Validation of National Burn Severity Mapping Project Techniques Within the Apalachicola National Forest

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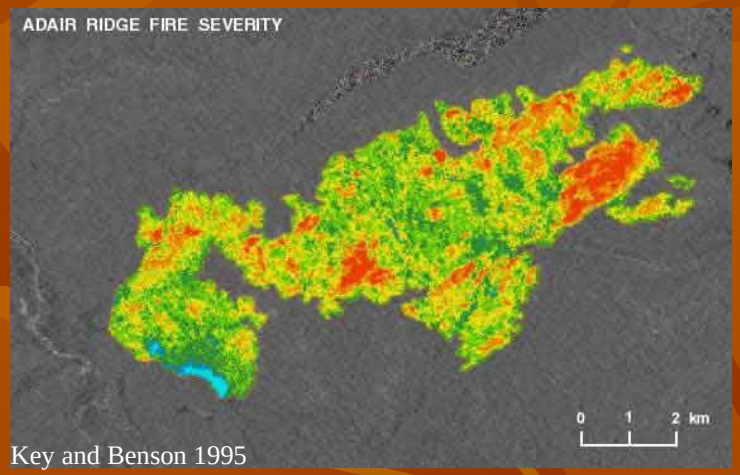
Project Overview

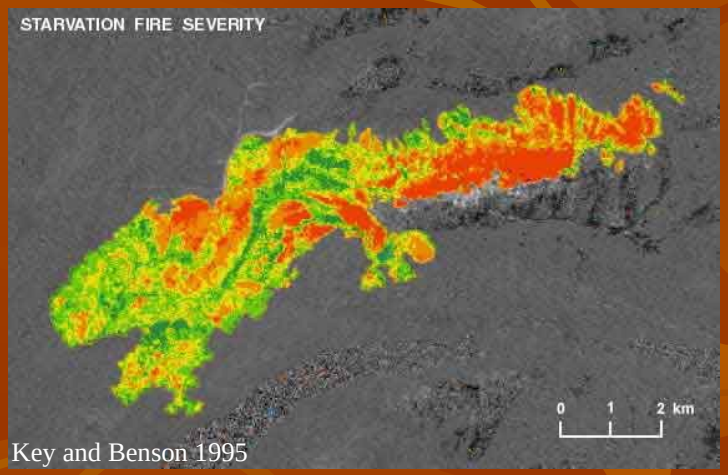
- Background
- Project Questions
- Results
- Problems
- Conclusions

Background-Burn Severity and Joint Fires Science Program (JFSP)

- Burn Severity-ecosystem change and landscape change
- System developed in 1996 by Carl Key and Nate Benson
- Started in the Western United States
  - Initial Fires Assessed-1994 Glacier National Park Fires
  - Needs more work in East
- JFSP was formed in 1998 to provide support for fuel and fire management programs



Key and Benson 1995



Key and Benson 1995

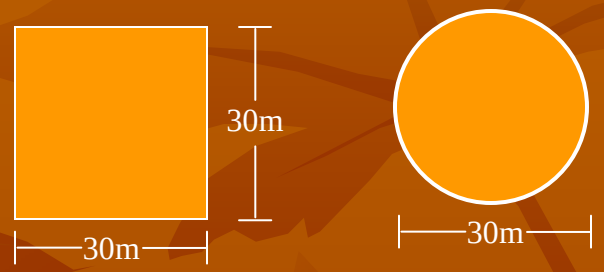
Background-Composite Burn Index (CBI) and Normalized Burn Ratio (NBR)

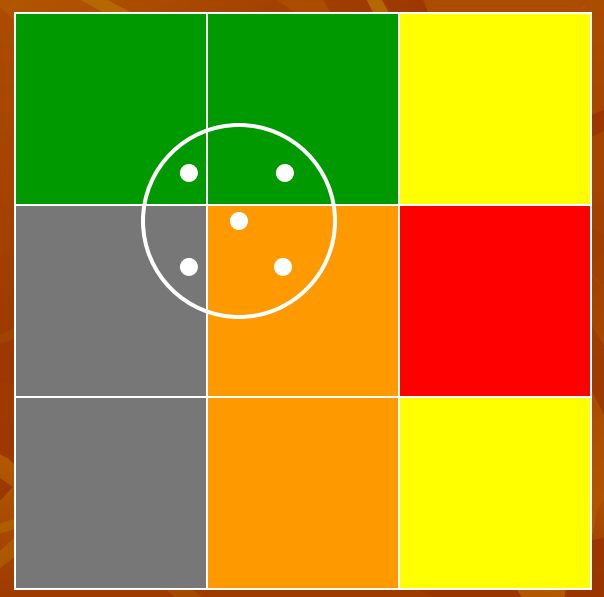
- NBR-Remote sensing of burn severity
  - Landsat bands R_4 and R_7
  - $NBR = (R_4-R_7)/ (R_4+R_7)$
  - dNBR=NBR prefire-NBR postfire
- CBI-Ground measure of burn severity
  - 30 m plot
- CBI should validate NBR values

Background-deltaNormalized Burn Ratio (dNBR)

- dNBR: Change in reflectance between pre-fire (1 year pre-fire) and post-fire NBR values
  - $dNBR = NBR_{prefire} - NBR_{postfire}$
- Weighted dNBR = Average of plot center and corners (N=5)

Severity	dNBR
Unburned	-100 - 99
Low	99 - 269
Low-Moderate	269 - 439
Moderate-High	439 - 659
High	659 - 1300





Background-Composite Burn Index (CBI)

- Burn Index: 0-3
  - 0-Unburned
  - 3-Severe Burn
- Five Strata
  - 4-5 Ratings Factors
  - Averaged
- CBI Score
  - Average of Five Strata

FIREMON LA Form

BURN SEVERITY -- COMPOSITE BURN INDEX (BI)

PD - Abridged	Examiners:		Fire Name:		
Registration Code		Project Code		Plot Number	
Field Date mmddyyyy	/ /	Fire Date mmyyyy	/		
Plot Aspect		Plot % Slope		UTM Zone	
Plot Diameter Overstory		UTM E plot center		GPS Datum	
Plot Diameter Understory		UTM N plot center		GPS Error (m)	
Number of Plot Photos		Plot Photo IDs			

BI – Long Form	% Burned 100 feet (30 m) diameter from center of plot =	Fuel Photo Series =

STRATA RATING FACTORS	BURN SEVERITY SCALE							FACTOR SCORES
	No Effect	Low		Moderate		High		
	0.0	0.5	1.0	1.5	2.0	2.5	3.0	
A. SUBSTRATES								
% Pre-Fire Cover: Litter = Duff = Soil/Rock = Pre-Fire Depth (inches): Litter = Duff = Fuel Bed =								Σ =
Litter/Light Fuel Consumed	Unchanged	--	50% litter	--	100% litter	>80% light fuel	98% Light Fuel	
Duff	Unchanged	--	Light char	--	50% loss deep char	--	Consumed	N =
Medium Fuel, 3-8 in.	Unchanged	--	20% consumed	--	40% consumed	--	>60% loss, deep ch	
Heavy Fuel, > 8 in.	Unchanged	--	10% loss	--	25% loss, deep char	--	>40% loss, deep ch	$\bar{X}$ =
Soil & Rock Cover/Color	Unchanged	--	10% change	--	40% change	--	>80% change	
B. HERBS, LOW SHRUBS AND TREES LESS THAN 3 FEET (1 METER):								
Pre-Fire Cover = % Enhanced Growth =								Σ =
% Foliage Altered (blk-brn)	Unchanged	--	30%	--	80%	95%	100% + branch loss	
Frequency % Living	100%	--	90%	--	50%	< 20%	None	N =
Colonizers	Unchanged	--	Low	--	Moderate	High-Low	Low to None	
Spp. Comp. - Rel. Abund.	Unchanged	--	Little change	--	Moderate change	--	High change	$\bar{X}$ =
C. TALL SHRUBS AND TREES 3 to 16 FEET (1 TO 5 METERS):								
Pre-Fire Cover = % Enhanced Growth =								Σ =
% Foliage Altered (blk-brn)	0%	--	20%	--	60-90%	> 95%	Significnt branch loss	
Frequency % Living	100%	--	90%	--	30%	< 15%	< 1%	N =
% Change in Cover	Unchanged	--	15%	--	70%	90%	100%	
Spp. Comp. - Rel. Abund.	Unchanged	--	Little change	--	Moderate change	--	High Change	$\bar{X}$ =
D. INTERMEDIATE TREES (SUBCANOPY, POLE-SIZED TREES)								
Pre-Fire % Cover = Pre-Fire Number Living = Pre-Fire Number Dead =								Σ =
% Green (Unaltered)	100%	--	80%	--	40%	< 10%	None	
% Black (Torch)	None	--	5-20%	--	60%	> 85%	100% + branch loss	N =
% Brown (Scorch/Girdle)	None	--	5-20%	--	40-80%	< 40 or > 80%	None due to torch	
% Canopy Mortality	None	--	15%	--	60%	80%	%100	$\bar{X}$ =
Char Height	None	--	1.5 m	--	2.8 m	--	> 5 m	
Post Fire: %Girdled = %Felled = %Tree Mortality =								
E. BIG TREES (UPPER CANOPY, DOMINANT, CODOMNANT TREES)								
Pre-Fire % Cover = Pre-Fire Number Living = Pre-Fire Number Dead =								Σ =
% Green (Unaltered)	100%	--	95%	--	50%	< 10%	None	
% Black (Torch)	None	--	5-10%	--	50%	> 80%	100% + branch loss	N =
% Brown (Scorch/Girdle)	None	--	5-10%	--	30-70%	< 30 or > 70%	None due to torch	
% Canopy Mortality	None	--	10%	--	50%	70%	%100	$\bar{X}$ =
Char Height	None	--	1.8 m	--	4 m	--	> 7 m	
Post Fire: %Girdled = %Felled = %Tree Mortality =								

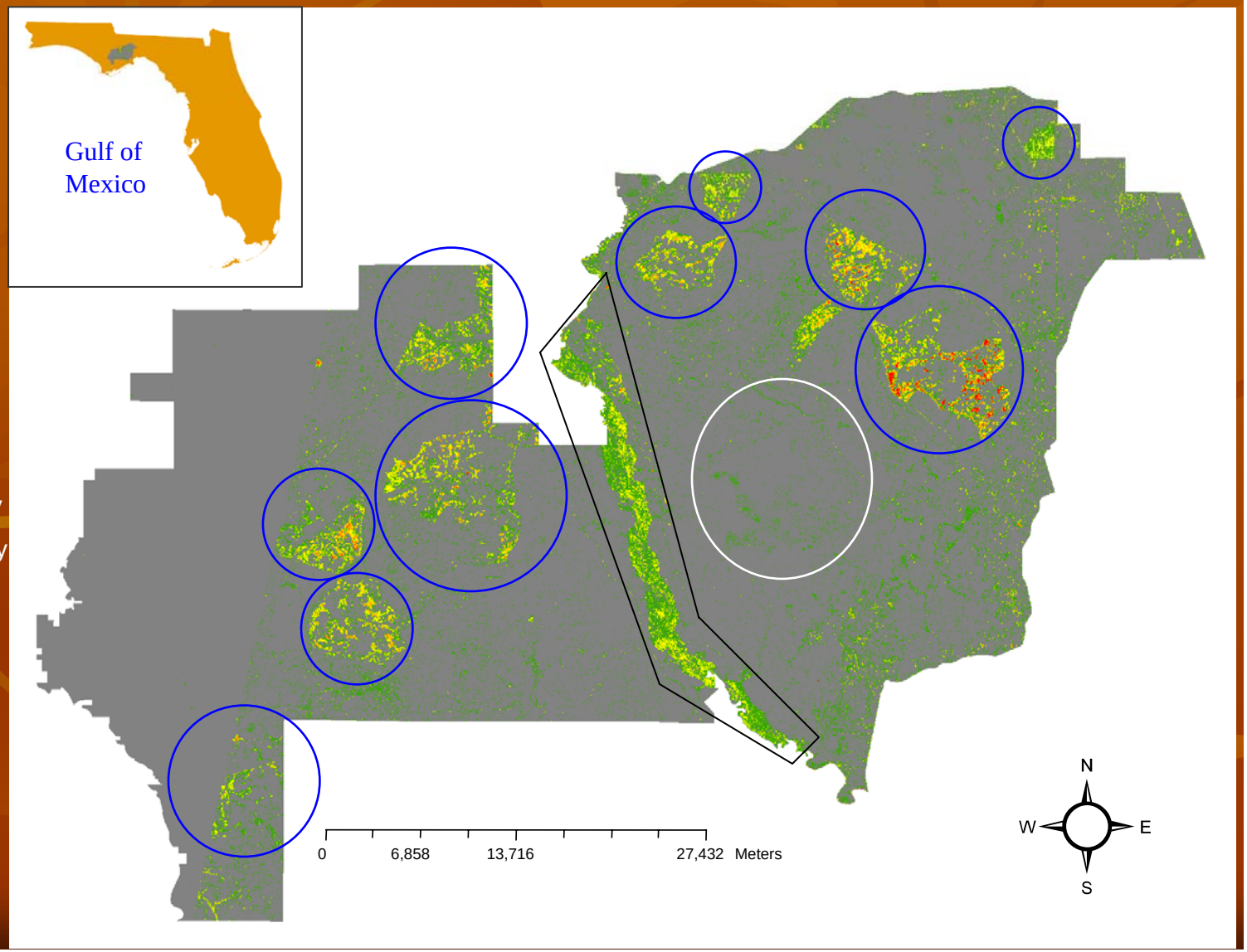
Community Notes/Comments:	CBI = Sum of Scores / N Rated:	Sum of Scores	N Rated	CBI
	Understory (A+B+C)			
	Overstory (D+E)			
	Total Plot (A+B+C+D+E)			

% Estimators: **20 m Plot:** 314 m^2 1% = 1x3 m 5% = 3x5 m 10% = 5x6 m
30 m Plot: 707 m^2 1% = 1x7 m (<2x4 m) 5% = 5x7 m 10% = 7x10 m

After Key and Benson 1999, USGS NRMSC, Glacier Field Station
Version 4.0 8 27, 2004

Strata and Factors are defined in FIREMON Landscape Assessment, Chapter2, and on accompanying BI "cheatsheet." www.fire.org/firemon/lc.htm

Background-Apalachicola National Forest (ANF)



2006 Dormant dNBR

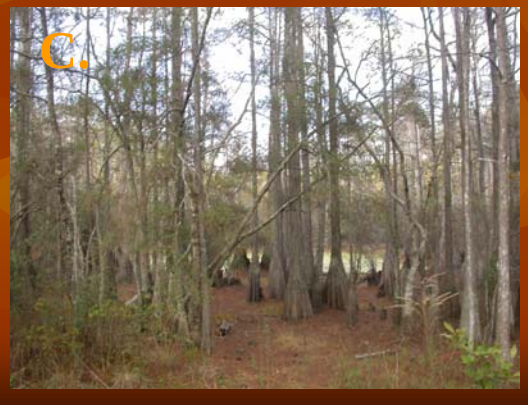
- Unburned
- Low Severity
- Low-Moderate Severity
- Moderate-High Severity
- High Severity

Background-Habitats Within ANF

A. Sandhill Pineland
- Turkey Oak
- Wiregrass
- Bracken Fern
- Long-Leaf Pine

B. Flatwood Pineland
- Palmetto
- Long-Leaf/Slash Pine

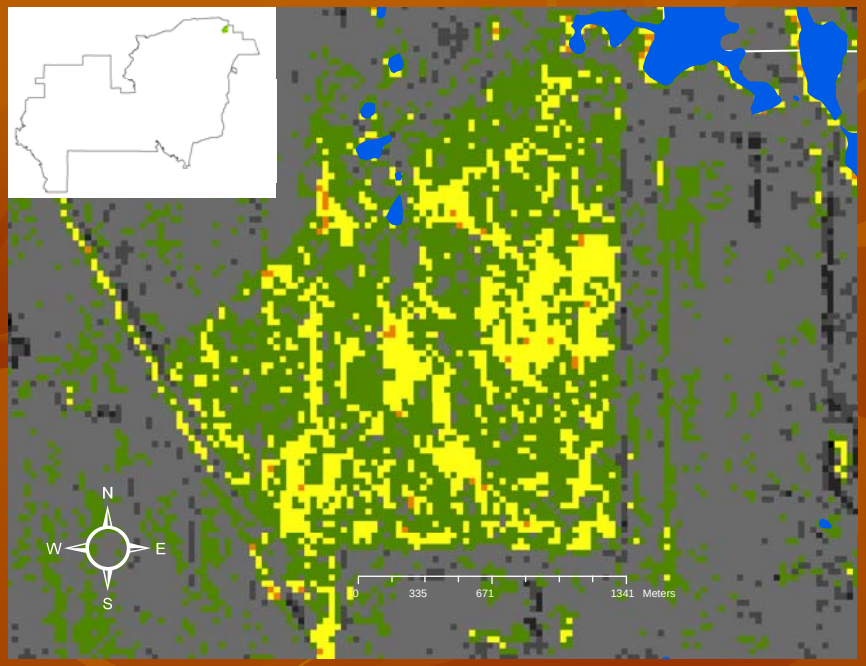
C. Depression Swamp
- Cypress
- Titi
- Pond Pine



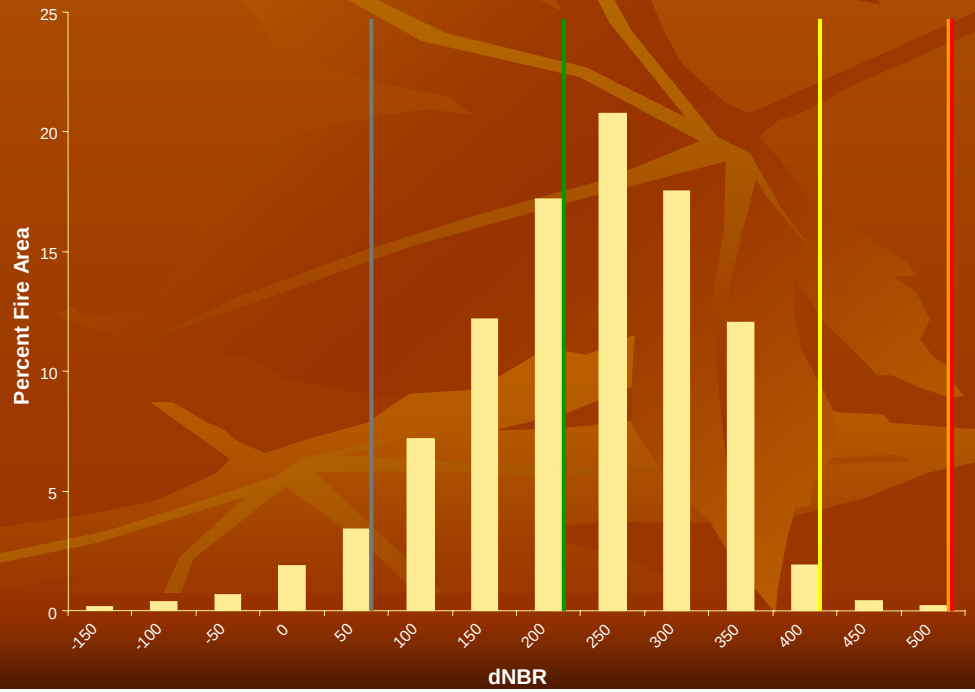
Project Questions

1. Does this system adequately describe burn severity with the South East ecosystems?
2. How long after a fire can burn perimeters be remotely sensed?
3. Are there differences in the effectiveness of using CBI and dNBR to categorize burn severity in the three community types of the ANF?
4. What are the appropriate ranges dNBR for given burn severity categories?
5. What problems arise in assessing burn severity?

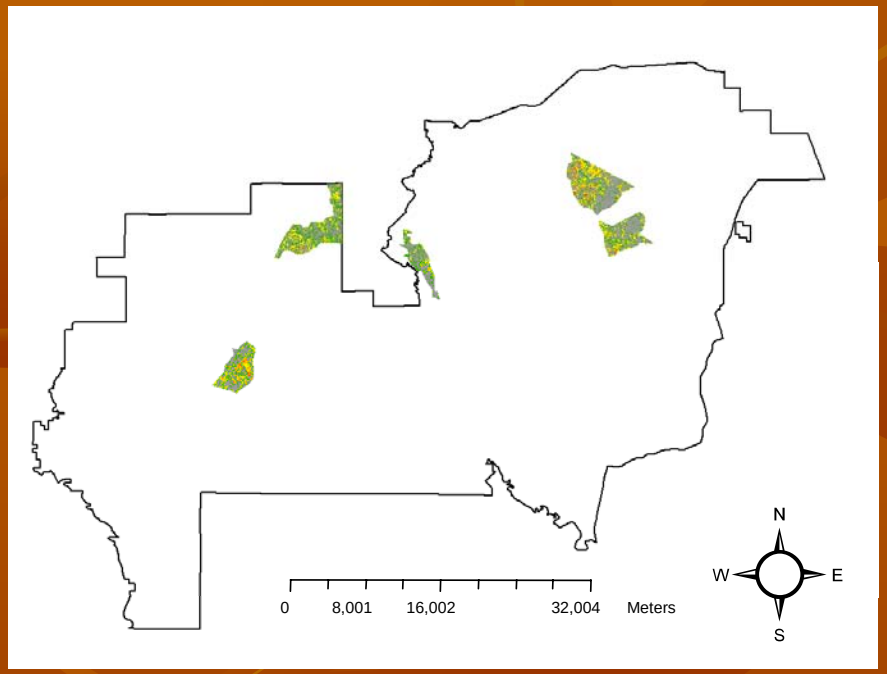
Results-Sandhill Burn Severity



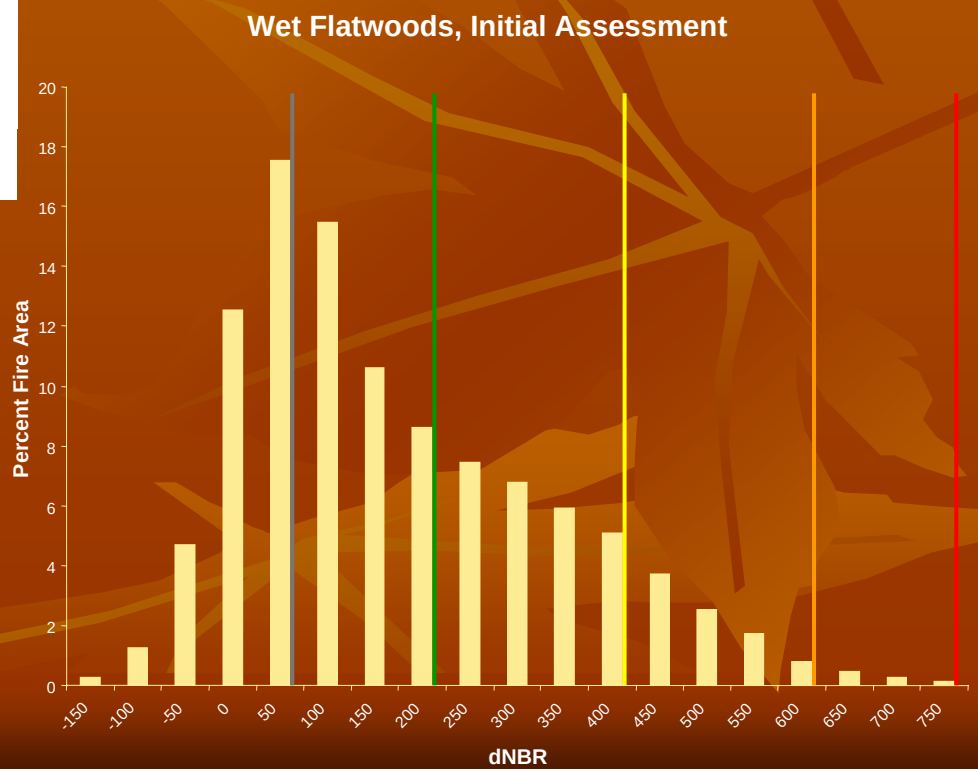
Severity	Acres
Unburned	146.7
Low	617.625
Low-Moderate	318.6
Moderate-High	9.675
High	0.225
Total	1092.825
Total Burned	946.125



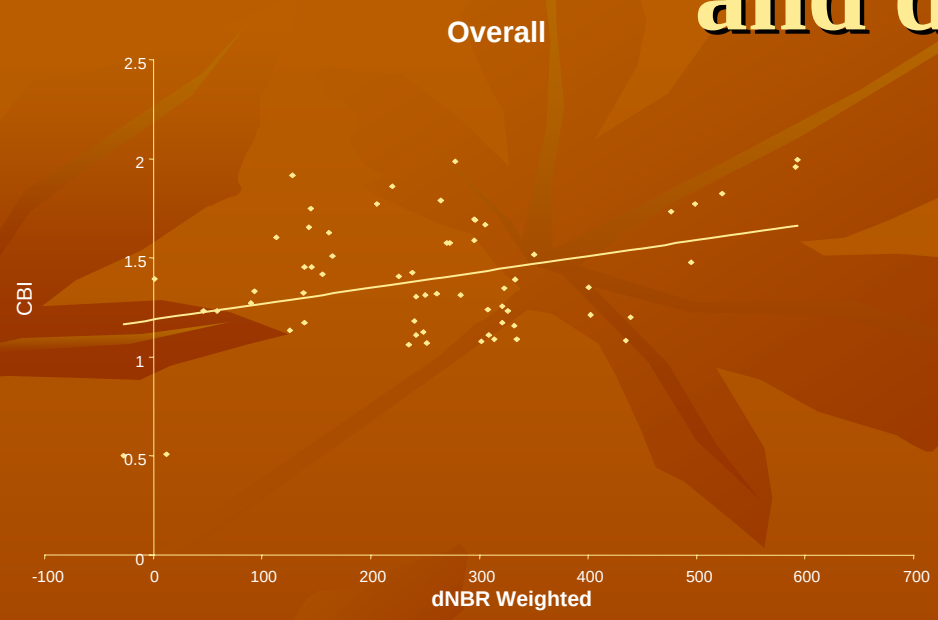
Results-Flatwood Burn Severity

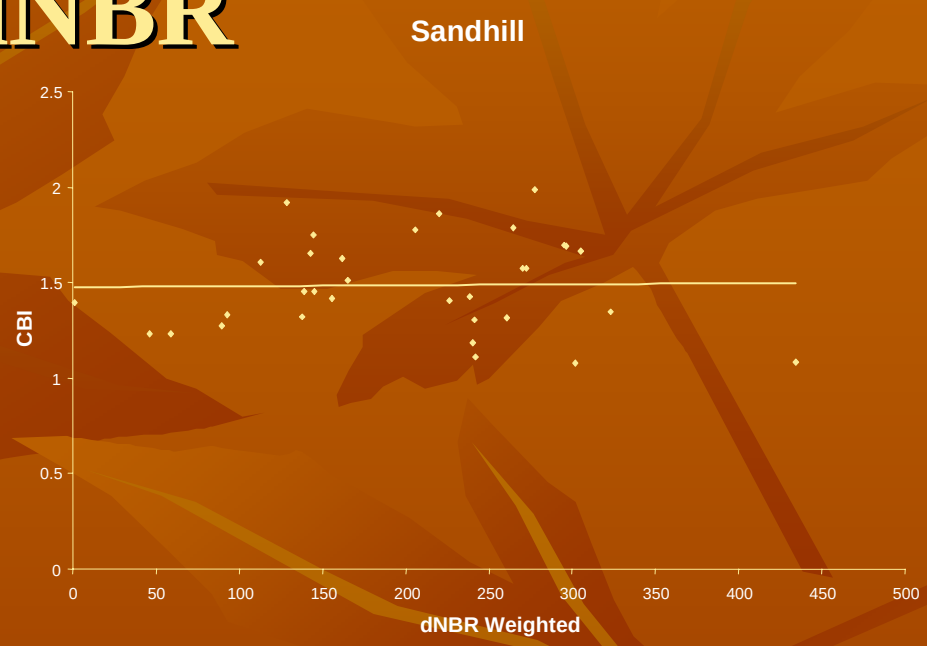


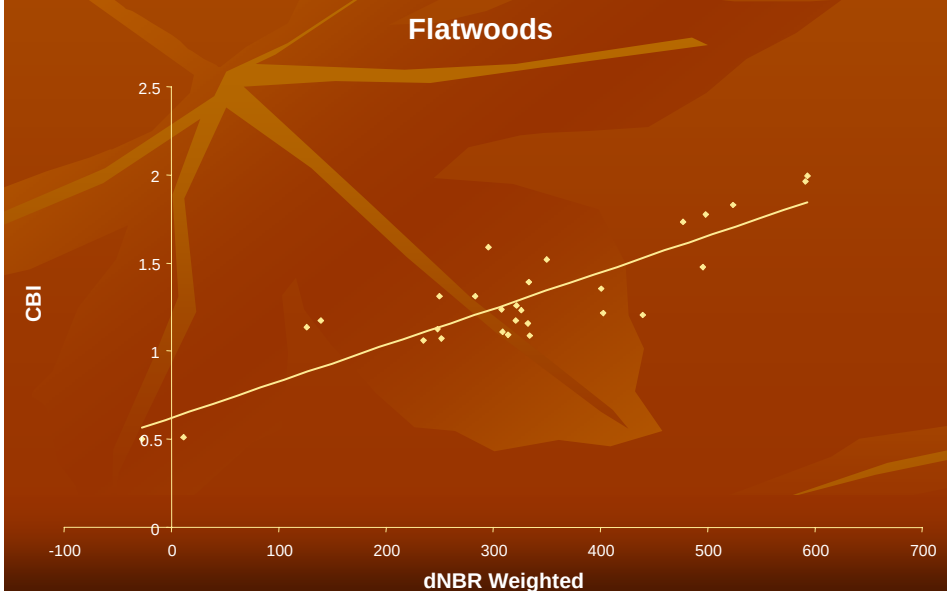
Severity	Acres
Unburned	9850.5
Low	5673.825
Low-Moderate	3442.725
Moderate-High	1312.2
High	168.975
Total	20448.23
Total Burned	10597.73



Results-Correlation Between CBI and dNBR







	R^2	P>Fr
Overall	0.125	**0.005**
Sandhills	0.000	0.913
Flatwoods	0.767	**<0.001**

Results-Correlations between CBI and dNBR Within Substrates

Overall

	R^2	P>Fr
Substrates	0.002	0.733
Vegetation < 1m	0.212	**<0.001**
1m < Vegetation < 5m	0.187	**<0.001**
Subcanopy Trees	0.040	0.174
Upper Canopy Trees	0.032	0.079

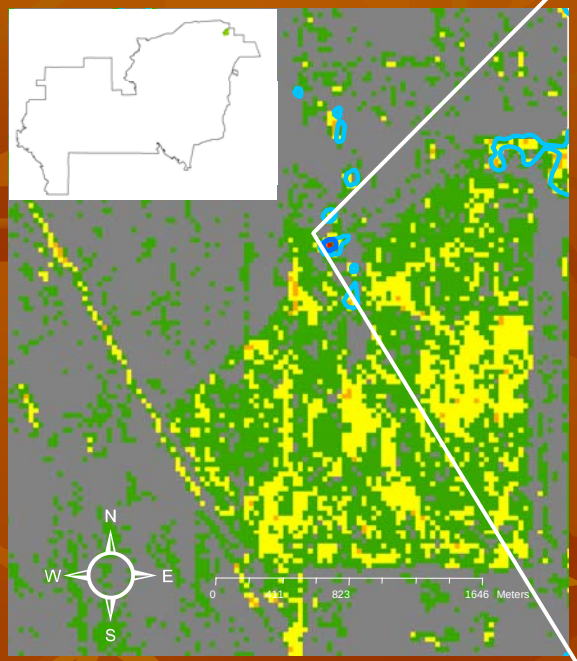
Sandhills

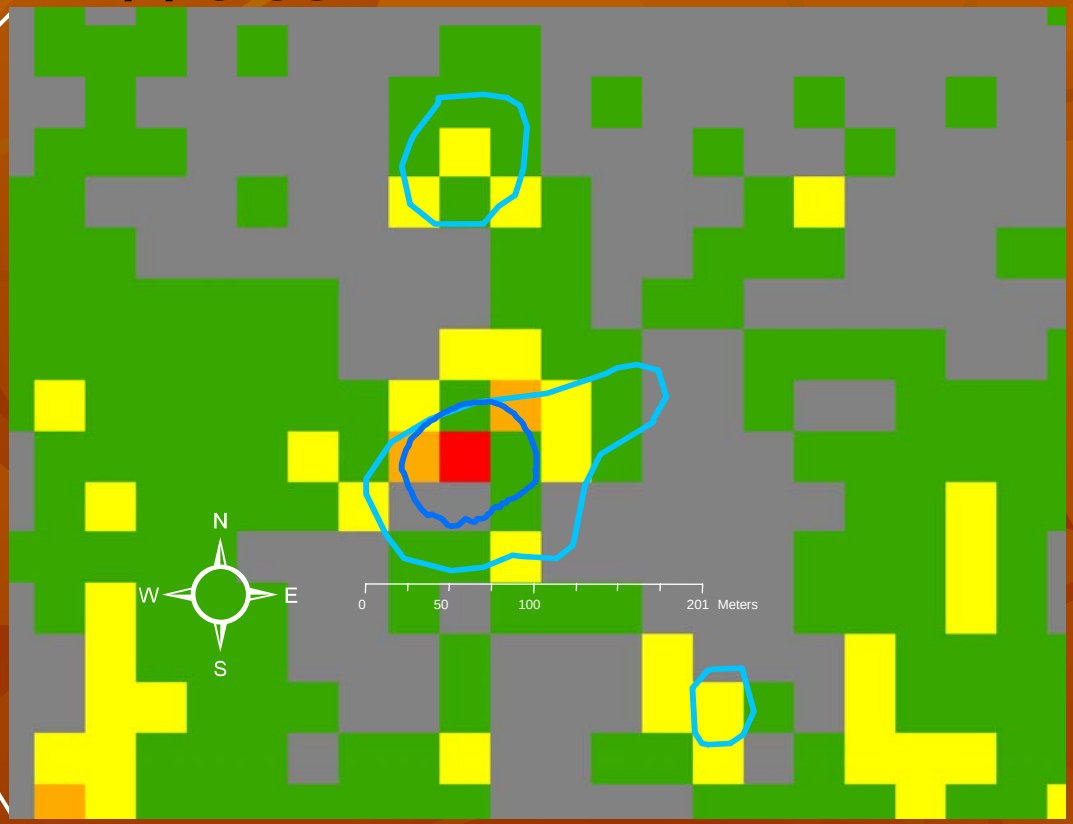
	R^2	P>Fr
Substrates	0.033	0.312
Vegetation < 1m	0.011	0.556
1m < Vegetation < 5m	0.038	0.278
Subcanopy Trees	0.005	0.739
Upper Canopy Trees	0.032	0.328

Flatwoods

	R^2	P>Fr
Substrates	0.304	**0.002**
Vegetation < 1m	0.372	**<.001**
1m < Vegetation < 5m	0.499	**<.001**
Subcanopy Trees	0.509	**<.001**
Upper Canopy Trees	0.516	**<.001**

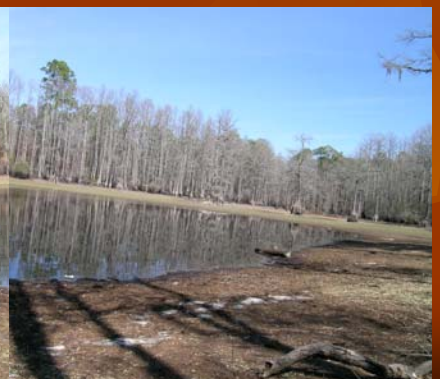
Burn Severity Change Detection-Water





2006 Dormant dNBR

- Unburned
- Low Severity
- Low-Moderate Severity
- Moderate-High Severity
- High Severity
- **Lakes and Ponds**
- **Actual Pond Boundary**

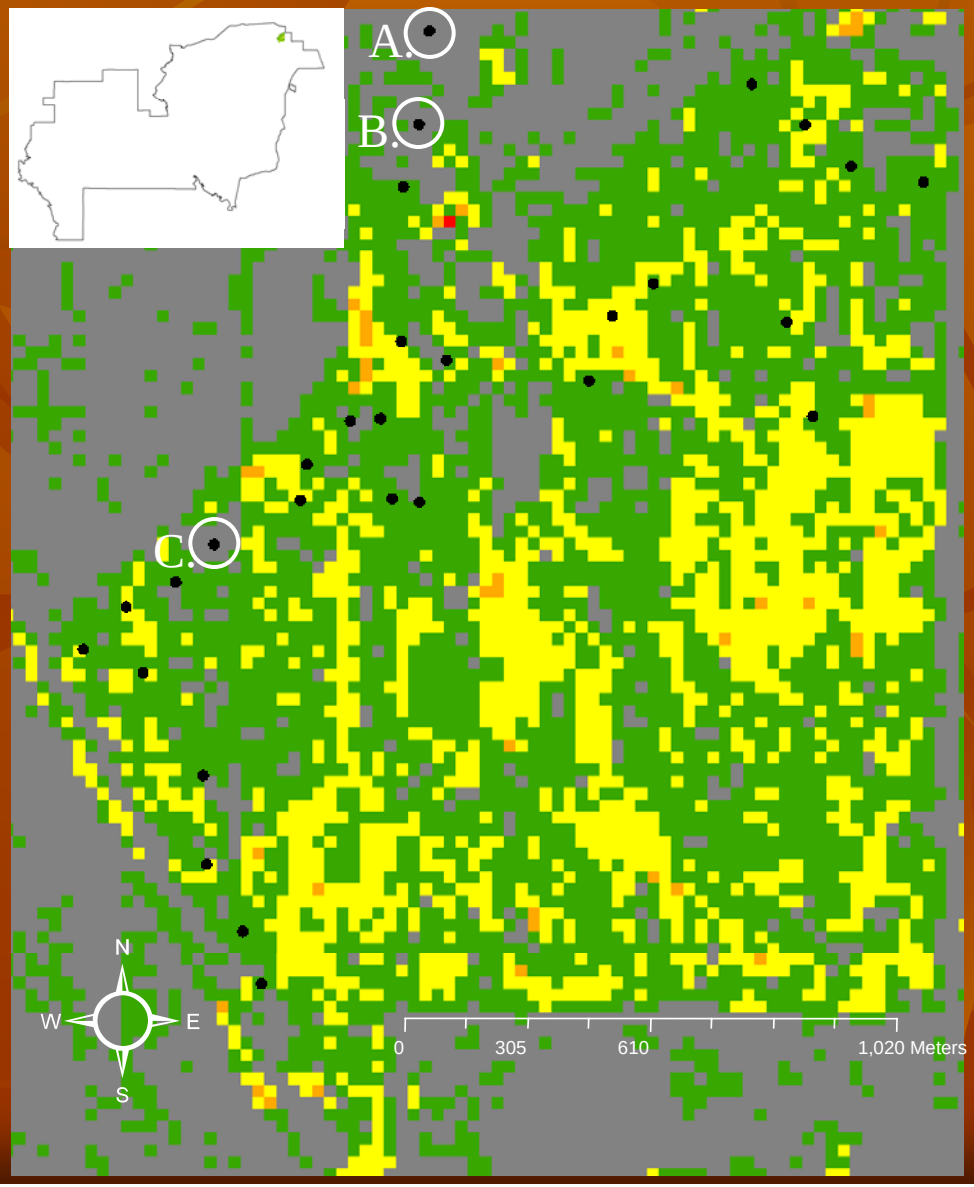


Problematic detection of Low Burn Severity

2006 Dormant dNBR

- Unburned
- Low Severity
- Low-Moderate Severity
- Moderate-High Severity
- High Severity
- **30m Plots**

Plot	CBI	dNBR
A.	1.23	1
B.	1.23	59.2
C.	1.27	89.6



Conclusions

- Successful in high fire frequency communities
  - Extrapolation to other communities within the East
- Useful system for burn monitoring
  - Sense perimeter months following the burn
- Season of remote-sensing (dNBR) may be limited
- Useful in assessing the “success” of burn management plans

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