

Increasing Pace and Scale of Fuels Reduction and Forest Restoration in the Sierra Nevada

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Outline:
1. Historical vs. Contemporary fire patterns
2. Contemporary treatment rates
3. Scaling Up: What are the opportunities with mechanical treatment?
4. Scaling up using fire: comparing the ecological effects of fire suppression and managed wildfire
5. Land management implications

Historical vs. current stand conditions: re-measurement of 1911 timber surveys

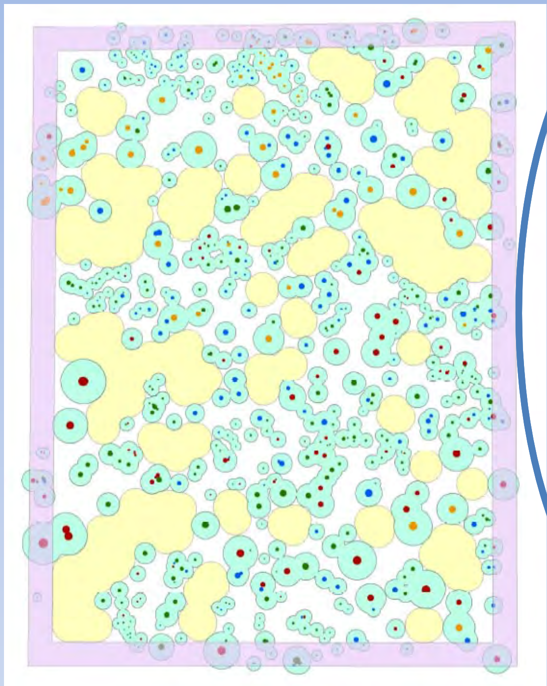
Year	Total basal area ($ft^2\ ac^{-1}$)	Number of trees > 6” (ac^{-1})	Shrubs (% cover)
1911	70	19	65 (ARPA, CEIN, QUCH, CHFO)
2013	248	225	5

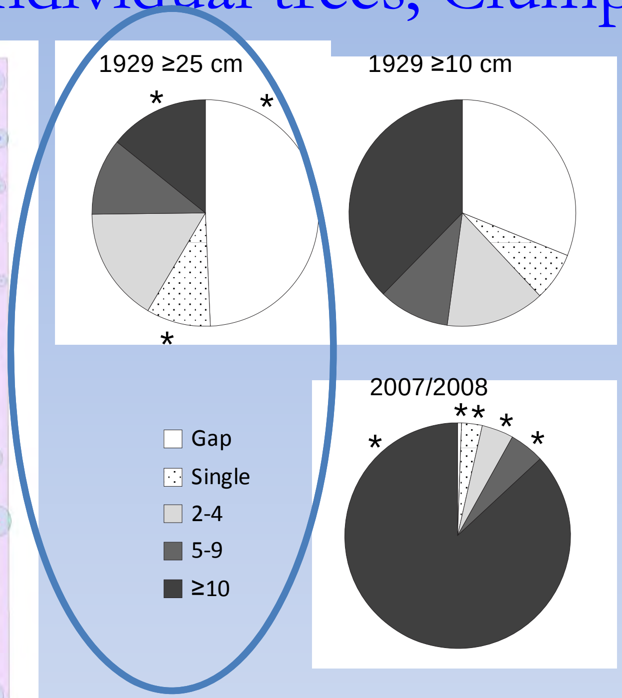
Fire-Suppressed Forests: Homogeneity adversely affects ecosystem services

1) High stem density: Many ecosystem processes (nutrient cycling, decomposition, etc.) stall.
2) High canopy cover: dramatically reduces variability in microclimate and wildlife habitat, reduces surface snowpack depth and possibly water production.
3) Fuels accumulations: Heavy litter and coarse woody debris homogenizes the forest floor substrate reducing understory plant diversity and cover.

Significant reduction in habitat, species diversity and ecosystem function

Within Stand Heterogeneity:
ICO Pattern (Individual trees, Clumps of trees, Openings)





Tree Groupings:

Trees/clump	#/ac	% of all trees
Single	6	13
2-4 tree	5	30
5-9 tree	2	24
≥10 tree	1.4	33

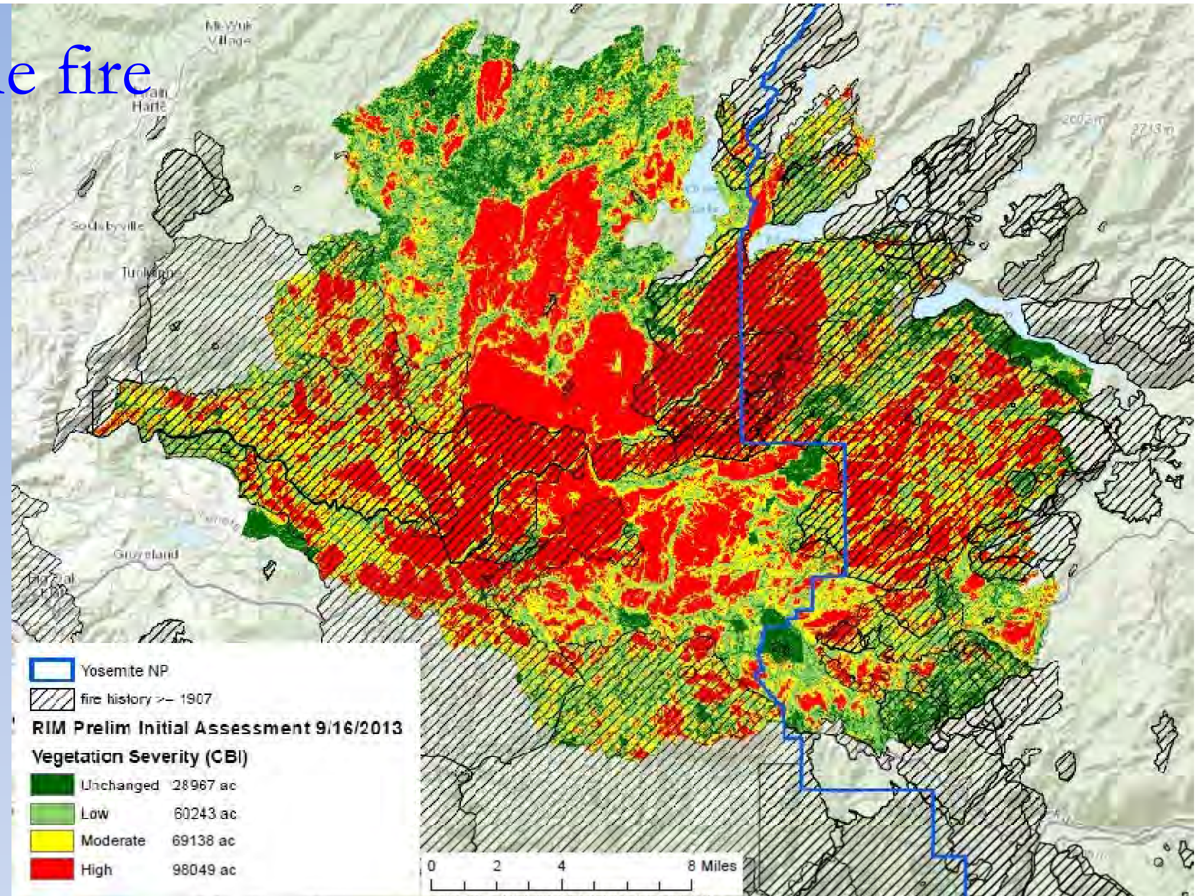
Lydersen et al. 2013. Forest Ecology and Management 304: 370-382.

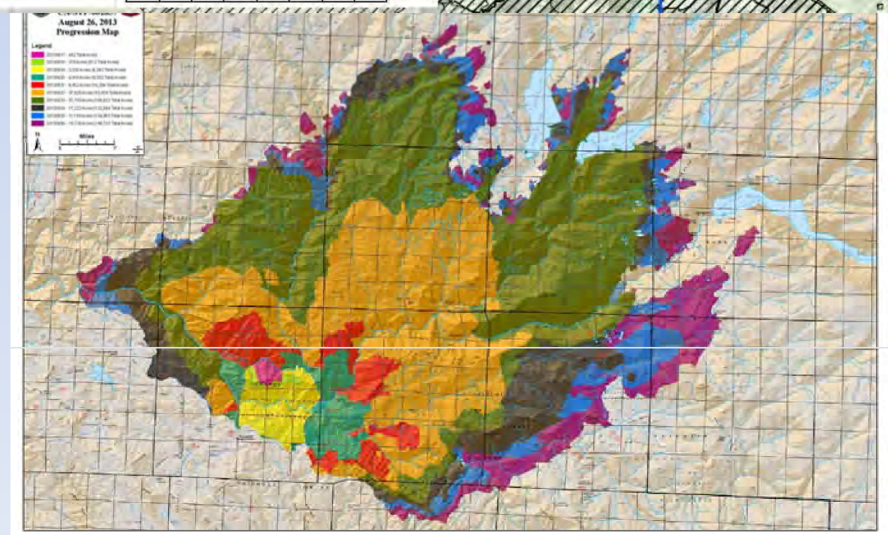
Canopy Cover = 37%

Fuel loading and extreme fire weather

Rim fire had 10 high-severity patches over 1000 acres:

63,296
17,510
9,654
2,228
1,276
1,262
1,227
1,142
1,073
1,025





Orange and Green are Aug. 22 and 23 with 98% weather conditions

Ecological Impacts after High-Severity Fire

Without live trees to provide seed, many patches become brush fields for decades

- The biggest problem is the lack of heterogeneity
- Post burn is homogenous shrub field
- When forest eventually grows in, it also lacks variability

Forest Homogeneity and Problem Wildfire

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2) Contemporary Treatments Rates: How Much of the Sierra Nevada May Have Burned/Yr?

Forest Type[2]	Area (ac)	HFRI[1] Mean (yr)	HFRI[1] High (yr)	Ownership	Forest Service Area (ac)	Forest Service Mean HFRI (ac/yr)	Forest Service High HFRI (ac/yr)	Ownership	National Park Service Area (ac)	National Park Service Mean HFRI (ac/yr)	National Park Service High HFRI (ac/yr)
Mix. conifer	1,466,539	12	25	0.62	909,254	75,771	36,370	0.05	73,327	6,111	2,933
West-side ponderosa	1,087,734	5	12	0.53	576,499	115,300	48,042	0.08	87,019	17,404	7,252
Lwr cismon. mix. con-oak	1,046,221	10	30	0.46	481,262	48,126	16,042	0.04	41,849	4,185	1,395
Jeff. pine-fir	730,428	8	25	0.8	584,342	73,043	23,374	0.09	65,738	8,217	2,630
Jeffrey pine	484,563	6	20	0.75	363,422	60,570	18,171	0.13	62,993	10,499	3,150
East-side ponderosa	398,819	5	15	0.76	303,103	60,621	20,207	0	0	0	0
Black oak	268,598	10	25	0.6	161,159	16,116	6,446	0.03	8,058	806	322
White fir	133,434	25	45	0.7	93,404	3,736	2,076	0.06	8,006	320	178
Aspen	24,463	30	90	0.89	21,772	726	242	0.02	489	16	5
Sequoia-mix con.	17,544	15	20	0.31	5,439	363	272	0.52	9,123	608	456
Active Man. Total	**5,658,343**				**3,499,655**	**454,371**	**171,241**		**356,602**	**48,166**	**18,321**
Red fir	838,905	45	90	0.61	511,732	11,372	5,686	0.3	251,671	5,593	2,796
Lodge. pine	532,748	30	110	0.6	319,649	10,655	2,906	0.42	223,754	7,458	2,034
Red fir-west. white p.	393,877	50	135	0.75	295,408	5,908	2,188	0.18	70,898	1,418	525
Whitebark p. mtn hemlock	93,404	85	180	0.62	57,910	681	322	0.37	34,559	407	192
Whitebark & lodge. pine	92,168	40	165	0.86	79,265	1,982	480	0.12	11,060	277	67
Up cismon. mix. con-oak	64,493	15	45	0.48	30,957	2,064	688	0.14	9,029	602	201
Foxtail pine	58,810	50	150	0.21	12,350	247	82	0.77	45,284	906	302
Whitebark p.	54,115	65	200	0.68	36,798	566	184	0.31	16,776	258	84
Passive Man. Total	**2,128,519**				**1,344,068**	**33,475**	**12,536**		**663,031**	**16,918**	**6,201**
All Man. Total	**7,786,862**				**4,843,723**	**487,846**	**183,778**		**1,019,633**	**65,084**	**24,522**

	Mechanical		Rx burn		Wildfire		
	Area (ac)	Cost ($/ac)	Area (ac)	Cost ($/ac)	Area (ac)	Cost ($/ac)	Tot. area (ac)
Forest Service[1]	28,598 (2004-2011)	$554 ($247-1056)	8,256 (2004-2011)	$142 ($71-607)	51,069 (1986-2010)	$789 ($709-27,409[2])	87,923
National Park	132 (2004-2011)	N/A	2803 (1970-2011)	$202[3] ($150-449)	8344 (1970-2011)	$486[3] ($405-2,023)	11,279

Current Fuels Reduction vs. Historic Levels:

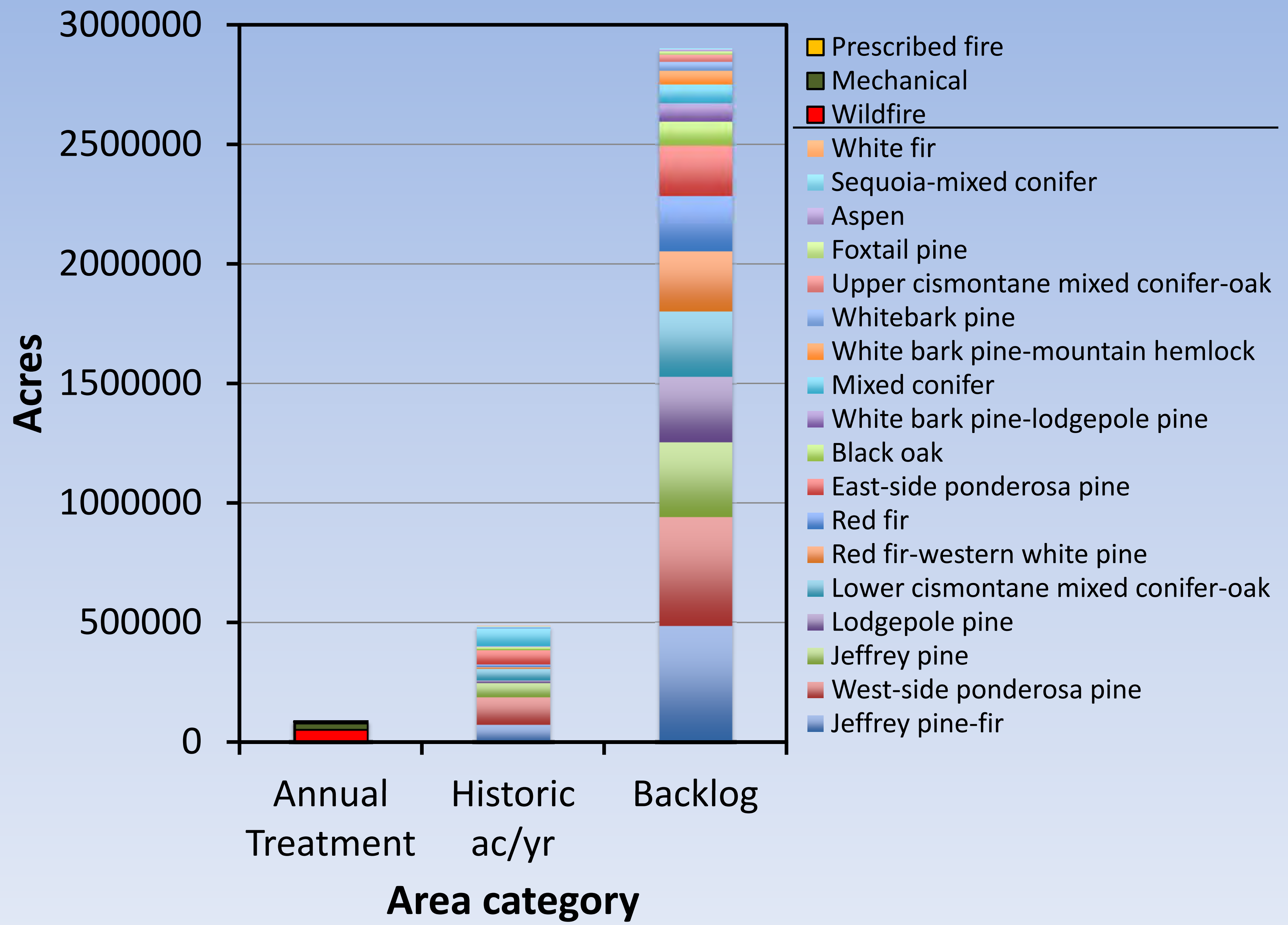
- On FS land 18% (87,923 ac) of land that historically burned/yr (487,846 ac) has some form of fuels reduction [only 7.6% intentional]

On NPS land 17% (11,279 ac) of land that historical burned/yr (65,084 ac) has some form of fuels reduction

- % high severity in wildfires: 33% (FS) vs. 15% (NPS)

Miller et al. 2012. Differences in wildfires among ecoregions and land management agencies in the Sierra Nevada region, California, USA. Ecosphere 3: article 80.

2. Contemporary "treatment" rates



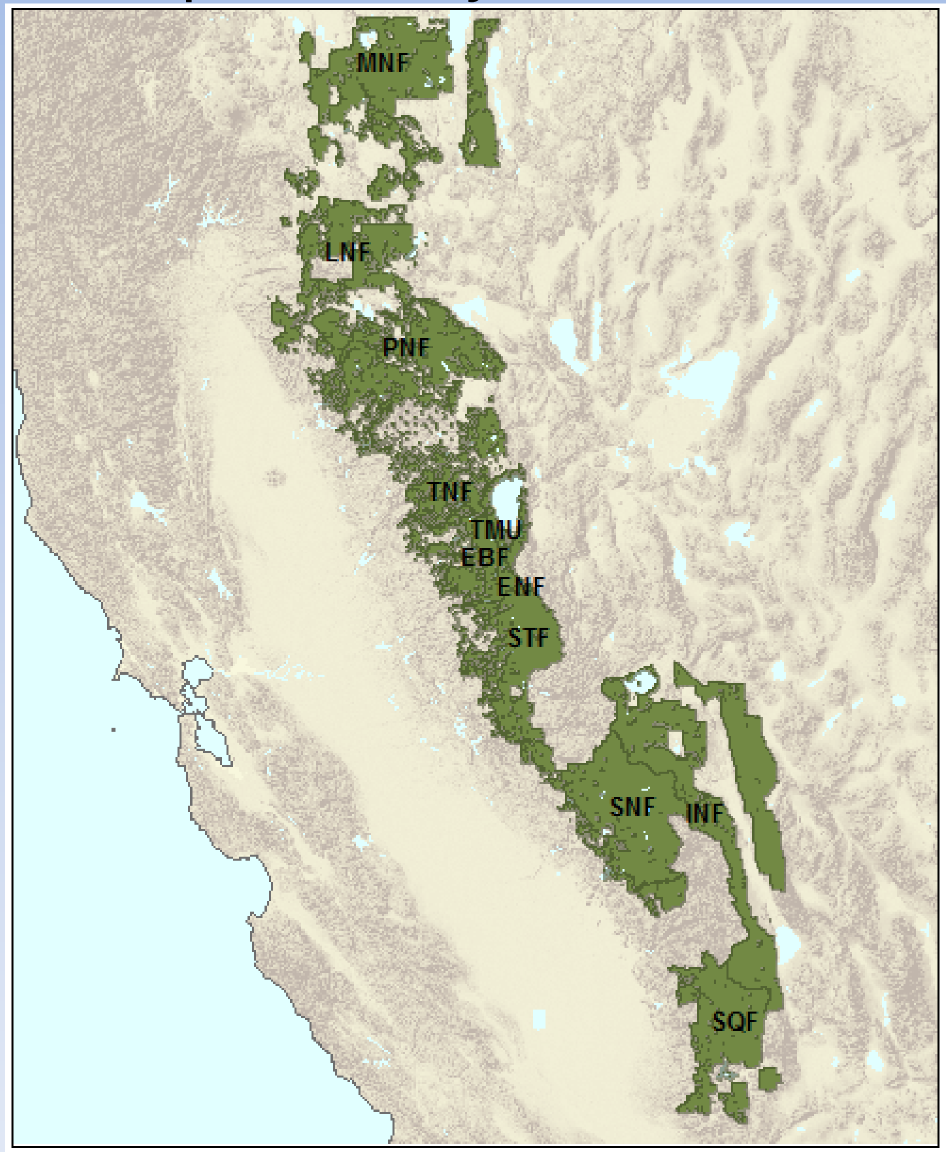
Effects of the Focus on Fire Suppression:

Costs vary widely but general trends are consistent amongst all studies: per acre prescribed fire is the lowest cost treatment, mechanical often 2-4 times more and wildfire 6-15 times more.

Future costs of mechanical are likely to increase, particularly for maintenance (2^{nd} entry and on). High cost of many projects is in the small material removal (often service contracts) which is sometimes offset with larger, commercial removal which will be absent in future entries.

Fuels treatment maintenance will eventually subsume the entire treatment effort leaving some proportion of the forest always in high fuel loads—'backlog'.

Fire is considered impractical:
So what can mechanical fuels treatments achieve?
Scope of Analysis



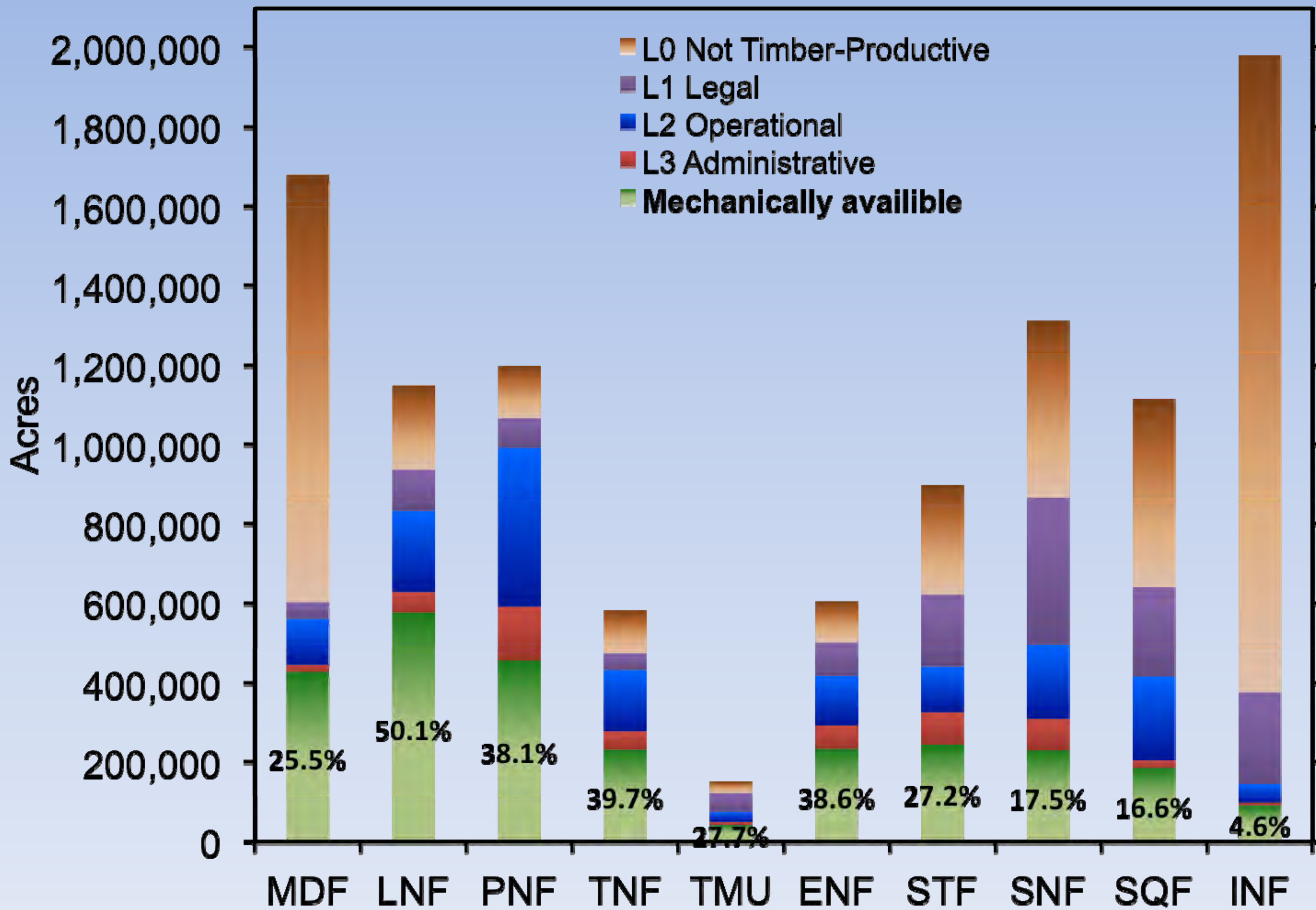
Hierarchy, types and criteria of mechanical treatment constraints used in our analysis.

CWHR (California Wildlife Habitat Relations) classification M and D refer to canopy cover 40-59% and 60-100%, 4, 5 and 6 indicating a quadratic mean diameter of 11-24”, > 24”, and >24” with a multi-layer canopy, respectively.

WUI is the wildland urban interface.

Constraint Type	Criteria:		
L0: Biological			
a. Not Timber Productive	a. Either non-forest or <10% cover		
b. Water/Barren			
L1: Legal			
a. Wilderness			
b. Recommended wilderness			
c. Inventoried roadless	c. all inventoried roadless except those areas where new road construction is allowed		
L2: Operational	Slope	Road Dis.	CWHR
A. Existing (most constrained, gentle slope near roads)	**A.** <35	<1000	-
B. **A** plus road distance increase (distance extended for areas with greater economic return)	**B.** <35	<1000	-
		<2000	4,5 M,D, 6 (WHR_CON)
C. **B** plus slope increase (if close to road, slope increased for areas with greater economic return)	**C.** <35	<1000	
		<2000	4,5 M,D, 6 (WHR_CON)
	35-50	<500	4,5 M,D, 6 (WHR_CON)
D. **C** plus all forest types (Least constrained by slope, road access and economics)	**D.** <35	<2000	-
	35-50	<1000	
L3: Administrative Constraints			
a. Research Natural Areas			
b. Riparian proximity	b. Buffer width: 100’ perennial; 50’ intermittent		
c. California spotted owl	c. WUI—500’ radius; otherwise 300 ac around activity center/nest		
d. Goshawk	d. WUI—500’ radius; otherwise management identified polygon (mean = 200 ac)		

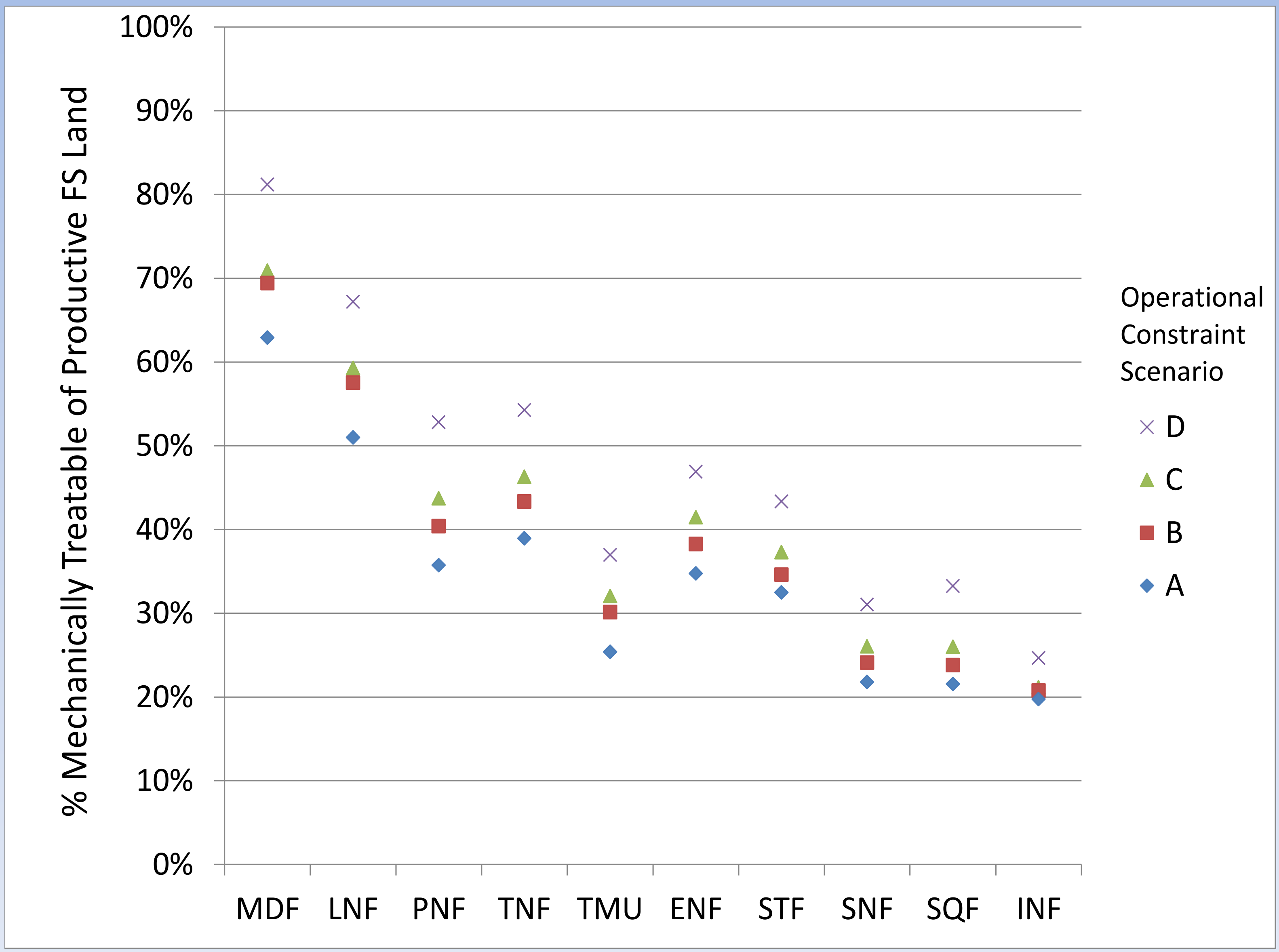
Reduction in FS acres from constraint levels – Scenario C



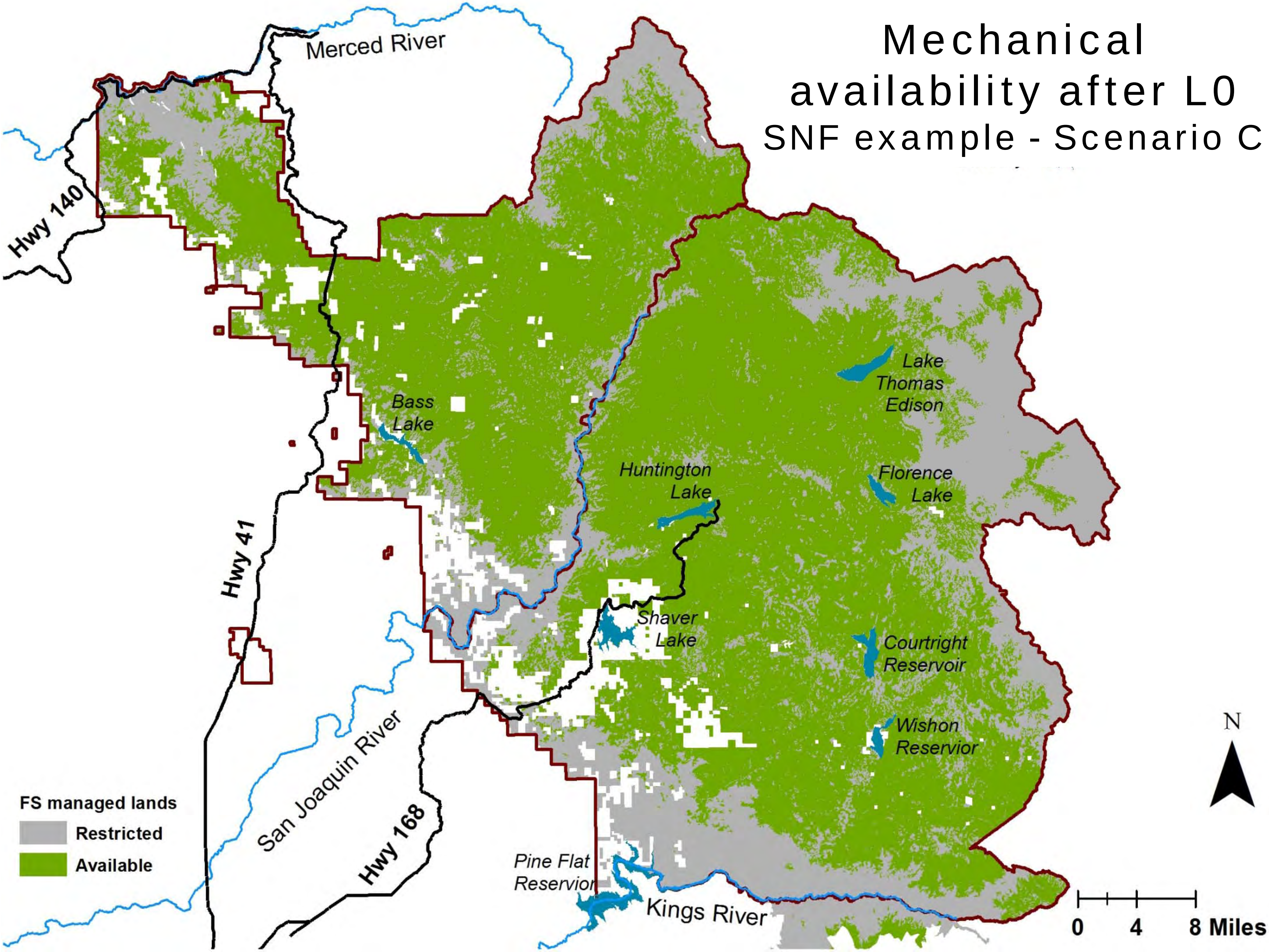
- Acreage and % reduction constraints on mechanical treatment by National Forest.
- L0 is the acres of productive forest remaining after removing water, barren and non-forested.
- Constraints L1-L3 are the percentage of reduction in productive forest (L2 reduction uses scenario.
- Total remaining is the productive forest acres that are available for mechanical treatment after all constraints are applied.

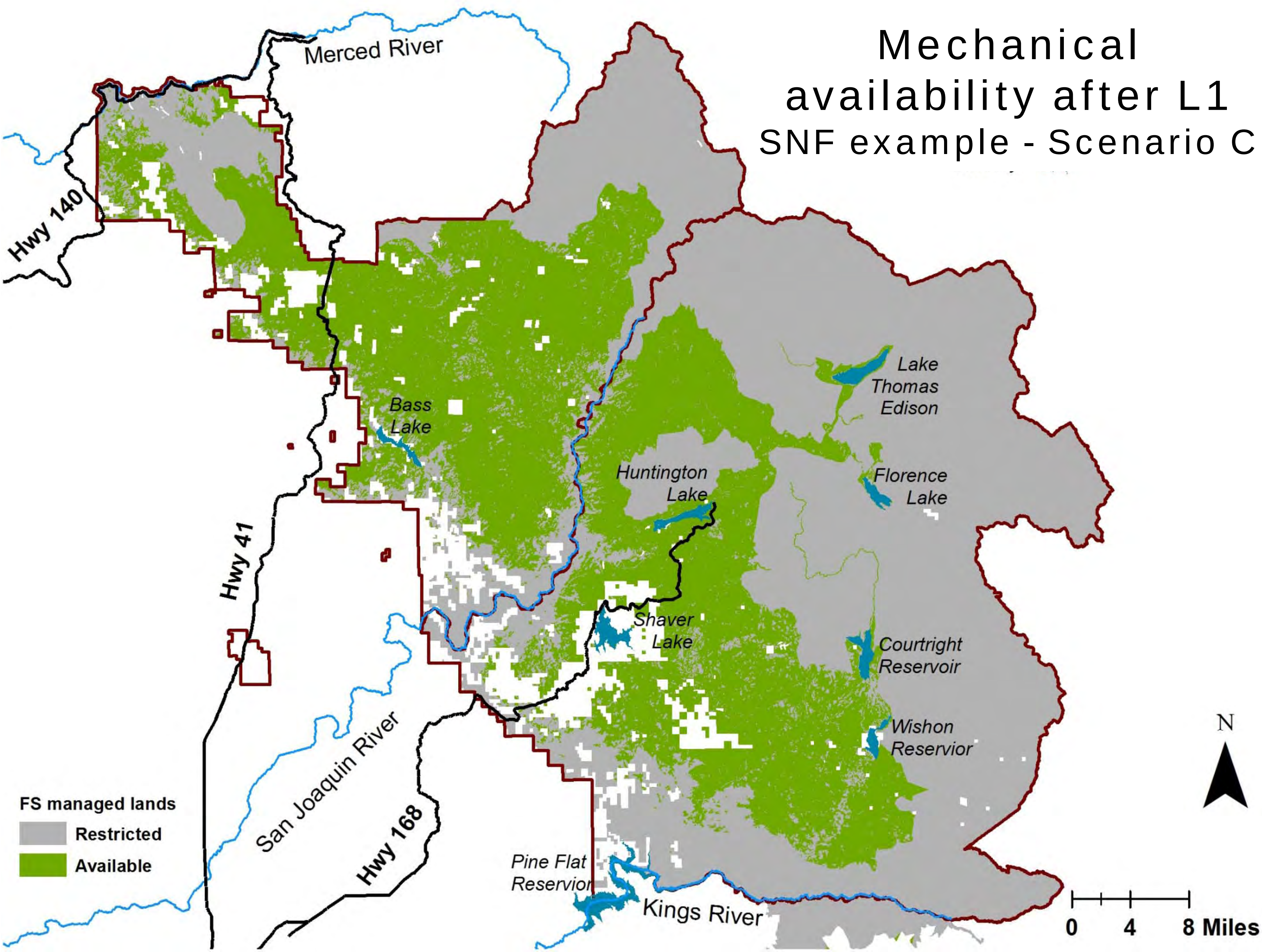
NF	L0: Productive Forest (ac)	L1: Legal	L2: Operational	L3: Admin.	Total Remaining (ac)
Modoc	602,209	-7.1%	-18.9%	-2.9%	428,223
Lassen	935,571	-11.0%	-21.9%	-5.5%	575,845
Plumas	1,065,594	-7.0%	-37.6%	-12.6%	456,714
Tahoe	474,902	-8.9%	-32.6%	-9.8%	231,276
LTBMU	121,434	-37.8%	-21.5%	-6.3%	41,882
Eldorado	499,798	-16.3%	-25.2%	-11.8%	233,448
Stanislaus	621,032	-28.9%	-18.7%	-13.2%	243,774
Sierra	864,993	-42.8%	-21.4%	-9.2%	229,502
Sequoia	639,808	-34.9%	-33.2%	-3.0%	185,156
Inyo	376,325	-61.6%	-12.3%	-1.9%	91,280
SNBR	**6,201,666**	**-22.5%**	**-25.6%**	**-8.1%**	**2,717,100**

Symbols show the percentage of mechanically available productive forest land left on each National Forest under four different operational constraint scenarios after all constraints (L0-L3) are applied.

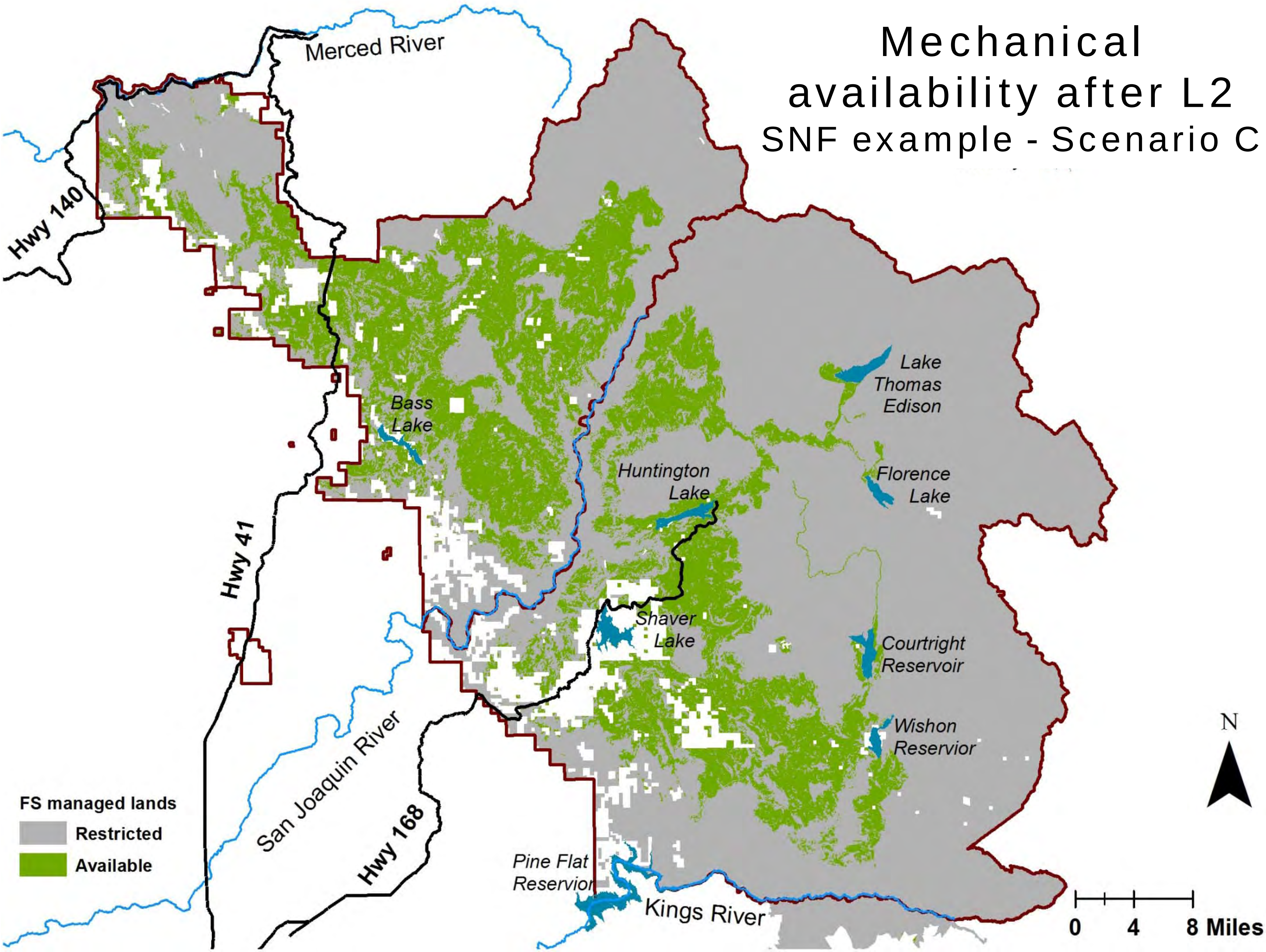


Mechanical availability after L0
SNF example - Scenario C



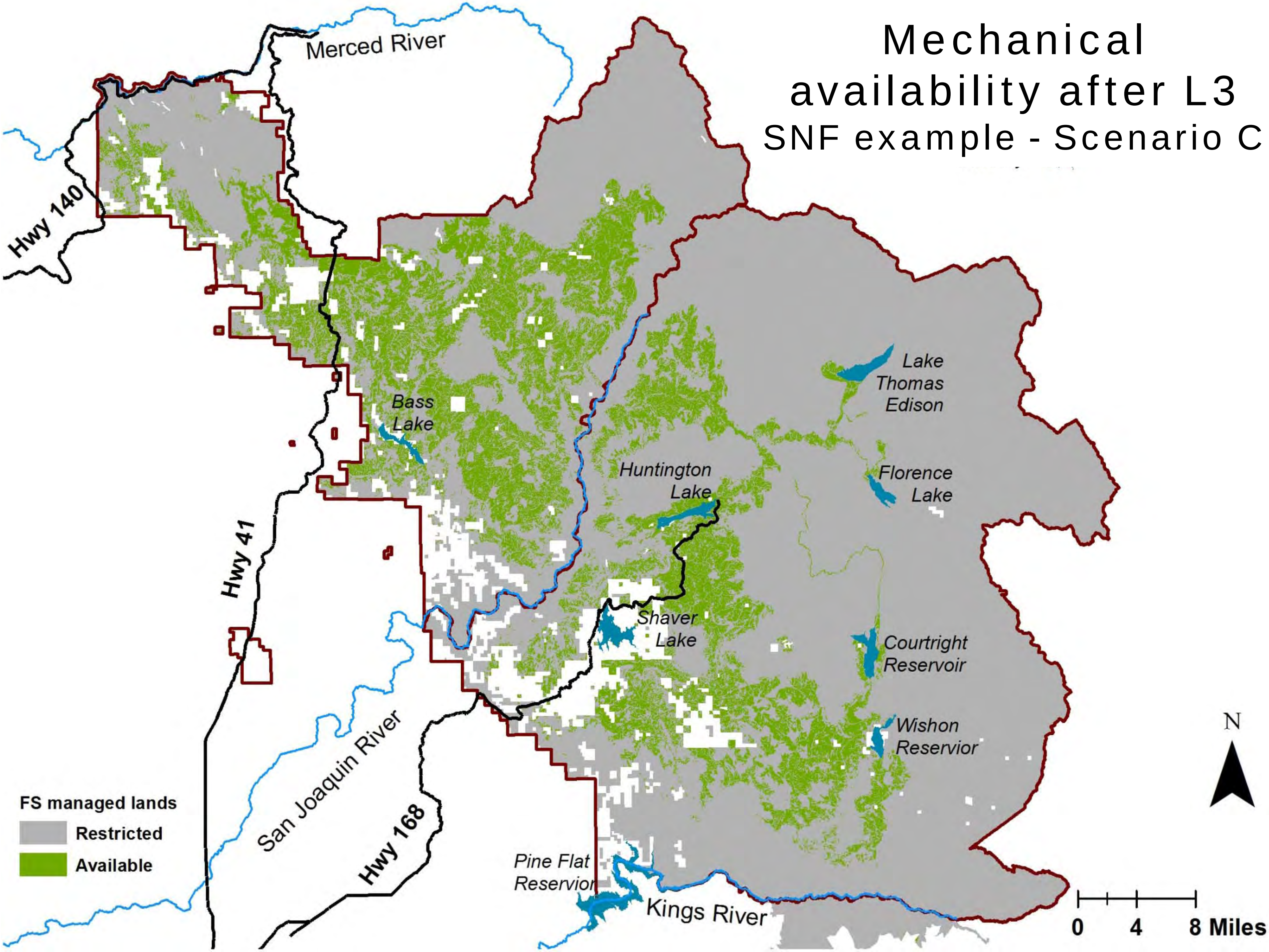

Mechanical
availability after L1
SNF example - Scenario C
Merced River
Hwy 140
Hwy 41
Hwy 168
San Joaquin River
Bass
Lake
Lake
Thomas
Edison
Huntington
Lake
Florence
Lake
Shaver
Lake
Courtright
Reservoir
Wishon
Reservoir
Pine Flat
Reservior
Kings River
FS managed lands
Restricted
Available
N
0
4
8 Miles

Mechanical availability after L2
SNF example - Scenario C



Mechanical availability after L3

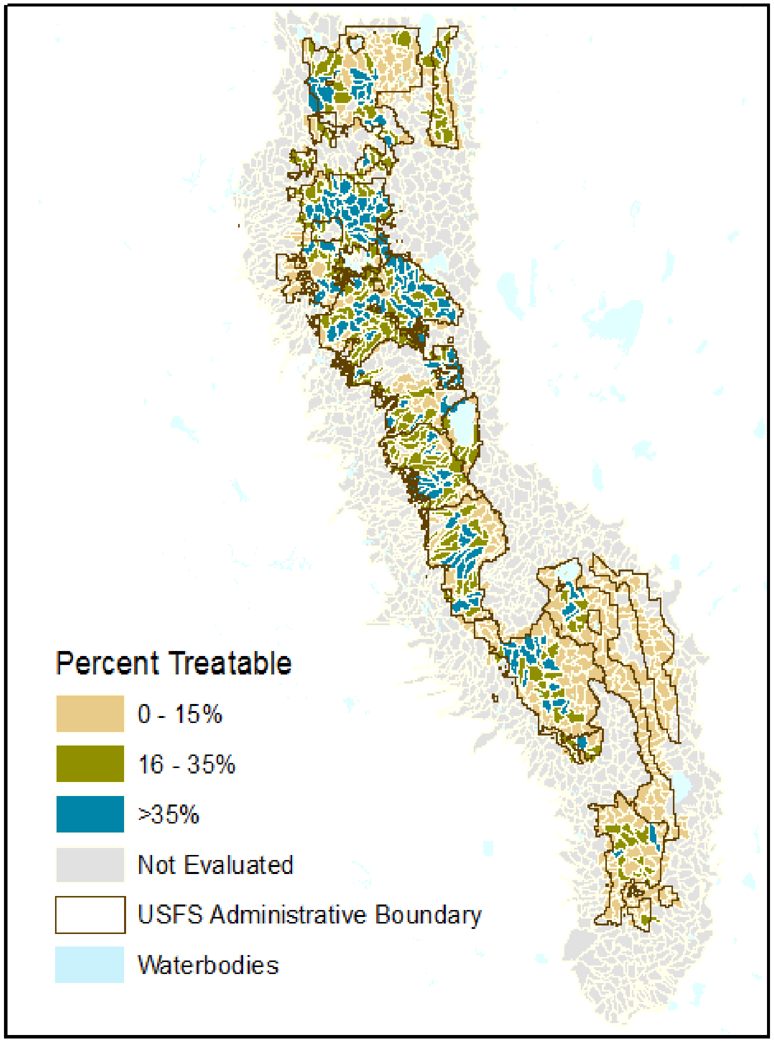
SNF example - Scenario C



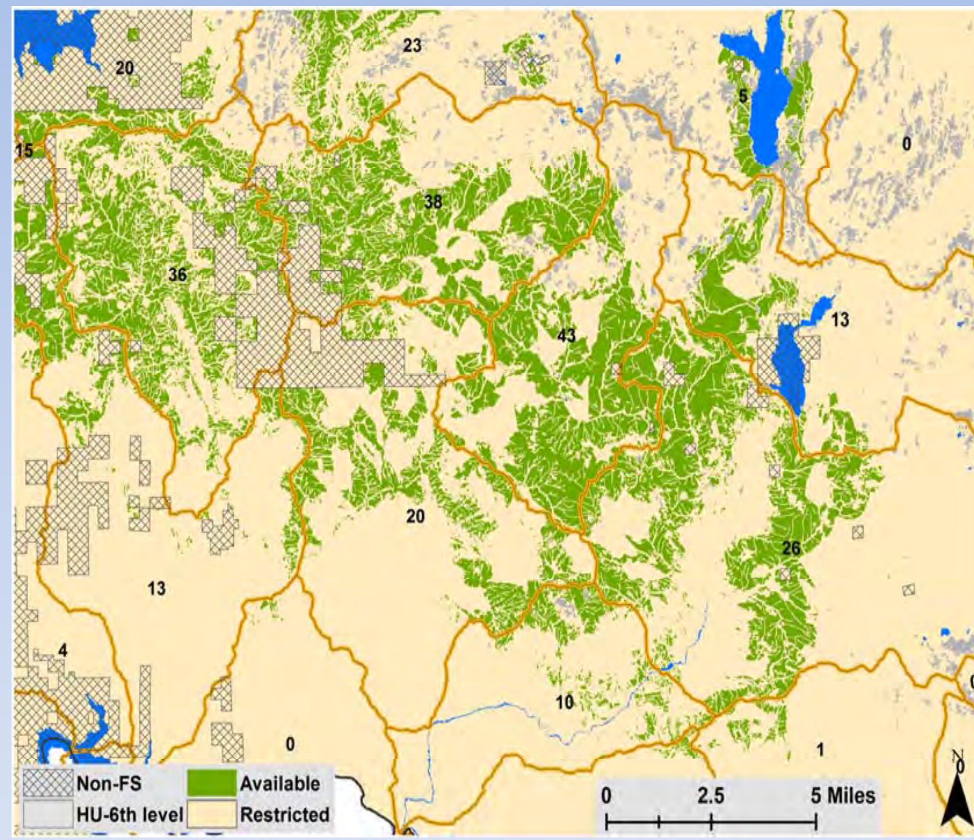
Total and number of subwatersheds (HUs) on each National Forest with ≥25% Forest Service ownership of all burnable acres. The three categories are calculated based on the number of FS acres available to mechanical treatment divided by the total burnable acres (across all ownerships) within the HU.

National Forest:			Level of Constraint		
	Total HUs	HUs >25% FS	High (85-100%)	Moderate (65-84%)	Light (<65%)
Modoc	144	96	51.0%	32.3%	16.7%
Lassen	150	98	22.4%	39.8%	37.8%
Plumas	111	87	20.7%	44.8%	34.5%
Tahoe	90	54	24.1%	48.1%	27.8%
LTBMU	27	16	37.5%	50.0%	12.5%
Eldorado	65	50	26.0%	50.0%	24.0%
Stanislaus	80	53	49.7%	30.2%	20.1%
Sierra	92	77	66.2%	15.6%	18.2%
Sequoia	103	70	72.9%	22.8%	4.3%
Inyo	167	109	91.7%	3.7%	4.6%
	1029	**710**	**46.2%**	**33.7%**	**20.1%**
	Total		**Average**		

Like Real Estate, Fuels Treatment Effectiveness is about location, location, location



Magnification of subwatersheds around the Dinkey Creek Area



Mechanical as a tool for increasing fire use:
What does managed wildfire suggested about the opportunity to increase fire in the Sierra Nevada?

Defining Resource Benefits of Wildland Fires in the Southern Sierra Nevada

Marc Meyer
Southern Sierra Province Ecologist
USDA Forest Service
Pacific Southwest Region

Beneficial Fire Effects

- Reduces fuel loading
- Enhances structural heterogeneity
- Promotes biodiversity
- Facilitates regeneration of shade-intolerant tree species

Aspen Valley, Yosemite NP

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Aspen Valley, Yosemite NP

Objective Approach

- Natural Range of Variation (NRV) Concept
  - Identifies "natural" or historic reference conditions indicative of a "healthy", functional, and resilient ecosystem
  - New Forest Planning Rule

Photo Credit: A. Wieslander

NRV Concept

- Incorporates diverse information sources
  - Historic – Recognizes importance of indigenous influence
  - Contemporary reference sites
  - Future projected changes
- Used in a variety of management applications

Sugarloaf Valley, Kings Canyon National Park

Basic Questions:

- Do managed fires (wildland fire use, managed wildfire) in the Southern Sierra provide resource benefits based on the NRV concept?
- How managed and suppression wildfires compare?

Sierra San Pedro Martir, Baja California

Resources

- Vegetation
- Wildlife habitat
- Watersheds/water quality
- Air quality
- Economic
- Cultural

Resources

- **Vegetation**
- Wildlife habitat
- Watersheds/water quality
- Air quality
- Economic
- Cultural

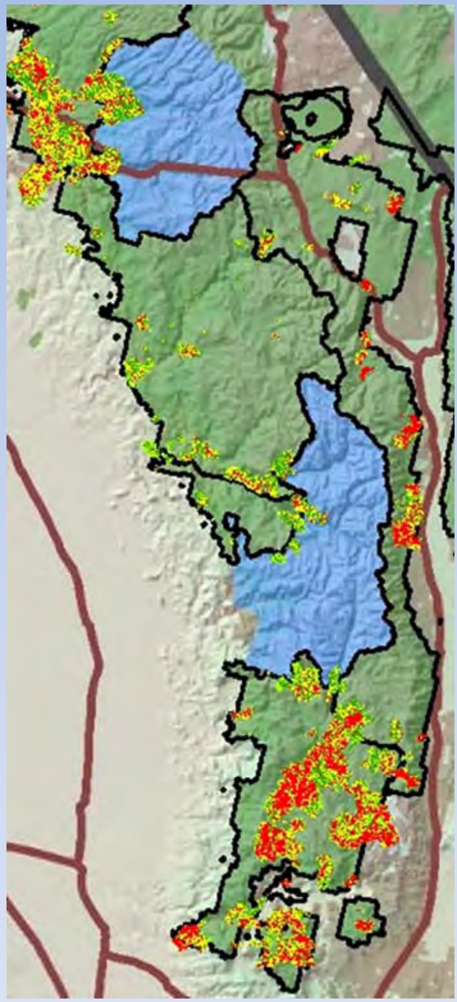
Forest Vegetation

- Natural Range of Variation (NRV) - Based on Region 5 Ecology Program NRV Assessments
- Indicators
  - Fire severity proportions
  - High severity patch size (mean and max)

Harden Fire, Yosemite N

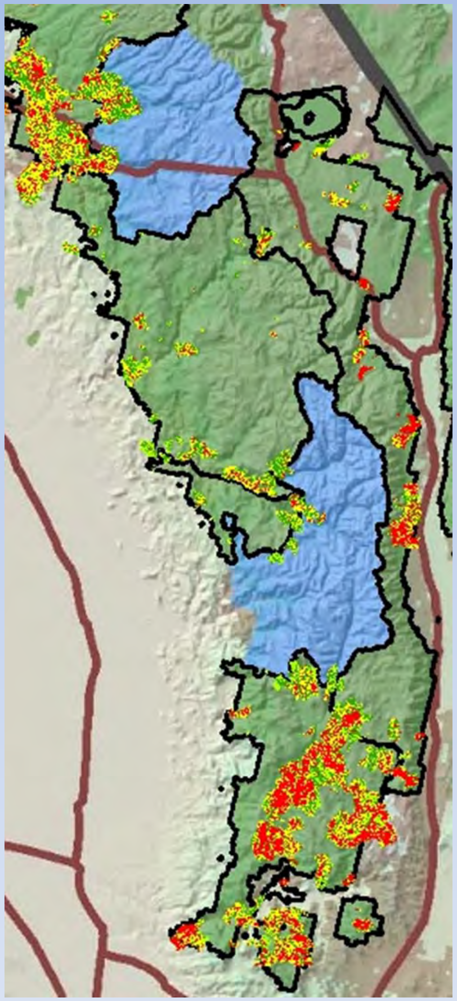
Methods

- Focus on national forests of the Southern Sierra Nevada (SQF, SNF, INF, STF)
- Total of 20 fires analyzed
  - Recent ignitions (2000-2011)
  - Larger fire size (>800 acres)
  - Dominated by mid-elevation forest types (mixed conifer, yellow pine, and red fir)
  - Mostly on Sequoia NF
  - Available fire severity data



Methods

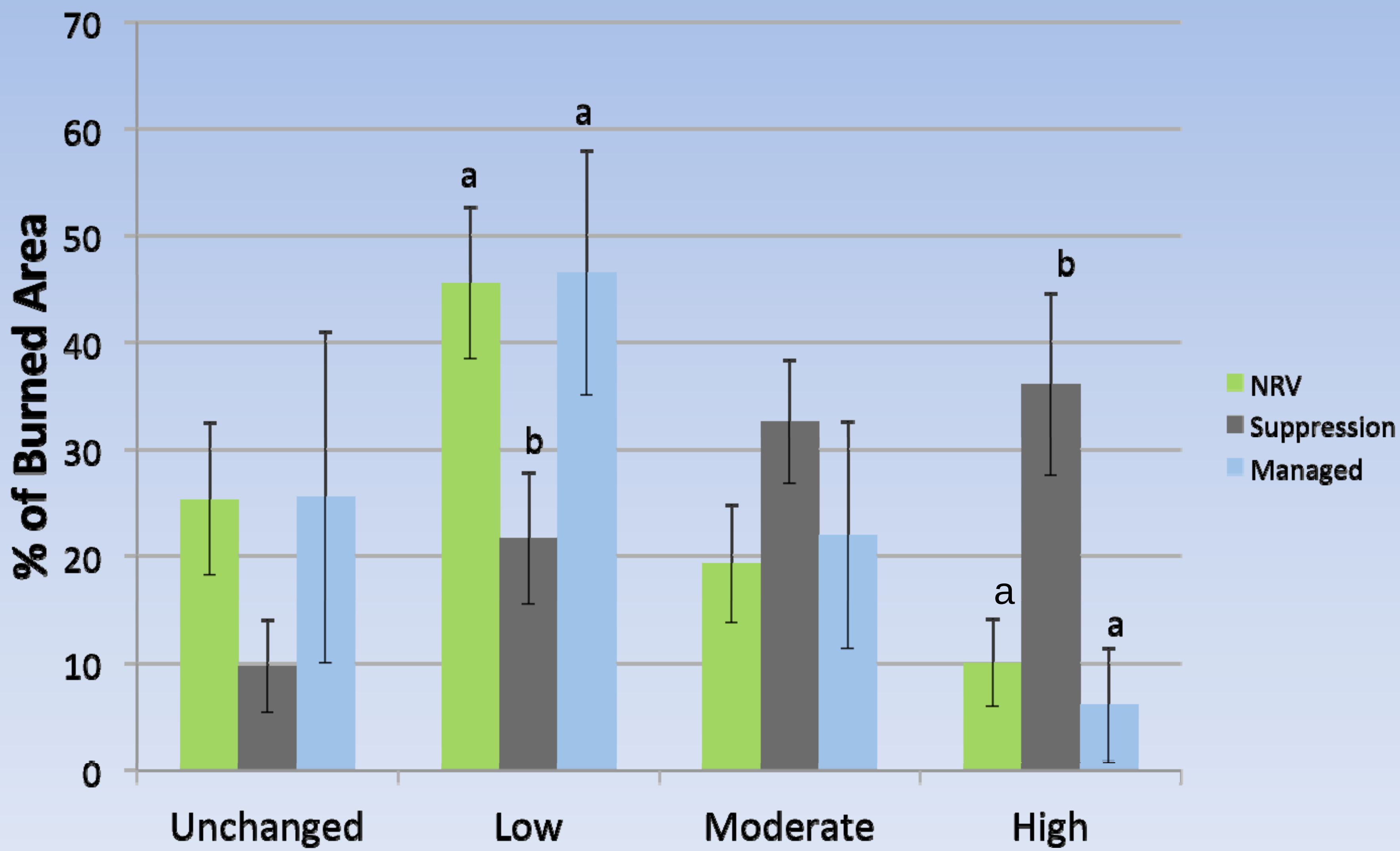
- Focus on national forests of the Southern Sierra Nevada (SQF, SNF, INF, STF)
- Total of 22 fires analyzed
  - Recent ignitions (2000-2011)
  - Larger fire size (>405 ha) on NFS lands
  - Dominated by mid-elevation forest types (mixed conifer, yellow pine, and red fir)
  - Available fire severity data (1-yr post)

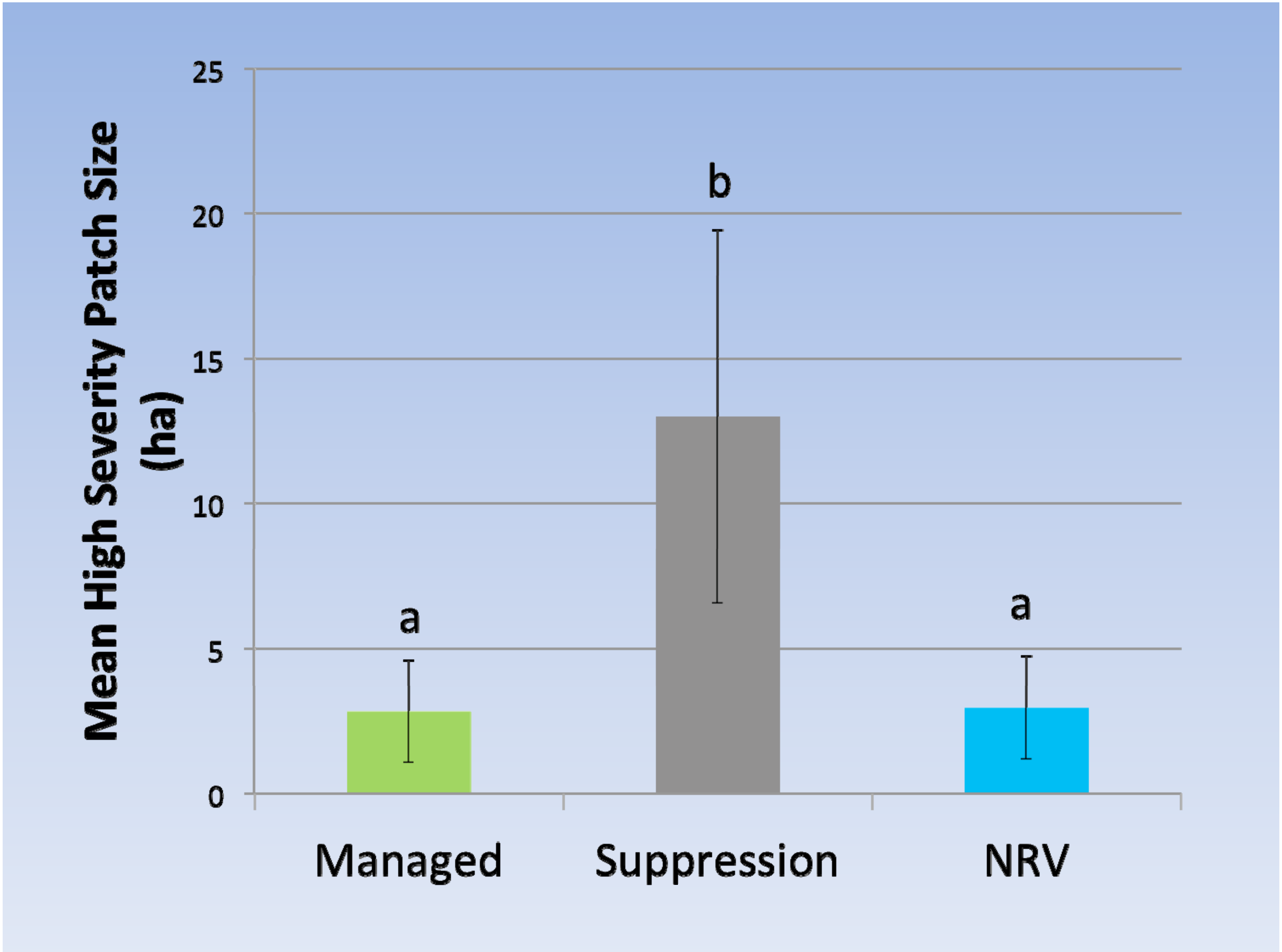


Results: Fire Severity

Black Mountain Grove Rx Fire, Robert

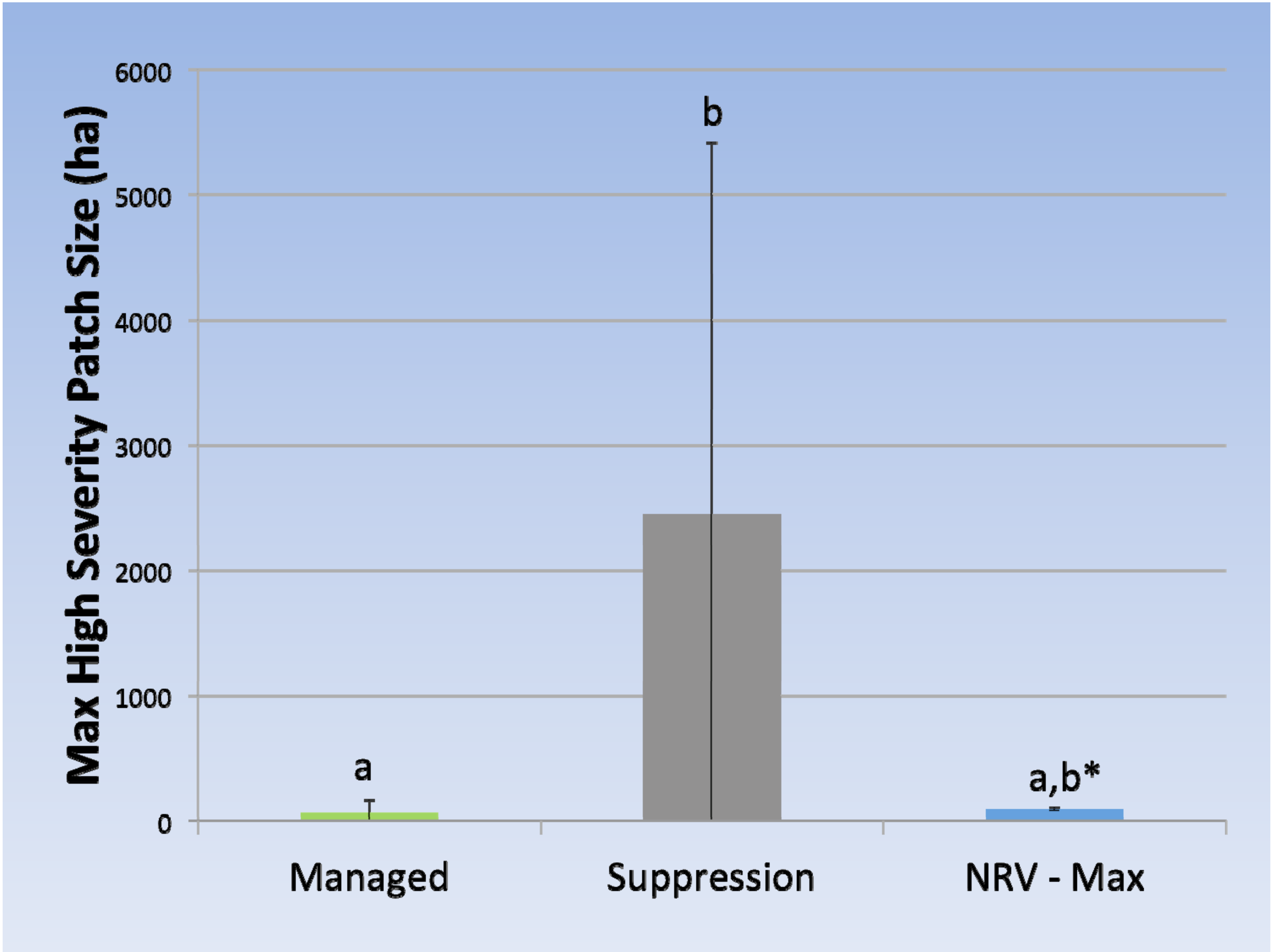
NRV and Wildfire Comparison



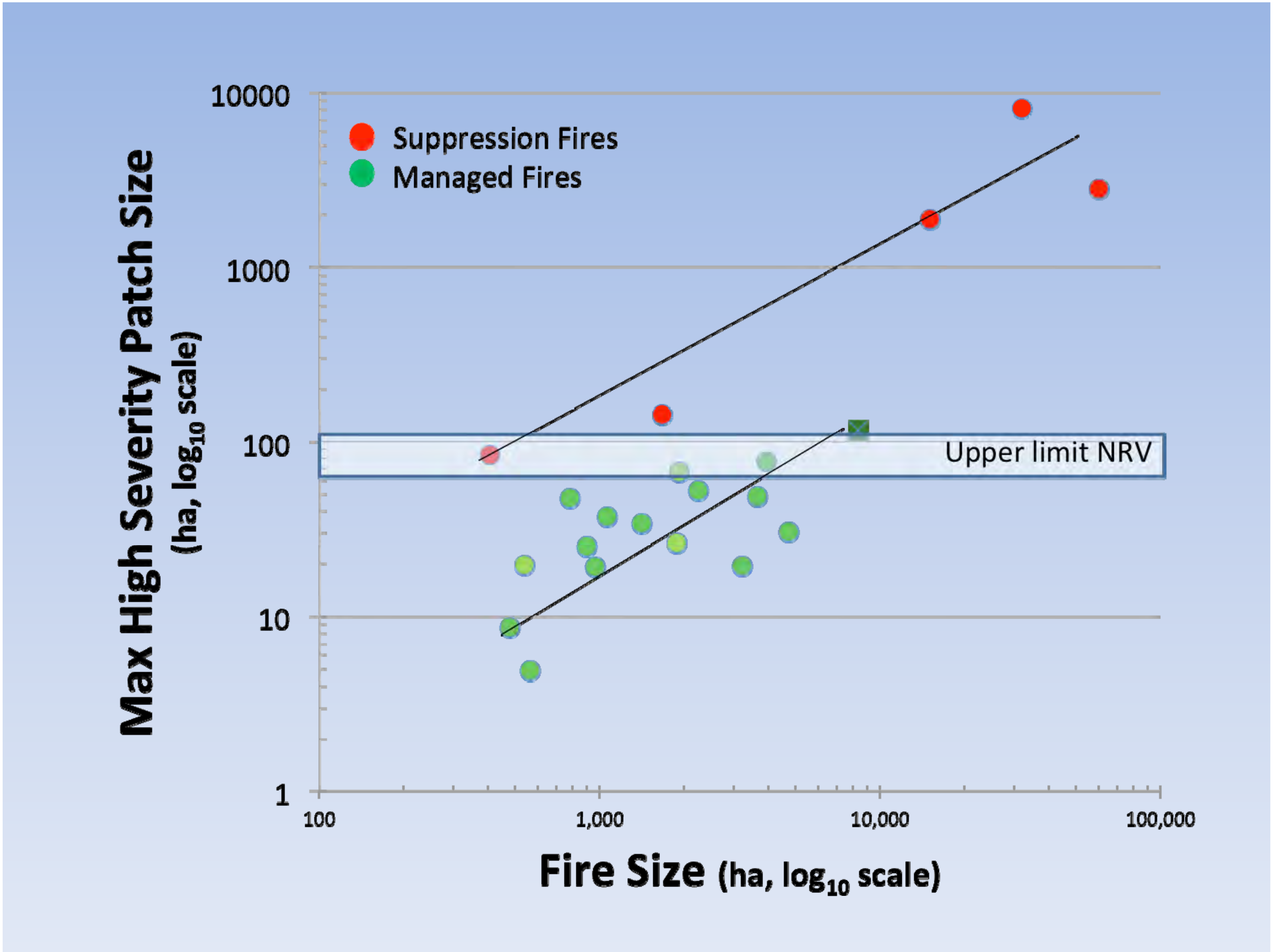


Mean High Severity Patch Size (ha)
25
20
15
10
5
0
b
a
a
Managed
Suppression
NRV


Lion Fire
SC1: Sheep Creek (upper)
P.Strand
8/3/2011



Max High Severity Patch Size (ha)
6000
5000
4000
3000
2000
1000
0
b
a
a,b*
Managed
Suppression
NRV - Max



Suppression Fires
Managed Fires
Upper limit NRV
Max High Severity Patch Size (ha, log10 scale)
Fire Size (ha, log10 scale)
10000
1000
100
10
1
100
1,000
10,000
100,000


Lion Fire
SC7: Sheep Creek (looking north at ridge above Unnamed Creek)
P.Strand 8/3/2011

Conclusions

- Managed wildfires in the ecoregion were:
  – Within NRV
    - Fire severity proportion
    - High-severity patch size – mean and max
- In contrast, suppression wildfires were:
  1. Outside the NRV and potential habitat suitability
  2. More costly per acre across a range of total fire sizes

Illilouette Basin, Yosemite NP

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Illilouette Basin, Yosemite NP

Management Implications

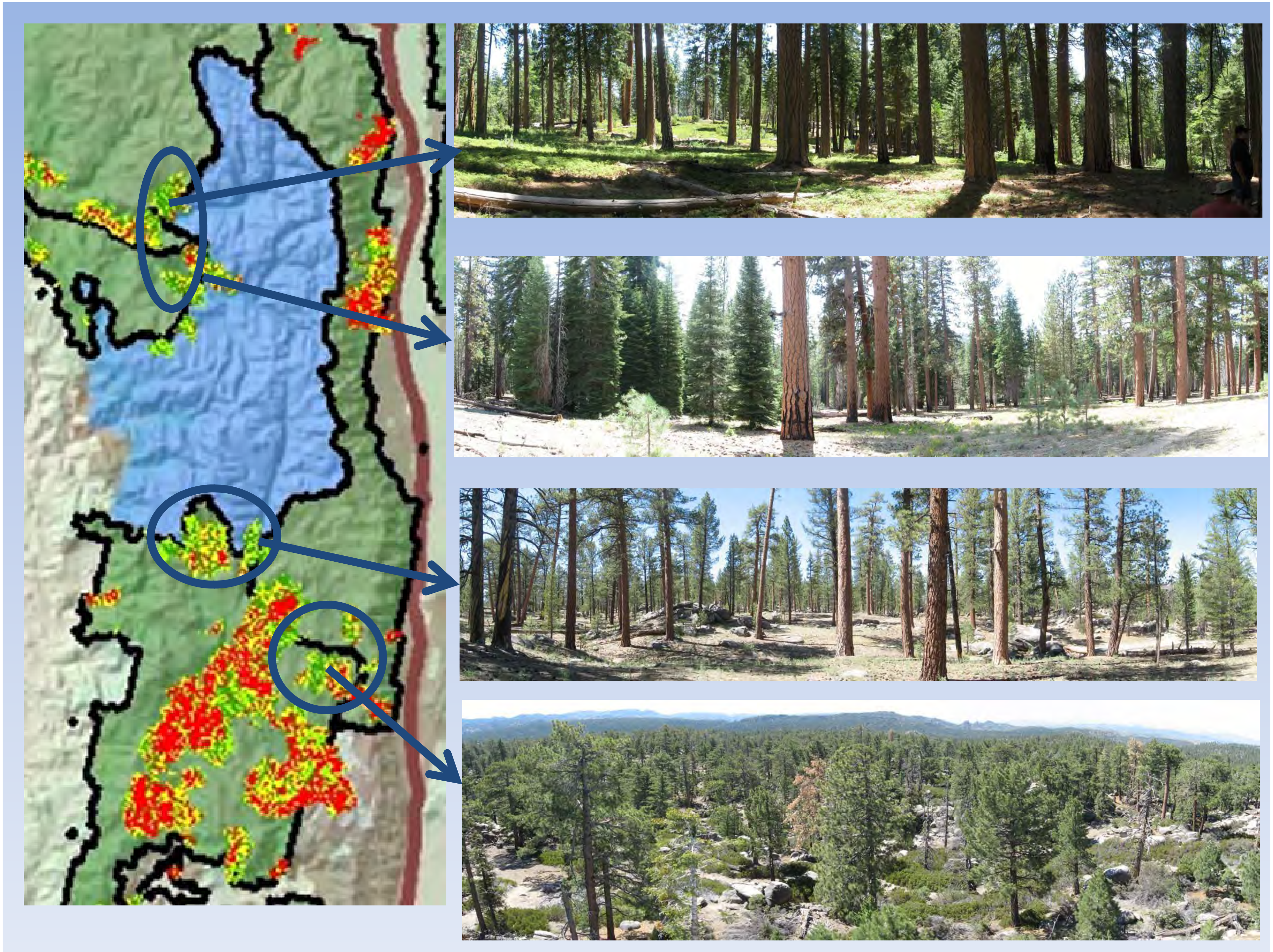
- Results support the expanded use of managed wildland fires to achieve resource benefits in the southern Sierra Nevada national forests


Lion Fire, Golden Trout Wilderness, Sequoia NF; Phil Strand, USFS

Management Implications

- Results support the expanded use of managed wildland fires to achieve resource benefits in the southern Sierra Nevada national forests
- Increase in the "pace and scale" of ecological restoration across large landscapes
- *Demonstration Areas or Firesheds*

Lion Fire, Golden Trout Wilderness, Sequoia NF; Phil Strand, USFS



Summary I:

• Even if the current rate of mechanical treatments were increased 4-5 times, it would still be less than 1/3 of what is needed

The 2007 Moonlight Fire

• The problem is that current practices often concentrate on containing fire, sustaining large trees and preserving current habitat, maintaining **stasis** with stand-level management.

• This approach is fundamentally at odds with dynamics in fire-dependent forests and will constrain rather than facilitate an adaptive forest response to climate change. **Frequent, low-intensity fire is the best means of making many Sierra Nevada forests resilient to climate change.**

Summary II:

- There is little incentive to treat areas with high ecological value because of potential litigation and higher costs due to management restrictions.

- The pattern and scale of current treatments is an order of magnitude too low and leaves 2/3's of FS lands constantly with elevated fuel loads.

- Progress against this persistent backlog is unlikely unless contiguous firesheds are identified, treated, and moved out of the suppression land base.

Currently habitat for sensitive species, such as this fisher, is often left untreated

- The New Forest Planning Rule and next round of plans may provide an opportunity to address the cultural, regulatory and institutional barriers to increased fire use.

Outside the box: We have to try something substantial different

What can we do?

- Encourage FS culture to support fire use
- Work to change current air quality standards that are out of step with science

Questions?