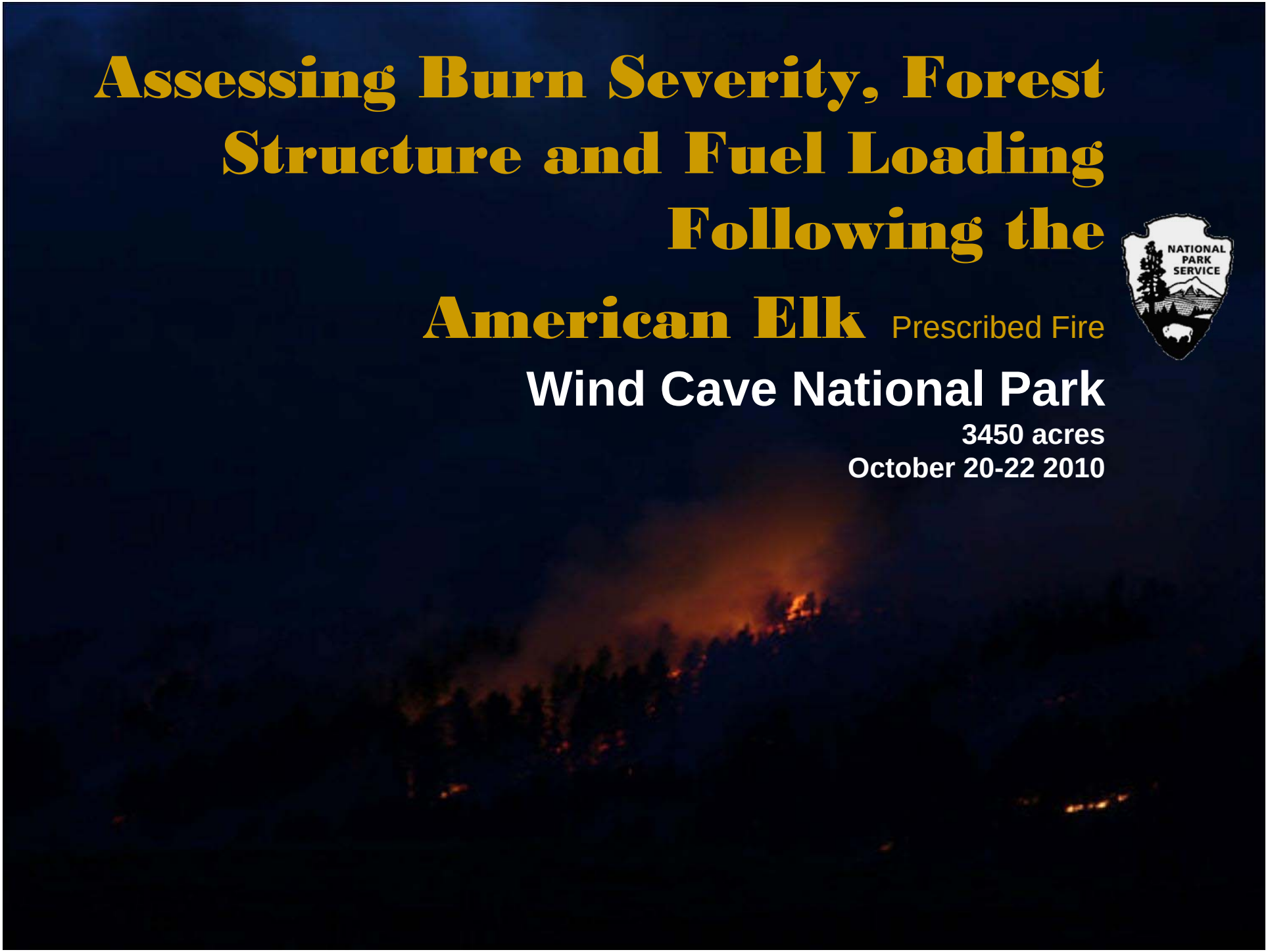
Assessing Burn Severity, Forest Structure and Fuel Loading Following the American Elk Prescribed Fire

Wind Cave National Park

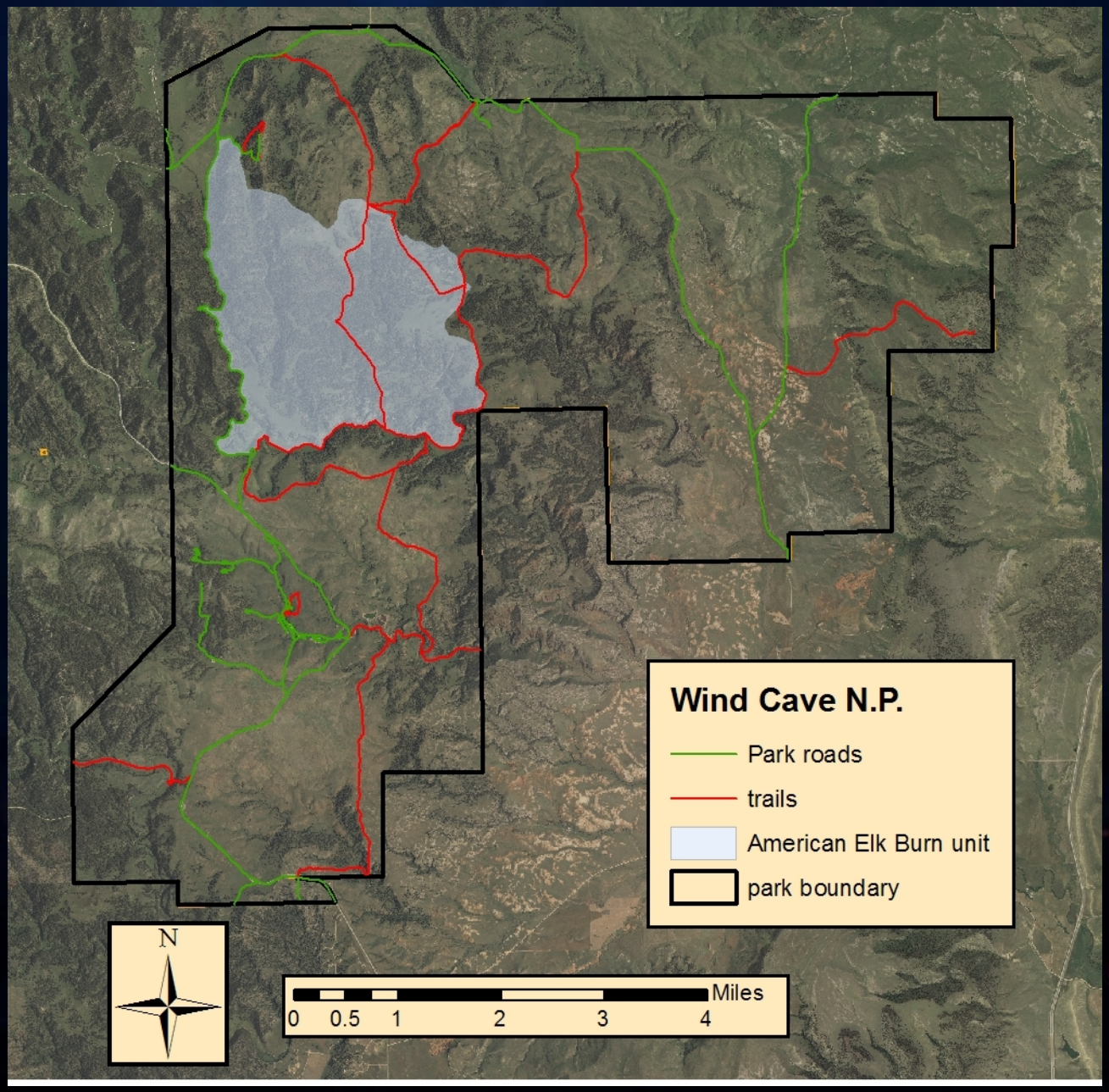
3450 acres

October 20-22 2010



Contents

- Objectives of American Elk RX fire
- Fire Effects Results
    - Composite Burn Index (CBI)
    - Forest Structure
    - Fuel Loading


Wind Cave N.P.
Park roads
trails
American Elk Burn unit
park boundary
N
Miles
0
0.5
1
2
3
4

Resource & Fuels Objectives

- Reduce 100 & 1000 hour fuels by at least 40%
- 70-95% mortality in ponderosa pine seedlings
- 50-70% mortality in ponderosa pine poles (1 - 6” dbh)
- 20-50% mortality in ponderosa pine overstory (> 6” dbh)
- Improve prairie dog habitat by increasing native grass and forb cover
- Decrease encroachment of ponderosa pine regeneration at the forest-prairie ecotone.

Composite Burn Index (CBI) – Forensic Ecology

Carl Key

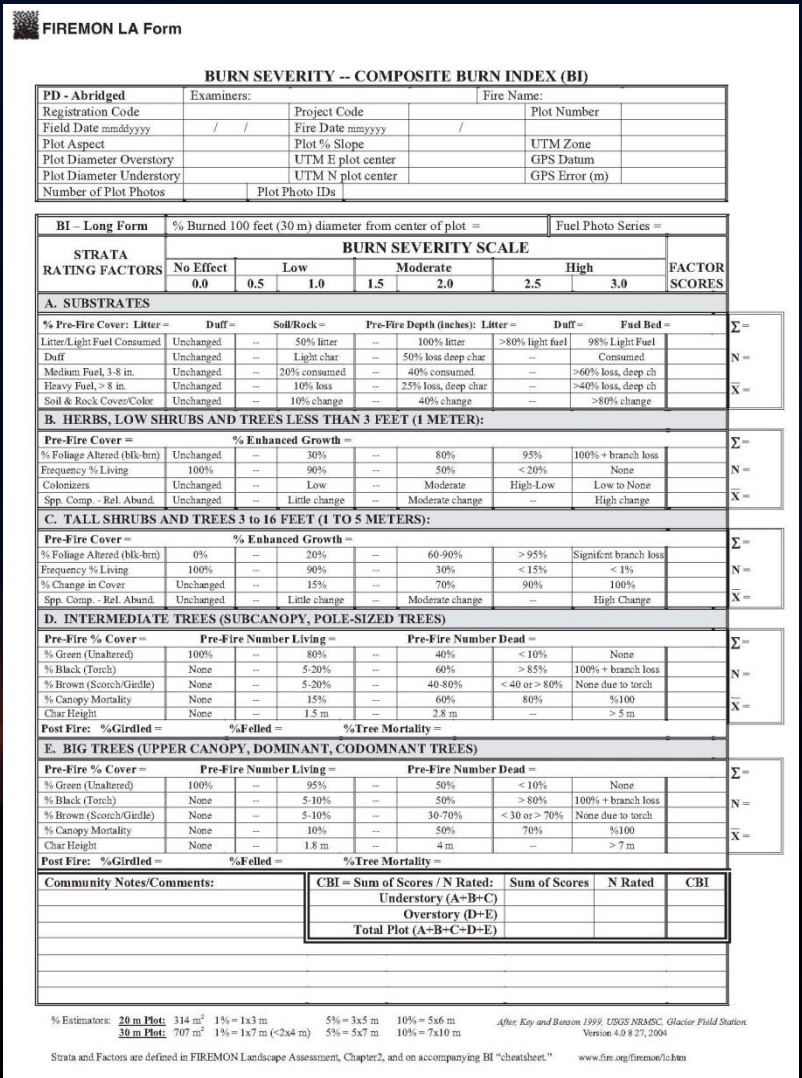
- Developed by Key and Benson in 1996
- Field-based method to assess burn severity
- Observer examines the degree of impact to the substrates and vegetation strata

CBI Objectives

- Validate the association between ground severity (CBI) and the remote sensing index (dNBR)
- Calibrate dNBR for levels of burn severity

CBI-Components

- 30 m diameter CBI plot
- Burn Index: 0-3
  - 0-Unburned
  - 3-Severe Burn
- Five Strata
  - 4-5 Ratings Factors
  - Averaged by strata and whole plot
- A representative measure of burn severity for the entire plot



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	X̄ =
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	X̄ =
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	X̄ =
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	
Char Height	None	--	1.5 m	--	2.8 m	--	> 5 m	X̄ =
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	X̄ =
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

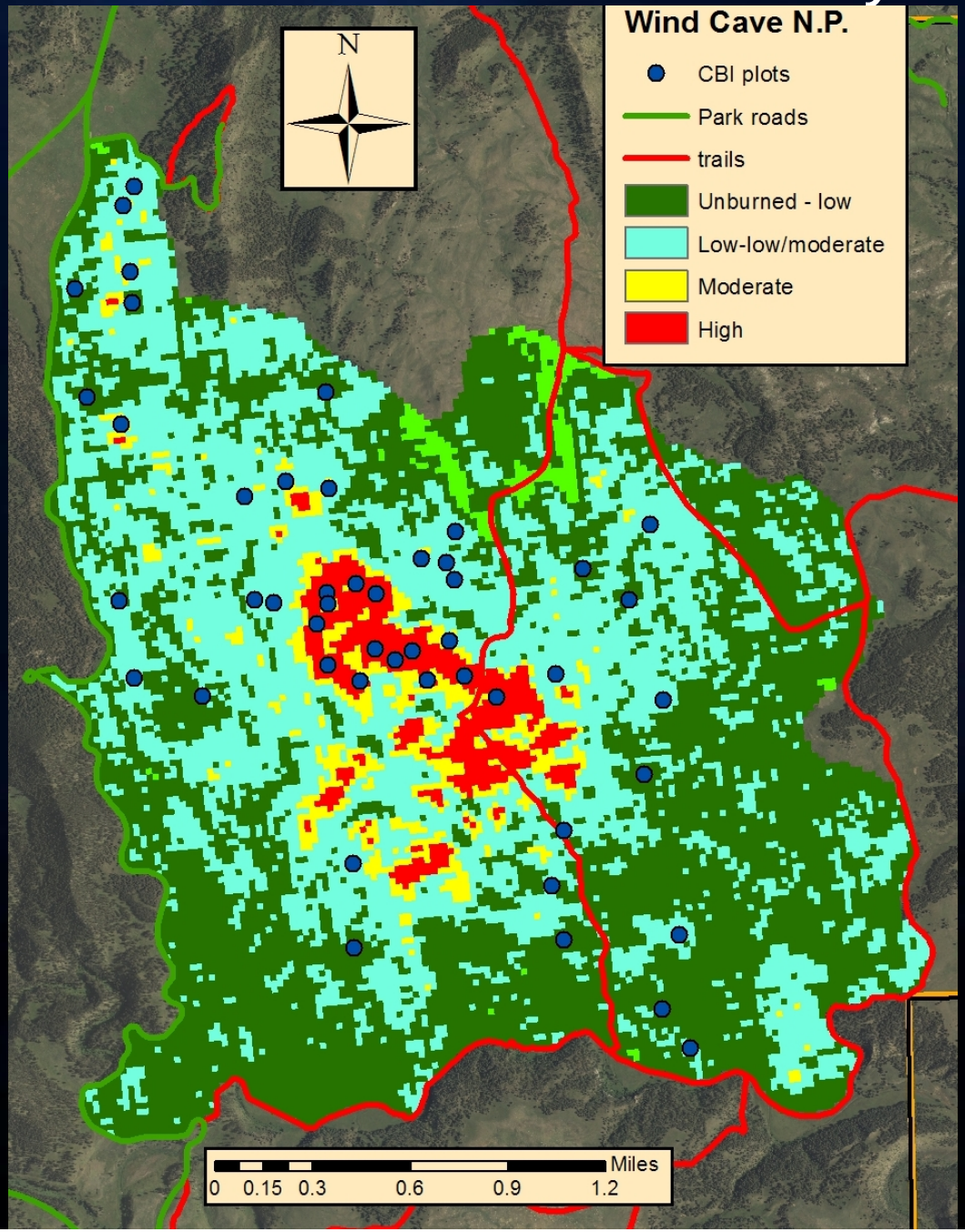
Strata and Factors are defined in FIREMON Landscape Assessment, Chapter2, and on accompanying BI "cheatsheet." www.fire.org/firemon/lc.htm

American Elk Extended Burn Severity Assessment

30 m resolution Landsat Imagery

Prefire - postfire datasets

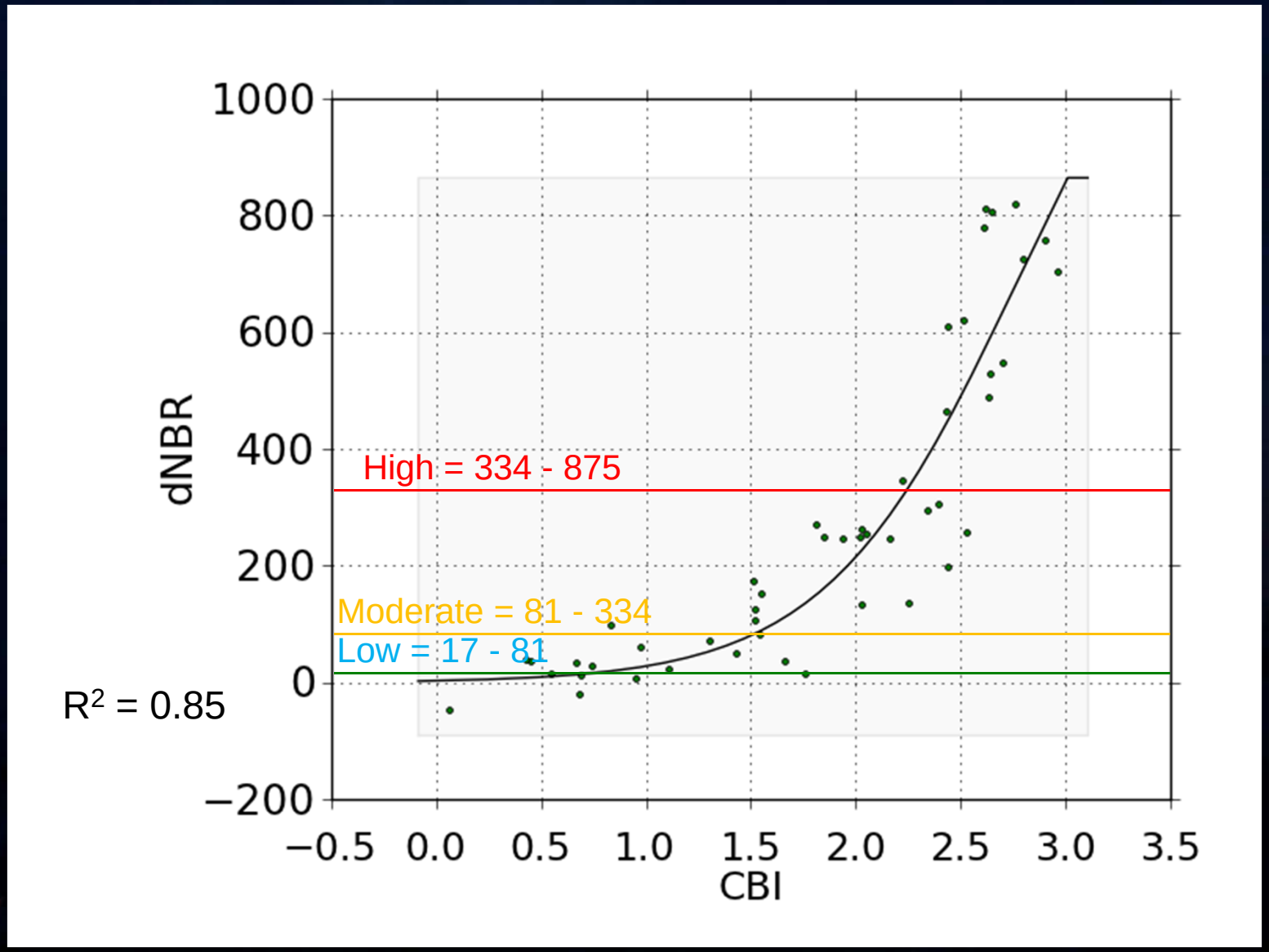
Averages individual fire effects results into one dNBR value



12 CBI plots read within each burn severity class

48 CBI plots within burn unit

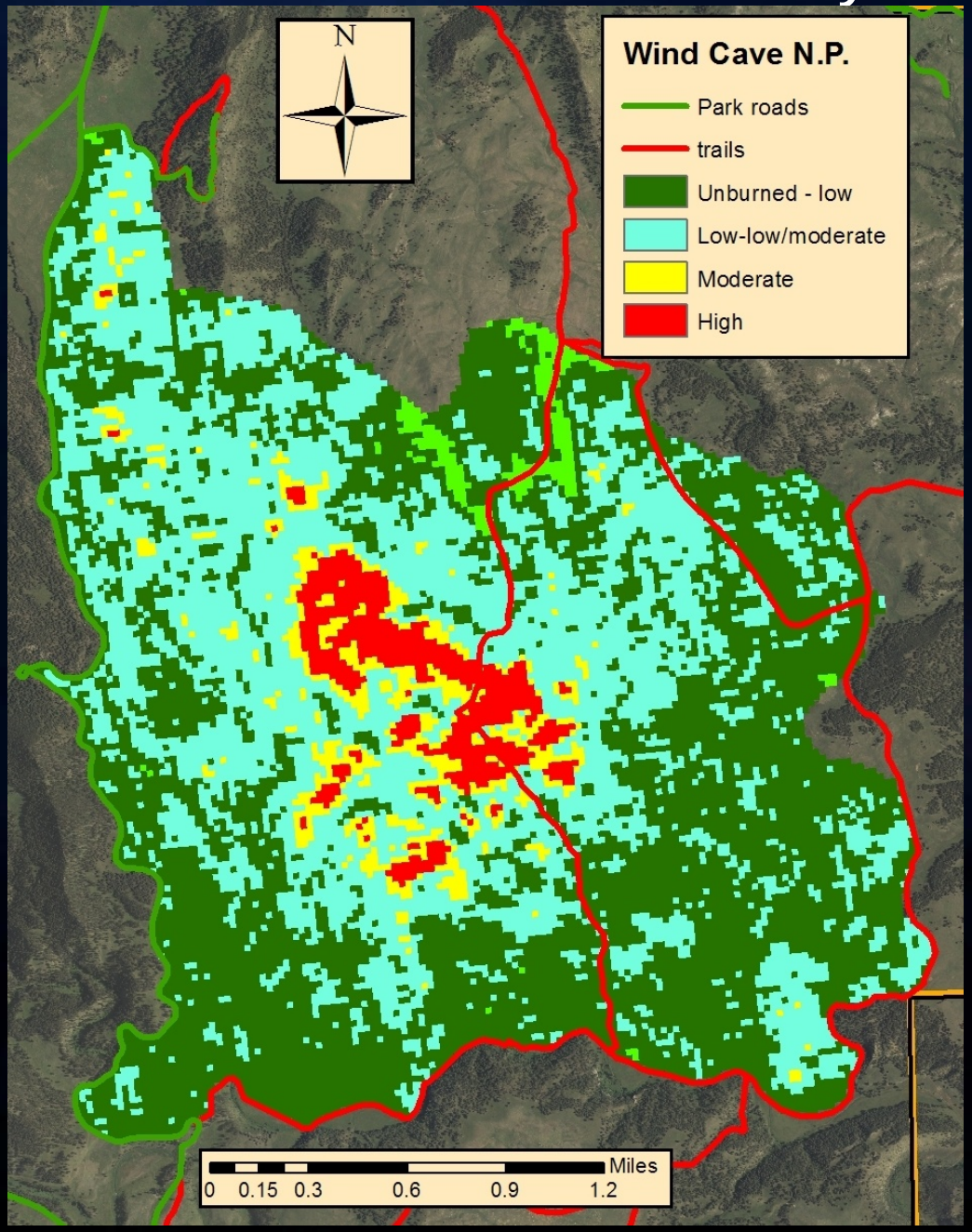
Curve Fitting Tool Used To Find Regression Model



$R^2 = 0.85$

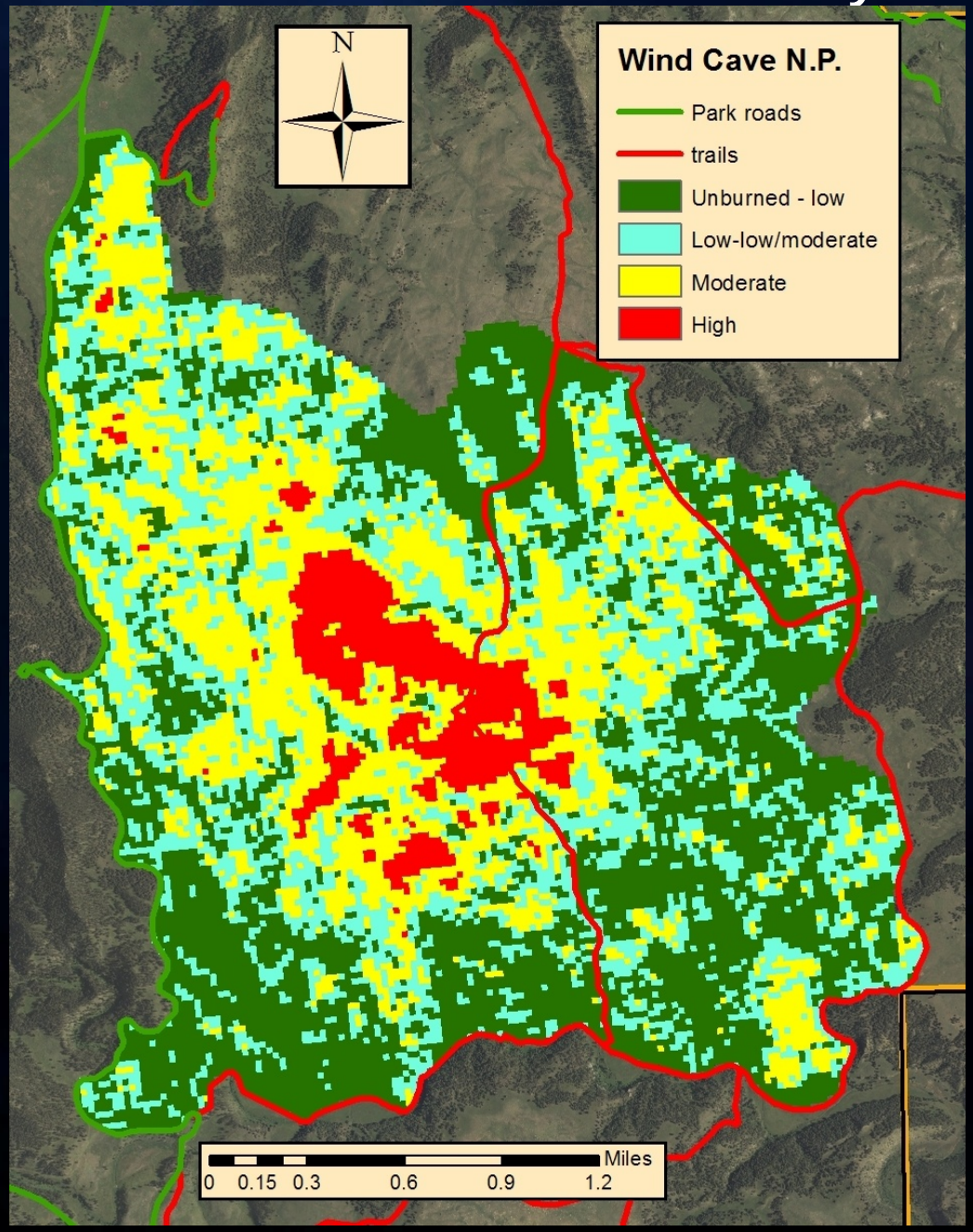
y = 1392 / (1.0 + exp(-(x-2.78)/0.459))

American Elk Extended Burn Severity Assessment



48%
41%
5%
4%

American Elk Calibrated Burn Severity Assessment



39%
29%
26%
6%

Unburned to Low Severity

Low to Low – Moderate Severity

CBI = 0.69

Moderate Severity

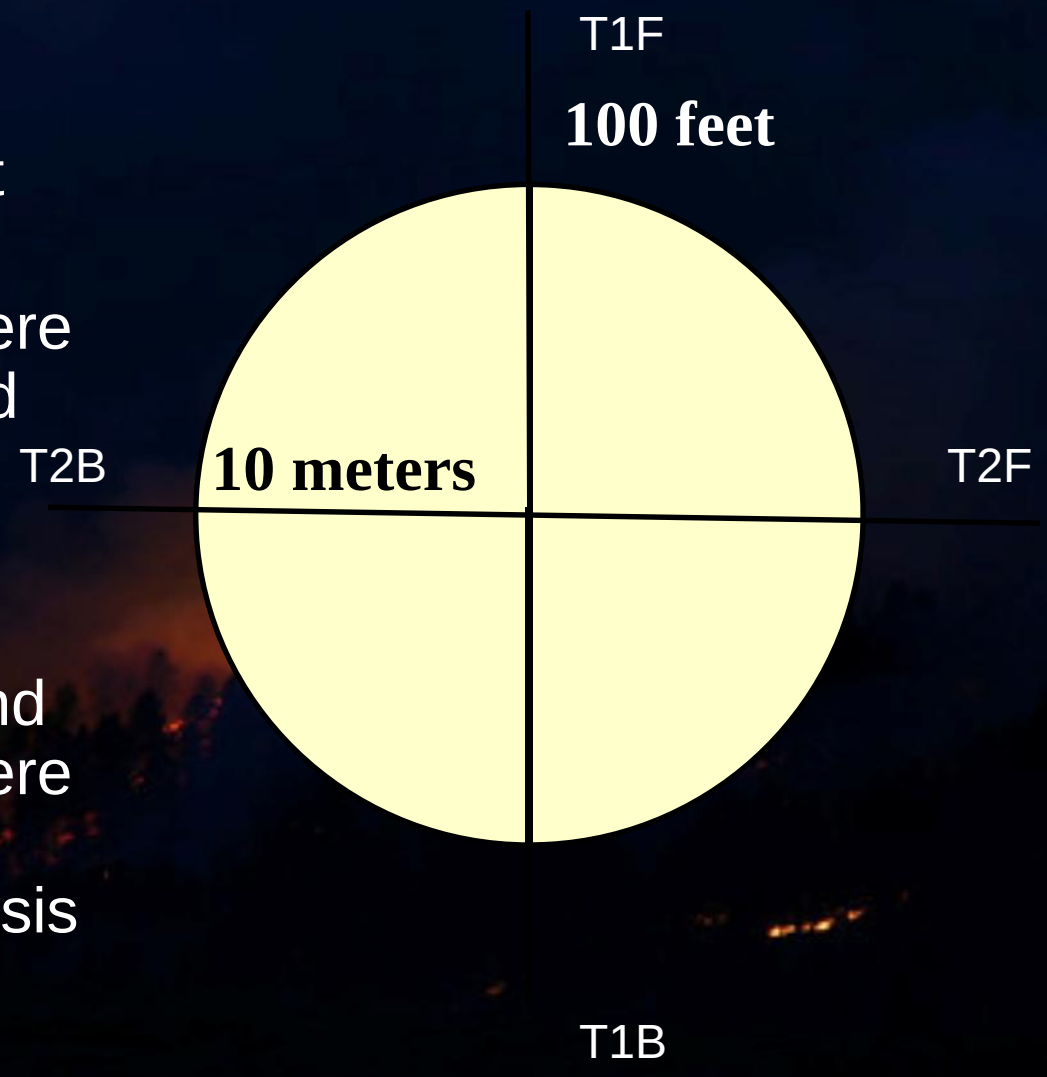
High Severity

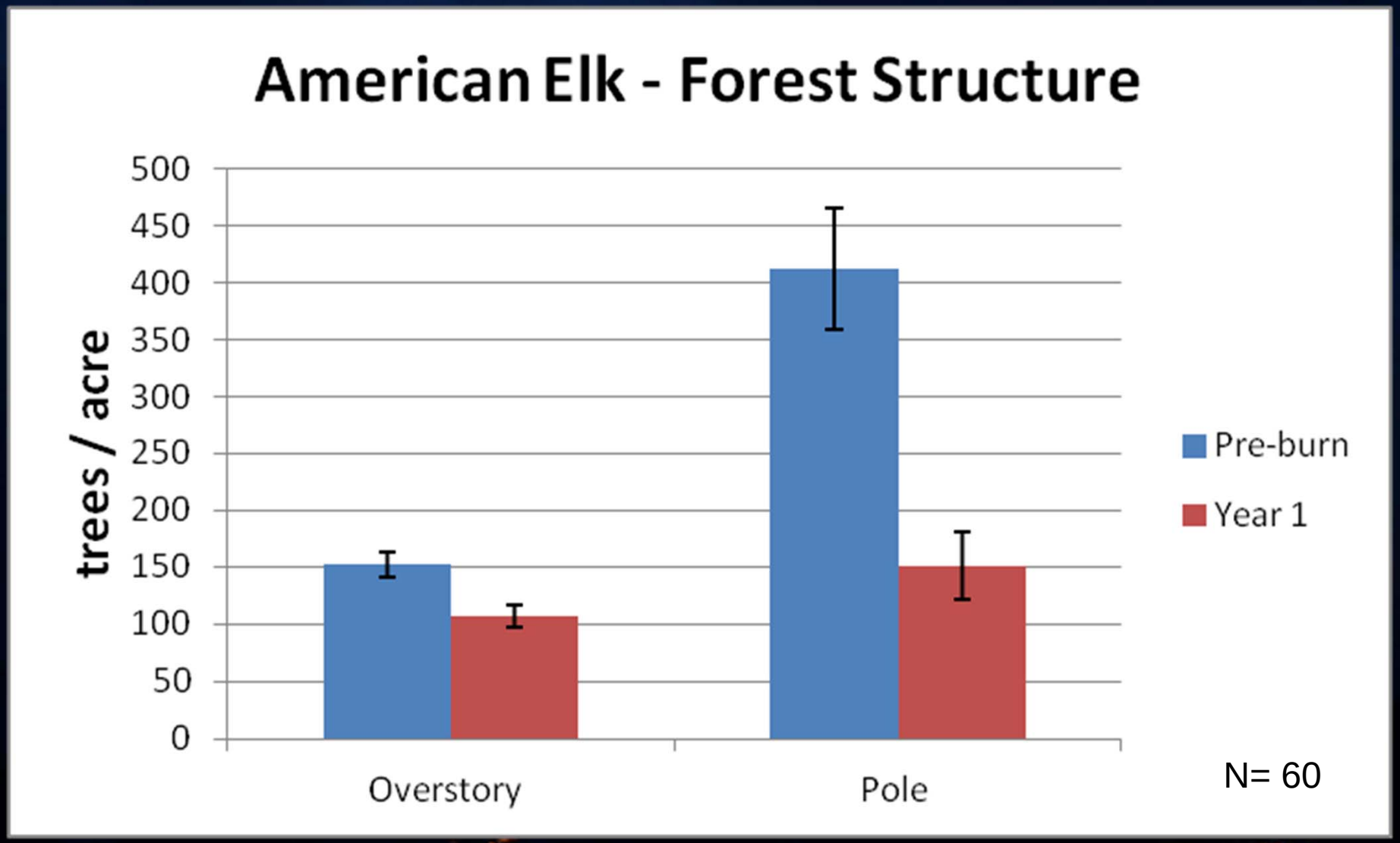
CBI = 2.65

Forest Structure and Fuel Loading Results

Methods

- Circular plot
- 10m Radius
- 2 fuels transects (100 ft long)
- Trees and seedlings were measured and recorded
- 75 plots monitored by NGP fire effects and invasive species crew
- At least 10 overstory and pole trees combined were needed to represent a forest plot for this analysis





Objectives

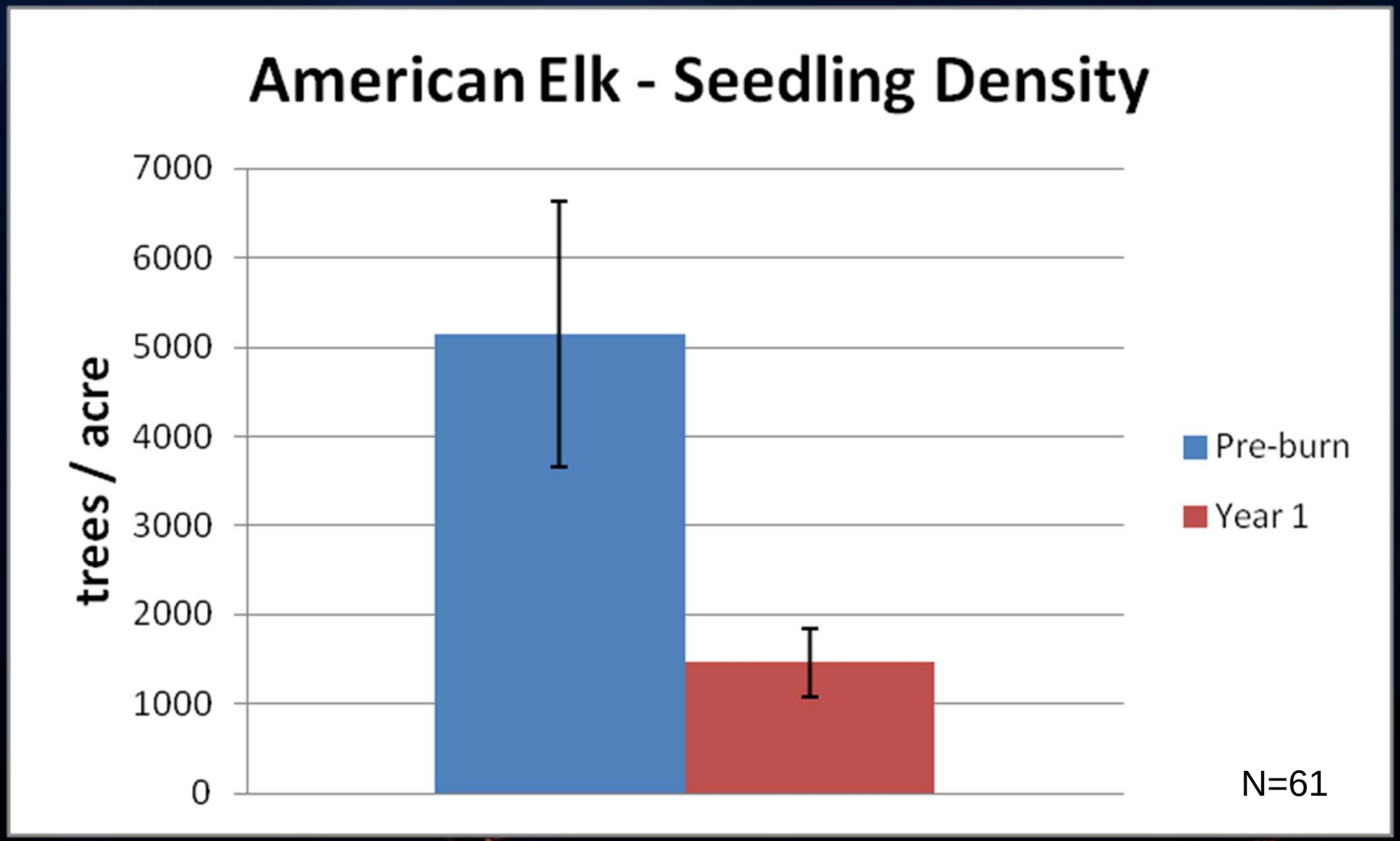
Overstory 20 - 50% decrease

Pole 50 - 70% decrease

Results (80% Confidence Level)

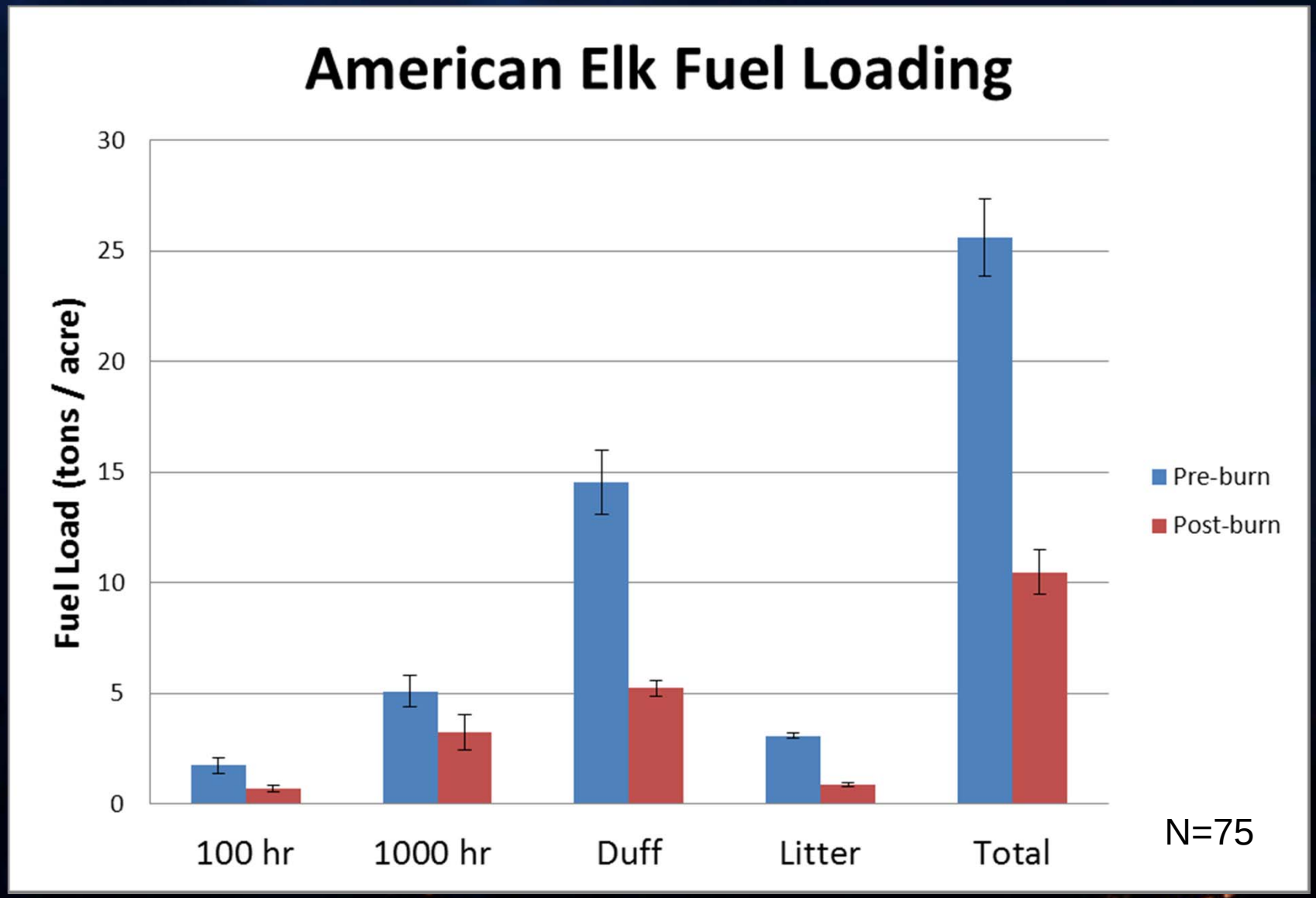
29% decrease; LB = 23%, UB = 37%

64% decrease; LB = 55%, UB = 72%



Objectives
70 - 95 % decrease

Results (80% Confidence Level)
72% decrease; LB = 59%; UB = 81%



Objectives

100 hr 40% decrease

1000 hr 40% decrease

Results (80% Confidence Level)

61% decrease; LB = 51%, UB = 70%

36% decrease; LB = 11%, UB = 50%

Conclusions

- Most fuels and resource management objectives met.
- Mtn Pine beetle risk mitigated in forest community due to decreases in stand density and basal area
- Large burn and helicopter ignition created a range of fire severities
- Extremely cost-effective - $25 per acre