Influence of Past Burn Mosaics to Future Fire Behavior and Implications for Management

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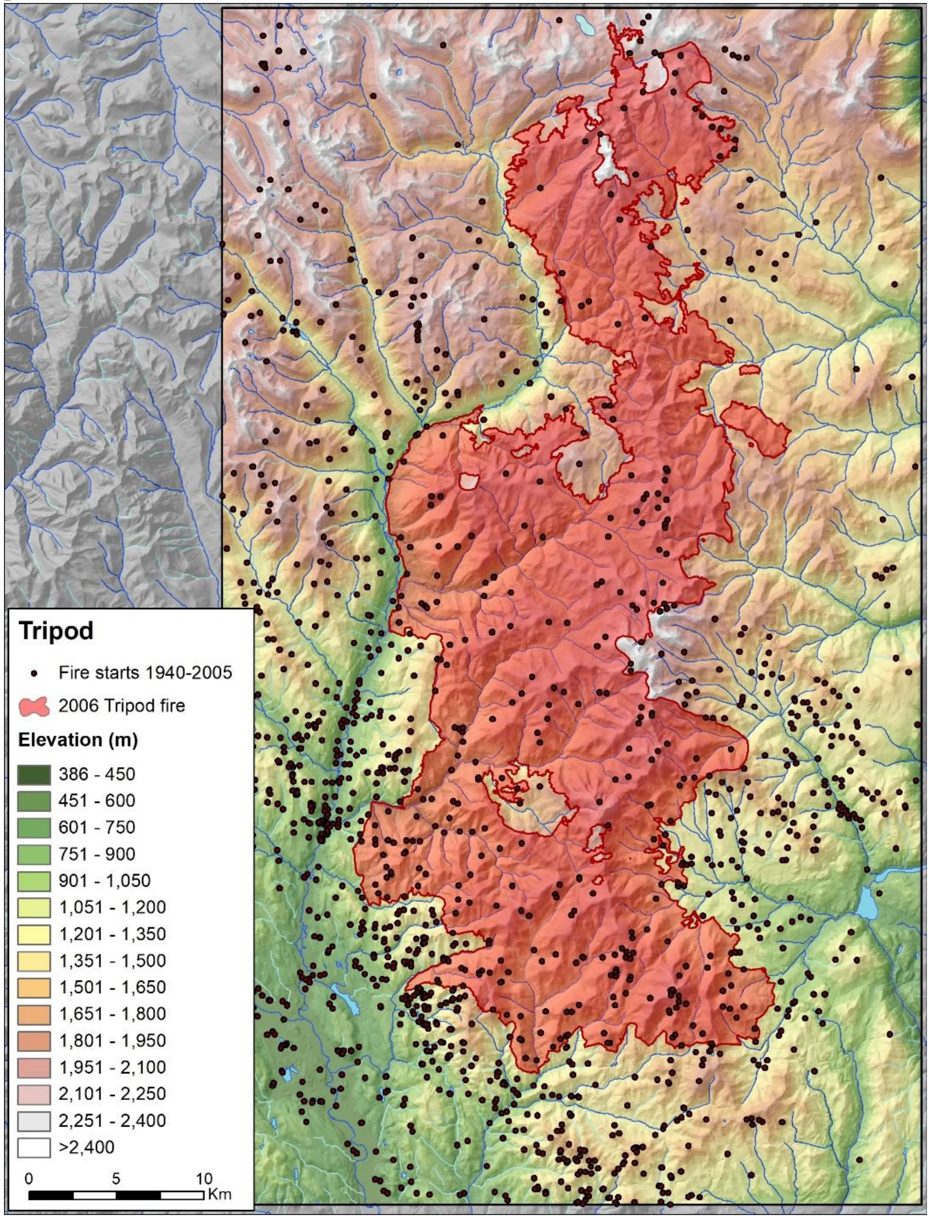
AGENDA

Agenda	Details	Presenter
0800 – 0820	Introduction to the Reburn Project	Prichard/Stevens-Rumann
0820 – 0840	Vegetation and fire dynamics	Gray
0840 – 0900	Wildland fire management scenarios	Prichard
0900 – 0920	Climate change and landscape resilience	Prichard
0920 – 0940	Discussion	Gray & Prichard
0940 – 1000	Break and load into vans	ALL

Tripod Historical Fire Starts



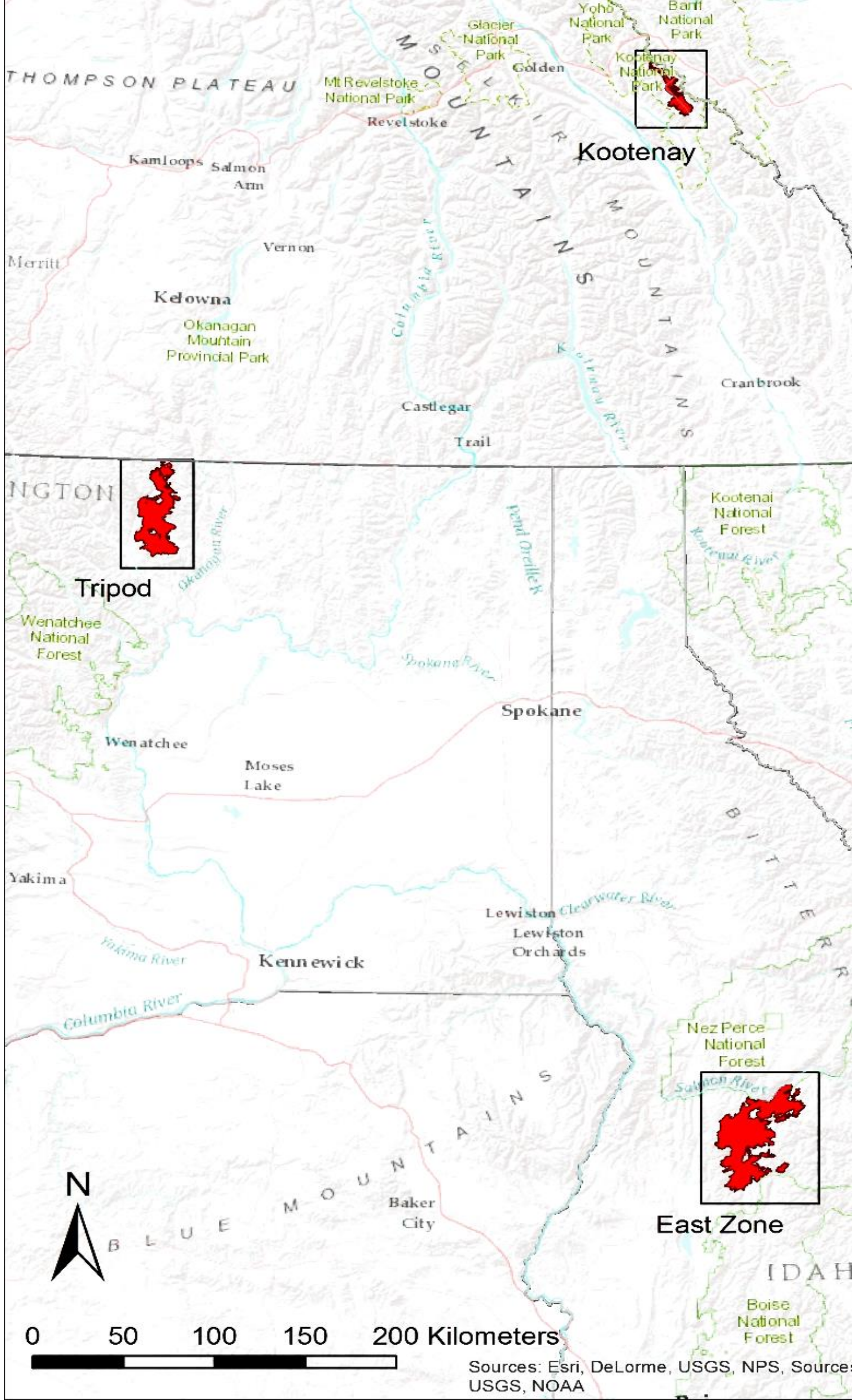
Suppressed fire starts (1940 – 2006, n > 300)

Objectives

To evaluate the effects of past wildfires on the:

1) Characteristics (e.g. fire spread and severity)

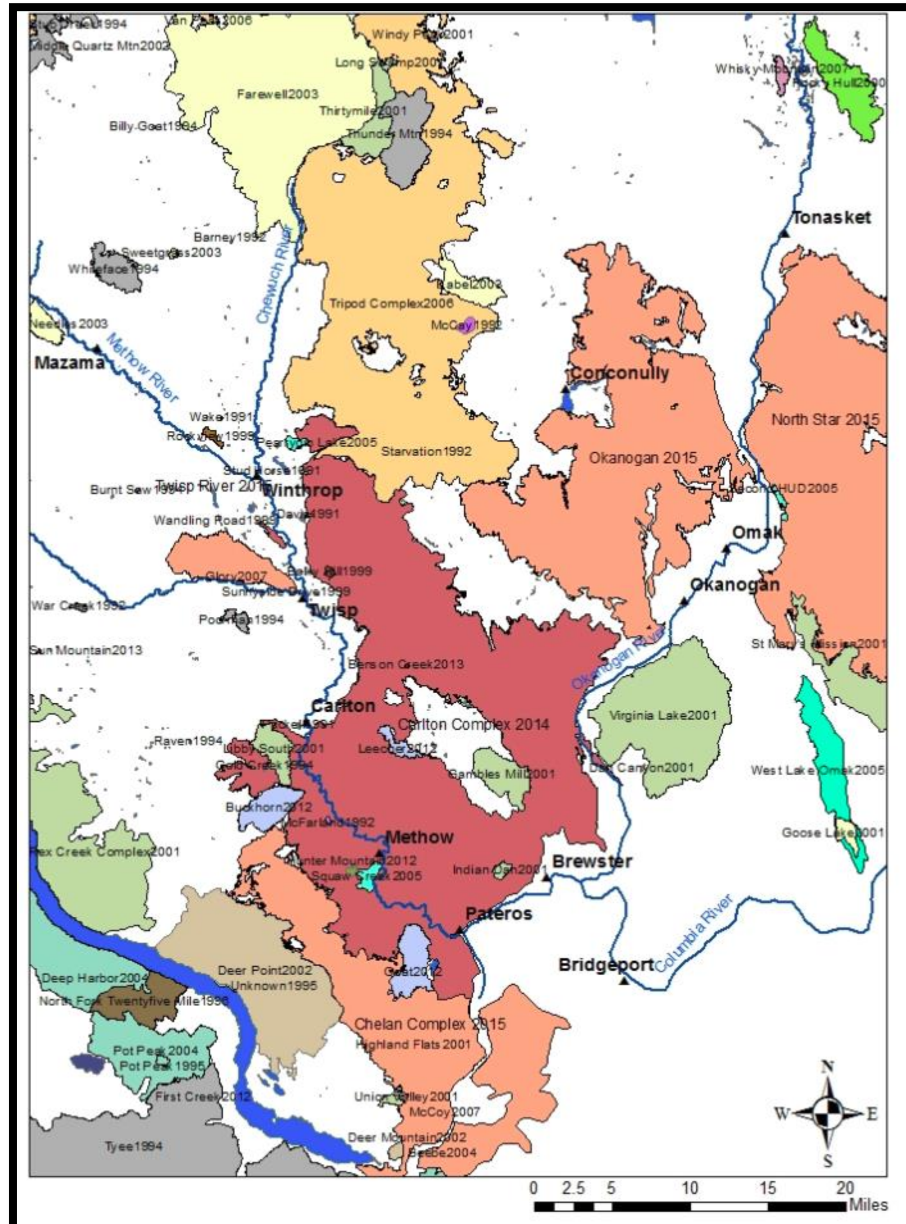
2) Management (e.g. firefighting strategies and costs) of subsequent wildfires.



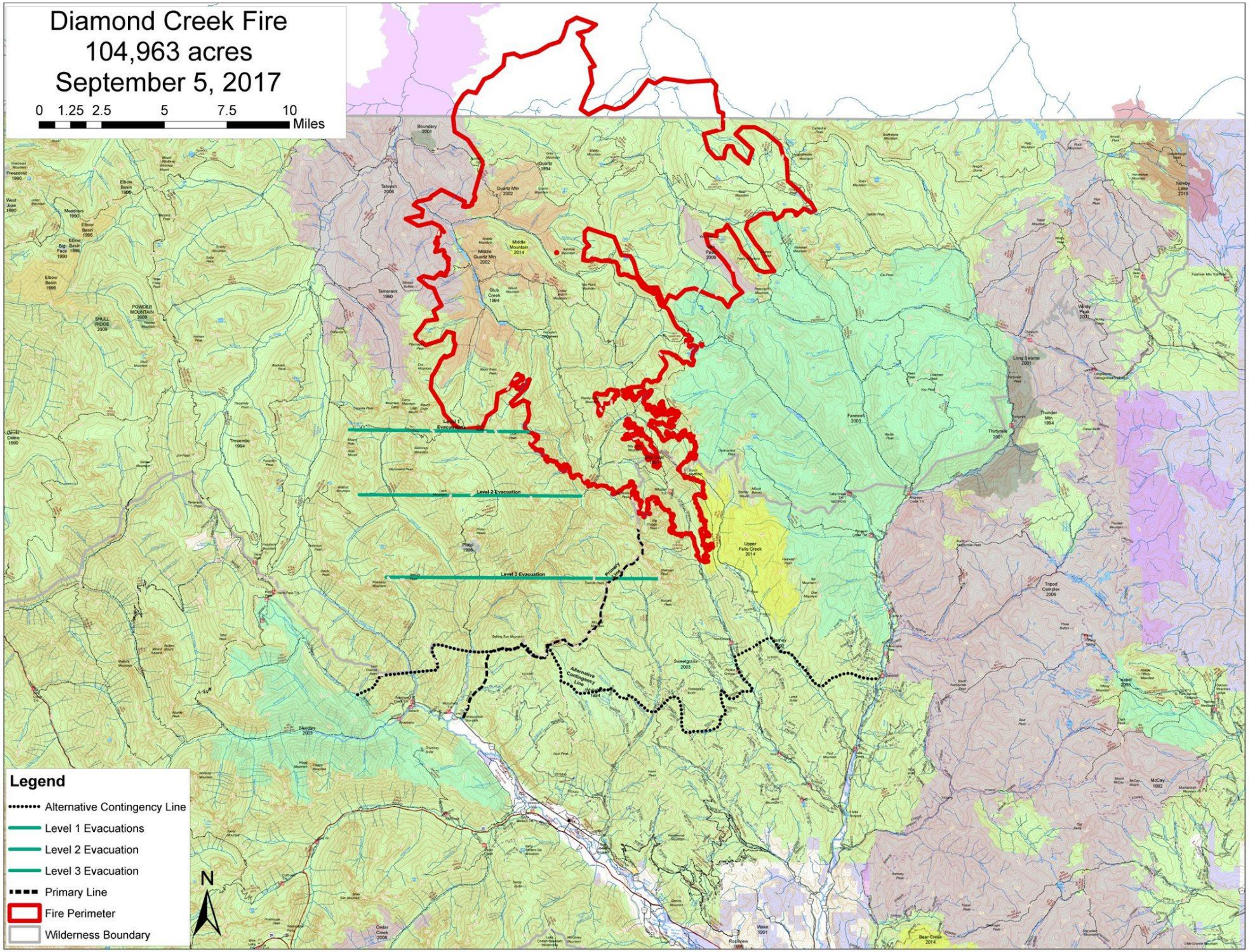
Research Questions

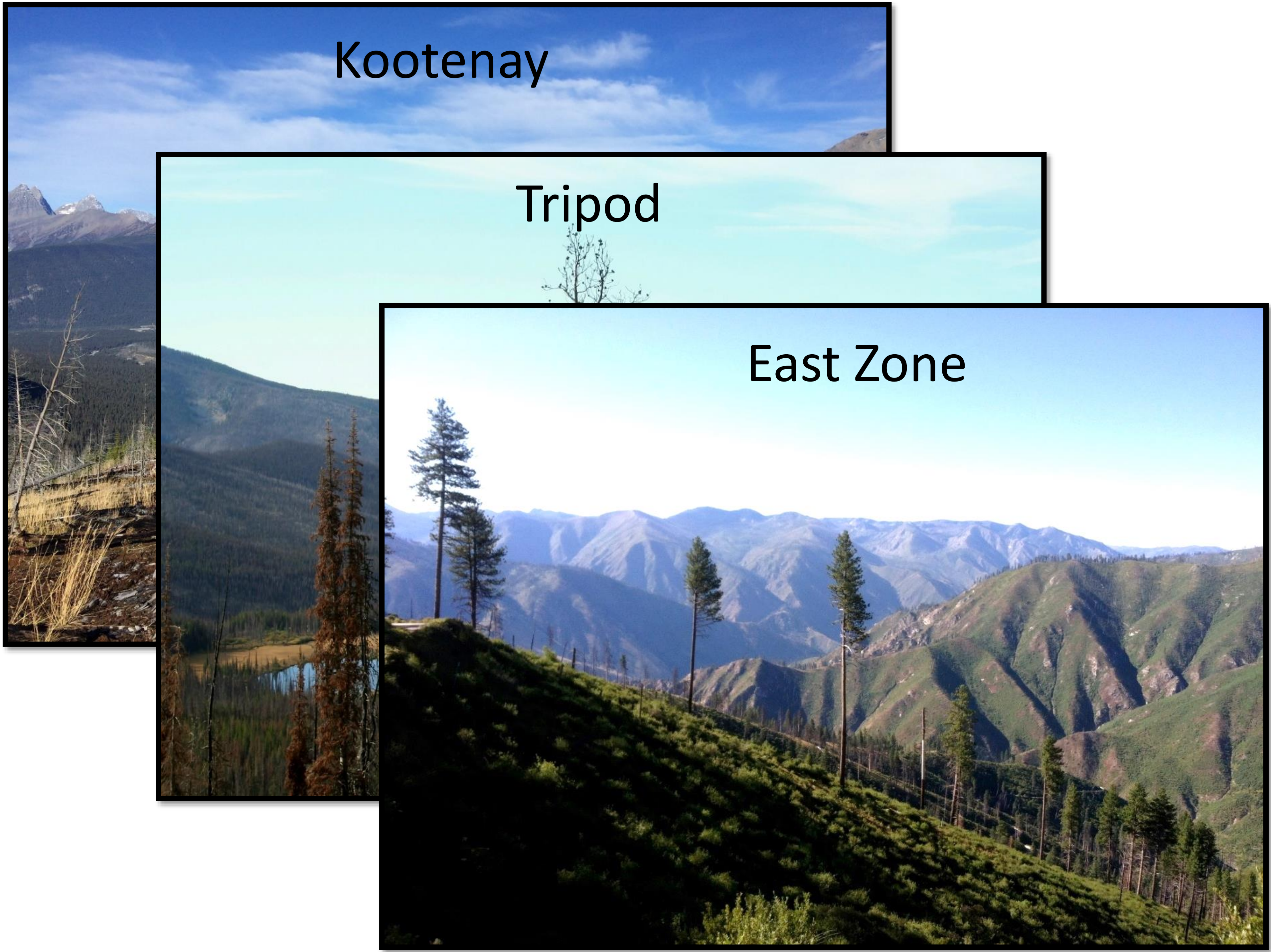
How do the location, size and age of past wildfires influence subsequent wildfire behavior and effects?

Were past wildfires effective as barriers to subsequent fire spread or to mitigate burn severity?



Research Questions, cont.

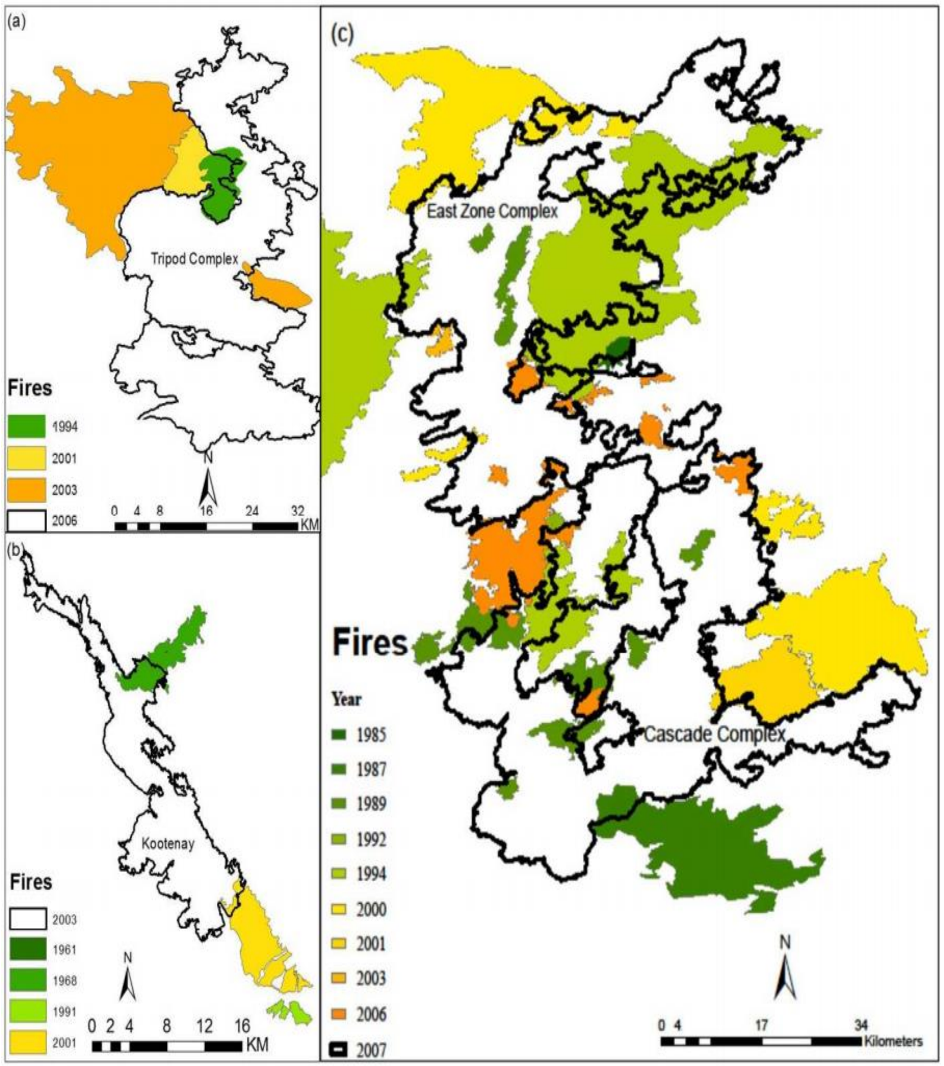



Kootenay
Tripod
East Zone

Task 1 – Burn Severity Analysis

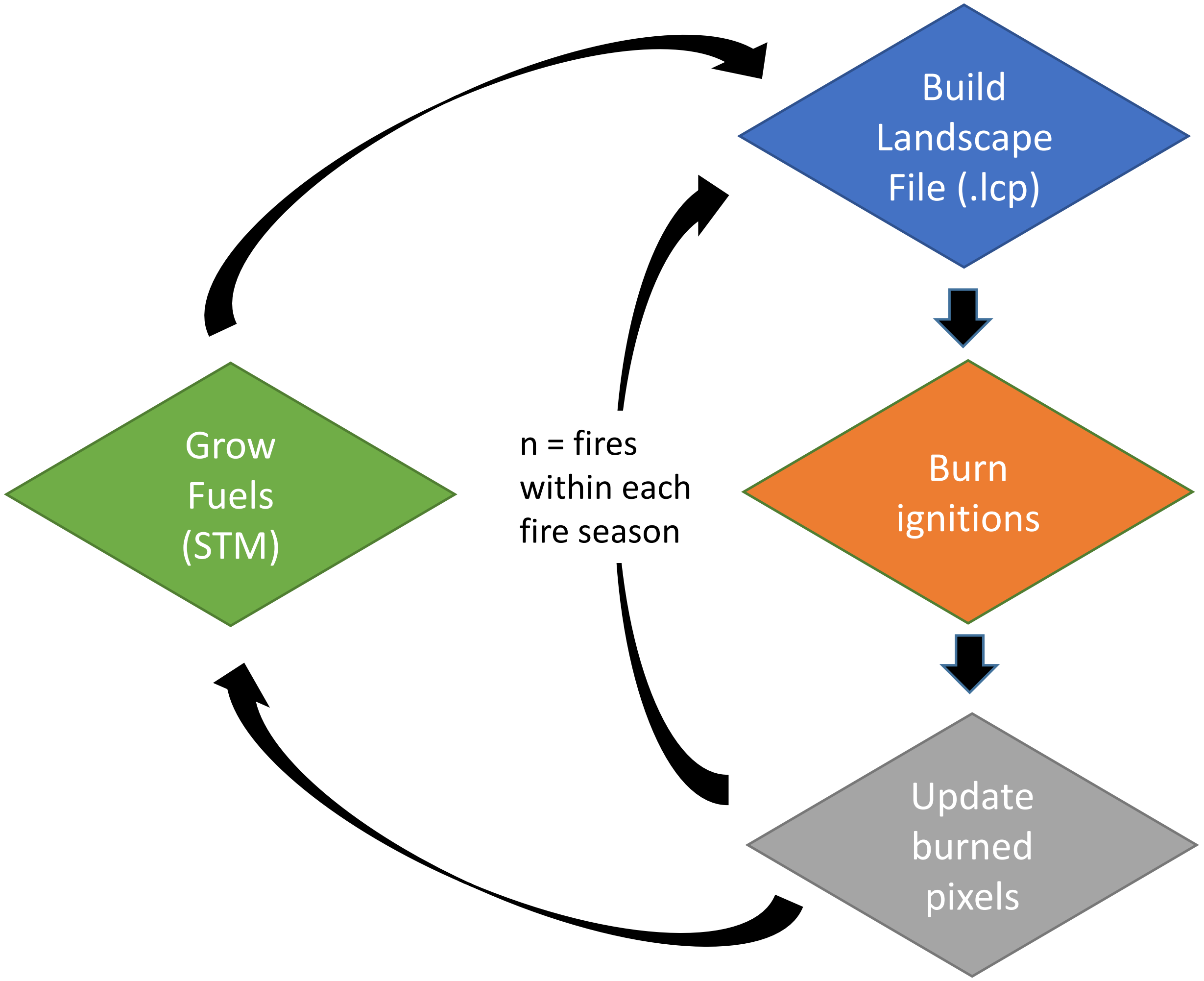
Prior wildfires influence burn severity of subsequent large fires

Camille S. Stevens-Rumann, Susan J. Prichard, Eva K. Strand, and Penelope Morgan

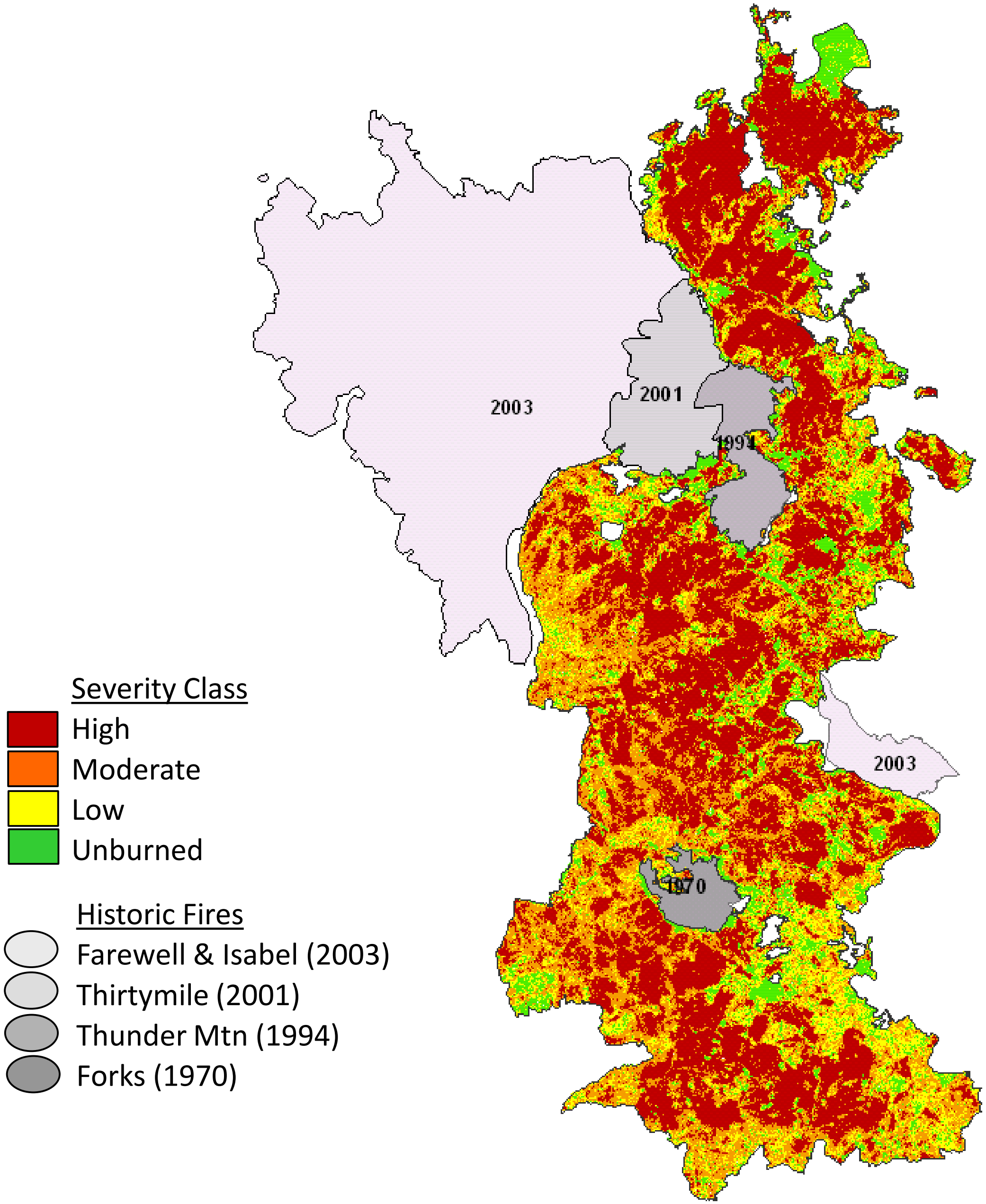


- Past burn severity reduced subsequent burn severity- more resistant
- Even under extreme fire weather conditions, vegetation, topography, and past burn severity all impacted reburn severity

Task 2 – Spatial Simulation Modeling



Task 3: Evaluate Alternatives to Tripod 2006



Tripod Progressions and Weather (July 2006)

BurnDate, Time	Cumulative Acres
7/24/06 9:00 PM	110
7/25/06 10:42 AM	1,267
7/26/06 8:00 AM	4,223
7/27/06 11:00 PM	14,985
7/28/06 9:00 AM	16,765
7/29/06 11:00 PM	27,106
7/30/06 11:00 PM	35,475
7/31/06 11:00 PM	35,838
8/1/06 11:00 PM	36,544
8/2/06 11:00 PM	40,831
8/4/06 2:19 AM	43,941
8/5/06 8:48 PM	49,328
8/6/06 10:13 PM	62,938
8/8/06 9:28 PM	74,587
8/10/06 2:00 AM	79,321
8/12/06 4:00 PM	82,754
8/13/06 2:00 AM	83,288
8/14/06 2:00 AM	89,509
8/15/06 2:00 AM	95,122
8/16/06 2:00 AM	99,388
8/17/06 2:00 AM	103,399
8/18/06 2:00 AM	109,441
8/19/06 2:00 AM	114,566
8/20/06 2:00 AM	119,640
8/21/06 2:00 AM	124,807

Burn Date	Max Temp (F)	Min RH (%)	Avg Wind (mph)	Avg Wind Dir (°)	Max Gust (mph)	Wind Direction	Haines Index
7/13/06	66	21	1	187	15	S	
7/14/06	69	31	2	221	15	SW	
7/15/06	72	22	1	194	14	S	
7/16/06	74	15	2	220	11	SW	
7/17/06	77	16	3	229	16	SW	
7/18/06	82	14	1	241	13	SW	
7/19/06	75	20	3	228	16	SW	
7/20/06	73	28	3	167	15	S	
7/21/06	82	16	2	181	12	S	
7/22/06	89	21	2	143	12	SE	
7/23/06	95	15	1	203	10		
7/24/06	92	14	4	252	12	W	
7/25/06	81	19	6	316	18	NW	
7/26/06	88	11	5	273	20	W	2 Very Low
7/27/06	91	12	3	267	19	W	3 Very Low
7/28/06	71	23	6	329	16	NW	5 Moderate
7/29/06	82	18	2	165	16	S	4-5 Moderate
7/30/06	65	25	2	244	14	SW	3 Very Low
7/31/06	61	24	2	225	15	SW	3 Very Low
8/1/06	70	21	1	233	13	SW	3 Very Low
8/2/06	74	16	5	263	20	W	3 Very Low
8/4/06	77	17	1.3	188	12	S	4 Low
8/5/06	76	20	2.7	210	14	SW	4 Low
8/6/06	81	17	2	194	13	S	4 Low

Wildland Fire Decision Analysis

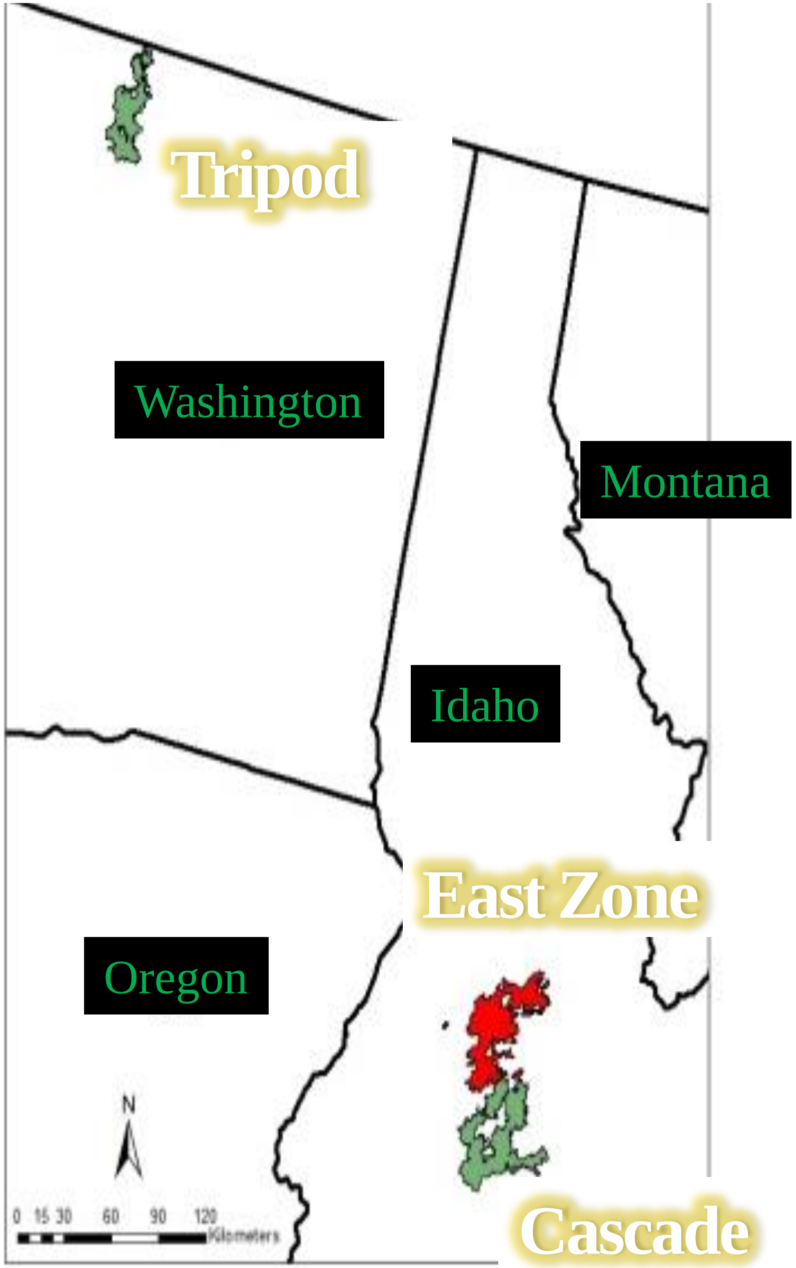
Strategic Planning - Fire Decision Analysis

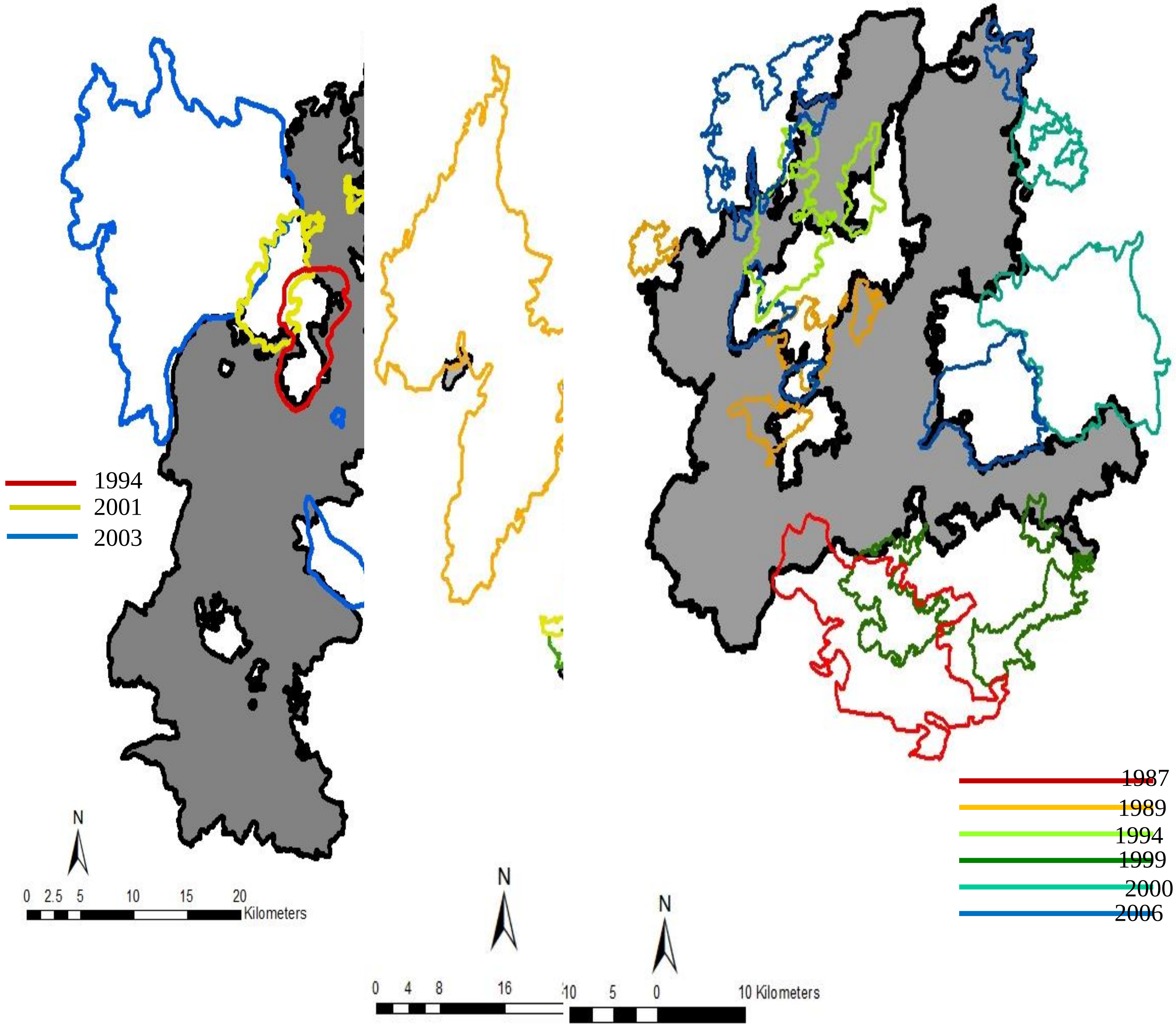
Sample incident decision document (WFDSS would normally be decision of record)

Alternative Landscape: ☑ No Fire ☐ Full Suppression ☐ Managed wildfires ☐ Let it burn

SITUATION INFORMATION				
Location of fire, cause				
Weather forecast				
Short-term fire behavior prediction (FARSITE)				
Objectives and requirements				
RISK ASSESSMENTS				
Relative risk assessment • Communities • Air quality • Water quality • Wildlife habitat • Fisheries • Forest health	Communities / other ownerships Risk, Air Quality	Water quality, fisheries	Fish & wildlife Habitat	Forest health, restoration
Values inventory				
Extended risk assessment				
Weather and fire behavior analysis				
Benefits analysis				
Cost analysis				
HAZARD/RISK CONTROL				
Incident objectives & requirements				
Course of action				
Strategies	Full suppression	Managed wildfire	Forest restoration	
Management action points				
Cost estimates				

Three Wildfires




1994
2001
2003
N
0 2.5 5 10 15 20
Kilometers
N
0 4 8 16
N
10 5 0 10 Kilometers
1987
1989
1994
1999
2000
2006

Methods

Spatial Autoregression (SAR)

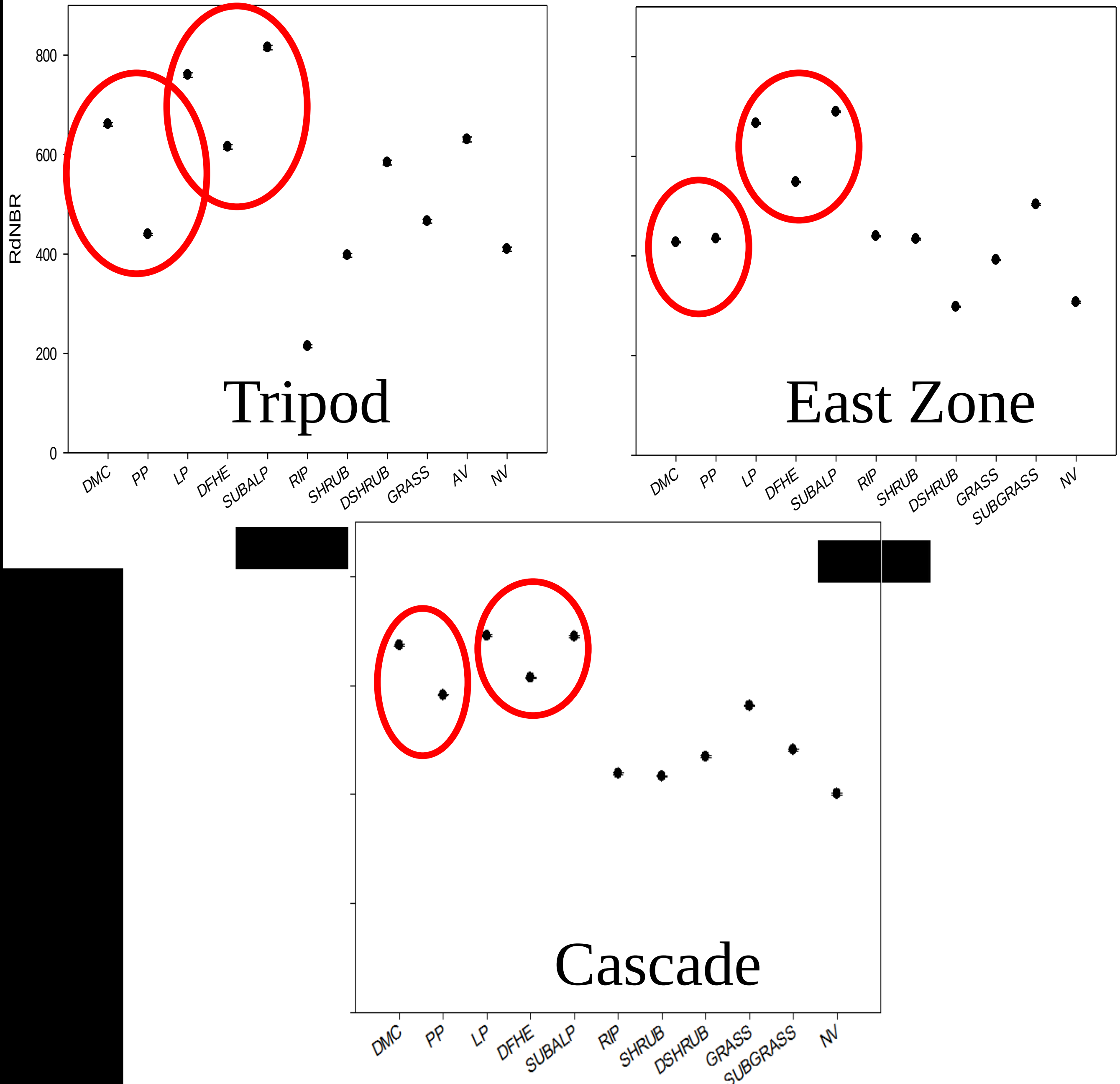
Multiple predictor variables to predict a single response: burn severity

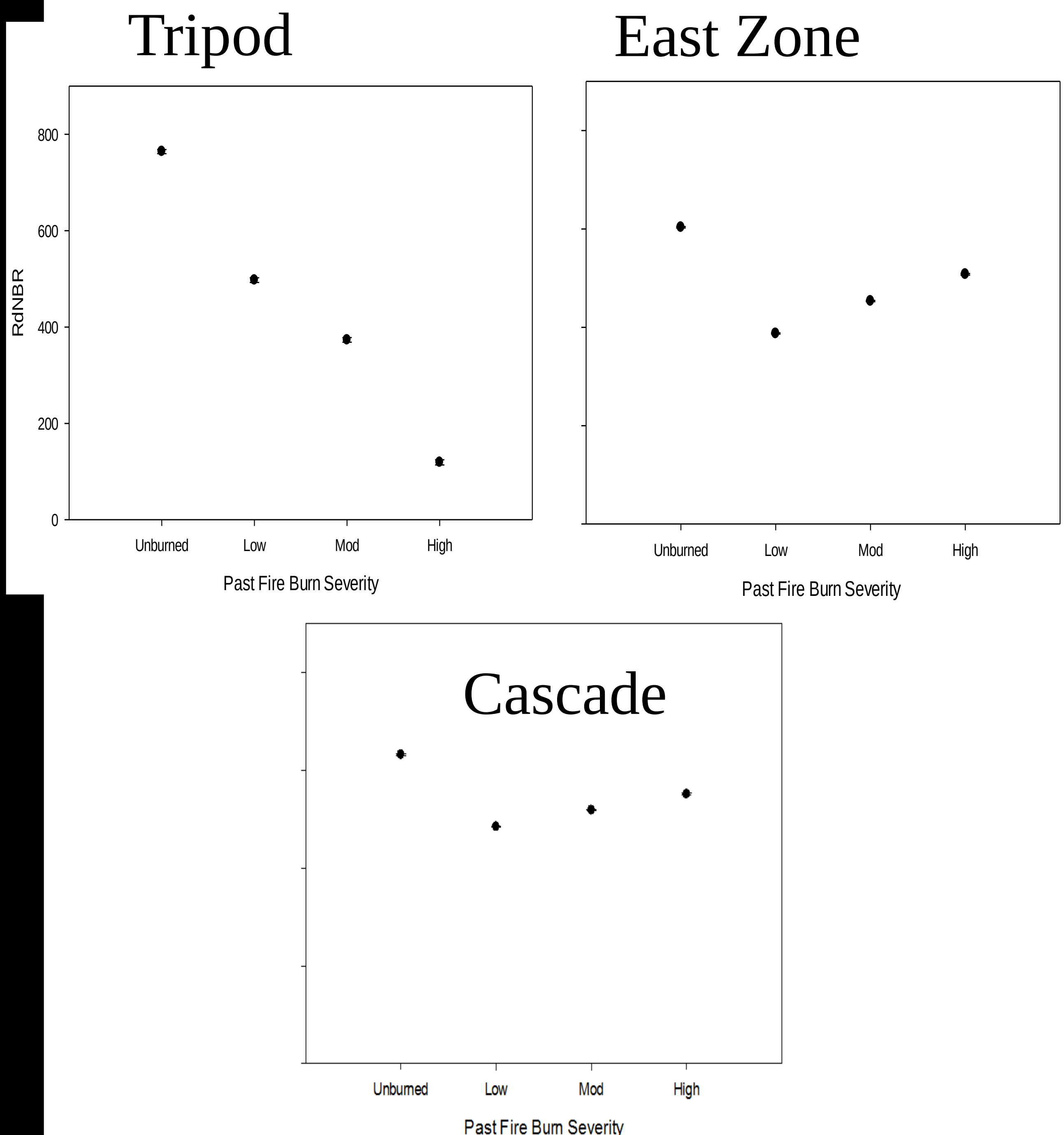
Tripod: 326,541 points
East Zone: 905,805 points
Cascade: 975,414 points

Type	Predictor Variables
Wildfire data	Past burn severity Distance to Edge (m) Time since fire
Fire Weather	MaxTemp(°C) AvgTemp(°C) MaxGust(kph) AvgWind(kph) MinRH (%)
Vegetation	Canopy height (m) Canopy bulk density (kg/m3) Cover Type Canopy Cover (%) Existing veg height (m)
Topography	Elevation (m) Hill Shade Slope(degrees) Solar radiation (WH/m^2) Topographic wetness (TWI) Valley bottom Ridgetop

Final model

Fire	Tripod	East Zone	Cascade
R^2	0.92	0.73	0.77
AIC	4211617	12705587	13728154
Past burn severity	✓	✓	✓
Distance to edge	✓	✓	✓
Cover type	✓	✓	✓
Max temp	✓	✓	✓
Valley	✓	✓	✓
Slope *or* TWI	✓	✓	✓
Elevation	✓	✓	
Canopy cover	✓		✓
Max gust		✓	✓


Tripod
RdNBR
800
600
400
200
0
DMC PP LP DFHE SUBALP RIP SHRUB DSHRUB GRASS AV NV
East Zone
DMC PP LP DFHE SUBALP RIP SHRUB DSHRUB GRASS SUBGRASS NV
[redacted]
Cascade
DMC PP LP DFHE SUBALP RIP SHRUB DSHRUB GRASS SUBGRASS NV


Tripod
East Zone
Cascade
RdNBR
800
600
400
200
0
Unburned
Low
Mod
High
Past Fire Burn Severity

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State and Transition Model Development

State 1A: Post-fire bare ground. Fuel model NB9. 0-14 yr.

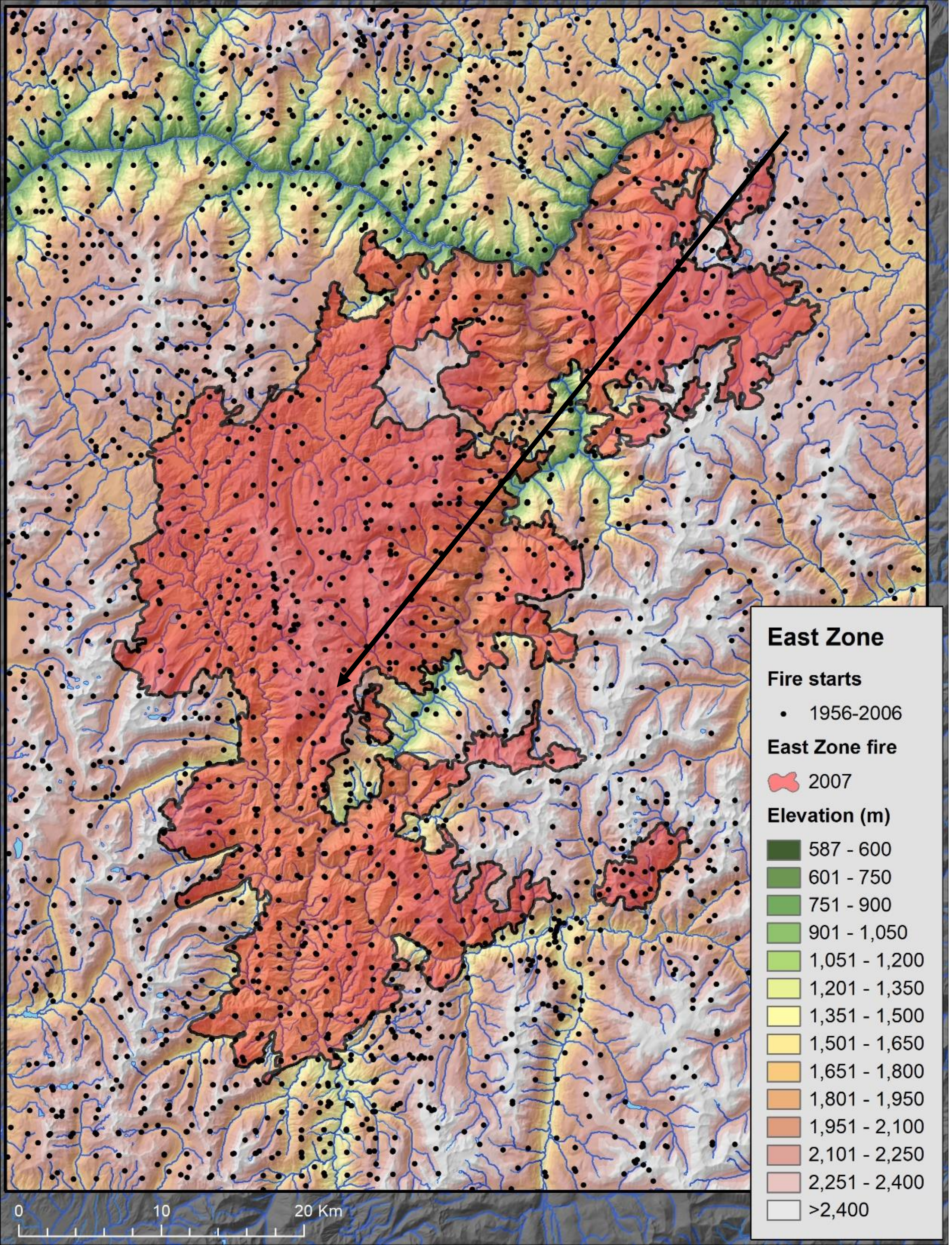
State 2A: Stand initiation. Fuel model GS1. 15-49 yr.

State 3A: Stem exclusion closed-canopy. Fuel model 2. 50-89 yr.

State 4A: Understory reinitiation. Fuel model TU5. 90-129 yr.

State 5A: Young forest multi-story. Fuel model TU5. 130-179 yr.

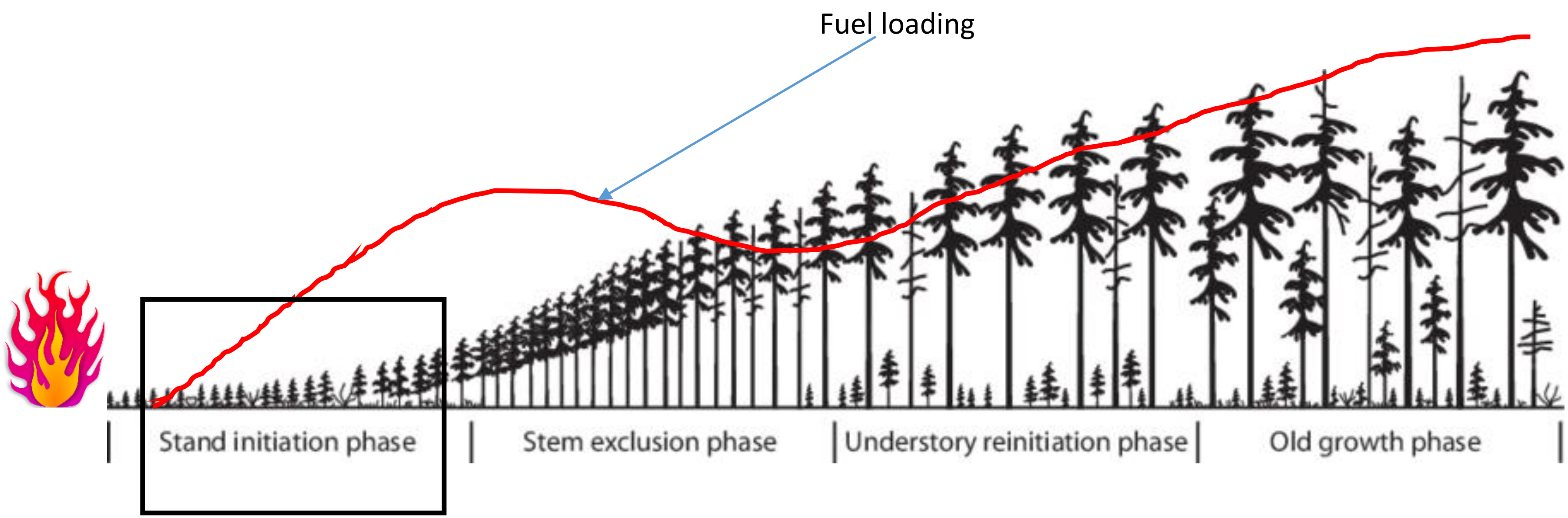
State 6A: Old forest multi-story. Fuel model TU5. ≥ 180 yr.



Pixel burned in 1956

- Assigned State 1A following fire season
- Add a time step prior to 1956
- In the absence of fire, this pixel will transition to State 2A in 1957.

Fuel succession is a continuum….



Ecological succession using stand structure classes (ICBEMP)

Fuelbed succession (chronosequence) using FCCS, local fuel succession models

GR2 (102)

Low Load, Dry Climate Grass (Dynamic)

Description: The primary carrier of fire in GR2 is grass, though small amounts of fine dead fuel may be present. Load is greater than GR1, and fuelbed may be more continuous. Shrubs, if present, do not affect fire behavior.

Fine fuel load (t/ac)	1.10
Characteristic SAV (ft-1)	1820
Packing ratio (dimensionless)	0.00158
Extinction moisture content (percent)	15

TU1 (161)

Low Load Dry Climate Timber-Grass-Shrub (Dynamic)

Description: The primary carrier of fire in TU1 is low load of grass and/or shrub with litter. Spread rate is low; flame length low.

Fine fuel load (t/ac)	1.3
Characteristic SAV (ft-1)	1606
Packing ratio (dimensionless)	0.00885
Extinction moisture content (percent)	20

TU5 (165)

Very High Load, Dry Climate Timber-Shrub

Description: The primary carrier of fire in TU5 is heavy forest litter with a shrub or small tree understory. Spread rate is moderate; flame length moderate.

Fine fuel load (t/ac)	7.0
Characteristic SAV (ft-1)	1224
Packing ratio (dimensionless)	0.02009
Extinction moisture content (percent)	25

TU5 (165)

Very High Load, Dry Climate Timber-Shrub

Description: The primary carrier of fire in TU5 is heavy forest litter with a shrub or small tree understory. Spread rate is moderate; flame length moderate.

Fine fuel load (t/ac)	7.0
Characteristic SAV (ft-1)	1224
Packing ratio (dimensionless)	0.02009
Extinction moisture content (percent)	25

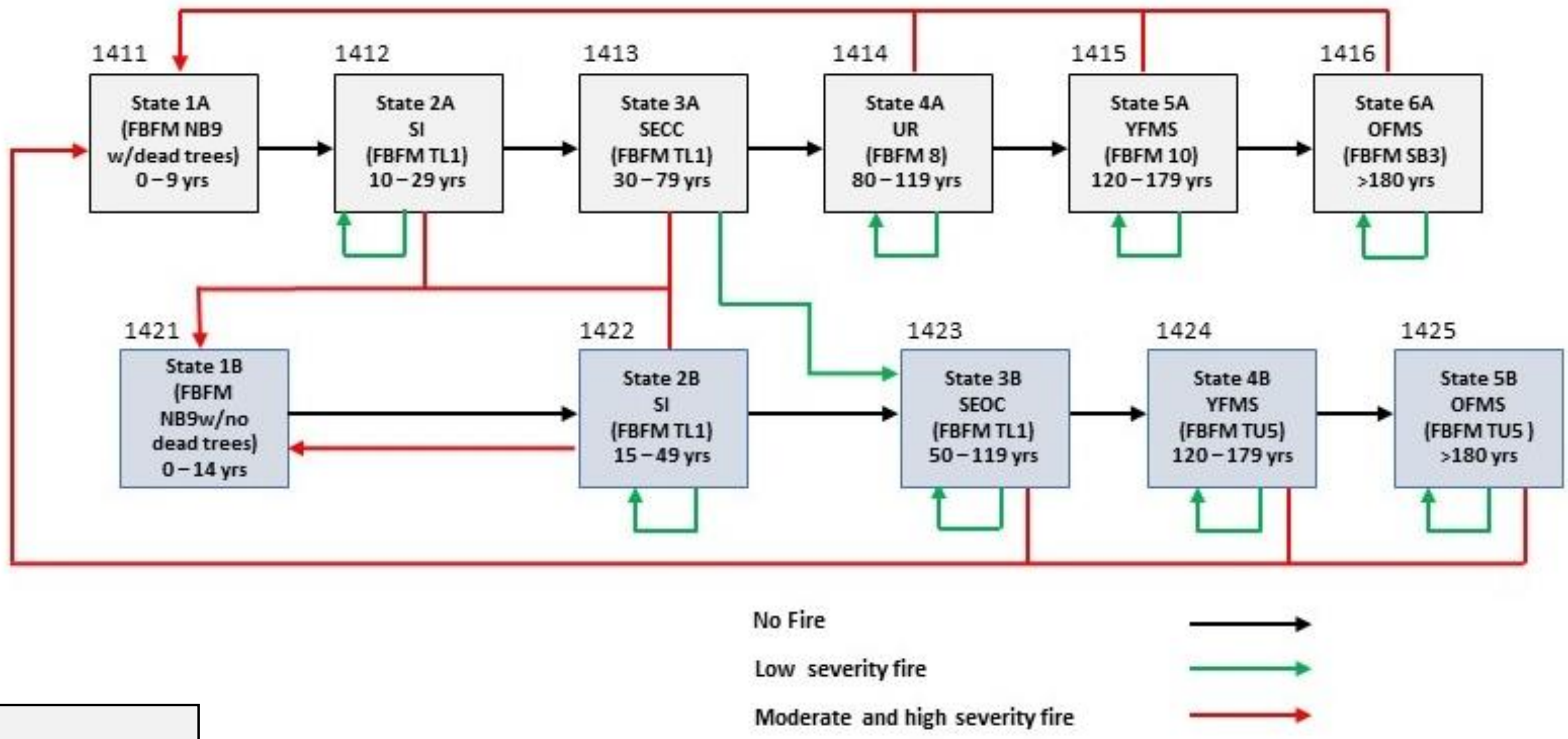
SB3 (203)

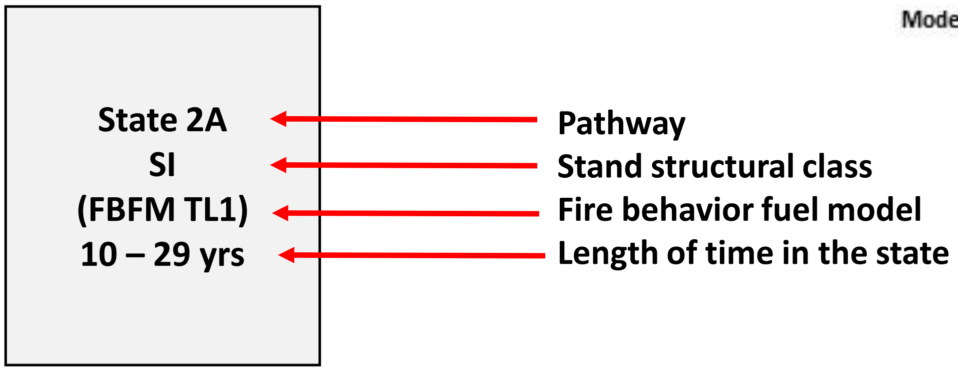
High Load Activity Fuel or Moderate Load Blowdown

Description: The primary carrier of fire in SB3 is heavy dead and down activity fuel or moderate blowdown. Fine fuel load is 7 to 12 t/ac, weighted toward 0 to 0.25 inch diameter class, depth is more than 1 foot. Blowdown is moderate, trees compacted to near the ground. Spread rate is high; flame length high.

Fine fuel load (t/ac)	5.50
Characteristic SAV (ft-1)	1935
Packing ratio (dimensionless)	0.01345
Extinction moisture content (percent)	25

State and Transition Model Tripod Cold Moist Conifer





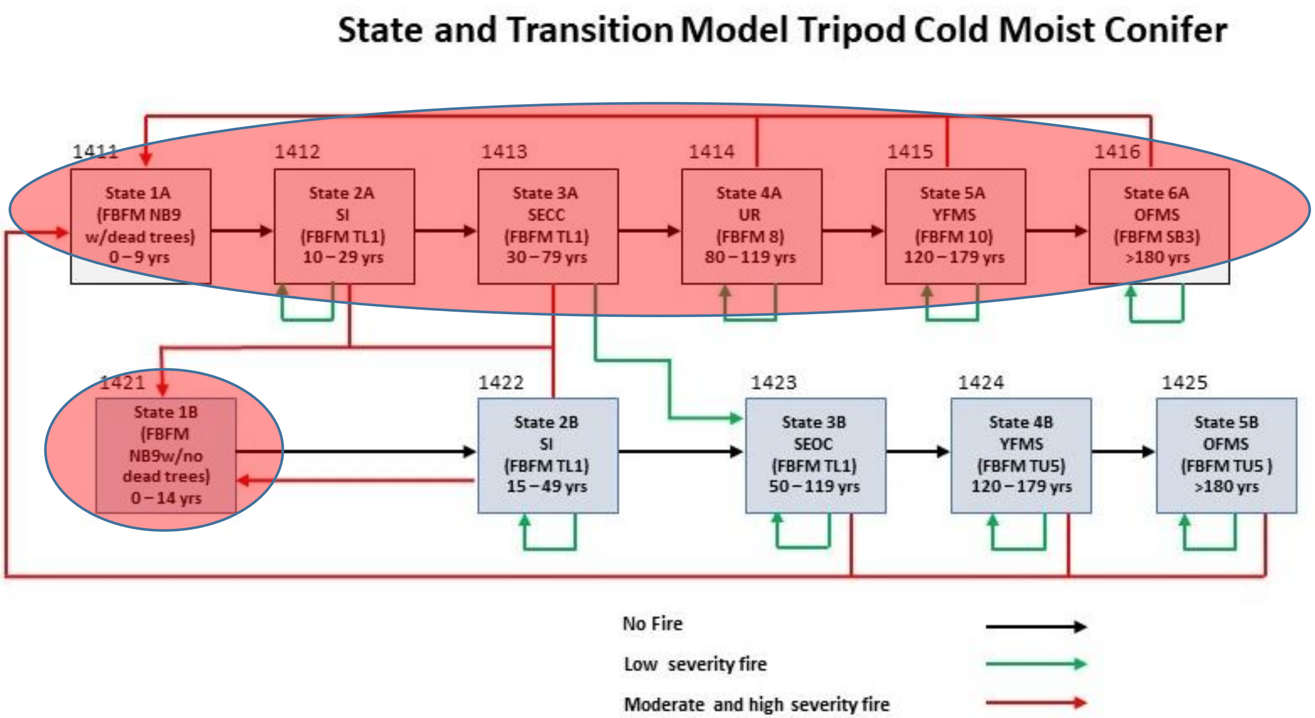
4) Cold Moist Conifer

The cold moist conifer STM follows successional trajectories in lodgepole pine, Engelmann spruce and subalpine fir forests on moist sites that are somewhat more productive than the cold dry conifer STM but with the same states and pathways.

Table 6: Cold moist conifer STM surface and canopy fuel assignments by state.

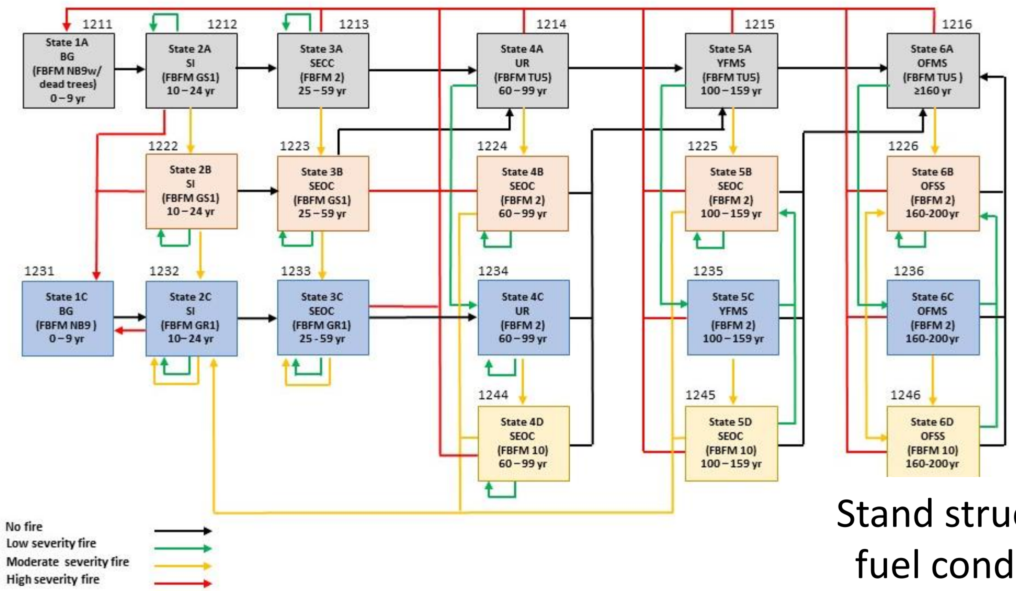
ID	State	Time period (yr)	Stand structure class	Surface fuel model	Canopy bulk density (kg/m³)	Canopy base height (m)	Crown closure (%)	Canopy height (m)
	1A	0-9	PFBG	NB9	0.0010	0.0	10	2.0
	2A	10-29	SI	TL1	0.0673	0.5	30	6.1
	3A	30-79	SECC	TL1	0.0993	0.8	70	16.2
	4A	80-119	UR	8	0.1137	0.8	60	22.3
	5A	120-179	YFMS	10	0.1185	0.8	65	33.2
	6A	≥180	OFMS	SB3	0.1185	0.4	70	33.2
	1B	0-14	PFBG	NB9	0.0010	0.0	5	2.0
	2B	15-49	SI	TL1	0.0336	0.5	26	6.1
	3B	50-119	SEOC	TL1	0.0673	1.0	46	22.3
	4B	120-179	YFMS	TU5	0.1185	0.8	65	33.2
	5B	≥180	OFMS	TU5	0.1185	0.6	70	33.2

Difference between pathways – function of fire behavior/effects at each successional stage



- Fuel load from antecedent forest carried forward through several stages of forest and fuel succession

- Fuels from antecedent forest mostly consumed early in succession on pathway “A” in a reburn. The result is much lower fuel loading carried forward on pathway “B” through several stages of succession.



Stand structure, fuel condition inputs

Fuel moisture, fire weather, terrain inputs

Fire behavior and effects outputs

- Low severity fire: 25% mortality
- Mod severity fire: 25-70% mortality
- High severity fire: >70% mortality

	A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	S	U	V	W	X	Y	AB	AC	AD
1	Pathway = Dry Mixed Conifer								Behave inputs											Behave outputs					
2	State	Season Bin	FBFM	Structure	Canopy cover (%)	Canopy height (m)	Canopy base height (m)	Canopy Bulk Density (kgm3)	Mortality tree species	DBH cm	1-hr (%)	10-hr (%)	100-hr (%)	Live herb (%)	Live woody (%)	Foliar (%)	20-ft windspeed (kph)	Air temp (°C)	Slope steepness (%)	Flame length (m)	Fire type	Probability of mortality (%)	Flame Length Bins low	mod	high
3	1A		NB9	BG	1	2.1	0	0.00019																	
4	2A	1a	GS1	SI	18	6.4	0.6	0.03200	PIPO	5	7	8	10	34	75	90	8	12	35	0.7	PASSIVE	10	< 0.75	> 0.75 < 0.85	> 0.85
5	2A	1b									4	5	7	19	68	90	13	33	35	0.9	PASSIVE	79			
6	2A	2a									5	6	9	61	98	120	8	21	35	0.6	SURFACE	10			
7	2A	2b									4	5	7	51	78	120	10	26	35	0.8	PASSIVE	31			
8	2A	2c									4	4	6	37	65	120	11	39	35	0.9	PASSIVE	80			
9	2A	2d									3	3	5	36	60	120	16	46	35	1.1	PASSIVE	80			
10	2A	3a									8	8	12	45	92	90	6	14	35	0.6	PASSIVE	8			
11	2A	3b									4	5	8	30	65	90	11	34	35	0.9	PASSIVE	79			
12	3A	1a	2	SEOC	34	14.6	0.1	0.02980	PIPO	28	7	8	10	34	75	90	8	12	35	1.2	PASSIVE	12	< 1.25	> 1.25 < 1.4	> 1.4
13	3A	1b									4	5	7	19	68	90	13	33	35	1.4	PASSIVE	70			
14	3A	2a									5	6	9	61	98	120	8	21	35	1.2	PASSIVE	19			
15	3A	2b									4	5	7	51	78	120	10	26	35	1.3	PASSIVE	36			
16	3A	2c									4	4	6	37	65	120	11	39	35	1.4	PASSIVE	80			
17	3A	2d									3	3	5	36	60	120	16	46	35	1.6	PASSIVE	80			
18	3A	3a									8	8	12	45	92	90	6	14	35	1.1	PASSIVE	11			
19	3A	3b									4	5	8	30	65	90	11	34	35	1.4	PASSIVE	71			
20	4A	1a	TU5	UR	34	19.8	1	0.02750	PIPO	36	7	8	10	34	75	90	8	12	35	1.5	PASSIVE	11	< 1.6	> 1.6 < 1.8	> 1.8
21	4A	1b									4	5	7	19	68	90	13	33	35	1.8	PASSIVE	75			
22	4A	2a									5	6	9	61	98	120	8	21	35	1.5	PASSIVE	16			
23	4A	2b									4	5	7	51	78	120	10	26	35	1.7	PASSIVE	40			
24	4A	2c									4	4	6	37	65	120	11	39	35	1.8	PASSIVE	80			
25	4A	2d									3	3	5	36	60	120	16	46	35	2.1	PASSIVE	80			
26	4A	3a									8	8	12	45	92	90	6	14	35	1.3	PASSIVE	9			
27	4A	3b									4	5	8	30	65	90	11	34	35	1.8	PASSIVE	76			
28	5A	1a	TU5	YFMS	45	27.4	1	0.02750	PIPO	46	7	8	10	34	75	90	8	12	35	1.5	PASSIVE	8	< 1.75	> 1.75 < 1.85	> 1.85
29	5A	1b									4	5	7	19	68	90	13	33	35	1.8	PASSIVE	38			

BehaveNotes | MMC | DMC | CMC | CDC

Cold Dry Conifer STMs

State 1A: Post-fire bare ground. Fuel model NB9. 0-14 yr.

State 2A: Stand initiation. Fuel model GS1. 15-49 yr.

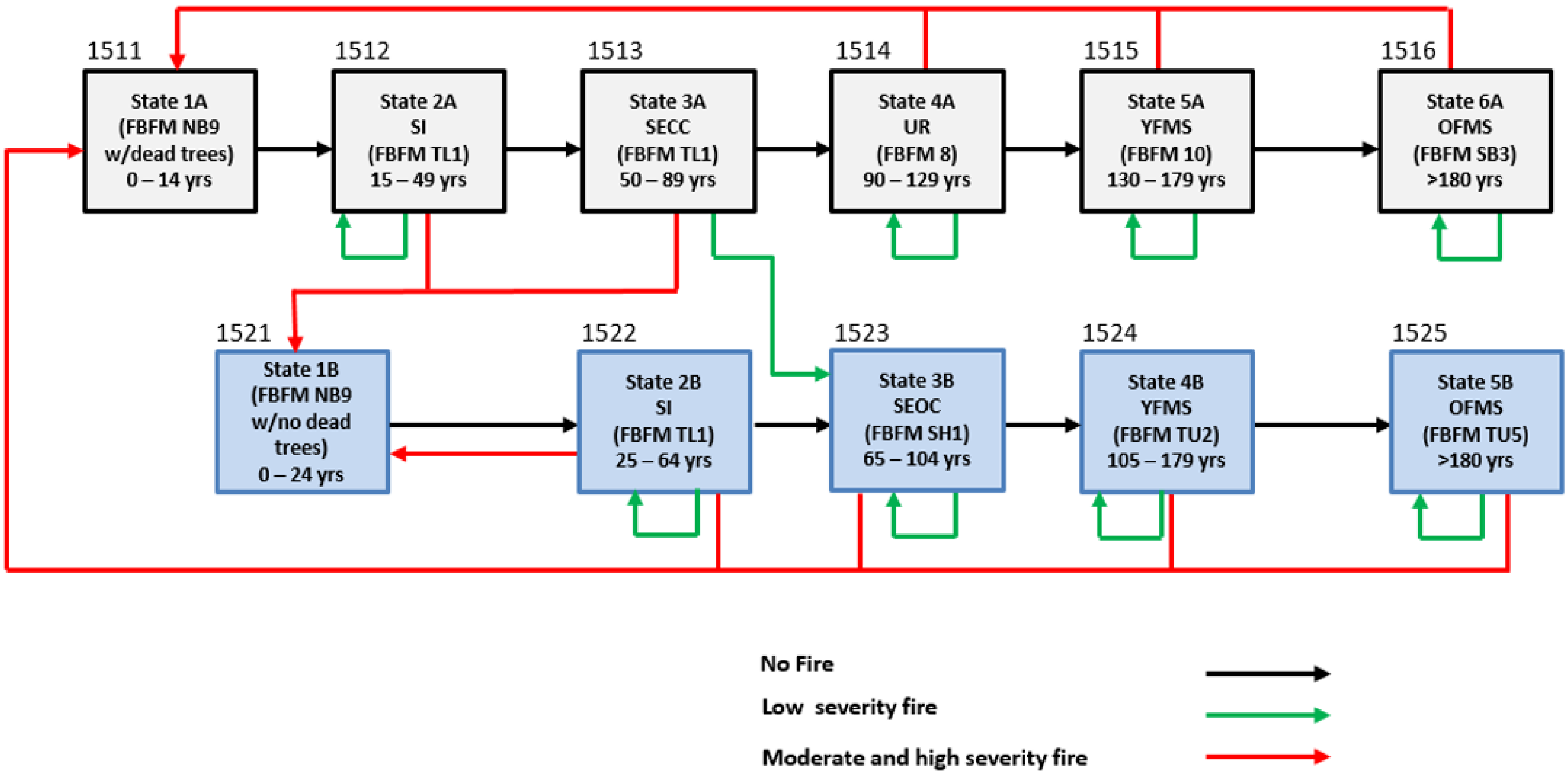
State 3A: Stem exclusion closed-canopy. Fuel model 2. 50-89 yr.

State 4A: Understory reinitiation. Fuel model TU5. 90-129 yr.

State 5A: Young forest multi-story. Fuel model TU5. 130-179 yr.

State 6A: Old forest multi-story. Fuel model TU5. ≥ 180 yr.

Cold Dry Conifer Model



Dry Mixed Conifer STMs

State 1A: Post-fire bare ground. Fuel model NB9. 0-9 yr.

State 2A: Stand initiation. Fuel model GS1. 10-24 yr.

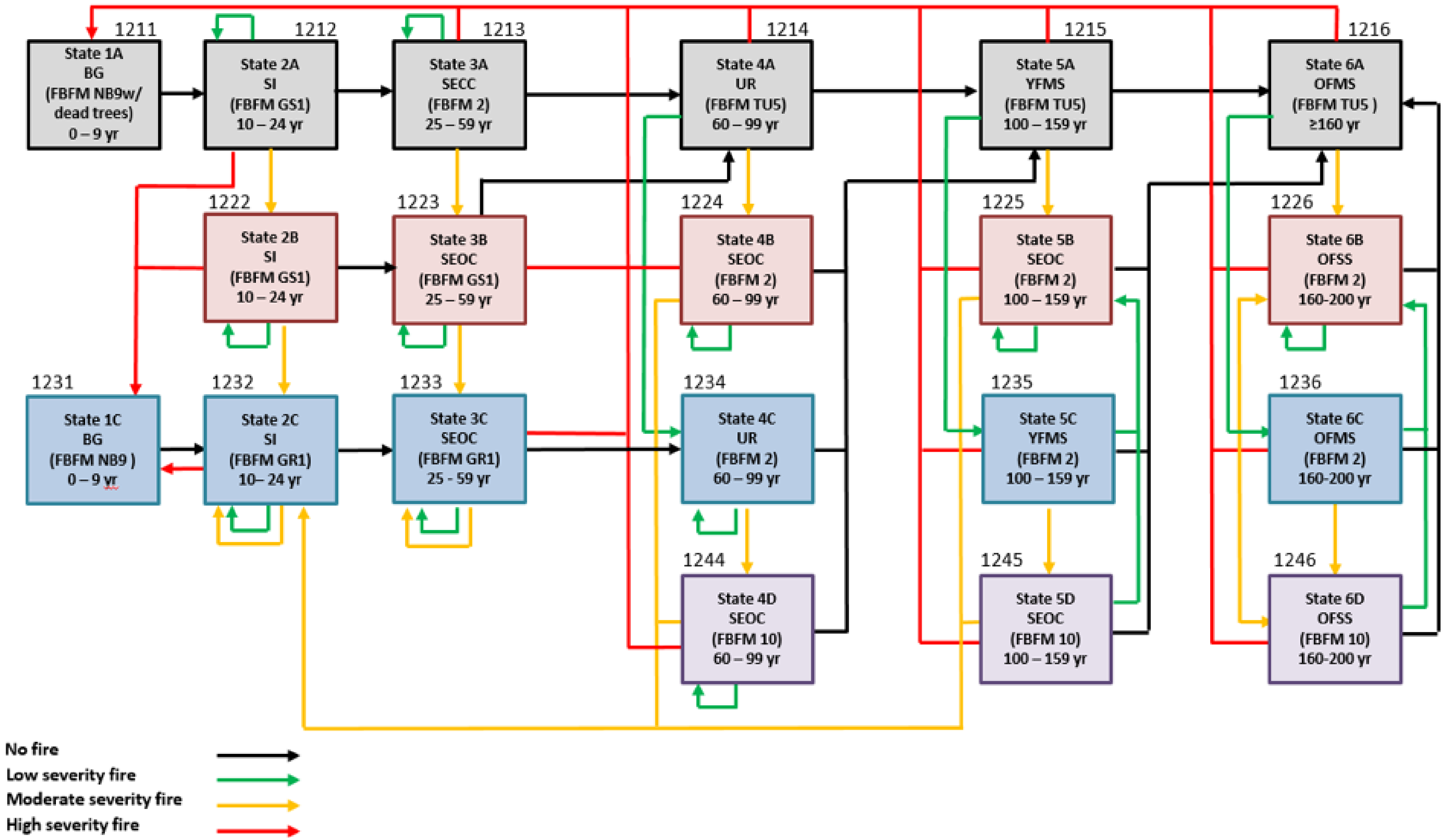
State 3A: Stem exclusion closed-canopy. Fuel model 2. 25-59 yr.

State 4A: Understory reinitiation. Fuel model TU5. 60-99 yr.

State 5A: Young forest multi-story. Fuel model TU5. 100-159 yr.

State 6A: Old forest multi-story. Fuel model TU5. 80-120 yr.

Dry Mixed Conifer Model



State and Transition Models of semi-arid forest landscapes in western North America: fire and fuel pathways

Authors:
Susan Prichard, Bob Gray, Richy Harrod, Paul Hessburg, Nicholas Povak, and Brion Salter

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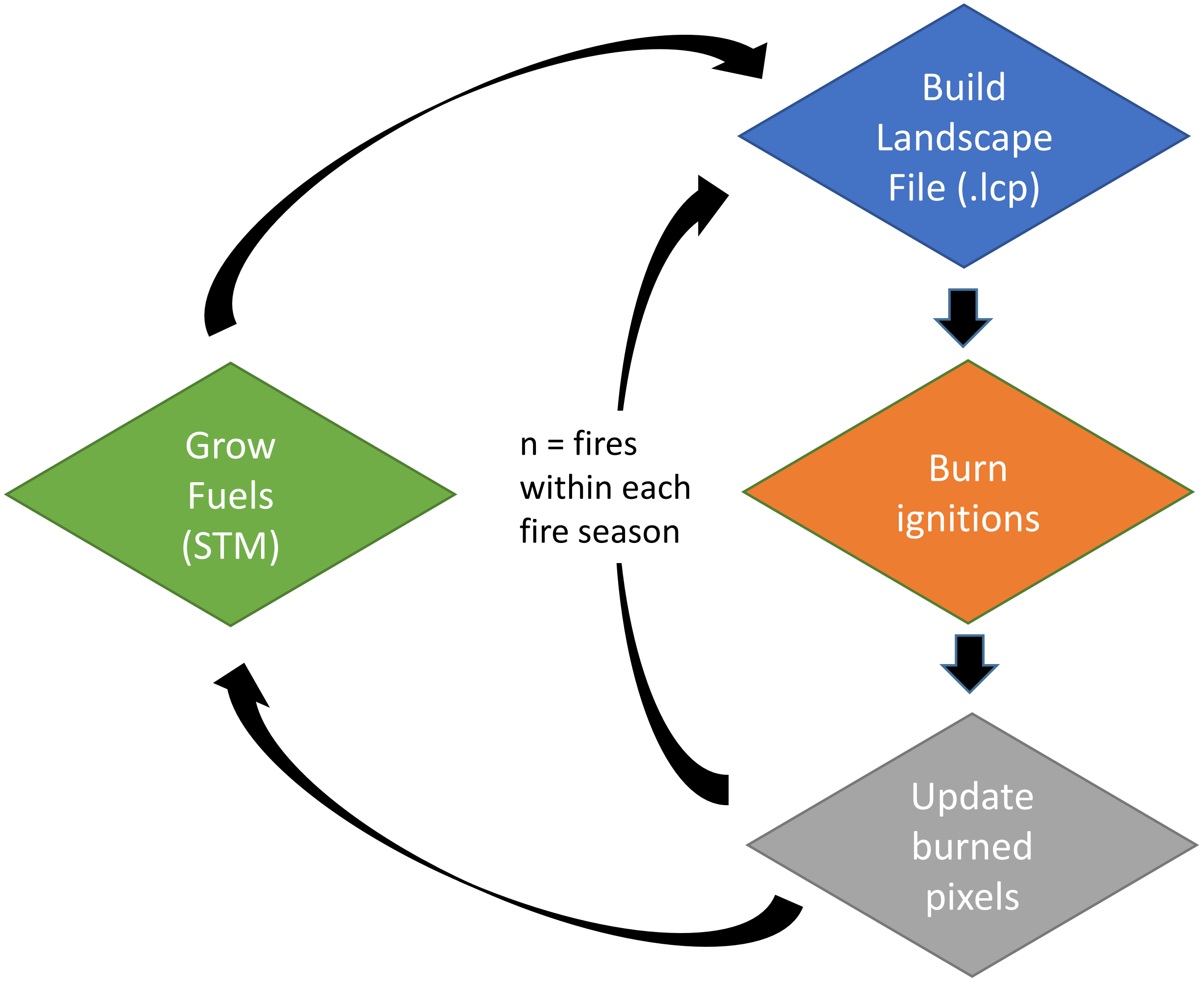
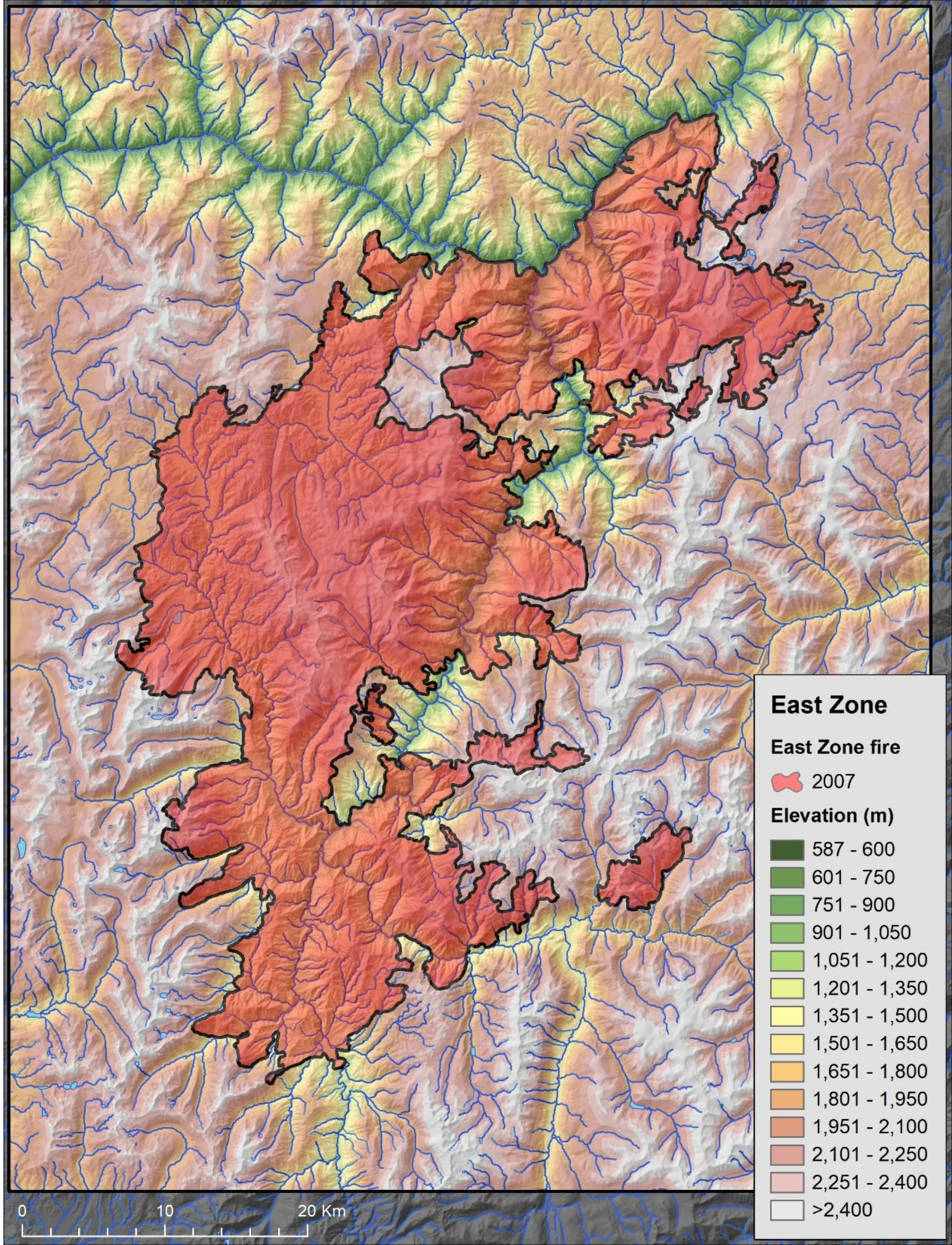
Task 2 – Spatial Simulation Modeling



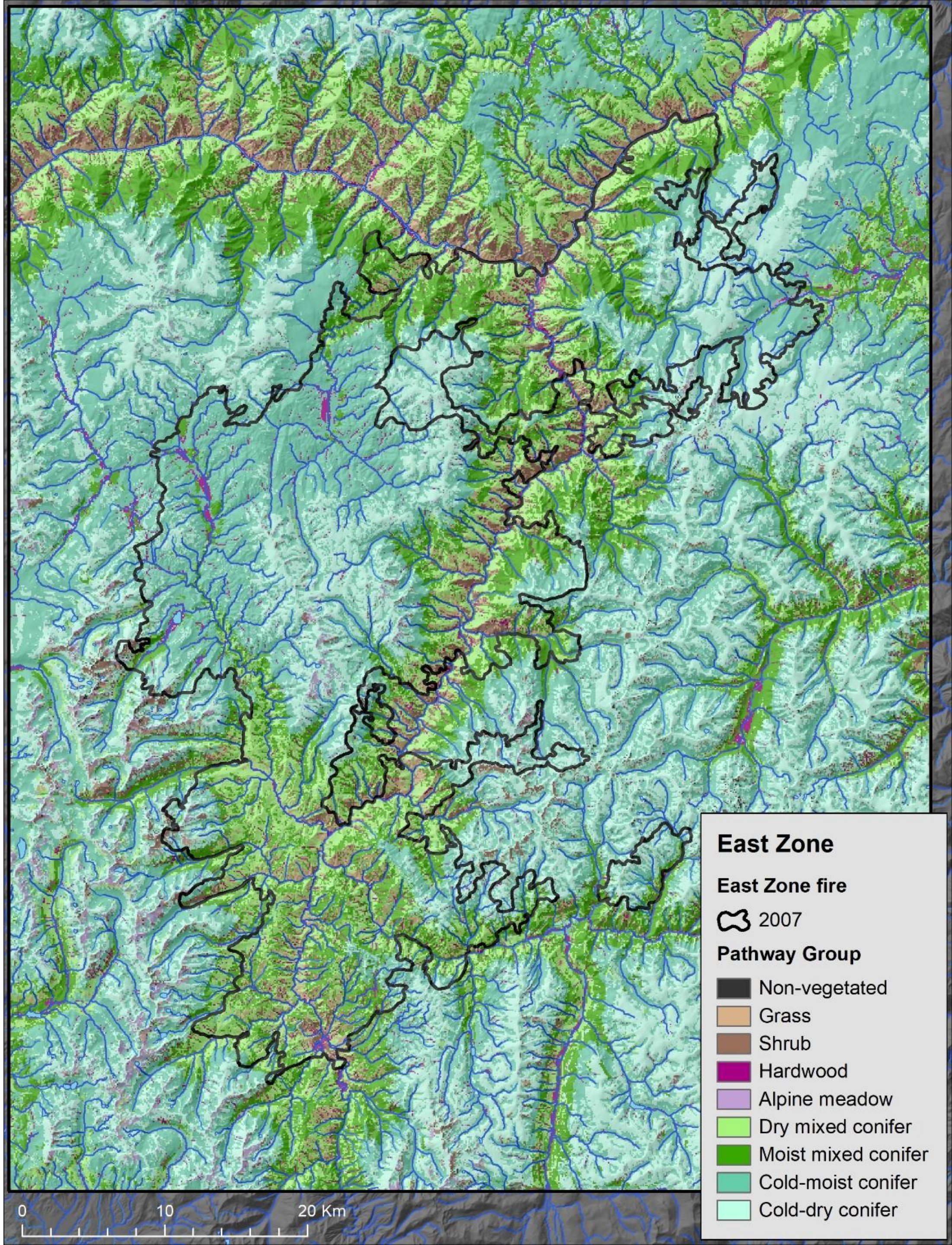
Beaverhead-De
National Fo
Payette
National Forest
Salmon -
Challis
National Forest
Sawtooth
National Forest
Boise
Nampa
IDAHO



East Zone
East Zone fire
2007
Elevation (m)
587 - 600
601 - 750
751 - 900
901 - 1,050
1,051 - 1,200
1,201 - 1,350
1,351 - 1,500
1,501 - 1,650
1,651 - 1,800
1,801 - 1,950
1,951 - 2,100
2,101 - 2,250
2,251 - 2,400
>2,400
0
10
20 Km

McCall

Base Landscape Development (East Zone)



Pathway Group Map Development

1) Spatially represented Pathway Groups across the study area (LANDFIRE base map reclassified to pathway groups and states).

2) Fine-tuned using aspect and topographic ridgetop and valley-bottom settings for all forest types/pathway groups.

3) For high-elevation forests used biophysical setting to differentiate high-elevation cold-dry and cold-moist and also between lower elevation dry-mixed conifer and moist-mixed conifer.

StateID	Pathway Group	State	Max Time in State	FBFM Name	FBFM	CC	CH	CBH	CBD	FRST_SS	Structure
1111	NoPath	1A	9999	NB9	99	0	0.0	0.0	0.0000	20	BG - rock/water/ice
1121	NoPath	1B	9999	GR4	104	0	0.0	0.0	0.0000	17	herbland
1131	NoPath	1C	9999	GS2	122	0	0.0	0.0	0.0000	18	shrubland
1141	NoPath	1D	9999	TU1	161	60	15.0	5.0	0.1314	19	hardwoods
1151	NoPath	1E	9999	TU1	161	0	0.0	0.0	0.0000	17	montane meadow
1211	DMC	1A	10	NB9	99	1	2.1	0.0	0.0019	20	PFBG
1212	DMC	2A	15	GS1	121	18	6.4	0.6	0.0320	10	SI
1213	DMC	3A	35	2	2	60	14.6	0.8	0.0298	12	SECC
1214	DMC	4A	40	TU5	165	34	19.8	1.0	0.0275	13	UR
1215	DMC	5A	60	TU5	165	45	27.4	1.0	0.0275	14	YFMS
1216	DMC	6A	9999	TU5	165	55	36.6	1.5	0.0320	15	OFMS
1222	DMC	2B	15	GS1	121	15	5.5	0.6	0.0205	10	SI
1223	DMC	3B	35	GS1	121	25	13.7	1.5	0.0228	11	SEOC
1224	DMC	4B	40	2	2	30	18.3	1.0	0.0259	11	SEOC
1225	DMC	5B	60	2	2	40	27.4	2.0	0.0275	11	SEOC
1226	DMC	6B	40	2	2	55	36.6	3.0	0.0275	16	OFSS
1231	DMC	1C	10	NB9	99	1	2.1	0.0	0.0019	20	PFBG
1232	DMC	2C	15	GR1	101	15	5.5	0.6	0.0205	10	SI
1233	DMC	3C	35	GR1	101	25	13.7	1.5	0.0228	11	SEOC
1234	DMC	4C	40	2	2	30	18.3	1.0	0.0259	13	UR
1235	DMC	5C	60	2	2	40	27.4	1.5	0.0275	14	YFMS
1236	DMC	6C	40	2	2	55	36.6	1.0	0.0275	13	UR
1244	DMC	4D	40	10	10	34	19.8	1.5	0.0275	11	SEOC
1245	DMC	5D	60	10	10	45	27.4	1.5	0.0275	11	SEOC
1246	DMC	6D	40	10	10	55	36.6	2.5	0.0320	16	OFSS

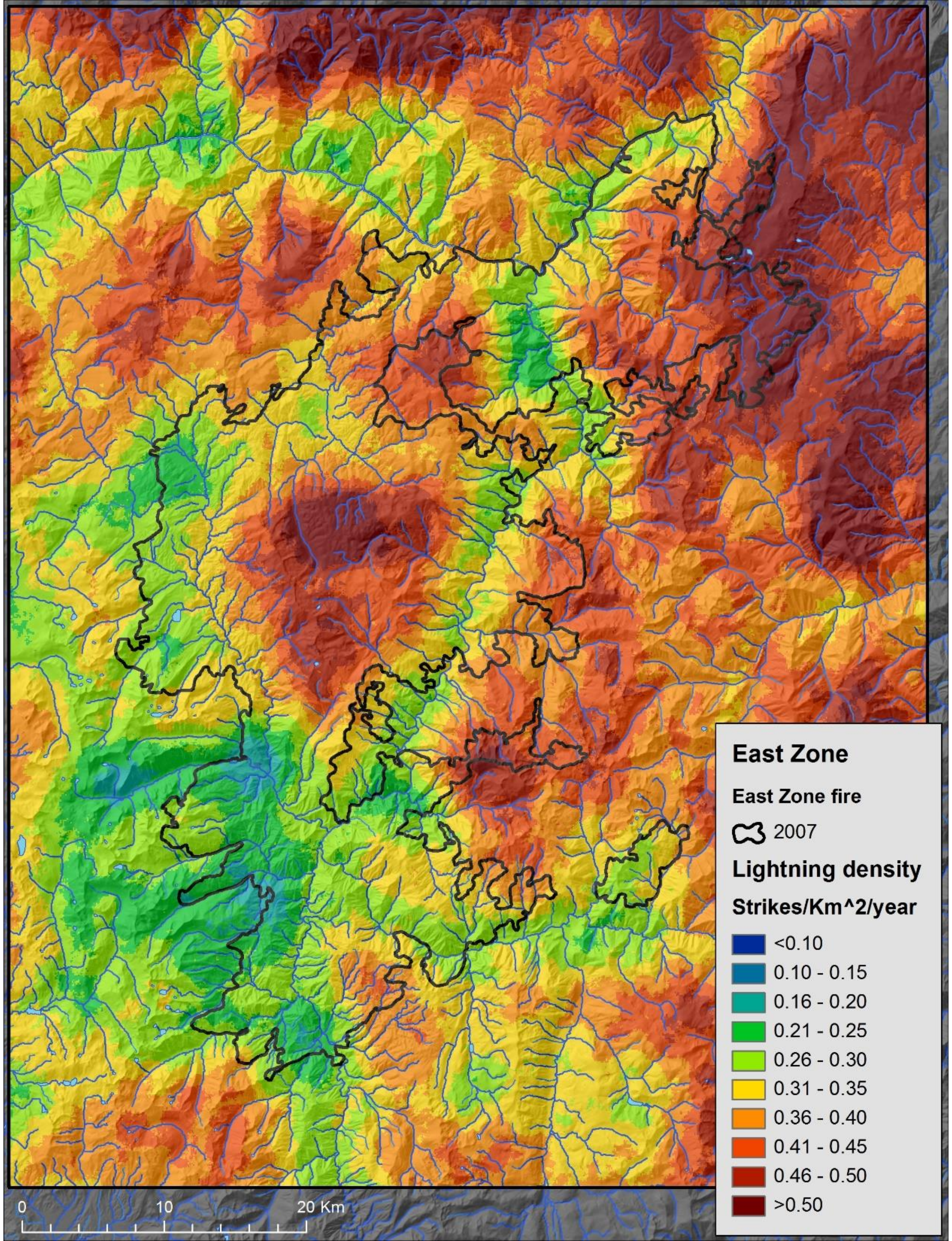
Model Selection

FSPro

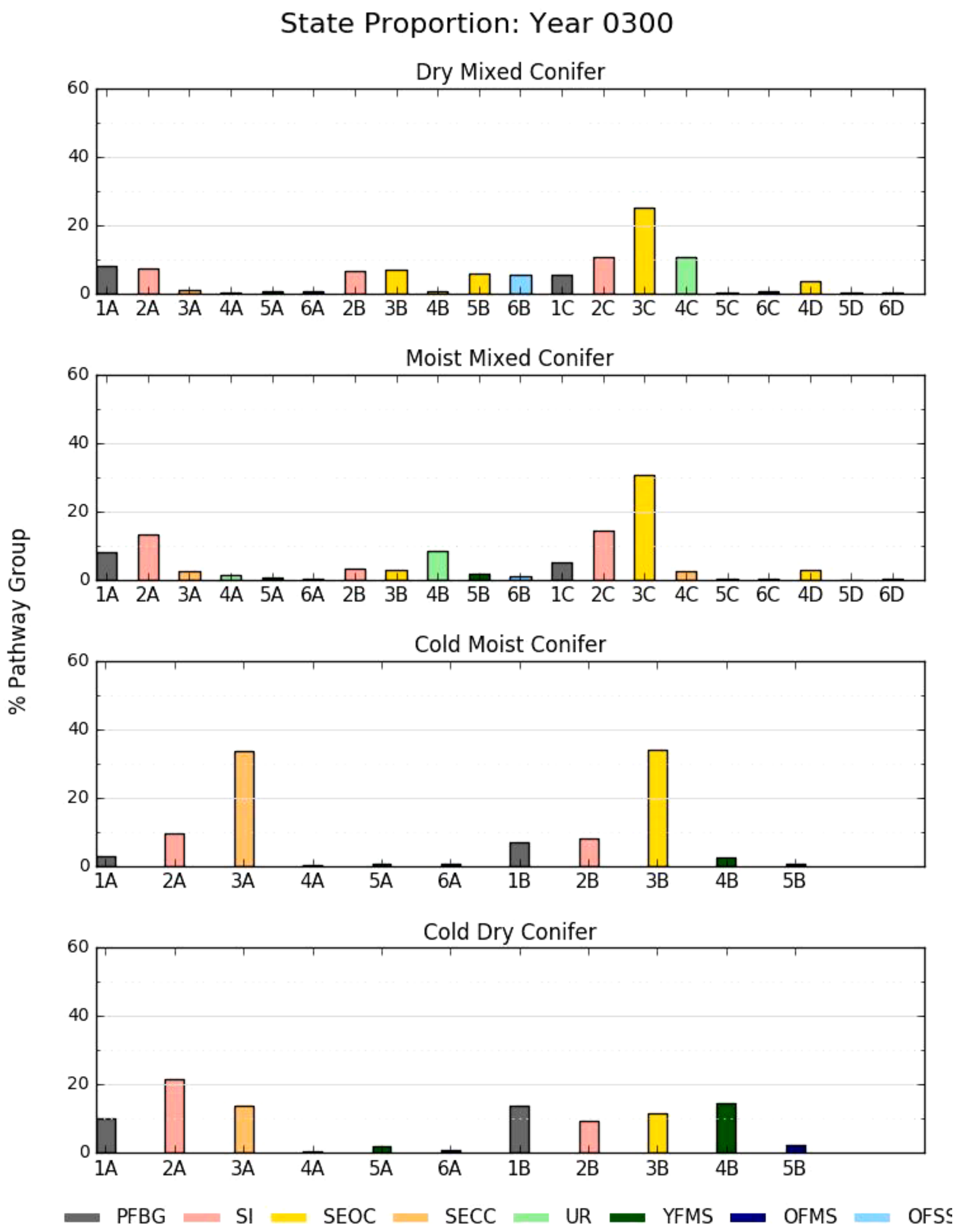
- Allows for daily ERC, wind speed and direction to vary across burn period.
- Some stochasticity allowed in fire progression.
- Command line version was available, allowing us to integrate into geospatial modeling framework.
- Commonly used in WFDSS – our implementation was more of a hybrid between FSPro and MTT that ran a single fire but varied weather across the burn period.

Simulation Modeling Steps

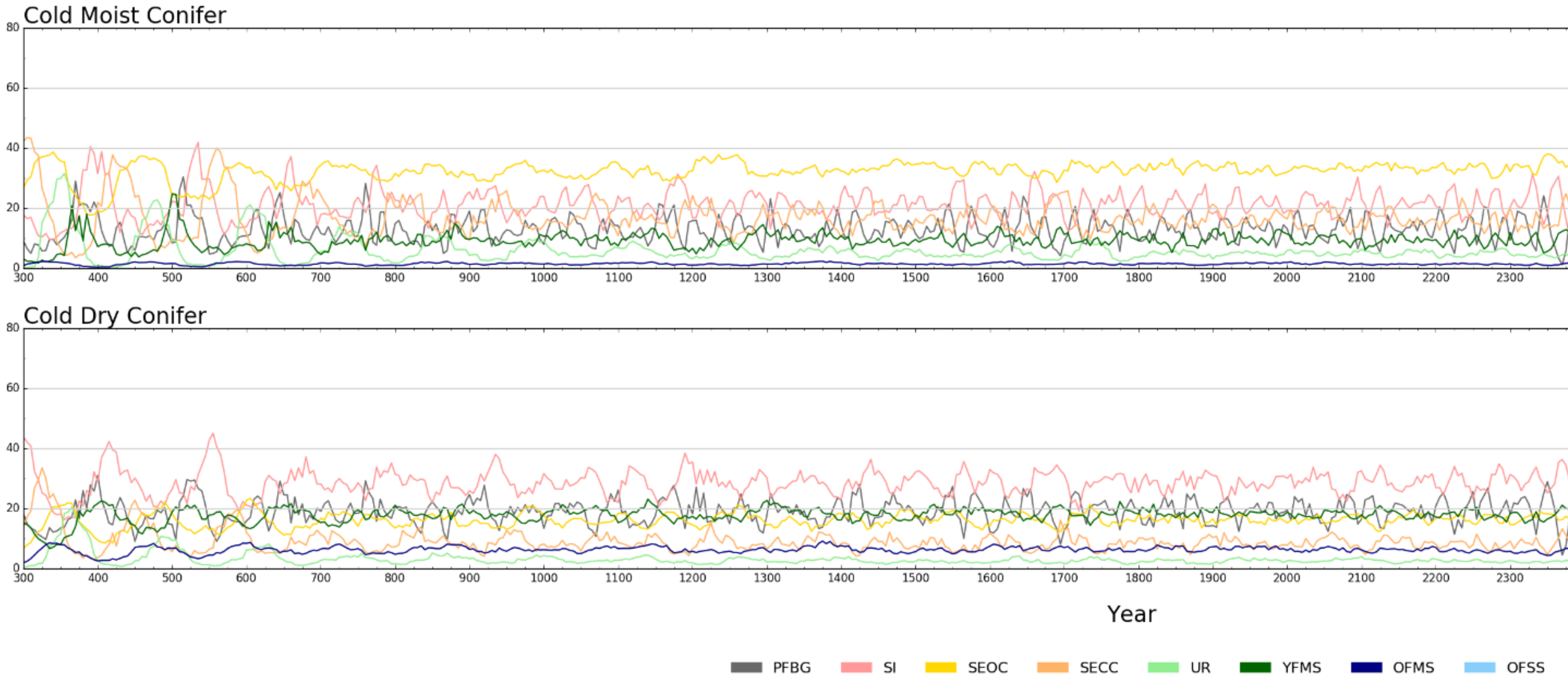
1. Start fire season with year + 1 and any STM transitions.
2. Randomly select fire year (number of fires)
3. For each fire, randomly select Julian date for ignition (based on known distributions of events)
4. Spatially allocate fires using lightning probability map
5. Ignite each fire by date (drawn from weather stream data for that day)
6. Fire runs until two consecutive days of ERC < 55 (2 week maximum)
7. Burned pixels remain NB9 through fire season
8. At end of fire season convert modeled flame lengths to burn severity and update state map


East Zone
East Zone fire
2007
Lightning density
Strikes/Km^2/year
<0.10
0.10 - 0.15
0.16 - 0.20
0.21 - 0.25
0.26 - 0.30
0.31 - 0.35
0.36 - 0.40
0.41 - 0.45
0.46 - 0.50
>0.50
0
10
20 Km

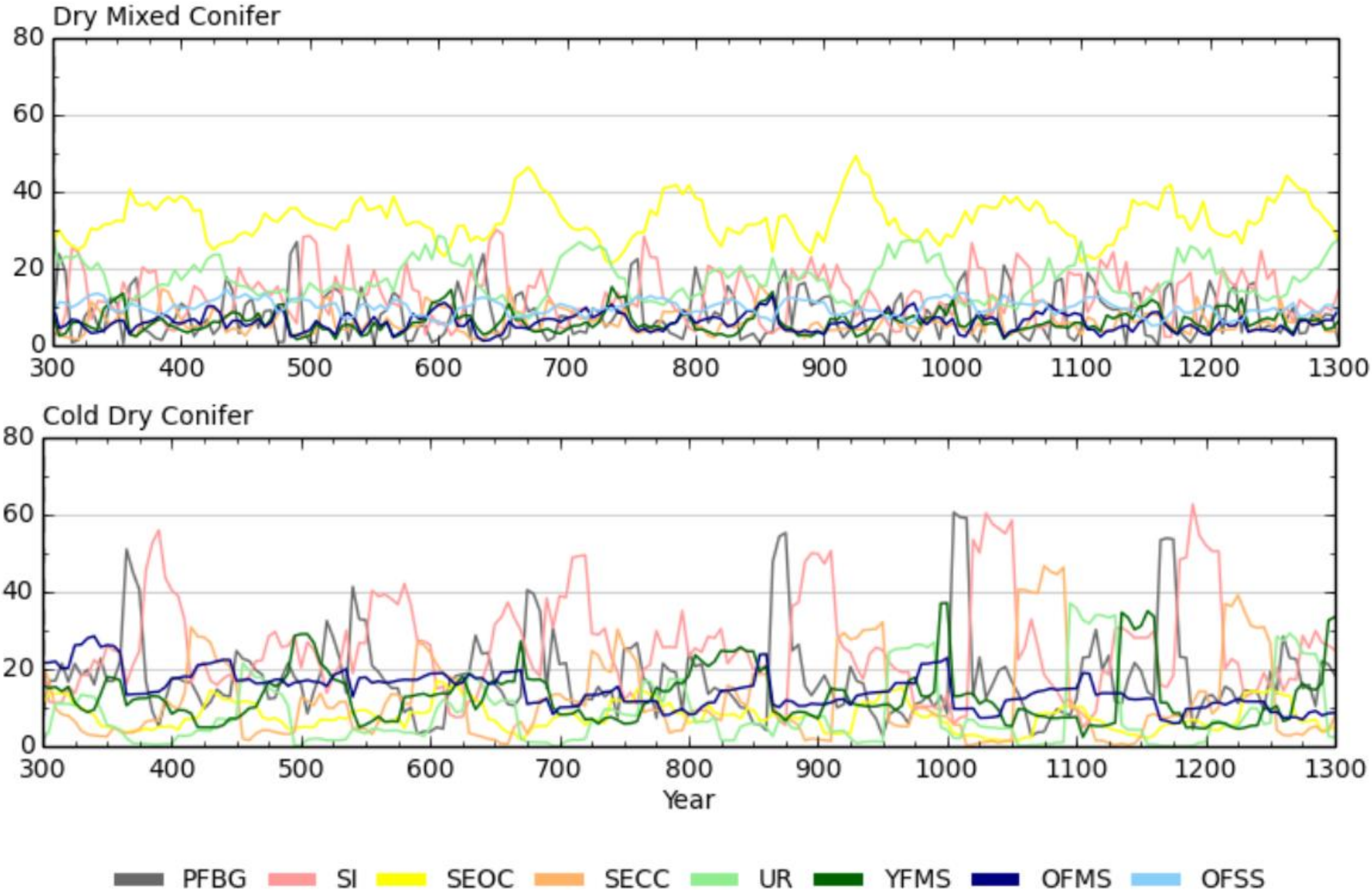
Calibration Tool – East Zone state movies



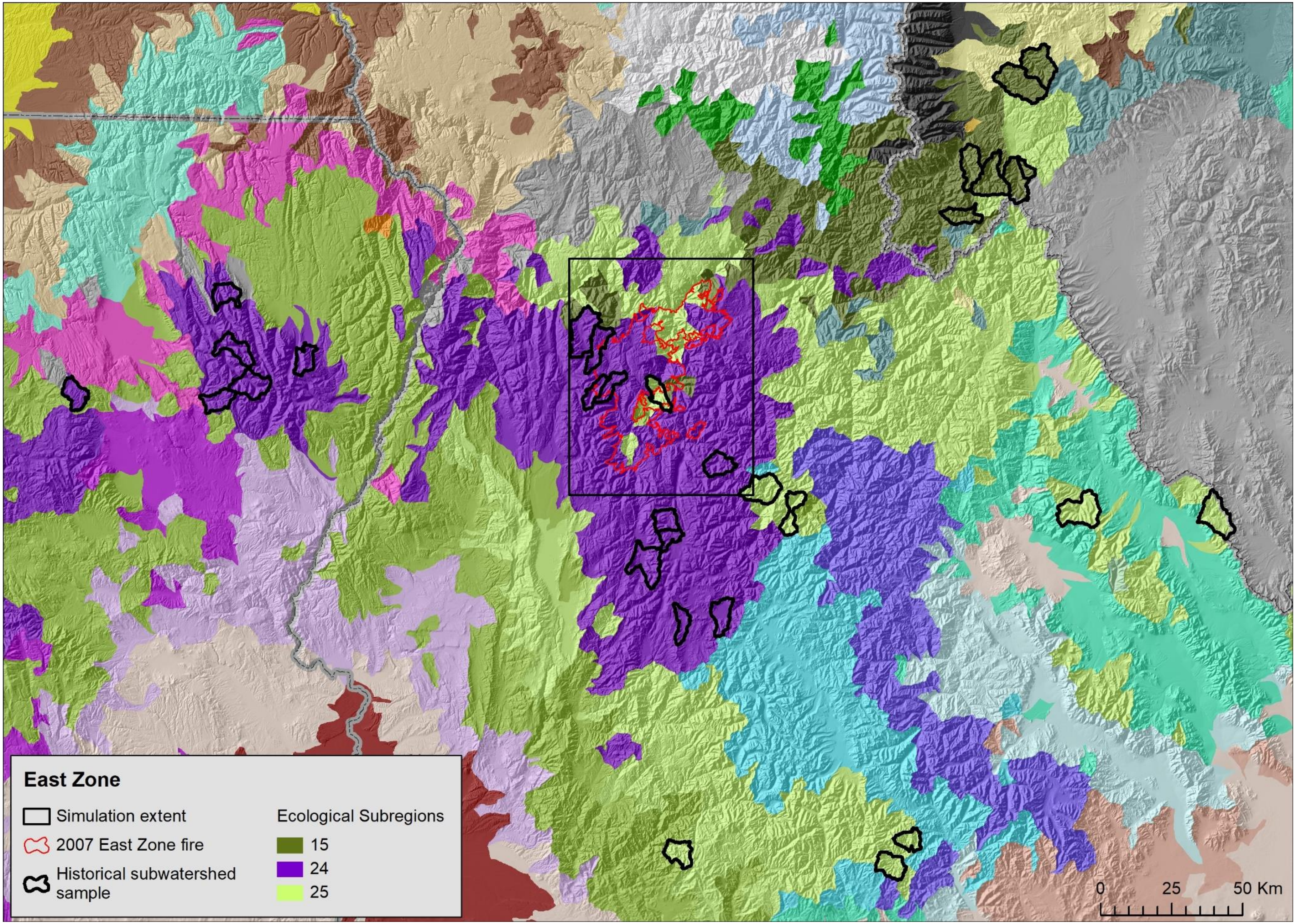
East Zone 3000-year Calibration and Spin Up


Cold Moist Conifer
80
60
40
20
0
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
Cold Dry Conifer
80
60
40
20
0
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
Year
PFBG
SI
SEOC
SECC
UR
YFMS
OFMS
OFSS

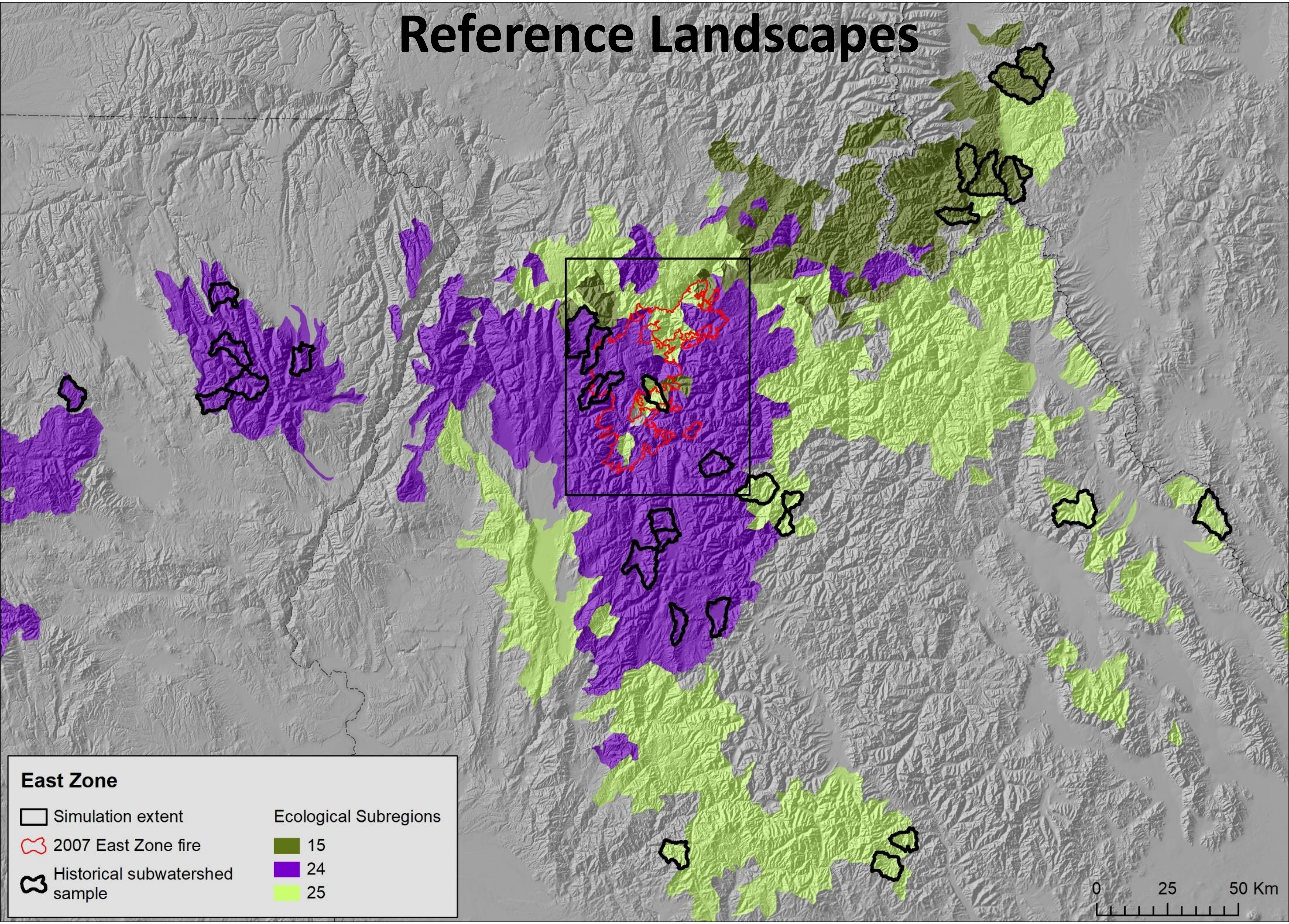
Tripod Year 300 - 1300



Reference Landscapes



Reference Landscapes



Comparison with Historical Reference Landscapes

PWG	Structure	HRV_Median	HRV_min	HRV_10th	HRV_90th	HRV_max
DMC	PFSI	7.9	0.0	0.0	47.4	65.0
DMC	SEOC	20.0	0.0	1.4	47.9	49.9
DMC	SECC	0.4	0.0	0.0	8.6	17.0
DMC	UR	23.5	0.0	0.0	51.8	92.3
DMC	YFMS	4.2	0.0	0.0	19.3	43.2
DMC	OFMS	1.1	0.0	0.0	43.8	52.8
DMC	OFSS	0.0	0.0	0.0	11.6	22.4
MMC	PFSI	11.4	0.0	1.3	30.7	87.7
MMC	SEOC	10.2	0.7	2.1	25.3	37.8
MMC	SECC	7.2	0.0	0.1	38.2	90.4
MMC	UR	17.0	0.0	2.2	44.1	50.2
MMC	YFMS	5.5	0.0	0.0	32.6	71.6
MMC	OFMS	16.1	0.0	0.0	38.8	47.7
MMC	OFSS	1.3	0.0	0.0	14.3	20.0
CMC	PFSI	3.6	0.0	0.0	35.2	73.7
CMC	SEOC	5.1	0.0	0.0	14.6	56.3
CMC	SECC	4.9	0.0	0.0	49.1	81.8
CMC	UR	15.7	0.0	0.0	70.1	100.0
CMC	YFMS	0.0	0.0	0.0	52.0	100.0
CMC	OFMS	0.0	0.0	0.0	17.4	46.5
CMC	OFSS	0.0	0.0	0.0	2.4	53.5
CDC	PFSI	7.8	0.0	0.0	33.2	79.1
CDC	SEOC	14.3	0.0	0.0	48.3	100.0
CDC	SECC	0.4	0.0	0.0	21.2	73.6
CDC	UR	12.2	0.0	0.0	65.5	100.0
CDC	YFMS	0.0	0.0	0.0	33.9	41.2
CDC	OFMS	0.0	0.0	0.0	25.7	64.2
CDC	OFSS	0.0	0.0	0.0	16.1	35.8

Wildland Fire Management Scenarios

A) Complete absence of fire -- no ignitions

B) Modern Suppression -- only fires that escape suppression

- Escaped wildfire threshold:
  - Ignition date between 135 and 304 (May 15 to Oct 31)
  - Minimum of 1 burnable pixel within ignition perimeter
  - Ignition day threshold to burning: ERC ≥ 67 and Wind ≥ 20 mph

C) Partial Suppression -- managed wildfires in the late-summer and fall fire seasons and escaped wildfires (above)

- Ignition date between 187 and 304 (July 5 to Oct 31)
- ERC < 67 and Wind ≤ 10 mph within first 5 days

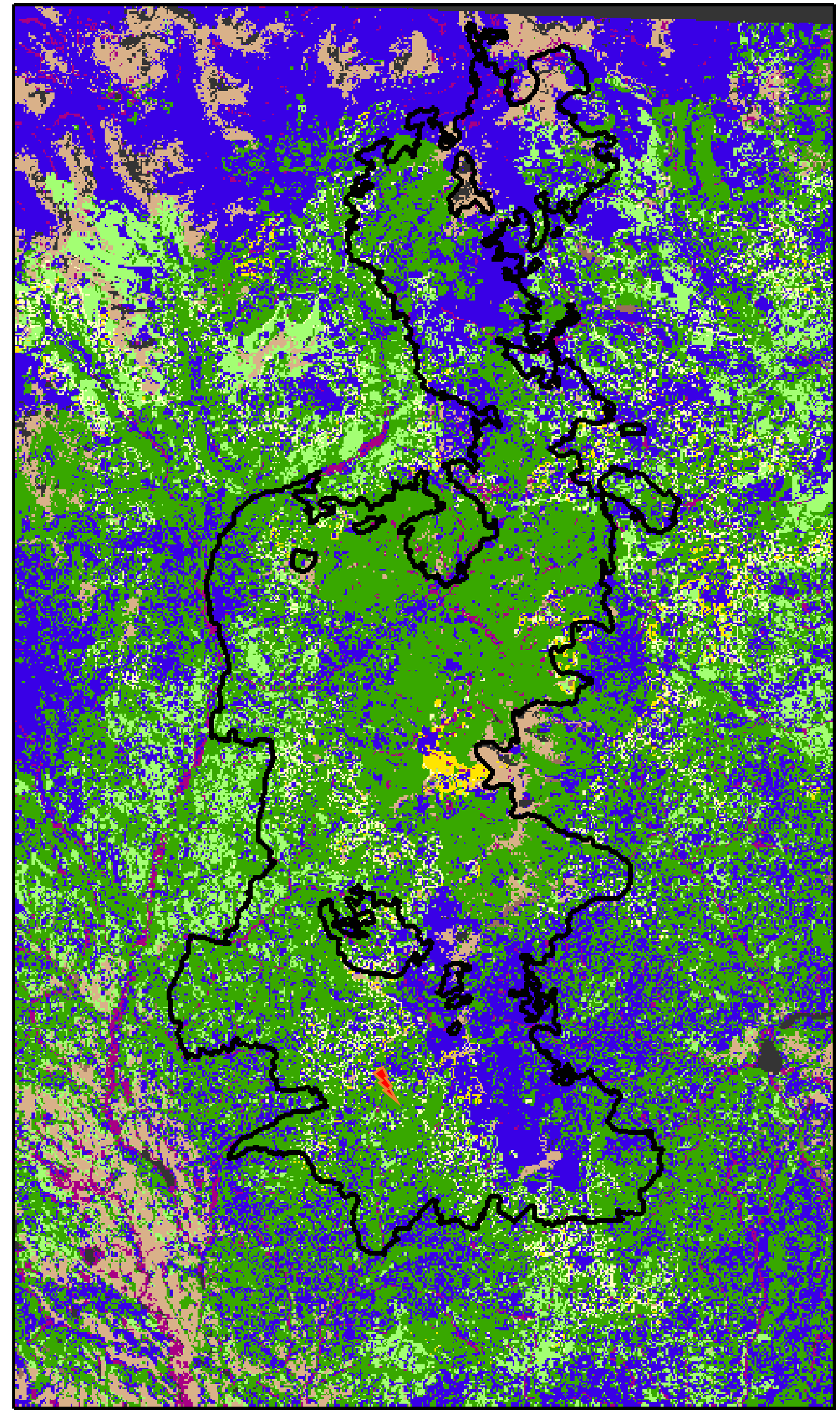
D) No Suppression – all ignitions that meet thresholds to burning:

- Ignition date between 135 and 304 (May 15 to Oct 31)
- Ignition day threshold to burning: ERC ≥ 55
- Minimum of 1 burnable pixel within ignition perimeter

Results - Tripod

A) Complete absence of fire (no ignitions from 1940 to 2005)

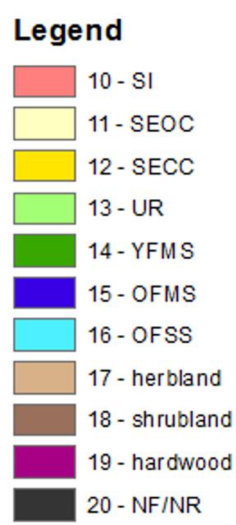
Homogenous landscape, mostly of young and old multi-storied forests.

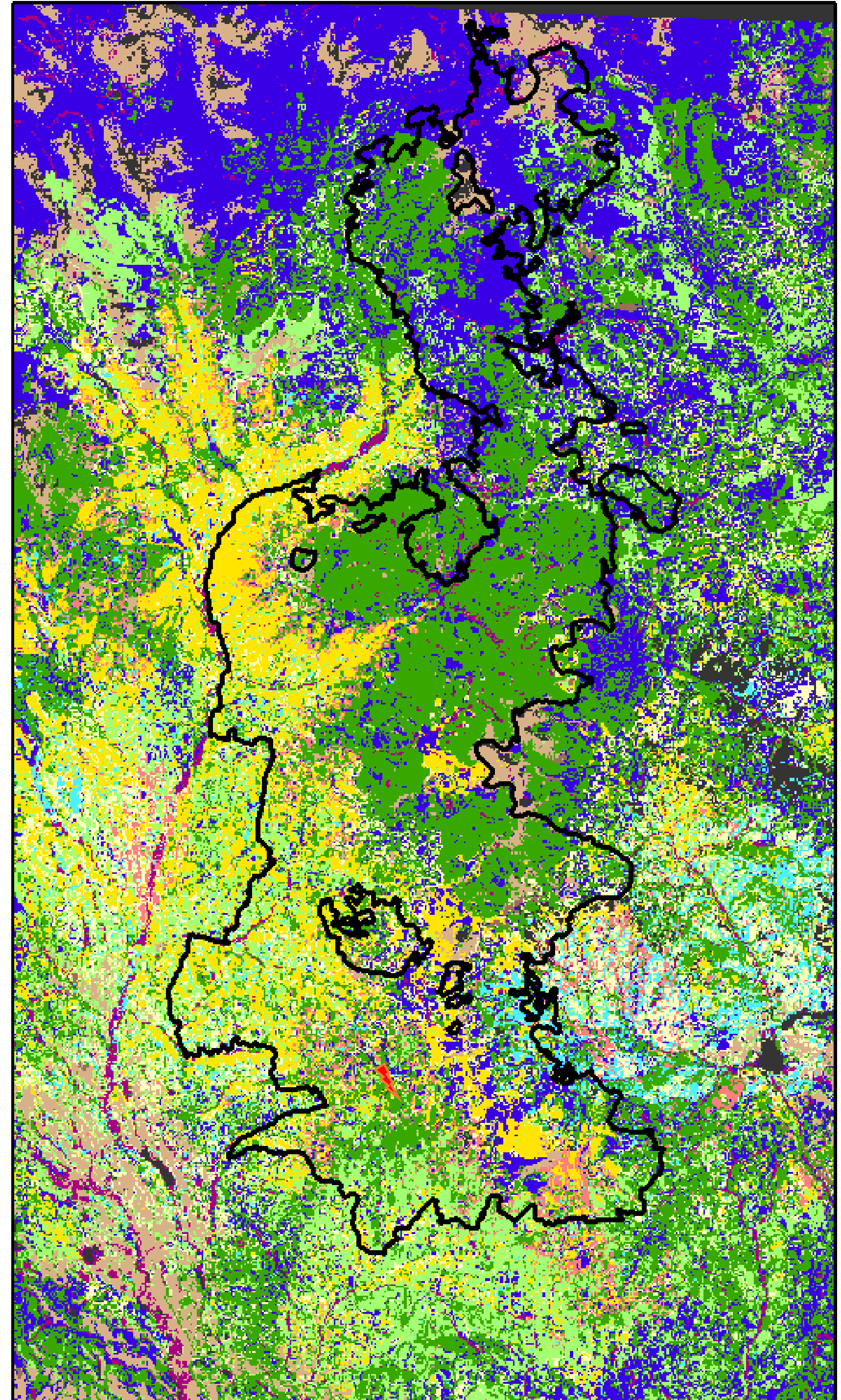


Results - Tripod

B) Full Suppression (2% fires)

- General infilling of the landscape with more mature forests prior to 2006.
- In some iterations of this scenario, random draws of wind scenarios resulted in large, recent fires before 2006.

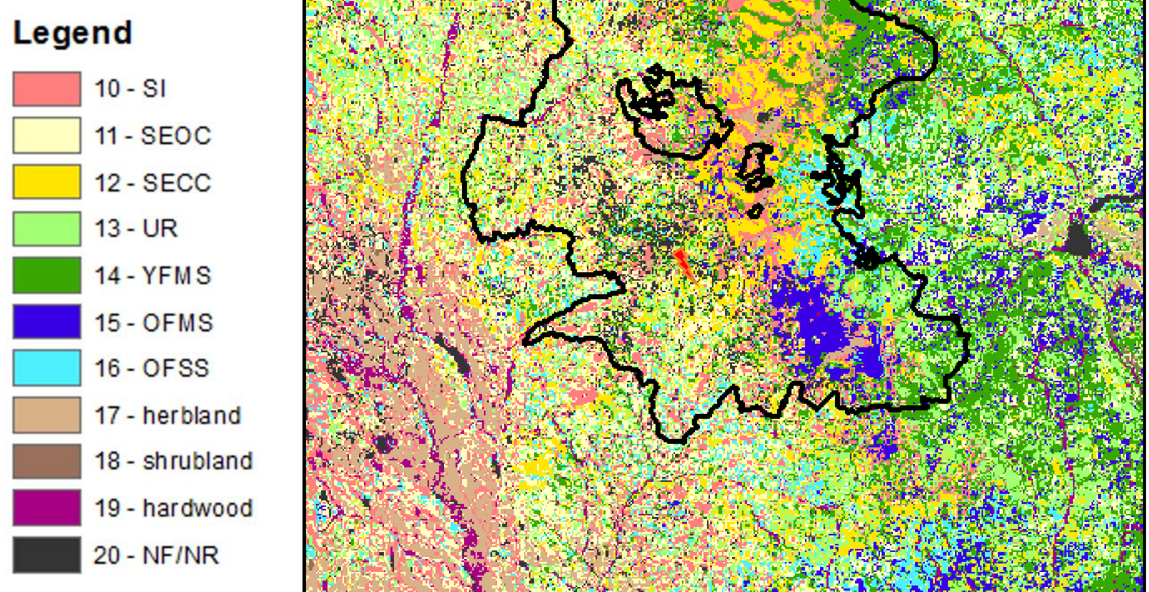




Results - Tripod

C) Partial Suppression

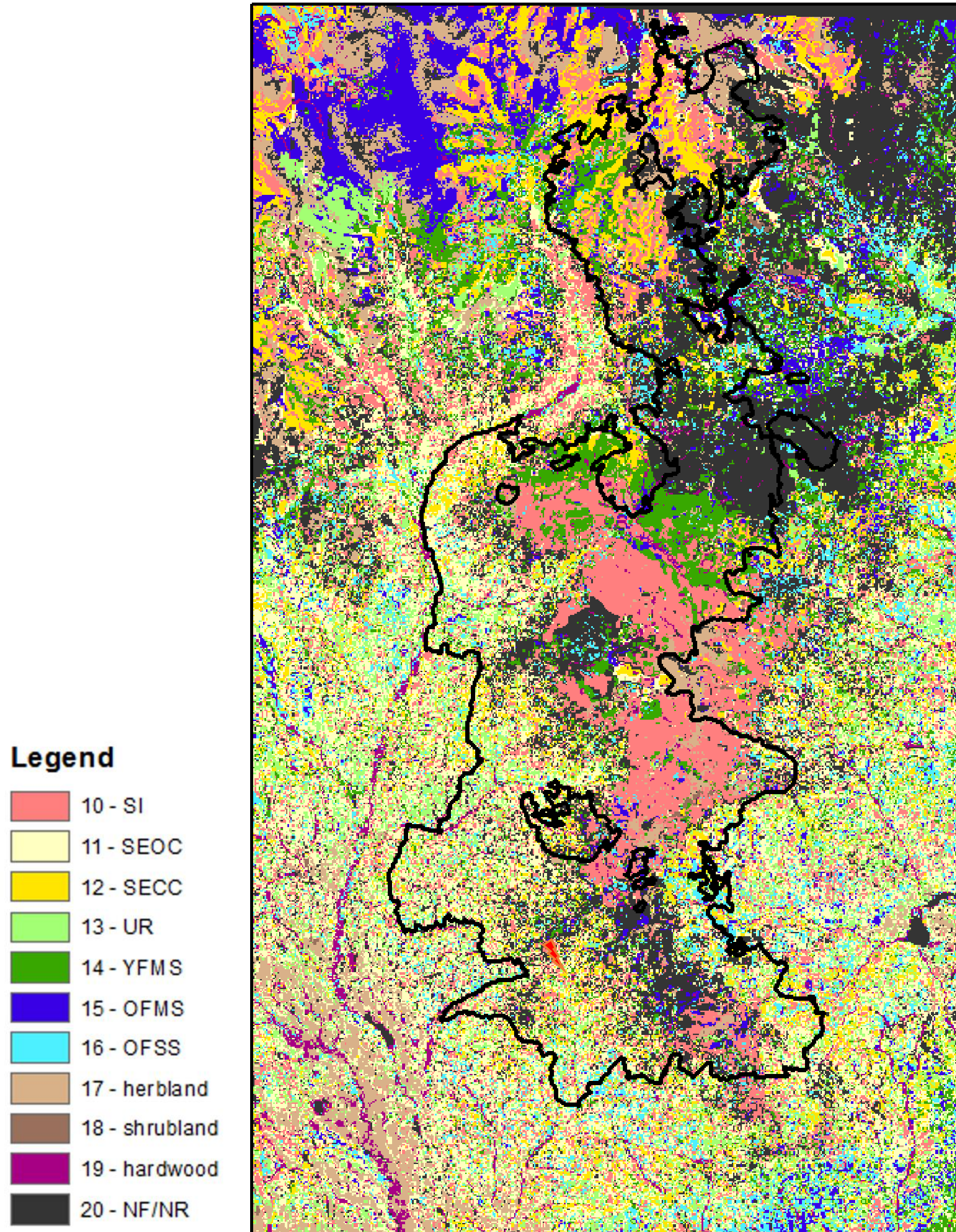
- Finer-grain landscape mosaics at lower elevations that support dry, mixed conifer forests
- Large, recent fire in cool high-elevation mixed conifer forests.

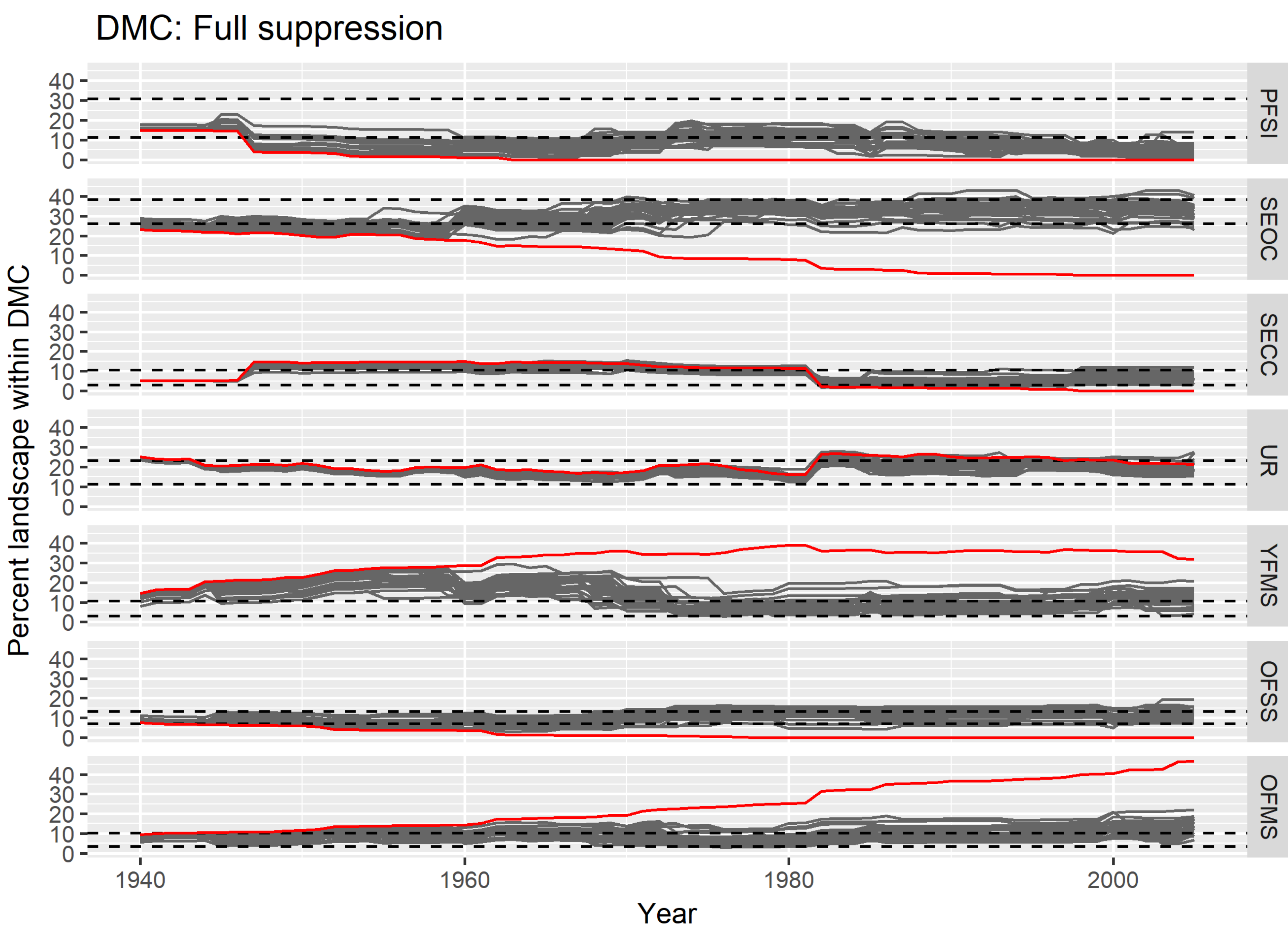


Results - Tripod

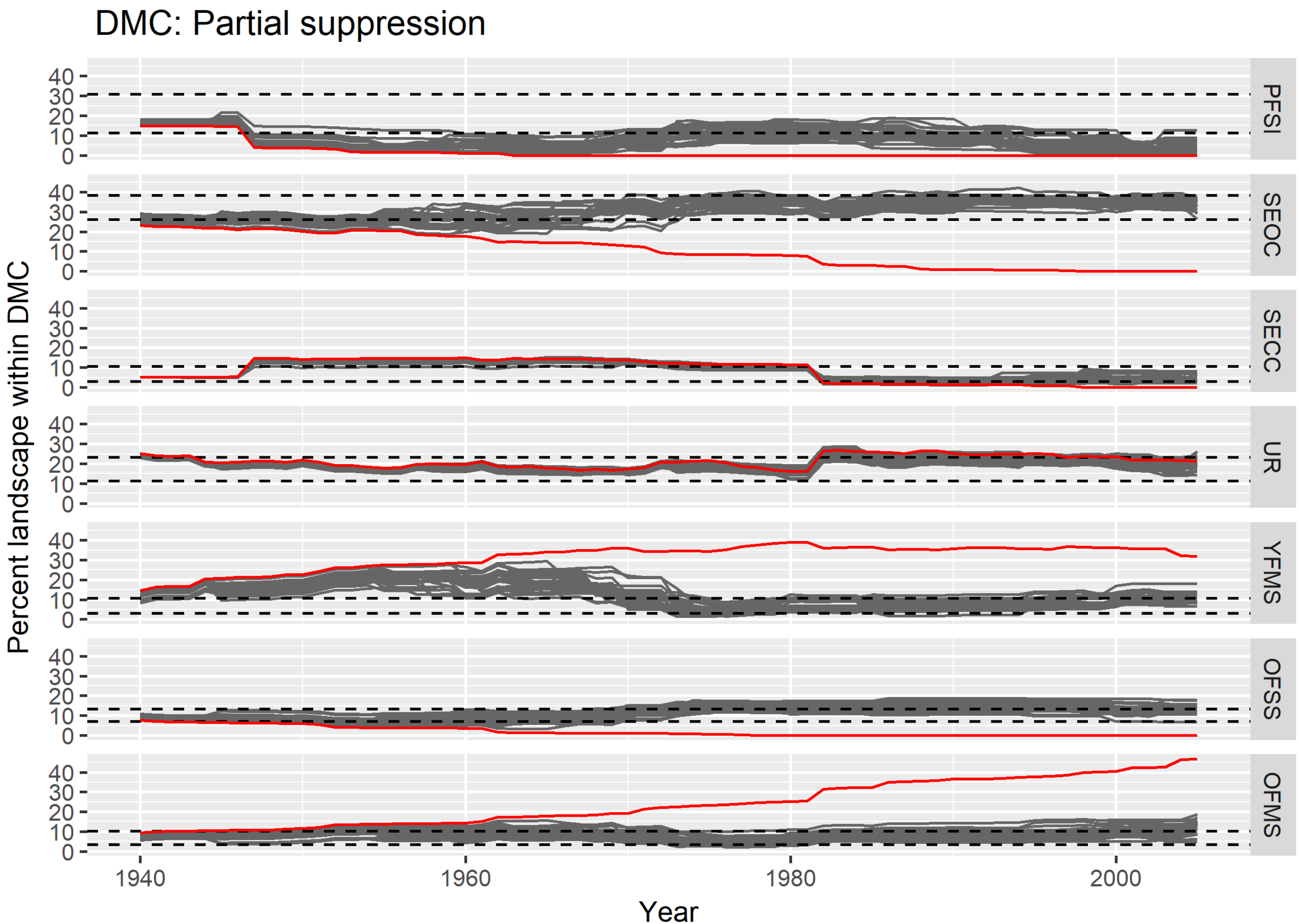
D. No suppression
(let it burn)

- Landscape supports low percentage of mature forest
- Highest pixilation of any of the scenarios.
- Patches of young forest multistory and old forest multistory generally surrounded by recent burns (black pixels) and regenerating forest.

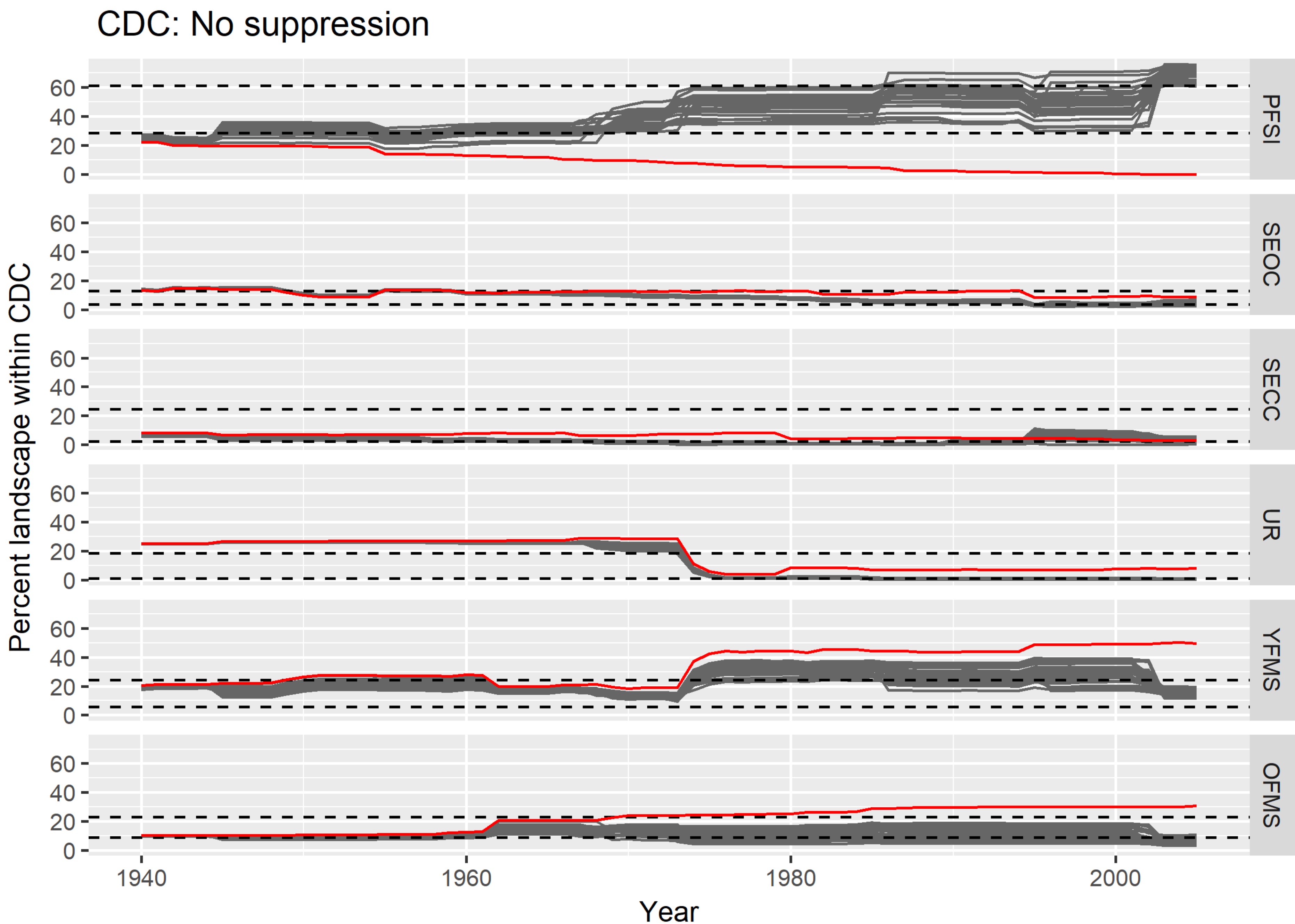




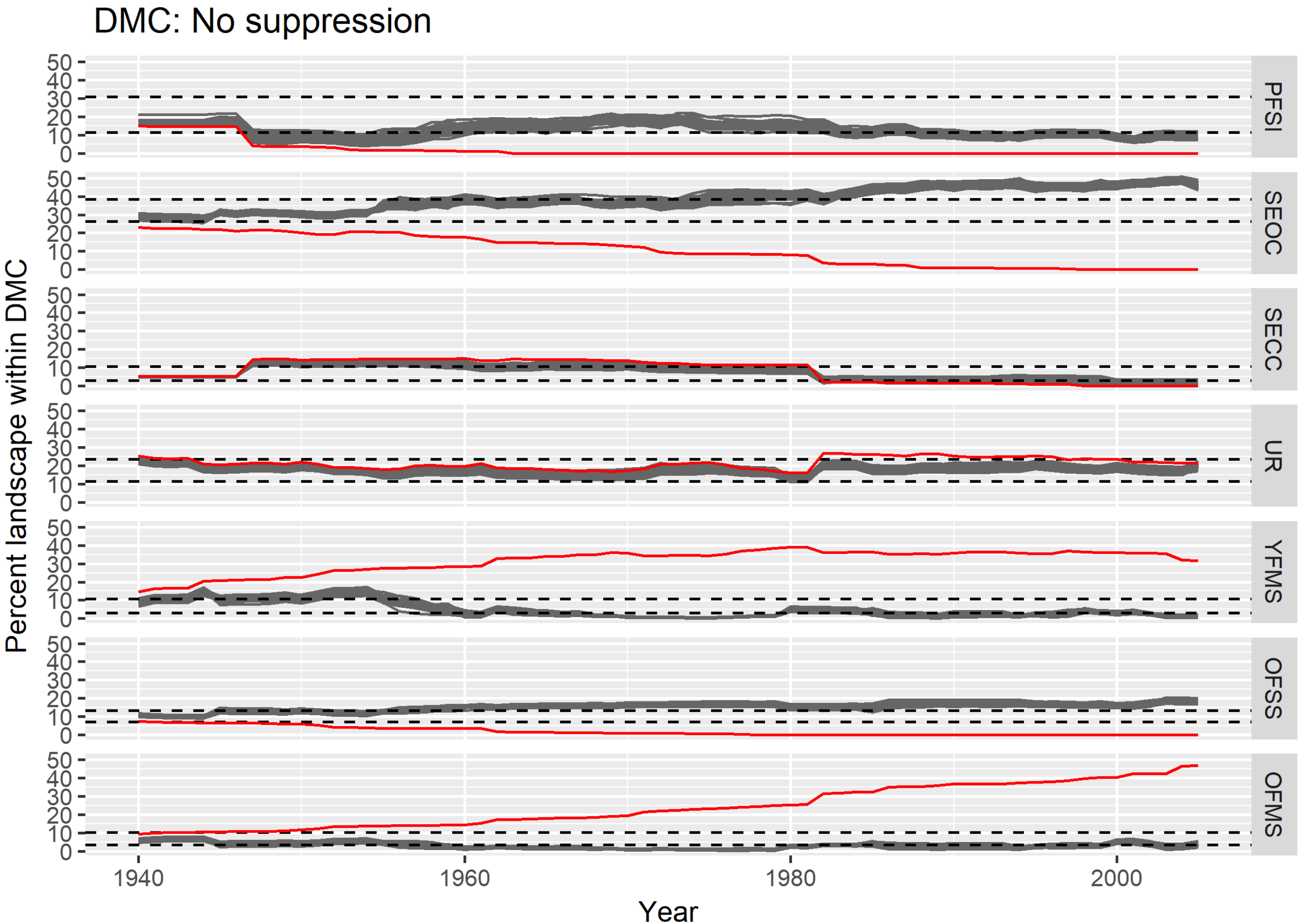
DMC: Full suppression
Percent landscape within DMC
Year
PFSI
SEOC
SECC
UR
YFMS
OFSS
OFMS
0
10
20
30
40
1940
1960
1980
2000



DMC: Partial suppression
PFSI
SEOC
SECC
UR
YFMS
OFSS
OFMS
0
10
20
30
40
Percent landscape within DMC
1940
1960
1980
2000
Year



CDC: No suppression
Percent landscape within CDC
Year
PFSI
SEOC
SECC
UR
YFMS
OFMS
0
20
40
60
1940
1960
1980
2000



DMC: No suppression
Percent landscape within DMC
Year
PFSI
SEOC
SECC
UR
YFMS
OFSS
OFMS
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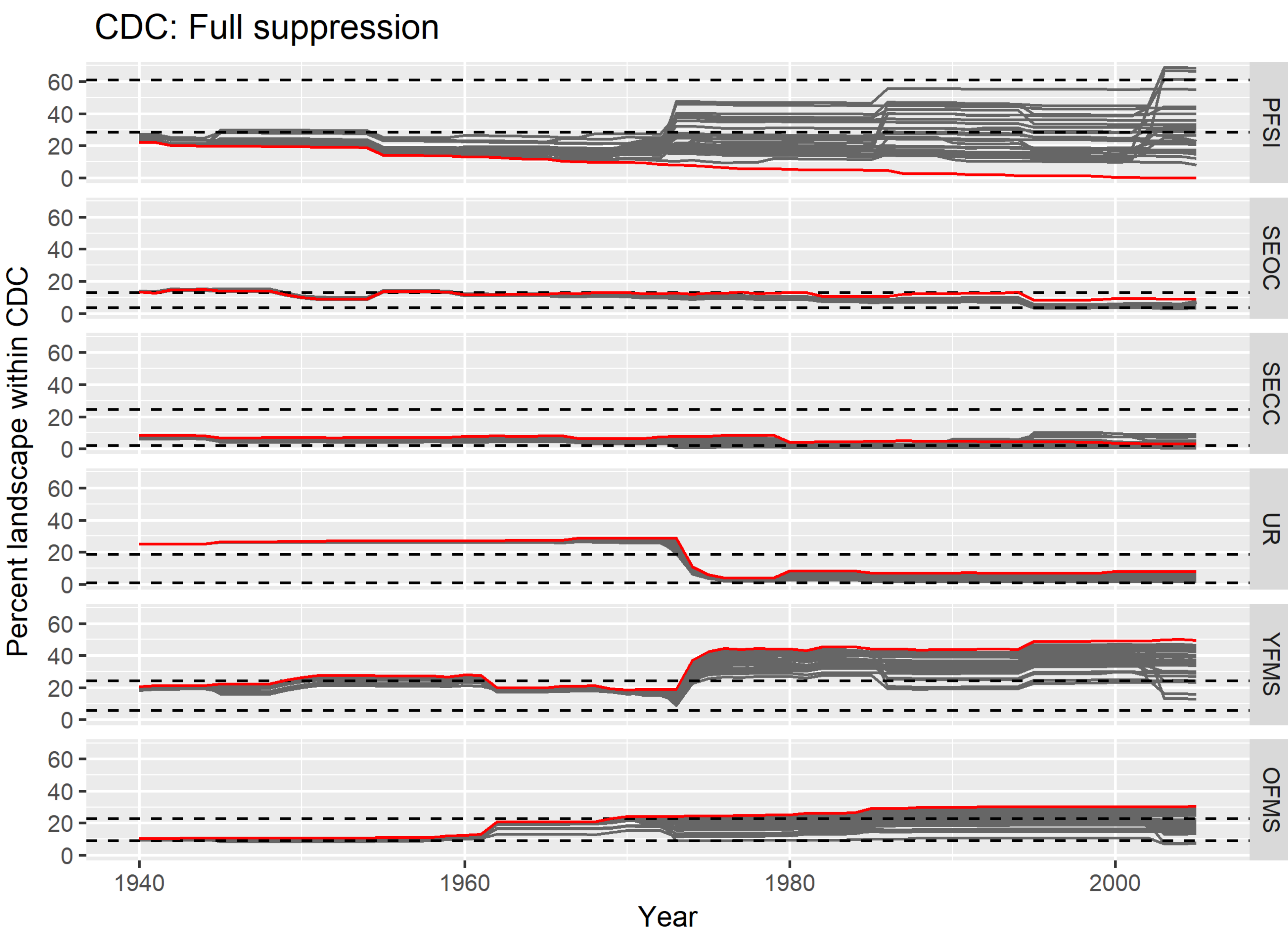
40
50
1940
1960
1980
2000


CDC: Full suppression
Percent landscape within CDC
Year
PFSI
SEOC
SECC
UR
YFMS
OFMS
0
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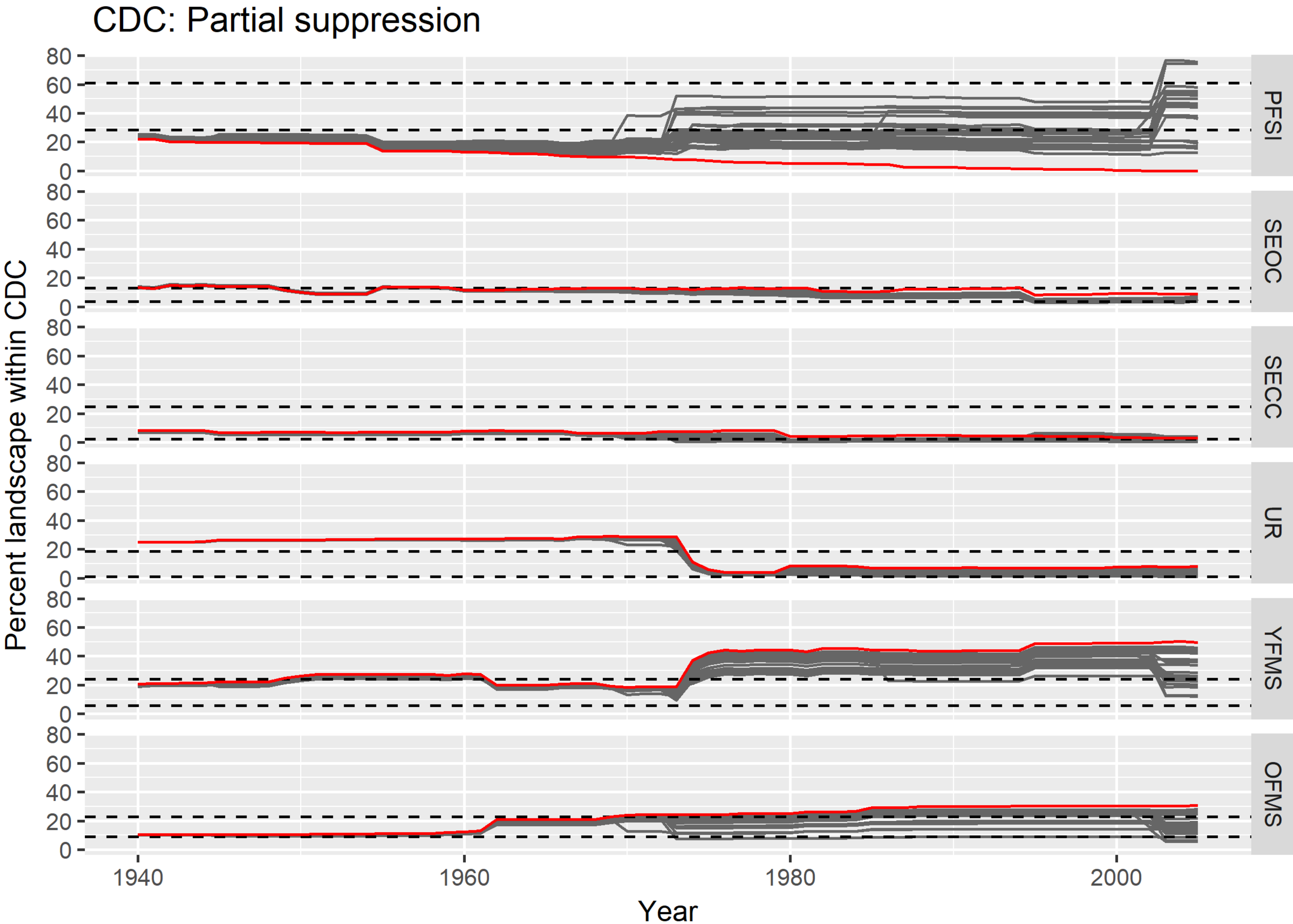
40
60
1940
1960
1980
2000


CDC: Partial suppression
Percent landscape within CDC
Year
80
60
40
20
0
1940
1960
1980
2000
PFSI
SEOC
SECC
UR
YFMS
OFMS

Summary

1) Proactive wildland fire management can reduce the likelihood of large-scale vegetation and fire regime shifts associated with large fires.

2) **No fire** and **Full Suppression** scenarios represent "boom and bust" landscapes -- continuous mature forests are capable of supporting large fire spread.

3) **Managed wildfires** and **Let it Burn** Scenarios have finer-grained patch mosaics and would potentially result in markedly different approaches to wildland fire management.

Management Applications –

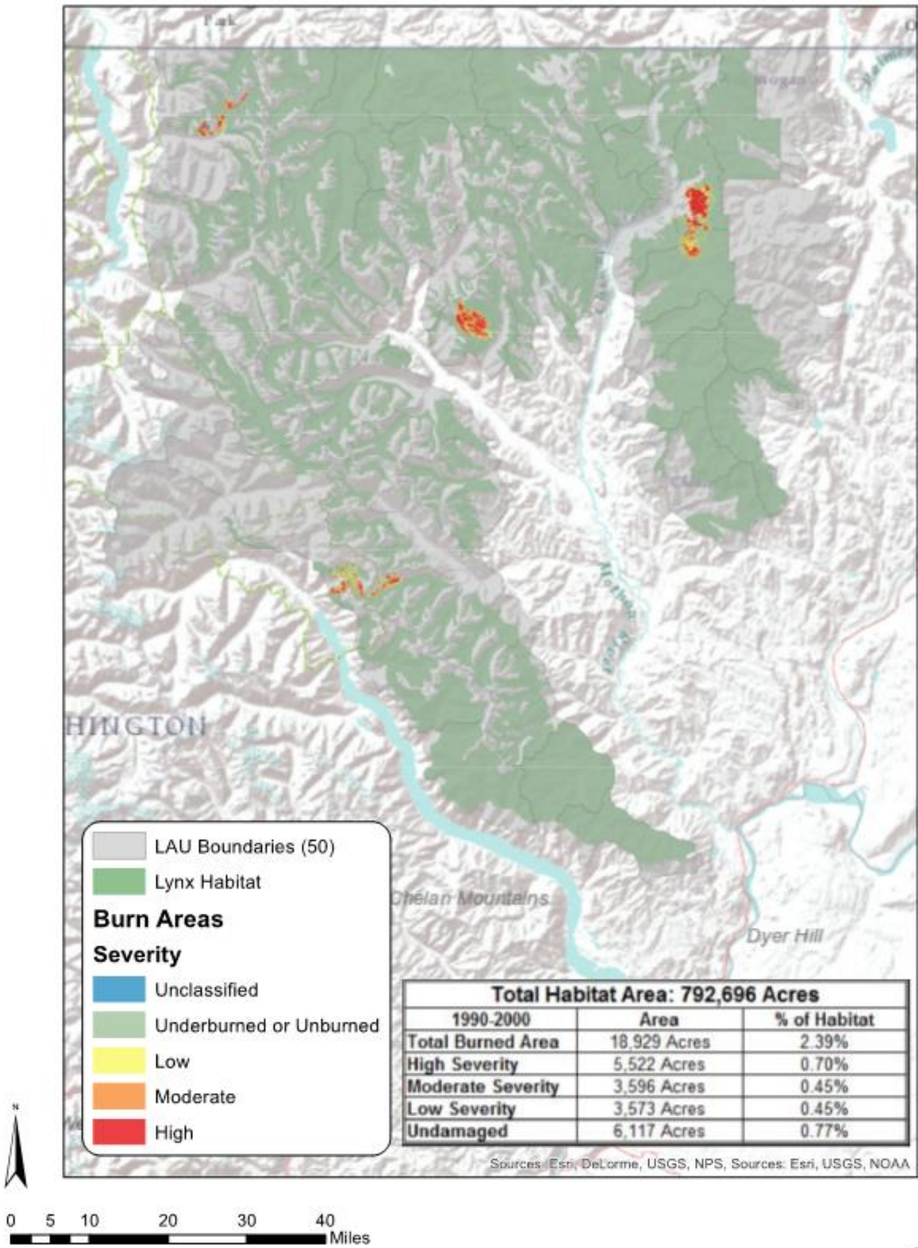
1)**Wildlife habitat management in the context of fire**– habitat is dynamically generated and tied to burn mosaics

2) **Managed wildfires -** implications of managed fire scenarios for wildlife habitat (e.g., Canada Lynx)

3) **Climate change** – improving resilience of landscapes

4) **Carbon storage** – stabilizing carrying capacity of landscapes under varying wildfire scenarios

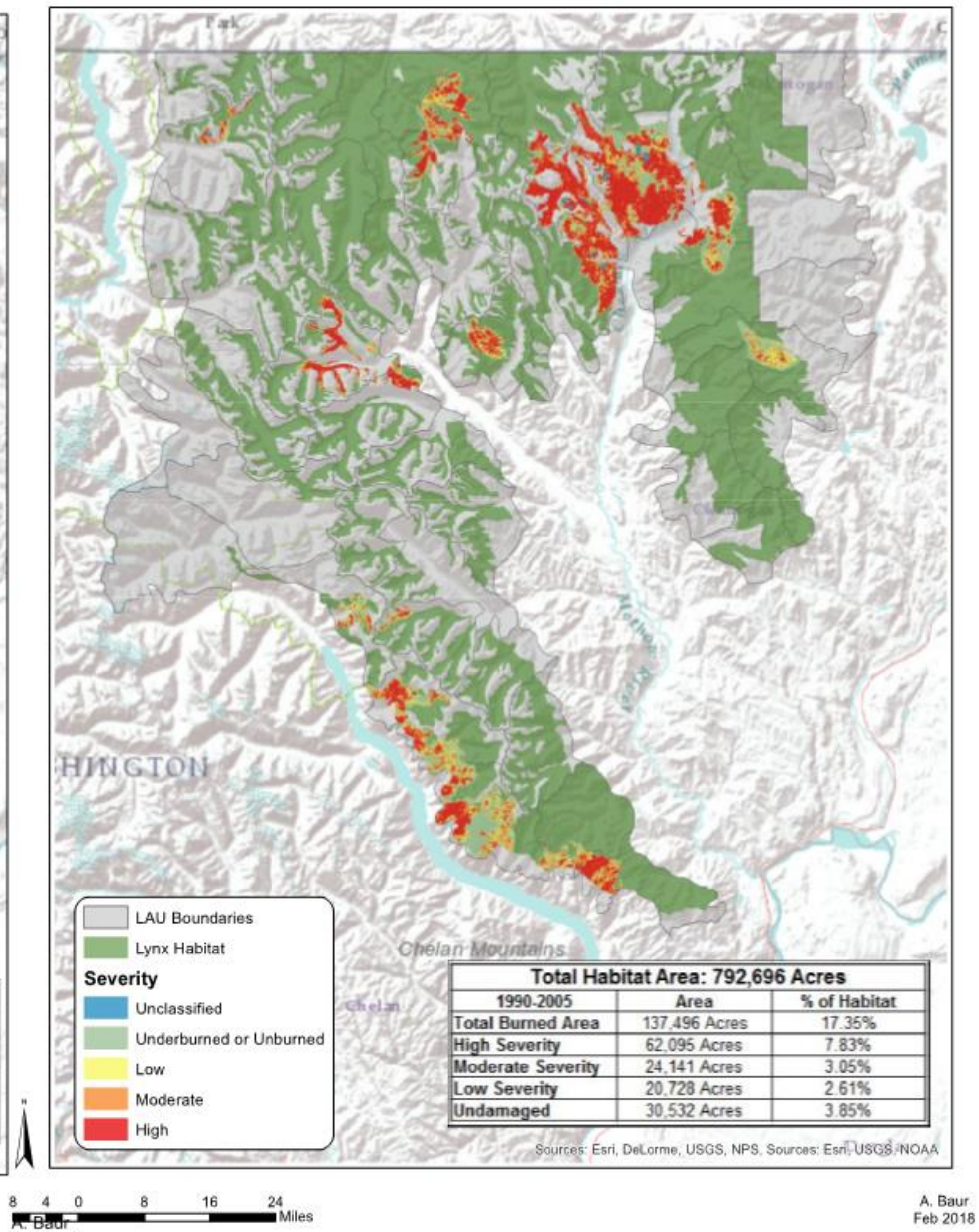
Lynx Habitat Burn Severity 1990-2000



Total Habitat Area: 792,696 Acres		
1990-2000	Area	% of Habitat
Total Burned Area	18,929 Acres	2.39%
High Severity	5,522 Acres	0.70%
Moderate Severity	3,596 Acres	0.45%
Low Severity	3,573 Acres	0.45%
Undamaged	6,117 Acres	0.77%

A. Baur
Jan 2018

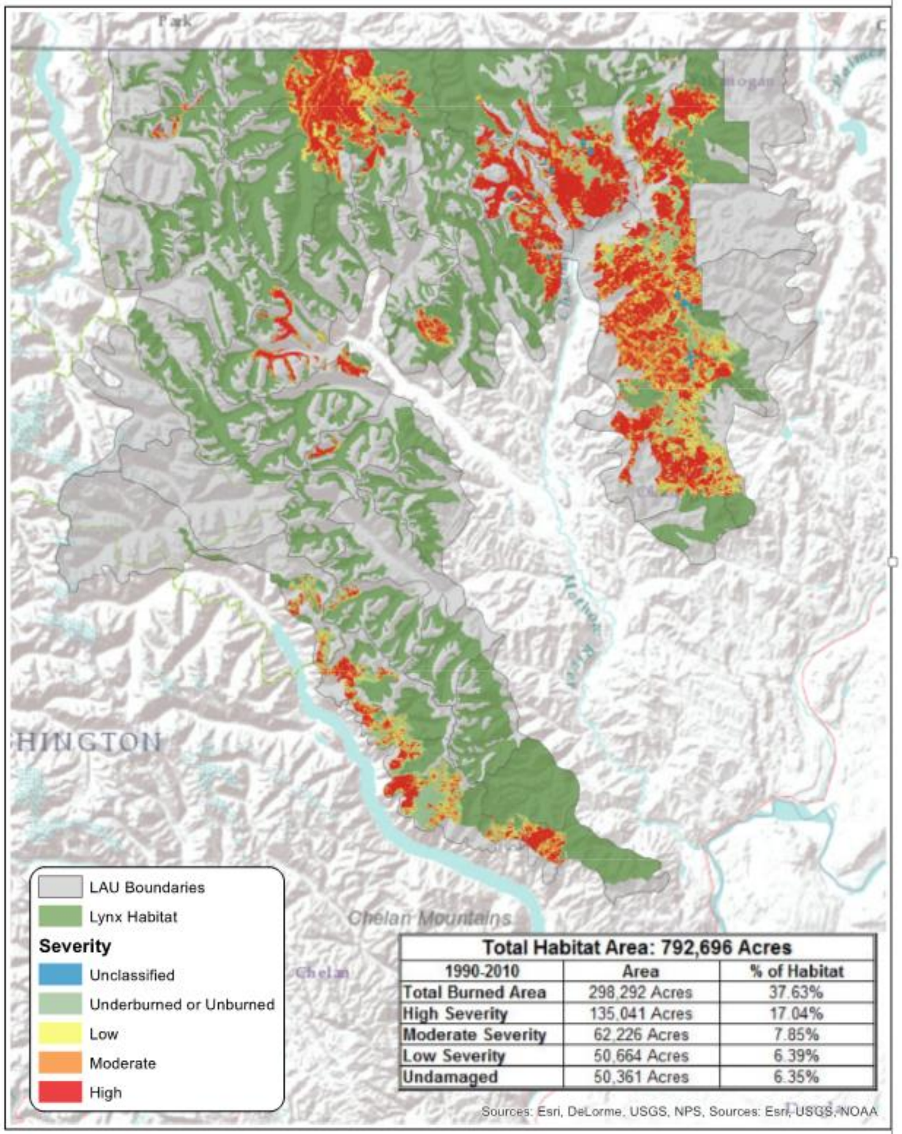
Lynx Habitat Burned 1990-2005



Total Habitat Area: 792,696 Acres		
1990-2005	Area	% of Habitat
Total Burned Area	137,496 Acres	17.35%
High Severity	62,095 Acres	7.83%
Moderate Severity	24,141 Acres	3.05%
Low Severity	20,728 Acres	2.61%
Undamaged	30,532 Acres	3.85%

A. Baur
Feb 2018

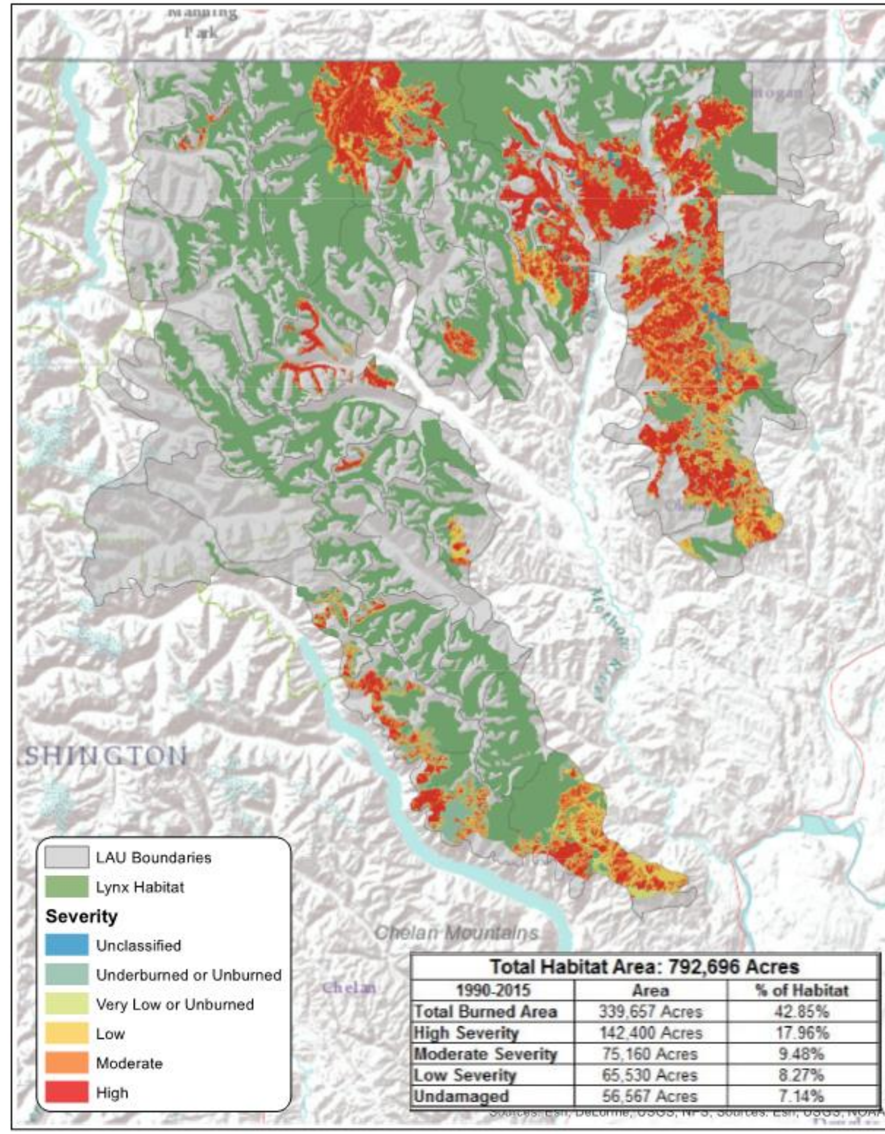
Lynx Habitat Burned 1990-2010



Total Habitat Area: 792,696 Acres

1990-2010	Area	% of Habitat
Total Burned Area	298,292 Acres	37.63%
High Severity	135,041 Acres	17.04%
Moderate Severity	62,226 Acres	7.85%
Low Severity	50,664 Acres	6.39%
Undamaged	50,361 Acres	6.35%

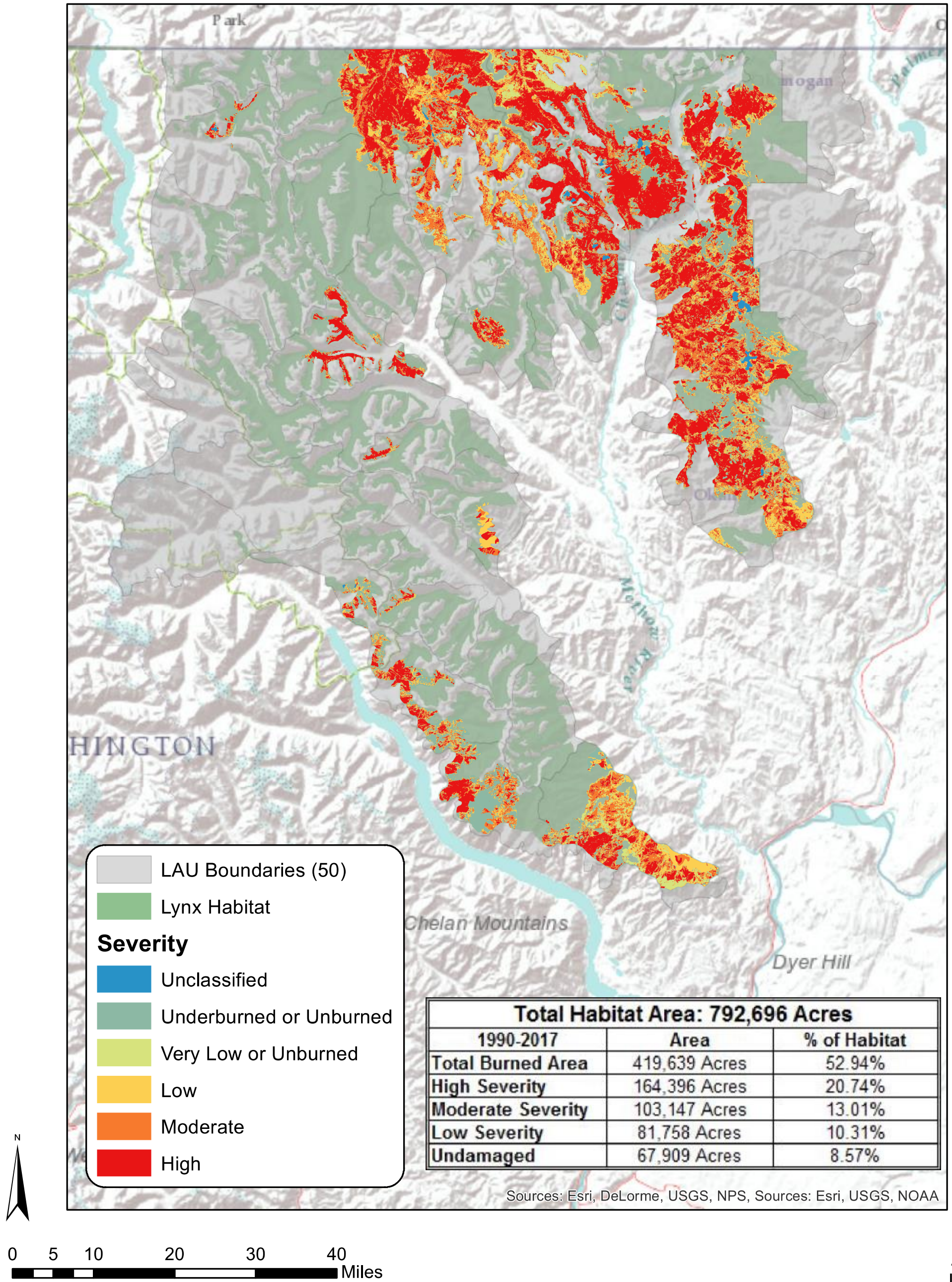
Lynx Habitat Burned 1990-2015



Total Habitat Area: 792,696 Acres

1990-2015	Area	% of Habitat
Total Burned Area	339,657 Acres	42.85%
High Severity	142,400 Acres	17.96%
Moderate Severity	75,160 Acres	9.48%
Low Severity	65,530 Acres	8.27%
Undamaged	56,567 Acres	7.14%

Lynx Habitat Burn Severity 1990-2017



Total Habitat Area: 792,696 Acres

1990-2017	Area	% of Habitat
Total Burned Area	419,639 Acres	52.94%
High Severity	164,396 Acres	20.74%
Moderate Severity	103,147 Acres	13.01%
Low Severity	81,758 Acres	10.31%
Undamaged	67,909 Acres	8.57%

A. Baur
Jan 2018

Next Steps

1) Complete management scenarios for East Zone, Kootenay

2) State and Transition Models – datasets for carbon, emissions inventories, wildlife habitat

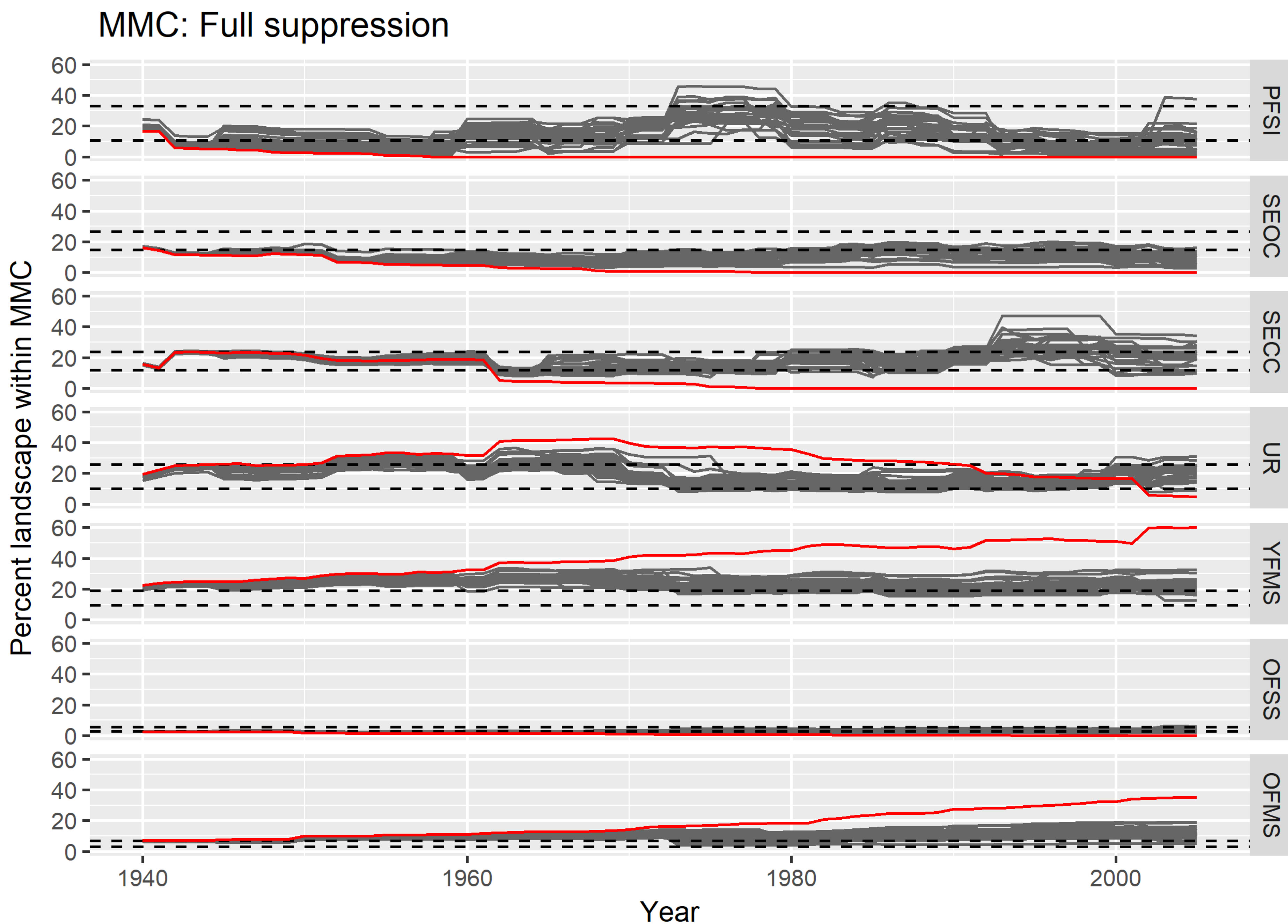
3) WFDSS training layers to explore management scenarios

4) Climate change scenarios, what happens when 2006 is a moderate scenario?

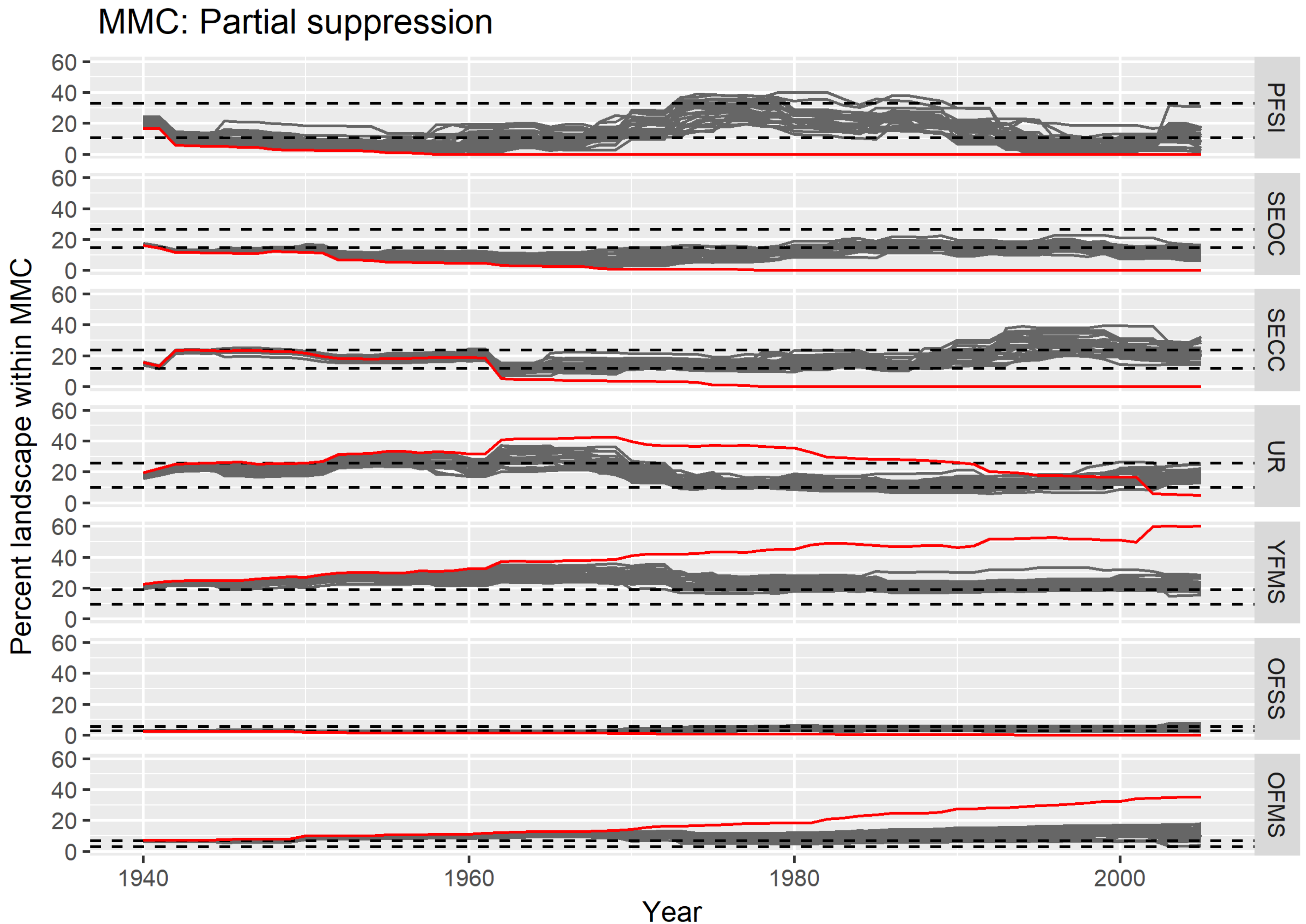
AGENDA

Agenda	Details	Presenter
0800 – 0820	Introduction to the Reburn Project	Prichard
0820 – 0840	Vegetation and fire dynamics	Gray
0840 – 0900	Wildland fire management scenarios	Prichard
0900 – 0920	Climate change and landscape resilience	Prichard
0920 – 0930	Discussion	Gray & Prichard
0930 – 1000	Break and load into vans	ALL

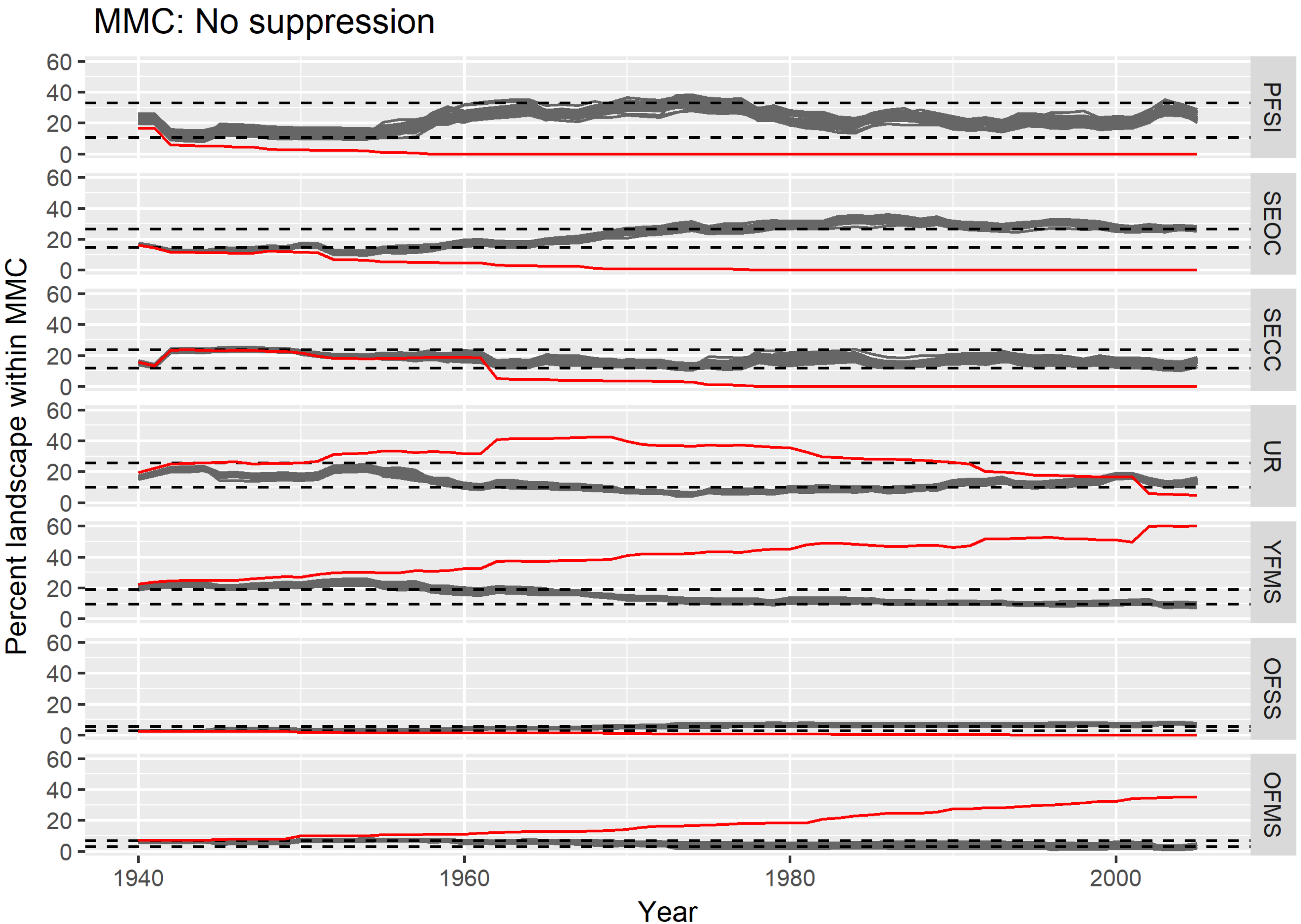
EXTRA SLIDES

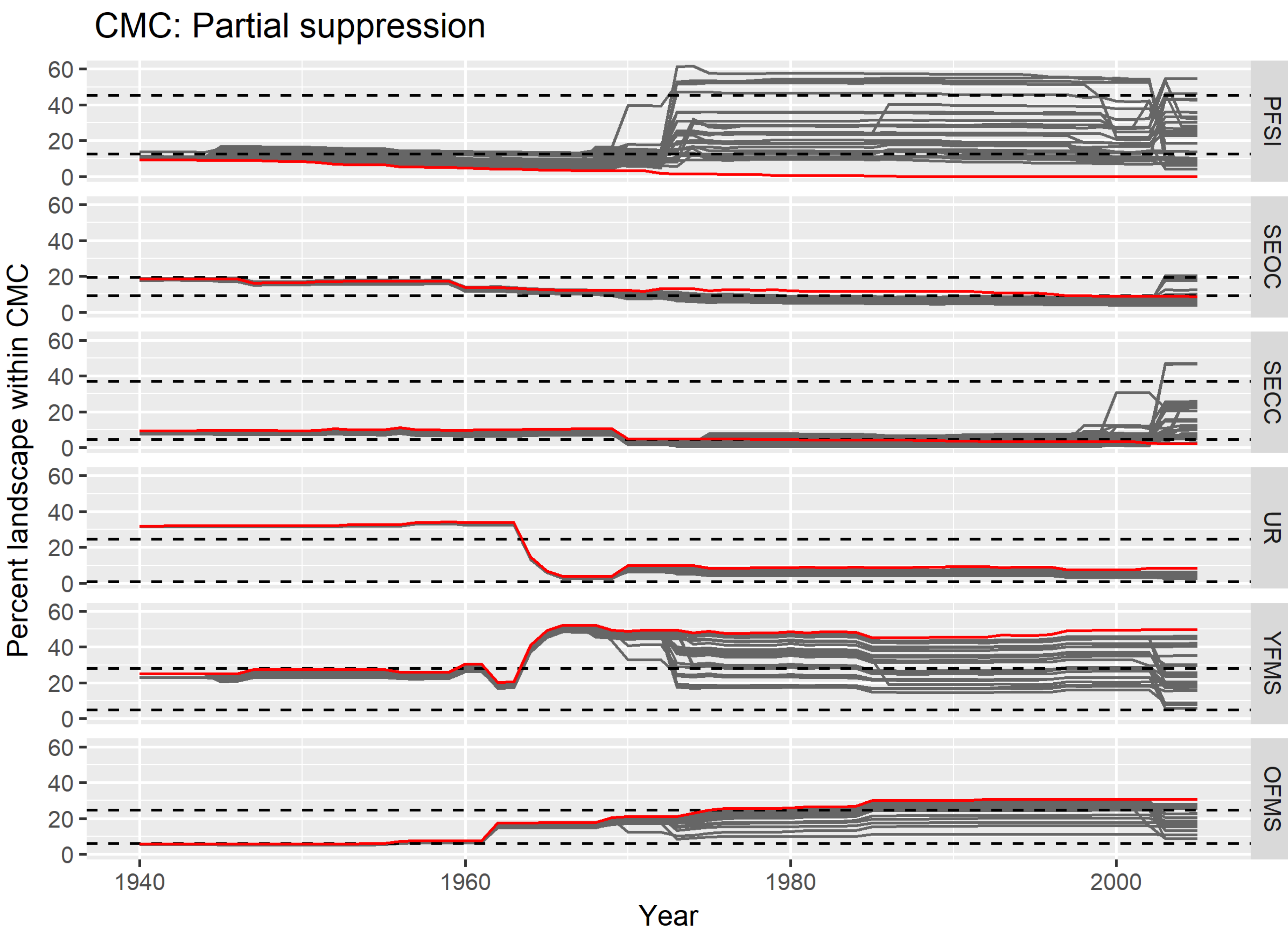


MMC: Full suppression
Percent landscape within MMC
Year
60
40
20
0
1940
1960
1980
2000
PFSI
SEOC
SECC
UR
YFMS
OFSS
OFMS



MMC: Partial suppression
Percent landscape within MMC
Year
PFSI
SEOC
SECC
UR
YFMS
OFSS
OFMS
0
20
40
60
1940
1960
1980
2000


MMC: No suppression
Percent landscape within MMC
Year
1940
1960
1980
2000
0
20
40
60
PFSI
SEOC
SECC
UR
YFMS
OFSS
OFMS



CMC: Partial suppression
Percent landscape within CMC
Year
PFSI
SEOC
SECC
UR
YFMS
OFMS
0
20
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1940
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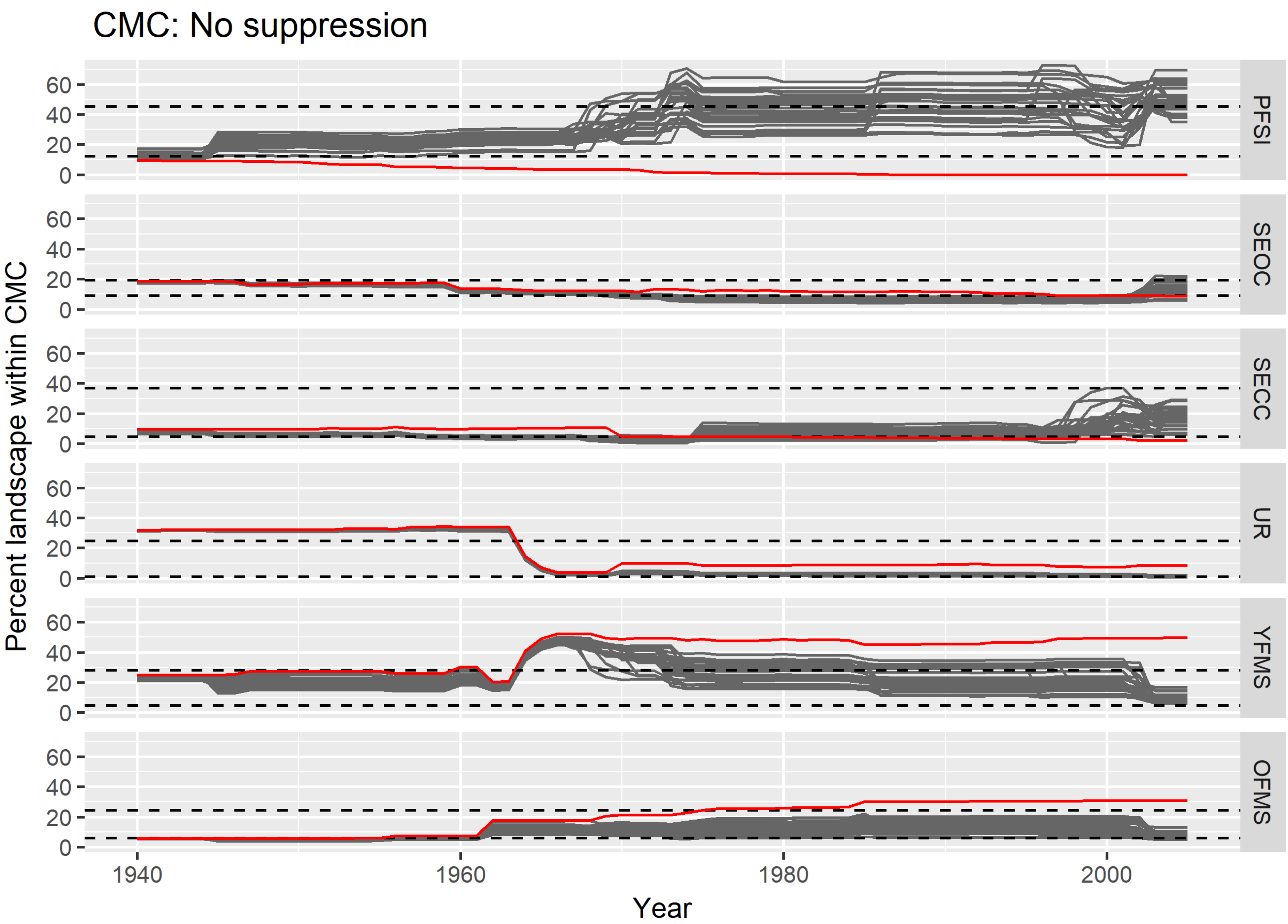
CMC: No suppression
Percent landscape within CMC
Year
PFSI
SEOC
SECC
UR
YFMS
OFMS
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