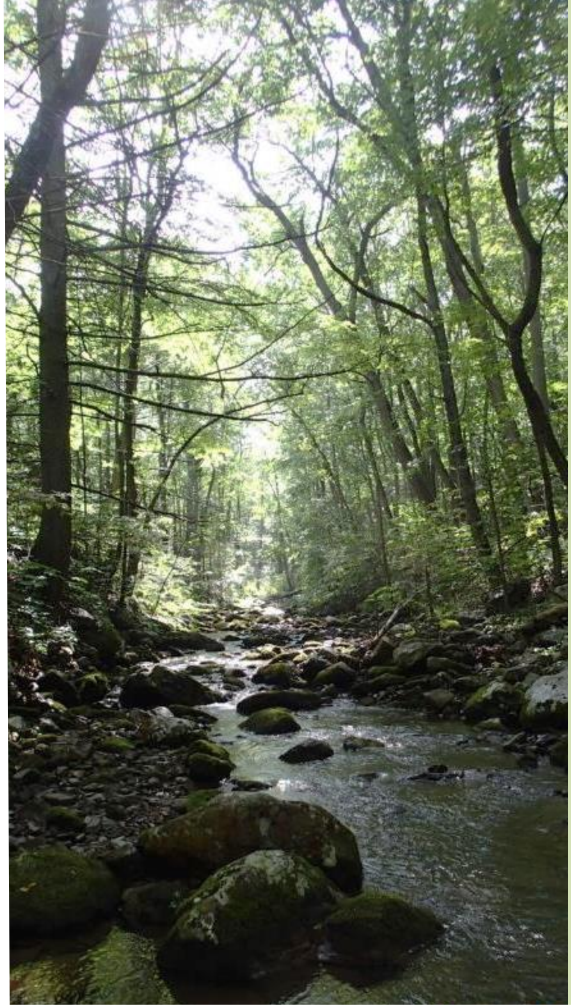
CENTRAL APPALACHIANS FLN

The Nature Conservancy
Protecting nature. Preserving life.

Forest Service U.S. Department of Agriculture

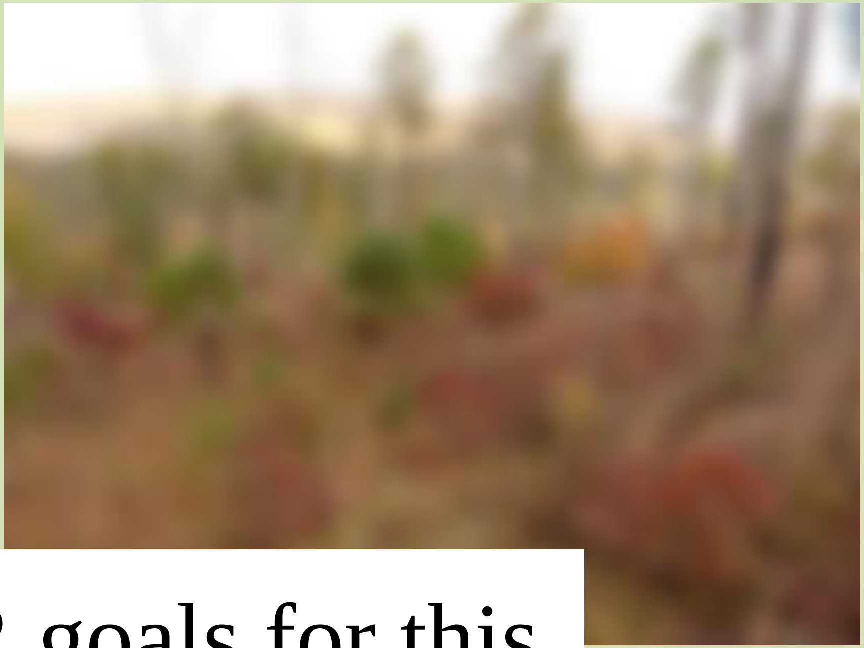
Virginia Department of Game & Inland Fisheries

DCR Virginia Department of Conservation & Recreation

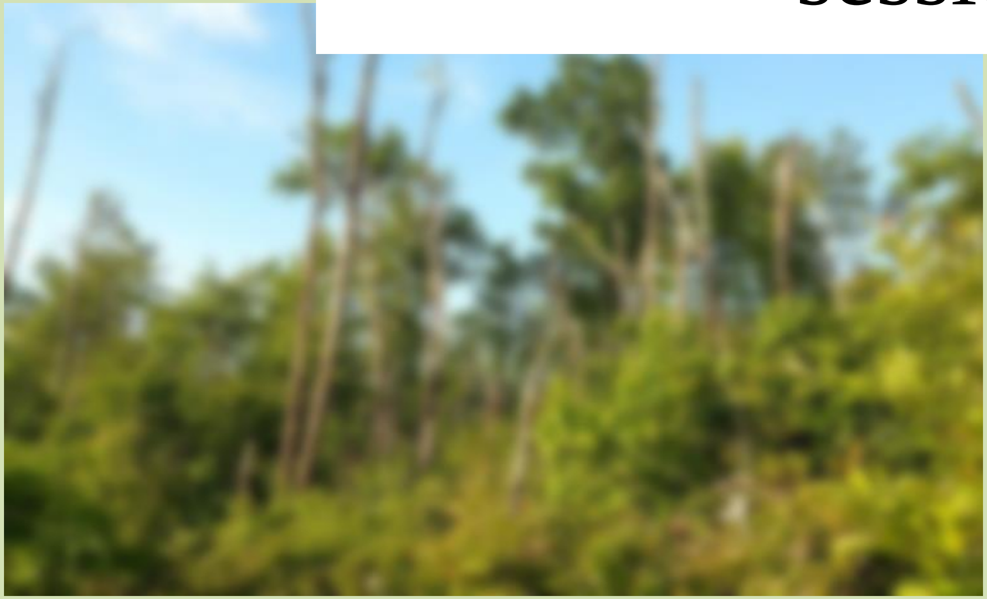


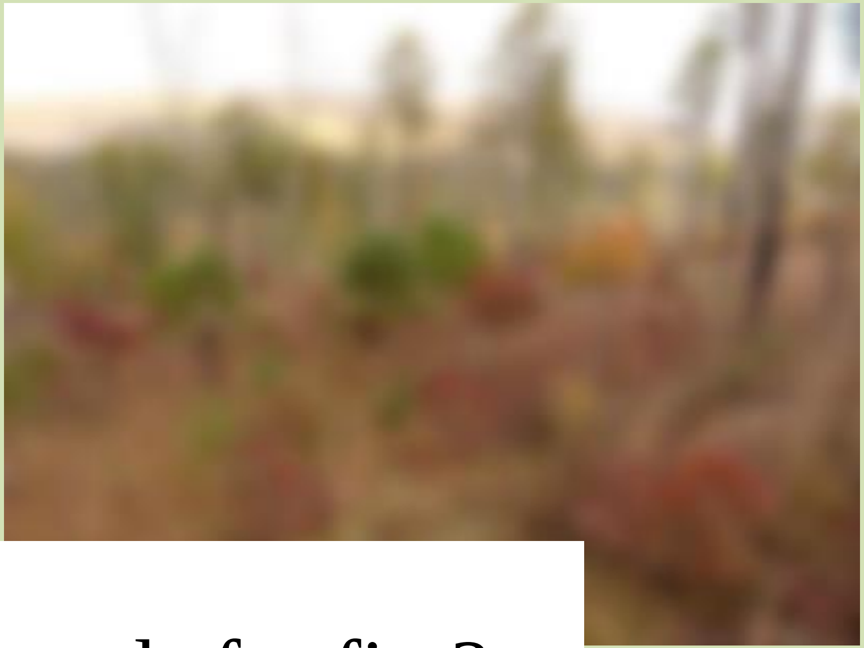
Fire Effects Monitoring

Jean Lorber
Central Appalachians FLN
September 11, 2019



What are YOUR goals for this session?





What are YOUR goals for fire?

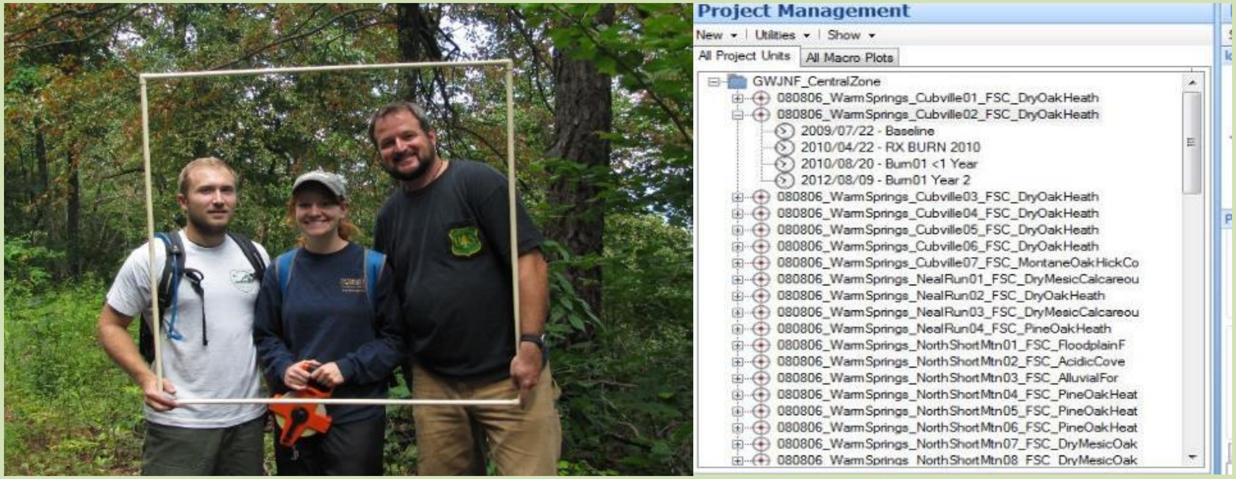
This shapes your monitoring efforts

Monitoring can:

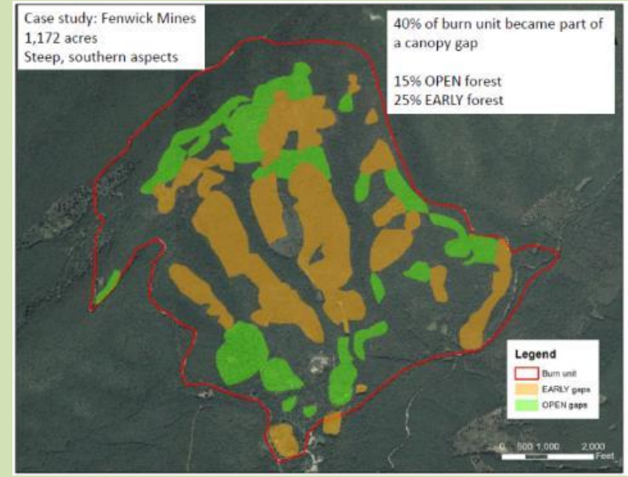
- provide data for future management decisions
- tell the story of what you’ve done
- be part of the process of long-term resource management
- be flexible, scalable to suit your goals



Fire Effects Monitoring in western VA

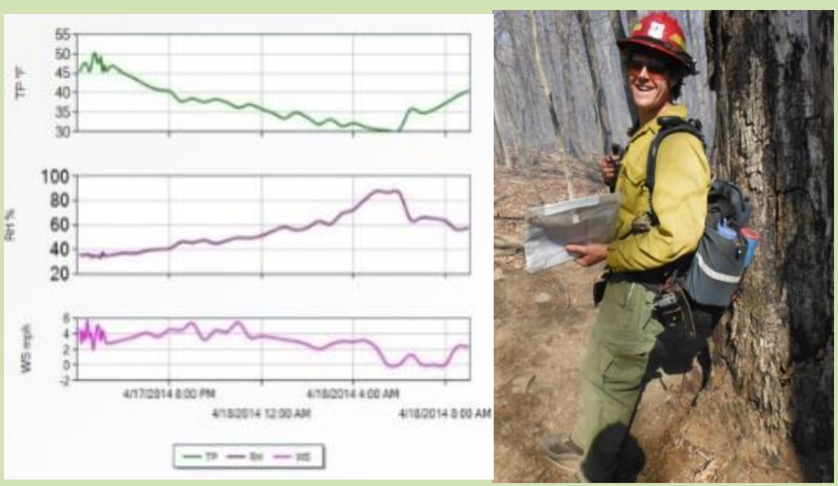


Forest Structure and Composition



Canopy Gap Analysis

Burn Severity



Fire Behavior & Weather

Avian Community

GW National Forest Plan Objectives

Desired Conditions for Ecological Systems Diversity

DC ESD-01: Native ecological systems occupy appropriate sites. Native ecosystems sustain strong, resilient populations of associated terrestrial and aquatic species.

DC ESD-02: There is a mix of closed canopy forest, intermittent canopy, and open canopy conditions. Forest and woodland ecological systems support a diversity of tree ages, from regeneration to old growth, providing a relatively stable mix of ecological conditions across the landscape over time. Openings occur in individual tree-sized gaps and larger. Vegetation structure within patches of regenerating forest and woodland is diverse due to the presence of snags and live overstory trees. These forested systems are dominated by hardwoods, pines, or combinations of both. Non-forested systems are primarily dominated by shrubs, forbs, and grasses. Snags, downed wood, stumps, and other organic matter occur in sufficient abundance to support native species.

Desired Structural Conditions for Oak Forest and Woodlands

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
% of ecological system	12	7	10	57	14
Age	0-15	16-69	16-69	70+	70+

Desired Stand Conditions

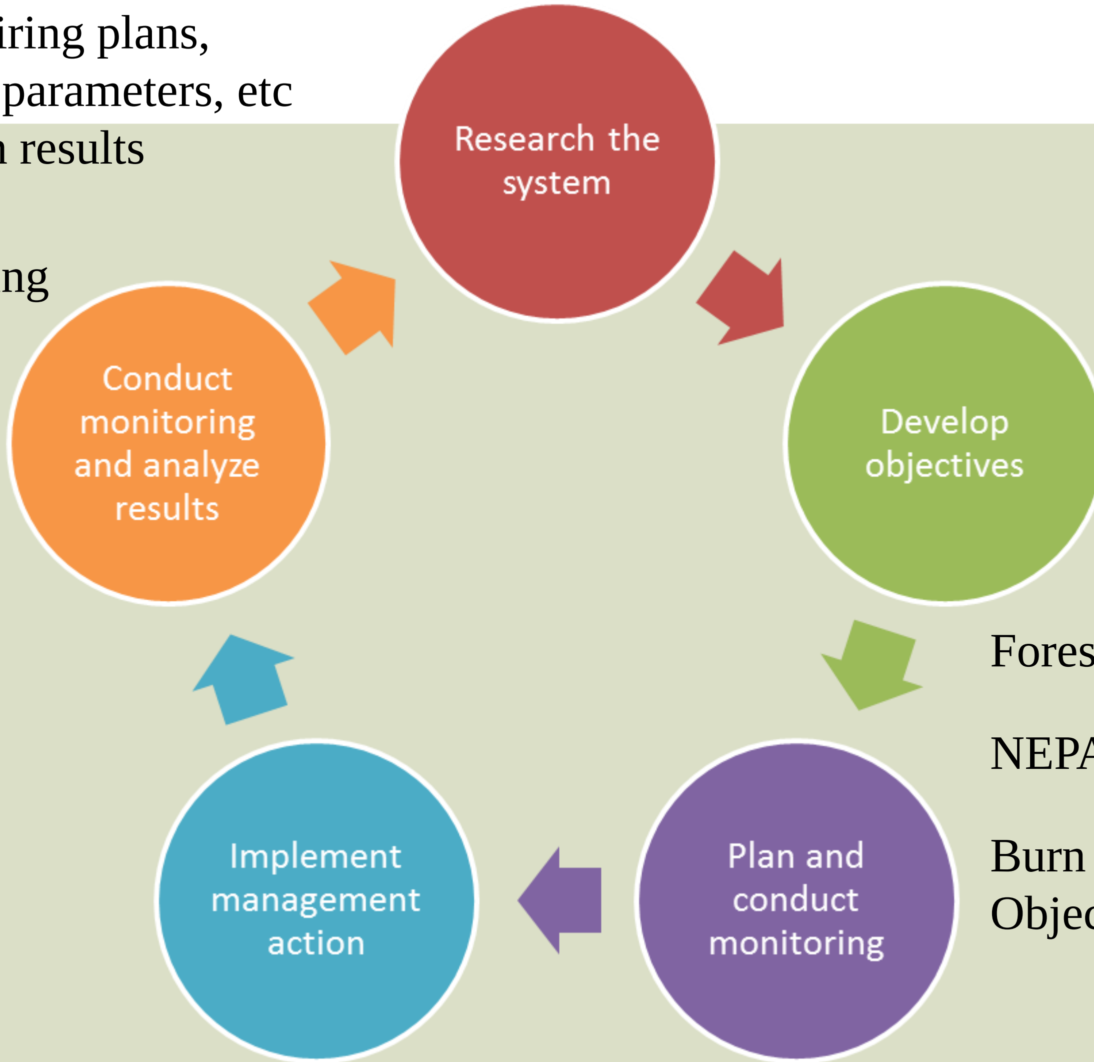
Oak & Hickory Forests and Woodlands

Pine Forests, Woodlands & Savannahs

Monitoring & Adaptive Management

Adjust firing plans, weather parameters, etc based on results

Are we meeting objectives?



Forest Plan

NEPA

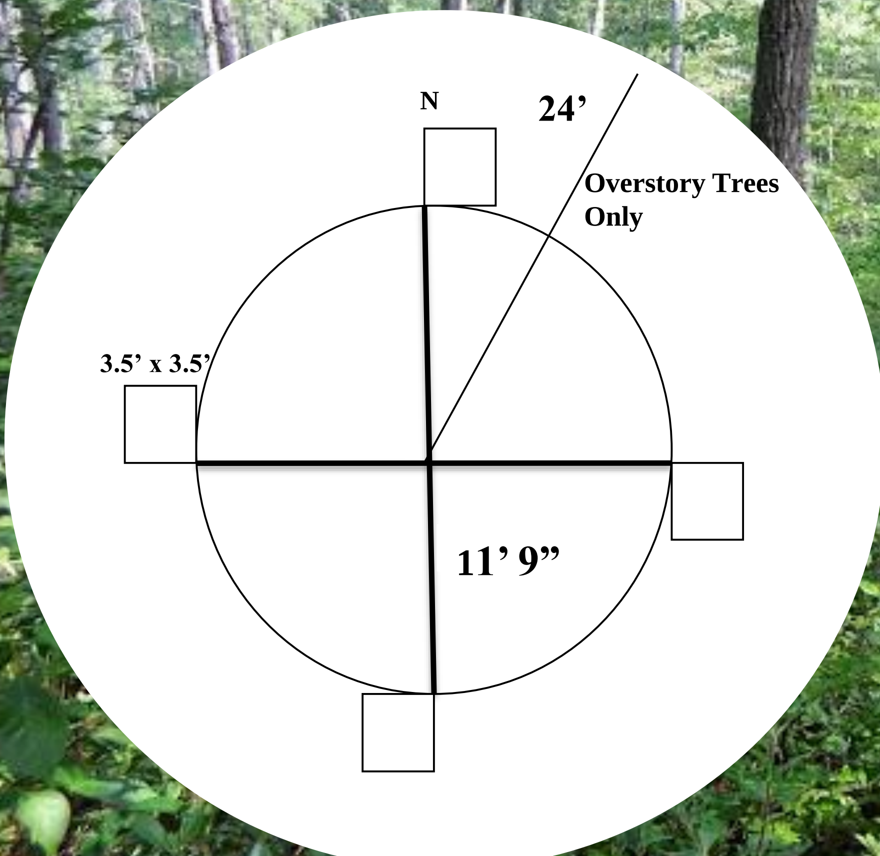
Burn Plan Objectives

Observe & document changes to the landscape over time

Forest Structure and Composition Monitoring Methods and Stats

425 Plots across the GWJEFF and other partner lands

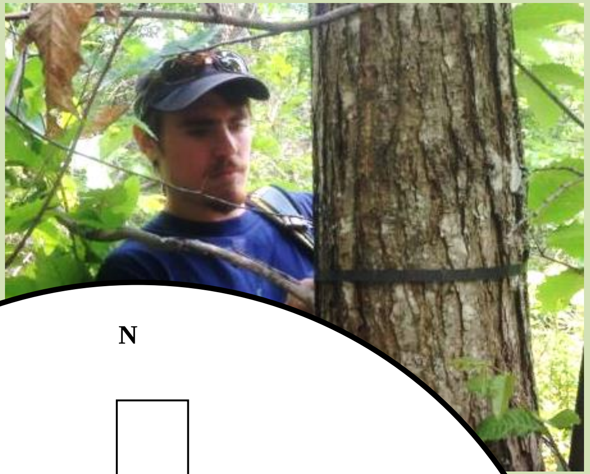
Plots classified by Vegetation Type and burn history



Sampling schedule

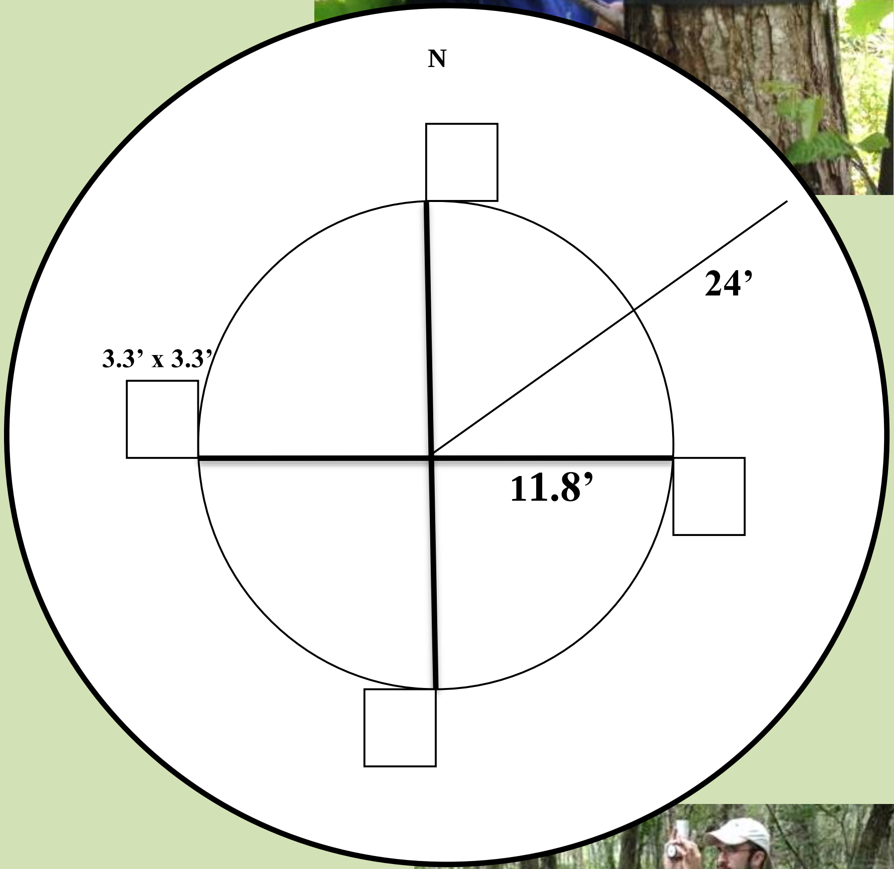
- pre-burn
- 1 year post burn
- 5 years post-burn

Forest Structure and Composition Monitoring Methods



Overstory basal area (plot = 24’ radius)
All trees >4”dbh

Canopy Cover (plot = 11.8’ radius)
Transects along cardinal directions



Midstory (plot=11.8’ radius)
woody tree & shrub stems, 1-4” DBH & >3.5’ tall

Understory (plot=11.8’ radius)
woody tree & shrub stems < 1” DBH & >3.5’ tall

Regeneration (four 3.3’ x 3.3’ quadrats)
All woody stems 6” to 3.3’ in height are tallied.

Understory cover (four 3.3’ x 3.3’ quadrats)
percent cover of graminoids, forbs, woody trees/shrubs, woody vines, and non-native invasive species are estimated.

Top: Patrick L measures an American Chestnut in the Middle Mountain burn unit. **Bottom:** *Dan Buckler measures canopy cover with a GRS densitometer.*

Monitoring results tied to burn objectives

Burn plan objectives	Monitoring result
Reduce overstory canopy in Oak and Pine woodlands by 5-15% each treatment	Overstory reduced by 15%
Decrease the number of <4" DBH of fire intolerant trees in the mid-story by 50% within one year post-burn.	Midstory stem density reduced by 64% • Oaks reduced by 71% • Maples reduced by 71%
Top kill at least 80% of all blueberry and huckleberry plants to encourage sprouting and berry production.	Understory stem density (*Vaccinium* spp.) increased by 50%

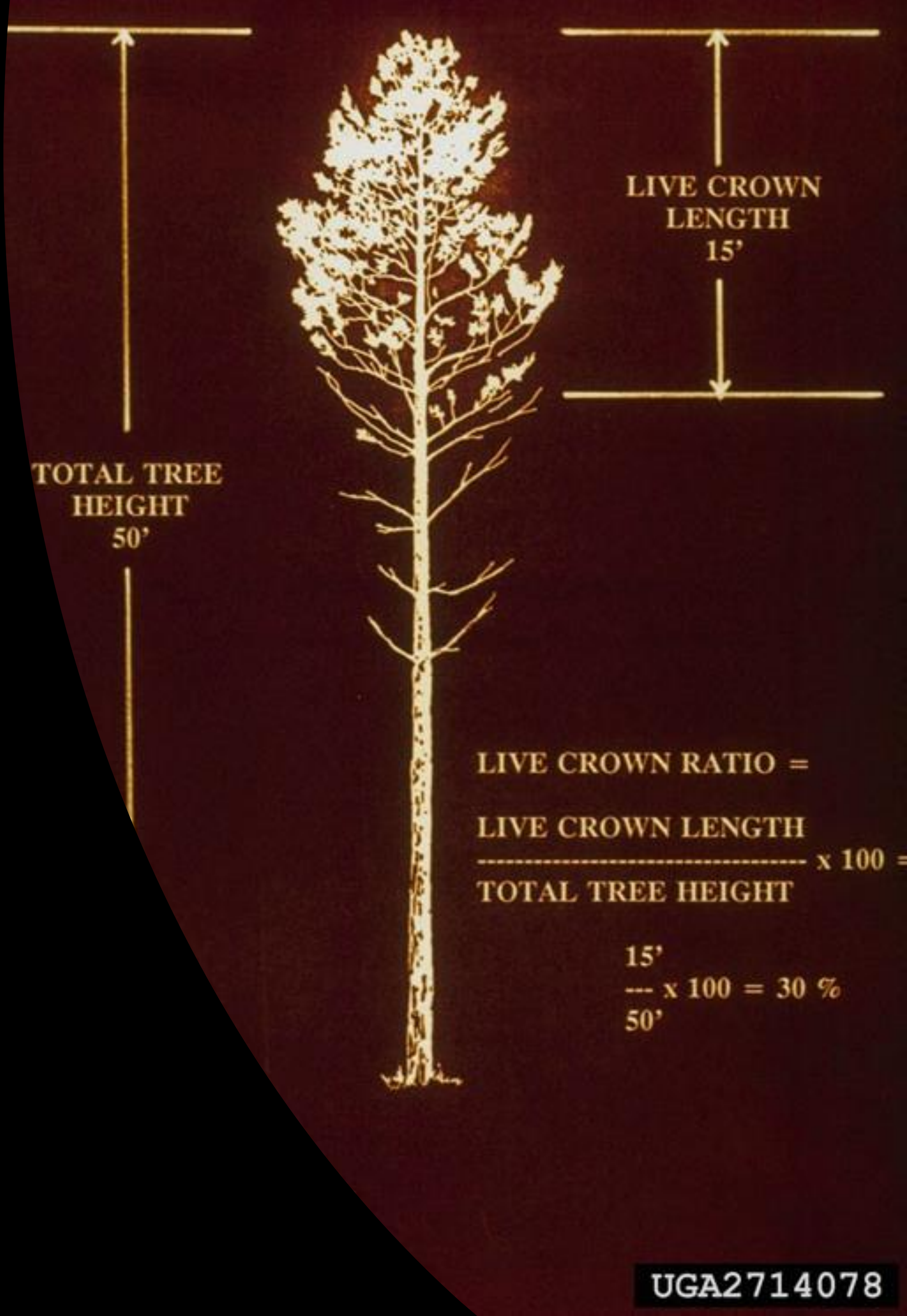
Composite Burn Index

Samples different forest strata, documenting fire's effects

Conducted very soon after burn

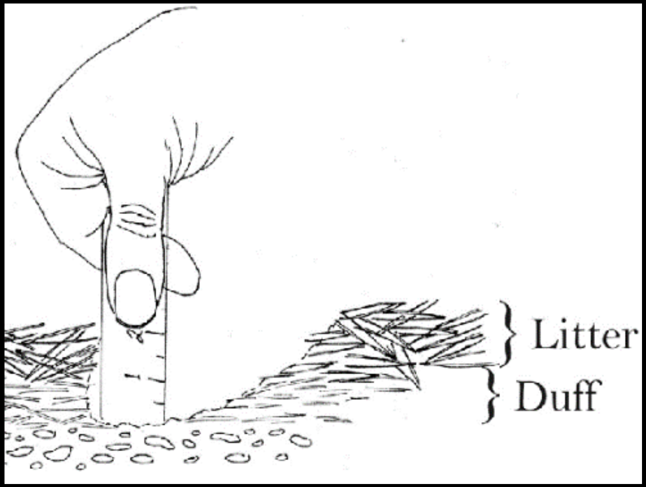
Forest health

Live Crown Ratio and other measurements can track long-term tree damage/mortality



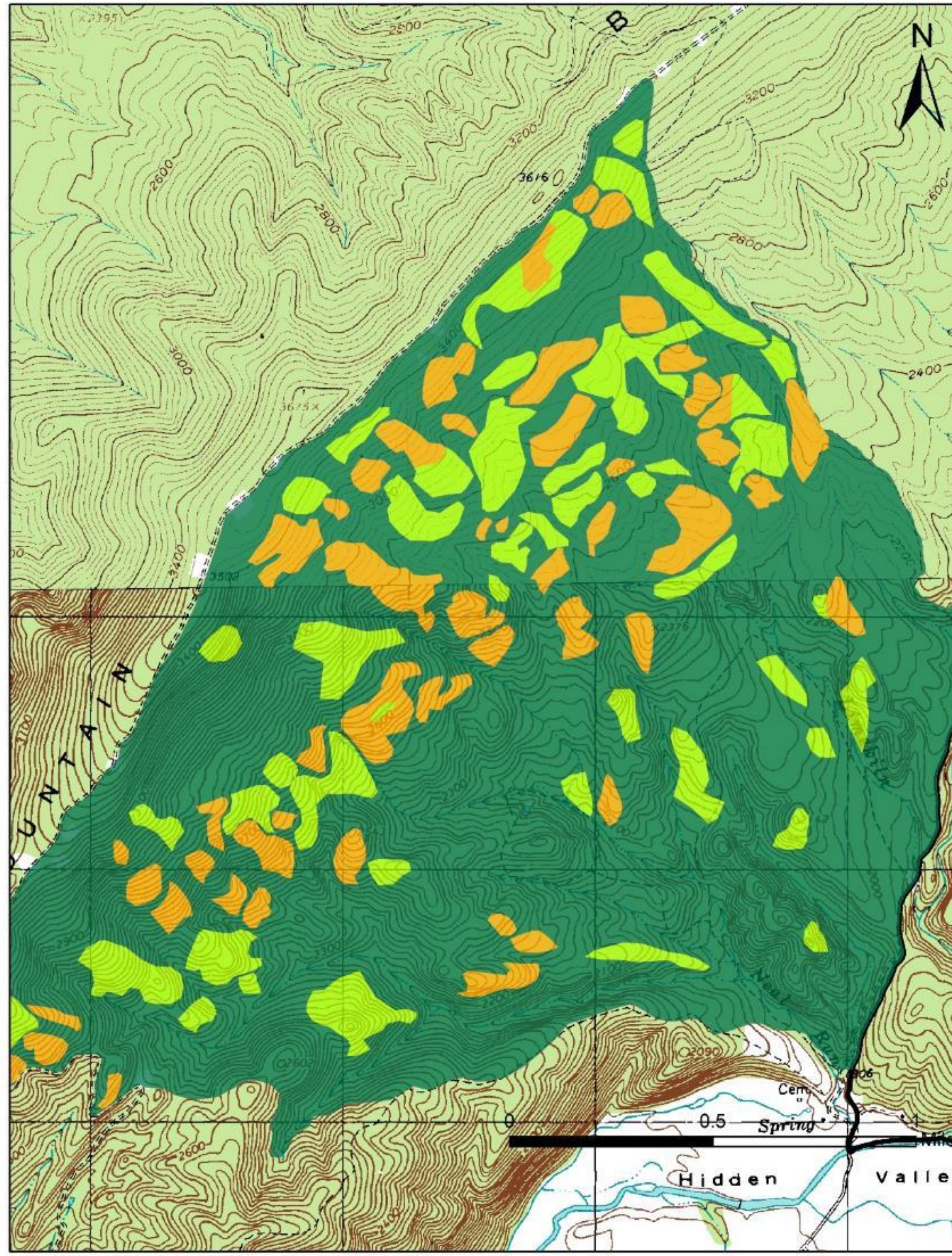
Litter/duff depth

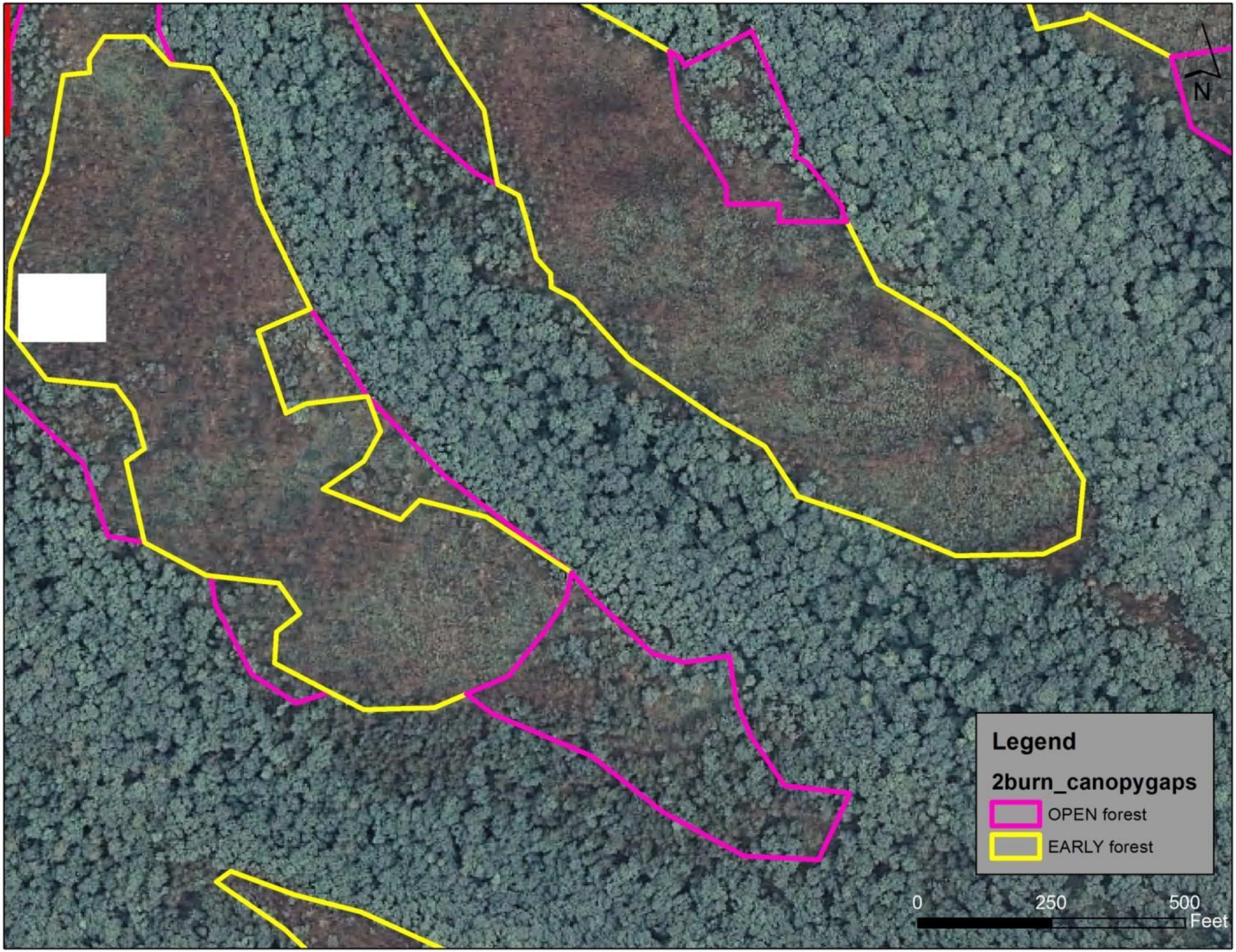
- Indicator of fire severity
- Indicator for pine seedling establishment success

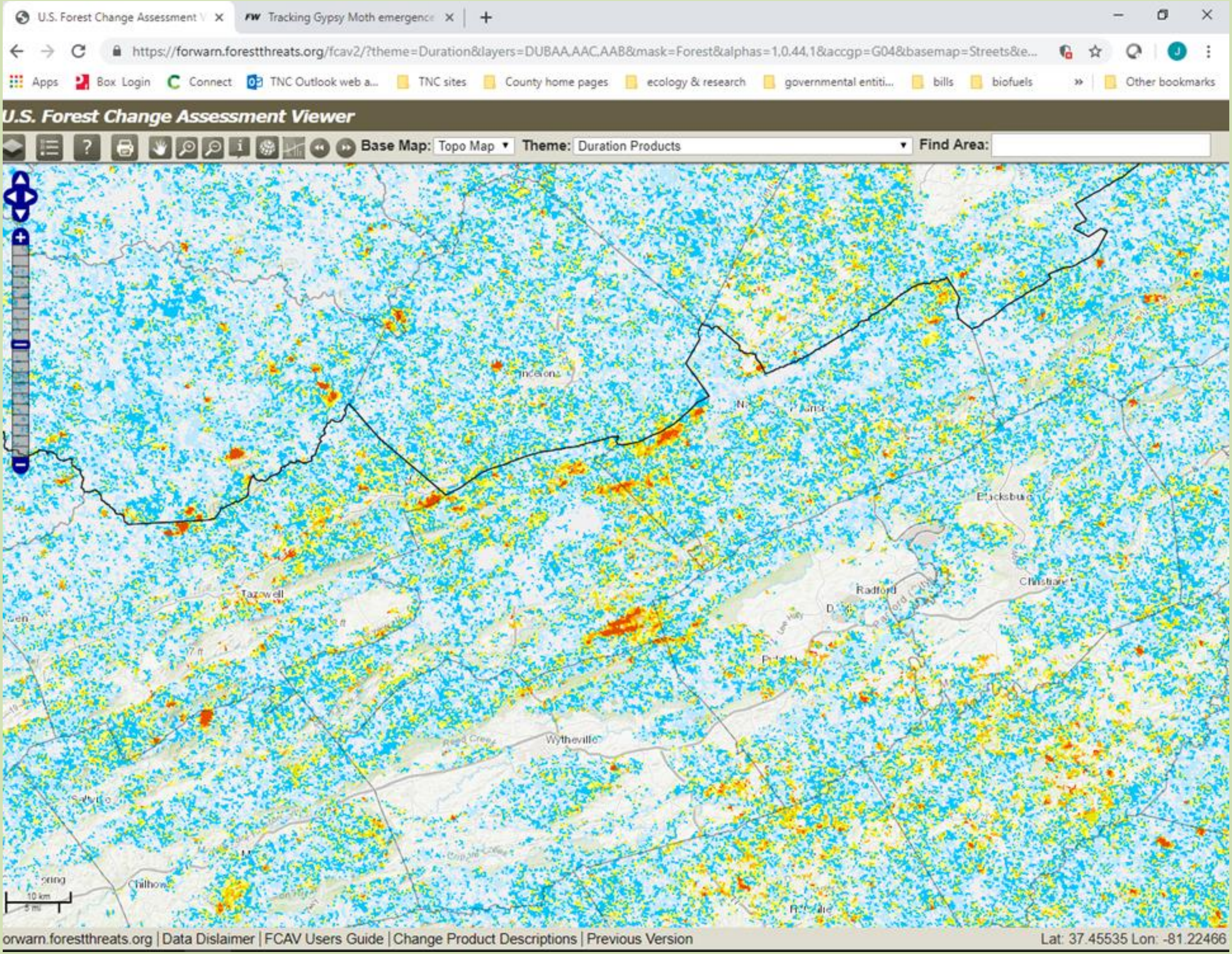


Remote sensing/GIS

- Can detect large-scale changes to forest canopy structure, health
- But blind to some characteristics (understory structure, species composition)




N
Legend
2burn_canopygaps
OPEN forest
EARLY forest
0
250
500
Feet



U.S. Forest Change Assessment V
Tracking Gypsy Moth emergence
https://forwarn.forestthreats.org/fcav2/?theme=Duration&layers=DUBAA,AAC,AAB&mask=Forest&alphas=1,0.44,1&accgp=G04&basemap=Streets&e...
Apps
Box Login
Connect
TNC Outlook web a...
TNC sites
County home pages
ecology & research
governmental entiti...
bills
biofuels
Other bookmarks
U.S. Forest Change Assessment Viewer
Base Map: Topo Map
Theme: Duration Products
Find Area:
Blacksburg
Radford
Christiansburg
Tazewell
Wytheville
10 km
5 mi
orwarn.forestthreats.org | Data Dislaimer | FCAV Users Guide | Change Product Descriptions | Previous Version
Lat: 37.45535 Lon: -81.22466

Photopoints

- Snapshot of overall condition at that location
- Good for showcasing the long-term development of a forest


09-10 MARE RUN
5-28-2013
POST BURN
SOUTH
05/28/2013


WSMRP Porter's Mill 05-01
08/30/2011
NORTH
PRE BURN 01


WSMRP Porters Mill Plot
05-01
06/15/2012
Two Months Post Wildfire
North


WSMRP Porters Mill Plot 05-01
08/06/2013
Burn 1 Year 1
North
08/06/2013


WSMRP Porters Mill Plot
05-01
06/02/2014
Burn 1 Year 2
North
06/02/2014 07:07


WSMRP Porters Mill Plot 05-01
05/29/2015
Burn 1 Year 3
North
PORTERS MILL
05/29/2015 11:02

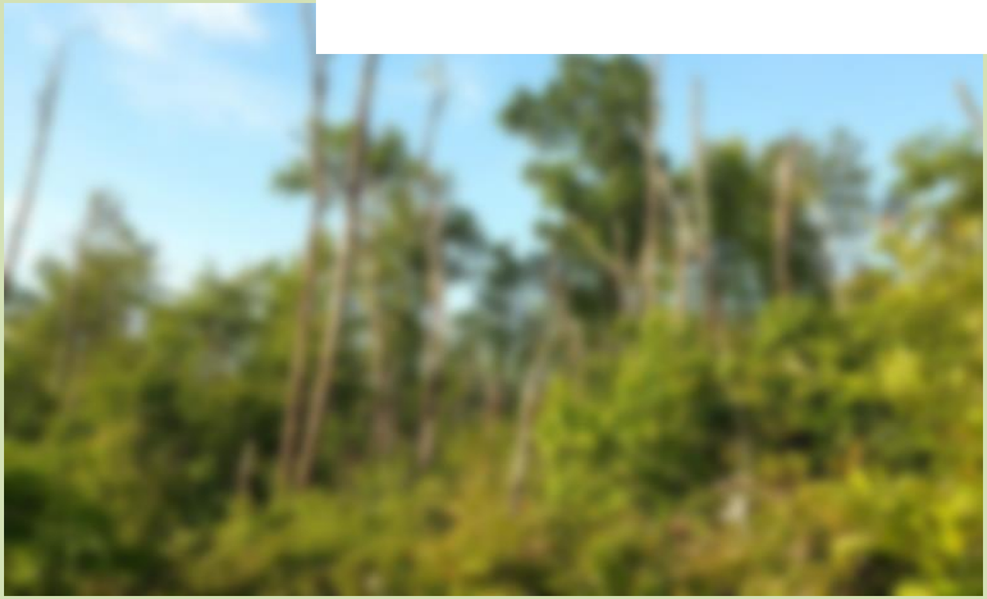
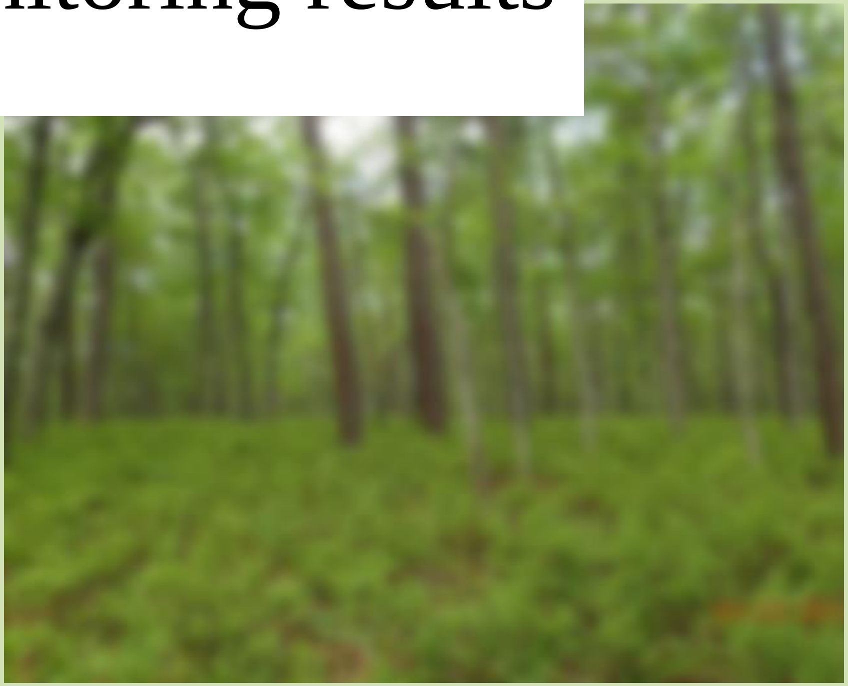

WSMRP Porters Mill Plot
05-01
08/02/2017
Burn 1 Year 5
North


07/29/2015


09/24/2013 22:23


07/30/2015


Some of our monitoring results

Overstory Changes: 1 burn

Basal Area	Pre-burn	After 1 Burn
Ft^2/acre	84	71
Canopy Cover	Pre-burn	After 1 Burn
%	85	78

All comparisons are statistically different

Moderate but consistent decrease in the canopy due to a single burn

Midstory Changes: 1 burn

Live Woody Stems Per Acre 1-4 inch DBH	Pre-burn	After 1 Burn
All Species	467	169
Tree Species	342	126
Shrub Species	125	43

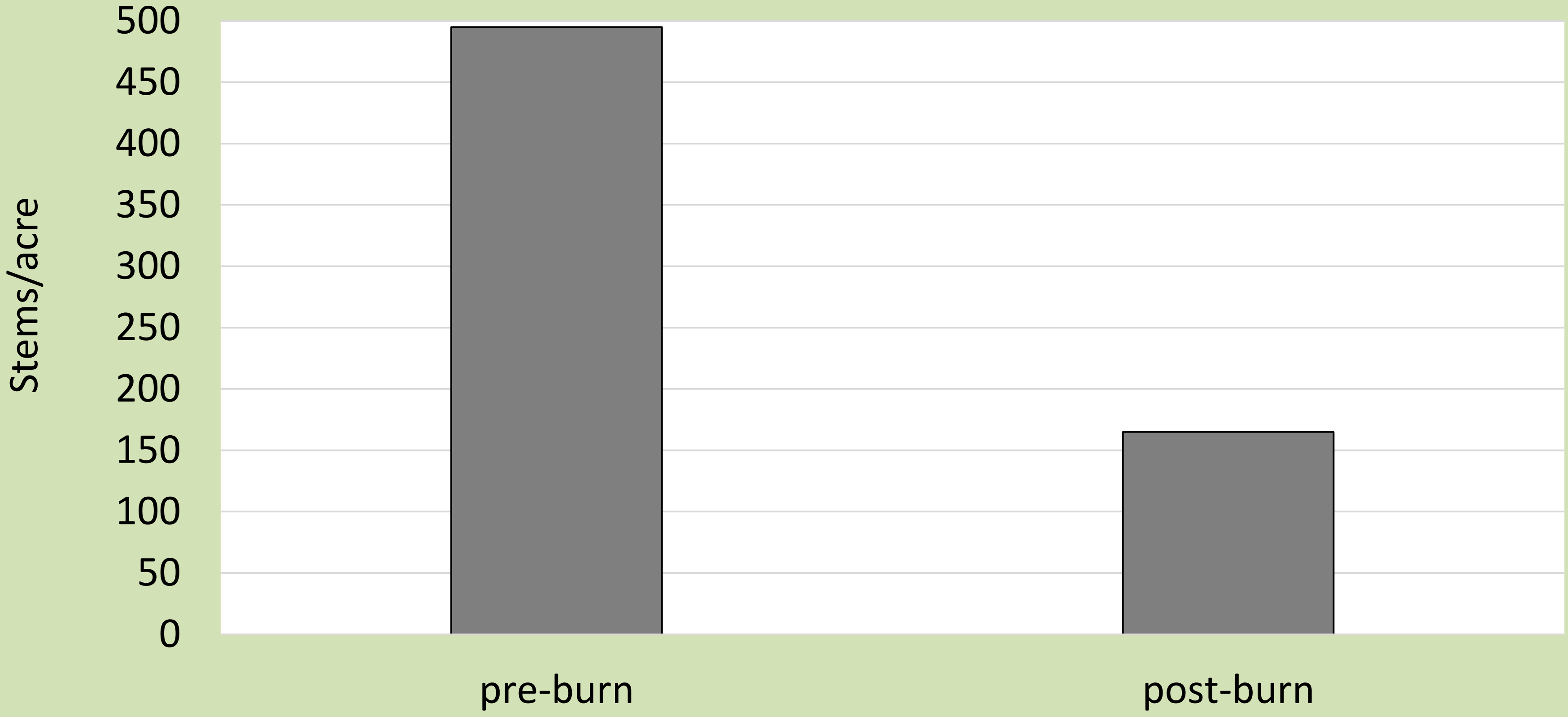
All comparisons are statistically different

Big Wilson Burn Plot 03-17 Baseline

Big Wilson Burn Plot 03-17 Burn 1

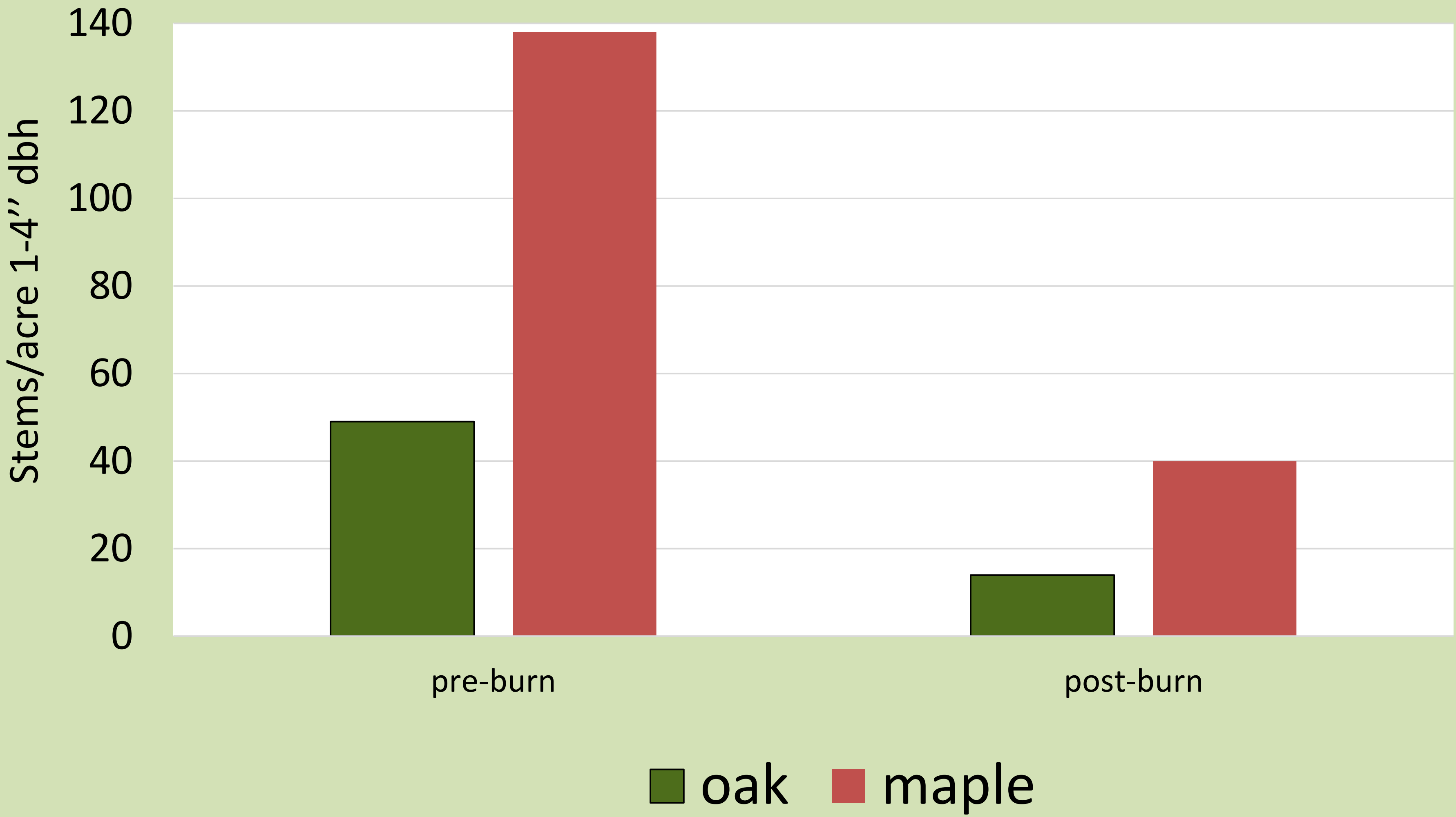
Midstory Changes 1burn

1-4”dbh



All species

Midstory Changes 1burn



- Both species groups decline in stem density following a 1st burn
- Wait a few years to see how this layer develops

Understory Changes 1 burn

stems >6” and <3.3’ tall

	Pre-burn	After 1 Burn
	thousands	
All Species	34	74
Shrub spp.	27	61
Tree spp.	7	13

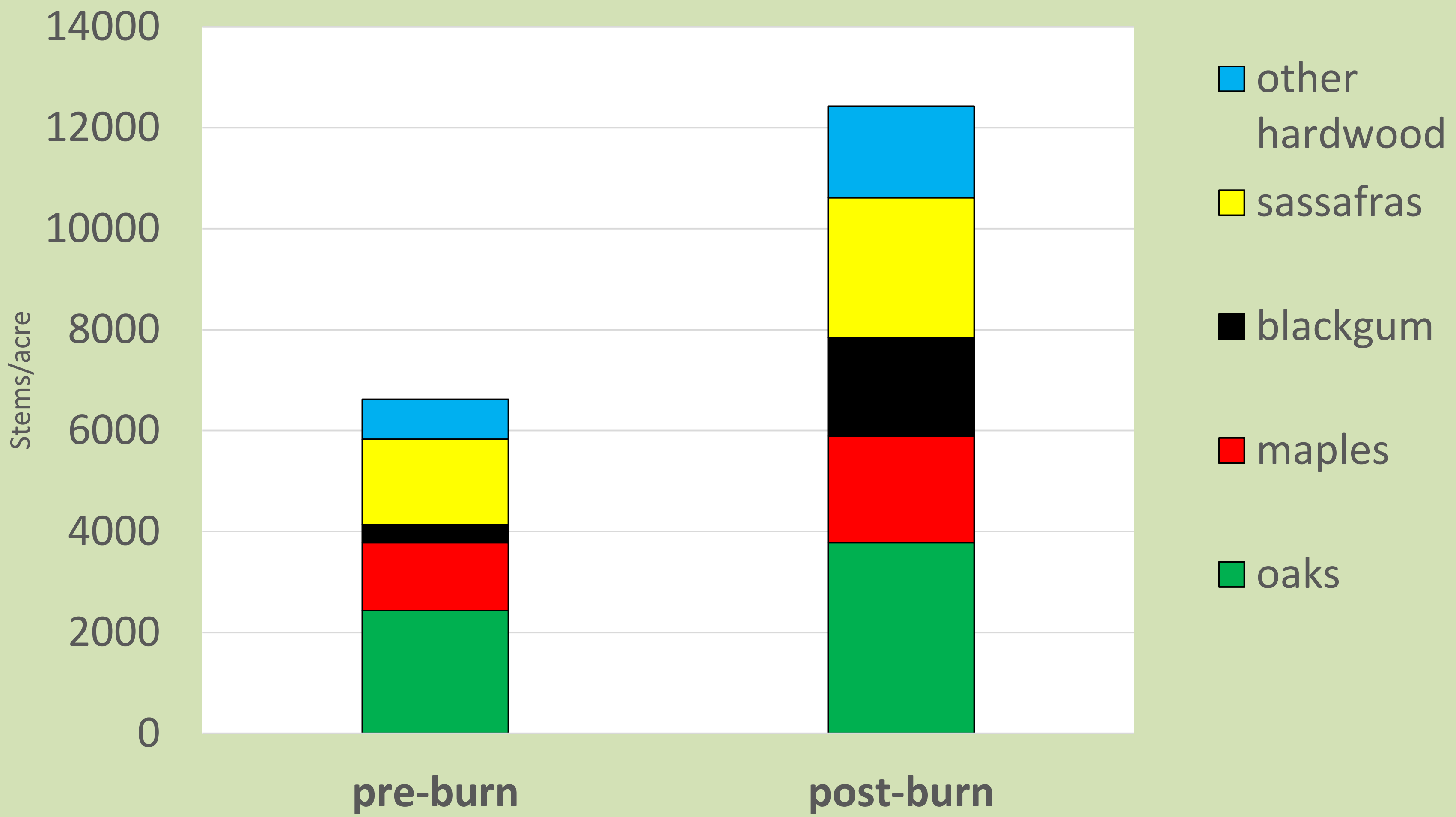
Berries in Porters Mill Unit

Cubville Plot 03 Burn 1 Year 1

Cubville Plot 03 Burn 1 Year 6

Understory Changes: 1 burn

stems >6” and <3.3’ tall, tree species only



Oaks show statistical increase, as do blackgum, sassafras

Understory Changes

Cover	Pre-burn	After 1 Burn
Forbs	4%	8%
Grasses	0.5%	3%

Part 1. Quantify the extent of canopy mortality resulting from prescribed fire

1 burn

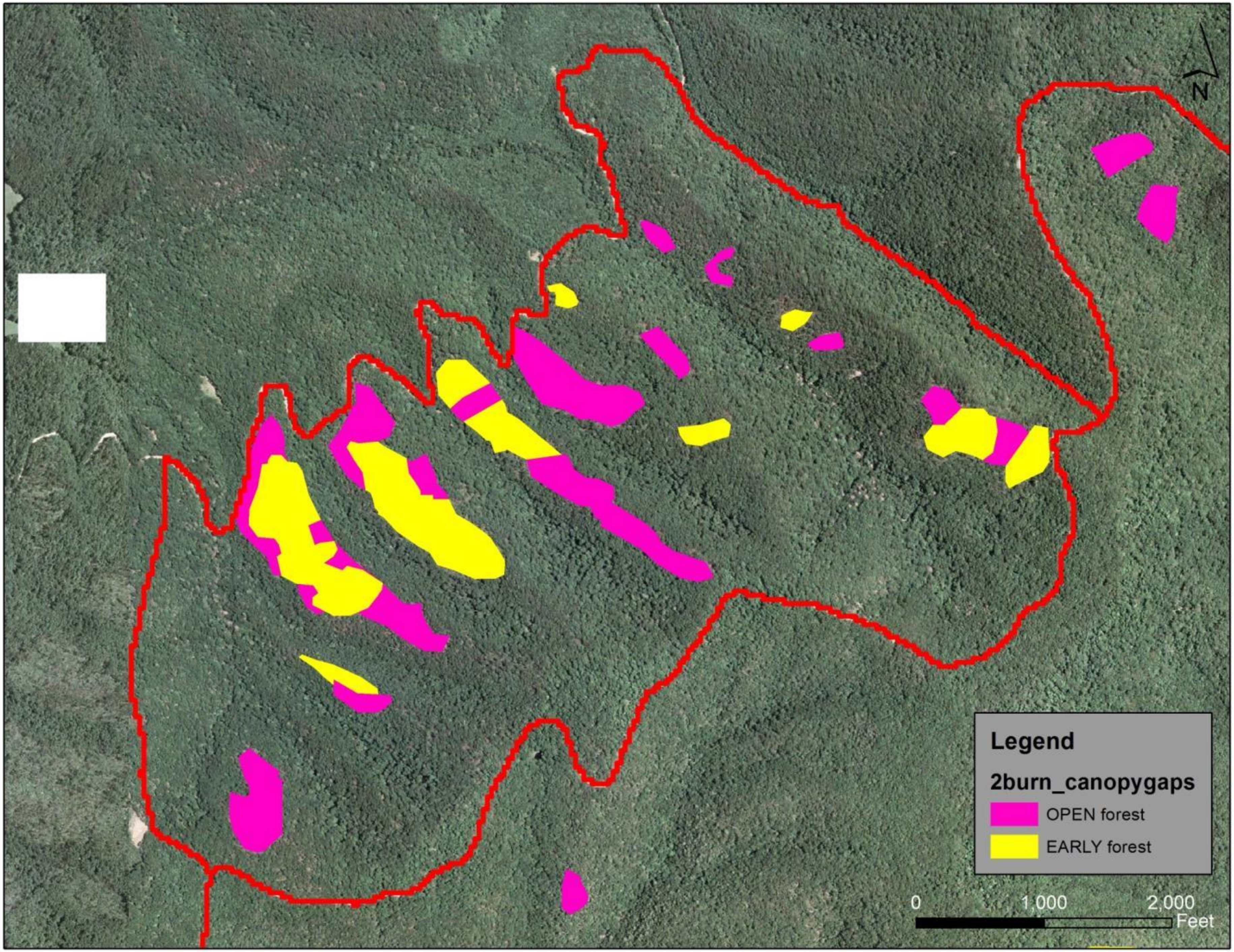
N=28	% OPEN acres	% EARLY acres	% all gaps
Average	**6.2%**	**6.5%**	**13%**
95% C.I.	± 2%	± 3%	± 4%

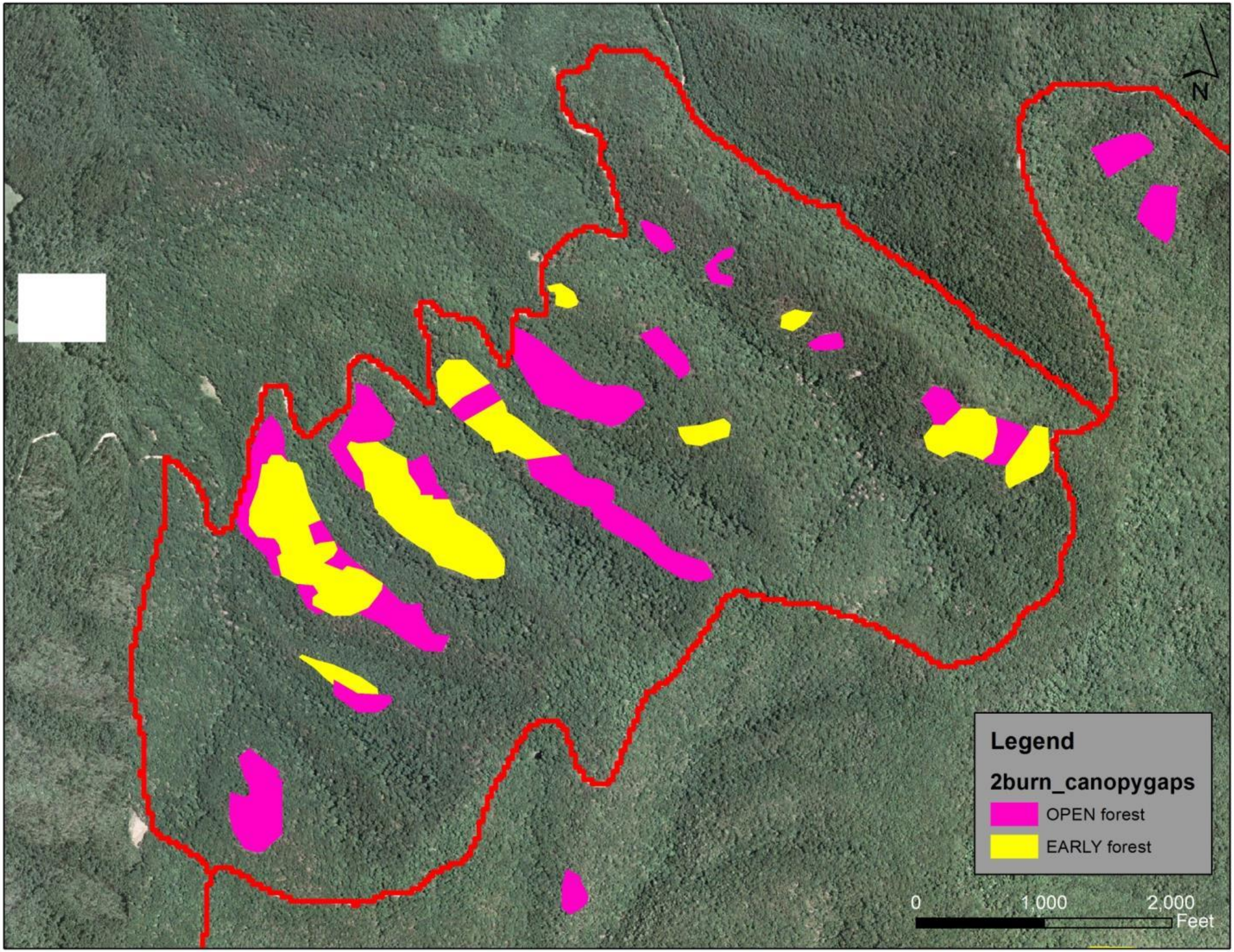
2 burns

N=14	% OPEN acres	% EARLY acres	% all gaps
Average	**7.9%**	**6.1%**	**14%**
95% C.I.	± 3%	± 5%	± 6%

3+ burns

N=6	% OPEN acres	% EARLY acres	% all gaps
Average	**11%**	**20%**	**31%**
95% C.I.	± 4%	± 20%	± 21%


N
Legend
2burn_canopygaps
OPEN forest
EARLY forest
0
1,000
2,000
Feet


N
Legend
2burn_canopygaps
OPEN forest
EARLY forest
0
1,000
2,000
Feet

Other monitoring:
Canopy Gap Analysis + FSC plot data

Sampling strata	Attribute	Canopy condition		
		EARLY (n=10)	OPEN (n=10)	CLOSED (n=60)
Overstory	Live basal area (ft^2/acre)	18 ± 6 a	56 ± 9 b	83±4 c
	Canopy cover (%)	26 ± 8 a	68± 7 b	87± 3 c
Mid-story	Live woody stems/acre (1–4 inch d.b.h.)	11 ± 11 ab	0 a	214± 37 b
Understory	Live woody stems/acre (<1 inch d.b.h. and >3.3 ft tall)	1,800 ± 392 a	2,180± 630 a	1,136± 243a
	Live woody stems/acre (0.5–3.3 ft tall)	170,758 ± 36,720 a	150,141 ± 35,749 a	47,535 ± 5,787 b
	Nonwoody vegetative cover (%) (<3.3 ft)	7 ± 3 a	1 ± 0.3 a	9 ± 3 a

Monitoring session notes

Central Appalachians FLN meeting
Sept.11, 2019

Participant questions for this session

1. Where do we start in designing our monitoring program?
2. What questions do we need to ask about our ecological outcomes?
3. How do we monitor to capture the effects on wildlife?

4. How do we match our monitoring program to our constraints (time, $)
5. How do we prioritize monitoring needs among multiple partners?
6. How does monitoring fit into Adaptive Management?
7. How do we use less-than-ideal datasets?
8. How do we not re-invent the monitoring wheel?

We didn't get to all these topics, but what we did cover is summarized here

To address questions 1 and 2 (and really all the questions) you should first determine:

what do you want your burning to achieve?

1. **Where do we start in designing our monitoring program?**
2. **What questions do we need to ask about our ecological outcomes?**
3. **How do we monitor to capture the effects on wildlife?**

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Appalachians
FLN meeting
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Establish what you want your burning to achieve

Sample goals from participants

Increase browse for specific wildlife species
Promote oak and pine regeneration
Decrease competing regeneration
Increase forest structural diversity
Increase RTE species populations
Increase hard mast for wildlife
Decrease fuel loading
Create a more drought and disease-resistant forest
Do all of the above without impacting timber value

Your monitoring should be tied directly to your goals

Monitoring ideas to address burning goals

Central Appalachians FLN meeting
Sept.11, 2019

Goal for burning	Feature(s) to measure	Type of monitoring
Increase browse for specific wildlife species	• Understory woody stem density and composition	• Plots • 1/season
Promote oak,pine regeneration	• Overstory species composition • Understory oak & pine stem density, by species • Understory non-oak & pine stem density, by species • Litter/duff layer depth	• Plots • 1/season
Decrease non-oak & pine regeneration	• Same as above	• Same as above
Increase forest structural diversity	• Overstory basal area and mortality • Overstory/midstory DBH distribution • Canopy gap presence/size • Light levels • Shrub layer density • Understory floristic diversity (e.g. grasses, forbs, trees)	• Plots, remote sensing • 1/season • Timing for light level sampling restricted by weather
Increase RTE species populations	• Occupancy/population of RTE species	• Plots, transects, habitat-specif. surveys • Many times/season • Timing of species sampling based on species life cycle
Increase soft/hard mast for wildlife	• Overstory hard mast producer density • Understory hard mast, soft mast-producer density • Hard mast currently on ground	• Plots, transects • 1/season • Timing of hard mast sampling limited
Decrease fuel loading	• Snags • Downed Woody Debris • Litter/duff layer • General fuel type	• Plots, transects (e.g. Brown's) • 1/season • Timing immed. Post-burn, or next year?
Create a more drought and disease-resistant forest	• Understory tree stem density and composition • Tree health, especially during drought	• Plots, remote sensing • 1/season
Minimal negative impact on timber value	• Overstory tree damage assessment (scarring, scorch) • Overstory mortality • Burn severity (Composite Burn Index)	• Plots, remote sensing • 1/season • Timing of severity immed. Post-burn • Timing of damage sampling should be years after burn

1. **Where do we start in designing our monitoring program?**
2. **What questions do we need to ask about our ecological outcomes?**
3. **How do we monitor to capture the effects on wildlife?**

Summary:

Many different goals for burning were identified

Many goals can be addressed with same types of monitoring…but

some specific questions require unique monitoring (e.g. species life cycle)

Assess whether *direct* or *indirect* impacts to your resource must be measured (i.e. actual population change vs indicator of habitat suitability)

Goal for burning	Feature(s) to measure	Type of monitoring
Increase browse for specific wildlife species	• Understory woody stem density and composition	• Plots • 1/season
Promote oak,pine regeneration	• Overstory species composition • Understory oak & pine stem density, by species • Understory non-oak & pine stem density, by species • Litter/duff layer depth	• Plots • 1/season
Decrease non-oak & pine regeneration	• Same as above	• Same as above
Increase forest structural diversity	• Overstory basal area and mortality • Overstory/midstory DBH distribution • Canopy gap presence/size • Light levels • Shrub layer density • Understory floristic diversity (e.g. grasses, forbs, trees)	• Plots, remote sensing • 1/season • Timing for light level sampling restricted by weather
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4. How do we match our monitoring program to our constraints (time, $)
5. How do we prioritize monitoring needs among multiple partners?
6. How does monitoring fit into Adaptive Management?
7. How do we use less-than-ideal datasets?
8. How do we not re-invent the monitoring wheel?

Did not discuss (*but here are some basic thoughts*)

1. Determine the level of monitoring you need to address identified goals/questions
    a) Acceptibility of
    b) Attributes with greater variability require more sampling (count of trees vs count of grass stems)

2. Refine questions
3. Refine accuracy needs

Attributes with greater variability require more sampling (count of trees vs count of grass stems)

Did not discuss (*but here's some guidance*)

Central Appalachians FLN meeting
Sept.11, 2019

4. **How do we match our monitoring program to our constraints (time, $)**

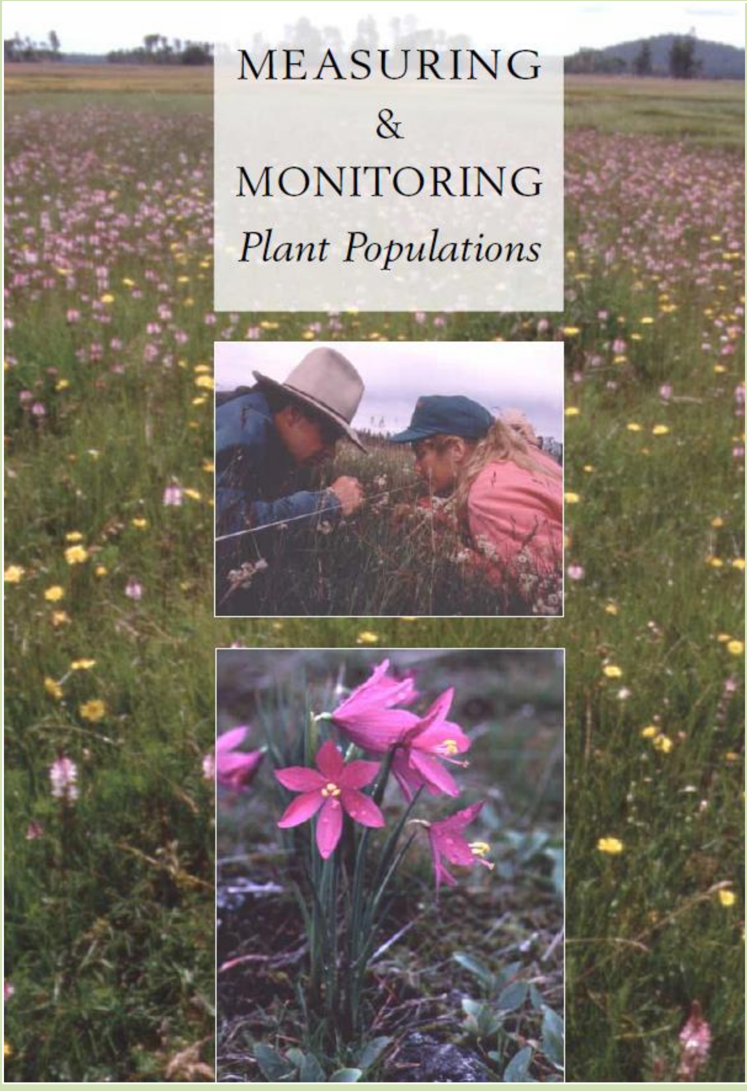
See chapter 3 of Elzinga et al (pages 32-34) for discussion of what criteria can be used when setting priorities

5. **How do we prioritize monitoring needs among multiple partners?**

See chapter 3 of Elzinga et al for discussion of what criteria can be used when setting priorities

7. **How do we use less-than-ideal datasets?**

See chapters 7 and 11 of Elzinga et al for discussion of sampling design and statistical analyses



6. How does monitoring fit into Adaptive Management?

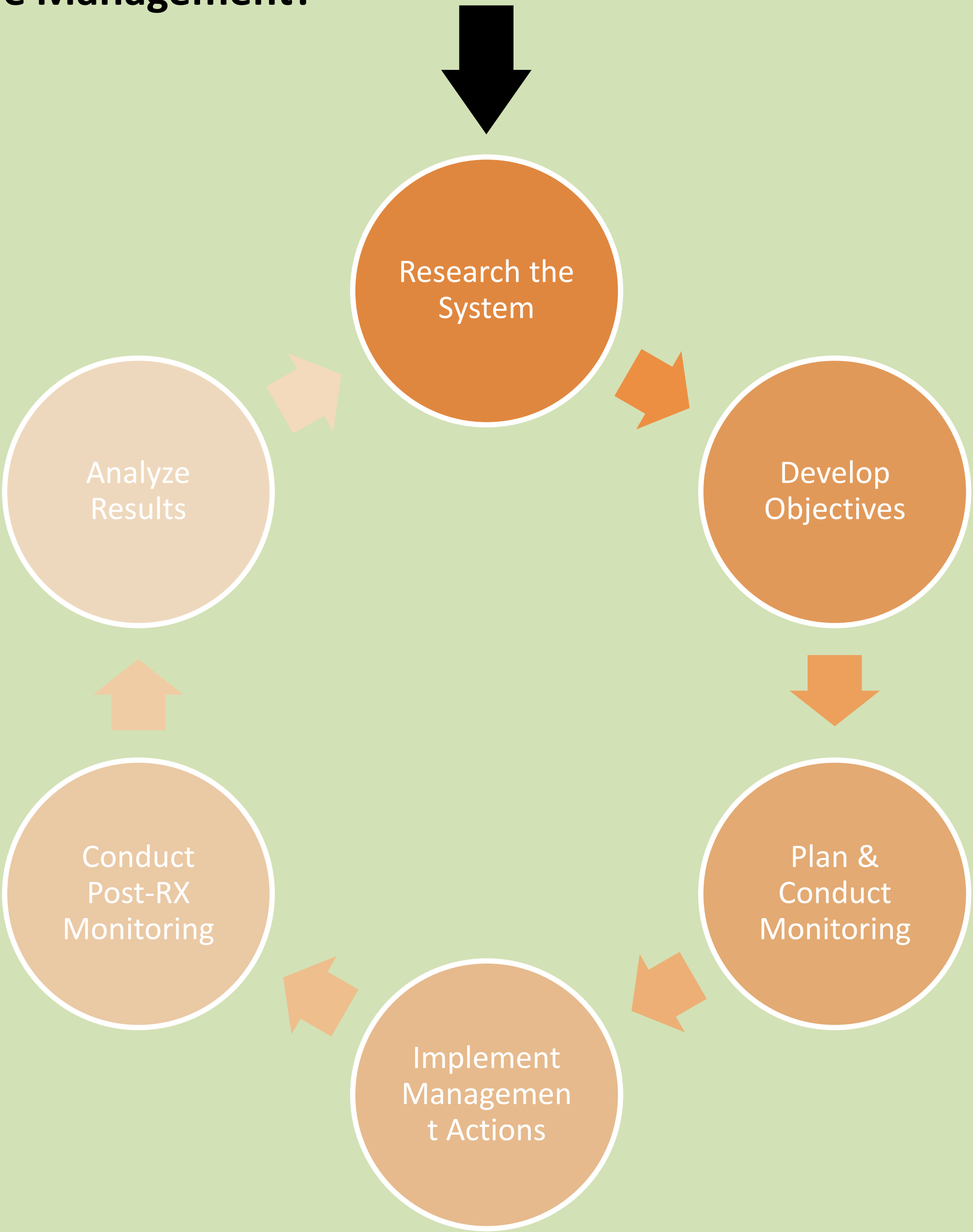
Monitoring occurs late in the Adaptive Management cycle

but <u>planning</u> to monitor and <u>agreeing</u> to use the results should happen at the beginning of the cycle

<u>Best practice</u>

Achieve consensus among decision-makers about:

- what should be monitored
- key thresholds for outcomes/observed fire effects
- How/when the monitoring data will be used



8. How do we not re-invent the monitoring wheel?

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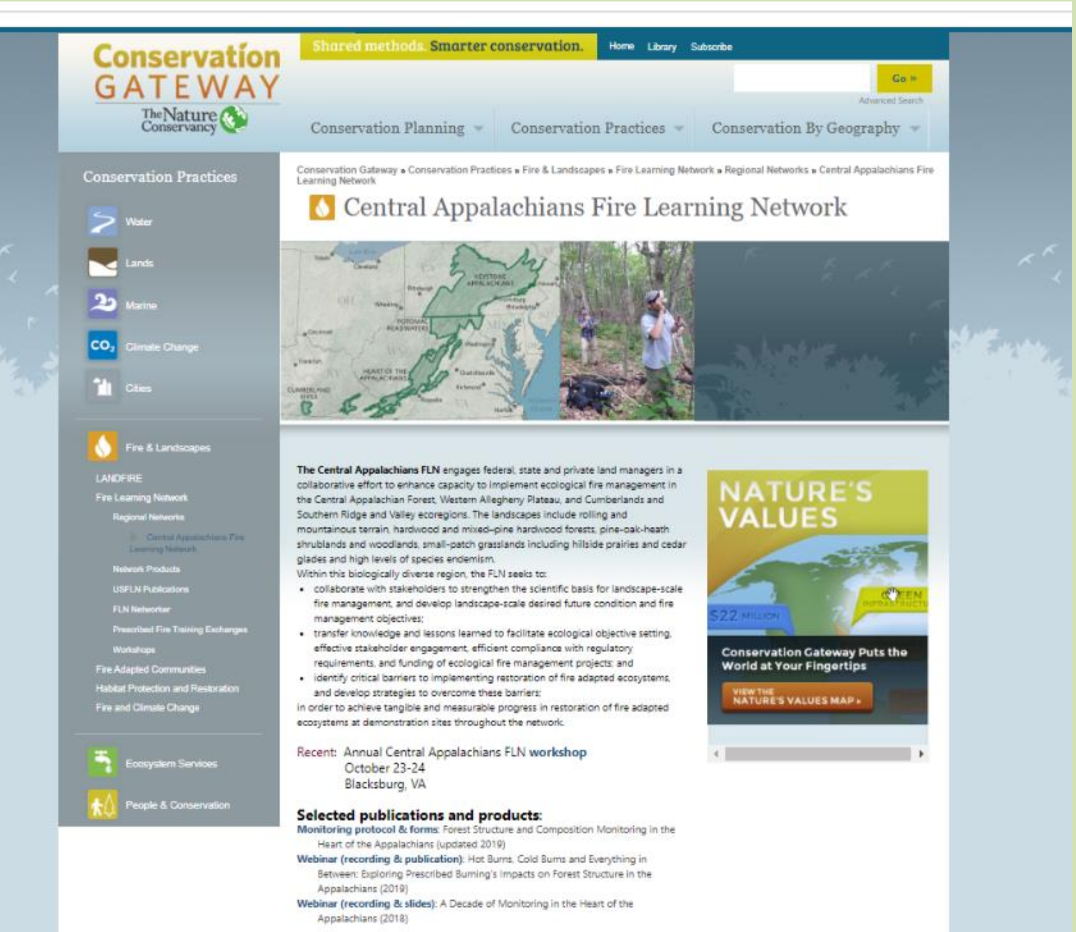
Sept.11, 2019

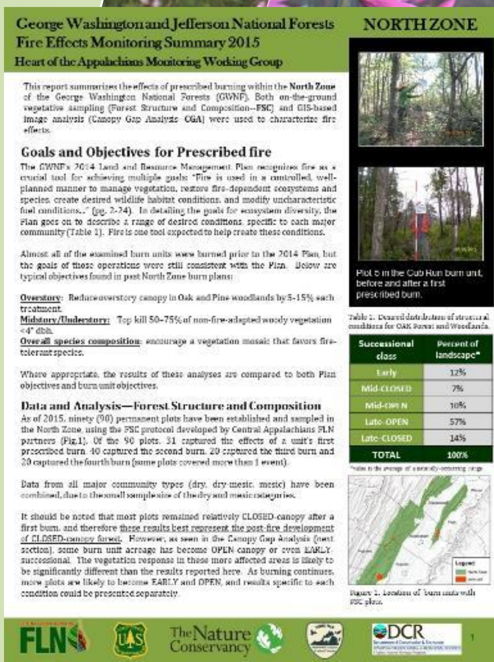
Use existing resources:

Websites that compile methods, data, reports

https://www.conservationgateway.org/ConservationPractices/FireLandscapes/FireLearningNetwork/RegionalNetworks/Pages/CentralApps.aspx



Technical guides for designing a monitoring program



George Washington and Jefferson National Forests
Fire Effects Monitoring Summary 2015
Heart of the Appalachians Monitoring Working Group

NORTH ZONE

This report summarizes the effects of prescribed burning within the **North Zone** of the George Washington National Forests (GWNF). Both on-the-ground vegetative sampling (Forest Structure and Composition--FSC) and GIS-based image analysis (Canopy Gap Analysis CGA) were used to characterize fire effects.

Goals and Objectives for Prescribed fire

The GWNF's 2014 Land and Resource Management Plan recognizes fire as a crucial tool for achieving multiple goals: "Fire is used in a controlled, well-planned manner to manage vegetation, restore fire-dependent ecosystems and species, create desired wildlife habitat conditions, and modify uncharacteristic fuel conditions..." (pg. 2-24). In detailing the goals for ecosystem diversity, the Plan goes on to describe a range of desired conditions, specific to each major community (Table 1). Fire is one tool expected to help create these conditions.

Almost all of the examined burn units were burned prior to the 2014 Plan, but the goals of those operations were still consistent with the Plan. Below are typical objectives found in past North Zone burn plans:

Overstory: Reduce overstory canopy in Oak and Pine woodlands by 5-15% each treatment.
Midstory/Understory: Top kill 50-75% of non-fire-adapted woody vegetation <4" dbh.
Overall species composition: encourage a vegetation mosaic that favors fire-tolerant species.

Where appropriate, the results of these analyses are compared to both Plan objectives and burn unit objectives.

Data and Analysis—Forest Structure and Composition

As of 2015, ninety (90) permanent plots have been established and sampled in the North Zone, using the FSC protocol developed by Central Appalachians FLN partners (Fig.1). Of the 90 plots, 31 captured the effects of a unit's first prescribed burn, 40 captured the second burn, 20 captured the third burn and 20 captured the fourth burn (some plots covered more than 1 event).

Data from all major community types (dry, dry-mesic, mesic) have been combined, due to the small sample size of the dry and mesic categories.

It should be noted that most plots remained relatively CLOSED-canopy after a first burn, and therefore these results best represent the post-fire development of CLOSED-canopy forest. However, as seen in the Canopy Gap Analysis (next section), some burn unit acreage has become OPEN canopy or even EARLY-successional. The vegetation response in these more affected areas is likely to be significantly different than the results reported here. As burning continues, more plots are likely to become EARLY and OPEN, and results specific to each condition could be presented separately.

Plot 5 in the Cub Run burn unit, before and after a first prescribed burn.

Table 1. Desired distribution of structural conditions for OAK Forest and Woodlands.

Successional class	Percent of landscape*
Early	12%
Mid-CLOSED	7%
Mid-OPEN	10%
Late-OPEN	57%
Late-CLOSED	14%
TOTAL	100%

Figure 1. Location of burn units with FSC plots.

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