Fire Effects Monitoring Breakout

- How can FLN support monitoring efforts?
- Evolution of the Heart of the Appalachians Monitoring Program
- Adaptive management loop
- Different monitoring protocols and examples.

Heart of the Appalachians FLN

Controlled burning in the Heart of the Apps

43,000 acres of prescribed fire since 2014

Average 15 burns per year

74% of all burns take place in March and April

Forest Structure and Composition Monitoring Milestones

2007

- FSC Monitoring Protocol Piloted

2009

- TNC/GWJNF adopted FSC monitoring protocol

2012

- Monitoring Working Group Established

2013

- FFI database launch
- 1st Plant ID and Protocol Refresher

2014

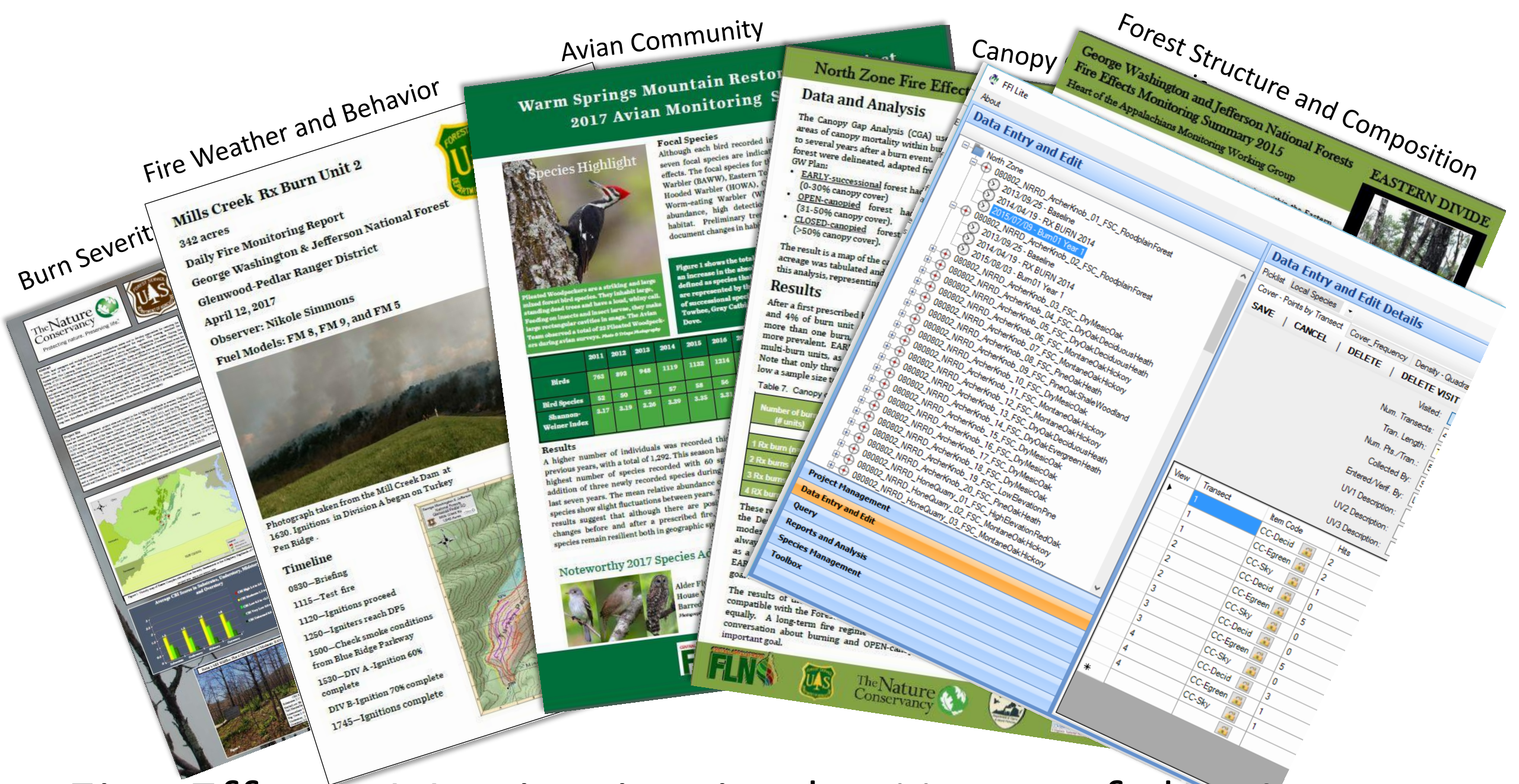
- All data entered into FFI
- 689 sample events

2015

- State agencies join group and begin FSC monitoring

2016

- Complete Summaries Of FSC Results



Fire Effects Monitoring in the Heart of the Apps

Mid-may to mid-June
107 plots
100 m fixed radius

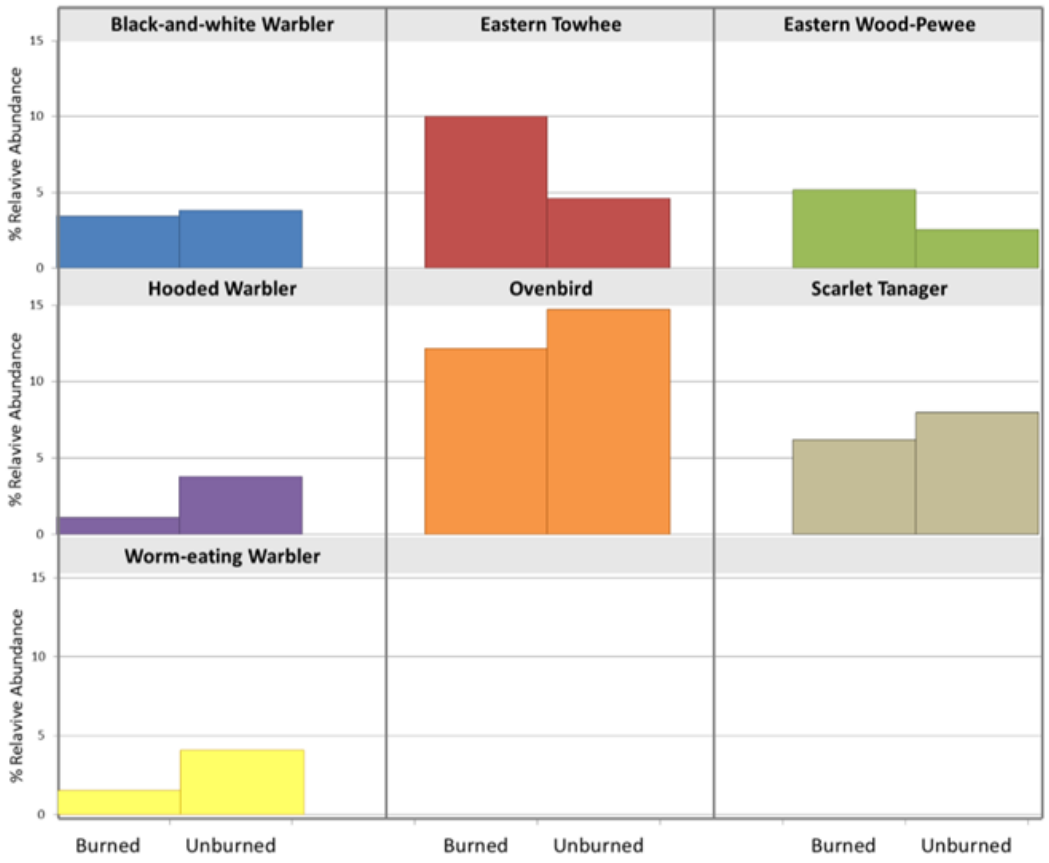


Figure 1: Mean differences in relative abundance of the study focal species in burned and un-burned plots.

Figure 1: Mean differences in relative abundance of the study focal species in burned and un-burned plots.

Figure 2: Mean annual differences in relative abundance of the study focal species (error bars indicate 1 standard error).

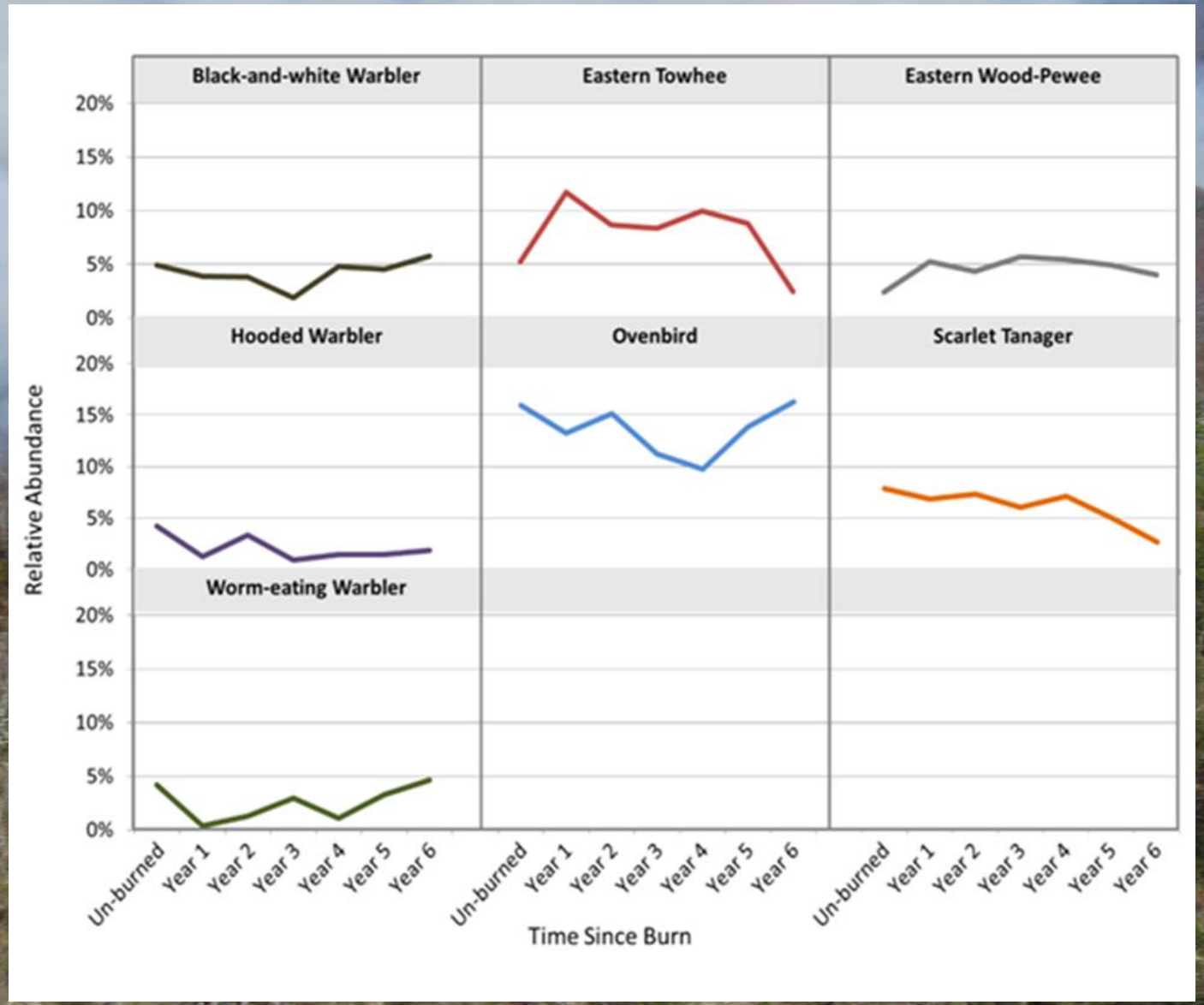


Figure 3: Mean differences in relative abundance of the study focal species since the last fire entry

Summaries of monitoring results

George Washington and Jefferson National Forest Fire Effects Monitoring Summary 2015

Heart of the Appalachians Monitoring Working Group

This report summarizes the effects of prescribed burning and one wildfire within the **Central Zone** of the George Washington National Forest (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 Central Zone burn plans:

- Overstory /Midstory: Reduce/maintain canopy cover of 40%-70%.
- Understory: Top kill 30-80% of all small trees and shrubs less than 1" DBH. Top kill at least 80% of all blueberry and huckleberry plants to encourage sprouting and berry production.
- 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 (FSC)

As of 2015, one hundred and twenty-two (122) permanent plots have been established and sampled in the Central Zone, using the FSC protocol developed by Central Appalachians FLN partners (Fig.1). Of those plots, 35 have been sampled both before and after a unit's first prescribed burn. Those results are summarized in this report.

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.

CENTRAL ZONE

Pine and oak communi... common to the forests of ... Central Zone.

Table 1. Desired distribution of stru... conditions for OAK Forest and Wood...

Successional class	Percent landsca...
Early	12%
Mid-CLOSED	7%
Mid-OPEN	10%
Late-OPEN	57%
Late-CLOSED	14%
TOTAL	100%

*Value is the average of a naturally-occurring ...

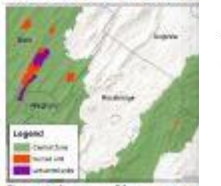


Figure 1. Location of burn units wi... FSC plots.

North Zone Fire Effects Mo...

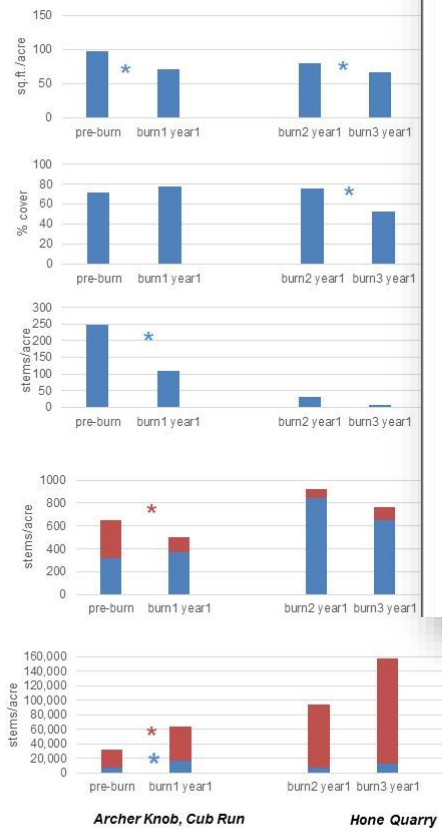


Figure 7. Small understory stems (<3.3ft)

Attributes of forest structure within burn units, by sampling period. Comparisons marked with an * are significantly different.

Eastern Divide Fire Effects Monitoring—FSC plots

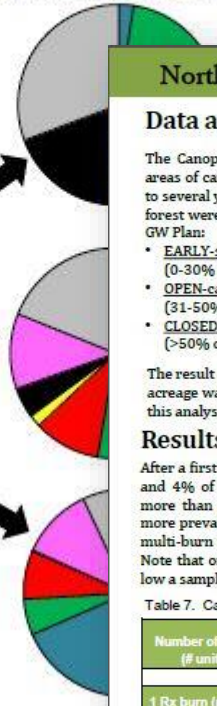
SUMMARY 2nd prescribed burn

In these twice-burned plots, the overstory is still relatively closed; both basal area and canopy cover are over 90 ft²/acre and 90% cover, respectively. A moderately-dense midstory still persists; it is a relatively diverse mix of oaks, maples, blackgum and other hardwood species. A dense understory is present, with large and small stems dominated by shrub species. Oaks are a relatively small component of tree regeneration. Non-woody ground cover is relatively sparse.

The condition of these plots before the 2nd burn isn't known, therefore conclusions about the impacts of fire based on the data below should be limited.

Table 4. Forest structure and composition attributes of plots after a second prescribed burn (1 year post, n=24, all communities combined. Round Mtn., Mill Creek, No Business #327, 355 and 977).

OVERSTORY Note that the prism protocol underestimates basal area	Basal Area (ft²/ac): 91 ± 12 Canopy Cover: 92 ± 4
MIDSTORY (stems 1-4" DBH)	Total stem density/acre 244 ± 86 • shrub 6 ± 12 • tree 231 ± 83
UNDERSTORY (stems >3.3ft tall and <1"DBH)	Total stem density/acre 900 ± 524 • shrub 420 ± 407 • tree 479 ± 264 • oaks 54 ± 38
UNDERSTORY (stems<3.3ft tall)	Total stem density/acre 42,071 ± 18,892 • shrub 28,792 ± 18,758 • tree 13,152 ± 5,058 • Oaks 2,360 ± 884
UNDERSTORY (ground cover)	Non-woody cover: 11% ± 5% • Forbs 10 ± 4 • Grass 1 ± 1 • Vines 1 ± 1



North Zone Fire Effects Monitoring—Canopy Gap Analysis

Data and Analysis

The Canopy Gap Analysis (CGA) uses GIS to identify areas of canopy mortality within burn units (Fig.8), up to several years after a burn event. Three categories of forest were delineated, adapted from definitions in the GW Plan:

- EARLY-successional forest had *substantial* mortality (0-30% canopy cover)
- OPEN-canopied forest had *moderate* mortality (31-50% canopy cover).
- CLOSED-canopied forest had *little* mortality (>50% canopy cover).

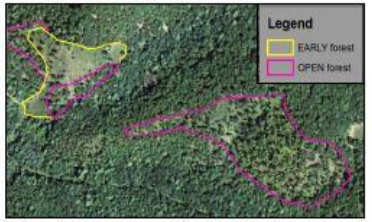


Figure 8. Canopy gaps delineated after a burn.

The result is a map of the canopy condition of entire burn units (Fig.9). The amount of EARLY, OPEN or CLOSED acreage was tabulated and reported as a percentage of the burn unit. Over 20 North Zone units were used for this analysis, representing first, second, third or fourth-entry burns from 1997-2014.

Results

After a first prescribed burn, EARLY and OPEN forest represented 5% and 4% of burn unit acreage, respectively (Table 7). In units with more than one burn, EARLY and OPEN were slightly to somewhat more prevalent. EARLY forest creation was also more variable among multi-burn units, as seen in the wider confidence interval (Table 7). Note that only three different units with 4 burns were examined, too low a sample size to draw any solid conclusions from now.

Table 7. Canopy conditions within prescribed burn units, by burn history.

Number of burns (# units)	OPEN	EARLY	CLOSED	Total acres examined
	% of unit acreage (± 95% C.I.)			
1 Rx burn (n=18)	4% (±2)	5% (±5)	91% (±6)	26,988
2 Rx burns (n=10)	6% (±2)	8% (±10)	87% (±10)	10,466
3 Rx burns (n=7)	8% (±5)	20% (±21)	72% (±23)	8,517
4 RX burns (n=3)	7% (±16)	9% (±13)	84% (±23)	2,764

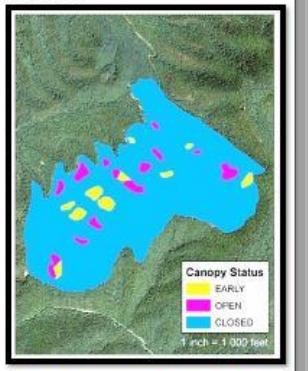


Figure 9. Post-burn canopy status for the New Road Run burn unit.

These results show that burning has begun to shift the forest towards the Desired Conditions of the Forest Plan. A single burn created modest amounts of EARLY and OPEN, but repeated burning did not always result in ever-increasing amounts of these conditions. Taken as a whole, the results of burning were close to the Plan's goal for EARLY forest creation (~12%, Table 1), but have not yet achieved the goal for OPEN forest creation (~67%, Table 1).

The results of the CGA are consistent with the results of the FSC plot data: prescribed burning has been compatible with the Forest Plan, even though not all of the newly-described ecological targets have been met equally. A long-term fire regime will be necessary to fully achieve Desired Conditions. Additionally, a conversation about burning and OPEN-canopied forest might provide insight into better addressing this important goal.

Heart of the Appalachians Monitoring Working Group
Lindsey Curtin, USFS.
lcurtin@fs.fed.us
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Avian monitoring

Located on 107 FSC plots across one landscape

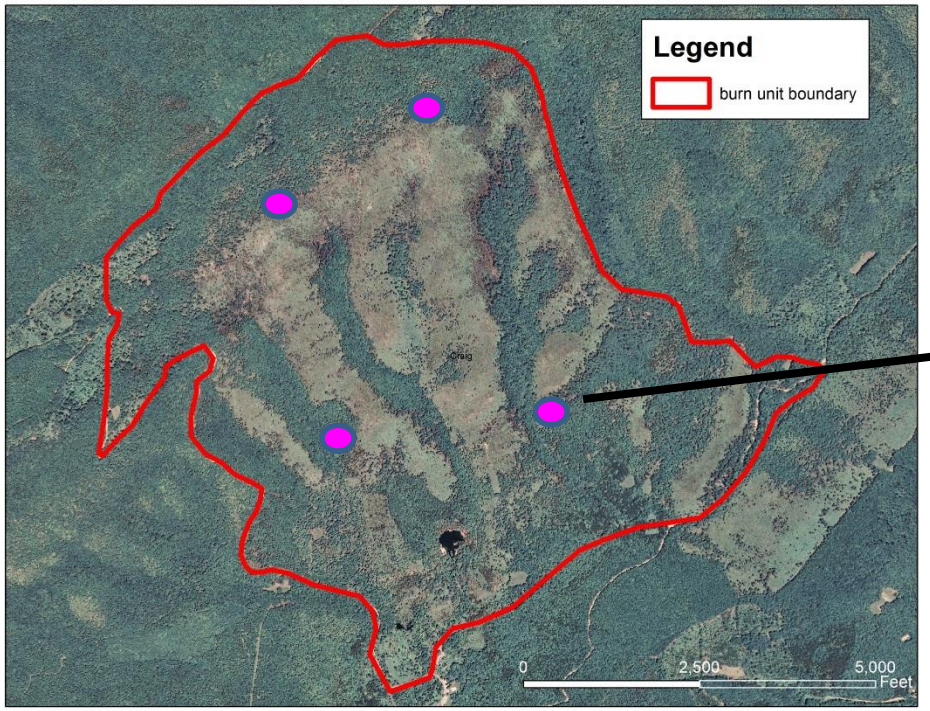
Training in Spring

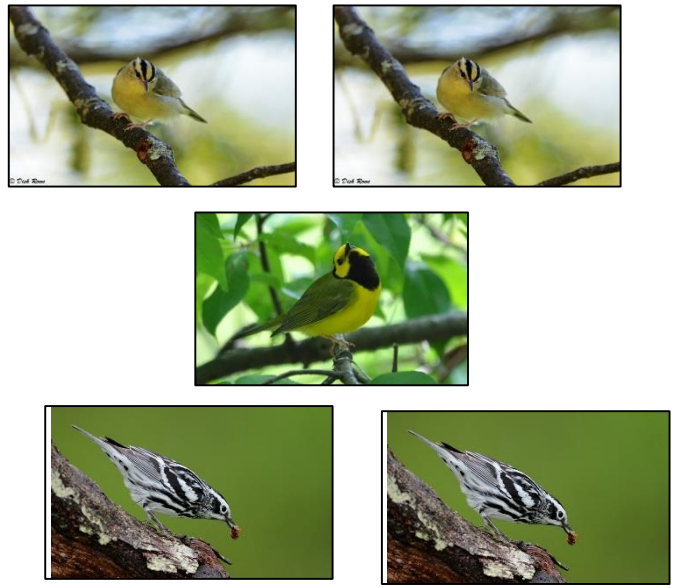
Monitoring done in late Spring (May-June)

2 crews (2 people each)

5-7 weeks of work

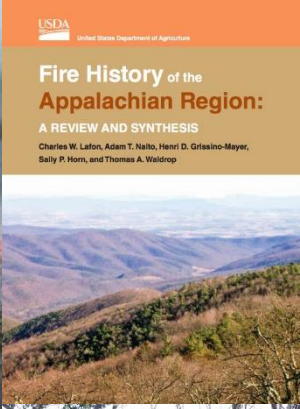
7 years of monitoring complete (pre and post-burn)





The importance of fire in the Heart of the Apps

- Fire has shaped the vegetation and habitat types in the region over thousands of years, though its frequent presence across the landscape was all but extinguished in the early 20th century



- Managers today burn to: promote healthy and resilient forests, maintain diversity of vegetation and habitat types, and promote oak and pine regeneration


Articles

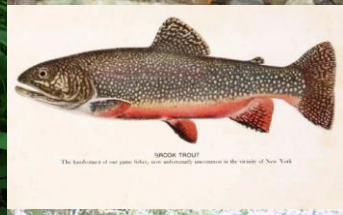
The Demise of Fire and "Mesophication" of Forests in the Eastern United States

Desired Conditions

Oak, Hickory & Pine Regeneration

Open Forests and Woodlands

Diverse stand classes



Desired Conditions

New Road Run Burn GWJNF North Zone

Creating conditions for a healthy and resilient forest

Heart of the Apps FLN Monitoring Working Group

FLN

Virginia Department of Game & Inland Fisheries

George Washington and Jefferson National Forests

The Nature Conservancy

Protecting nature. Preserving life.

DCR

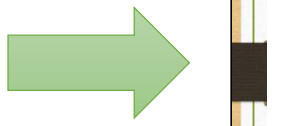
Virginia Department of Conservation & Recreation

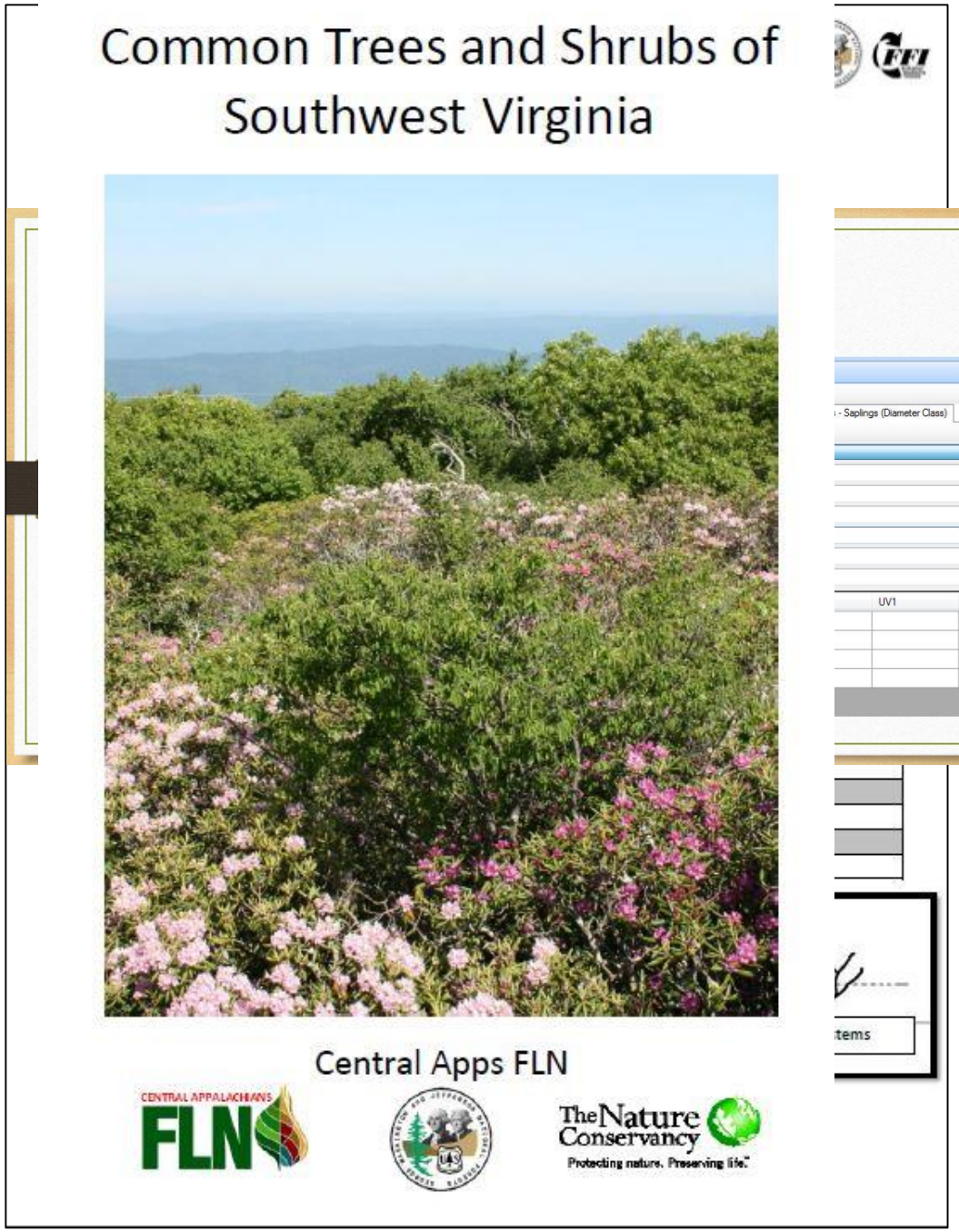
National Park Service

Fire Effects Monitoring in the Heart of the Apps

Forest Structure & Composition
Species List

Common Name	Symbol	Scientific Name
alder	ALNUS	Alnus
Allegheny serviceberry	AMLA	Amelanchier laevis
alternateleaf dogwood	COAL2	Cornus alternifolia
American basswood	TIAM	Tilia americana
American beech	FAGR	Fagus grandifolia
American chestnut	CADE12	Castanea dentata
American elm	ULAM	Ulmus americana
American hazelnut	COAM3	Corylus americana
American holly	ILOP	Ilex opaca
American hornbeam/ironwood	CACA18	Carpinus caroliniana
American mountain ash	SOAM3	Sorbus americana
American witchhazel	HAVI4	Hamamelis virginiana
ash	FRAXI	Fraxinus
autumn olive	ELUMP	Elaeagnus umbellata var. parvifolia
beaked hazelnut	COCO6	Corylus cornuta
bear oak	QUIL	Quercus ilicifolia
bigtooth aspen	POGR4	Populus grandidentata
birch	BETUL	Betula
black cherry	PRSE2	Prunus serotina
black huckleberry	GABA	Gaylussacia baccata
black locust	ROPS	Robinia pseudoacacia
black oak	QUVE	Quercus velutina
black walnut	JUNI	Juglans nigra
blackberry	RUBUS	Rubus
blackgum	NYSY	Nyssa sylvatica
blackhaw	VIPR	Viburnum prunifolium
blackjack oak	QUMA3	Quercus marilandica
Blue Ridge blueberry	VAPA4	Vaccinium pallidum
blueberry	VACCI	Vaccinium
boxelder	ACNE2	Acer negundo
bristly locust	ROHI	Robinia hispida
buffalo nut	PYPU	Pyrularia pubera
Burning Bush	EUAL8	Euonymus alata
butternut	JUCI	Juglans cinerea
Carolina hemlock	TSCA2	Tsuga caroliniana
cat greenbrier	SMGL	Smilax glauca
Catawba rosebay	RHCA8	Rhododendron catawbiense
chestnut oak	QUMO4	Quercus montana
chinkapin	CAPU9	Castanea pumila
cogongrass	IMCY	Imperata cylindrica





Forest Structure and Composition Monitoring Milestones

2007

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- 1st Plant ID and Protocol Refresher

2014

- All data entered into FFI
- 689 sample events

2015

- State agencies join group and begin FSC monitoring

2016

- Complete Summaries Of FSC Results

Lessons Learned

Make it easy for people to do

Dedicate someone to help drive the monitoring forward

People will ask a lot of questions, don’t be afraid to answer them

Keep folks informed of progress, even if you don’t have a lot of results to share

Make it fun

Forest Structure and Composition Monitoring Stats

439 Plots Total

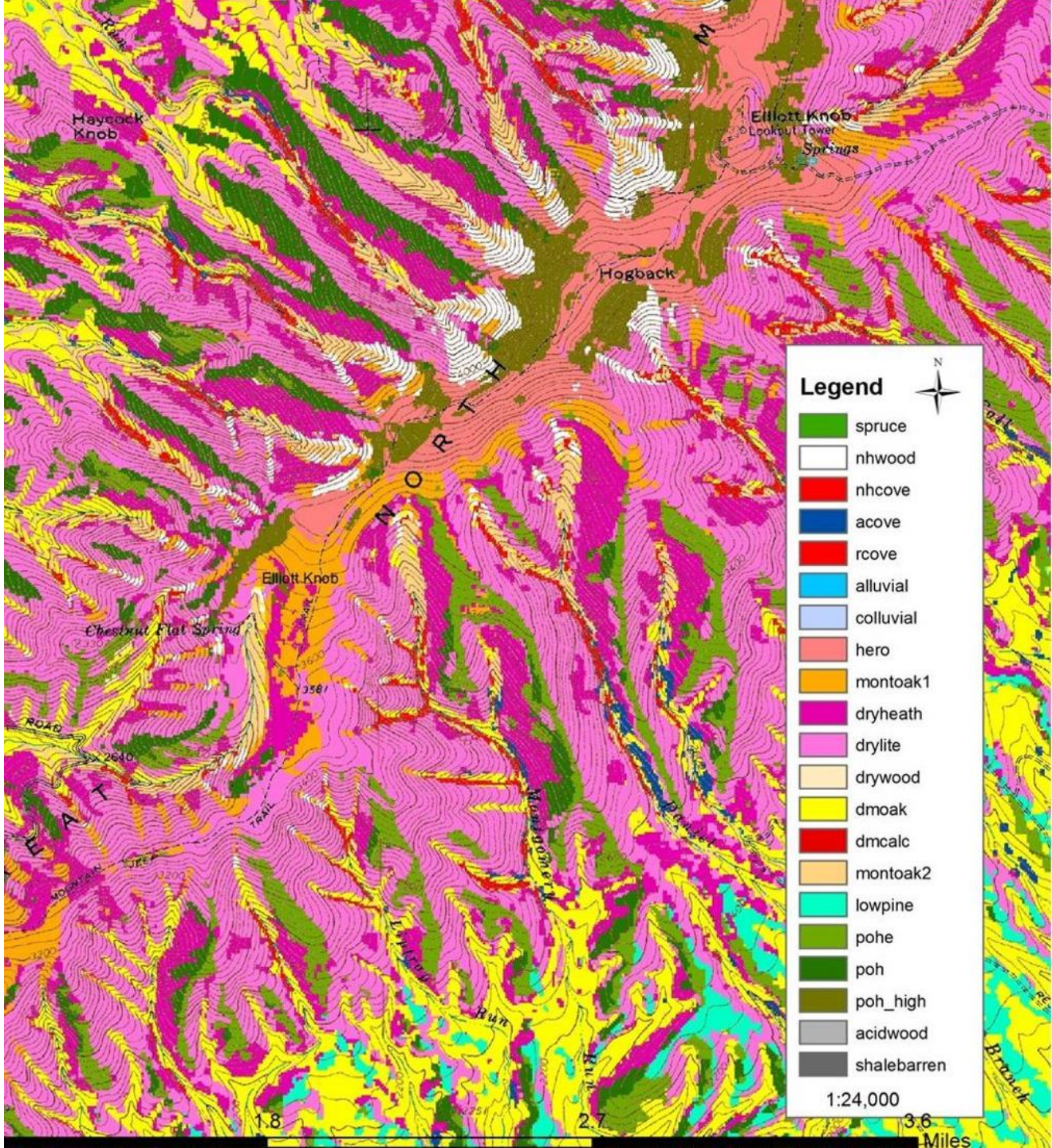
2,245 Plot Visits

Plots Stratified by Vegetation Type

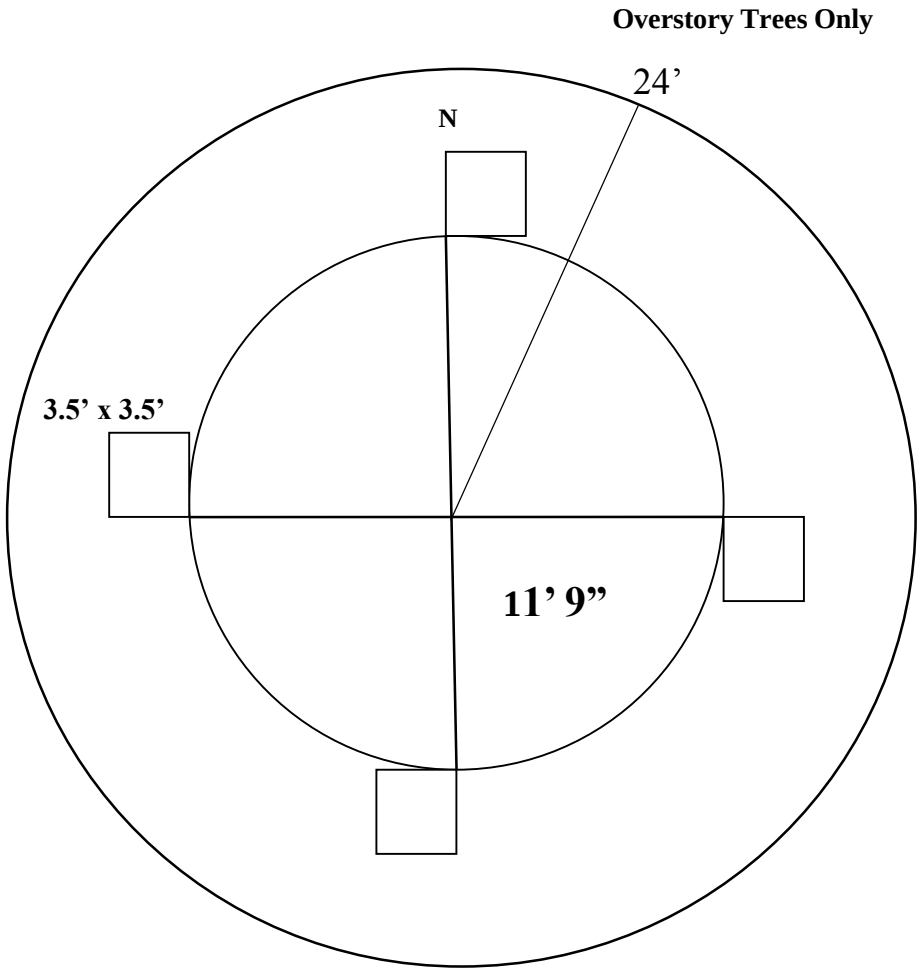
46 burn units, 63,000 acres

Plots visited 1 year post burn and again at 5 years

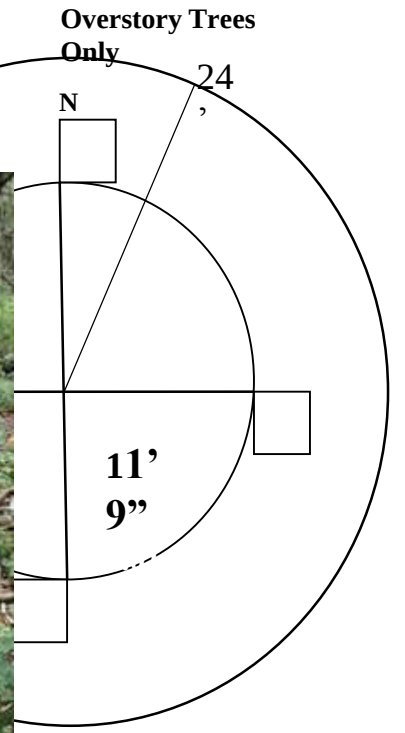
All Data is entered into Feat and Fire Mon Integrated (FFI)



Forest Structure and Composition Monitoring Methods



Forest Structure and Composition Monitoring Methods



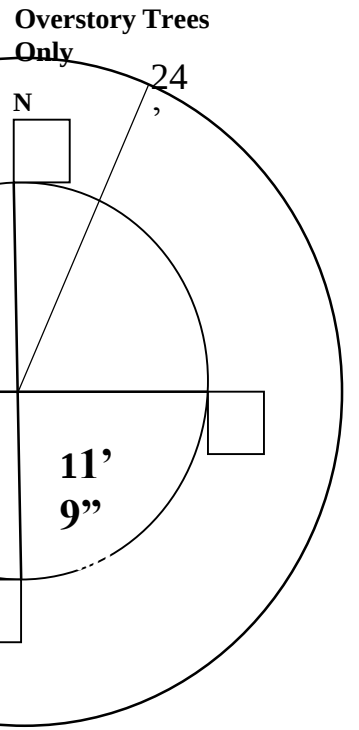
Percent Canopy Cover determined at five points along each of four transects located in the cardinal directions from plot center.

Percent Cover Class within four 3.5’ x 3.5’ quadrats, all woody stems 6” to 3.5’ in height are counted.

Stem Regeneration a percent aerial cover of graminoids, forbs, woody trees/shrubs, woody vines, and non-native invasive species are estimated.

Top: Dan Buckler measures canopy cover with a GRS densitometer. **Bottom:** Laurel Schablein measures stems with a density quadrat frame.

Forest Structure and Composition Monitoring Methods



Saplings within 11.9’ radius, all woody tree and shrub stems **< 1” at DBH and >3.5 feet tall** are tallied.

Trees within 11.9’ radius, all woody tree and shrub stems **<4” and >1” at DBH** and >3.5 feet tall are measured and tallied.

Fixed Radius Trees within 24’ radius, all trees **>4” at DBH** are measured, tagged and tallied.

Top: Adam Christie counted 170 live and 89 dead Sassafras stems in the 2016 Burn 3 Year 1 visit.
Bottom: Patrick Lacienski measures an American Chestnut in the Middle Mountain burn unit.


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

OVERSTORY changes 1 year after a 1st burn

On average, basal area (>4” DBH) **decreased by 17%**

High variability: some plots had complete canopy mortality, some had none

Burn Plan Objectives

Reduce overstory canopy in Oak and Pine woodlands by 5-15% each treatment

MIDSTORY changes 1 year after a 1st burn

Tree and Shrub stem density (1”-4” DBH) **decreased by 66%**

Low variability: almost all plots experienced a substantial decrease

Burn Plan Objectives

Decrease the number of <4” DBH of fire intolerant trees in the mid-story by 50% within one year post-burn.

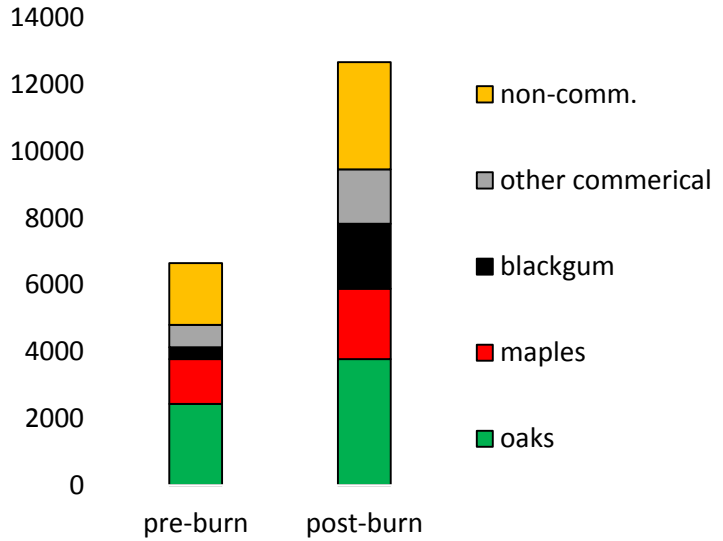
Top kill 50-75% of woody vegetation <4” DBH across the unit.

UNDERSTORY changes

Oak stem density **increased by 55%**

Vaccinium density **increased by 50%**

1 year after a 1st burn



Burn Plan Objectives

Increase oak regeneration

Top kill at least 80% of all blueberry and huckleberry plants

UNDERSTORY
(non-woody) changes

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

5 years after a 1st burn

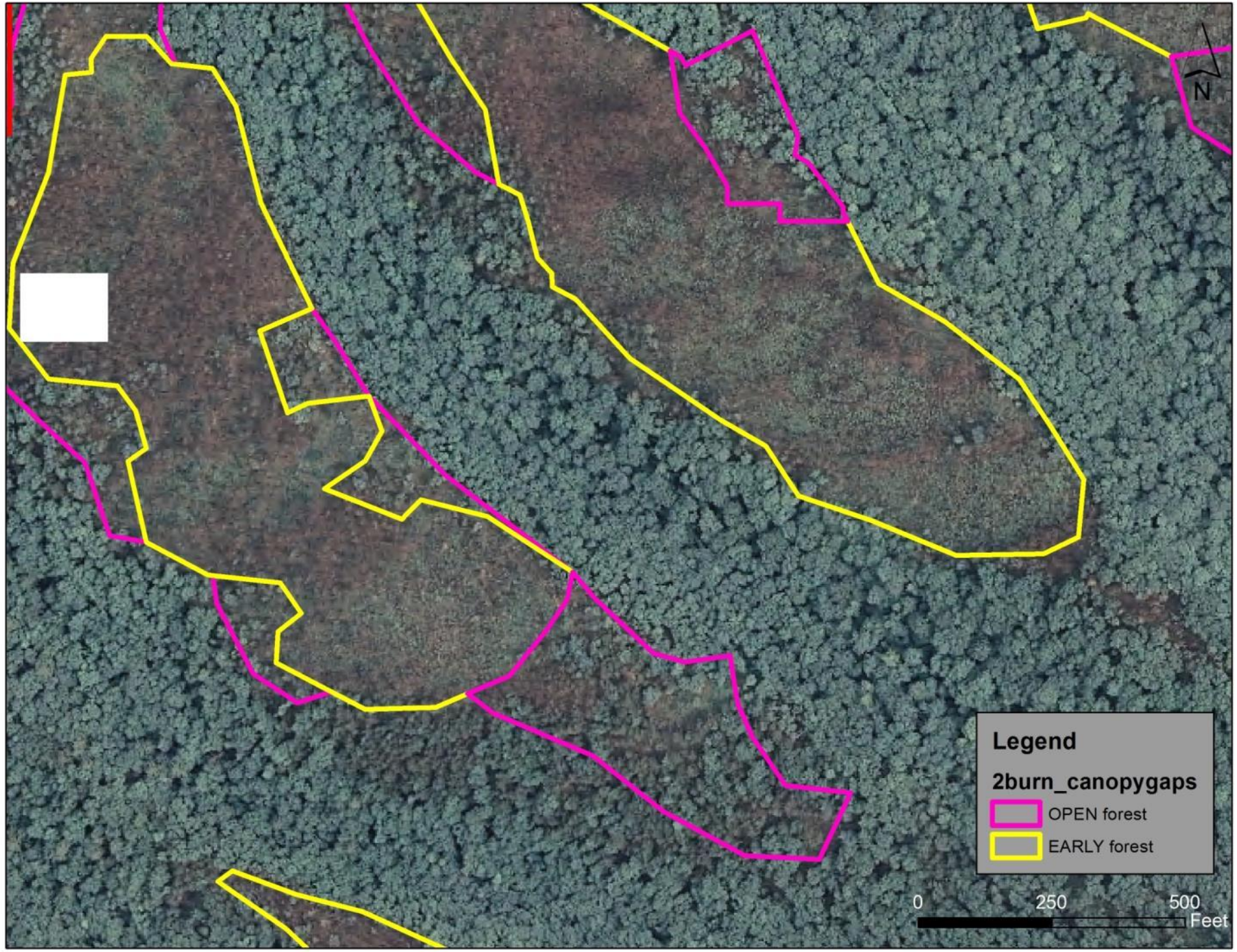
Remote sensing of canopy conditions

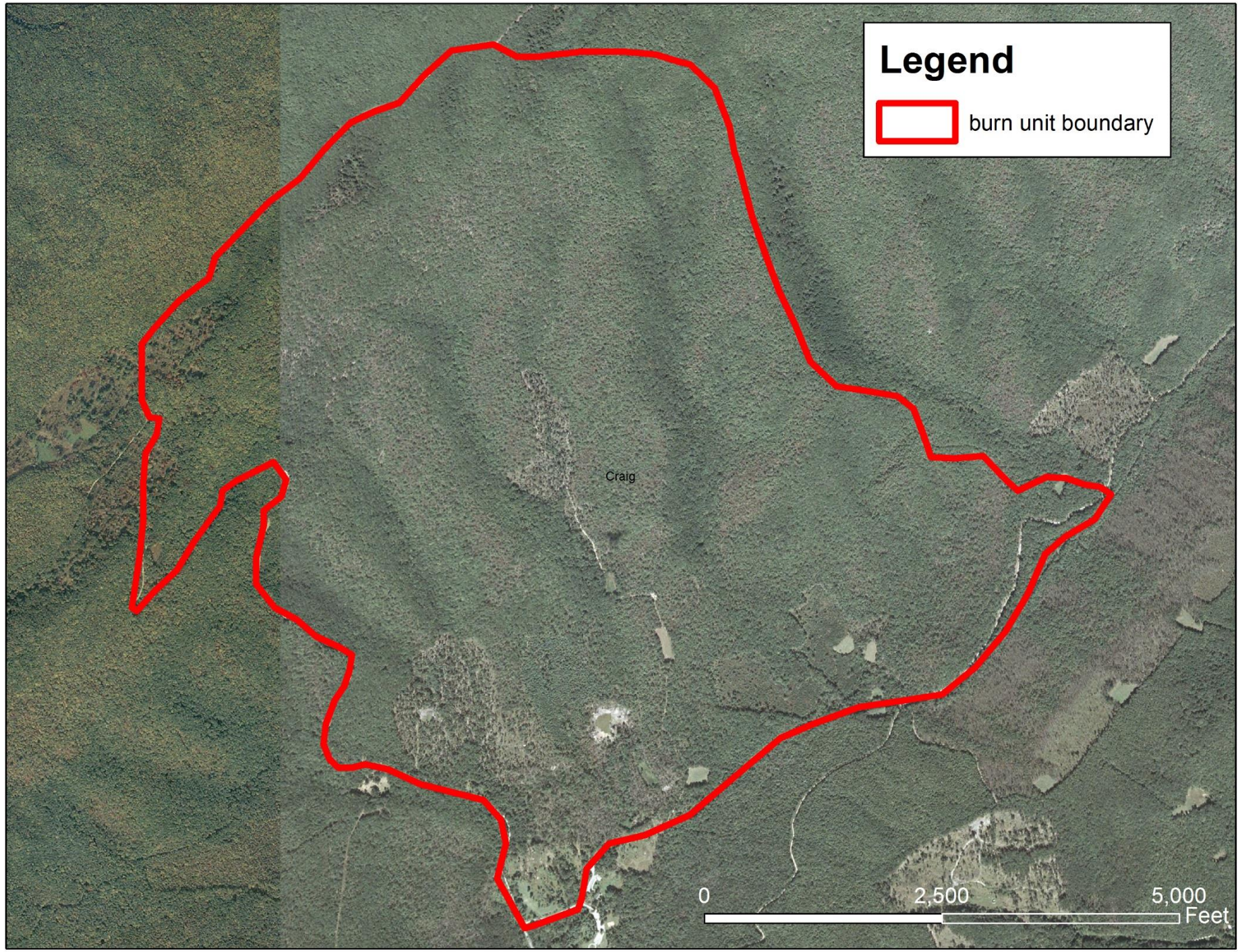
GWNF Plan Goals

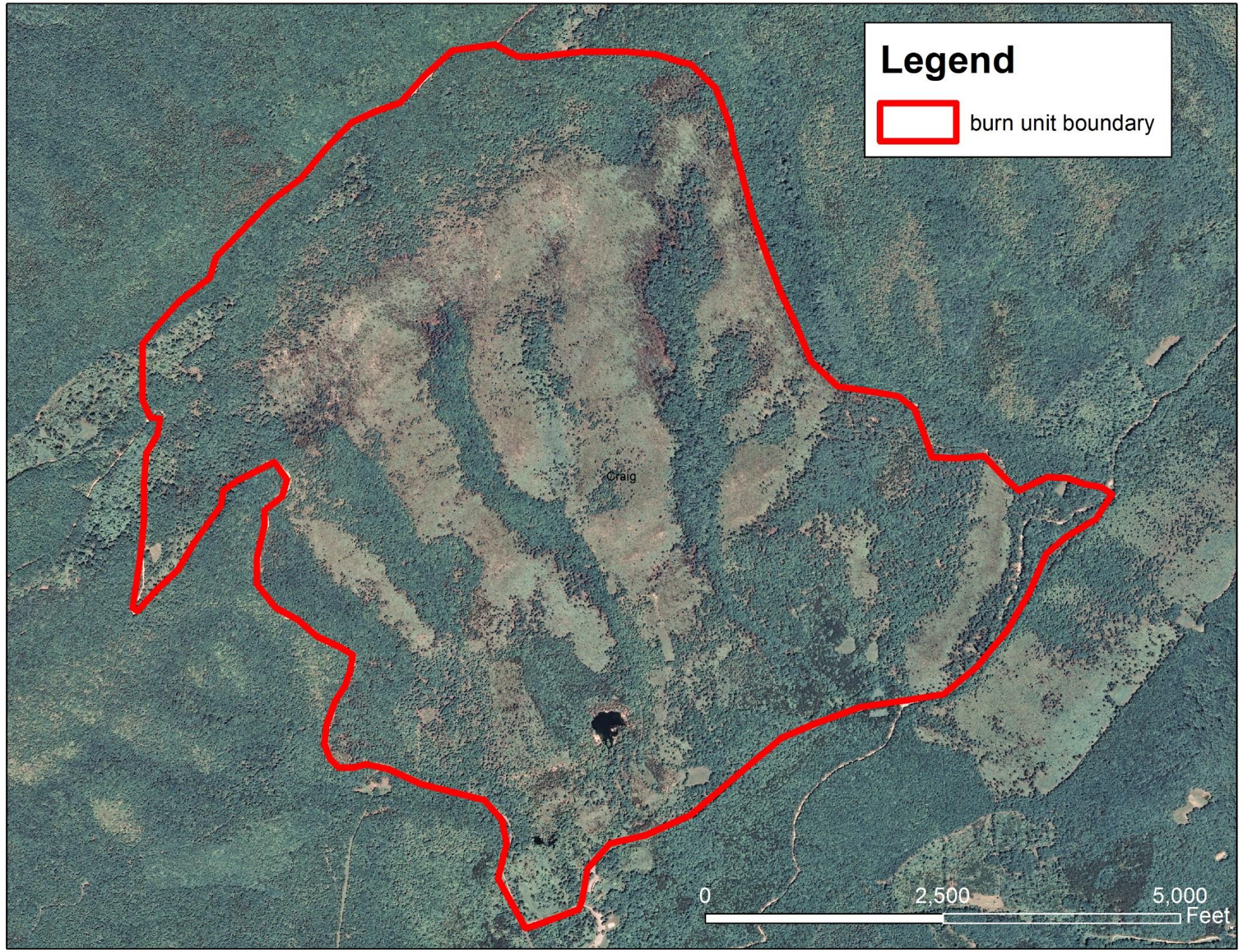
EARLY
0-30% Canopy Cover

OPEN
31-50% Canopy Cover

CLOSED
51-100% Canopy Cover


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


Legend
burn unit boundary
Craig
0
2,500
5,000
Feet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burn unit boundary
Craig
0
2,500
5,000
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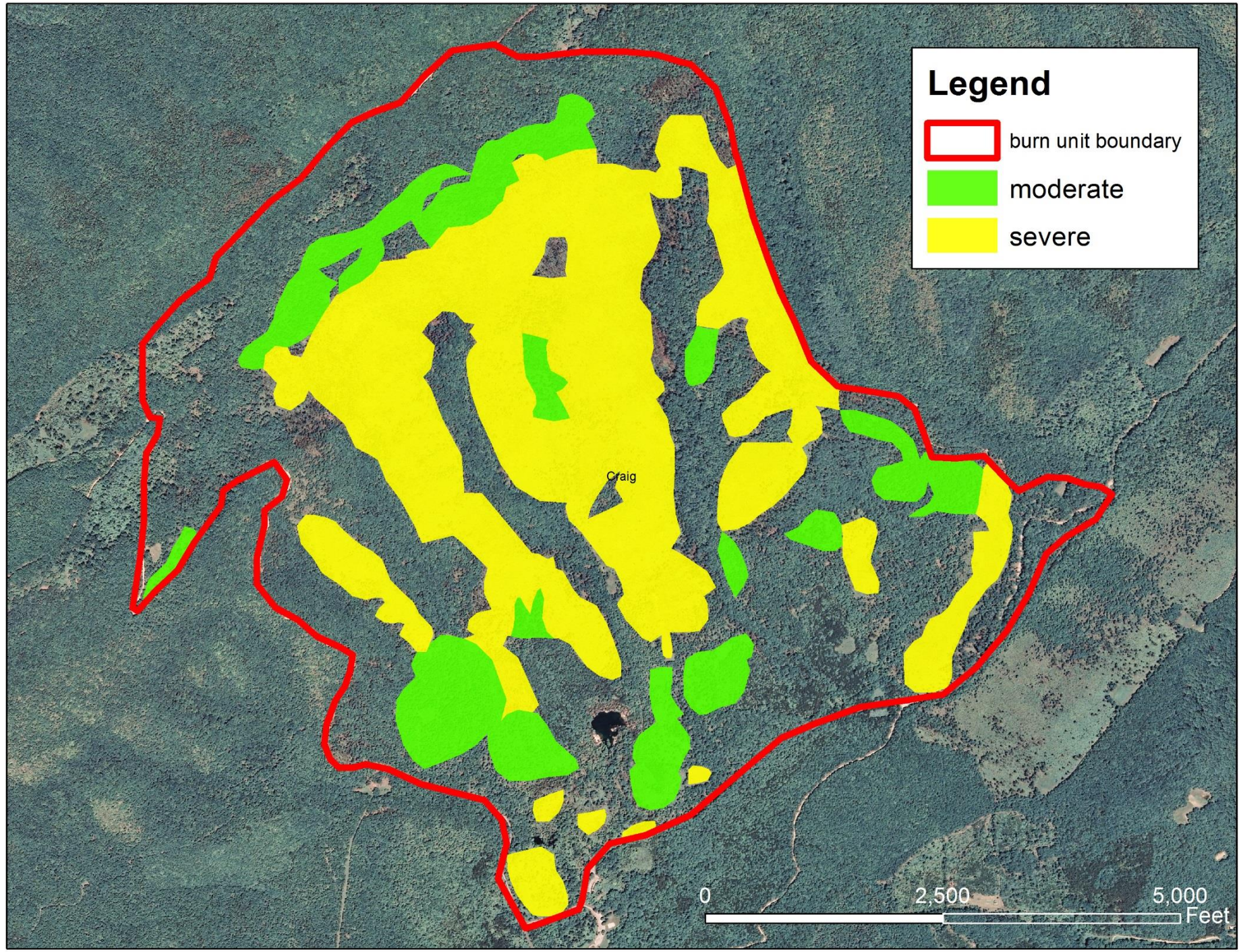
Legend
burn unit boundary
moderate
severe
Craig
0
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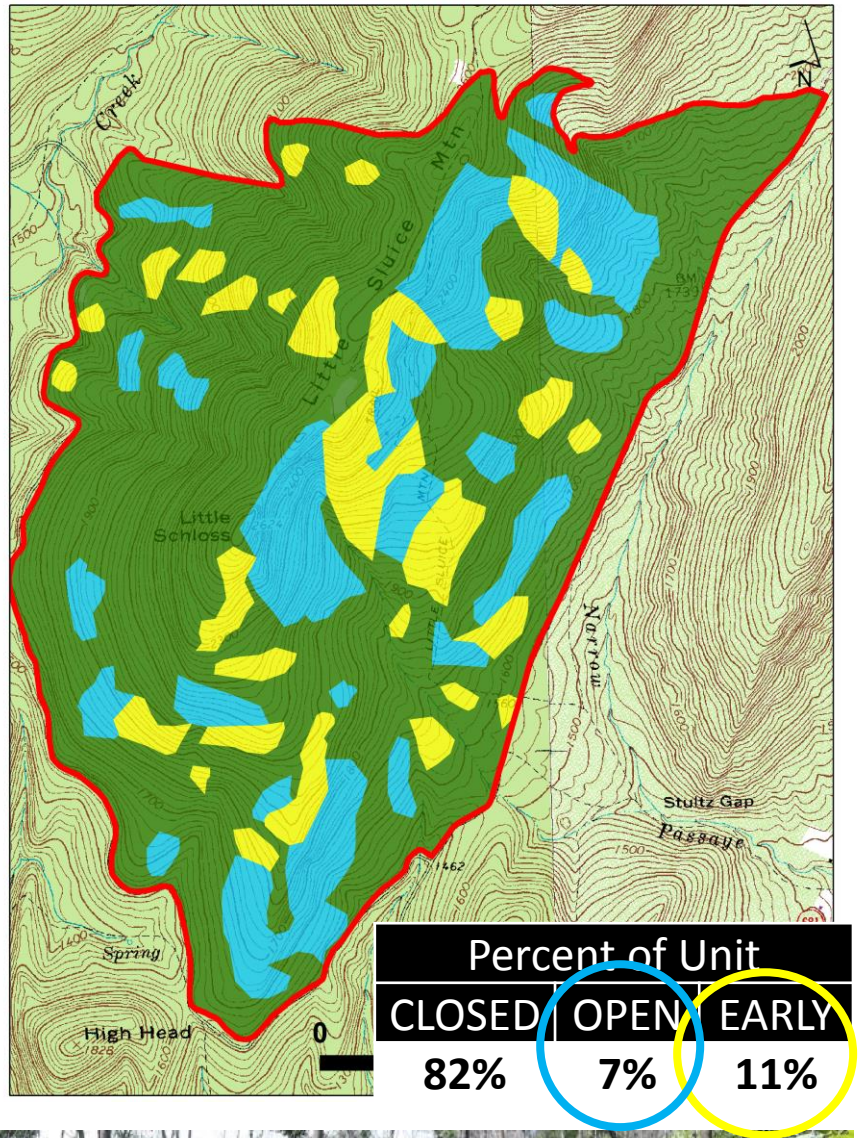
5,000
Feet

Remote sensing of canopy conditions

Burn Plan Objectives:

Reduce overstory canopy in Oak and Pine woodlands by 5-15% each treatment



Forest Plan Objectives:

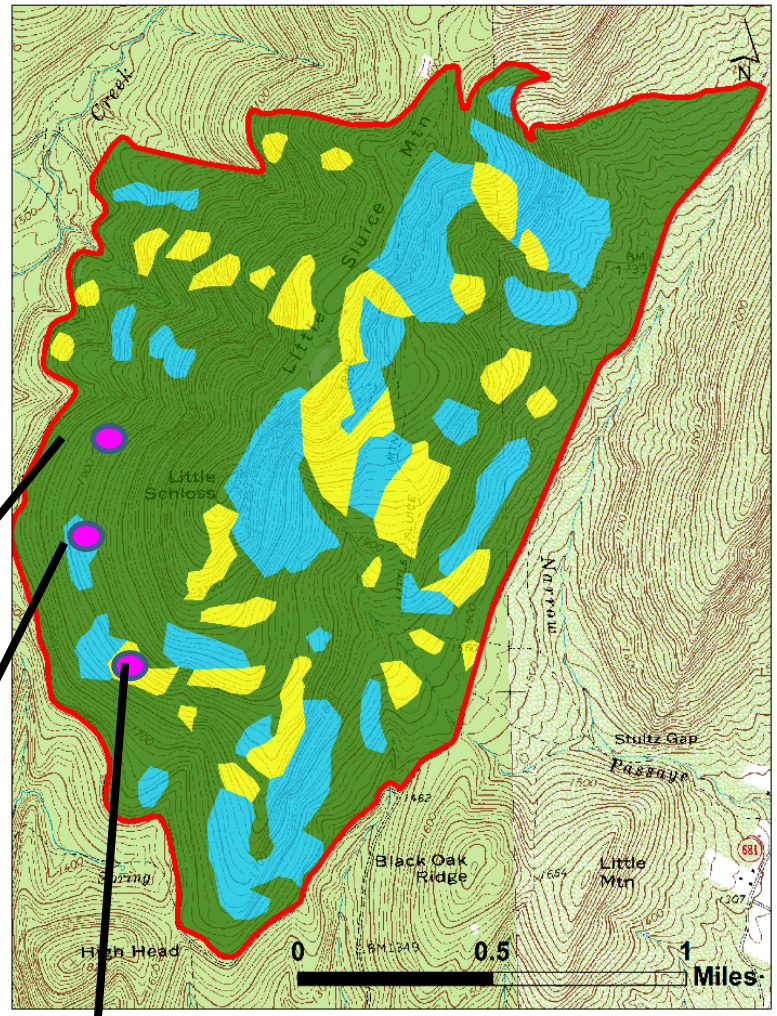
	EARLY	MID CLOSED	MID OPEN	LATE OPEN	LATE CLOSED
Target % of acreage	12	7	10	57	14

Combine monitoring data

- On-the-ground veg data

STRATIFIED BY

- Remote sensing canopy data



Sampling strata		Canopy condition		
		CLOSED	**OPEN**	**EARLY**
OVER-STORY	Basal area/acre	83 c	56 b	18 a
MID-STORY	Woody stems/acre	214 b	0 a	11 ab
UNDERSTORY	Woody stems/acre	47,000 b	150,000 a	171,000 a

Putting the results to work

- Adaptive Management
- National Environmental Policy Act (NEPA)
- Shared Learning
- Informing Research
- Sharing data with Southern Blue Ridge FLN
- Strategic planning for Heart of the Apps FLN

Mill Creek Burn Central Zone GWJNF

Contributors:

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