Fuel Treatment Effectiveness and Prioritization on Industrially Managed Coast Redwood Forests

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Overview

Background

Fuel treatment effectiveness

Fuel treatment prioritization

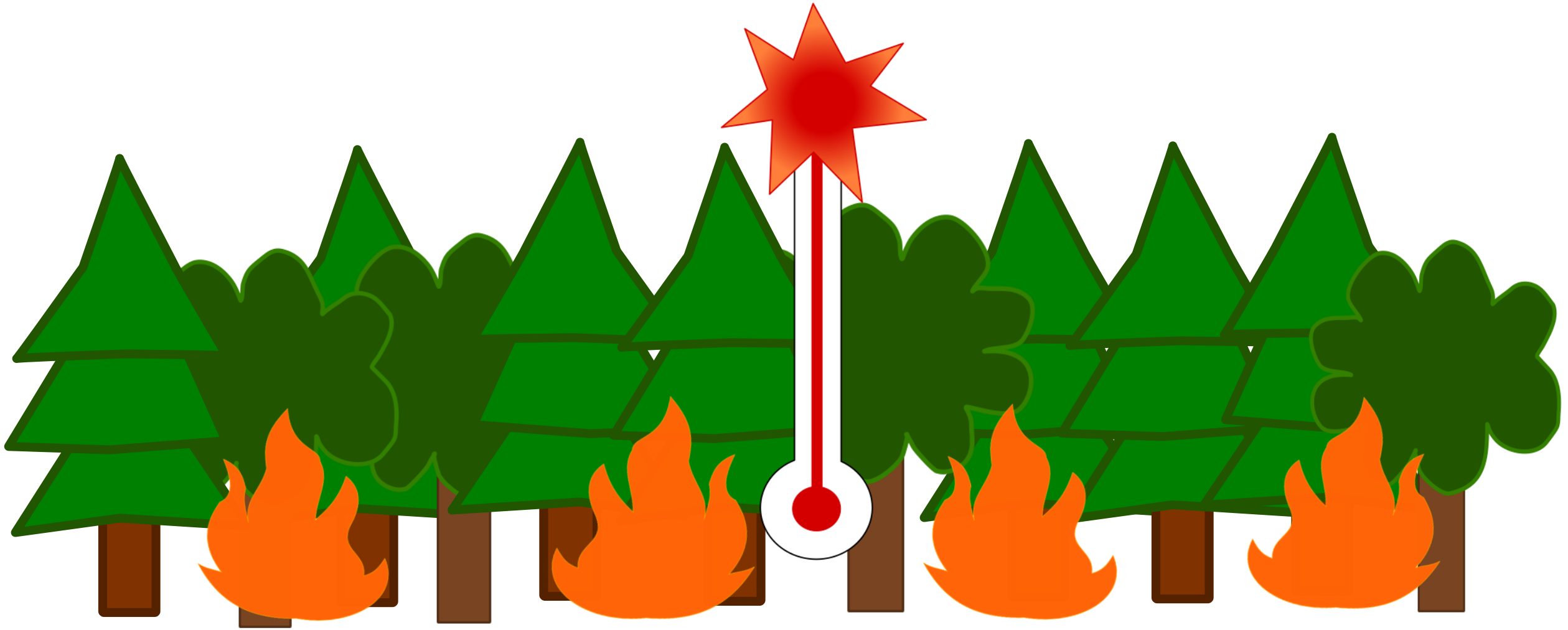
Conclusion

How both studies fit together & future directions

Managing redwoods for wildfire risk is increasingly important

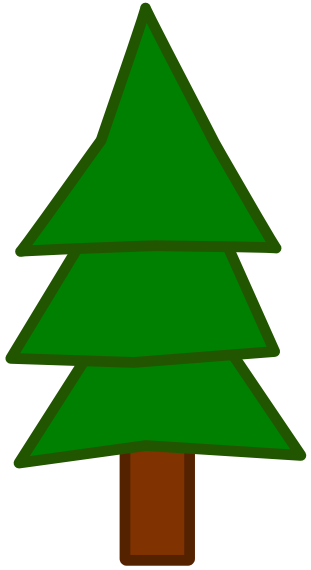
Harvest operations add to wildfire hazard by creating surface fuels

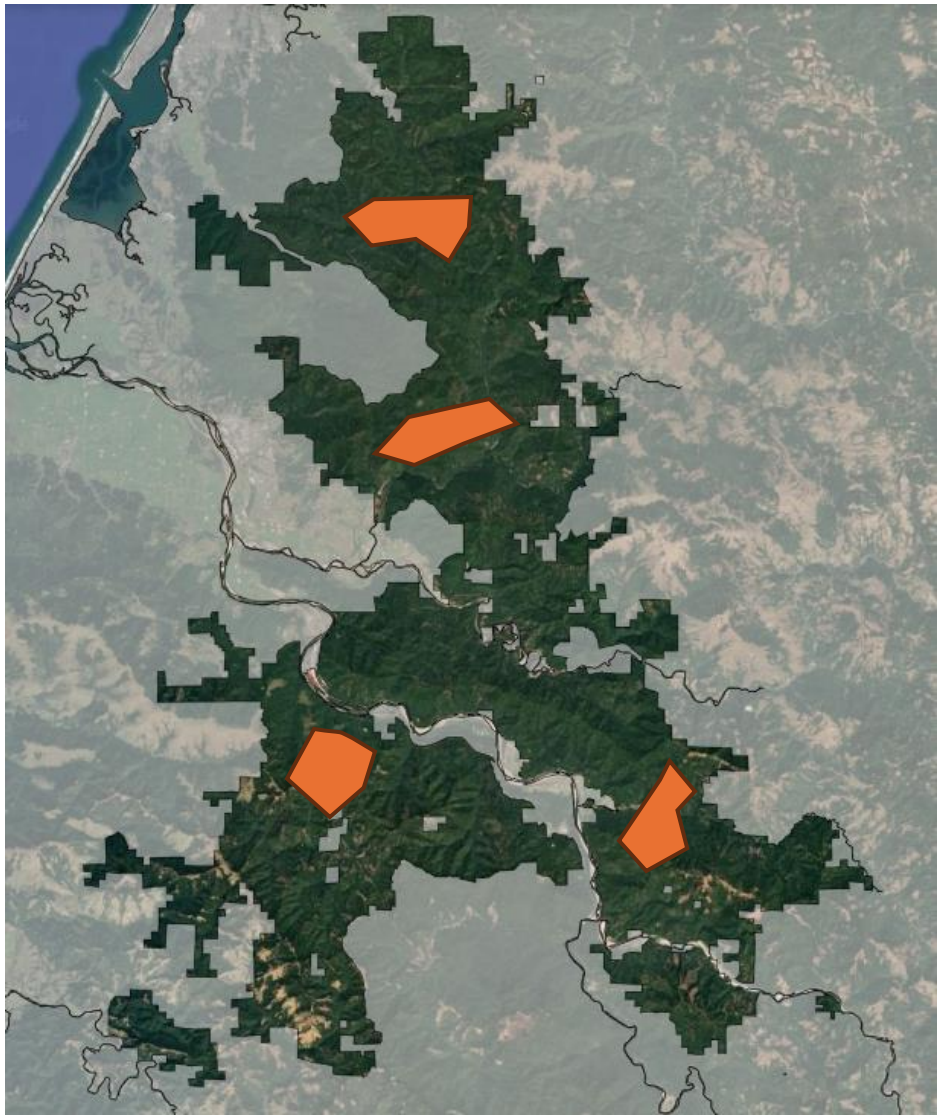
Current stands are vulnerable to wildfire

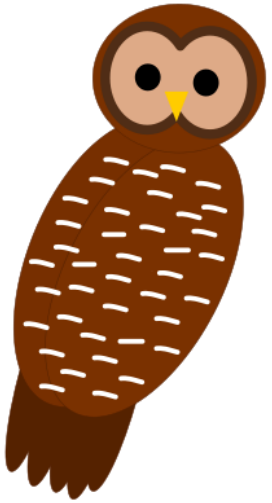


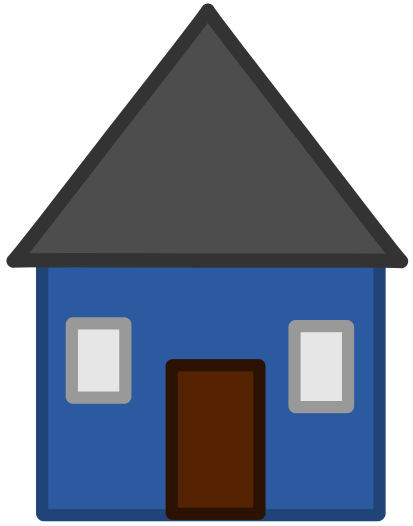
Treatments are being used, but effectiveness is unquantified

Placement of treatments is important, but has not been assessed for private timberlands



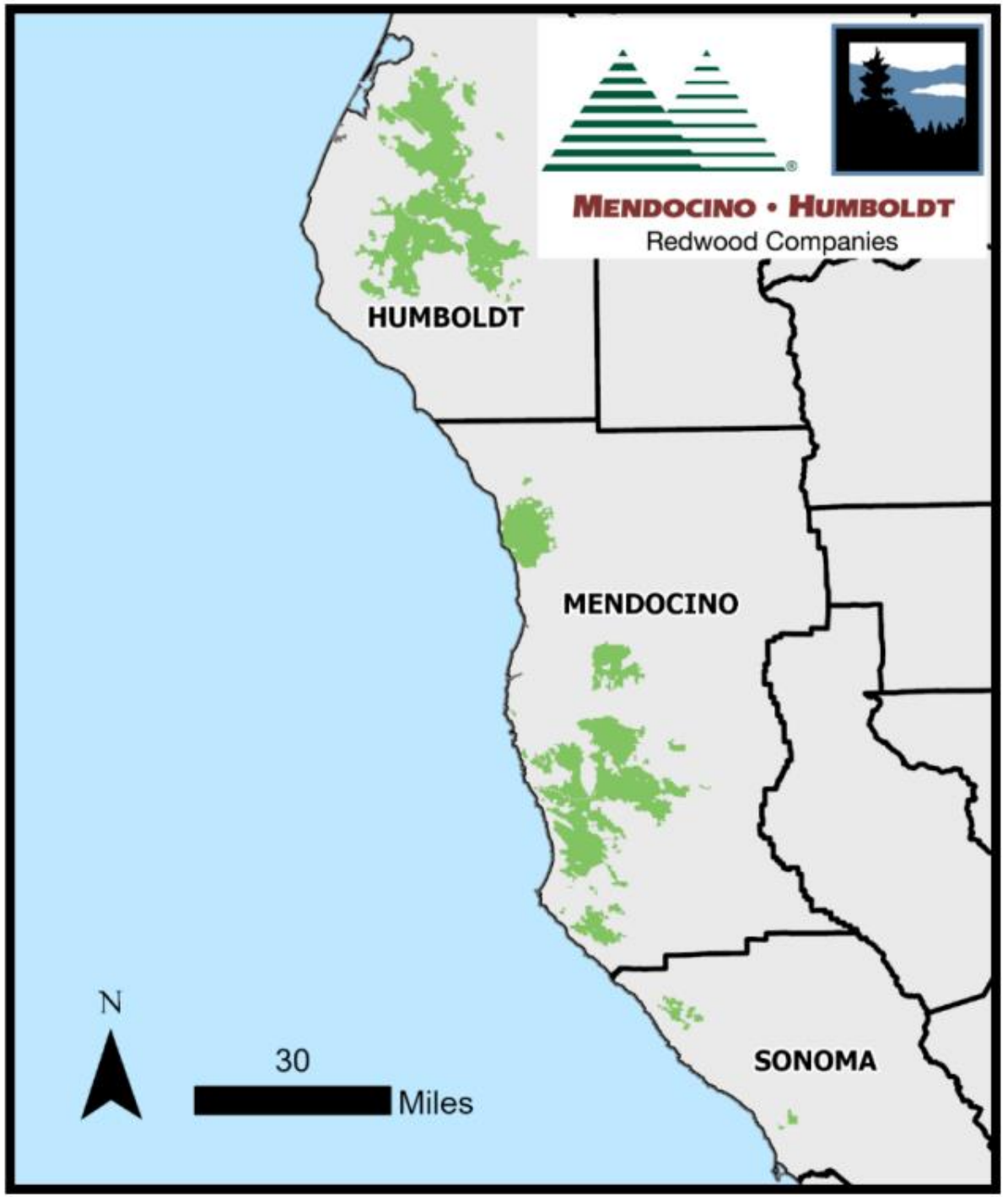






Study area

- Mendocino and Humboldt Redwood Companies
- Second- and third-growth redwood and Douglas-fir forest
- Maritime Mediterranean climate



Research goals

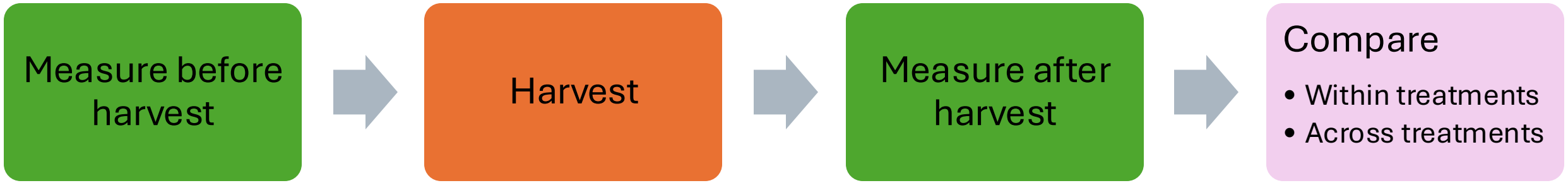
Thesis Goal: Understand how silvicultural operations affect fuel loads and develop a framework for prioritizing fuel treatments on private timberland

- Quantify how common silvicultural treatments interact to influence post-harvest fuel load
- Develop and apply a multi-criteria prioritization framework for fuel treatments on MHRC

Effectiveness of Current Fuel Management in an Industrial Redwood Forest

Research questions

- Do fuel treatments create a meaningful decrease in surface fuel levels, and if so, which treatments are the most effective?
- How does the composition of the fuel bed change after treatment?



Selection silviculture

Variable retention (VR) silviculture

Commercial thin silviculture

Harvesting systems

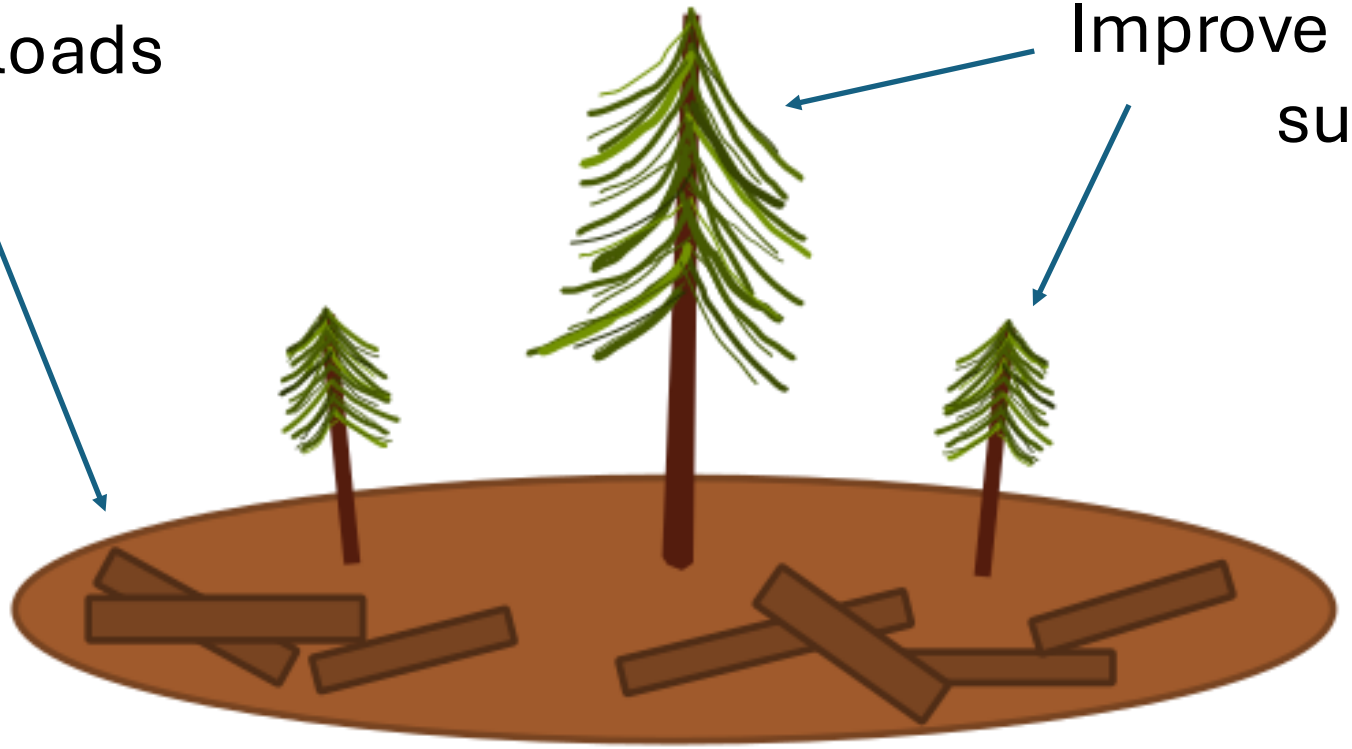
Ground based

Cable based

Site preparation has two main functions

Reduce fuel loads

Improve regeneration success



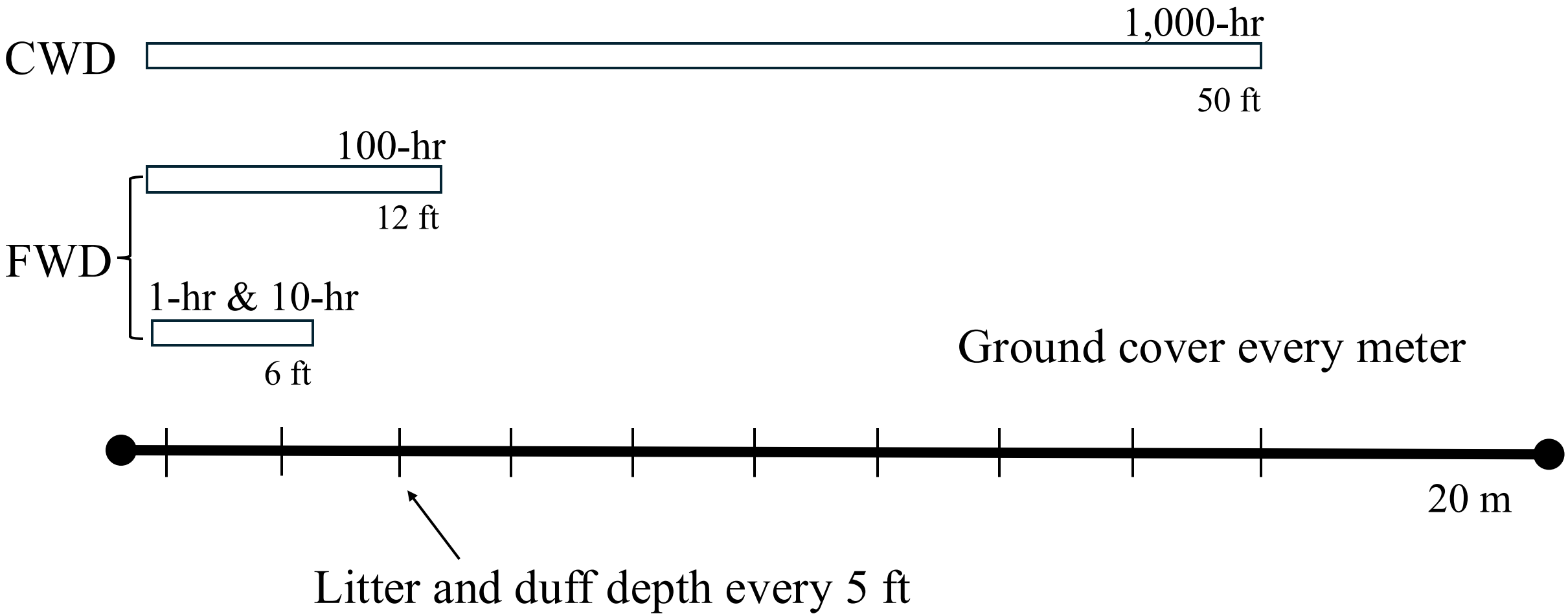
Site preparation – pile burn

Site preparation – basic/lop and scatter

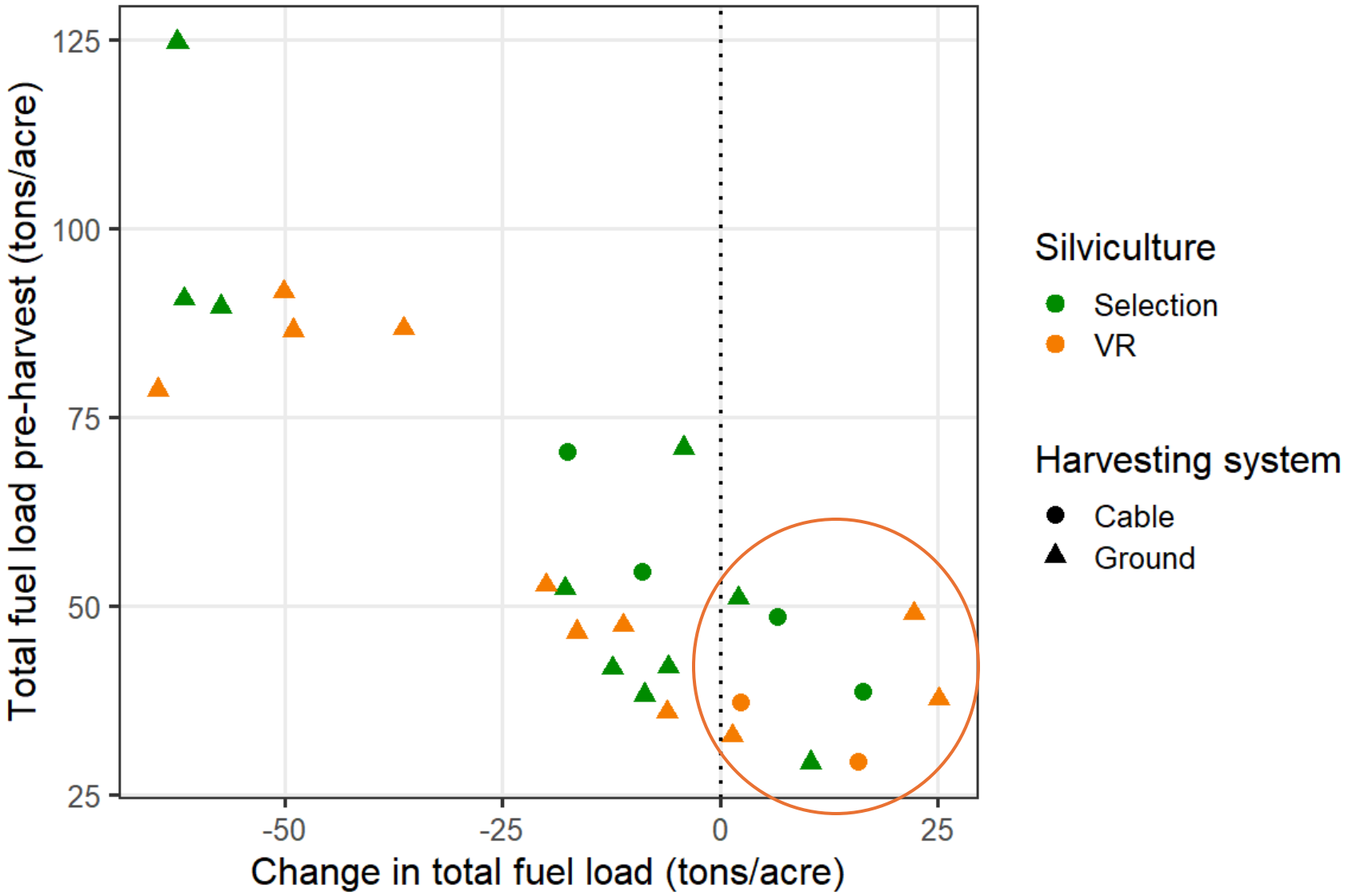
Site preparation - none

Treatment combinations

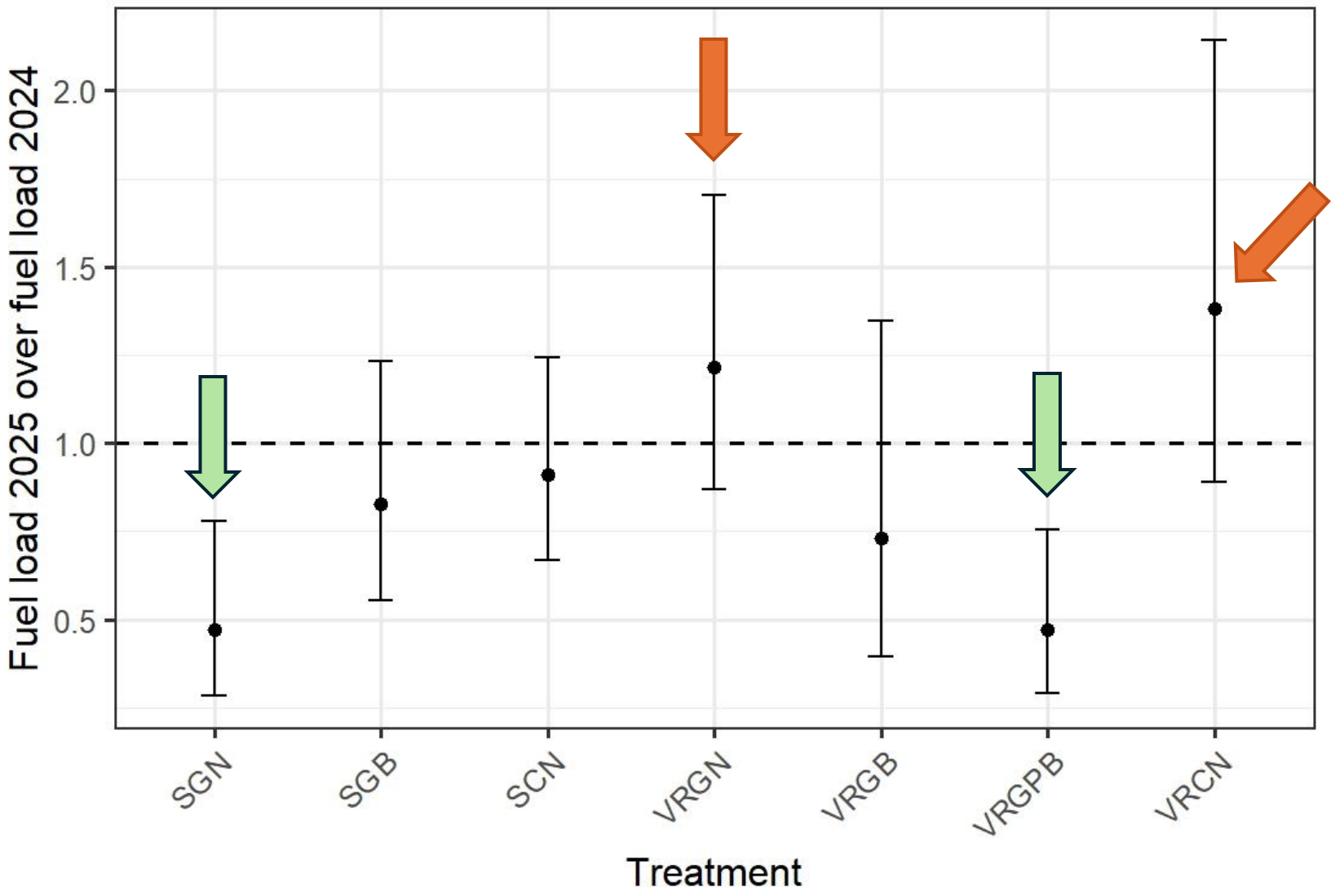
Treatment	Silvicultural System	Harvest System	Site Preparation
VRGPB	Variable Retention	Ground	Pile Burn
VRGB	Variable Retention	Ground	Basic
VRGN	Variable Retention	Ground	None
VRCN	Variable Retention	Cable	None
SGB	Selection	Ground	Basic
SGN	Selection	Ground	None
SCN	Selection	Cable	None


1,000-hr
CWD
50 ft
100-hr
12 ft
FWD
1-hr & 10-hr
6 ft
Ground cover every meter
20 m
Litter and duff depth every 5 ft

Sites with higher pre-harvest fuel load had larger reductions in fuel



Total fuel load was reduced in five treatments



SGN **–53%**

Selection, ground, no site prep

VRGPB **–53%**

VR, ground, pile burn

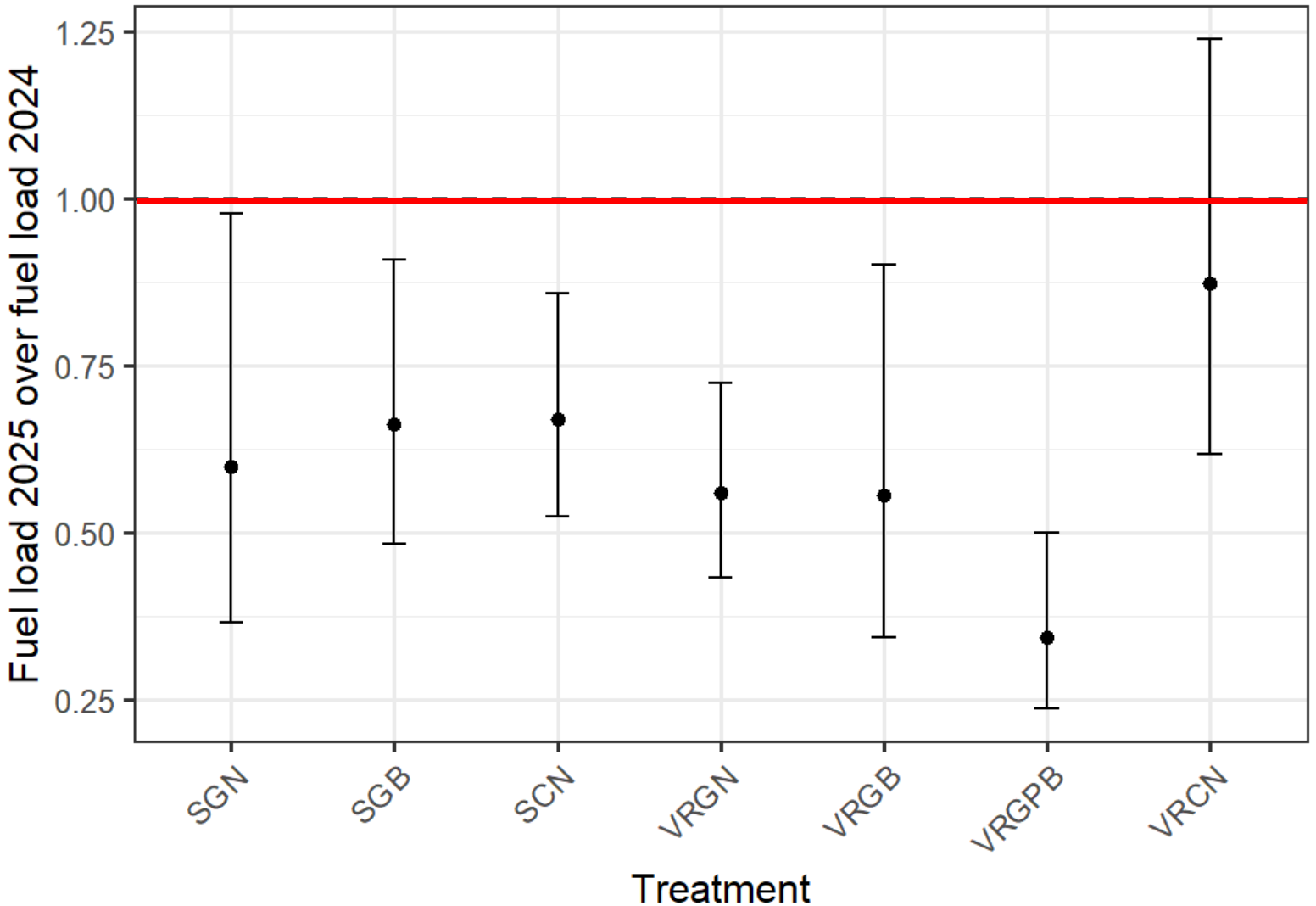
VRGN **+22%**

VR, ground, no site prep

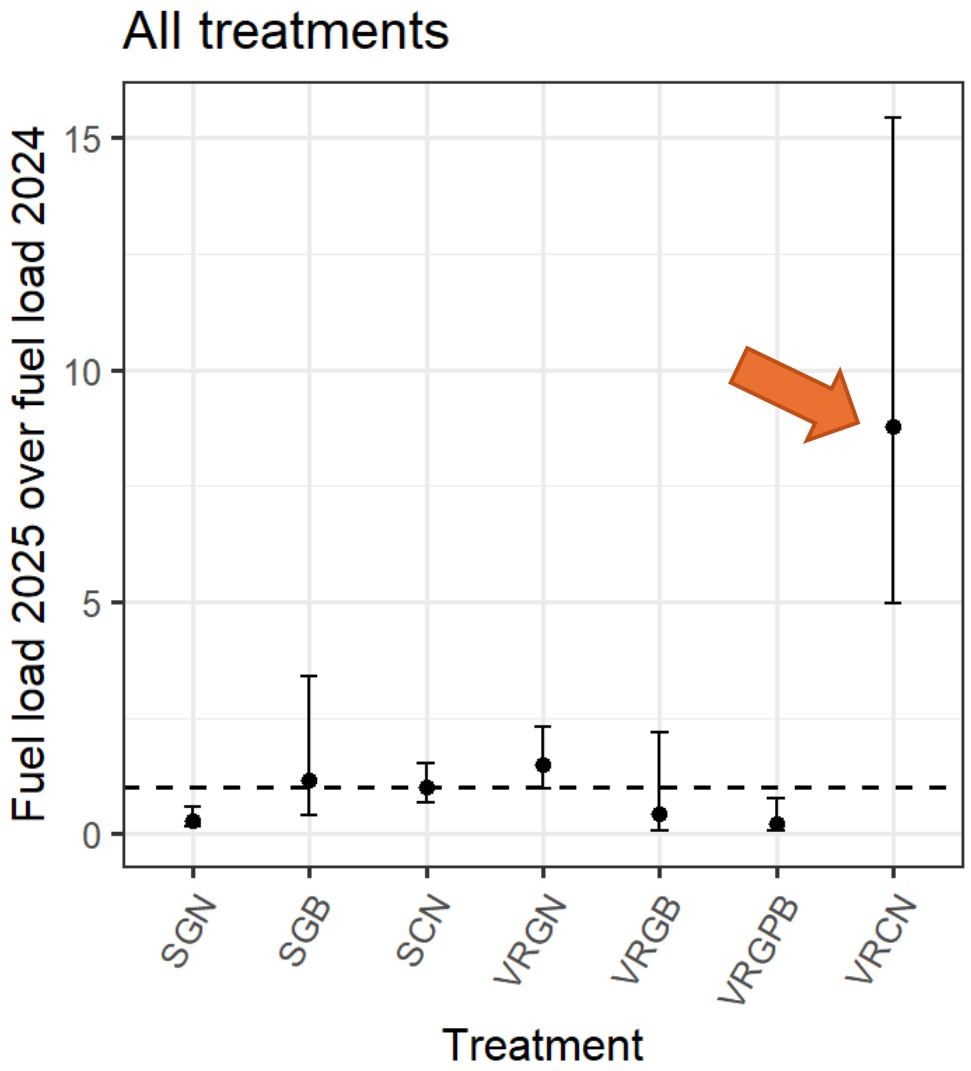
VRCN **+38%**

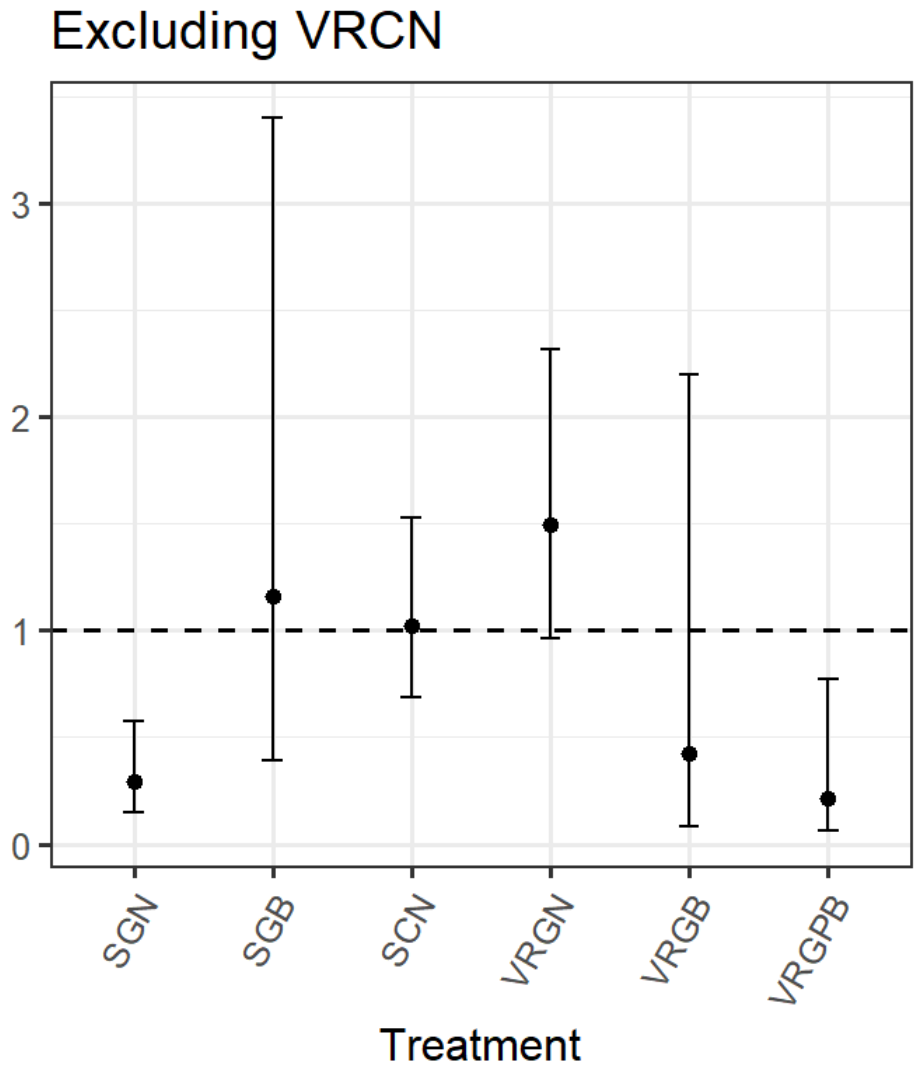
VR, cable, no site prep

Fuel load of litter and duff decreased in all treatments

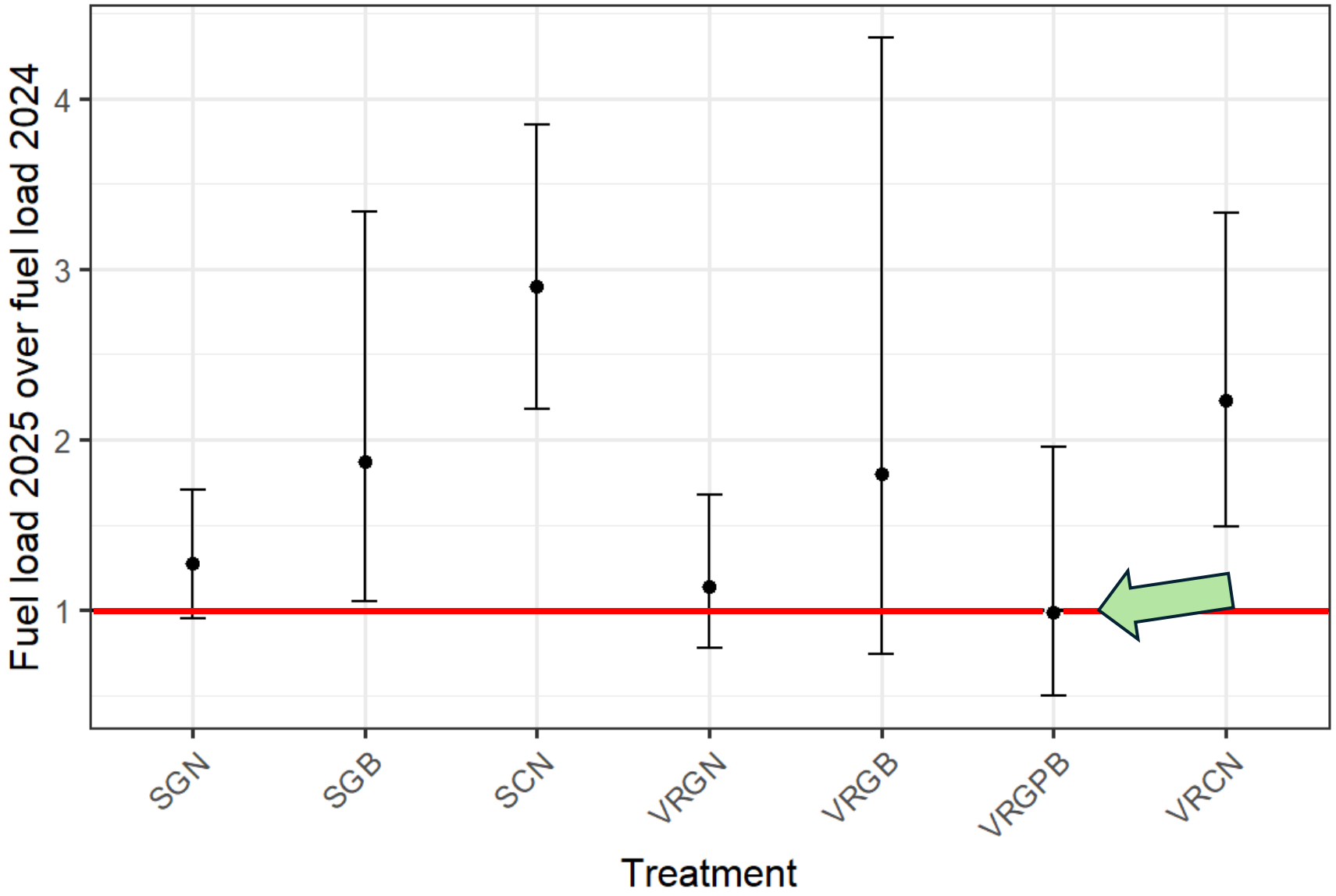


Coarse woody debris followed similar trends to total fuel load

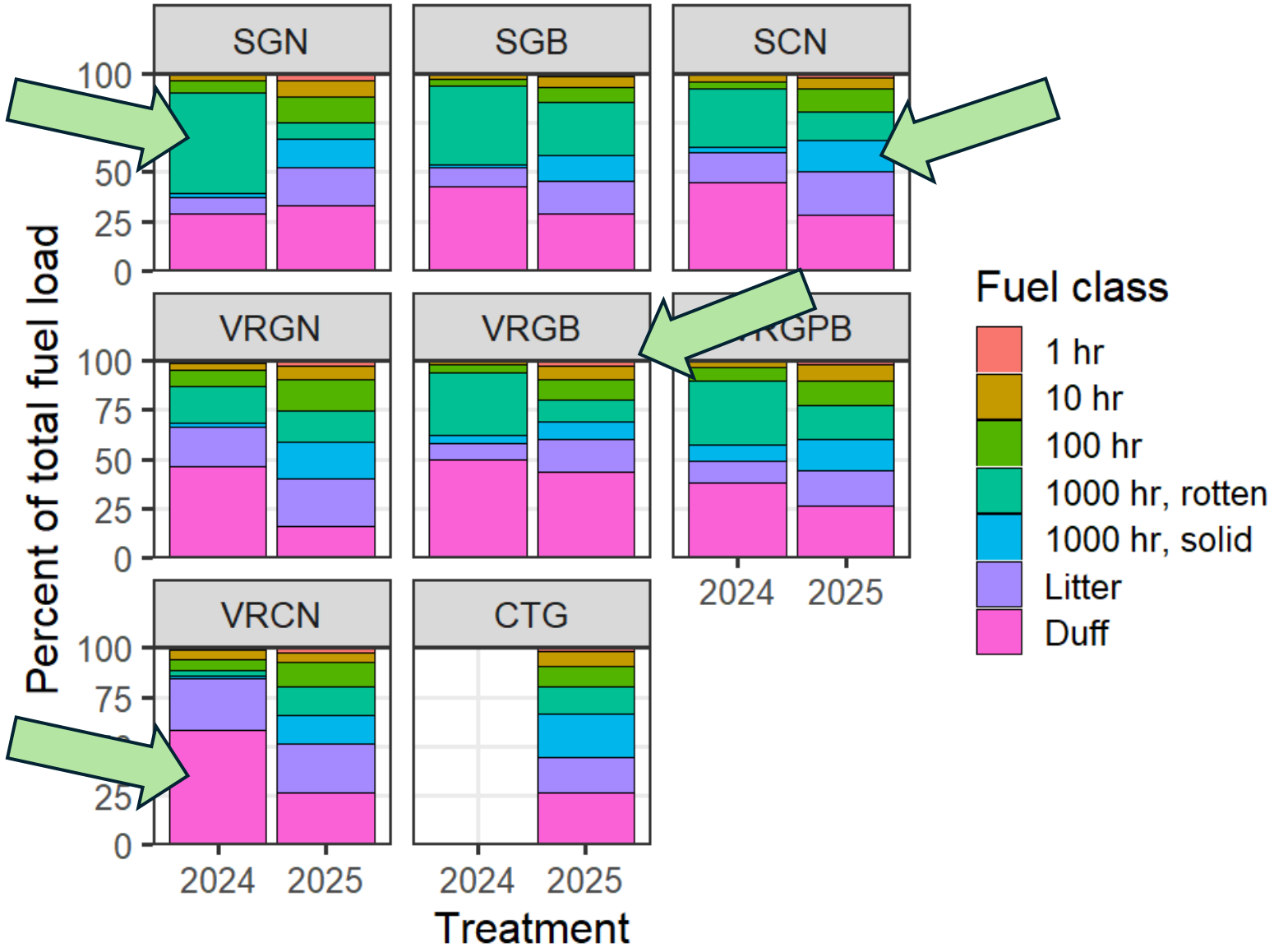




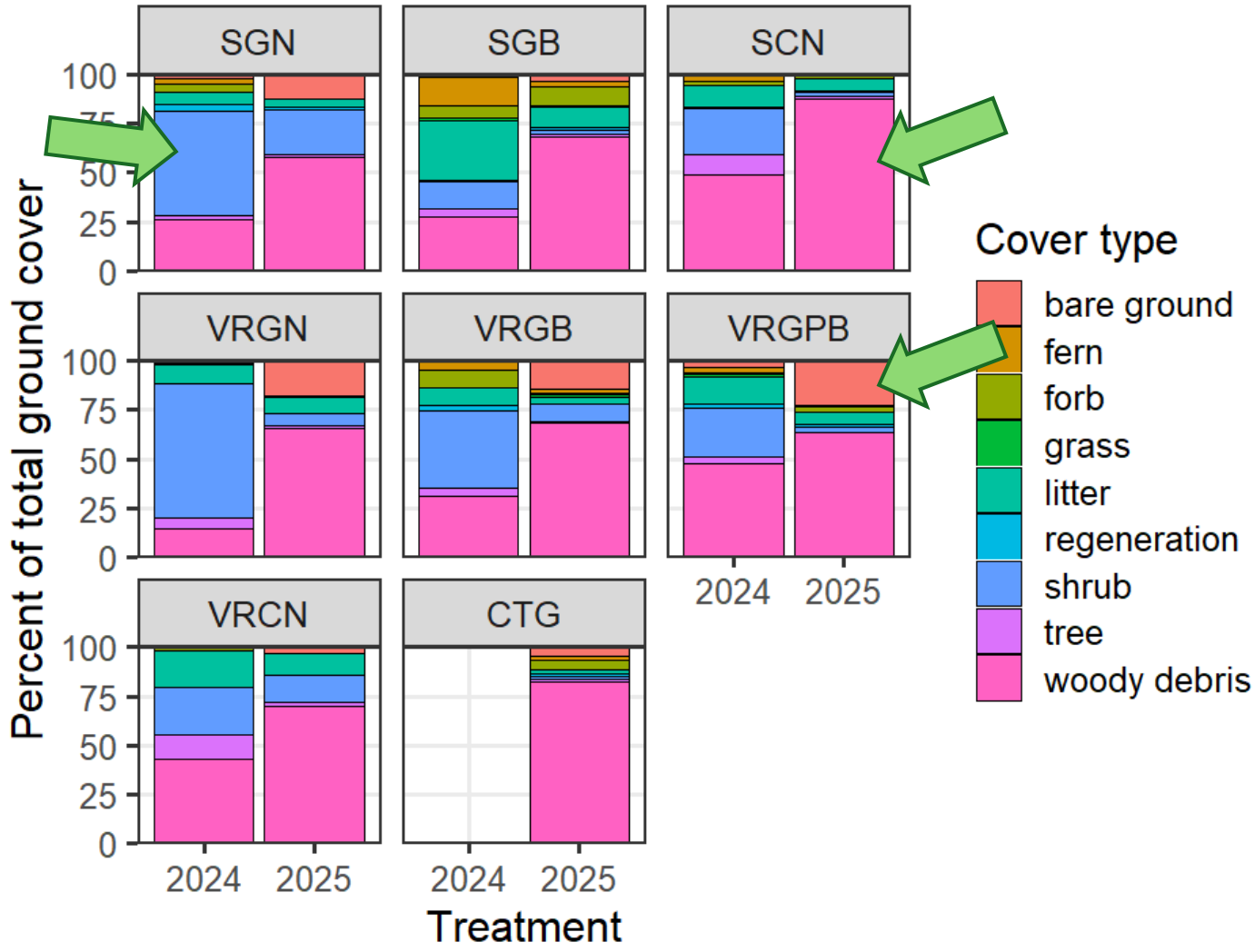
Fine woody debris increased in most treatments



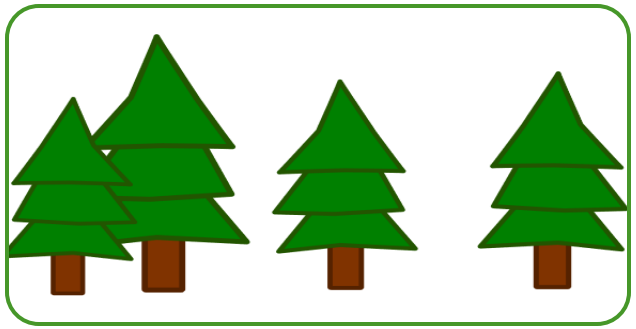
Fuel bed composition changed after treatment



Ground cover changed from vegetation to woody debris dominated

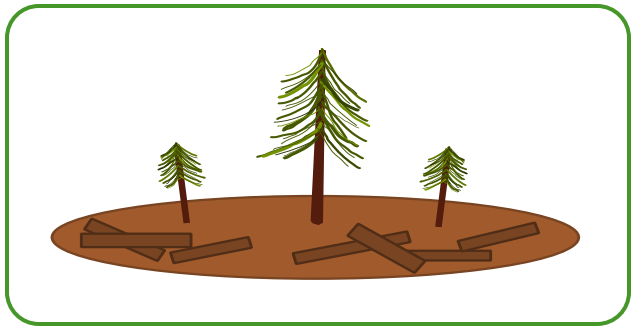


Silvicultural system, harvest system, and site preparation all influence outcomes



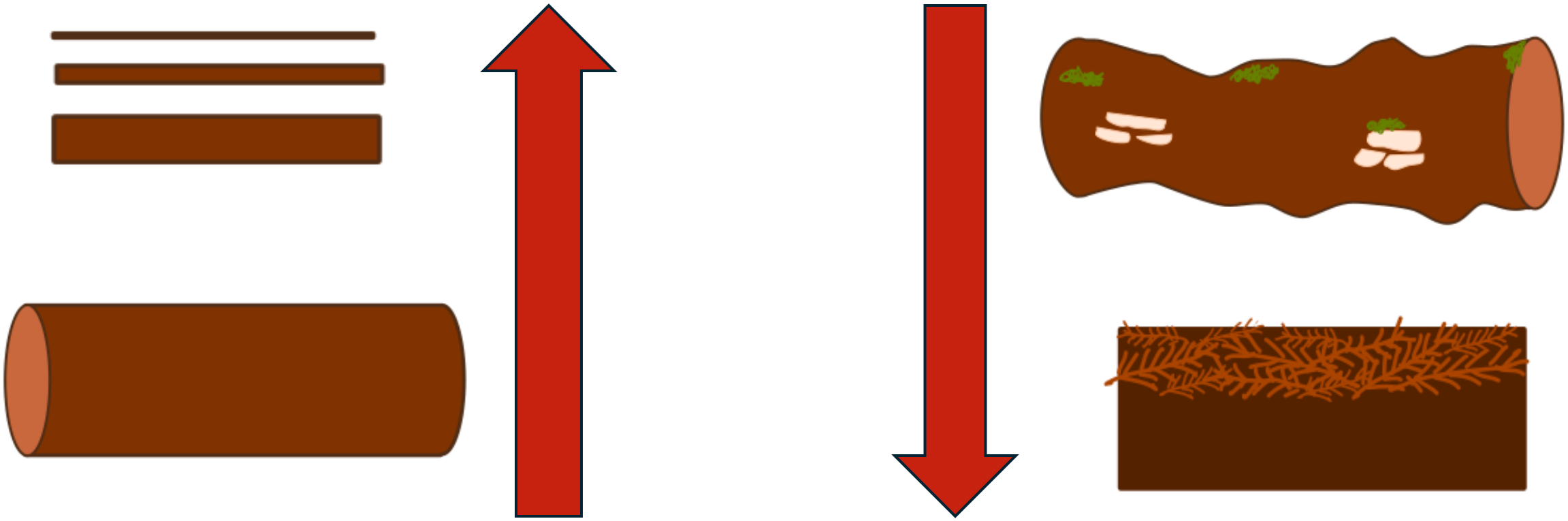
Selection vs. VR

Ground vs. Cable



Site preparation decision

Fuel bed composition changed after treatment



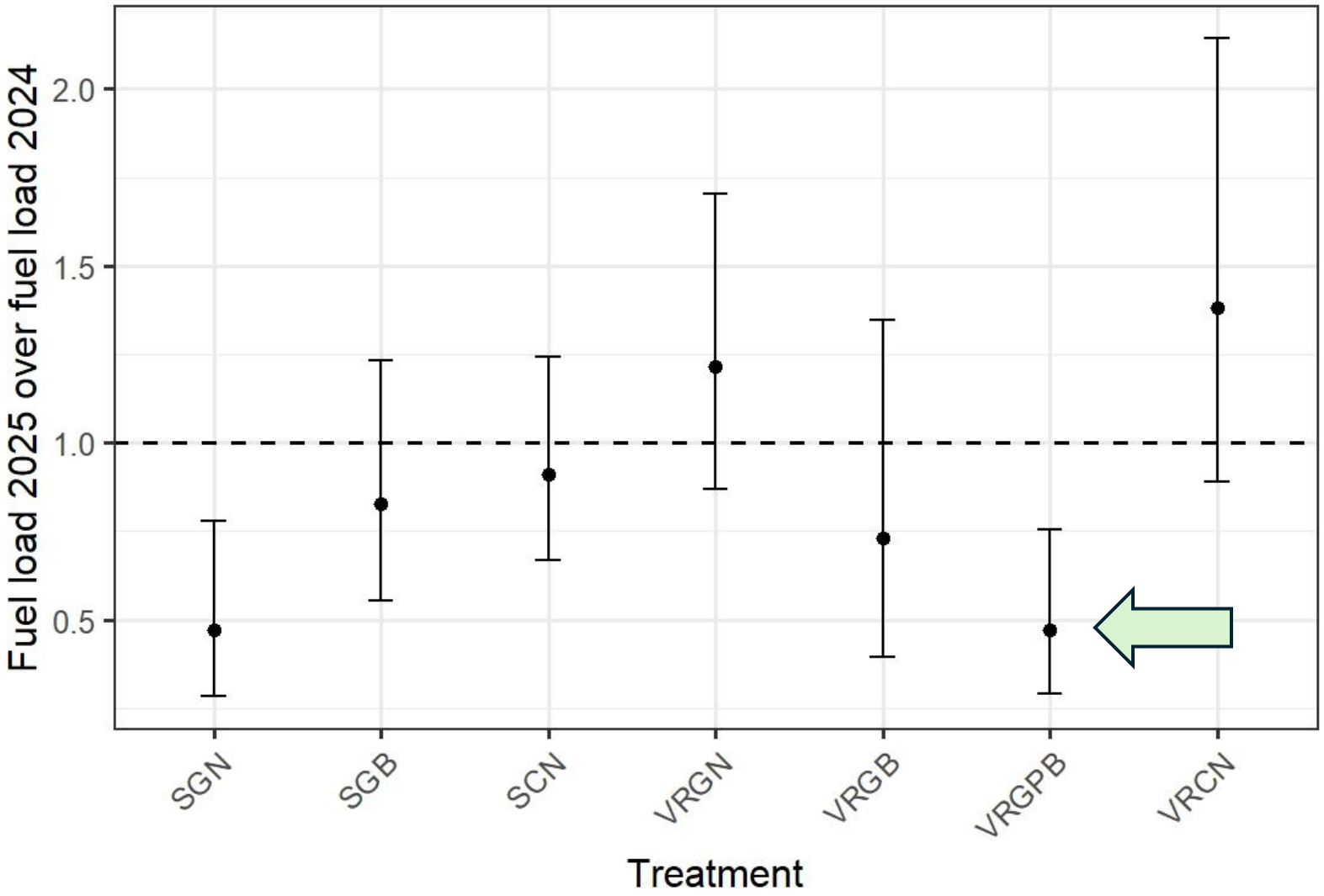
Ground cover changed after treatment

Ground cover changed after treatment

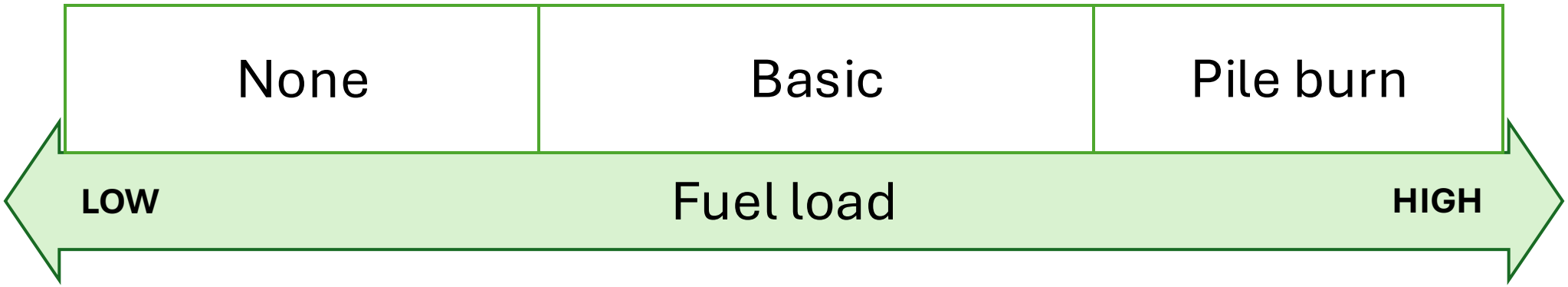
Ecological implications

- Wildlife habitat
- Invasive species

Current treatments are not consistently effective



Changes in implementation may be needed to successfully reduce wildfire hazard



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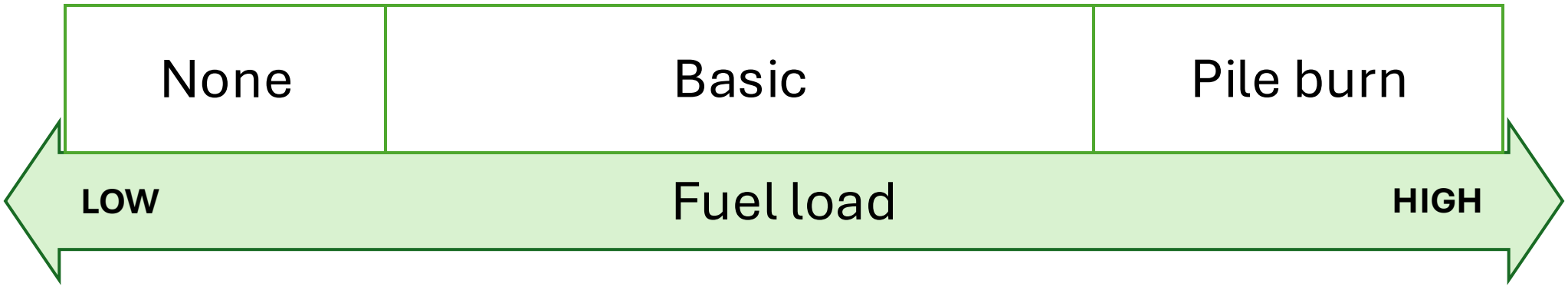

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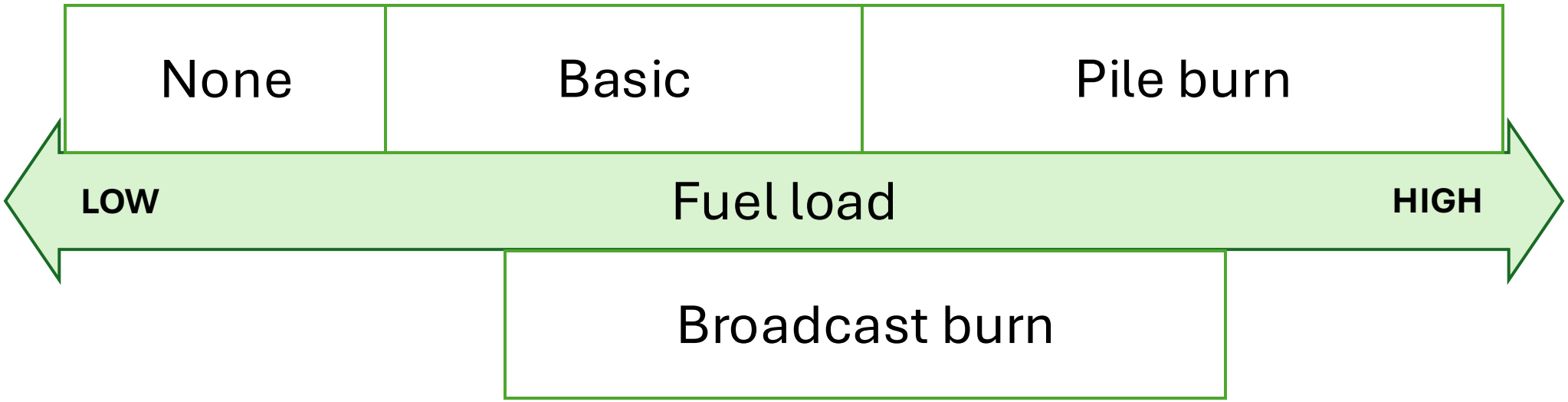


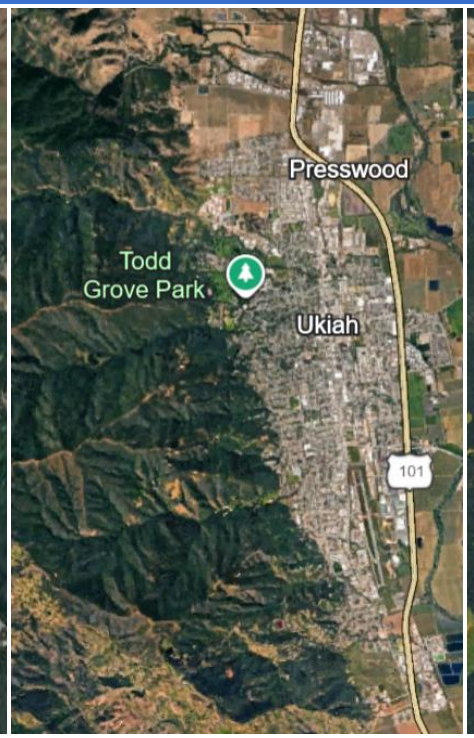
Prioritizing fuel treatments on industrially managed coast redwood forests

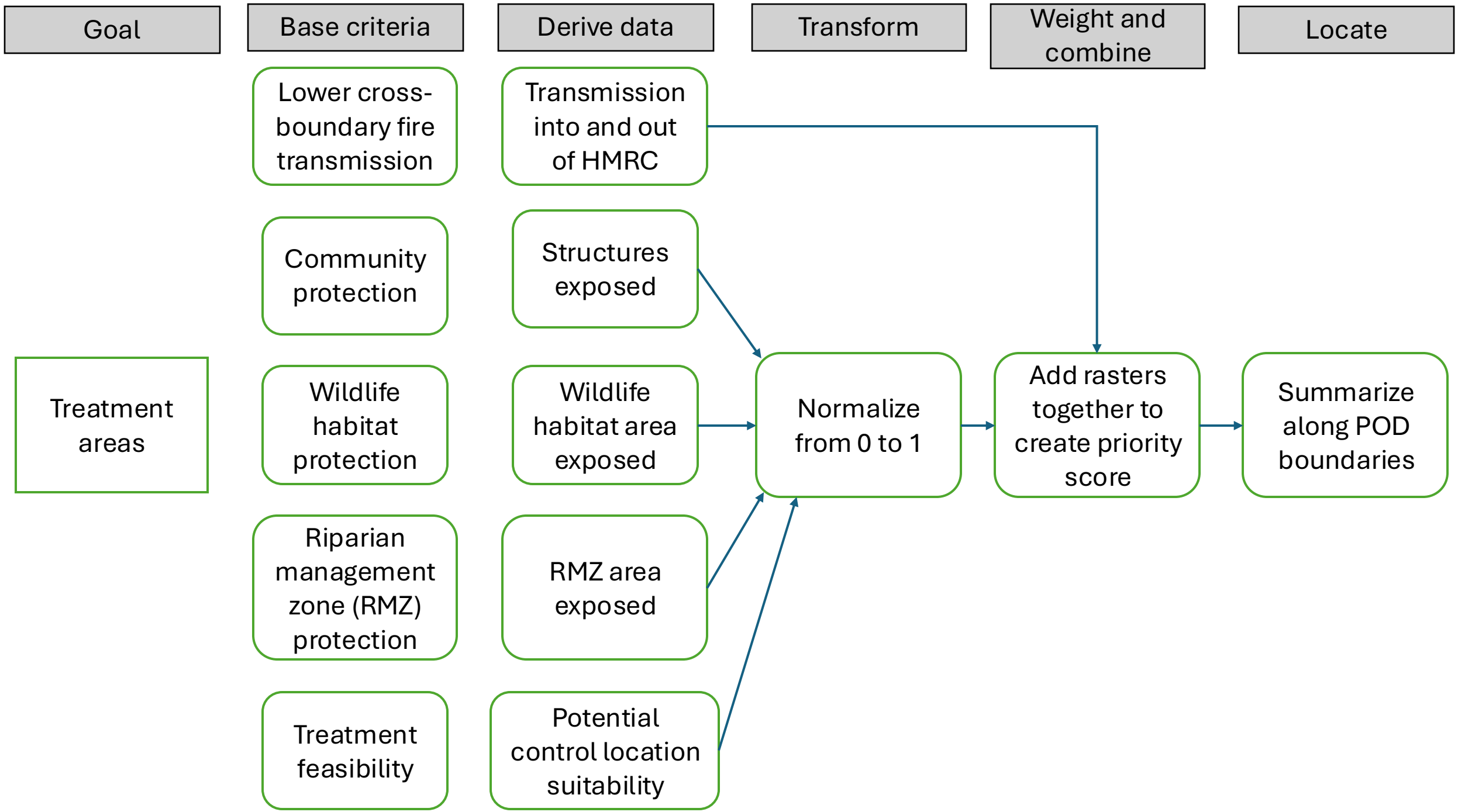
Chapter 3

Research questions

- What areas of the landscape transmit the most fire?
- Where are the highest-priority opportunities for fuel treatment investment on HMRC timberland?

Wildfire threatens many values for HMRC




Goal
Base criteria
Derive data
Transform
Weight and combine
Locate
Treatment areas
Lower cross-boundary fire transmission
Community protection
Wildlife habitat protection
Riparian management zone (RMZ) protection
Treatment feasibility
Transmission into and out of HMRC
Structures exposed
Wildlife habitat area exposed
RMZ area exposed
Potential control location suitability
Normalize from 0 to 1
Add rasters together to create priority score
Summarize along POD boundaries

a) HRC IDW

Pseudo-probability of incoming transmission

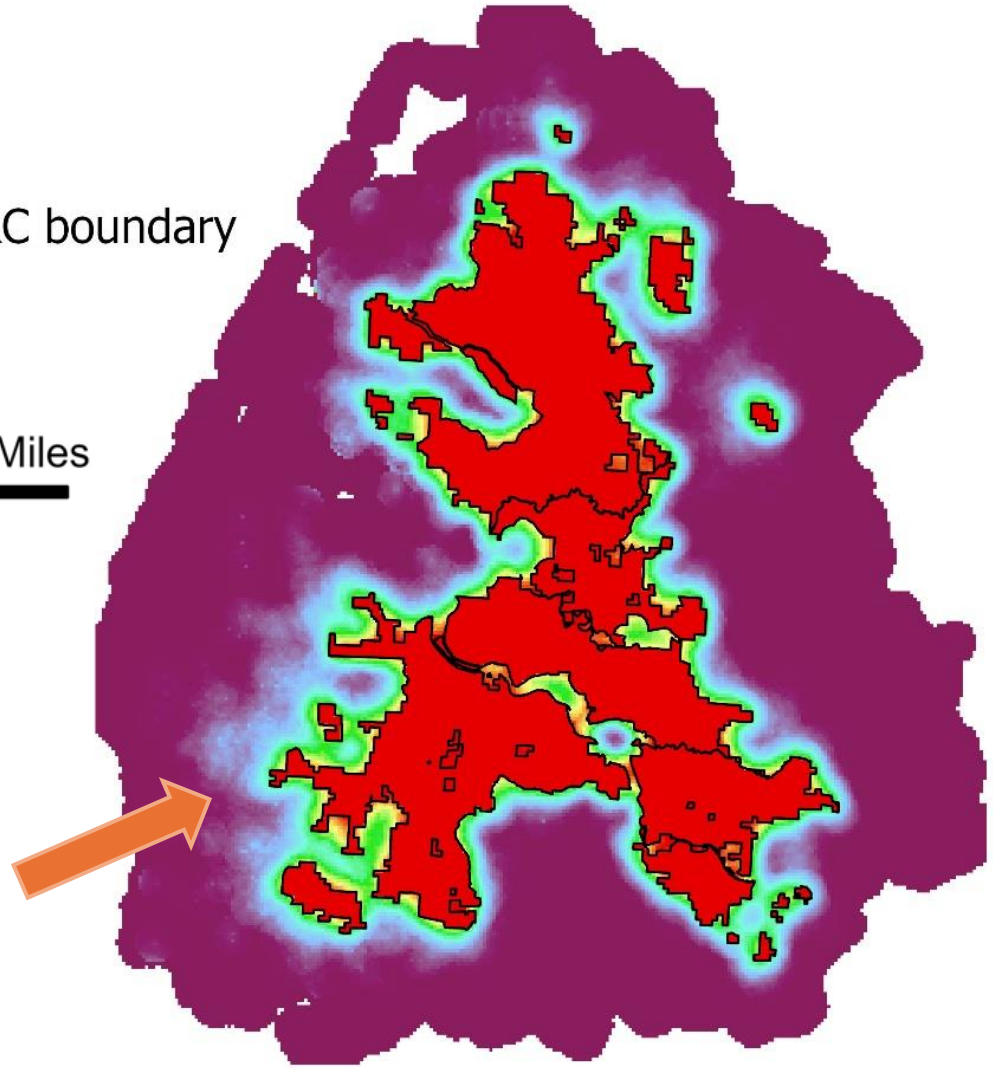
Value

1

0

HRC boundary

10 Miles



b) HRC PODs

Pseudo-probability of incoming transmission

MEAN

0 - 0.1

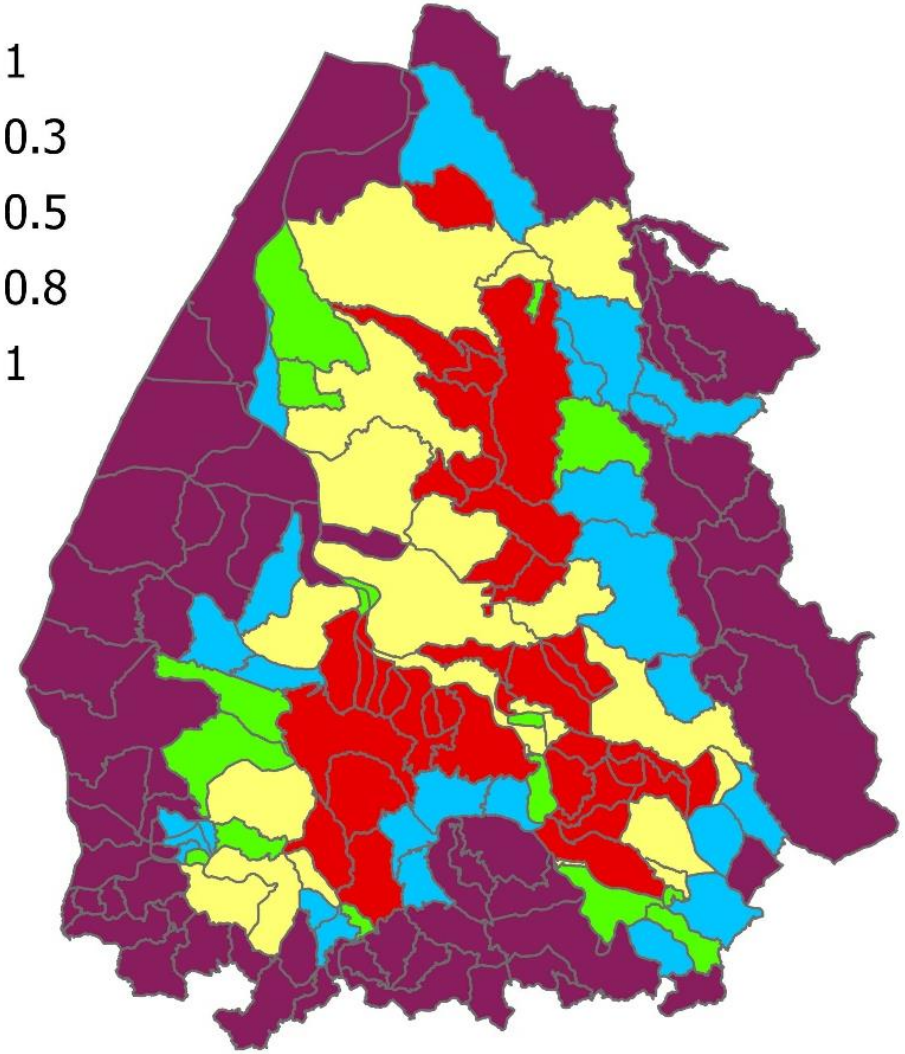
0.2 - 0.3

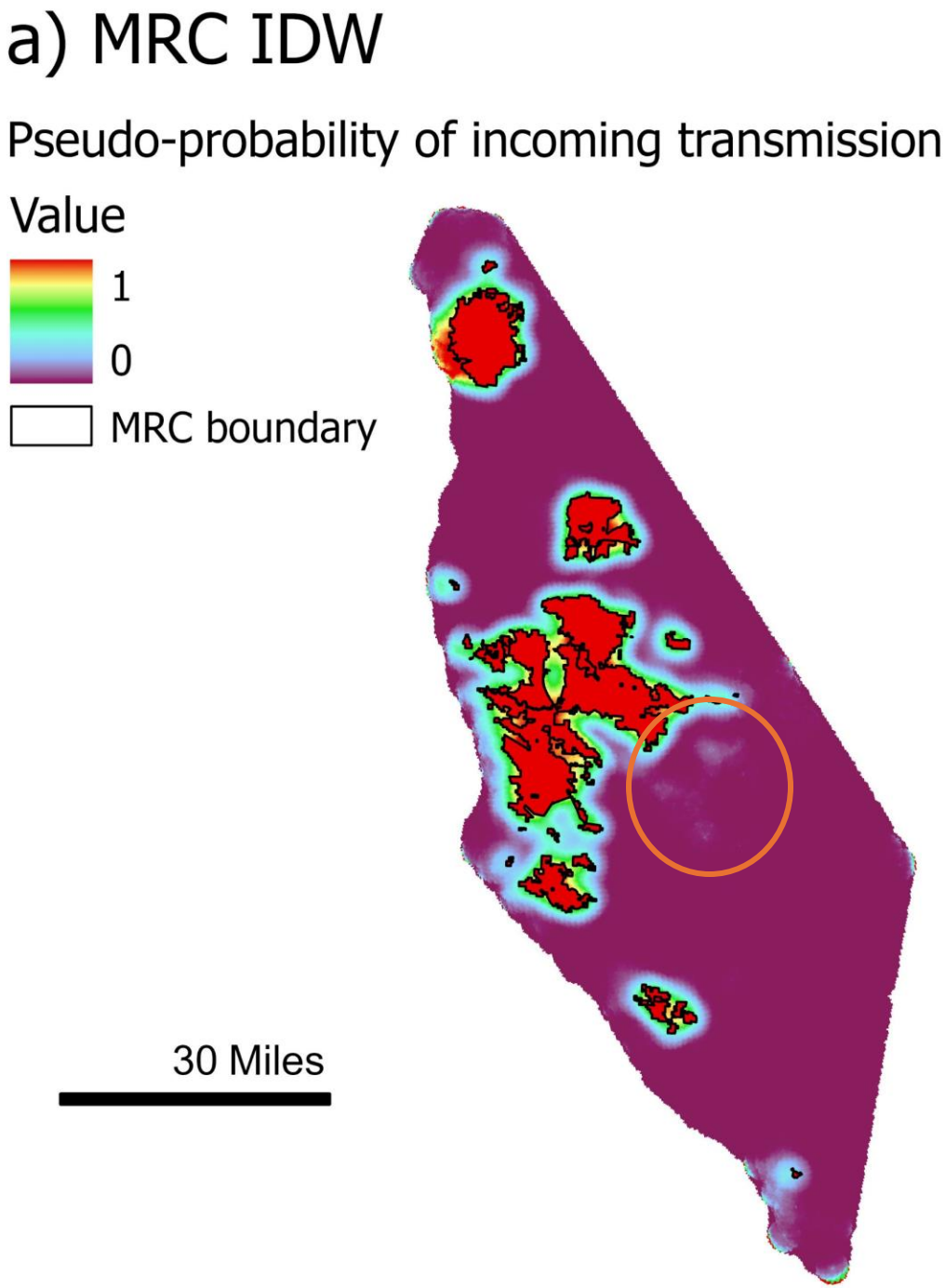
0.4 - 0.5

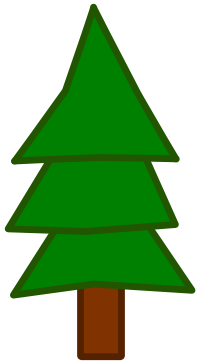
0.6 - 0.8

0.9 - 1

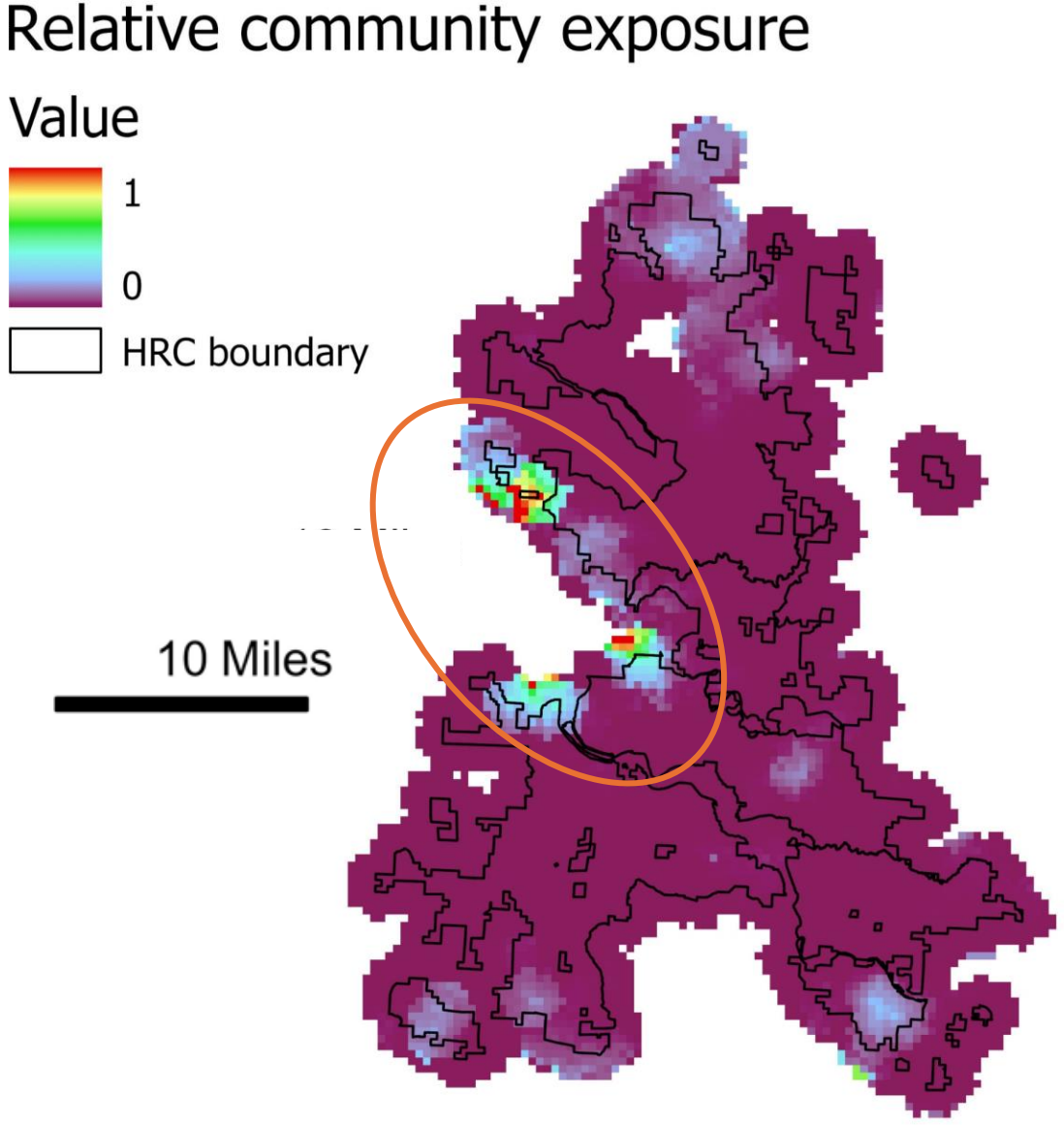
10 Miles

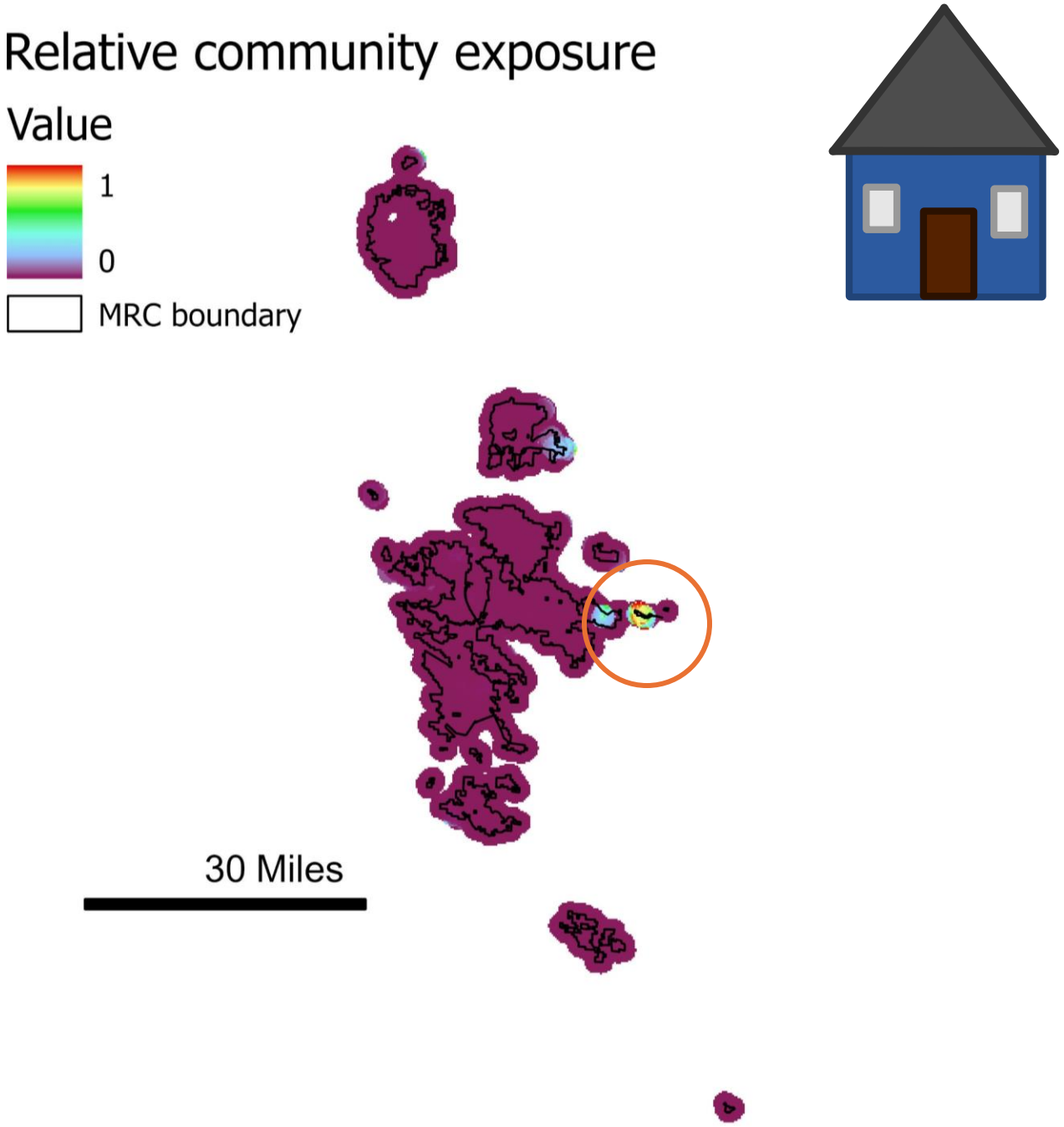


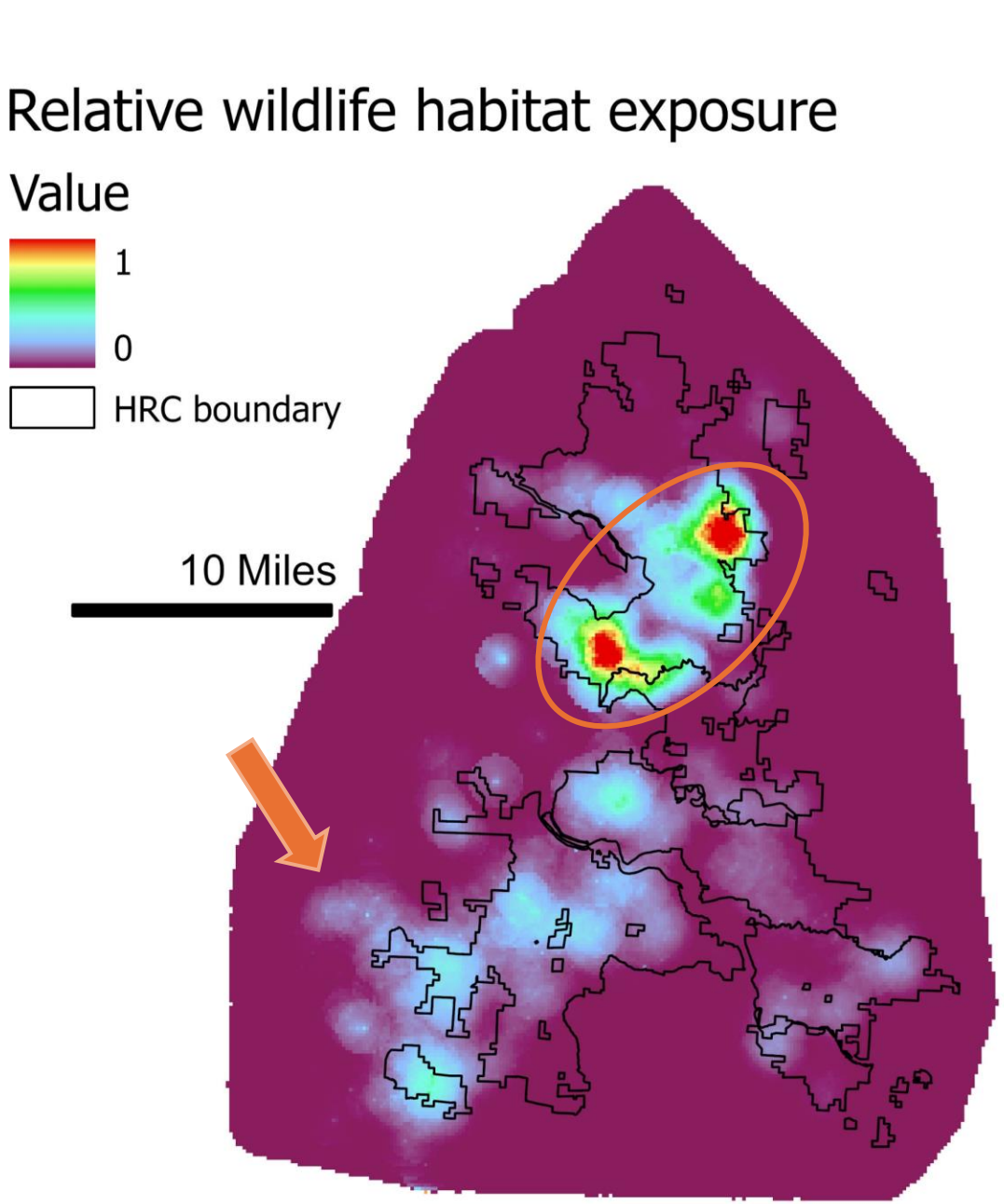


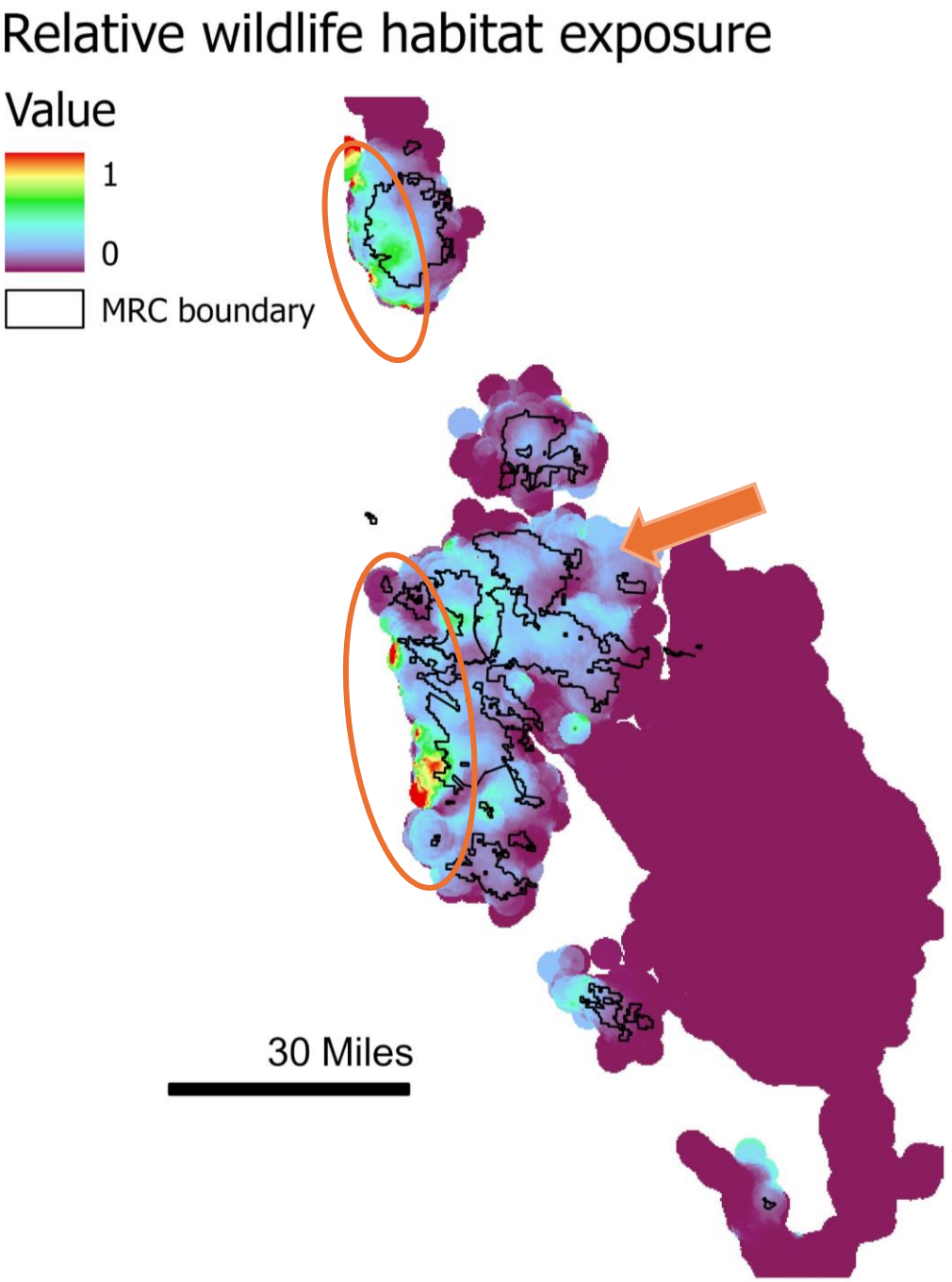


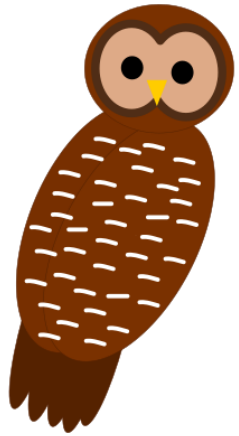
Incoming transmission

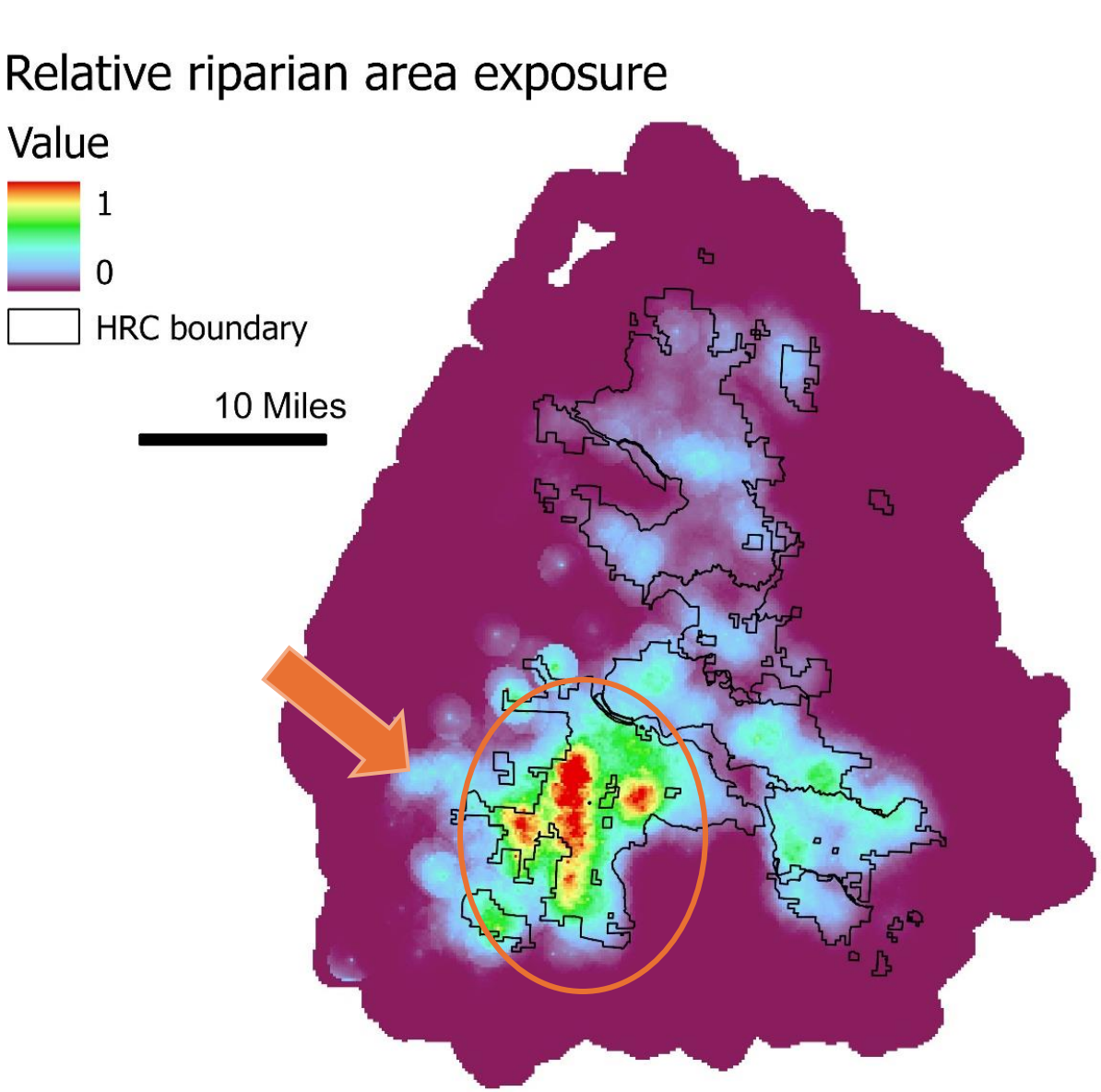

Relative community exposure
Value
1
0
HRC boundary
10 Miles

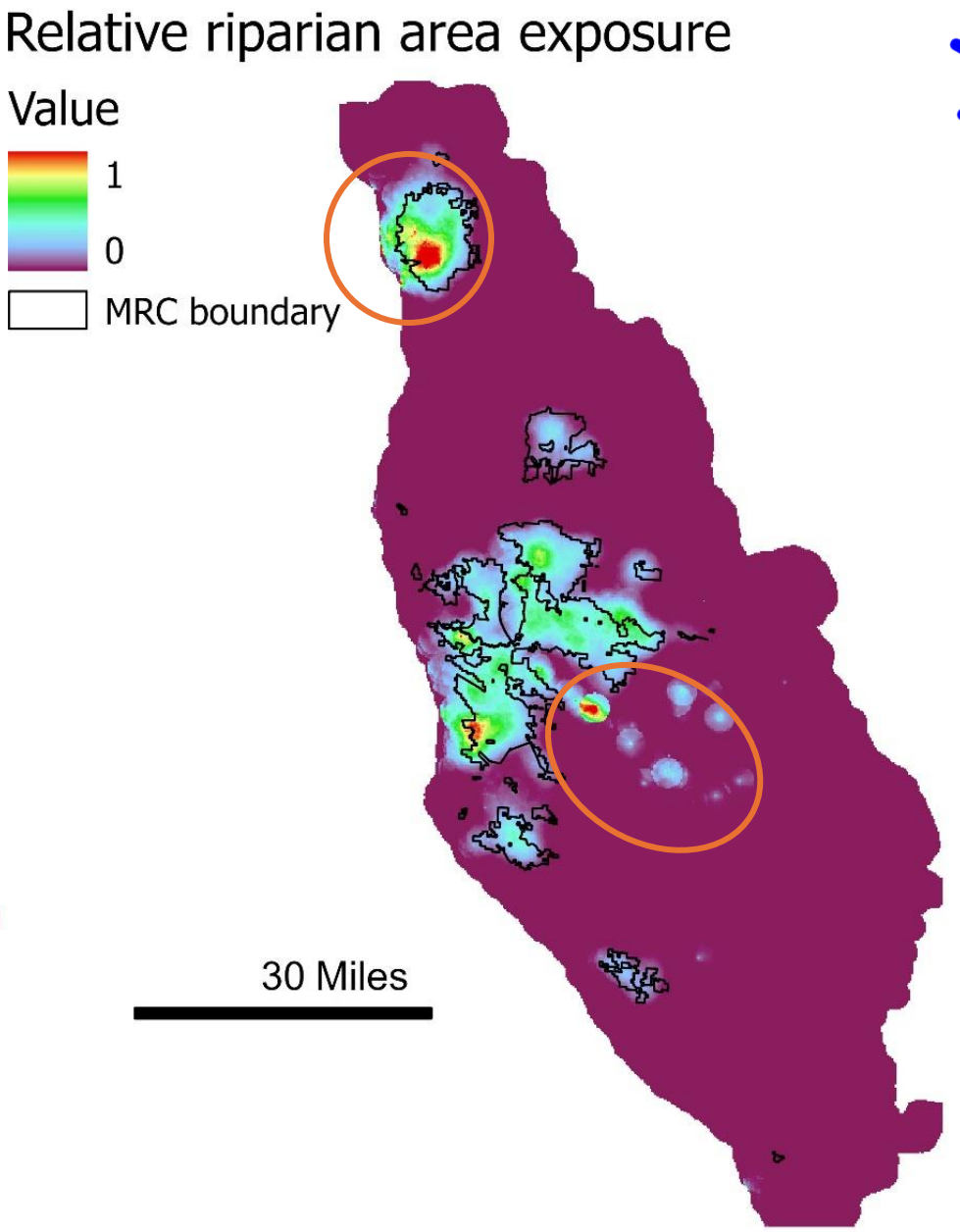

Relative community exposure
Value
1
0
MRC boundary
30 Miles


Relative wildlife habitat exposure
Value
1
0
HRC boundary
10 Miles


Relative wildlife habitat exposure
Value
1
0
MRC boundary
30 Miles

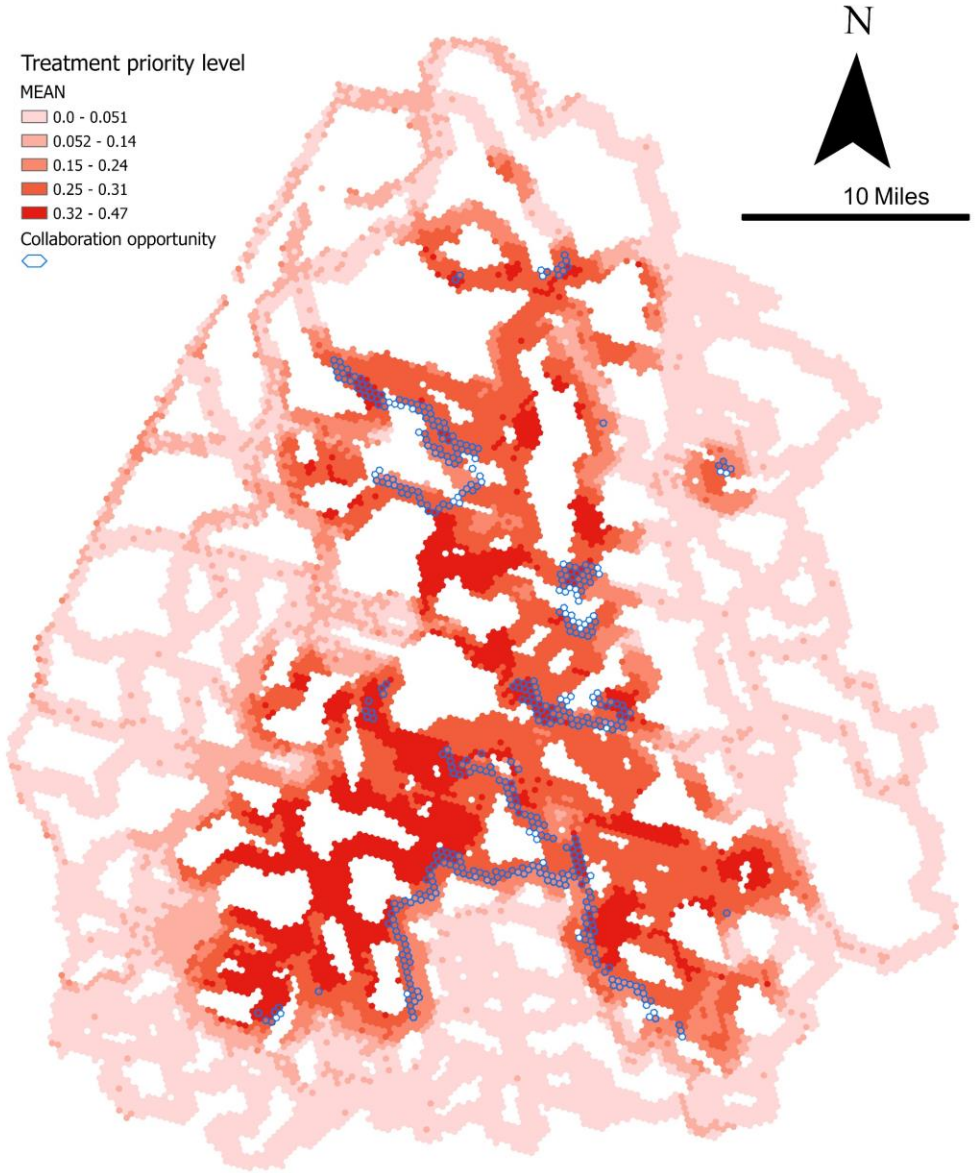



Relative riparian area exposure
Value
1
0
HRC boundary
10 Miles

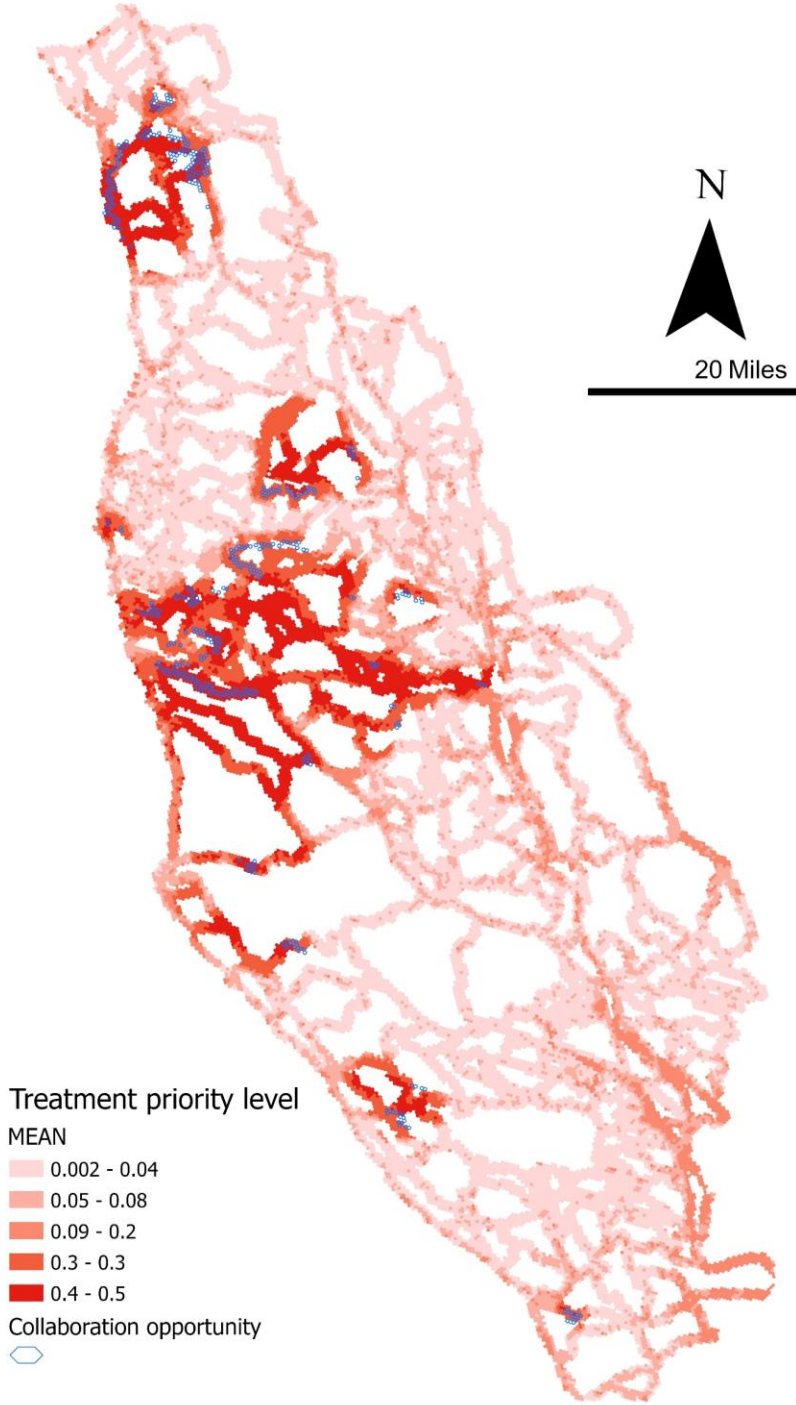

Relative riparian area exposure
Value
1
0
MRC boundary
30 Miles

Treatment prioritization

HRC



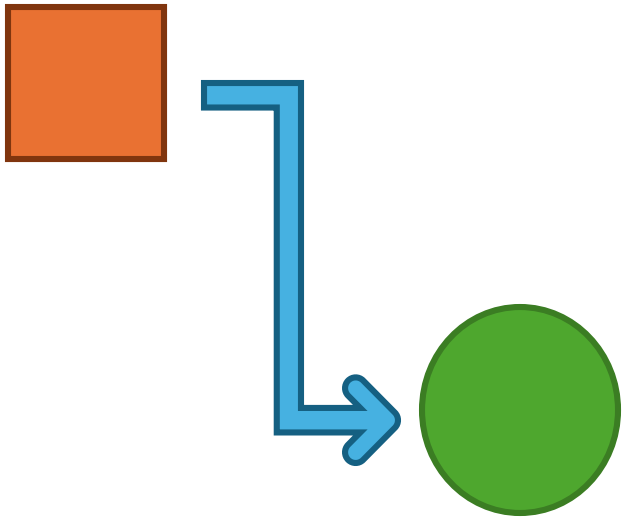
MRC

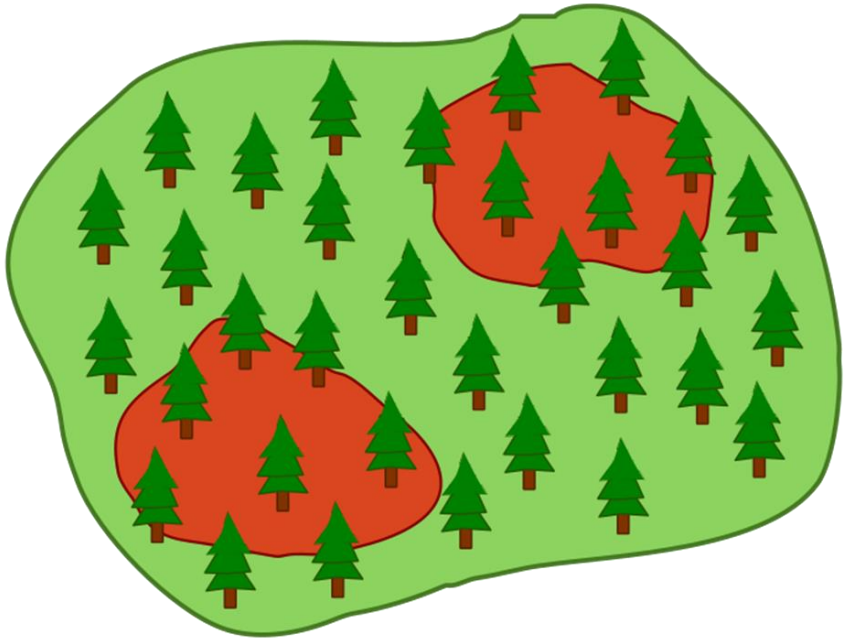


Key findings

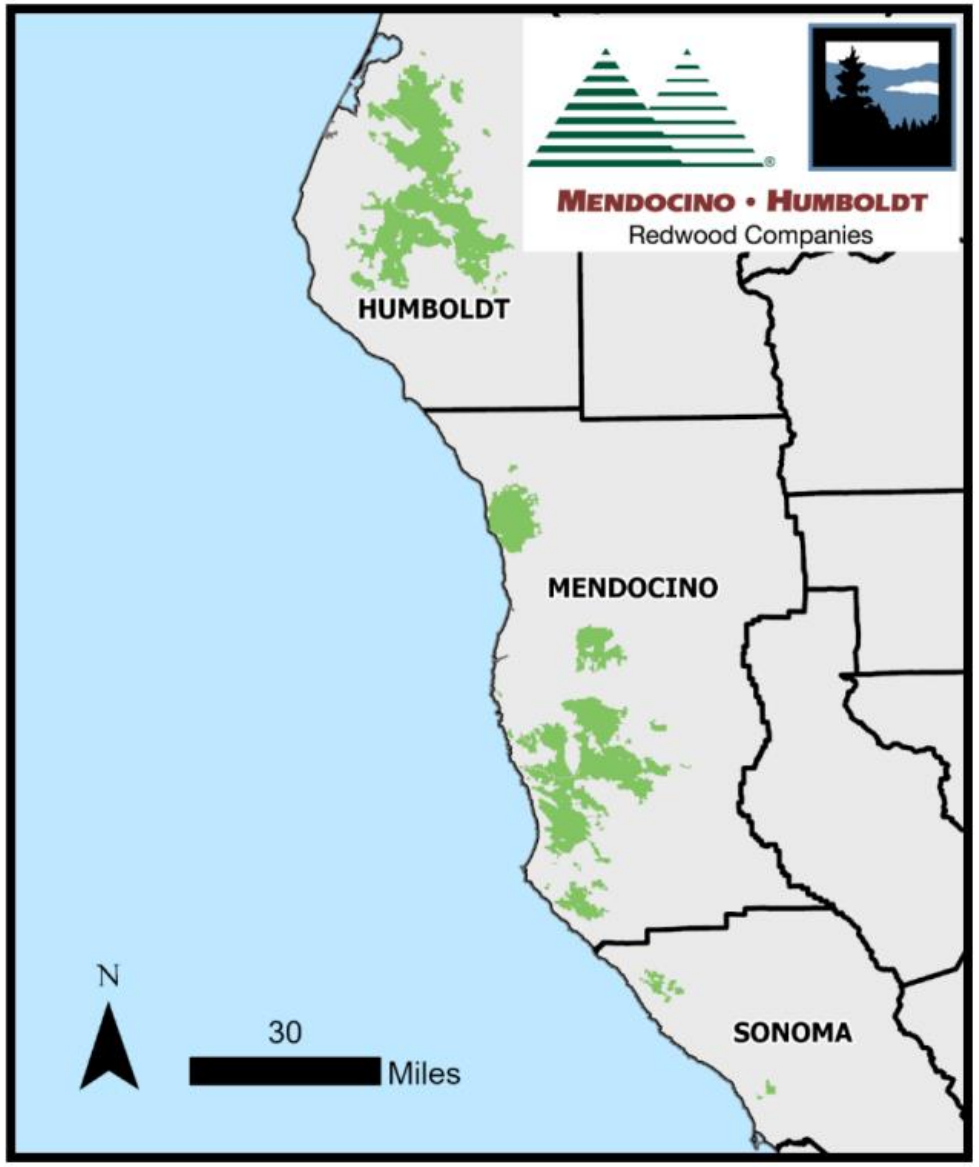
- Fine-scale targeting is more efficient than uniform POD-level treatment
- On-site management alone cannot address the full scope of transmission risk
- Coordination with neighboring landowners is essential

Successful wildfire management on industrial timberlands requires operational adaptation and strategic spatial planning.





Limitations on scope of study and sample size



Limitations for prioritization

- Fuels based on 2025 conditions, need to be updated as time passes

- Weights are exploratory and don't reflect the relative priority of each value to HMRC

Future research directions

- Fire behavior modeling
- Long-term fuel monitoring
- Overstory and ladder fuels

Acknowledgements

- Dr. John Bailey
- Committee: Dr. Chris Dunn, Dr. Molly Kile, Dan Stark
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- Josh Dulin


Questions?