Restoring Heterogeneity at Multiple Scales in Mixed Conifer Forests

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Stewardship Forestry
April 15, 2013

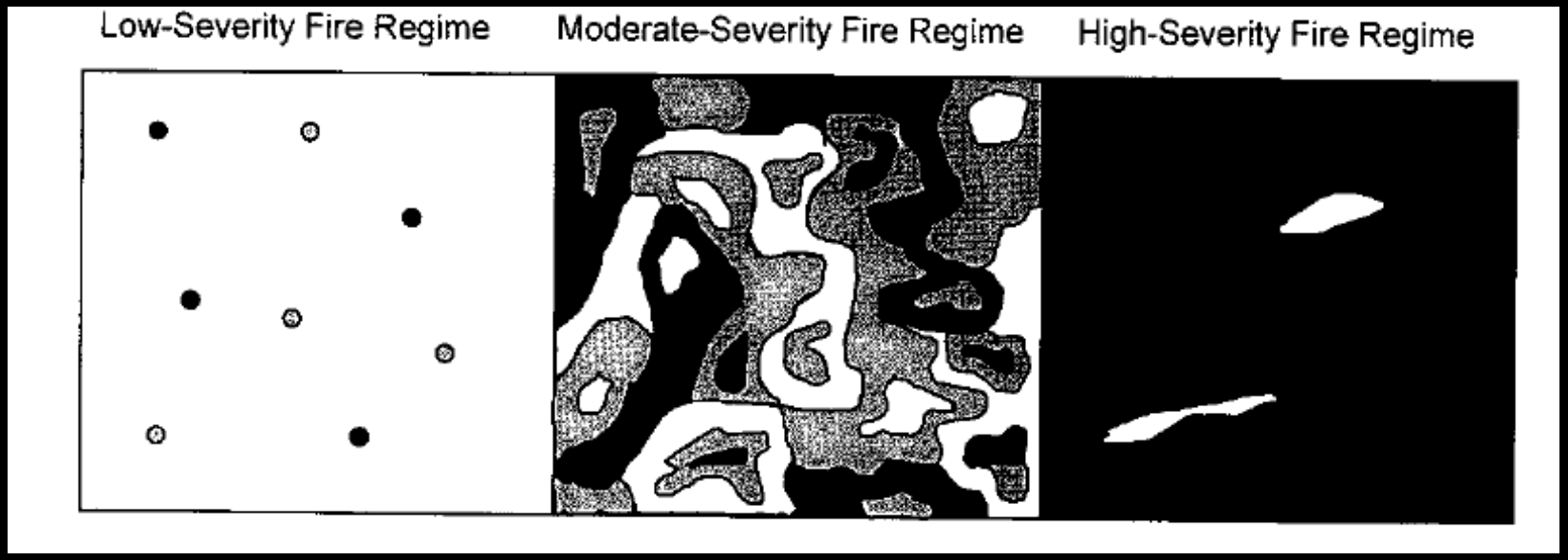
Restoration Goals

Restoration: the process of assisting the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed. (CFLRP 2012)

Ecological resilience: the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (Walker et al., 2004).

Adaptive capacity: Response and re-alignment to climate change

Resilience & Heterogeneity



- Pattern matters: fire, insects, habitat, snow retention, etc.
- Self reinforcing mosaic: needs disturbance & mortality
- Fire, insects, root disease necessary parts of system

Resilience ➔ Heterogeneity at Multiple Scales

- Agee, J.K. 1998. Landscape ecology of western fire regimes. Northwest Science 72: 24-34

Heterogeneity at Multiple Scales??

Cool idea, how do you do it ?

Heterogeneity at Multiple Scales??

Guiding Principles:

1. Set up landscape so future wildfires burn at mixed severity
2. Landscape: range of patch sizes (structure/cover)
3. Within-stand variability: skips, openings, & variable thinning
4. Power law principle: Lots of small patches, few big patches

ELSEVIER

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

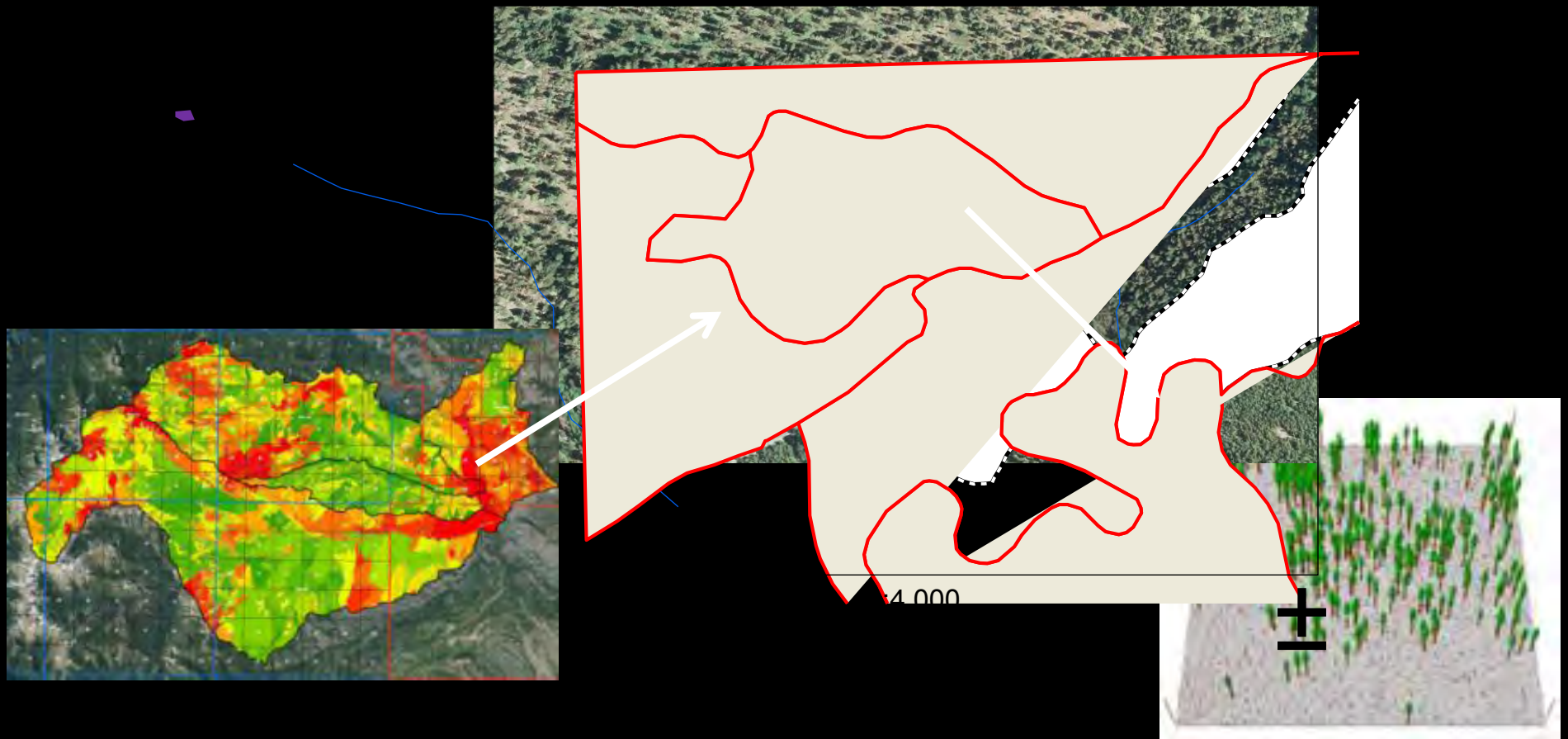
Review

The ecology of mixed severity fire regimes in Washington, Oregon, and Northern California

David A. Perry [a,*], Paul F. Hessburg [b], Carl N. Skinner [c], Thomas A. Spies [d], Scott L. Stephens [e], Alan Henry Taylor [f], Jerry F. Franklin [g], Brenda McComb [a], Greg Riegel [h]

Landscape Hierarchy

Level	Extent	Grain
Project Area - Watershed	10k-50kha	Stands
Stands	1-1000ha	Tree-neighborhoods
Tree Neighborhoods: sub-patches	0.1 – 1ha	Clumps, individuals, openings.

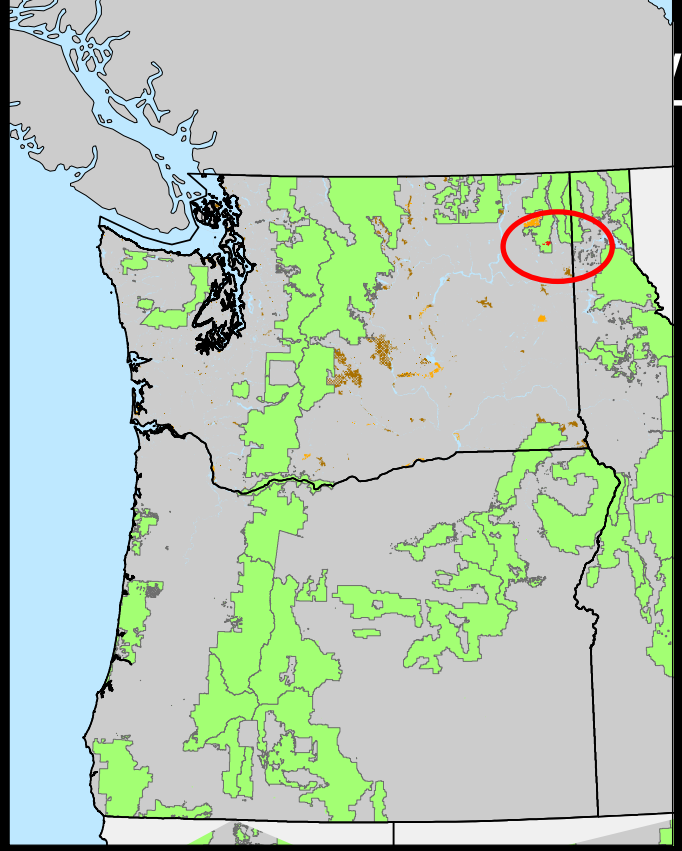


Power Lake Project

Objectives:

- Restore Resilience & Adaptive Capacity
- Habitat
  - Maintain/increase: Large-tree, closed, multi-layered
  - Increase Large tree, open, mosaic
- WUI: reduce risk of large, high severity fires
- Maintain aquatic functions
- Forest health for future wood production

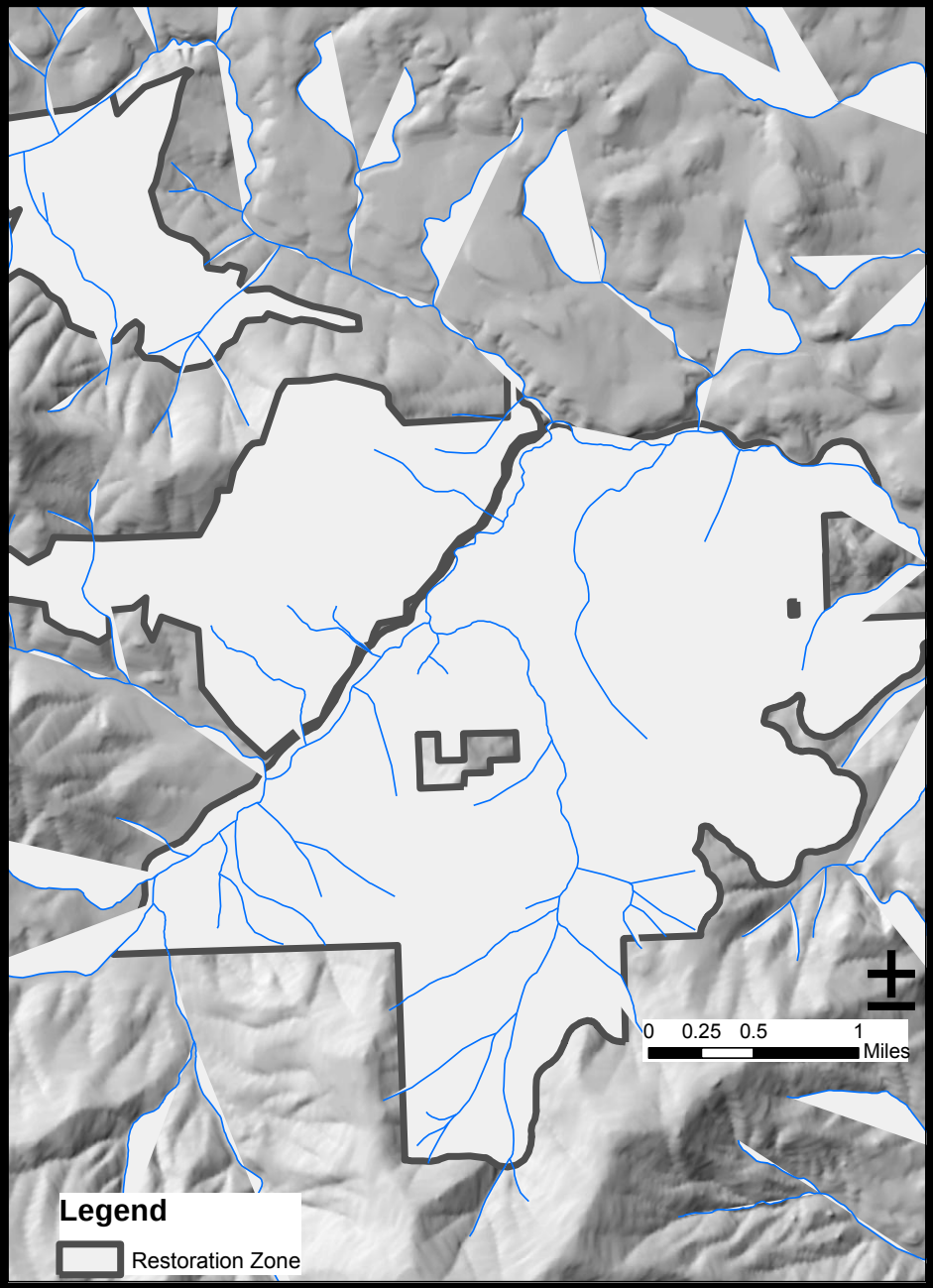
ver Lake Project



Northern Rocky Mountains

2800 – 3800’

Moderate Topographic Complexity



Power Lake Project

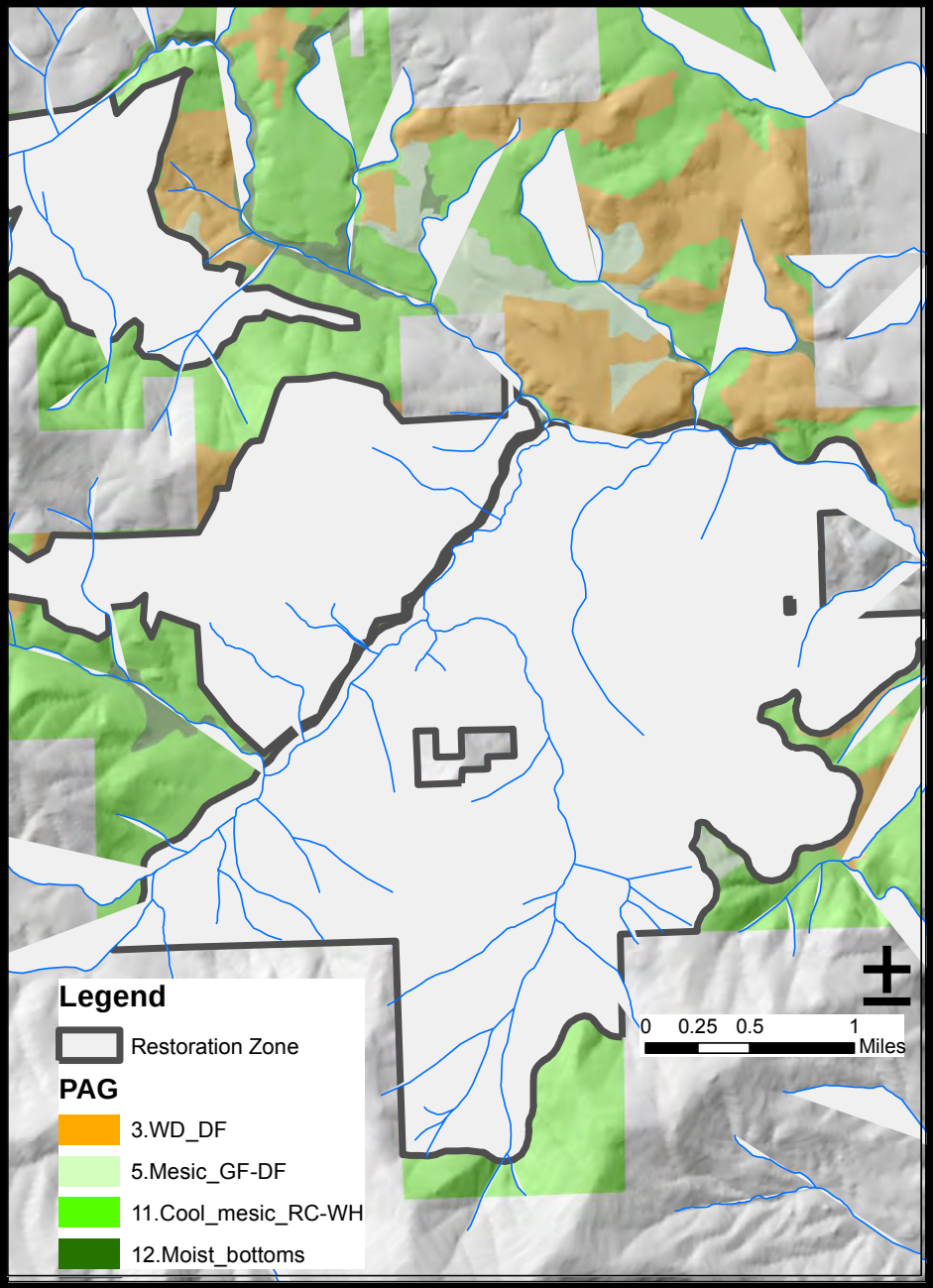
PAGS:

- Dry DF – PP

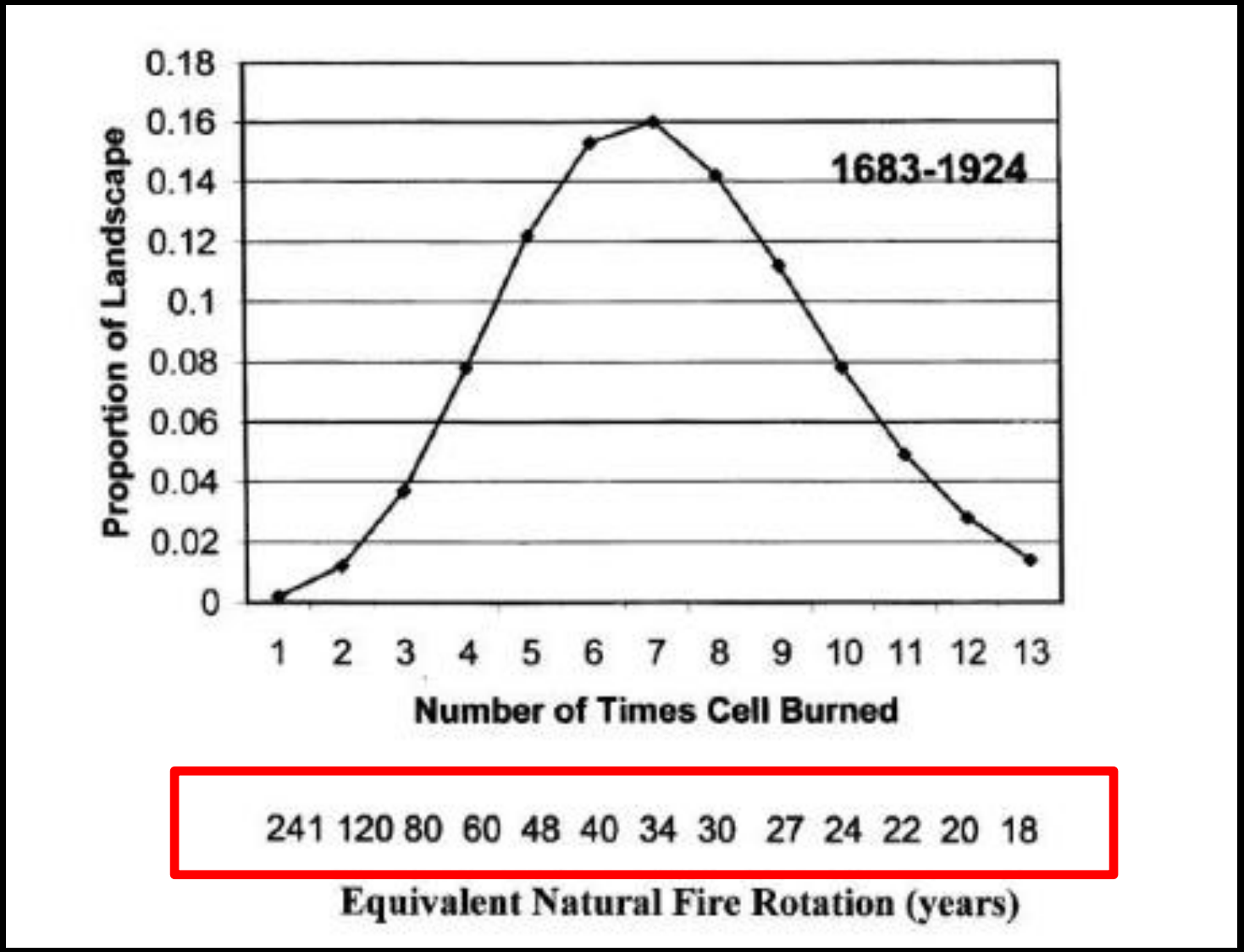
- Mesic GF-DF
- Mesic Cedar – Hemlock

- Moist Cedar-Hemlock

Diverse Forest Types



Mixed Severity Fire Regime



- Agee, J.K. 2005. The complex nature of mixed severity fire regimes. Seattle, WA: University of Washington.

Watershed- Project Level

HRV Analysis

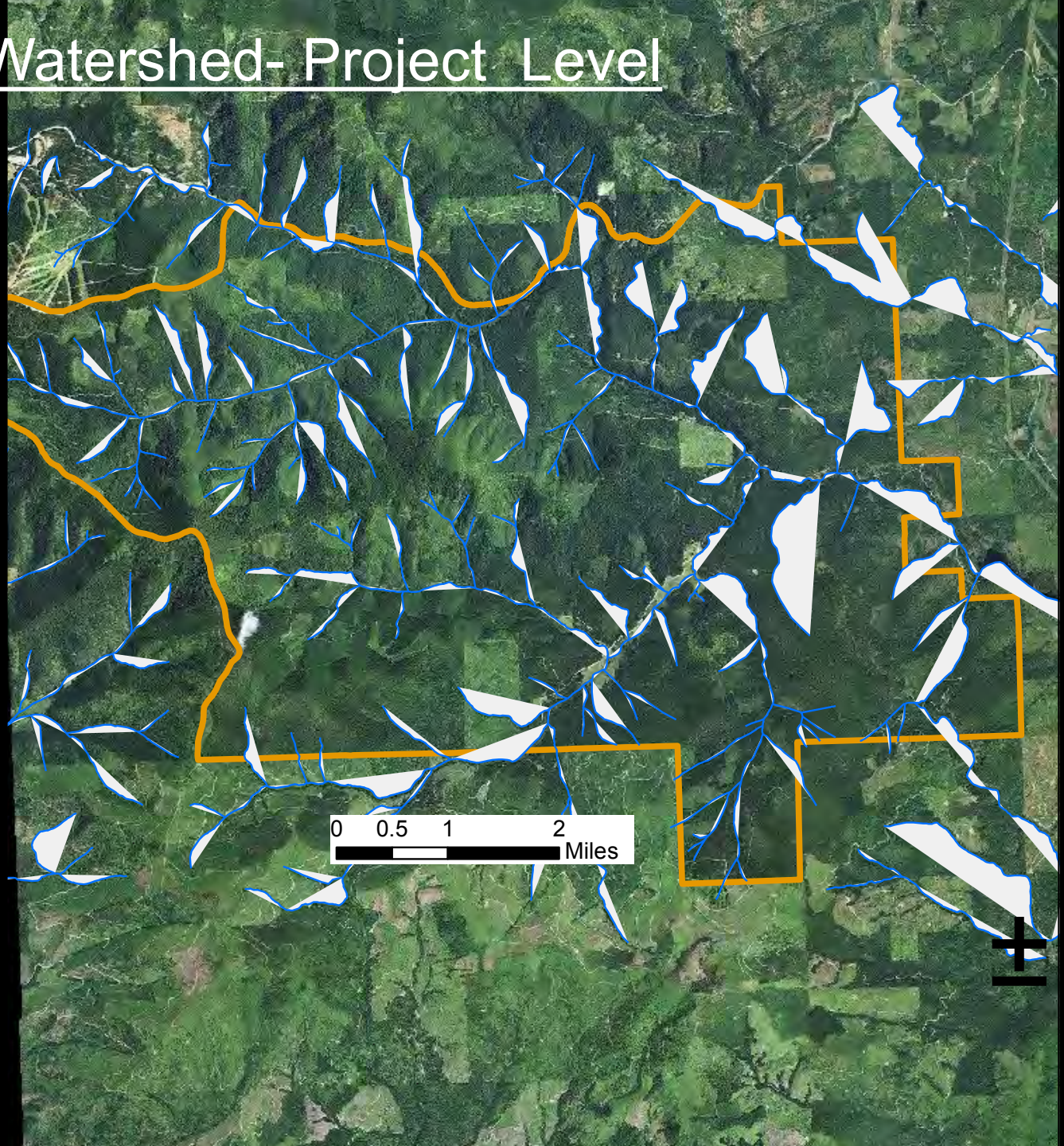
Low on LT – open-mosaic (Structure Stage 7, OFSS)

.

High on YFMS & UR & OFMS: SS: 4, 5, 6

Shift towards fire tolerant species: WL, PP, WP

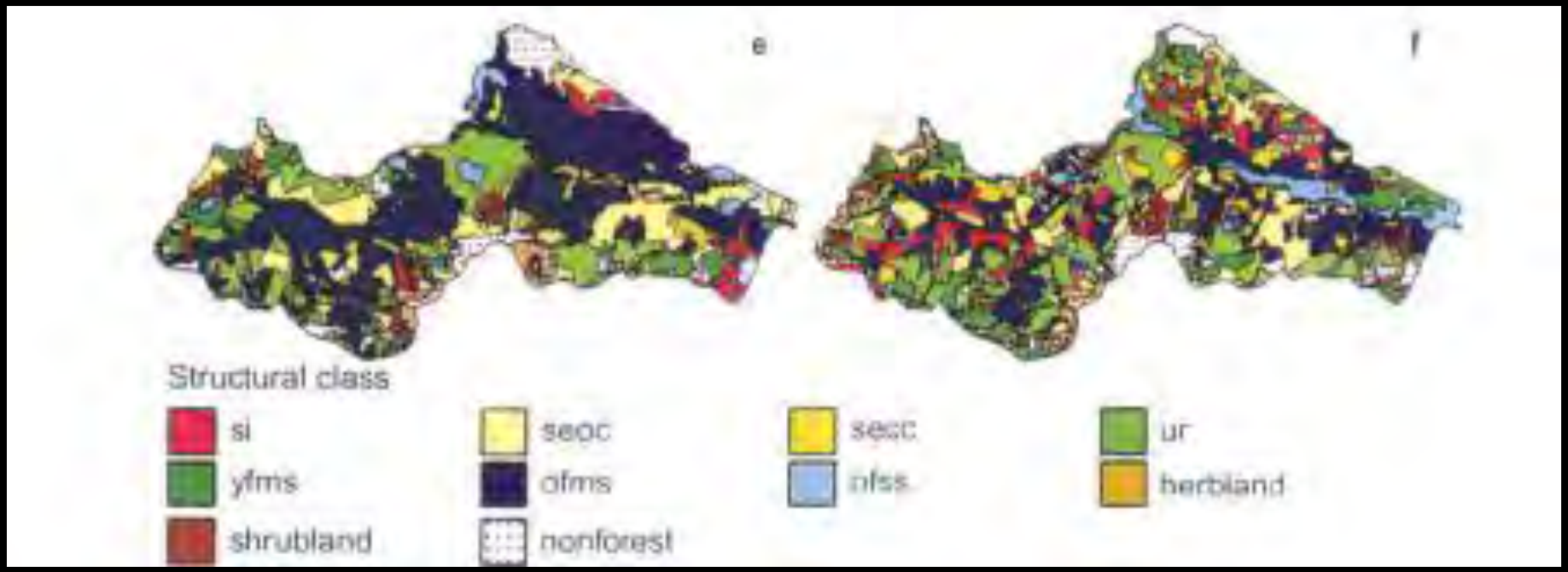
Pattern out of whack!



Watershed- Project Level

Historical

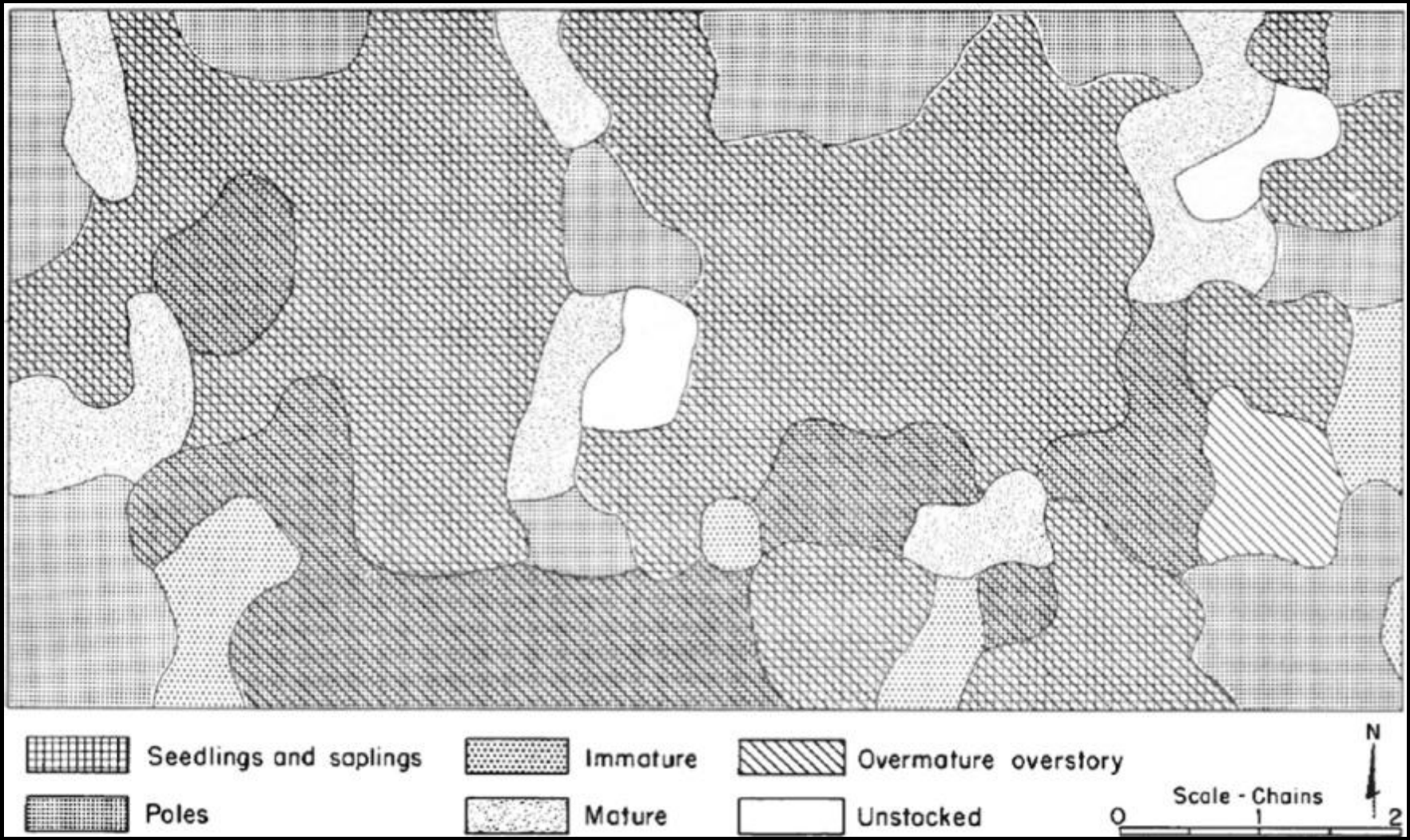
Current



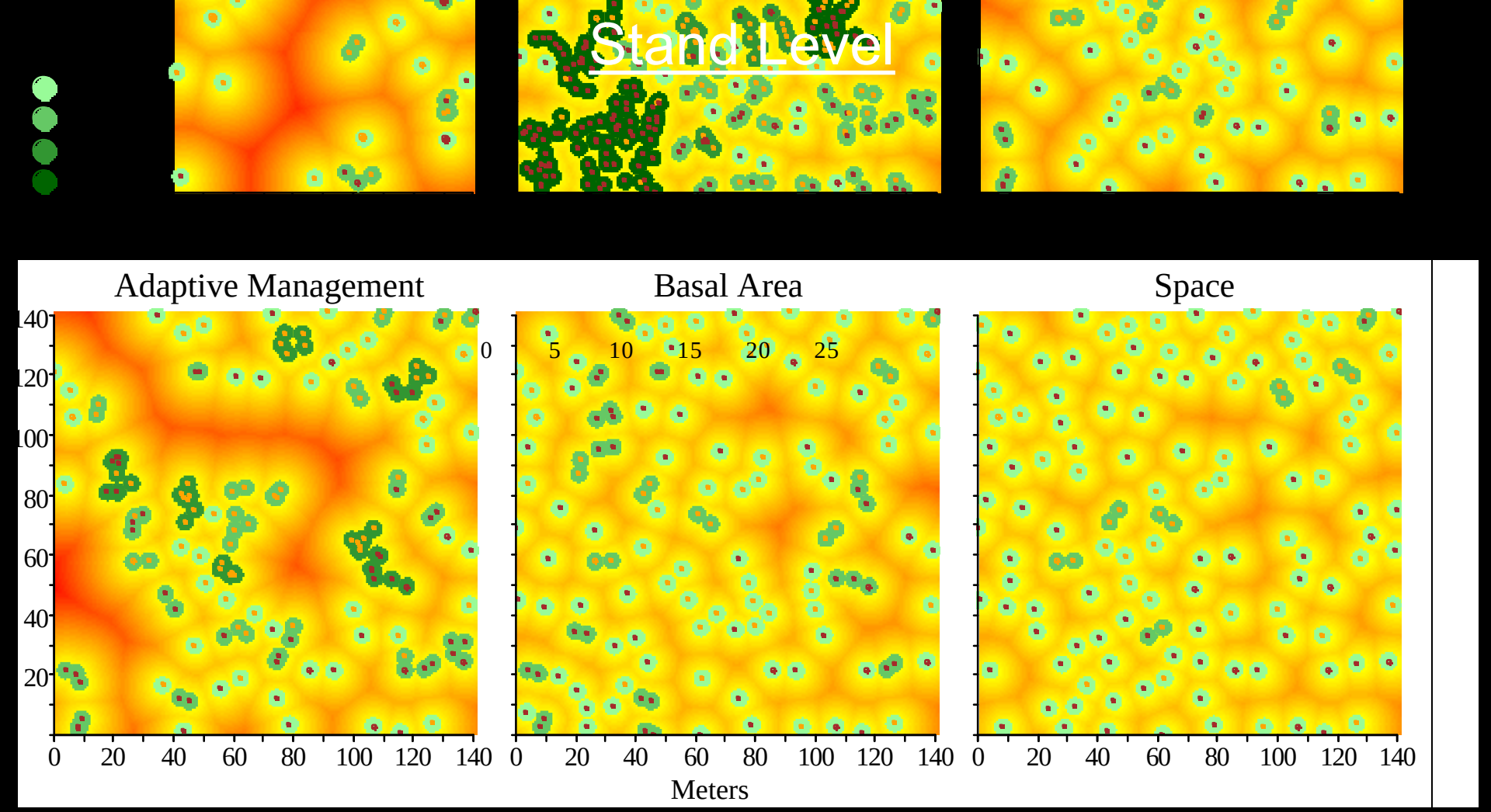
No landscape prescription: pattern analysis to guide us!

Hessburg et al. 2007. re-examining fire severity relations in pre-management era mixed conifer forests. Landscape Ecology: (23) 725-740

Stand Level



Hallin, W.E., 1959. The application of unit area control in the management of ponderosa-Jeffrey pine at Blacks Mountain Experimental Forest, US Department of Agriculture Technical Bulletin 1191.


Stand Level
Adaptive Management
Basal Area
Space
0
5
10
15
20
25
0 20 40 60 80 100 120 140
Meters
Reference
Pre-Treatment
Treat
AM
BA
Space

Stand Level

Patch Type	Function	Size Range/Density
No-thin skips	- Mimic areas “skipped” by fire - Protect biological hotspots - High canopy cover, multistory areas. - Deadwood & disturbance:insects,fire	- Large: 1- 5+ acres - Small: 0.1 - 0.5 ac
Openings	- Mimic high severity patches - Regenerate or plant new species - Release hardwoods - Barriers to crown fire & pathogens	- 0.2 to 1+ acre - Sinuous,irregular shape - 0-5 trees per acre
Heavy Thin	- Mimic moderate severity patches - Release/protect old/large PP/DF/WL - Release hardwoods - Develop understory-midstory - Inhibit crown fire & pathogens	- Single tree or clump release - 5-20% Max Stocking - Patch: 0.5 – 5+ ac.
General Thin Area	- Mimic low severity fire - Improve vigor & growth - Stimulate understory development	- Majority of stand - 25-50% of full stockng - Variable pattern

How much variability?

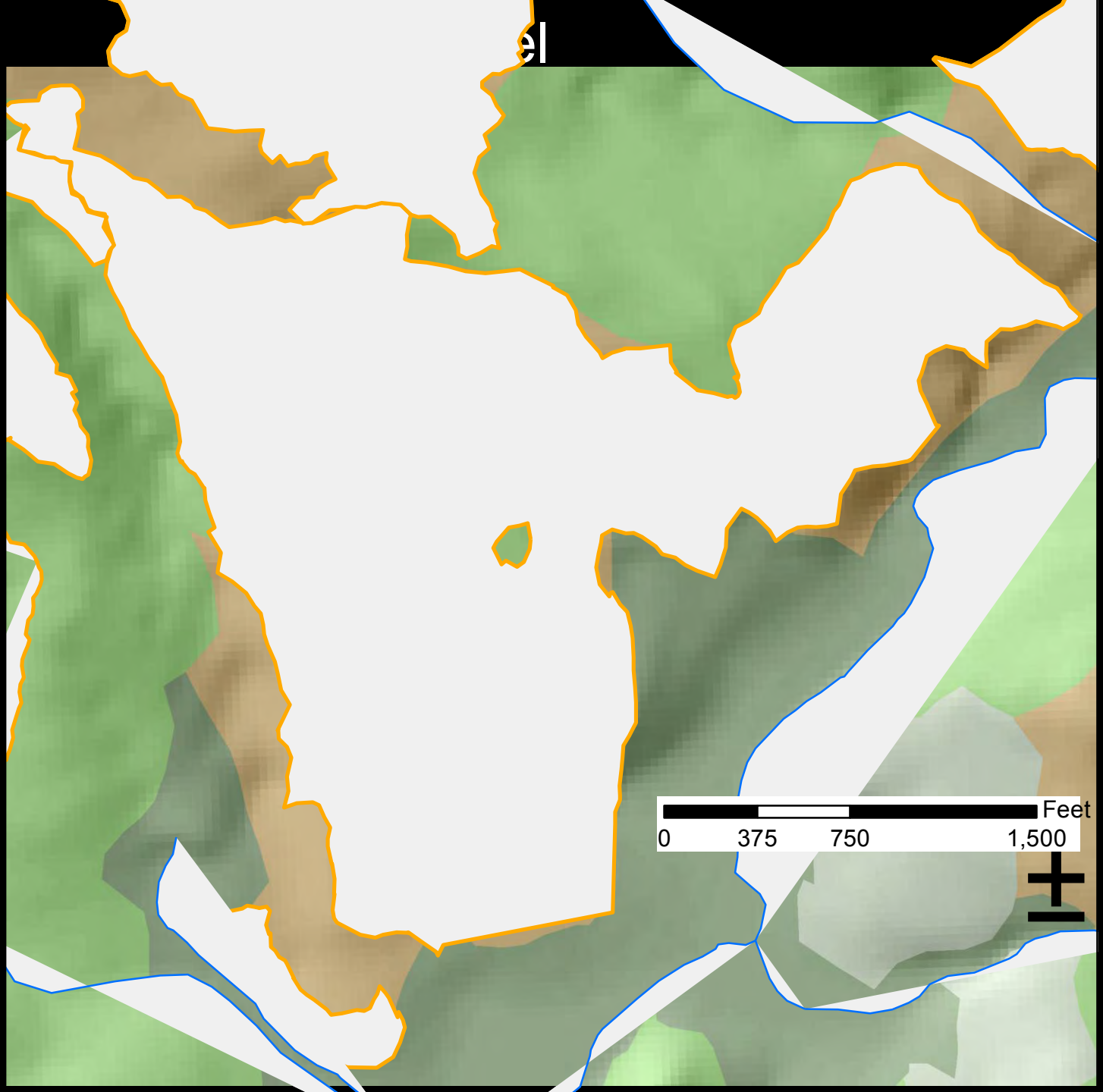
Percent in skips?

Opening Size?

How much variability?

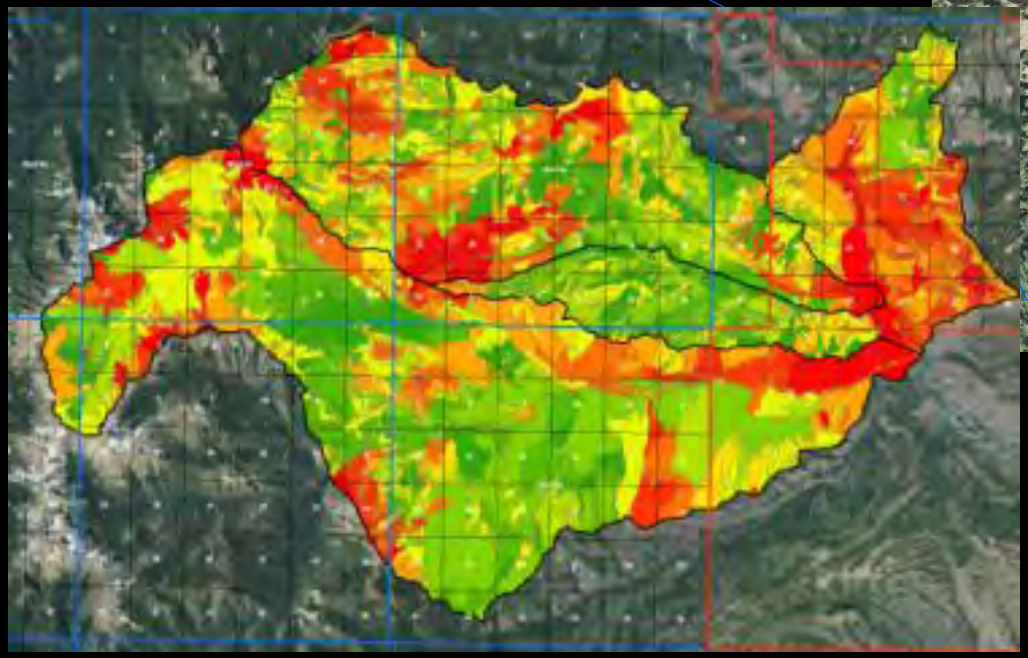
Percent in skips?

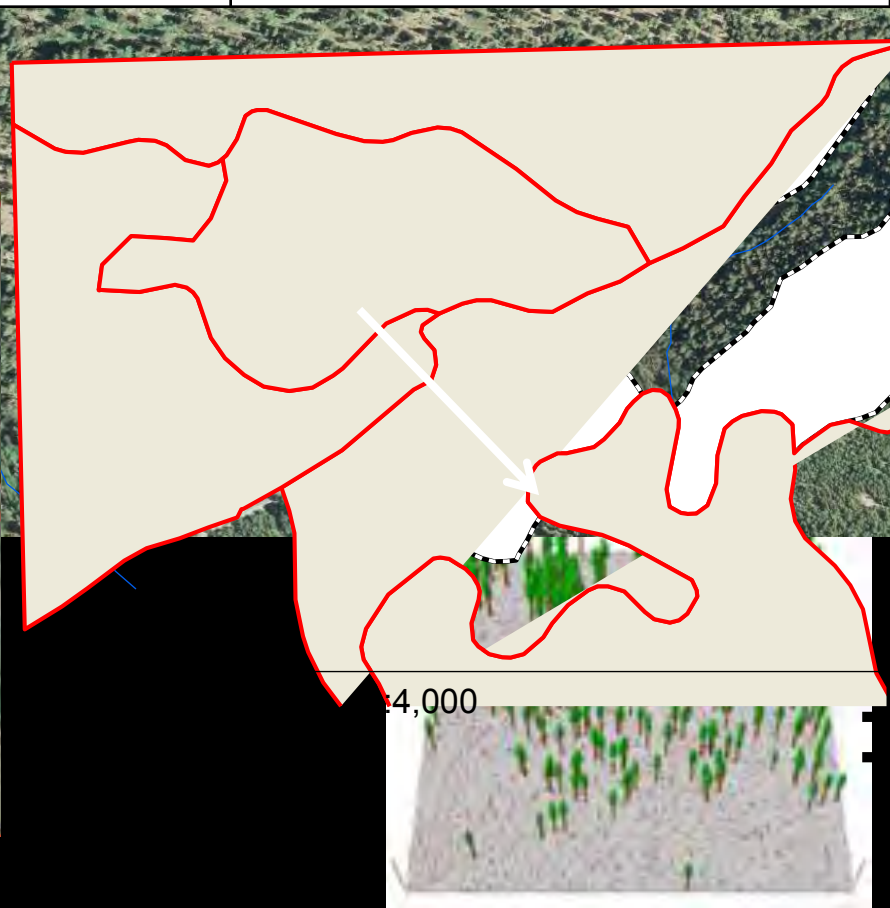
Opening Size?



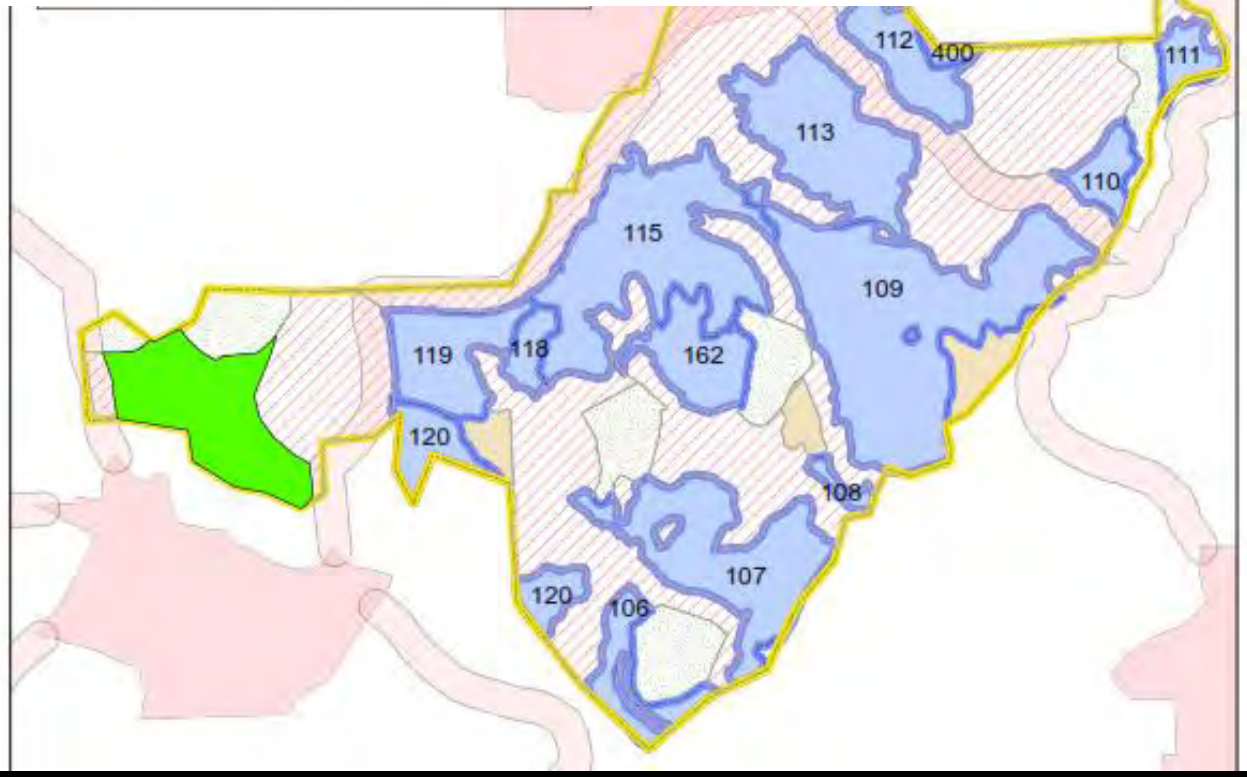
Landscape Hierarchy

Level	Extent	Grain
Project Area - Watershed	10k-50k ac	Stands neighborhoods
Stand neighborhood (Block)	500-2000ac	Stands
Stands:	1-1000ac	Tree-neighborhoods
Tree Neighborhoods: sub-patches	0.1 – 2ac	Clumps, individuals, openings.



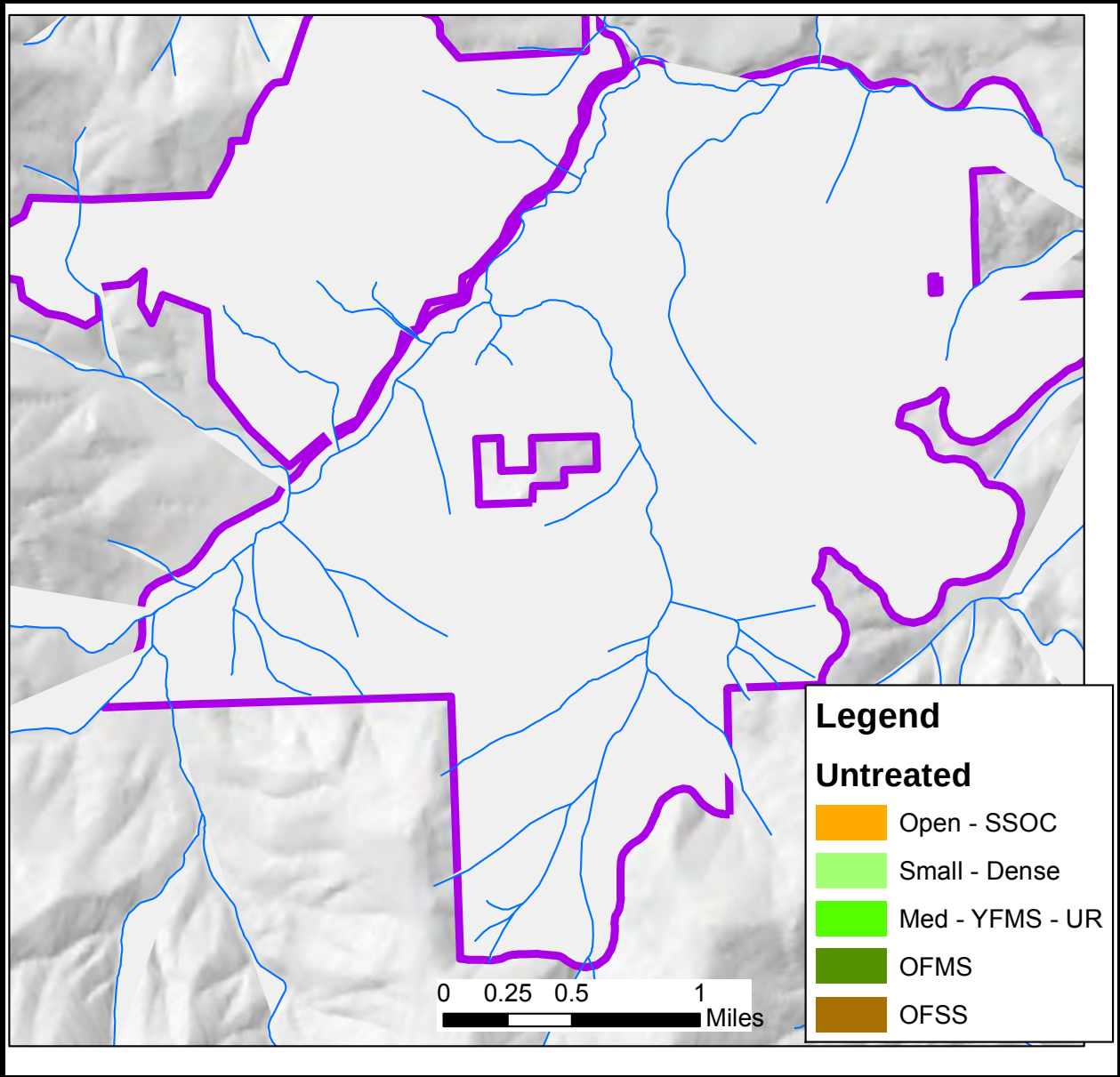


	Acres	% of Restoration Area
NEWFC Restoration	1281	100%
Proposed Harvest not currently flagged	60	4.7%
Currently flagged/gpsd (Harvest Units)	538	42.0%
Early Seral	100	7.8%
Skips	548	42.8%
Gaps	31	2%



Stand Neighborhood

Develop functional rationale for heterogeneity



Stand Neigborhood/Block	General Implications for Stands
Landscape Needs/Goals:	• Shift structure stage from 6 towards 7 on drier PAGs. • Create more complex SS6 on RC-WH sites
Biophysical Context: PAG's, topography, soils	• More intensive treatments on drier slopes. • More skips in cooler, moister areas of stands
Structure, Composition, & Forest Health	• Shift species composition towards fire tolerants • No major need to treat DMT & RR. May reduce levels • Remove patches of mature LP in some stands
Bio-Hotspots	• Large portion untreated due to PMP & Riparian buffers • Mesic sites, skips ➔ patches with complex, large and old tree structure and high downed wood levels • Dripline/HT around old PP-WL-DF. • Openings/HT around Aspen
Habitat Needs	• Large dense-multistory patches exist • Avoid large areas of thinning (>5-10 acres) • Create openings & HT areas for forage species
Rx Fire & Wildfire:	• Need to break up continuity:, but tough to burn mesic • Create a landscape of low-mod-high severity patches • **"Let fire do some of the work".** • Most skips can be burned through. Skips ➔ torching
Access-operational Issues	• Large areas dropped ➔ no road access • Areas difficult to yard within stands ➔ can be skips

Stand Neighborhood

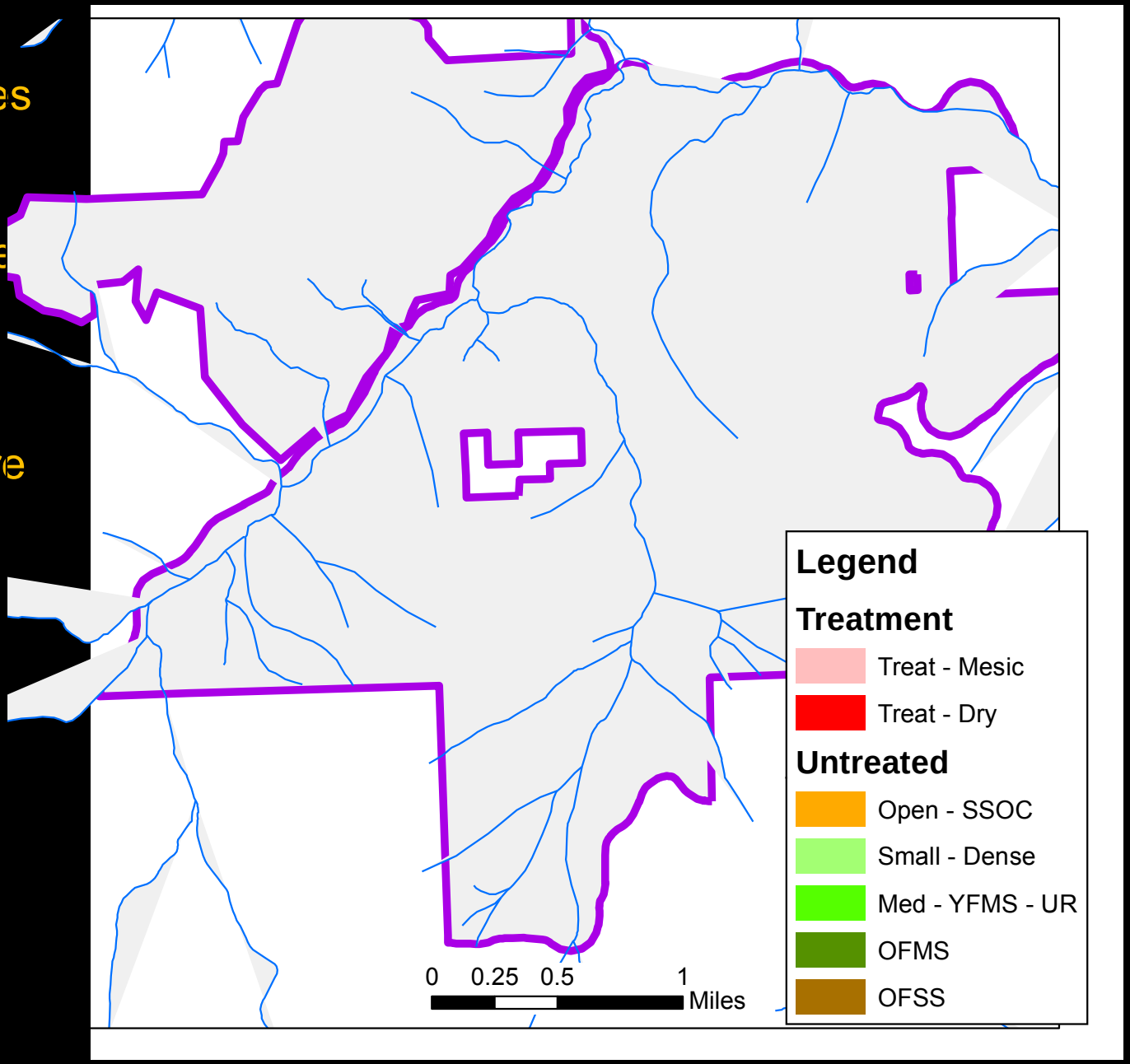
- Retain large patches dense forests

- Create large patche of low density

- Opening already exist:, more future fire

- Plenty of medium patches

- Smaller patches within stands



Stand Level

Patch Type	Dry Dominated	Mesic Dominated
DFC	Large tree, open mosaic (SS – 7, OFSS)	Large tree, closed, multi-story (SS- 6, OFMS)
No-thin skips	- Fewer: ~10-20%	- More: ~20-50%
Openings & Heavy- Thin	- More 20%+	- Less??
General Thin Area	- Lower density: Individuals, clumps, & openings	- Higher density, more patchy?

Existing conditions: species composition, pathogens, etc.
Landscape needs!

Stand Level

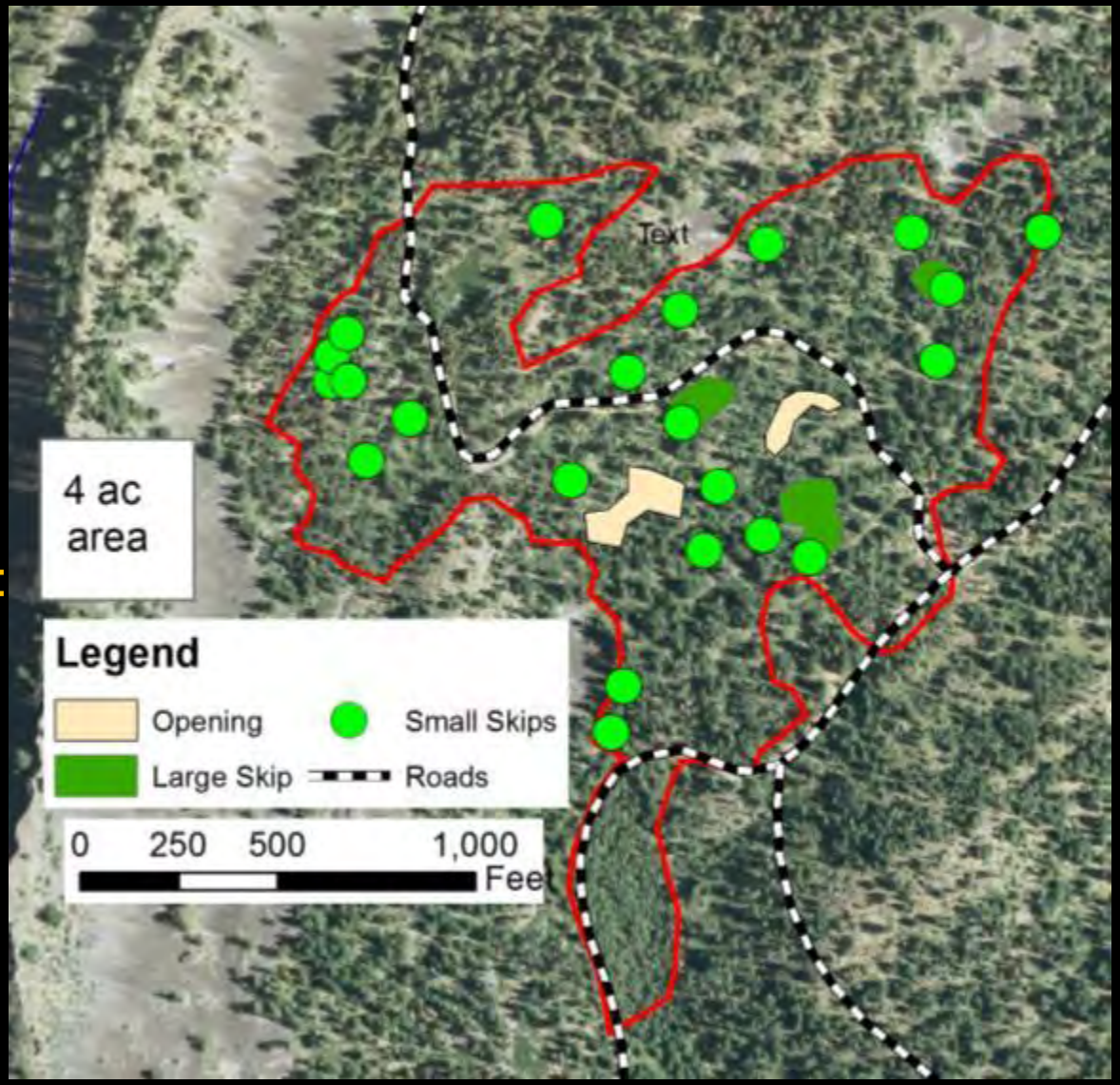
Skips:

- Max thin area 4-10ac

Openings – Heavy Thin

General Thin Area

- Avg: 60-120 BA: + range
- Fine scale clumpy & gappy: don't worry about spacing
- Thin from ~below
- PP=WL>DF>>RC>>>GF



Implementation

Patch Type	Size Range/Density
No-thin skips	- Large: 1+acres - Small: 0.1 - 0.5 ac
Openings	- 0.2 to 1 acre - Sinuous, irregular shape - 0-5 trees per acre
Heavy Thin	- Single tree or clump release - 5-20% Max Stocking - Patch: 0.5 – 1+ ac.
General Thin Area	- Majority of stand - 25-50% of Max stocking -Variable pattern with individuals, clumps, & small openings

FS Crews: Marking & Layout

DxP guidelines

- ICO
- Basal Area + target for large clumps
- BA variation: 1/3rd low, 1/3rd mod, 1/3rd high

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Restoring forest resilience: From reference spatial patterns to silvicultural prescriptions and monitoring

Derek J. Churchill [a,*], Andrew J. Larson [b], Matthew C. Dahlgreen [c,1], Jerry F. Franklin [a], Paul F. Hessburg [d], James A. Lutz [e]

The ICO Approach to Restoring Spatial Pattern in Dry Forests

Implementation Guide

Version 1.0. January 2013

Implementation

Designation Approach	Achieving Complexity	Layout Efficiency	Operator Efficiency	Implement Flexibility	Sale Admin. Efficiency
Marking	+	-	+	-	+
Designation by Description (DxD)	~	+	~	-	~
Designation by Prescription (DxP)	~	+	~	+	-
Combination DxP/DXD & mark	+	~	+	+	~

Conclusions

1. Pattern matters: Resilience ➔ Heterogeneity multiple scales
   - Landscape/Watershed scale:
   - Stands: skips, openings, variable thinning
   - Stand Neighborhood: tractable scale for work & add up.

2. Set landscape up for mixed severity fire
   - Let fire do some work: comfort with Rx fire killing trees
   - Retaining more insect, pathogenic & DMT mortality

3. Develop rationale for heterogeneity tailored to project area
   - No set percentages:
   - Dry stands vs. Mesic stands
   - Use topography; PAGs, existing conditions
   - Maximum thinned area without skip or opening

4. Implementation
   - Focus on species & tree quality, not spacing
   - Mix of marking & DxP – DxD
   - Yes, more time, but can be efficient

Next Steps
Discussion Questions

- This is complicated, but we can make some educated approaches

- Need for more scientific guidance on pattern
  - FRV & HRV: EMDS
  - Stand level guidelines

- Need to monitor/research this approach
  - Ecological effects
  - Implementation challenges

Power Lake Pr

Power Lake Project

- Objectives: restore reslience, set up for mixed severity fire: replenish the mosaic Resilience ➔ heterogeneity PATTERN MATTERS

- Location & forest types (3 PAGS) & historic disturbance regime,. Structure classes

- Hierachy: Mosaic & heterogeneity:
- Great: multiscale heterogeniety: How the hell to do it???

    - Landscape Analysis ➔ composition targets: no pattern info
    - Stands: Know that we want skips & gaps
    - Power law principle

- Landscape (project area) + stands + block of stands neighborhood
    - Within block: add up percentages & range of patch sizes
    - Much already set: wildlife, road access, etc.
    - Use topography

- Neighborhood Checklist:

- Prescriptions for stands:
    - Dry ➔ SS7
    - Mesic ➔ SS6 or 7 .

- GIS skips & major openings

Pattern with Stand Neighborhood Block

1. Create Initial Map of dropped areas & post-treatment conditions

2. Define the functional rationale for skips and openings across block:
   - Habitat
   - Fire & other disturbances:
   - Species composition & forest health considerations

3. Determine kinds and sizes of skips and openings

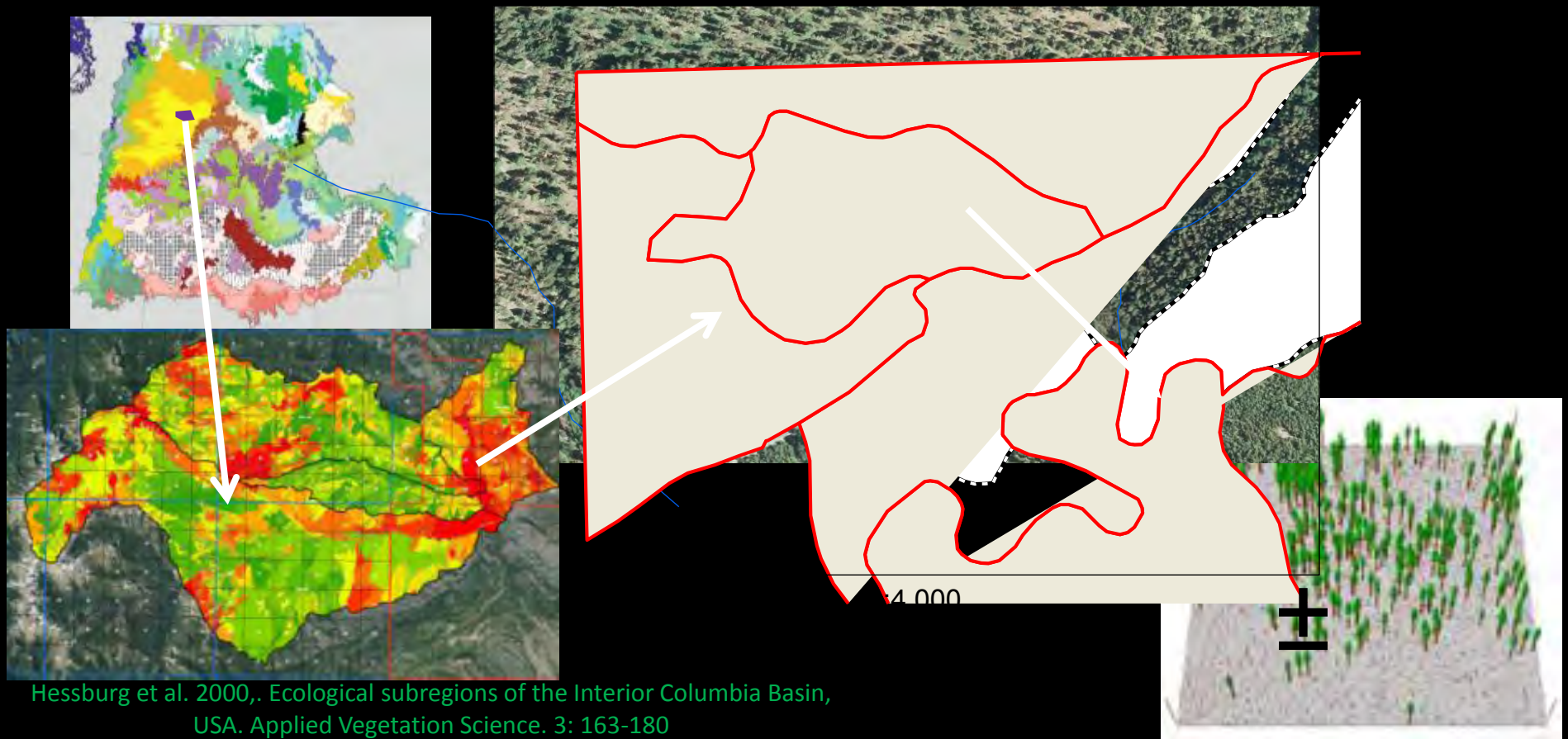
4. Define a maximum thinned area patch size for treated stands:

5. Derive initial targets skips and openings for each stand:

6. Adjust for:
   - Existing stand conditions
   - Old tree or >21" trees populations
   - Prescribed fire:
   - Logging systems
   - Implementation Issues

Landscape Hierarchy

Level	Extent	Grain
Ecological Subregions	200k+ha	Watersheds
Local landscapes: watersheds	10k-50kha	Stands
Stands: successional & topo-edaphic patches	1-1000ha	Tree-neighborhoods
Sub-patches: Tree Neighborhoods	0.1 – 1ha	Clumps, individuals, openings.



Hessburg et al. 2000,. Ecological subregions of the Interior Columbia Basin, USA. Applied Vegetation Science. 3: 163-180

Quantifying Stand-Level Mosaics

Past Methods not sufficient

Neighborhoods of individuals, clumps, and openings.

Some clear patches, lots of gradient

Pattern of neighborhoods

Figure 2—An example of the clumped tree distribution and canopy gaps produced by an active fire regime. The photograph is an aerial view of the Beaver Creek Pinery, which has experienced very little fire suppression.

North, et al. 2009. An Ecosystem Management Strategy for Sierran Mixed- Conifer Forests. USDA Forest Service:

ICO Marking