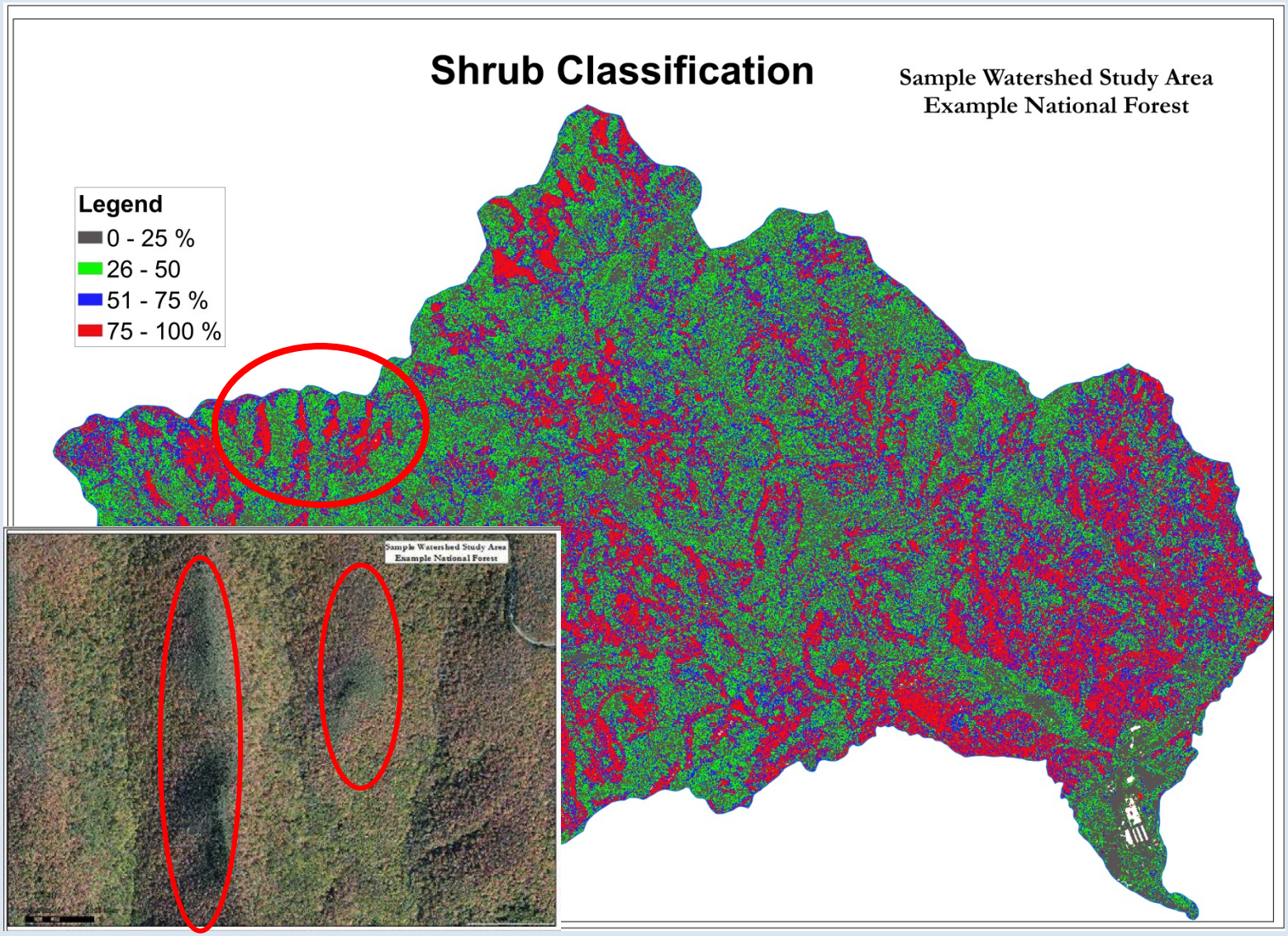
LiDAR – Light Detection and Ranging

- LiDAR uses laser light to measure distances – most frequently translated as heights

- Devices are generally mounted in airplanes and data is collected as the airplane flies across a landscape in lines that overlap the scanned areas

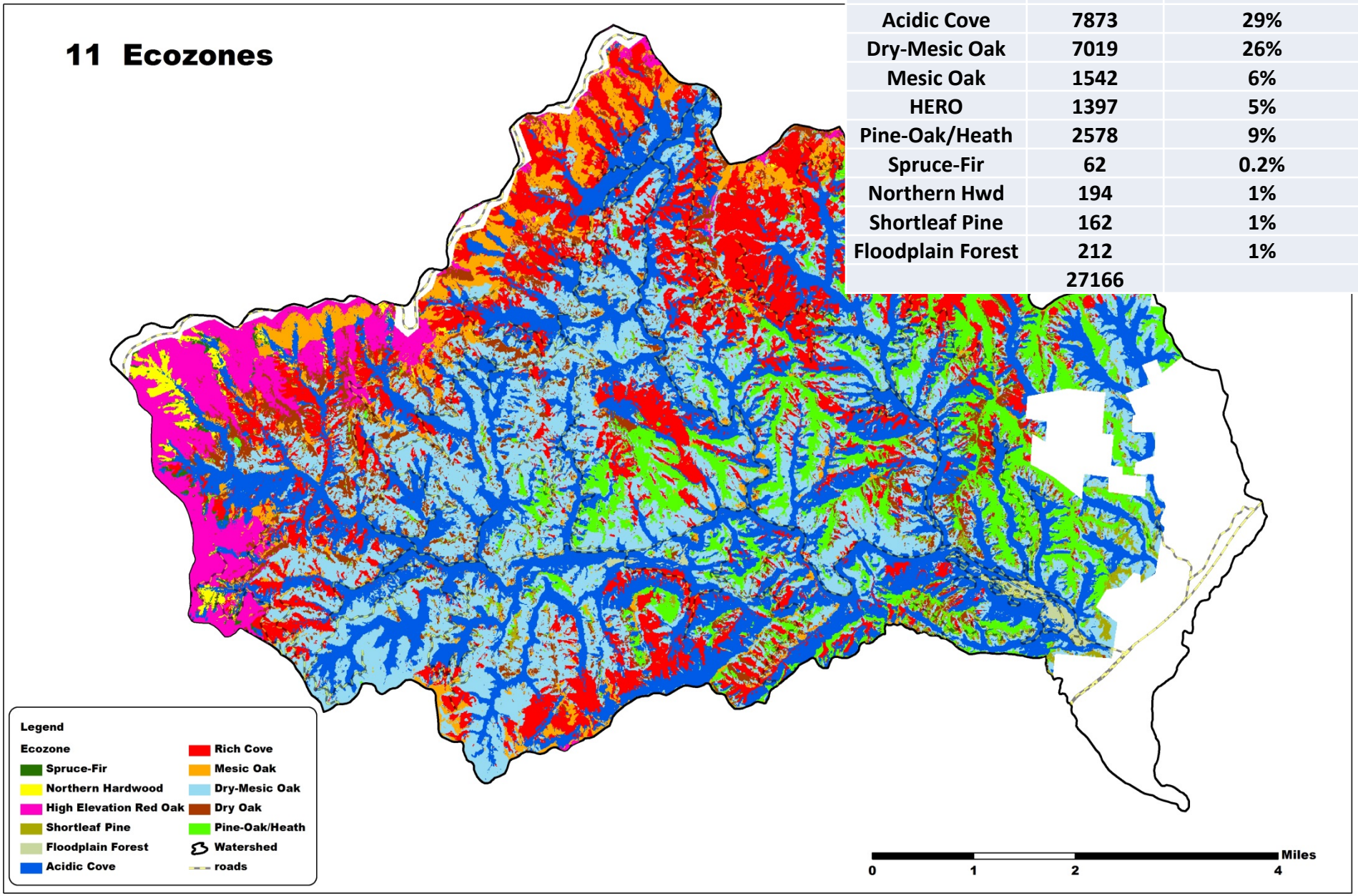


Structure - Shrub Layer Density



Potential Natural Vegetation

Watershed		
Ecozone	Acres	Percent
Dry Oak	1465	5%
Rich Cove	4662	17%
Acidic Cove	7873	29%
Dry-Mesic Oak	7019	26%
Mesic Oak	1542	6%
HERO	1397	5%
Pine-Oak/Heath	2578	9%
Spruce-Fir	62	0.2%
Northern Hwd	194	1%
Shortleaf Pine	162	1%
Floodplain Forest	212	1%
	27166	



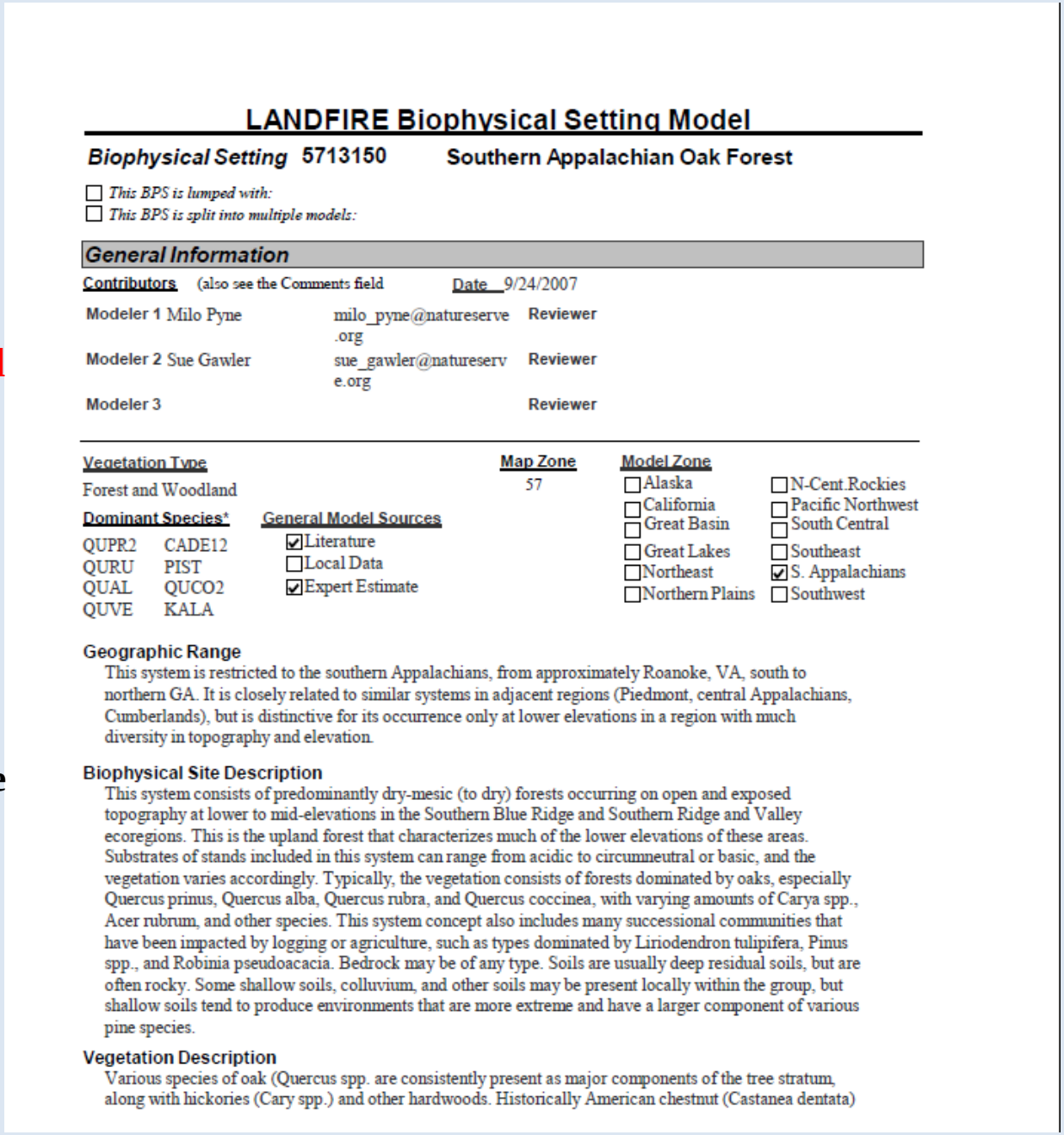
Natural Range of Variation components:

1) Ecozones

2) Correlate Ecozones with Biophysical Settings (BPS)

- **Biophysical Settings (BpS) represents vegetation that may have been dominant on the landscape prior to Euro-American settlement and are based on both the current biophysical environment and an approximation of the historical disturbance regime.**

- **Map units are defined by Nature Serve (NatureServe.org) Ecological Systems, a nationally consistent set of mid-scale ecological units.**



LANDFIRE Biophysical Setting Model

Biophysical Setting **5713150** **Southern Appalachian Oak Forest**

☐ *This BPS is lumped with:*
☐ *This BPS is split into multiple models:*

General Information

Contributors (also see the Comments field) **Date** 9/24/2007

Modeler 1 Milo Pyne	milo_pyne@natureserve.org	**Reviewer**
Modeler 2 Sue Gawler	sue_gawler@natureserve.org	**Reviewer**
Modeler 3		**Reviewer**

Vegetation Type
Forest and Woodland

Dominant Species*

QUPR2	CADE12
QURU	PIST
QUAL	QUCO2
QUVE	KALA

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Map Zone
57

Model Zone
☐ Alaska
☐ California
☐ Great Basin
☐ Great Lakes
☐ Northeast
☐ Northern Plains
☐ N-Cent.Rockies
☐ Pacific Northwest
☐ South Central
☐ Southeast
☑ S. Appalachians
☐ Southwest

Geographic Range
This system is restricted to the southern Appalachians, from approximately Roanoke, VA, south to northern GA. It is closely related to similar systems in adjacent regions (Piedmont, central Appalachians, Cumberlands), but is distinctive for its occurrence only at lower elevations in a region with much diversity in topography and elevation.

Biophysical Site Description
This system consists of predominantly dry-mesic (to dry) forests occurring on open and exposed topography at lower to mid-elevations in the Southern Blue Ridge and Southern Ridge and Valley ecoregions. This is the upland forest that characterizes much of the lower elevations of these areas. Substrates of stands included in this system can range from acidic to circumneutral or basic, and the vegetation varies accordingly. Typically, the vegetation consists of forests dominated by oaks, especially Quercus prinus, Quercus alba, Quercus rubra, and Quercus coccinea, with varying amounts of Carya spp., Acer rubrum, and other species. This system concept also includes many successional communities that have been impacted by logging or agriculture, such as types dominated by Liriodendron tulipifera, Pinus spp., and Robinia pseudoacacia. Bedrock may be of any type. Soils are usually deep residual soils, but are often rocky. Some shallow soils, colluvium, and other soils may be present locally within the group, but shallow soils tend to produce environments that are more extreme and have a larger component of various pine species.

Vegetation Description
Various species of oak (Quercus spp. are consistently present as major components of the tree stratum, along with hickories (Cary spp.) and other hardwoods. Historically American chestnut (Castanea dentata)

Southern Appalachian Montane Pine disturbance parameters used in computer simulations

	Succession stage (Age and Structure)				
	Class A 0-15 yrs	Class B (closed) 16-70 yrs	Class C (open) 16-70 yrs	Class D (open) 71 yrs+	Class E (closed) 71 yrs+
Disturbance type	---------- return interval (years) ----------				
surface fire	5	5	5	5	25
mixed fire		50	75	100	75
replacement fire	20	75	150	200	500
major wind event		500	1000	1000	1000
ice damage		250			250
insects / disease		50	100	75	75

Natural Range of Variation components:

1) Ecozones

2) Correlate Ecozones with Biophysical Settings (BPS)

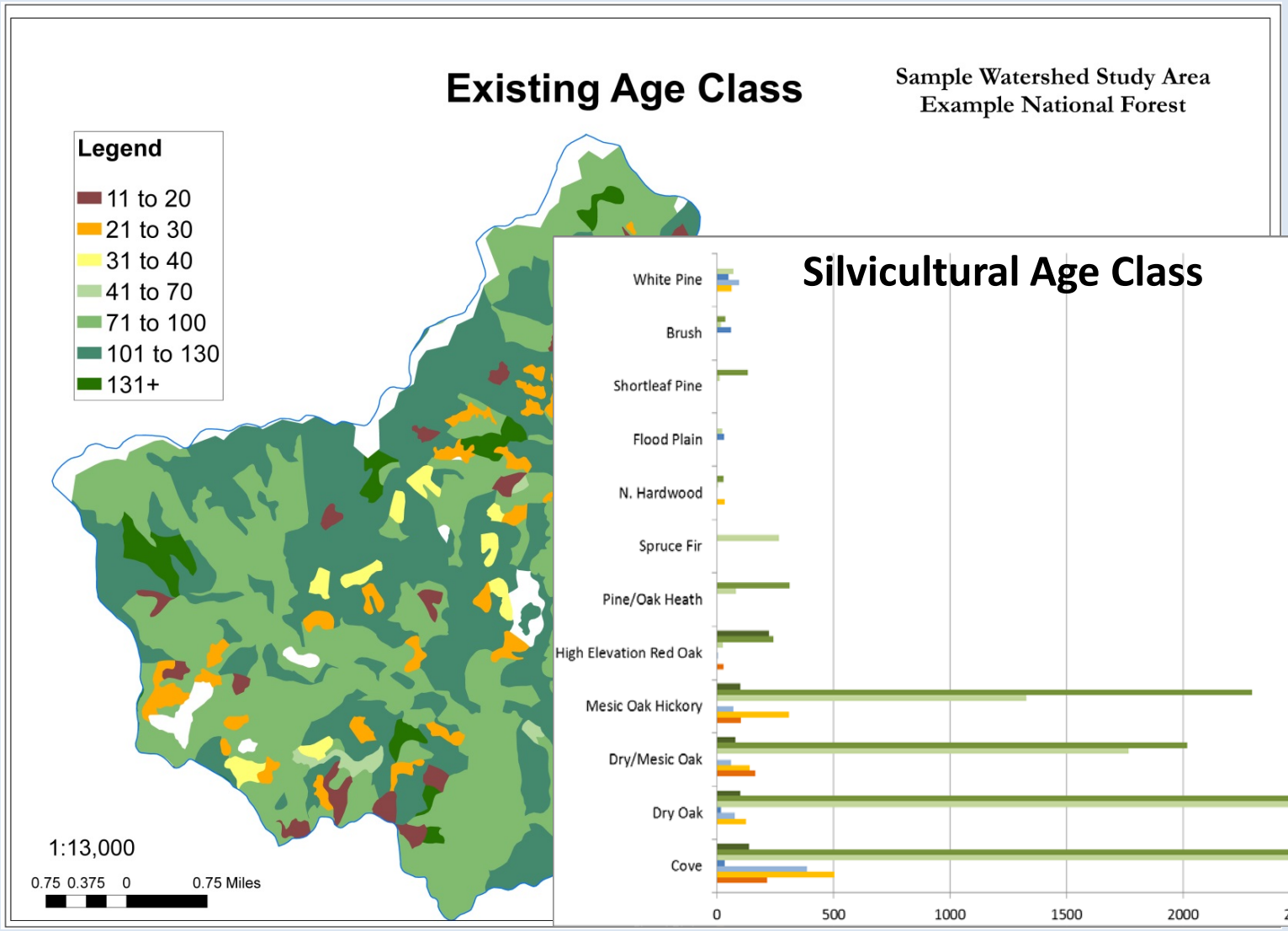
3) Review and modify Ecological Systems descriptions (type and rate of disturbance, structural diversity) for appropriate area

4) Run Computer simulations: VDDT (vegetation dynamics development tool), quantifies rate and effects of vegetation change

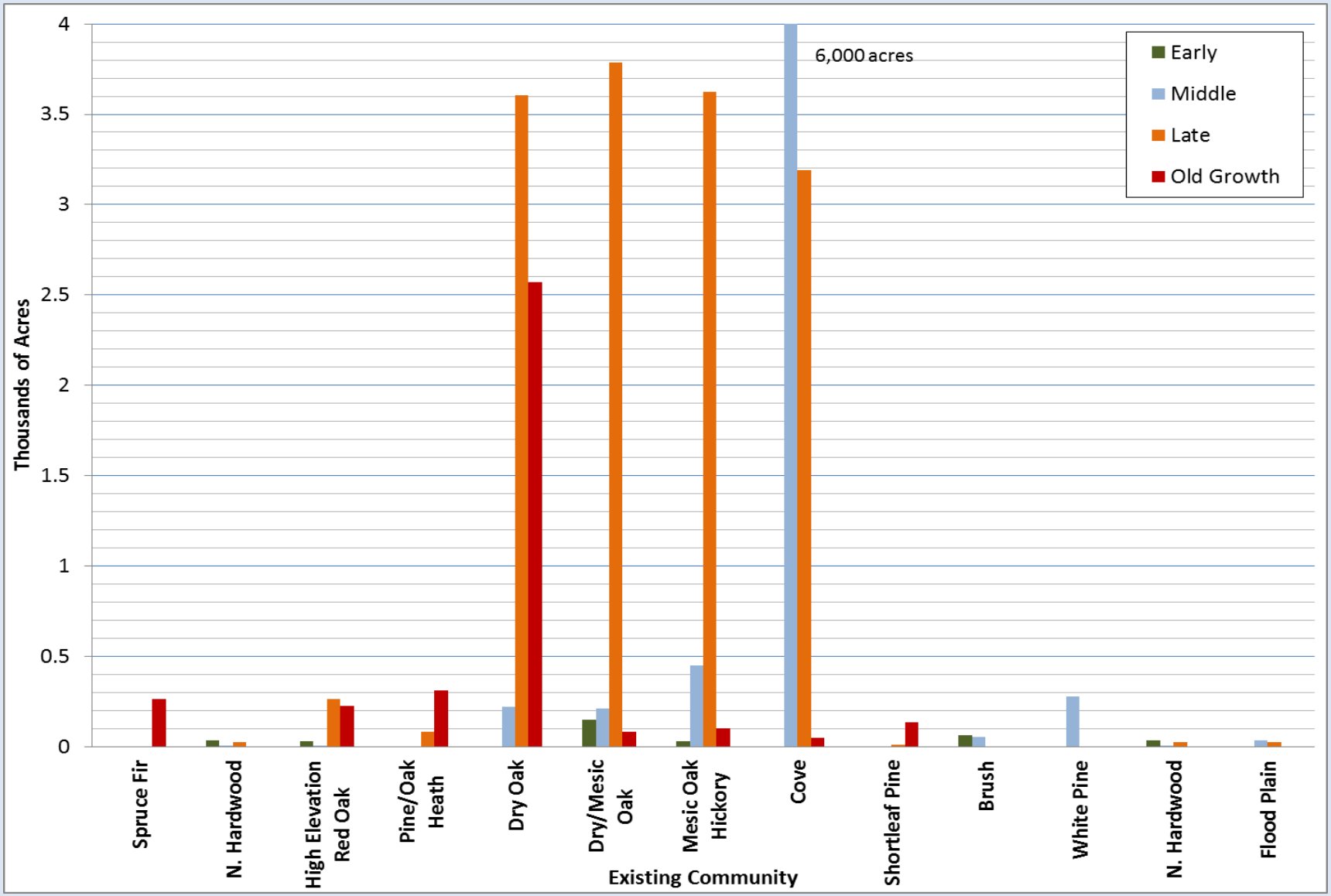
Natural Range of Variation

Dry-Mesic Oak				
	Age	Chattahoochee NF	Cherokee NF	So. Apps
Early	0-19	7%	7%	6%
Mid-Closed	20-70	6%	15%	10%
Mid-Open	20-70	13%	25%	10%
Late -Open	71-130	14%	23%	14%
Late- Closed	71-130	5%	13%	5%
Old Growth Open	> 130	42%	11%	49%
Old Growth Closed	> 130	12%	6%	6%
Total Closed		23%	34%	21%
Total Open		76%	66%	79%

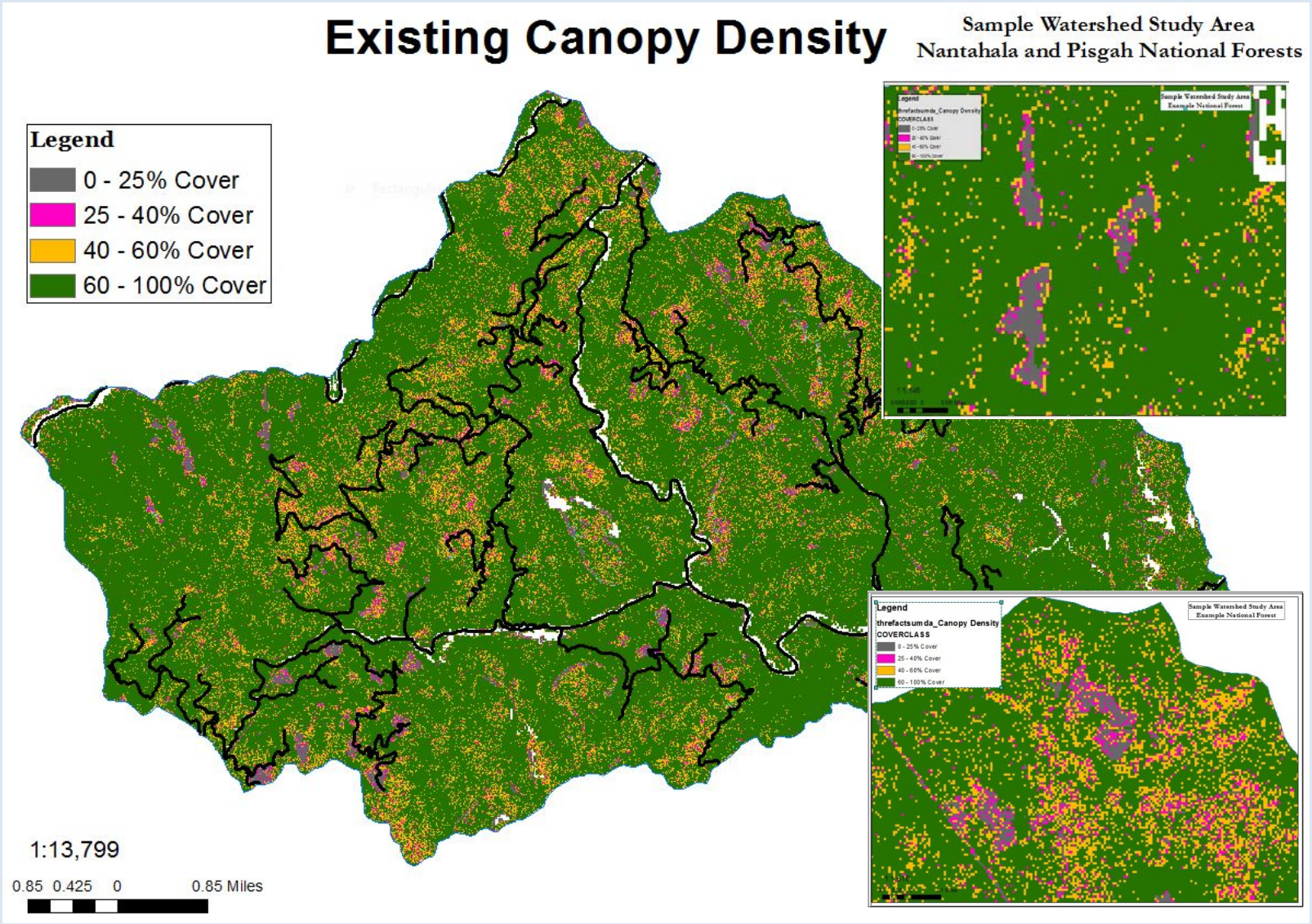
Forest Community Age Class Structures – FS Veg Data



Forest Community Age

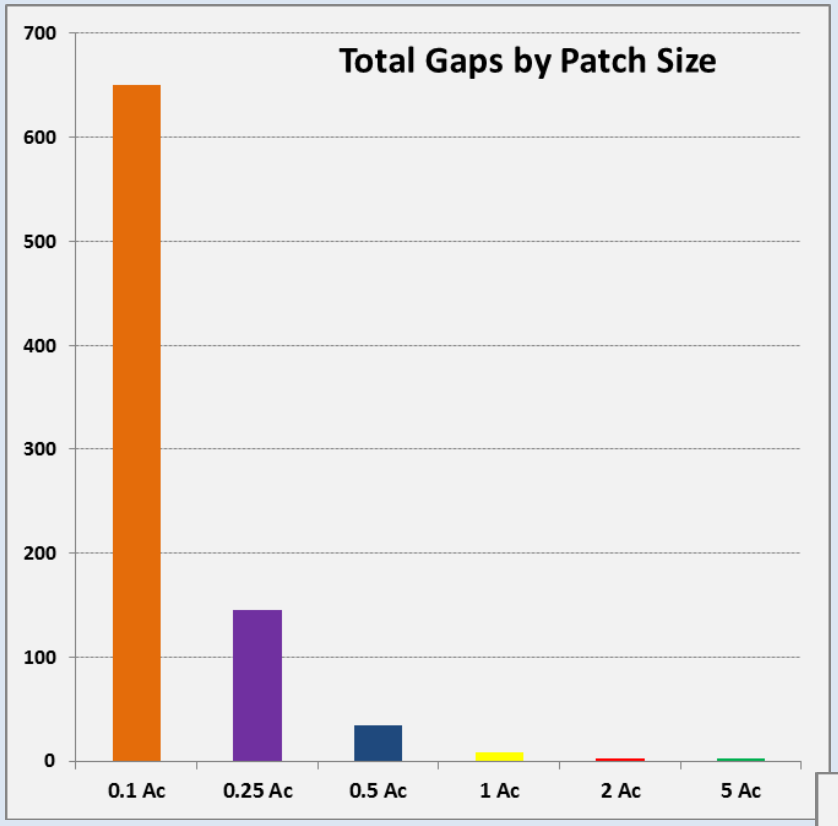


Structure – Canopy Density



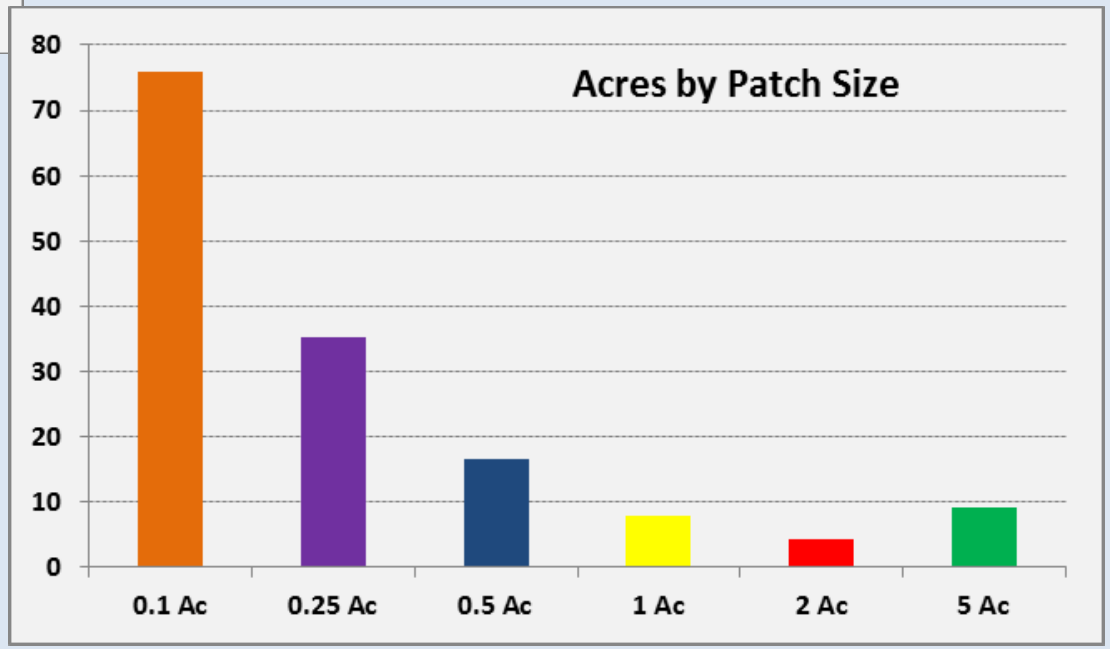
Dry-mesic oak Structure - Gaps

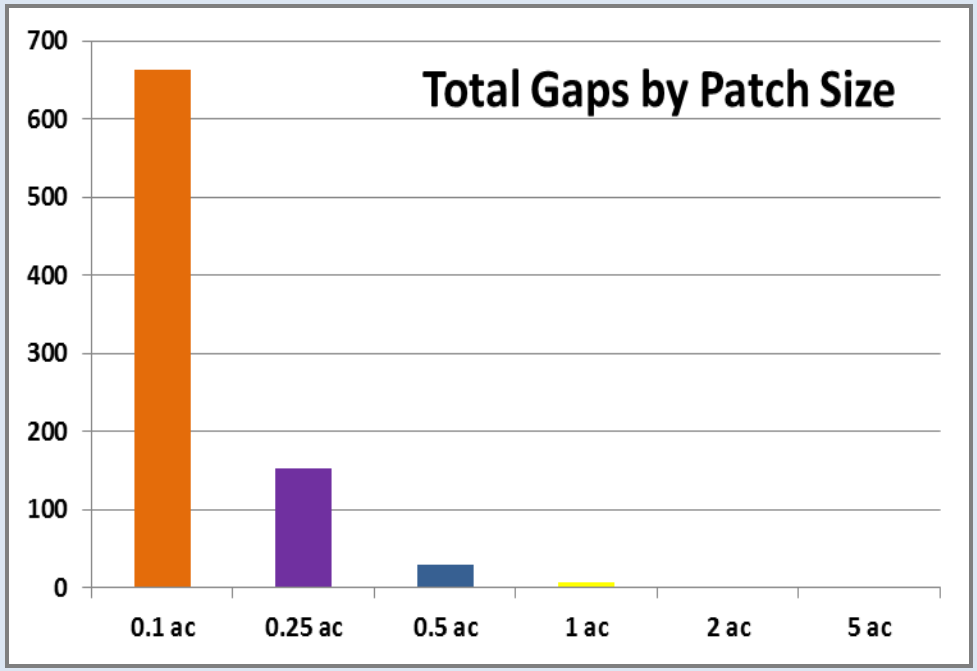
- Dry-mesic oak – 7,019 acres
- Vast majority (1,000s) < 1/10 acre
- 841 patches are 1/10 – 5 acres



Patch Sizes 1 acre or larger had < 25% canopy cover

Within smaller patch sizes, ~70% have scattered trees



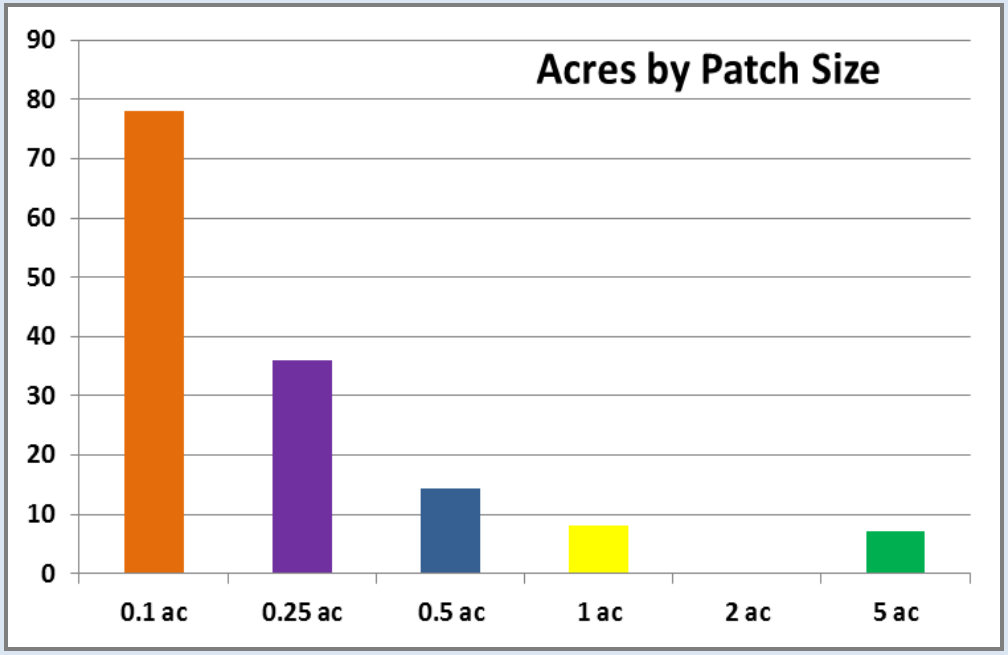


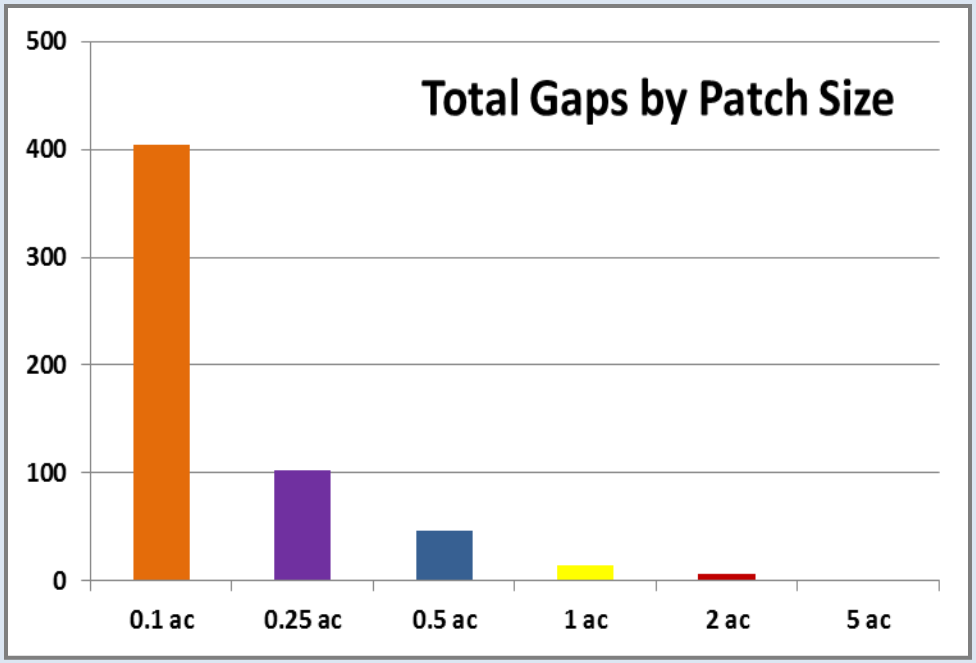
Rich Cove Structure - Gaps

- Rich Cove - 4,662 acres
- Vast majority < 1/10 acre
- 852 patches 1/10 – 5 acres

Patch Sizes 1 acre or larger had < 25% canopy cover

Within smaller patch sizes, ~70% have scattered trees



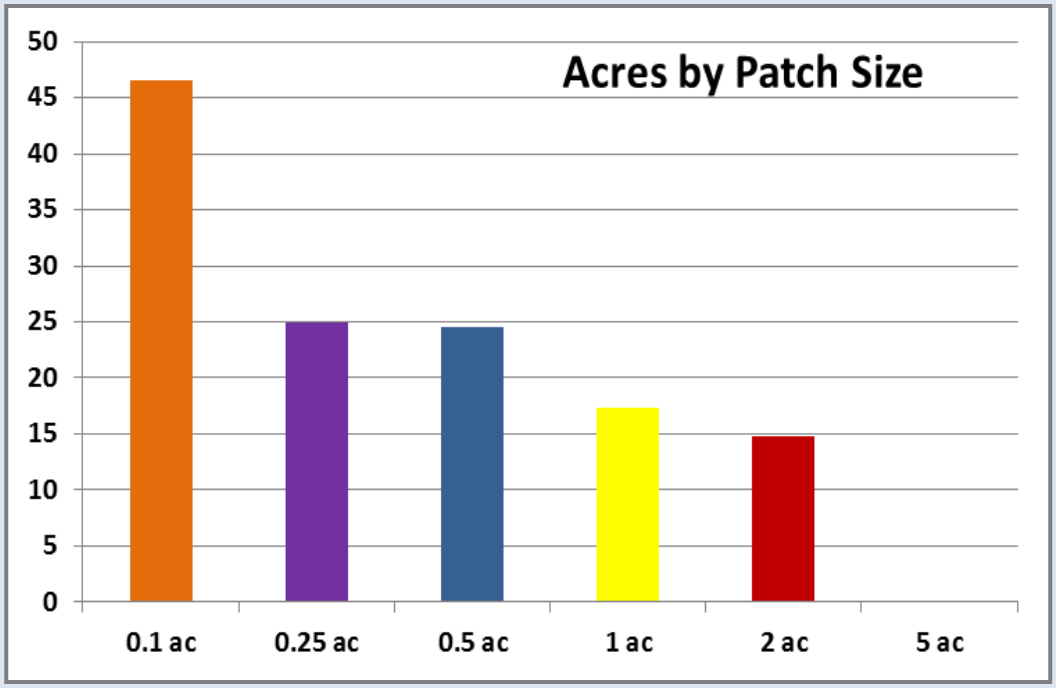


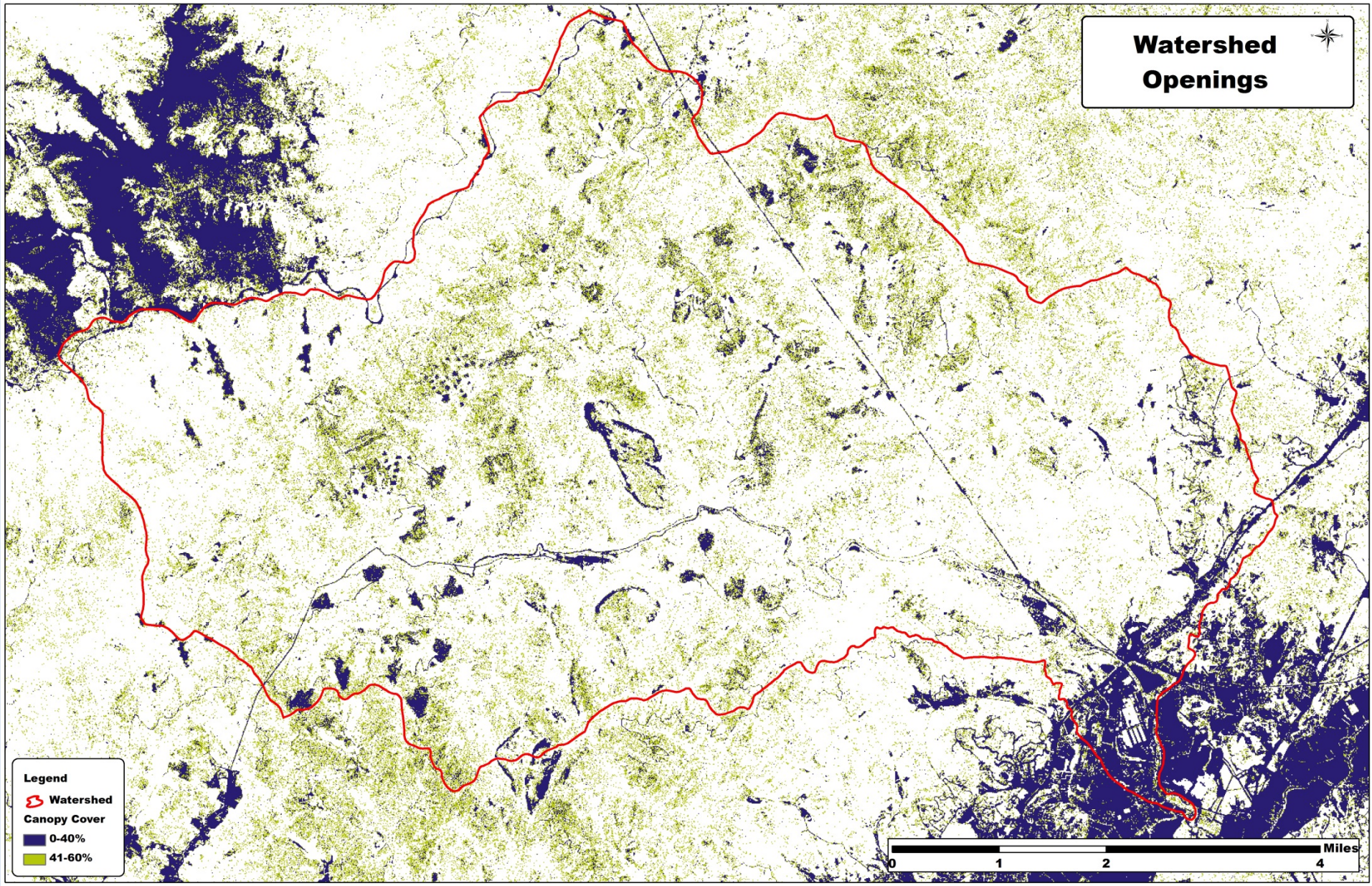
Acidic cove Structure - Gaps

- Acidic cove – 7,873 acres
- Vast majority < $^{1}/_{10}$ acre
- 573 patches $^{1}/_{10}$ – 5 acres

Patch Sizes 1 acre or larger had < 25% canopy cover

Within smaller patch sizes, ~70% have scattered trees



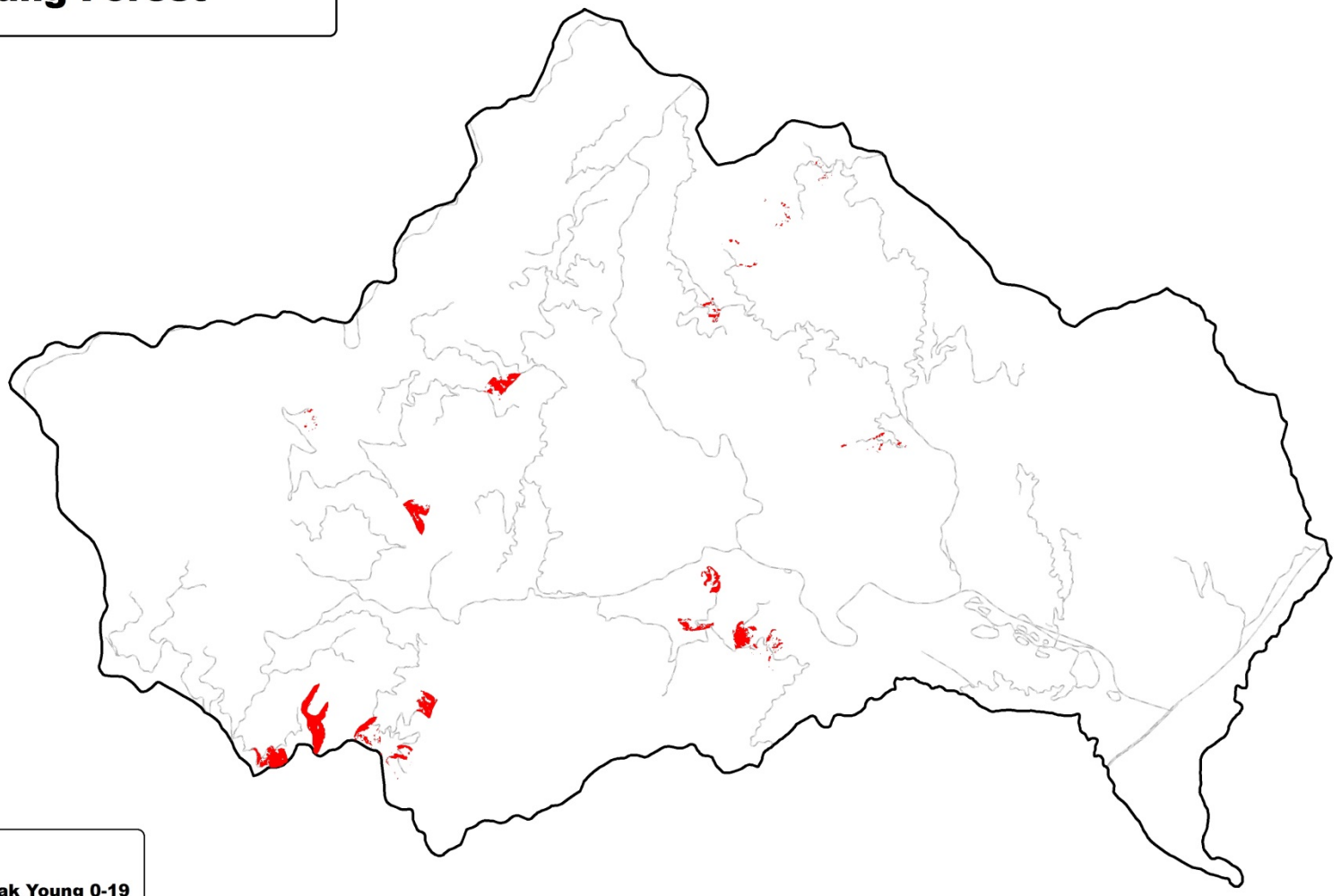


Canopy Openings By Percent Density

Natural Range of Variation

Dry-Mesic Oak			
	Age	So. App	Existing in Watershed
Early	0-19	6%	2%
Mid-Closed	20-70	10%	8%
Mid-Open	20-70	10%	2%
Late -Open	71-130	14%	8%
Late- Closed	71-130	5%	78%
Old Growth Open	> 130	49%	.5%
Old Growth Closed	> 130	6%	1.5%
Total Closed		21%	87%
Total Open		79%	13%

Dry-Mesic Oak Ecozone
Young Forest

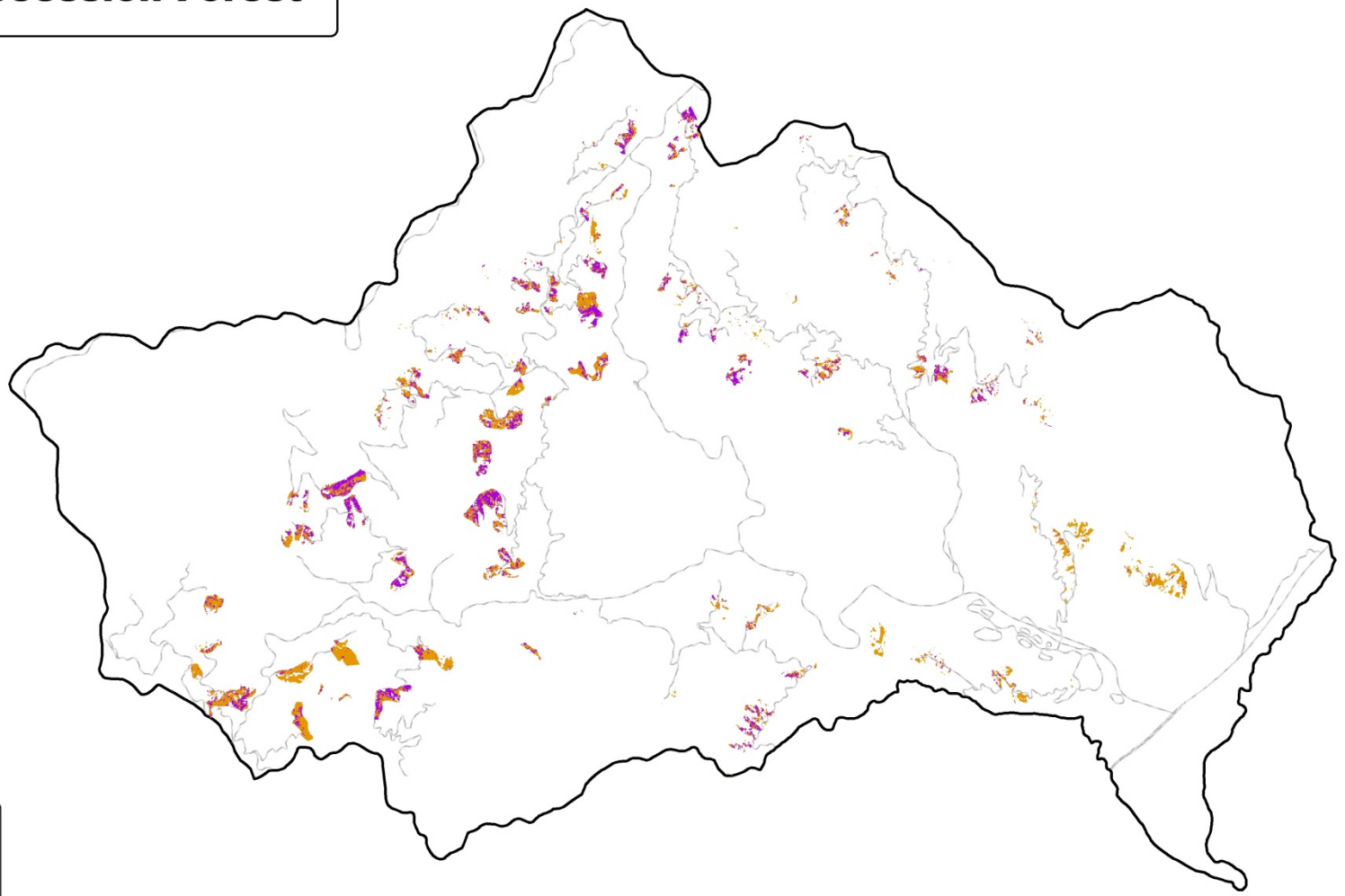


Legend

- Dry Mesic Oak Young 0-19
- Watershed
- roads

0 1 2 4 Miles

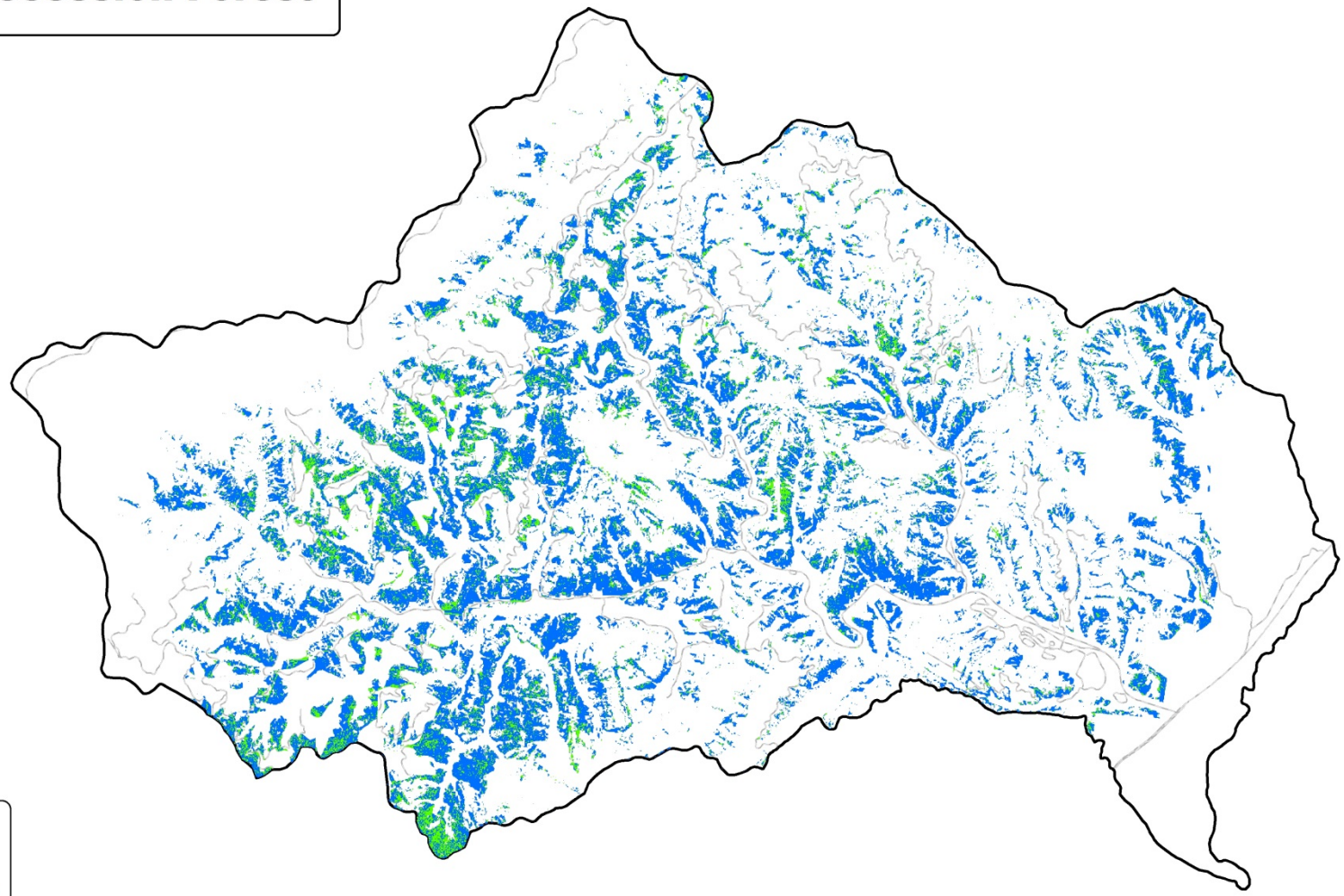
Dry-Mesic Oak Ecozone
Mid Succession Forest



Legend
- Mid Open
- Mid Closed
- Watershed
- roads

0 1 2 4 Miles

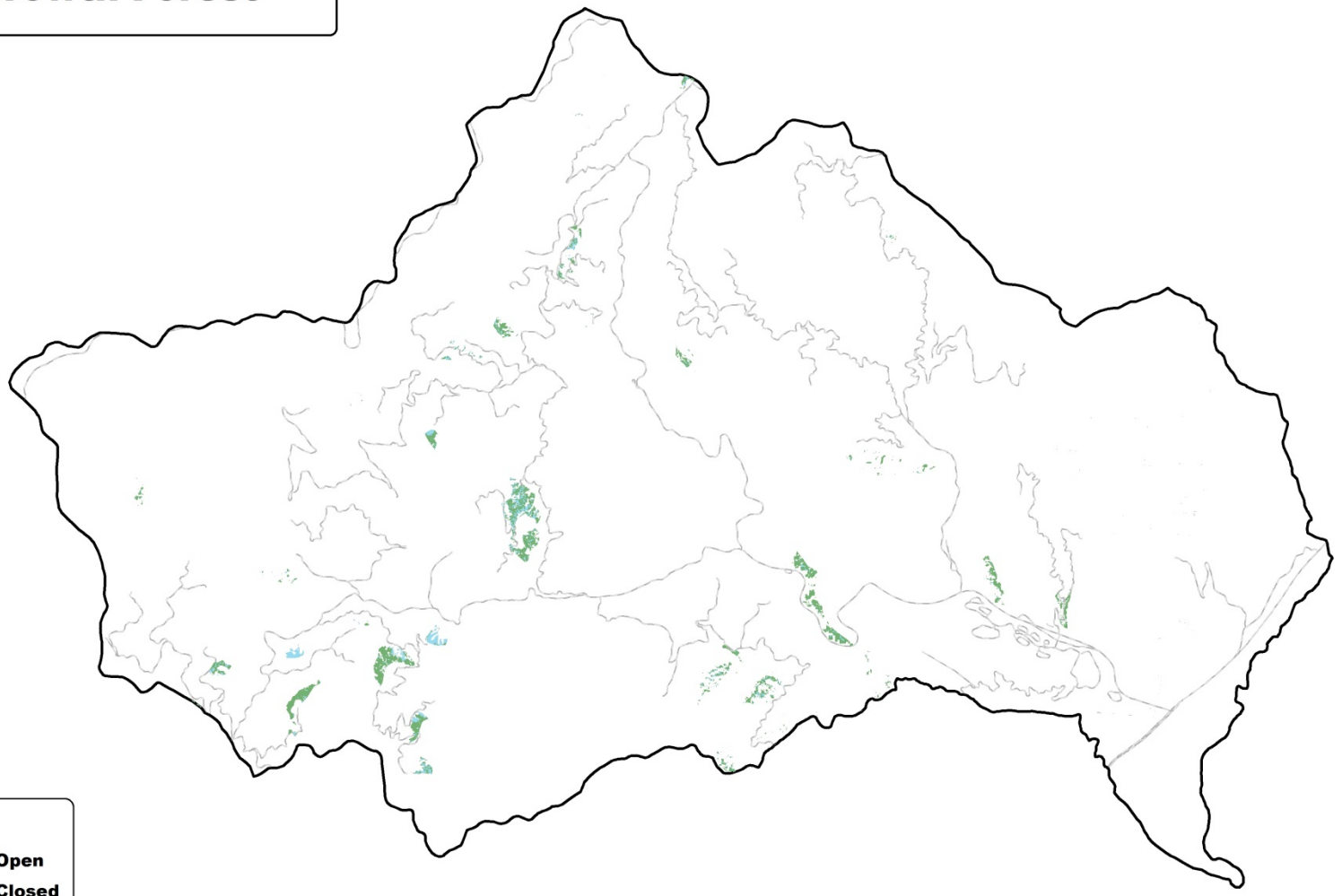
Dry-Mesic Oak Ecozone
Late Succession Forest



Legend
- Late Open
- Late Closed
- Watershed
- roads

0 1 2 4 Miles

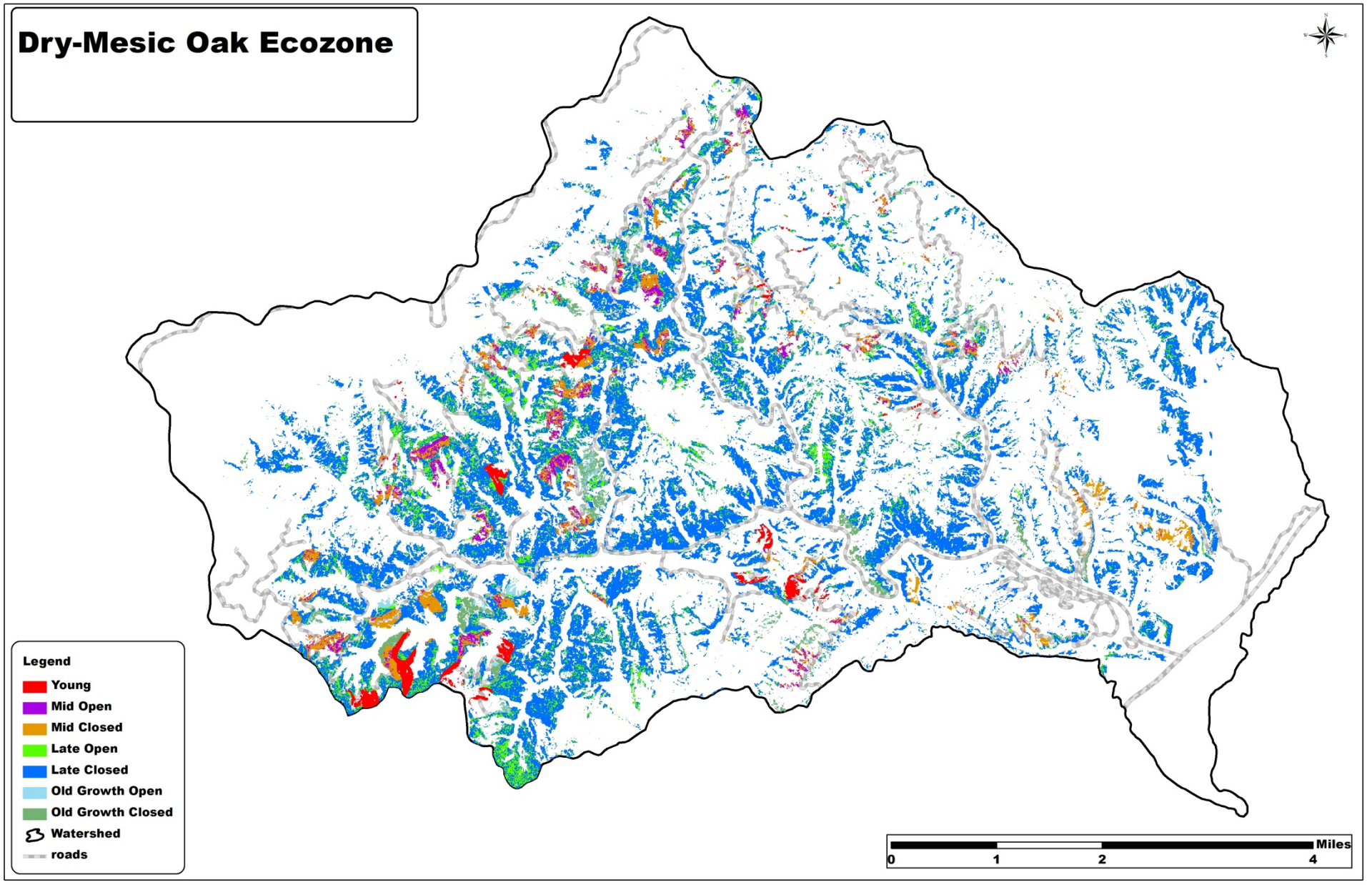
Dry-Mesic Oak Ecozone
Old Growth Forest



Legend

- Old Growth Open
- Old Growth Closed
- Watershed
- roads

0 1 2 4 Miles


Dry-Mesic Oak Ecozone
Legend
Young
Mid Open
Mid Closed
Late Open
Late Closed
Old Growth Open
Old Growth Closed
Watershed
roads
0
1
2
4
Miles

Natural Range of Variation

Dry-Mesic Oak				
	Age	Chattahoochee NF	Cherokee NF	So. Apps
Early	0-19	7%	7%	6%
Mid-Closed	20-70	6%	15%	10%
Mid-Open	20-70	13%	25%	10%
Late -Open	71-130	14%	23%	14%
Late- Closed	71-130	5%	13%	5%
Old Growth Open	> 130	42%	11%	49%
Old Growth Closed	> 130	12%	6%	6%
Total Closed		23%	34%	21%
Total Open		76%	66%	79%

SOUTHERN APPALACHIAN MONTANE OAK ECOLOGY – Dry-Mesic Oak

<19 years
Early
Development

NRV: 6%
Current: 2%

20-70 years
Mid Dev.
Closed

NRV: 10 %
Current: 8 %

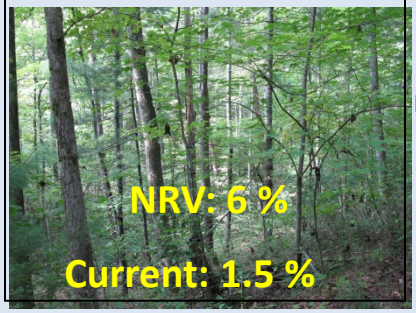
20-70 years
Mid Dev.
Open

NRV: 10
Current: 2%

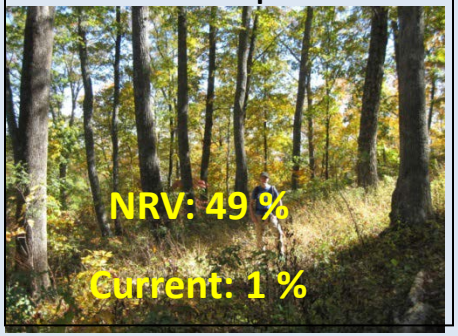
71- 130 years
Late Dev.
Open

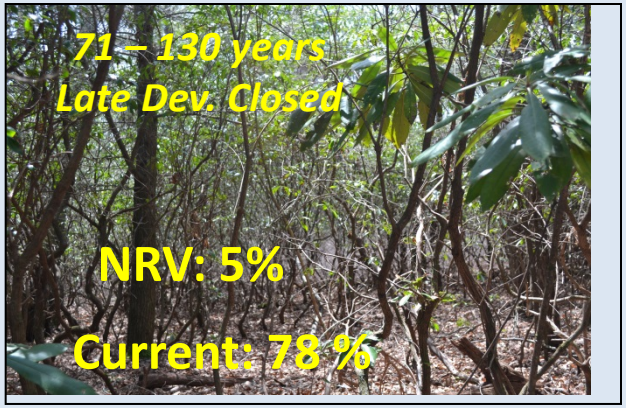
NRV: 14 %
Current: 8 %

> 130 years
Old Growth Closed



> 130 years
Old Growth Open

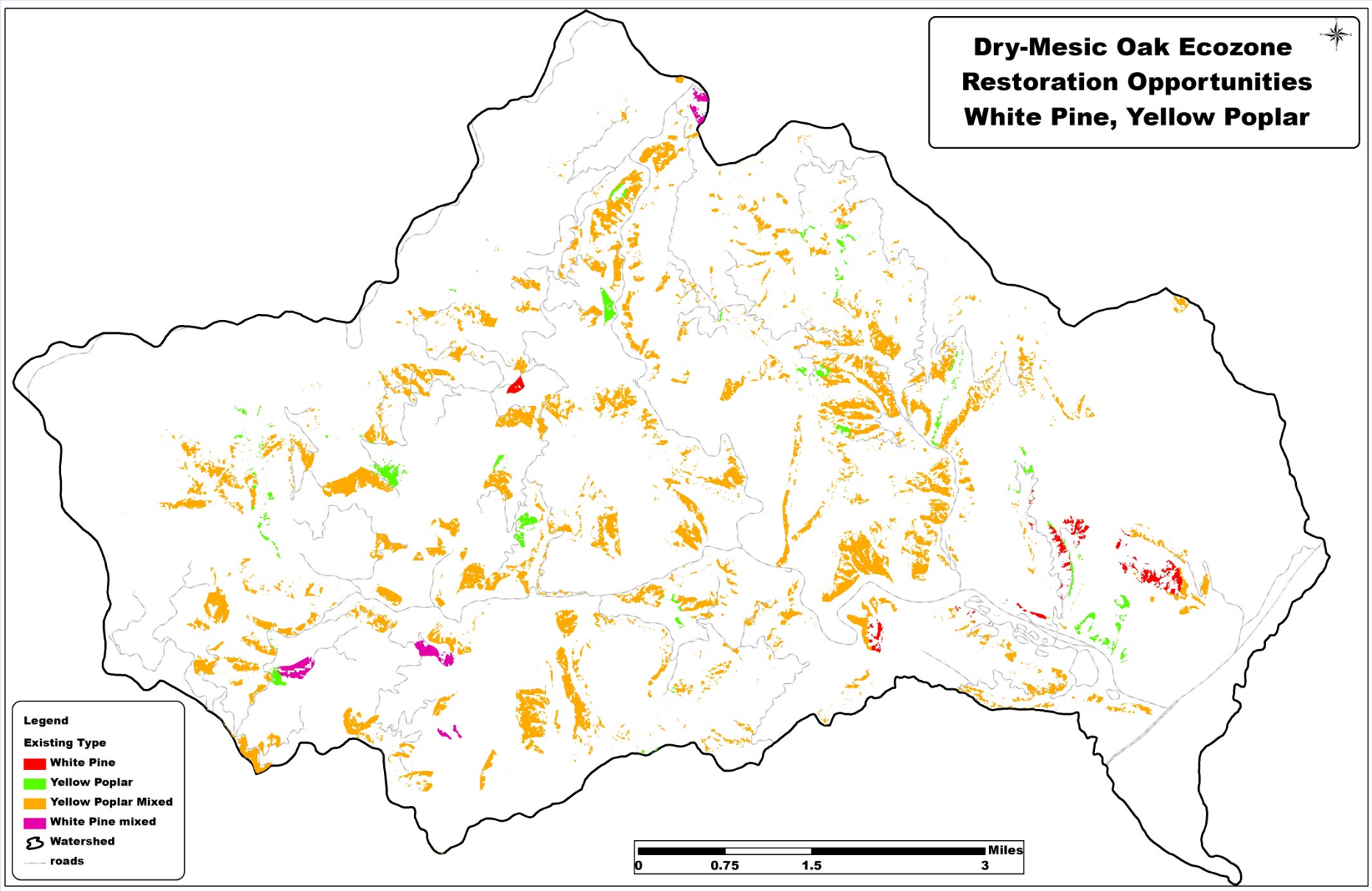




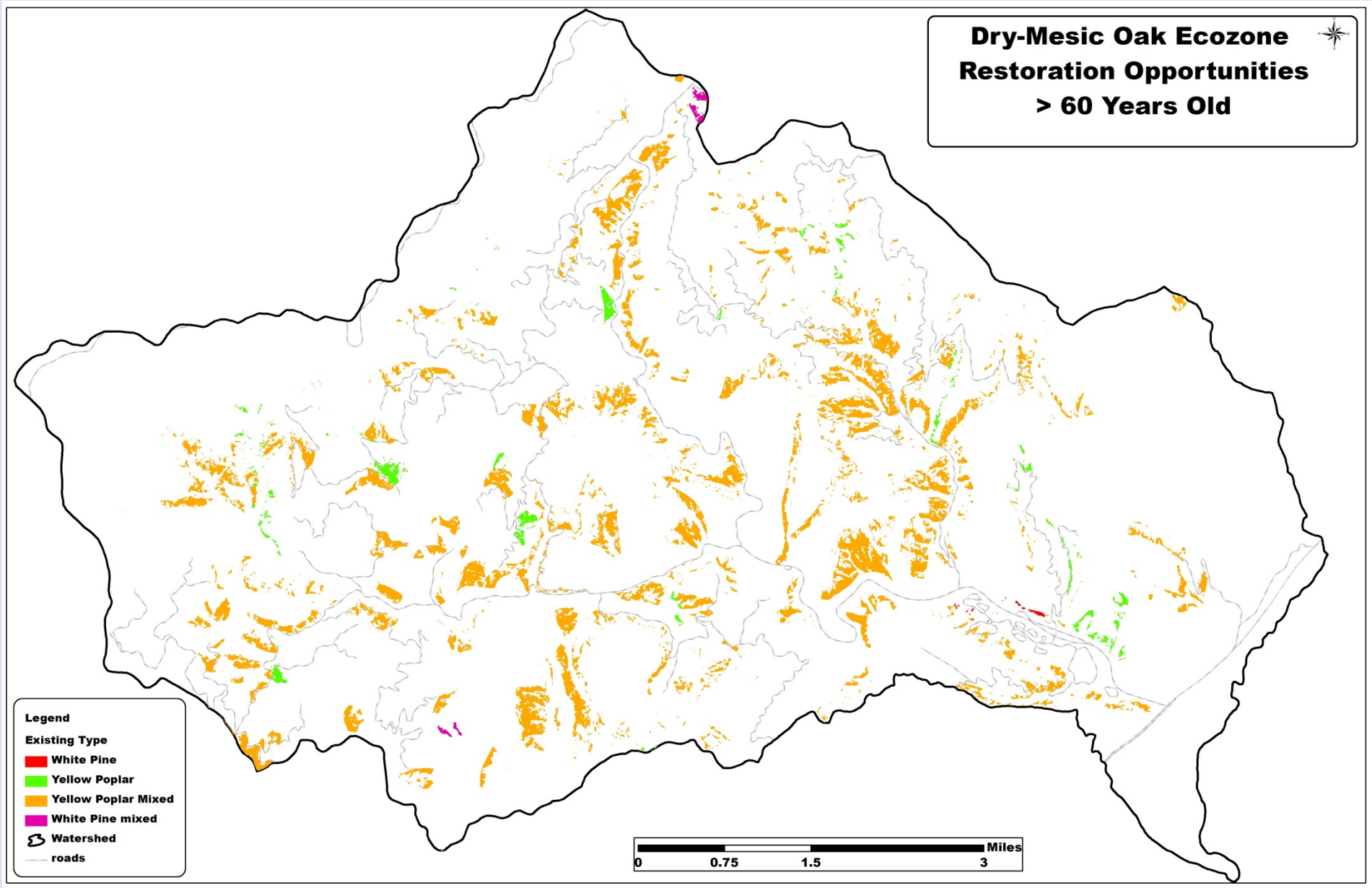
Break – 10 minutes

When we come back:

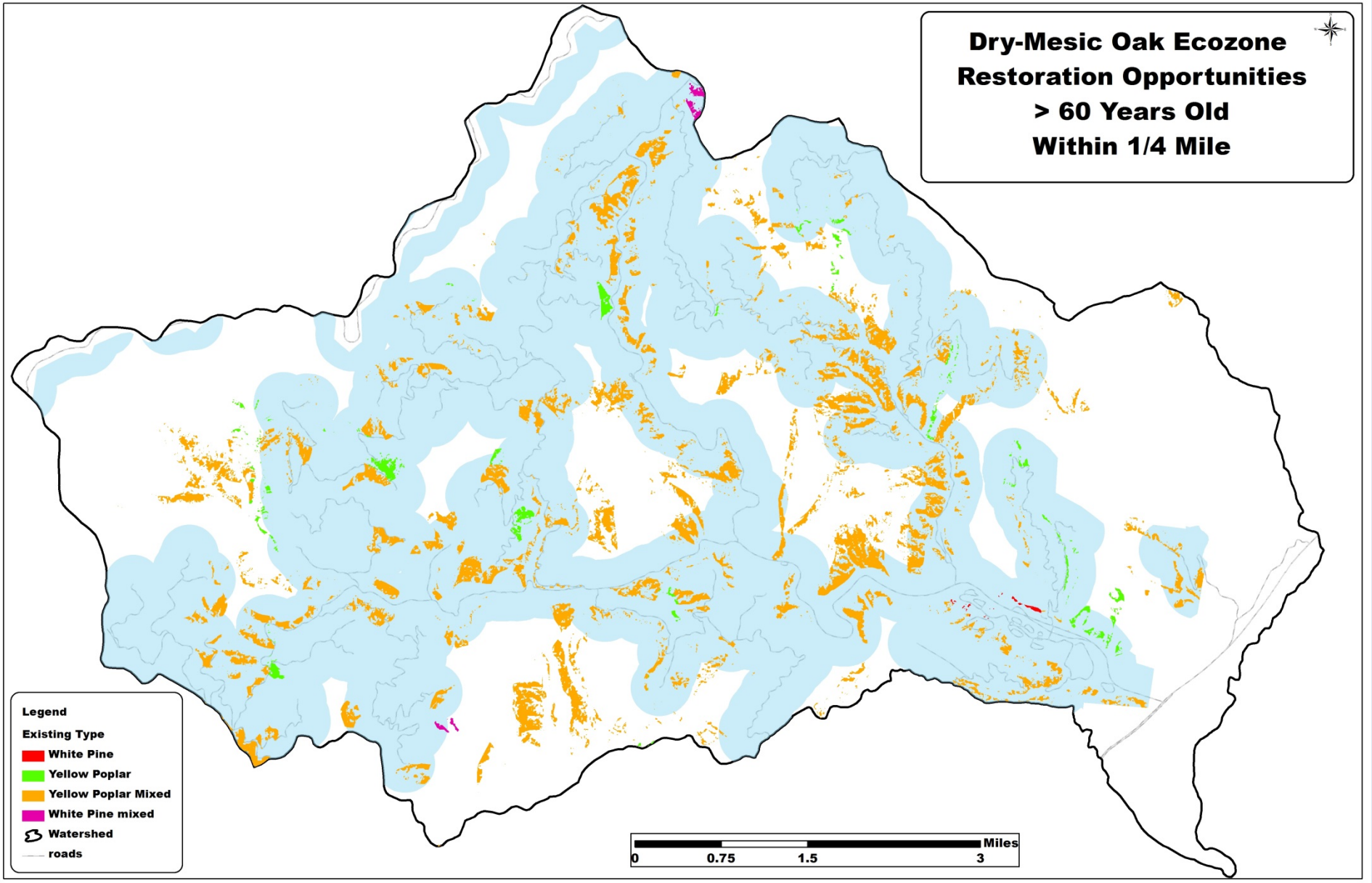
Given the information that has been presented regarding the Natural Range of Variation and existing conditions, what management activities might be appropriate in this watershed?

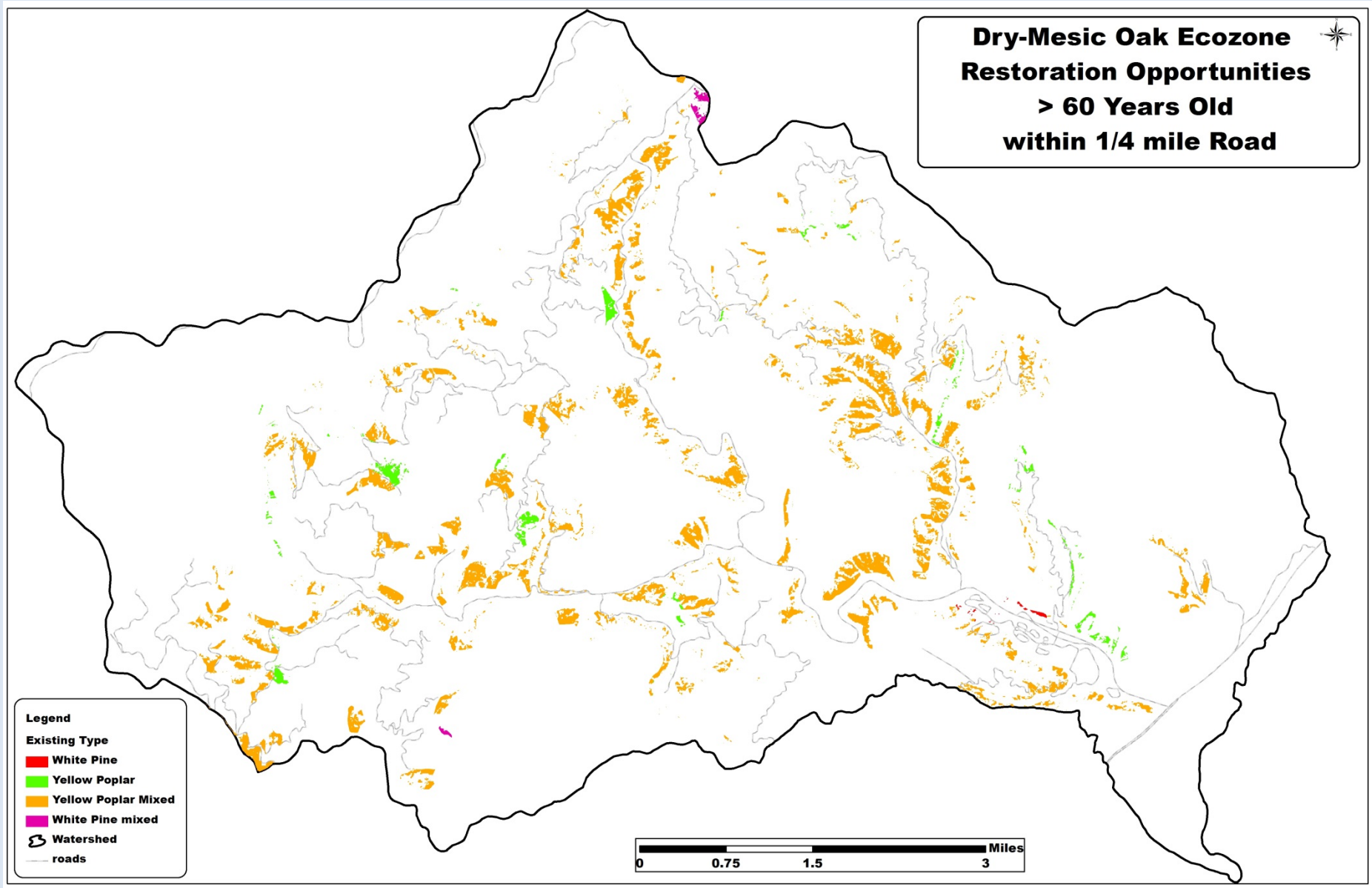


2,084 acres dominated by white pine or yellow poplar in dry-mesic oak ecozone in watershed



1,739 of 2,084 acres are greater than 60 years of age


Dry-Mesic Oak Ecozone
Restoration Opportunities
> 60 Years Old
Within 1/4 Mile
Legend
Existing Type
White Pine
Yellow Poplar
Yellow Poplar Mixed
White Pine mixed
Watershed
roads
Miles
0
0.75
1.5
3

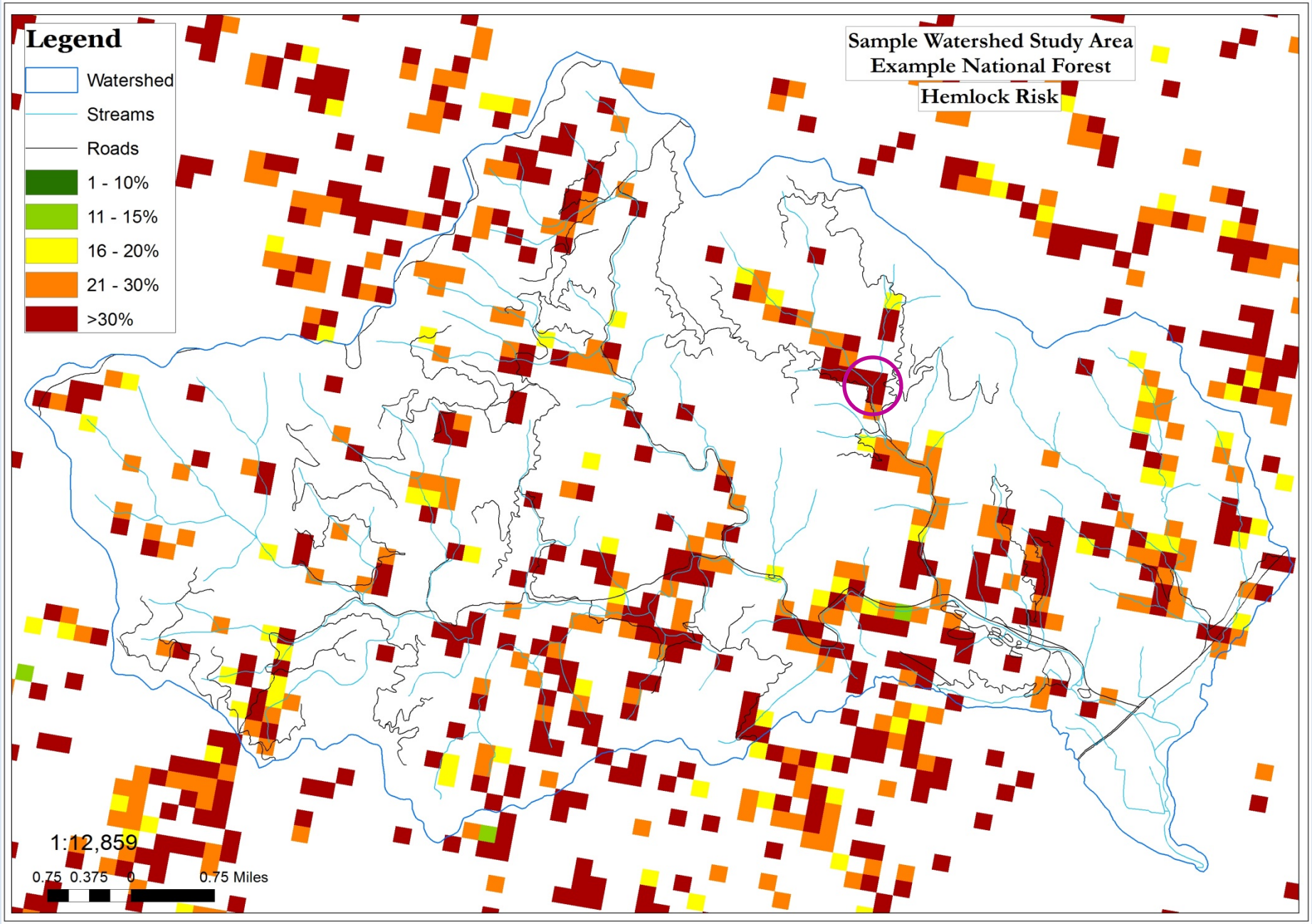


1,275 of 2,084 acres are greater than 60 years of age AND within a ¼ mile of an existing road

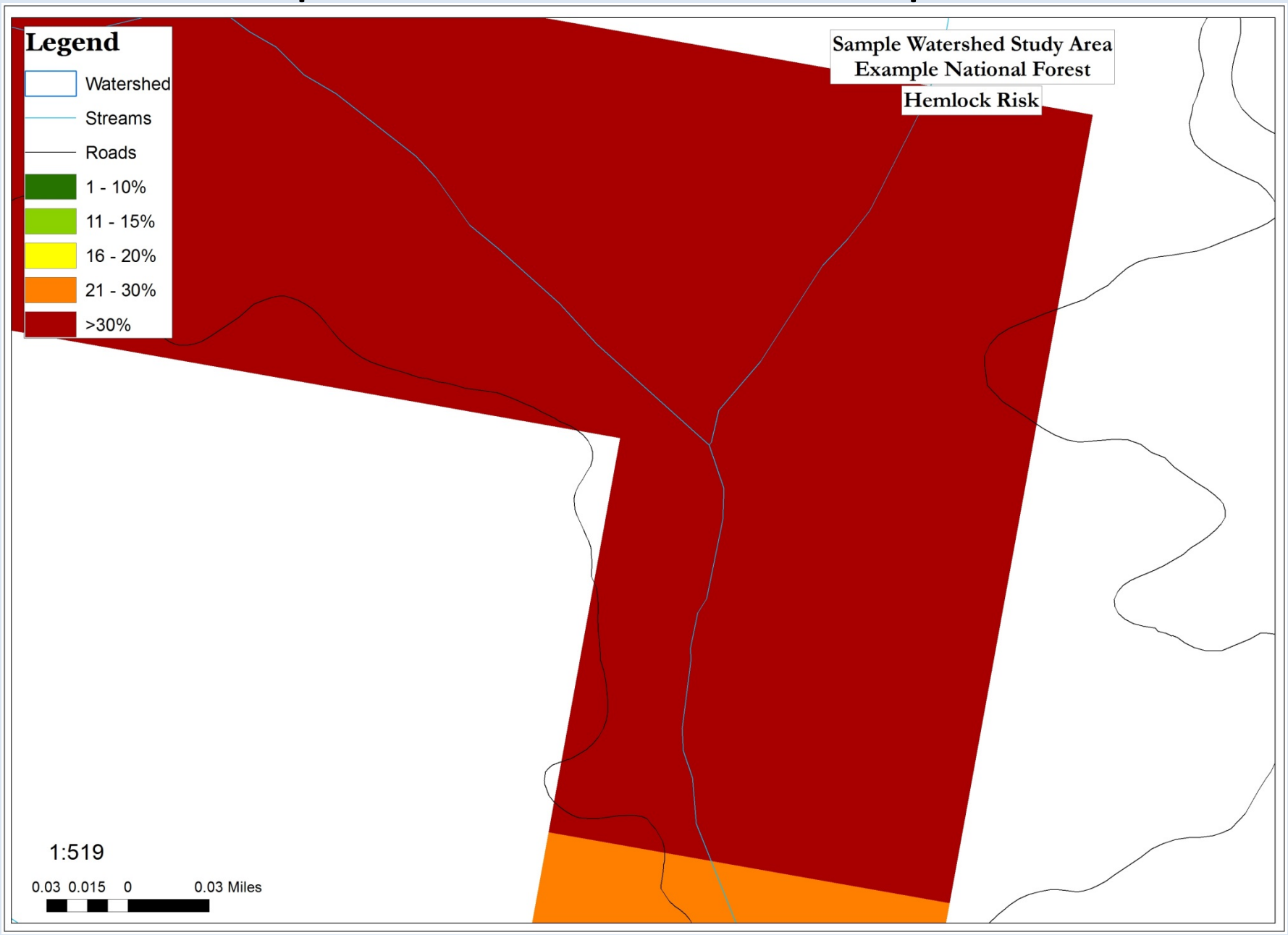
Management Opportunities

- **Reduce late or mid-closed forests to late or mid-open forests with thinning/group selection treatments**
- **Increase young forest using 2-age treatment in dense white pine or yellow poplar forest and restore to dry mesic oak**
- **Burn in mid and late forest to increase open conditions in the understory**

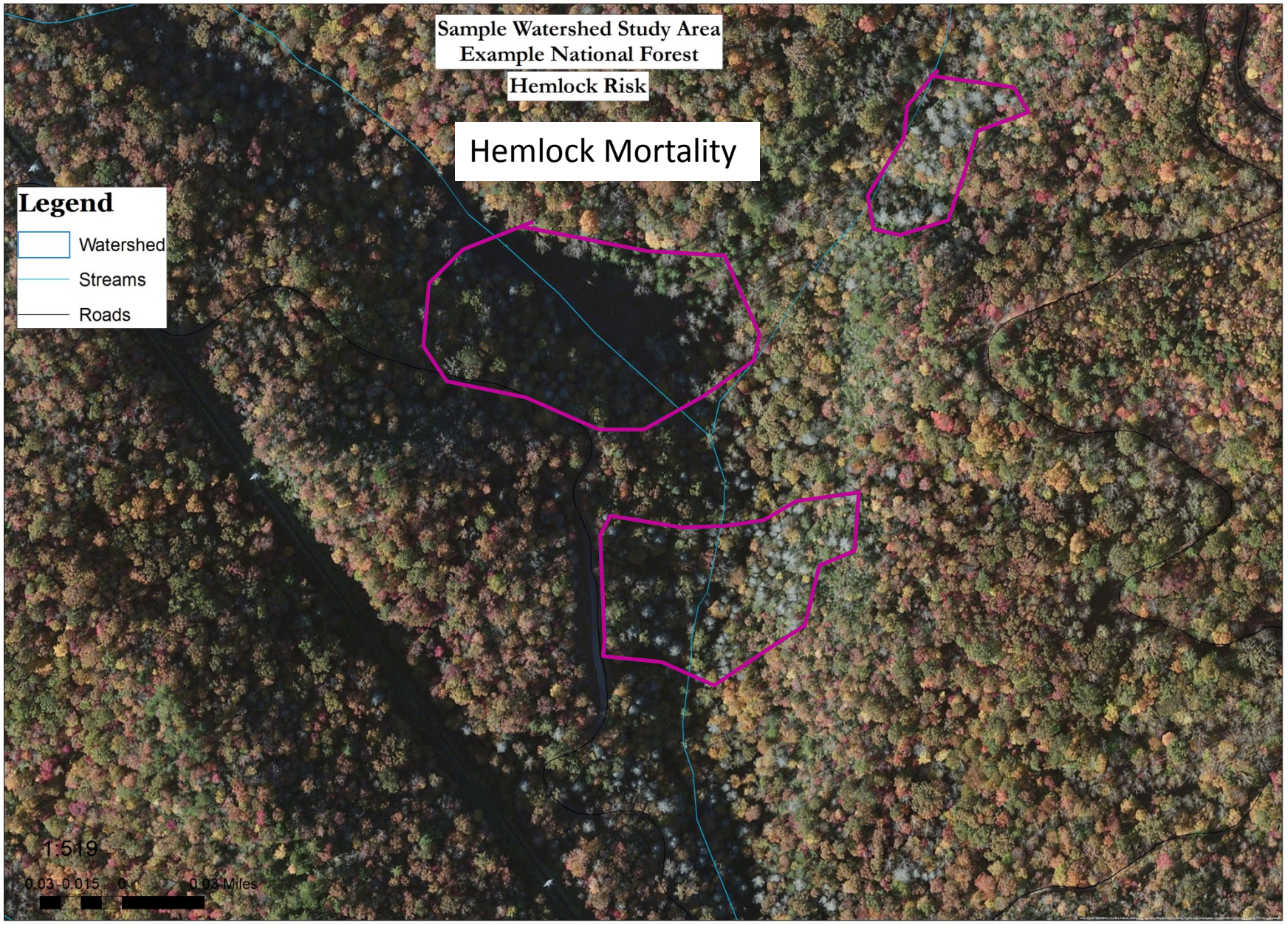
Riparian Restoration Example



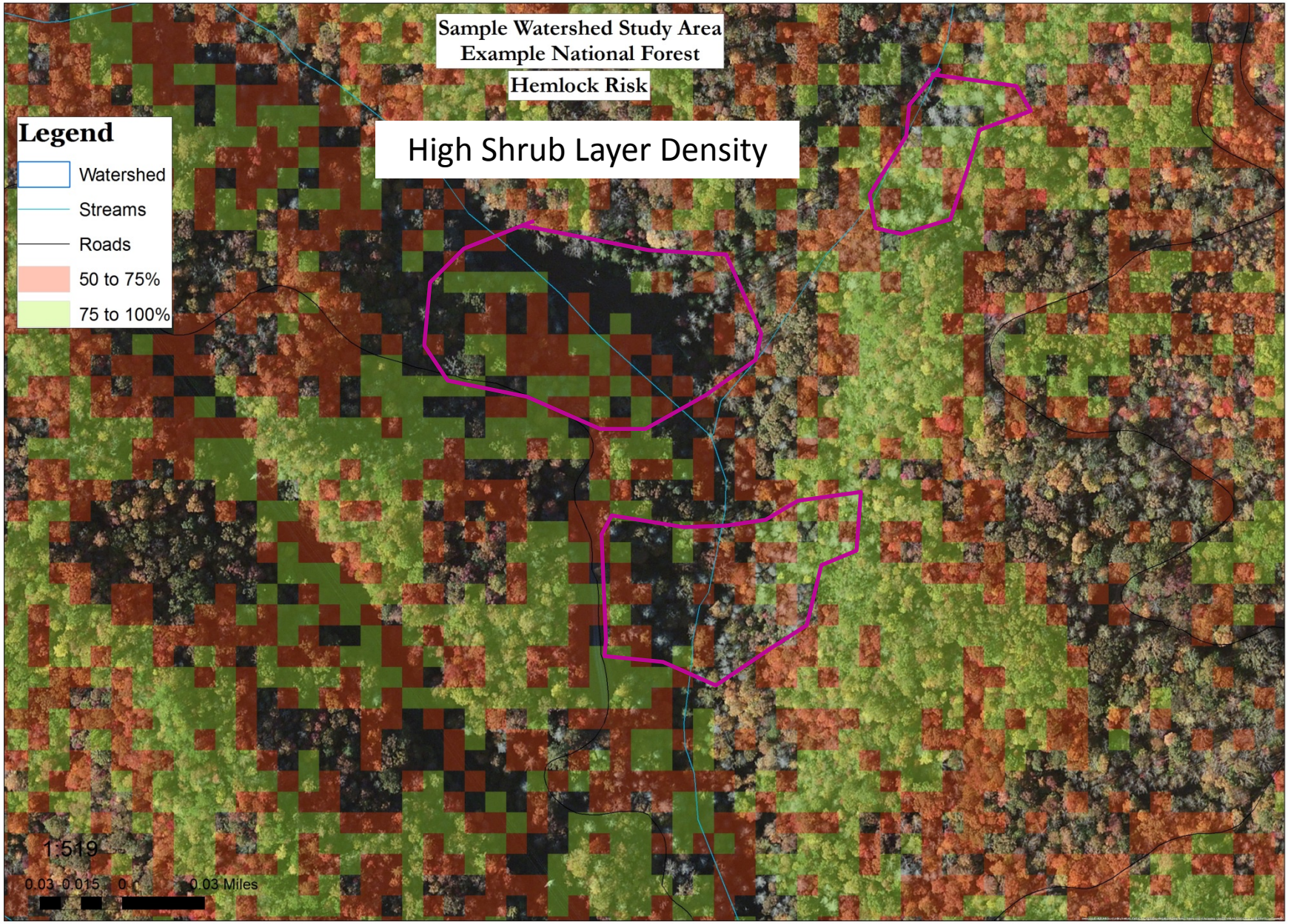
Riparian Restoration Example



Riparian Restoration Example



Riparian Restoration Example

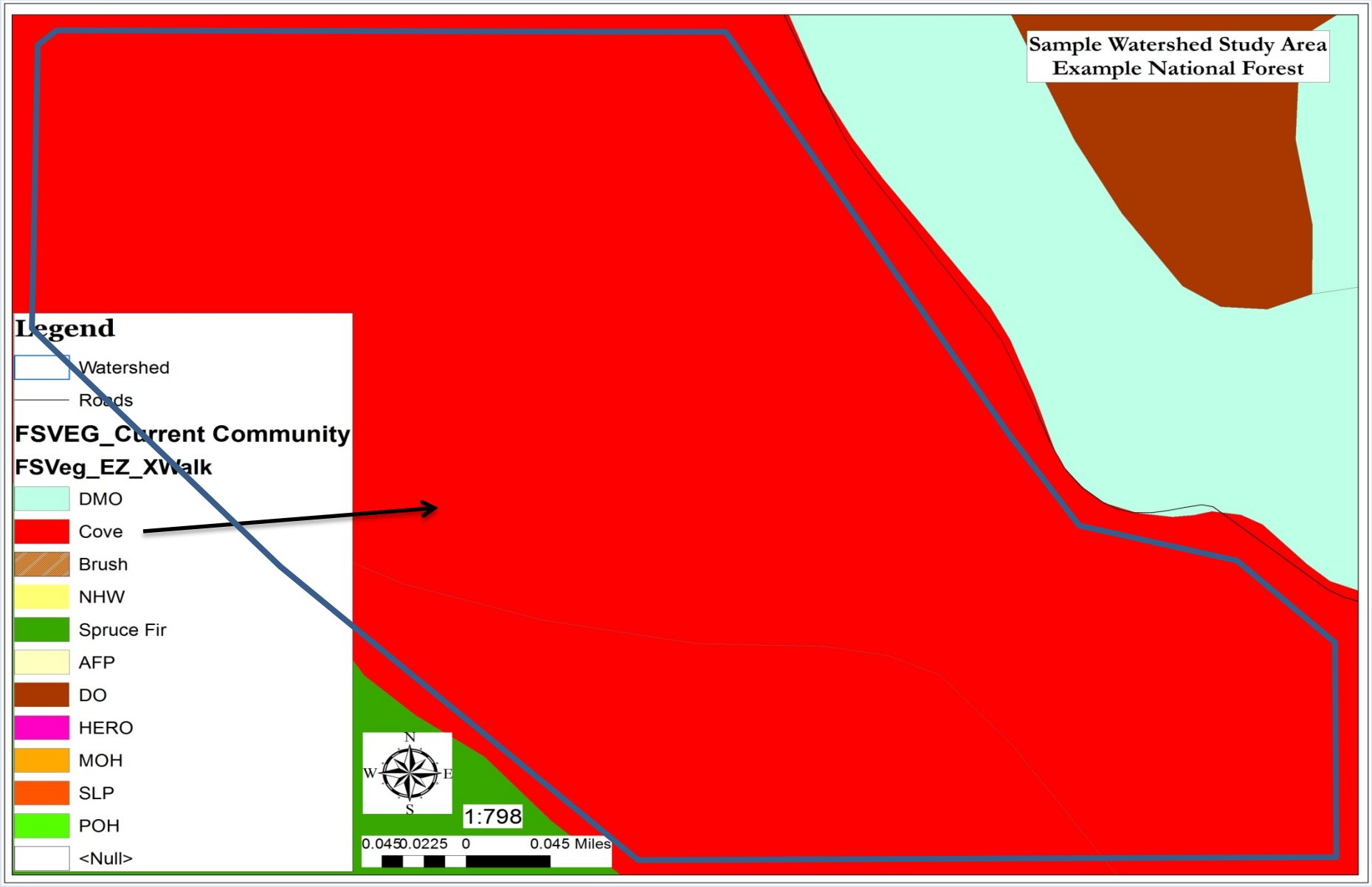


Management Opportunities

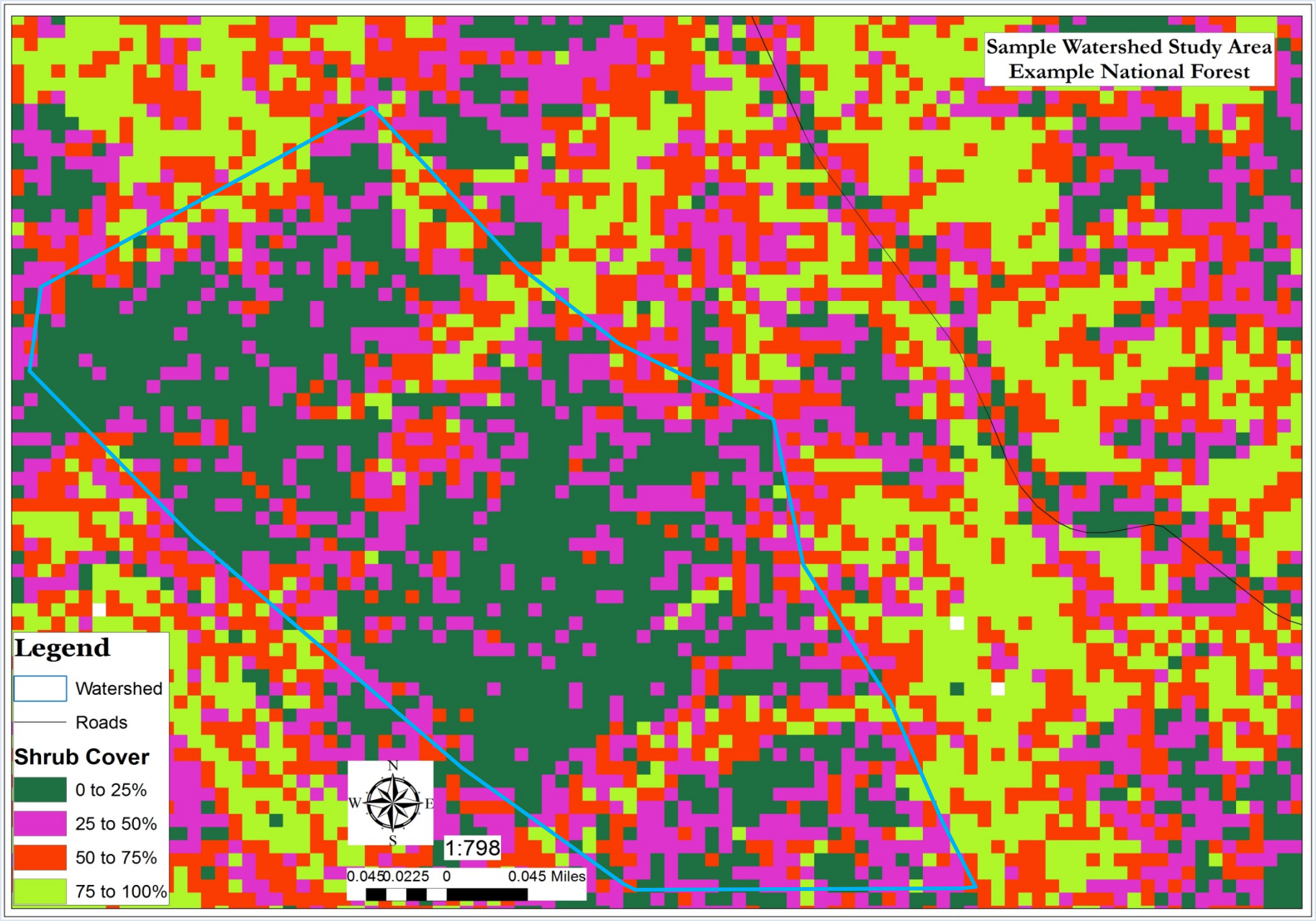
- **Reduce rhododendron density**
- **Restore native tree species and other understory vegetation**

Enhance Canopy Structure Example 1

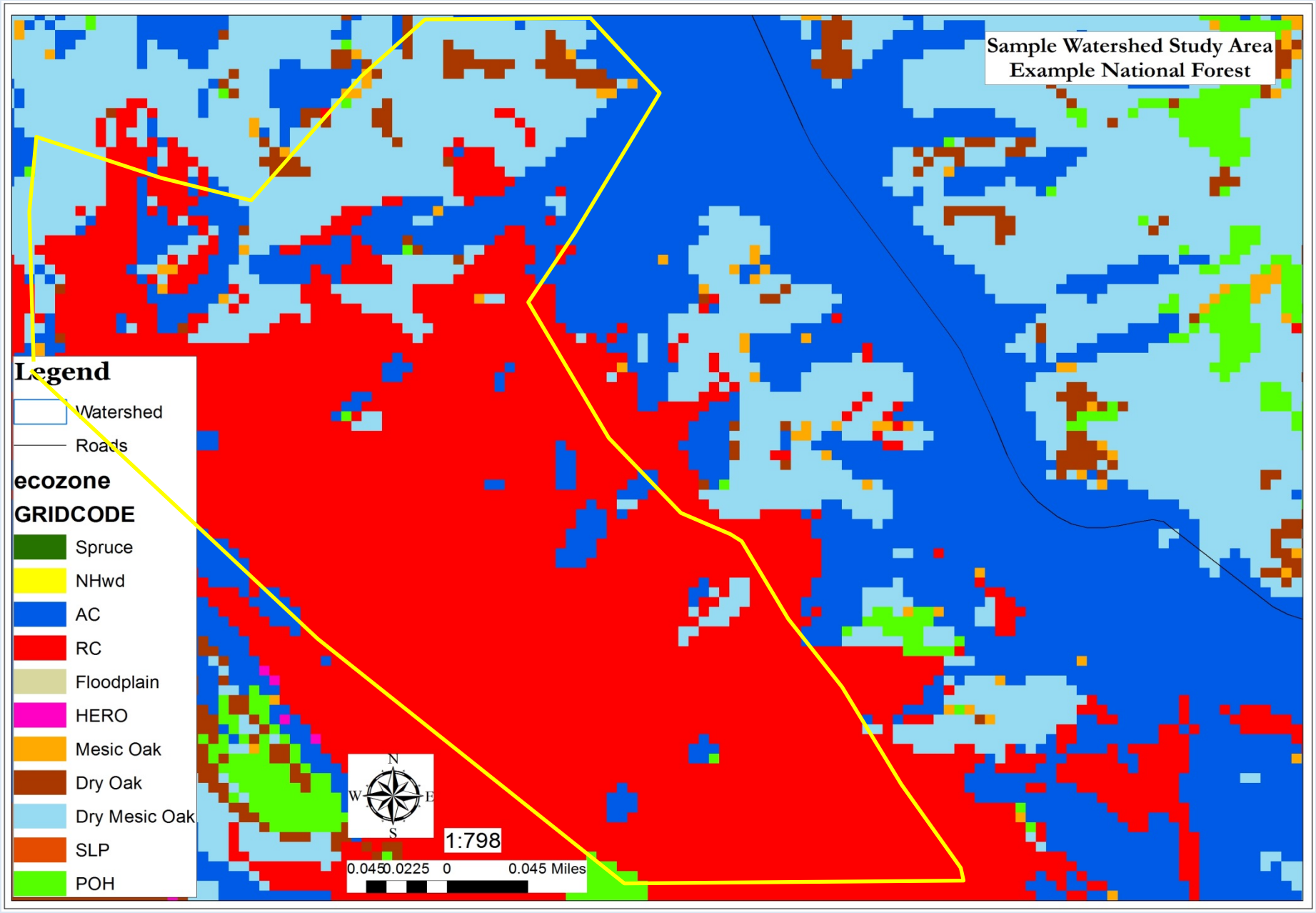
Current Conditions



Enhance Canopy Structure Example 1



Enhance Canopy Structure Example 1

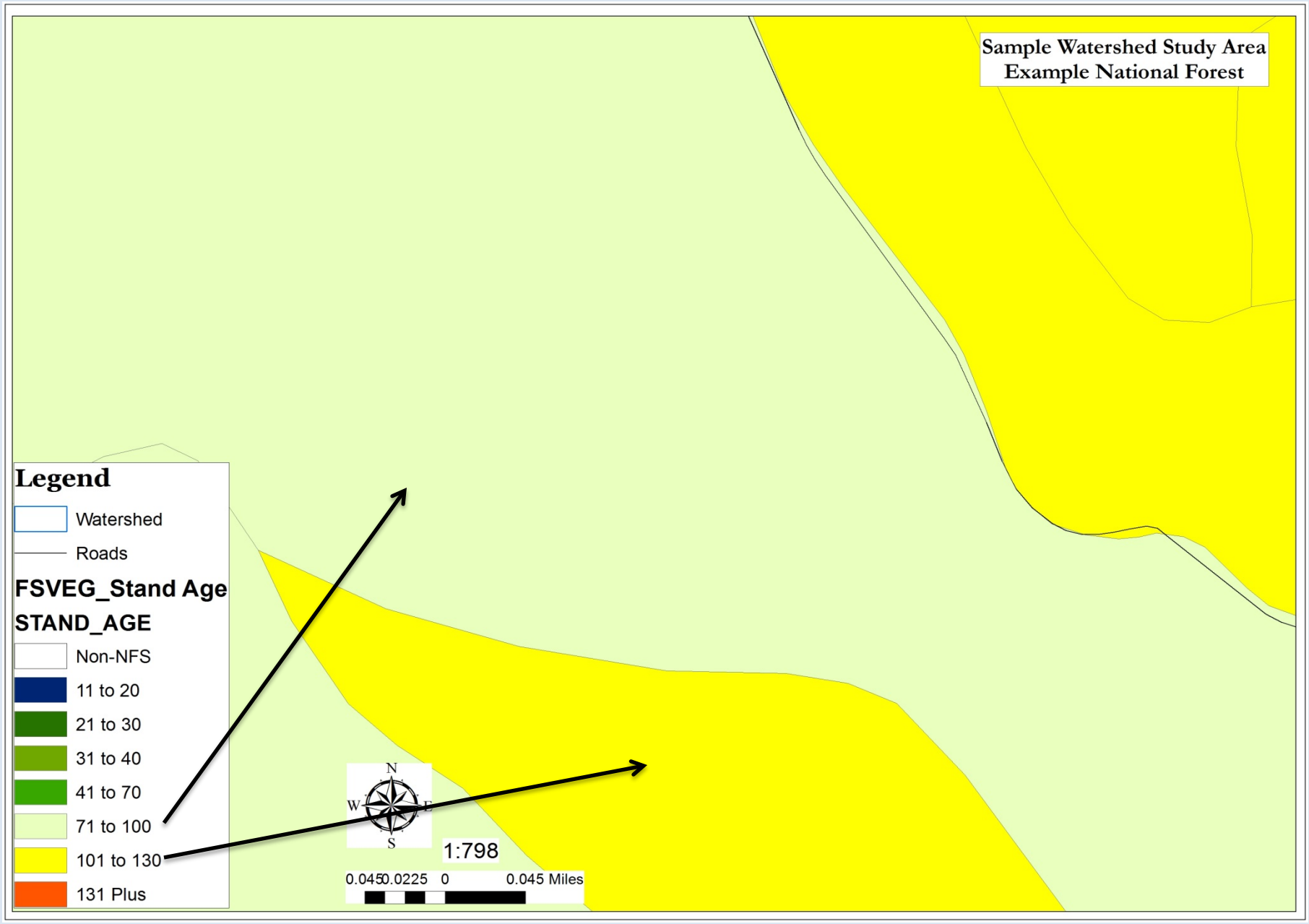


Enhance Canopy Structure Example 1

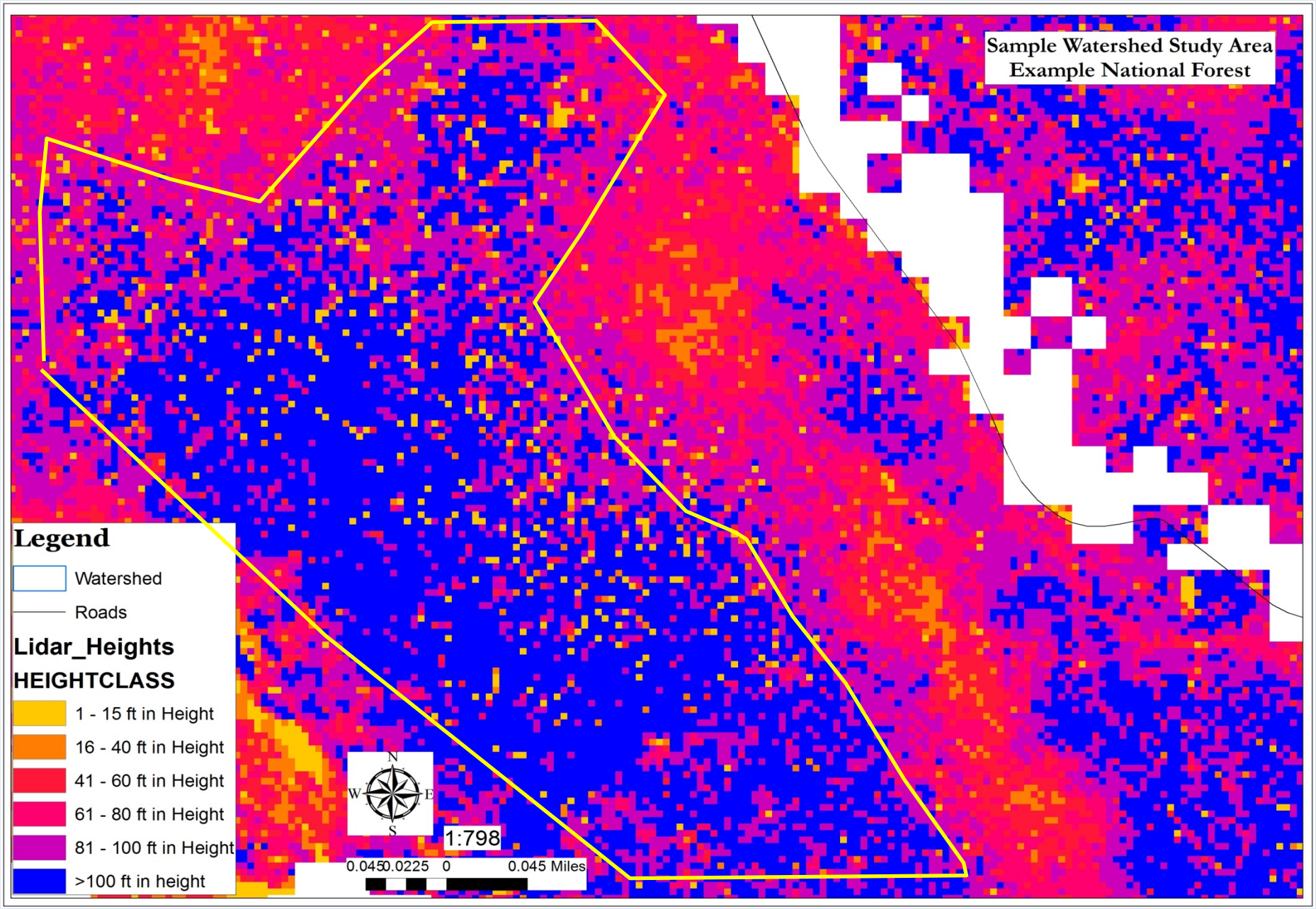
Natural Range of Variation

Rich Cove			
		NRV	Existing
	Age	So. App	in Watershed
Early	0-10	4%	0%
Mid-Closed	11-99	29%	44%
Mid-Open	11-99	0%	11%
Late -Open	100-140	1%	6%
Late- Closed	100-140	22%	37%
Old Growth Open	> 140	0%	.3%
Old Growth Closed	> 140	54%	1%
Total Closed		96%	
Total Open		5%	

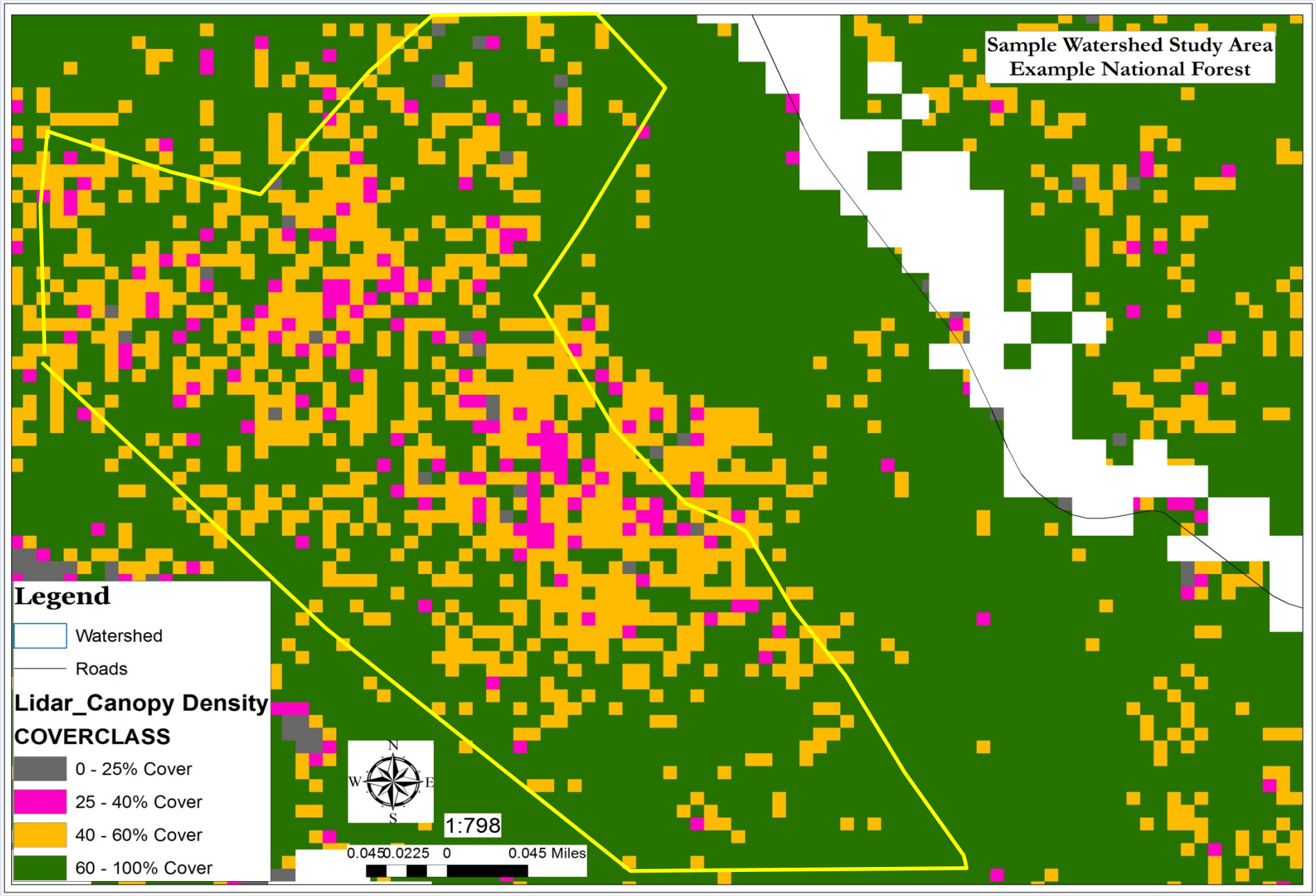
Enhance Canopy Structure Example 1



Enhance Canopy Structure Example 1



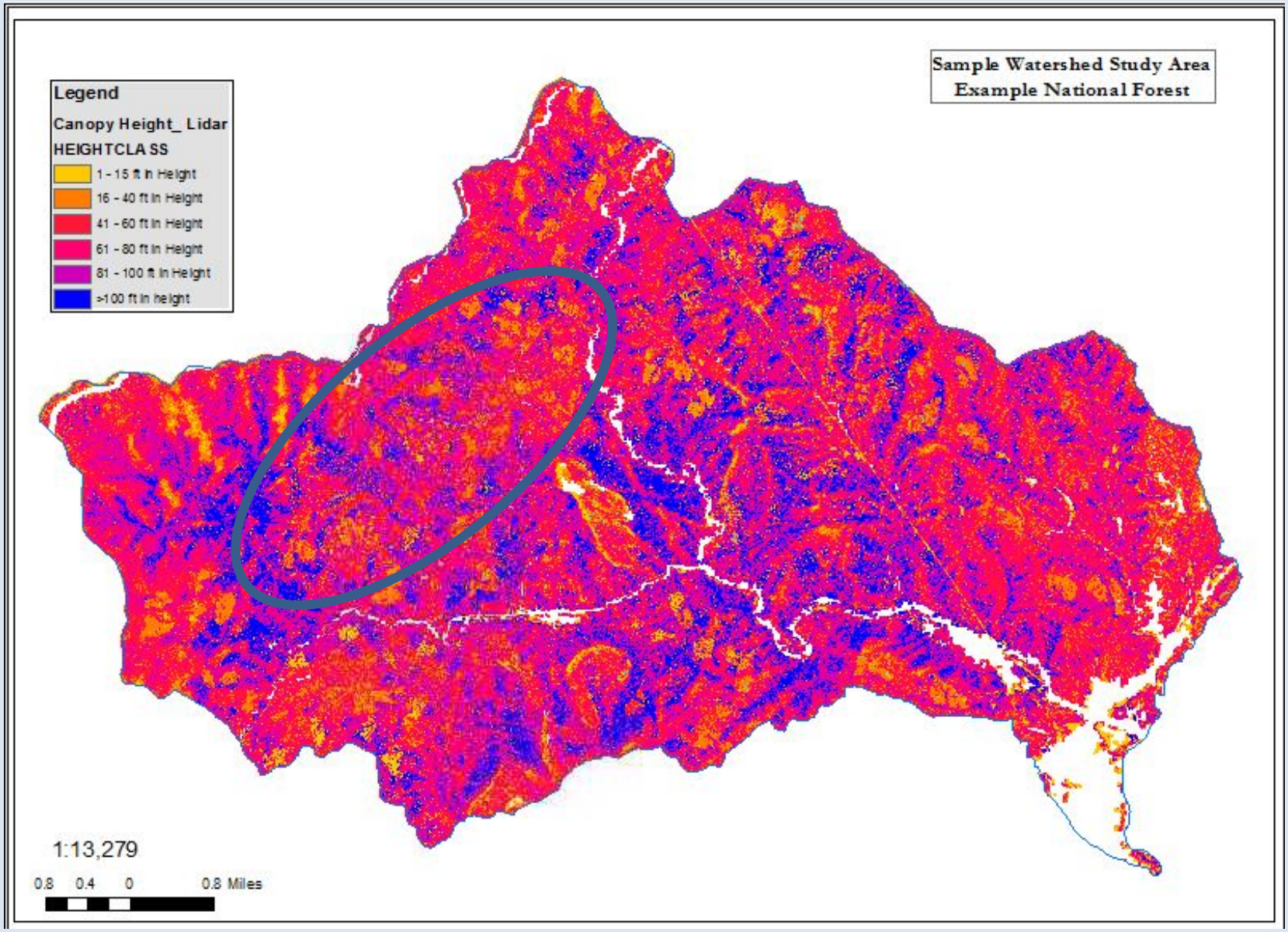
Enhance Canopy Structure Example 1



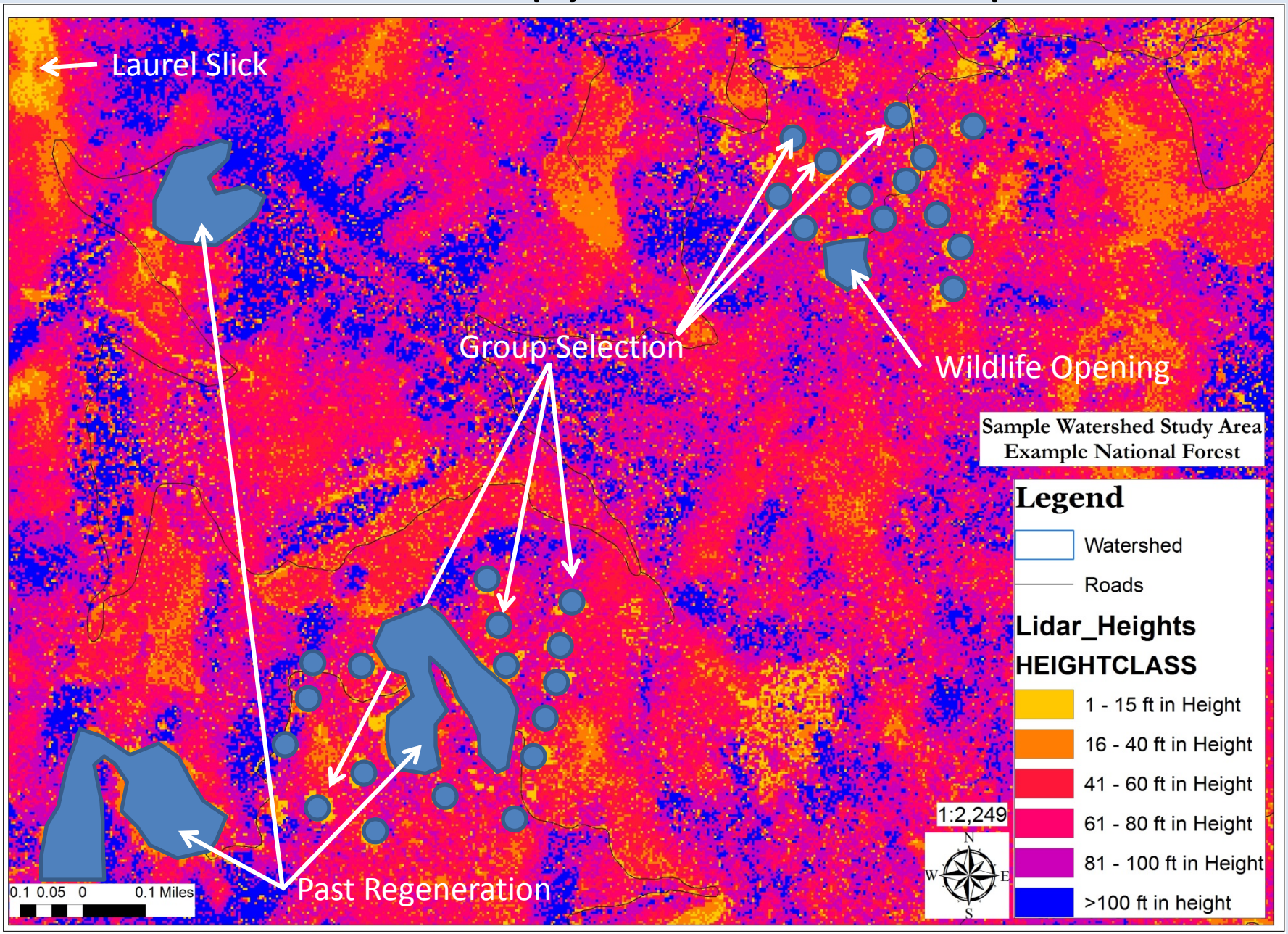
Management Opportunities

- Add early successional habitat
- Increase the number of canopy gaps
- Increase the size of existing gaps
- Enhance late structural characteristics (old growth)

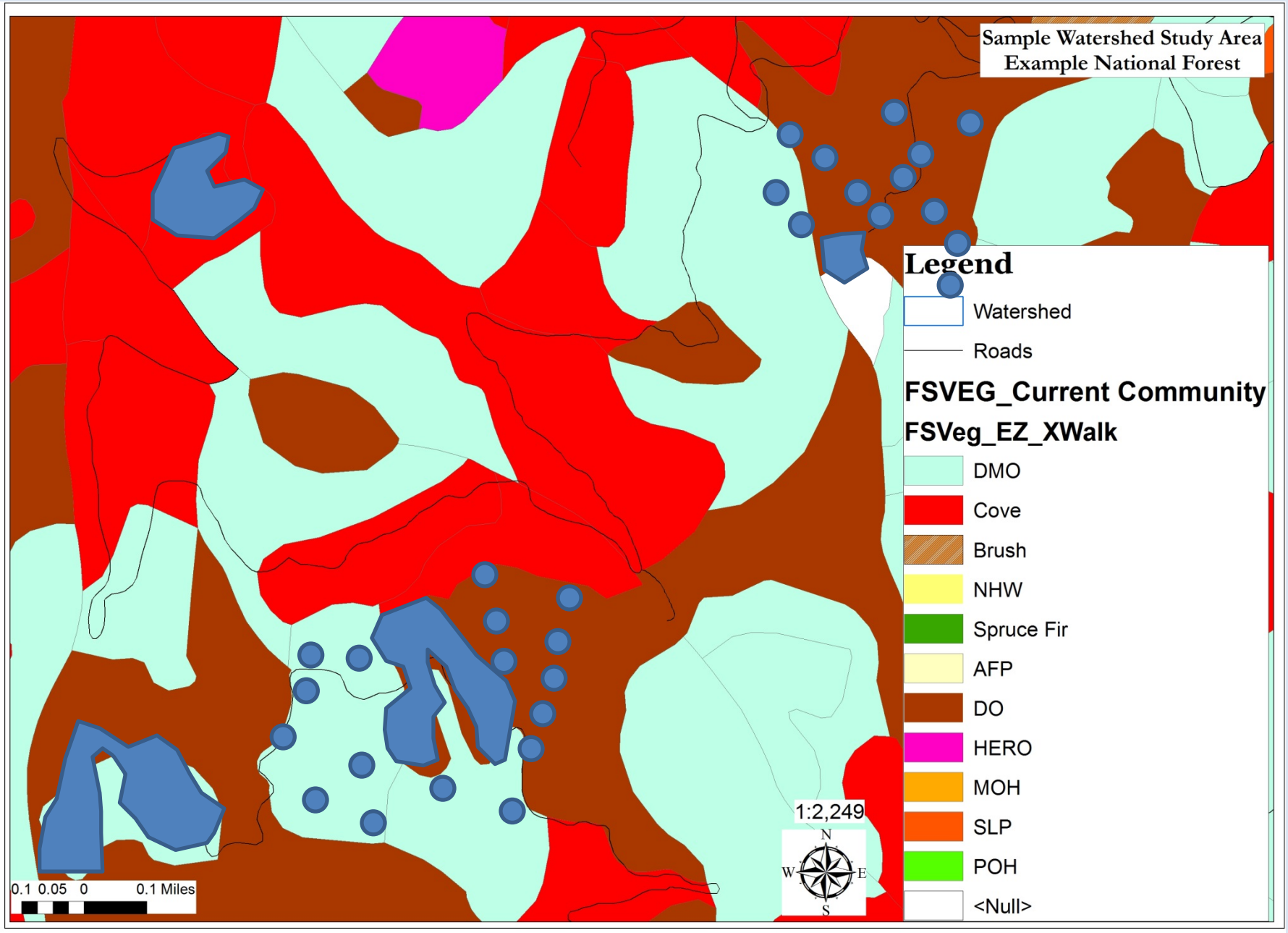
Enhance Canopy Structure Example 2



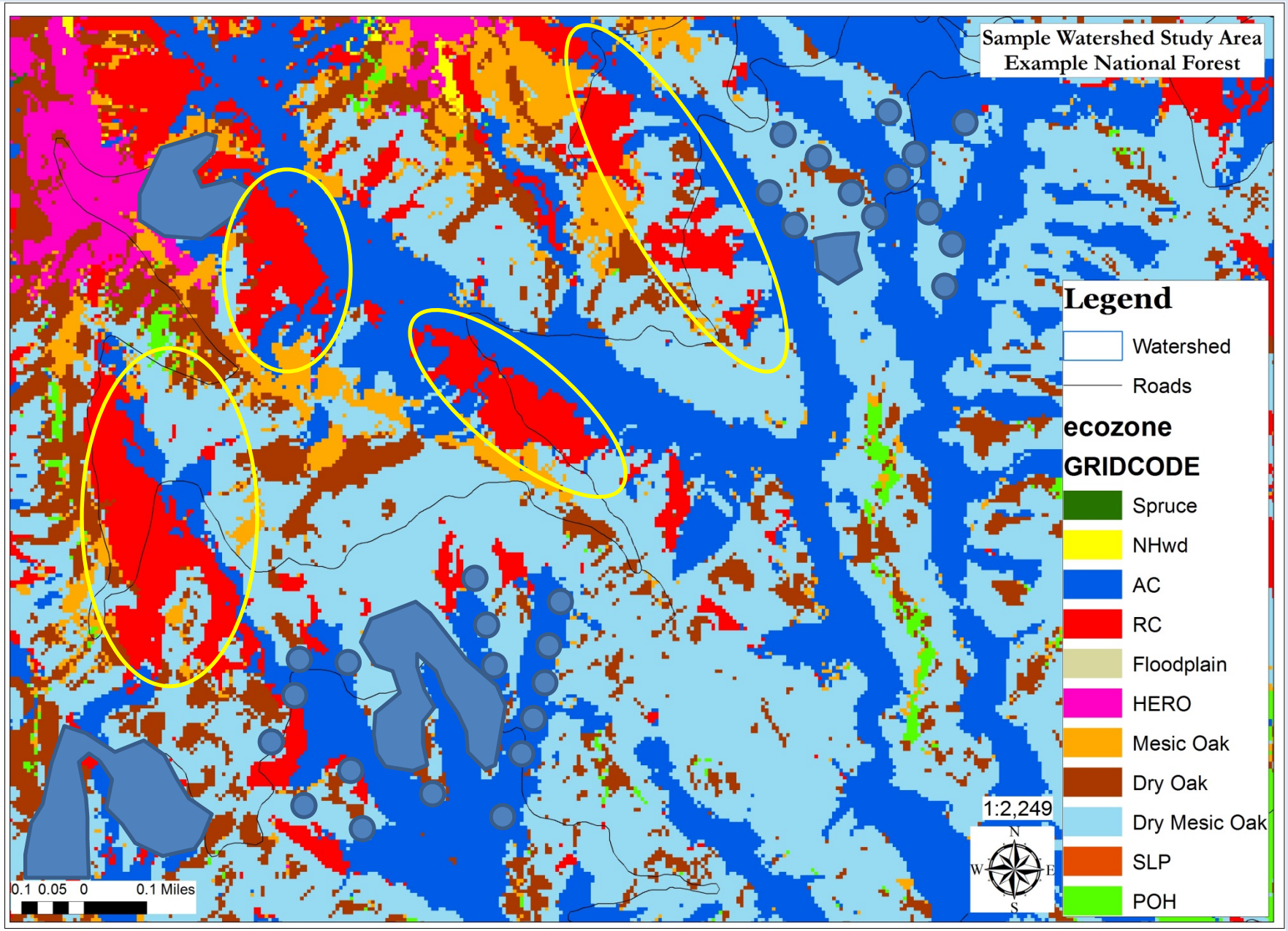
Enhance Canopy Structure Example 2



Enhance Canopy Structure Example 2

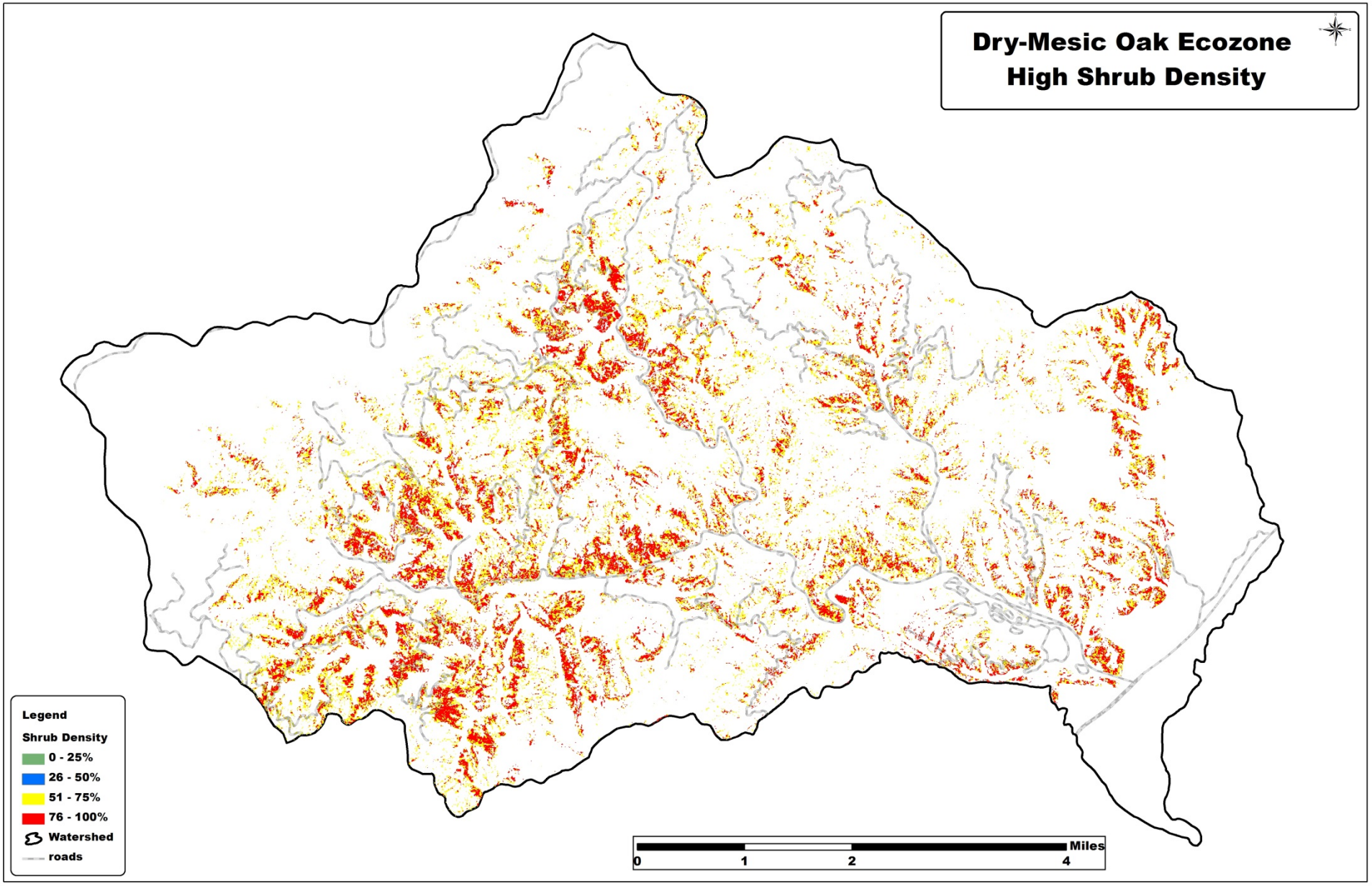


Enhance Canopy Structure Example 2



Management Opportunities

- **Increase canopy openings through group selection and thinning**
- **Create early successional habitat through group selection**



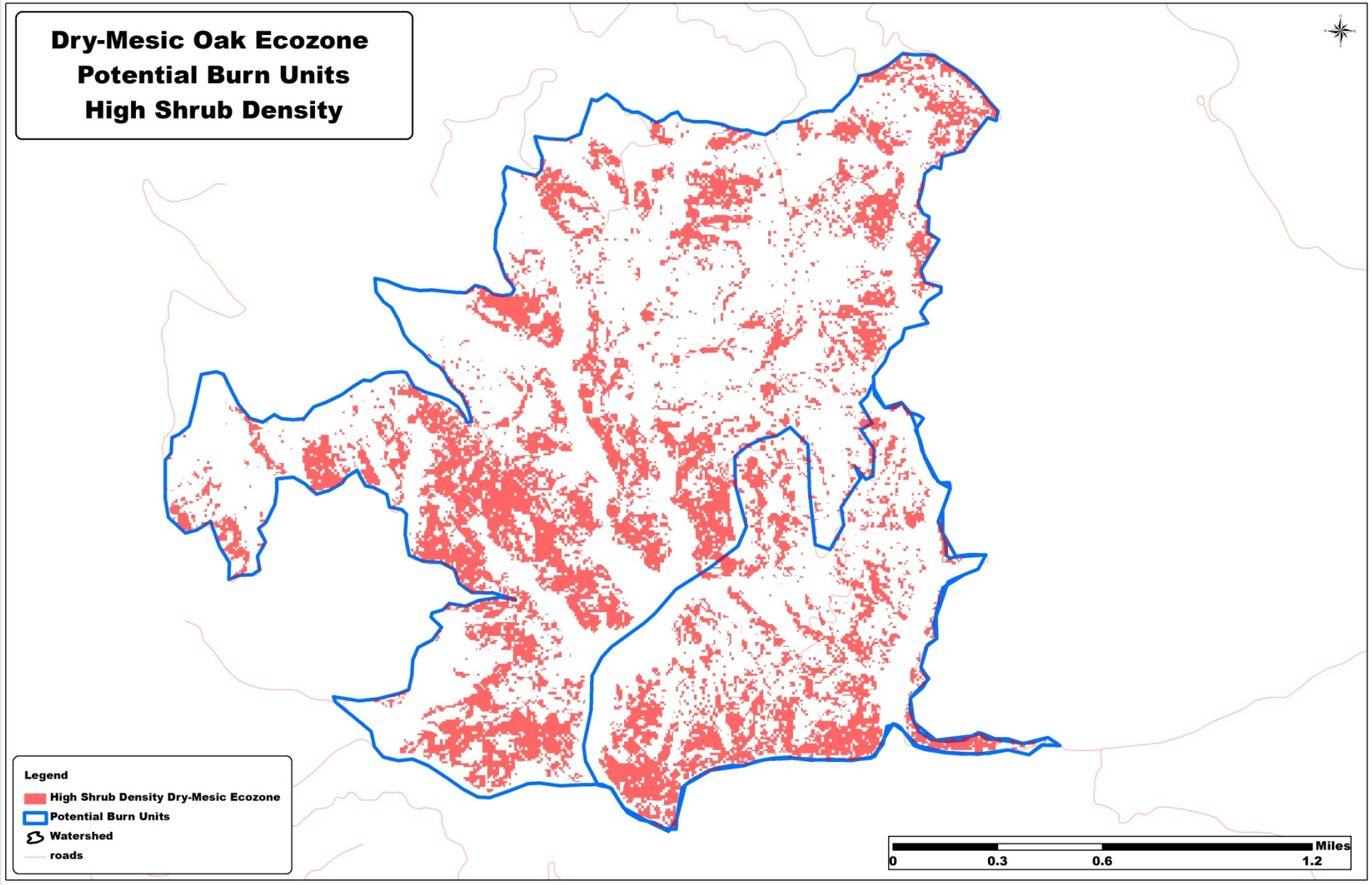
3717 acres with > 50% shrub density, mostly heath, mountain laurel, huckleberry, rhododendron

Dry-Mesic Oak Ecozone
High Shrub Density

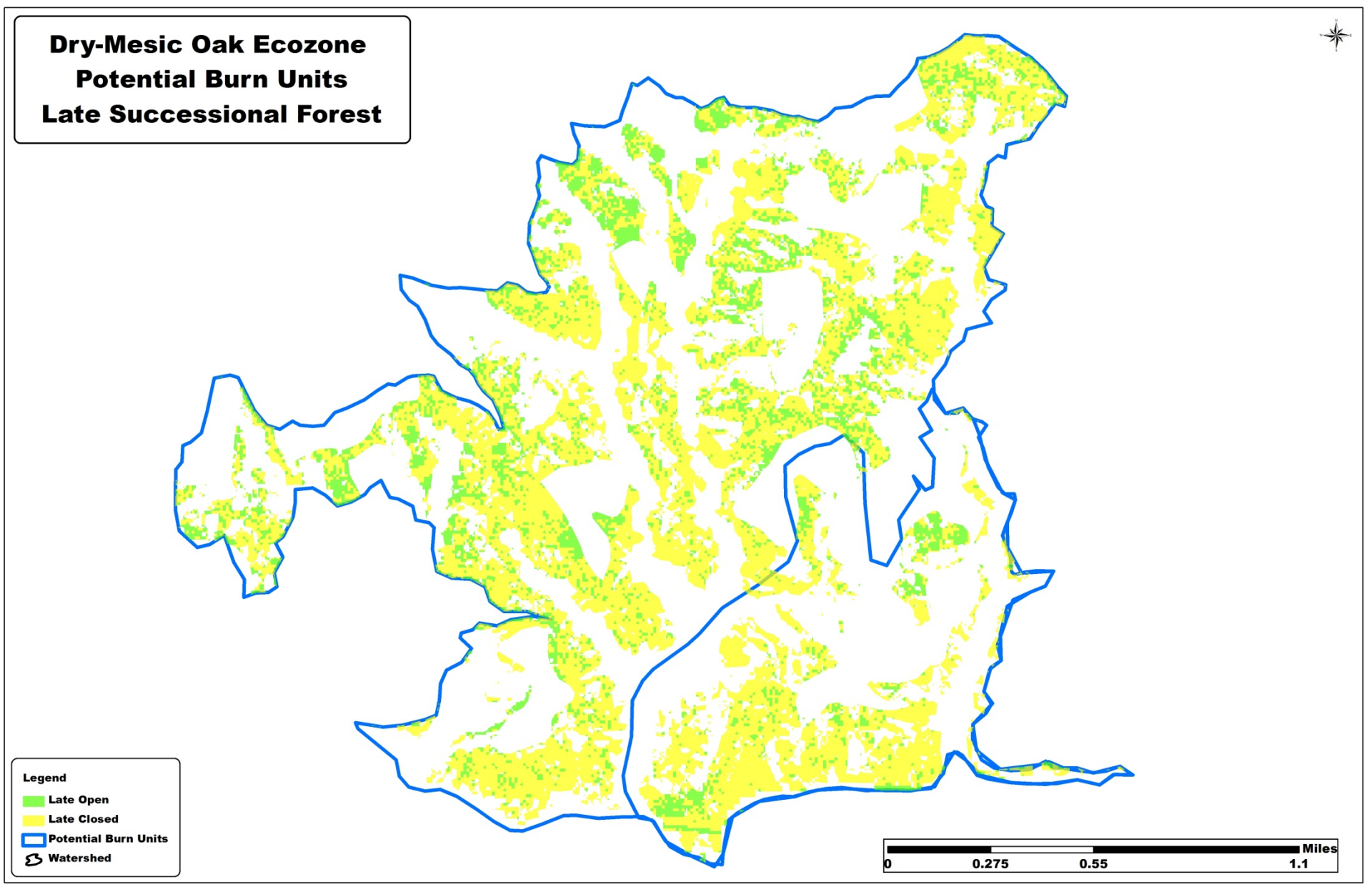
Legend
Potential Burn Units
Shrub Density
0 - 25%
26 - 50%
51 - 75%
76 - 100%
Watershed
roads

Miles
0 0.75 1.5 3

Two potential burn units identified with primary use of roads as firelines. Units - 467 acres, 1405 acres, or combined 1872 acres



631 acres dominated by dense shrubs - 132 acres in small unit, 499 acres in larger unit



932 acres from 71-130 year old forest - 725 acres in closed forest condition

Management Opportunities

- **Burn in late forest to reduce the shrub density and improve understory herbaceous diversity**

- **Change some late closed forest to late open forest using thinning/group selection treatments followed by prescribed burn to improve understory diversity**

Summary of Potential Opportunities

- Reduced rhododendron density in riparian areas
- Created more open structure in mid to late dry mesic oak ecozone
- Created early successional habitat in dry mesic oak and rich cove
- Restored species composition in riparian areas and dry mesic oak
- Reduced white pine and yellow poplar density in dry mesic oak and increased tree species diversity

- What are some other opportunities that have occurred to you during this presentation?

- What activities might address the range of perspectives that we have heard throughout this plan revision?