Fire severity in sub-boreal managed forests

BCWS Fuel Treatment Efficacy & Wildfire Resiliency Workshop

February 28, 2023

Bulkley Valley Research Centre

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Funders: BCWS, CFS

Background - SBS

- Sub-boreal forests
  - Cool continental climate
  - Transitional zone: Temperate – Boreal
- Upland forest-types dominated by
  - Lodgepole pine
  - Hybrid spruce
  - Subalpine fir
  - Trembling aspen
  - (Douglas-fir, Paper birch, Cottonwood)
- Classified as NDT3 (frequent stand initiated events

Photos: I. Farnell

Background – fire and forest change

Natural disturbance regime will interact with:

Forest management and fire suppression

- Stand structure
- Ground, ladder and canopy fuels
- Age-class distribution

Photos: I. Farnell

Background – managed forests

- SBS – vast majority of harvests clearcut/clearcut with reserves
- Silviculture and site preparation in forest operations objectives:
  - Reduce impacts of harvest (remove fuels)
  - Increase tree planting success
  - Improve crop tree growth
- Objectives, methods, and frequency of application have all changed over time


Photo: Silviculture handbook


Photo: Silviculture manual


Photo: Silviculture manual


Photo: I. Farnell

Fuel treatment efficacy and wildfire resiliency

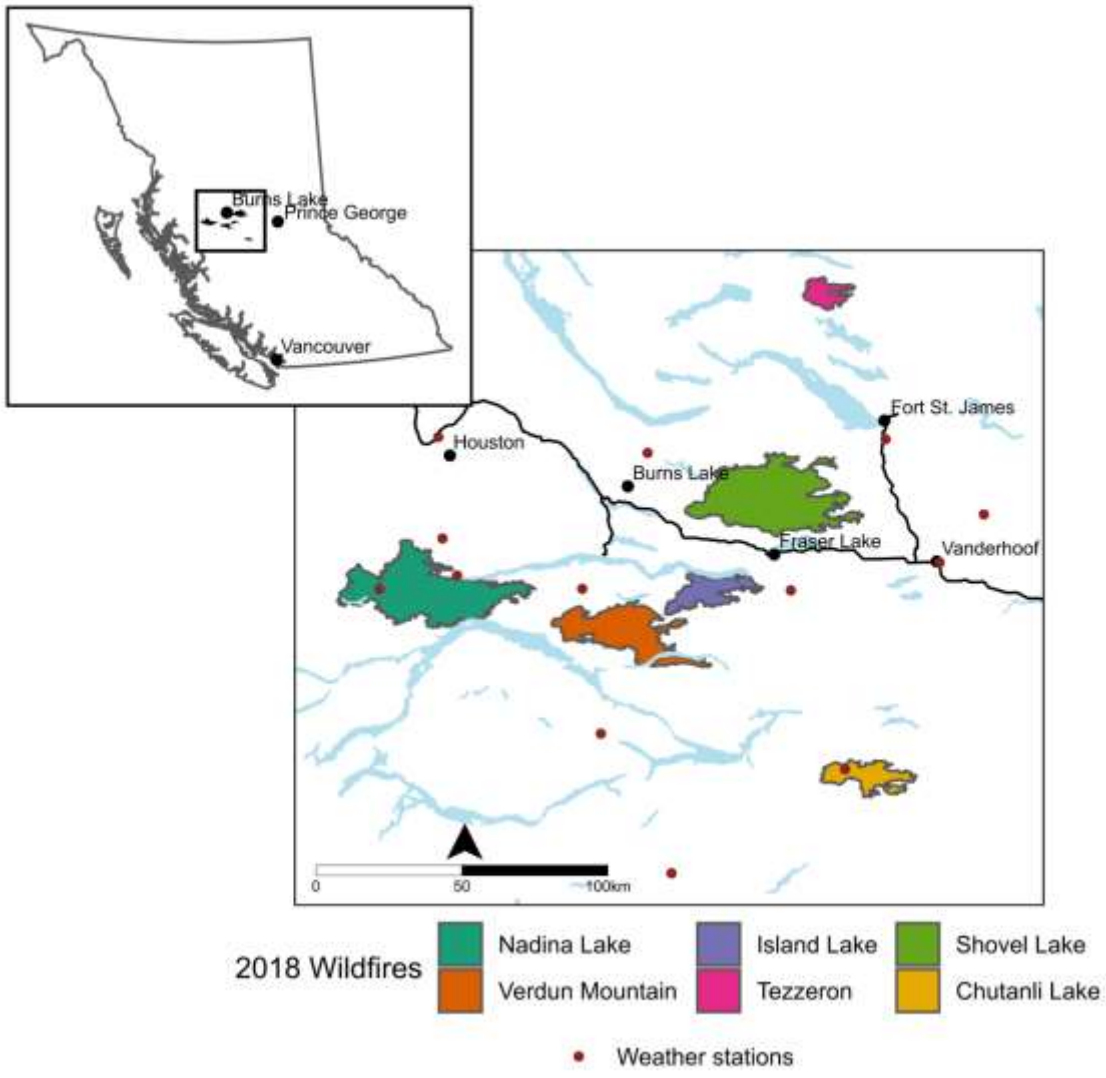
How do forestry practices contribute to fuels and wildfire resilience?

High severity 27 yrs, soil disturbance, brushed

Moderate severity 12 yrs, disc trenched, brushed

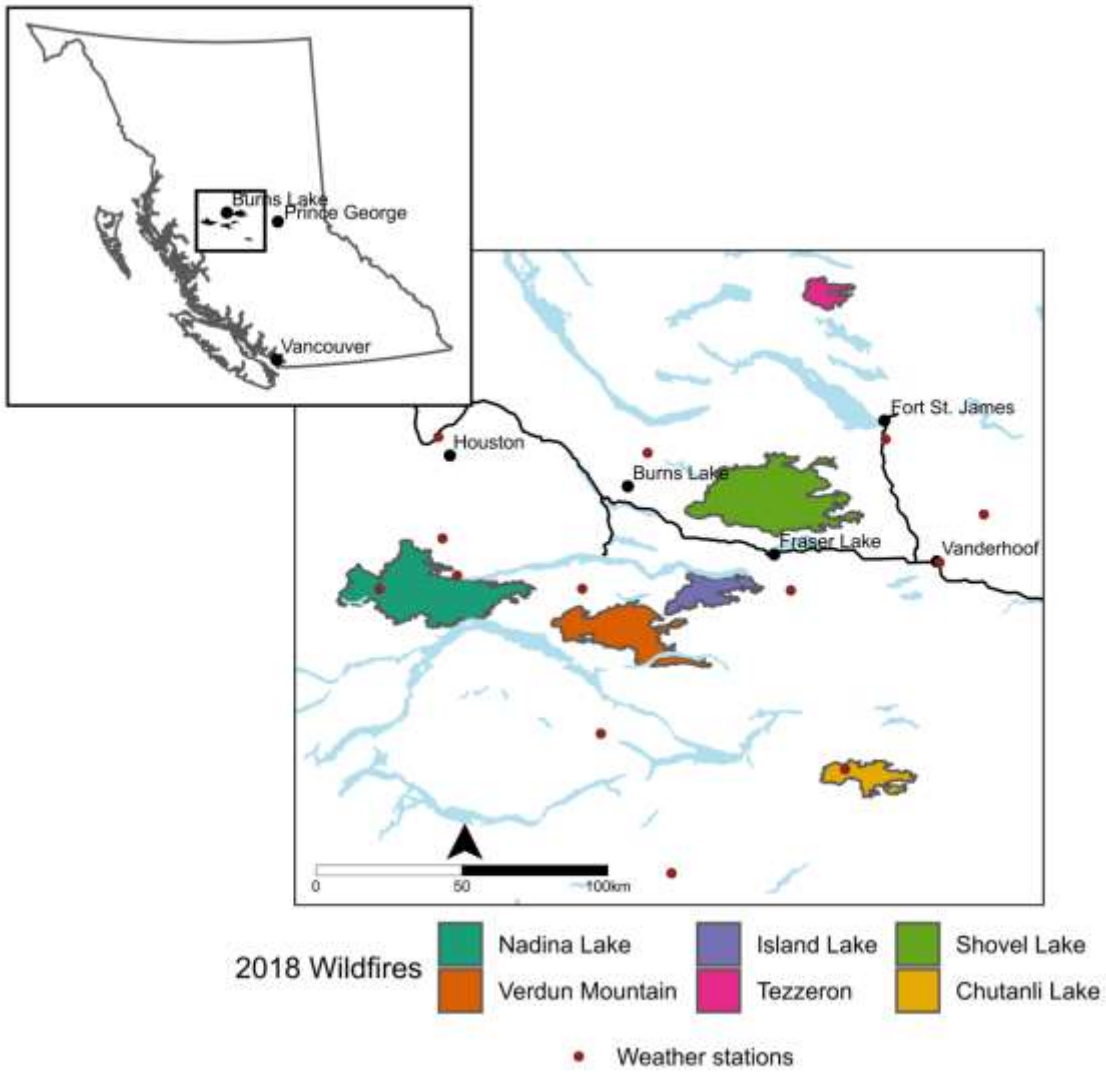
Unburned 41 yrs - spaced

Background



- Six large fires (10,000 – 90,000+ha burned) from 2018 burned under similar conditions at similar times with lots of managed forests

Background



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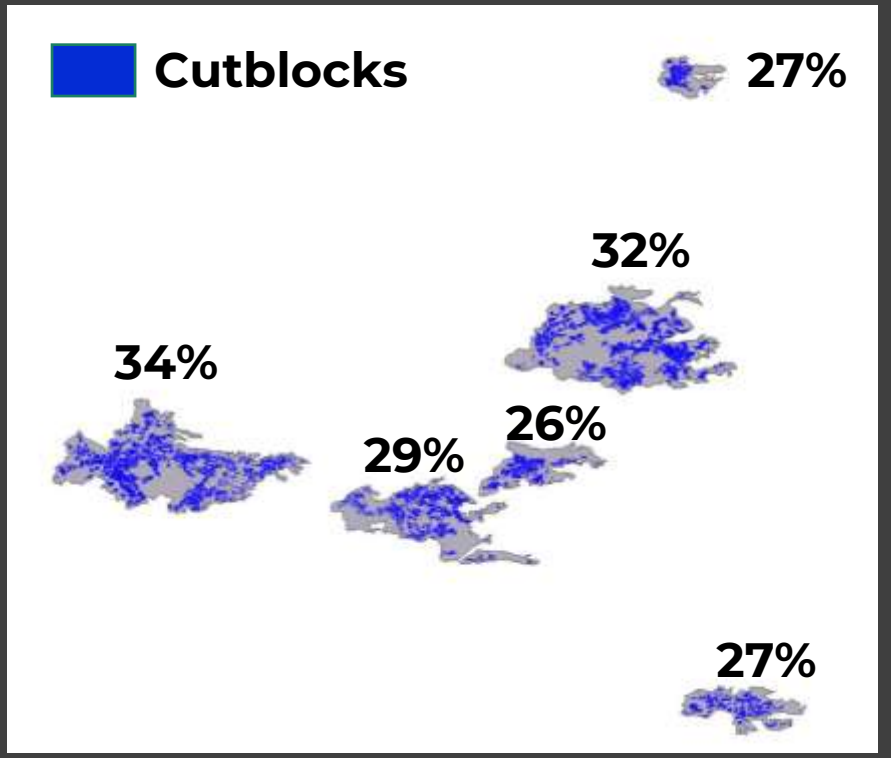
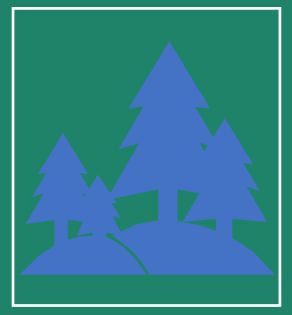


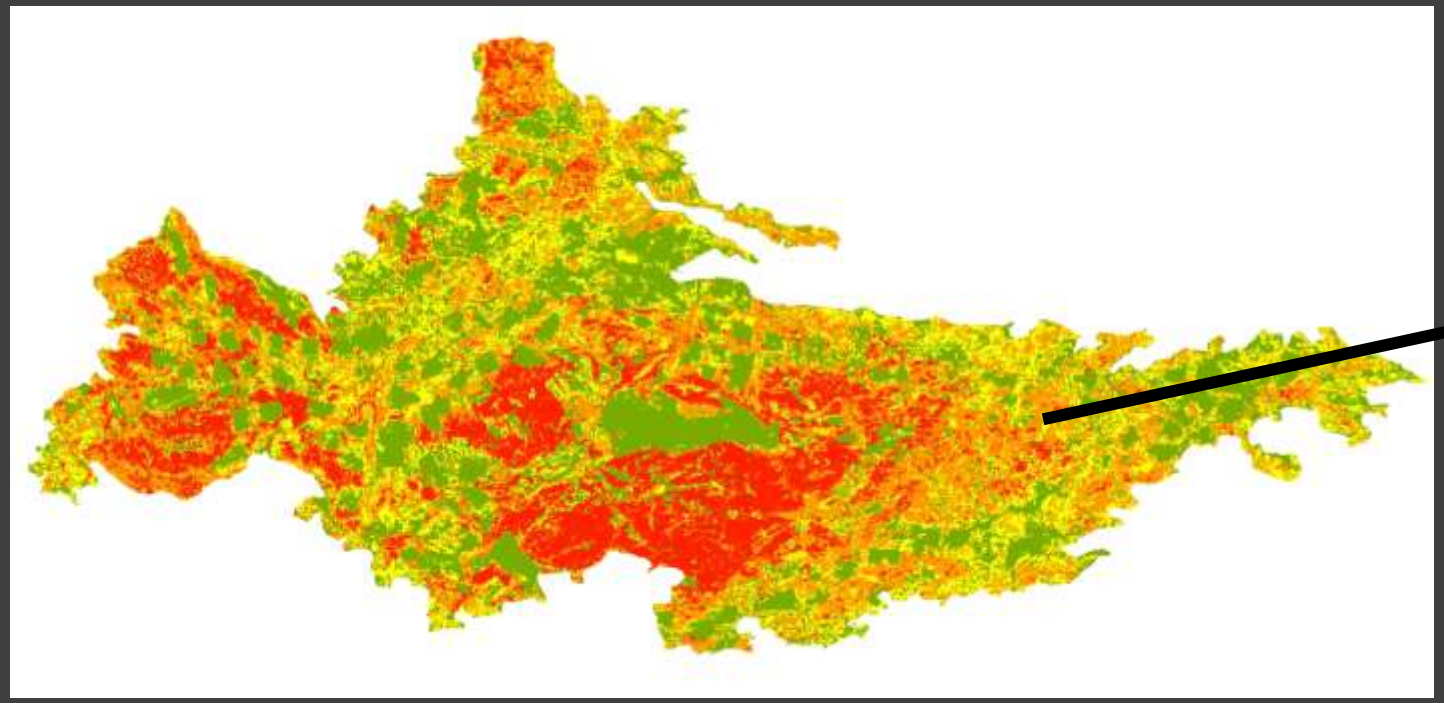
Research Questions:

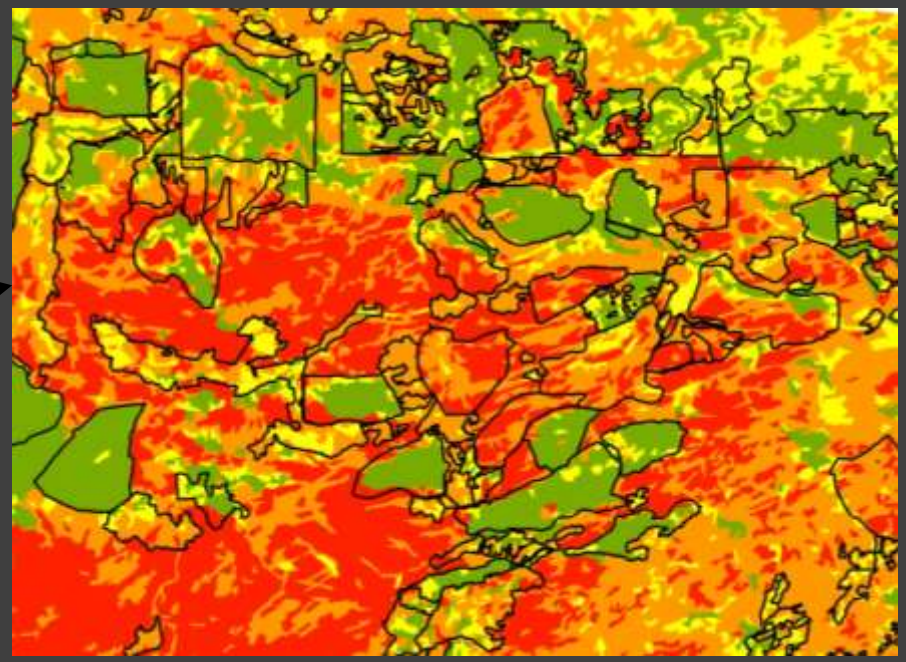
What was the relative contribution of site preparation and silviculture to fire severity in managed forests in 2018 compared to other drivers?



Did site preparation or silviculture treatments such as broadcast burning, disc trenching, spacing or brushing reduce fire severity compared to managed forests without these treatments?

Response: dNBR (classified Key & Benson)





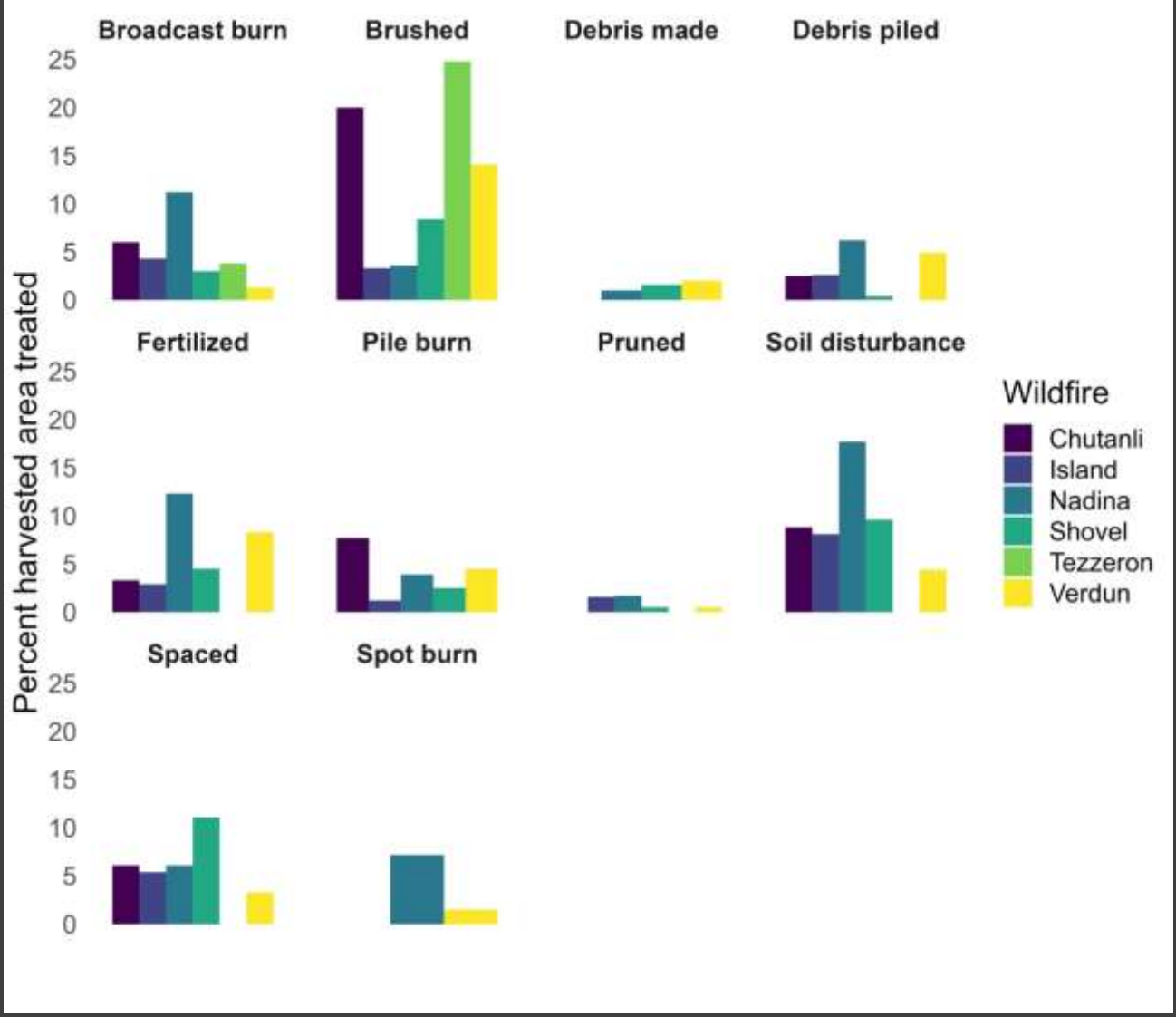
High Medium Low Unburned

CBI plots: 62% correctly classified (mostly under-predicted severity)

Predictors – random forests

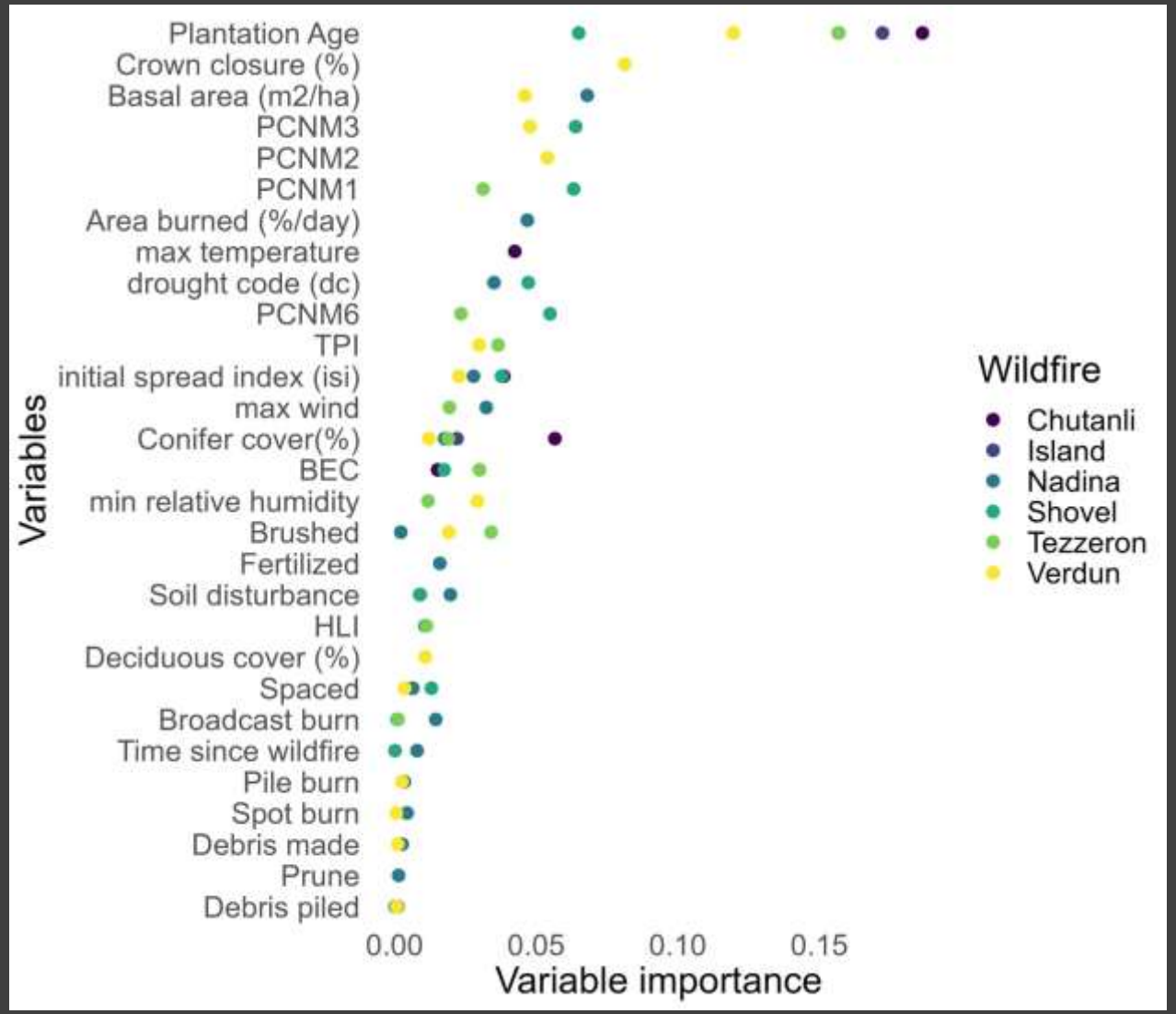
- Forest management
- Stand structure (stand age, basal area, crown closure, % conifer, % deciduous)
- Topography (heat load index, topographic position index)
- Spatial autocorrelation (pcnm axes)
- Fire spread (daily proportion burned)
- Fire weather (max temperature, min relative humidity, max wind speed)
- Fuel moisture (drought code)
- Fire behaviour (initial spread index)
- Climate (BEC zone)
- Historic fire (time since fire)

Predictors: Forest management



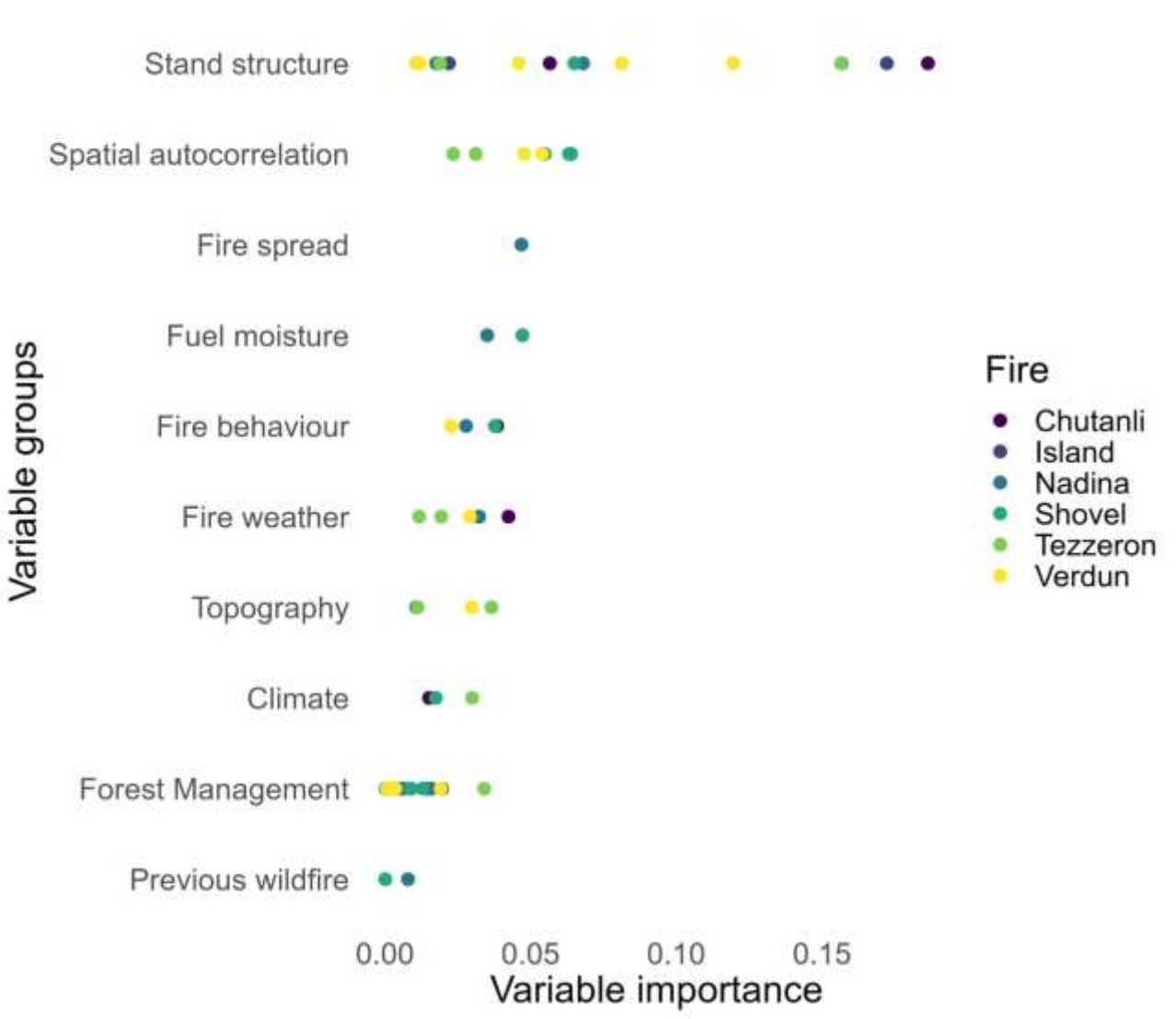
- Of the 26 – 34% managed forest, smaller subset treated (or recorded treated)
- Treatments varied from 0 – 24% (in our dataset), many treatments applied to <10% of managed forests
- Variation between fires

1. Role of forest management compared to all other drivers



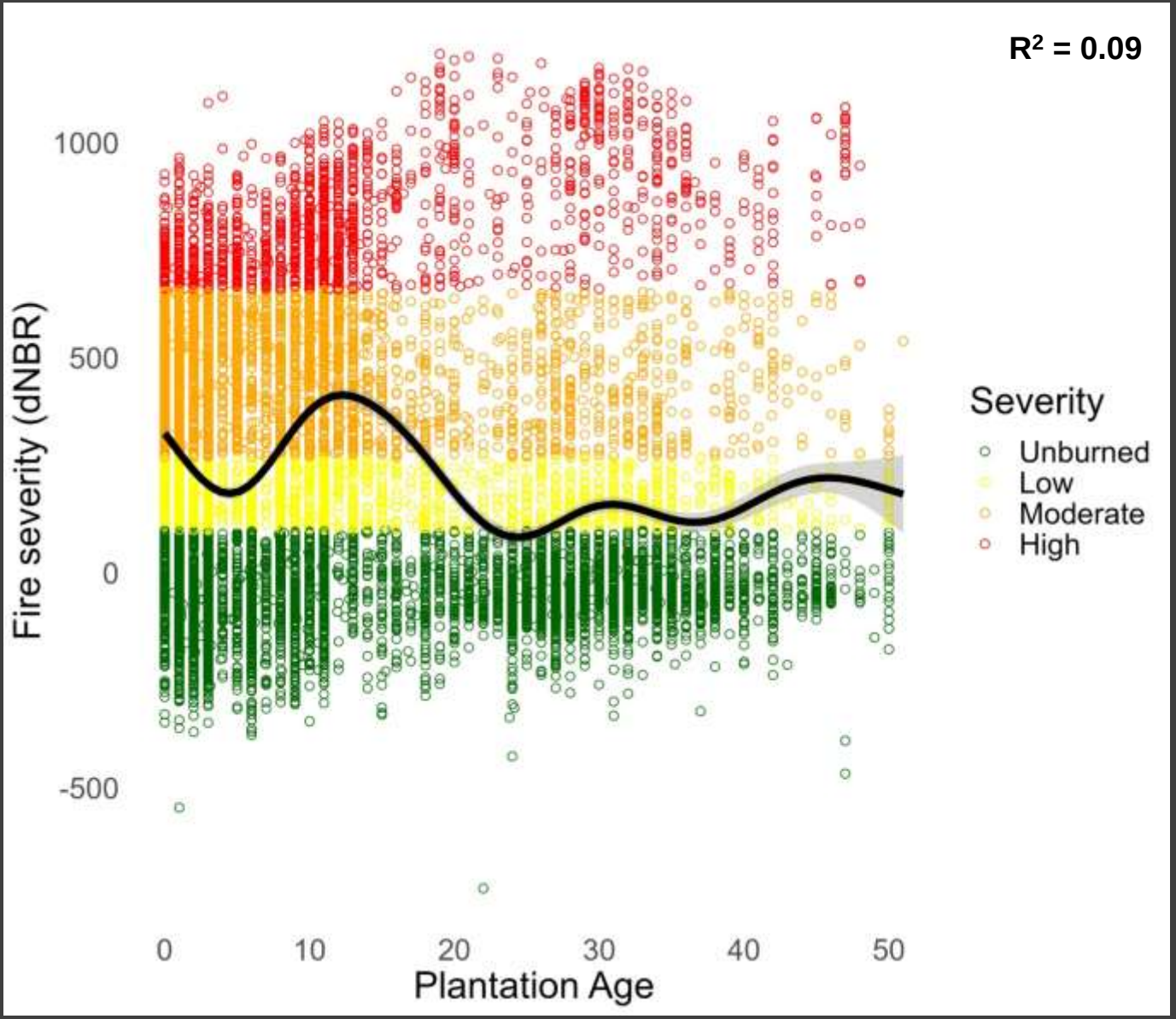
- Plantation age – top predictor in all 6 fires

1. Role of forest management compared to all other drivers

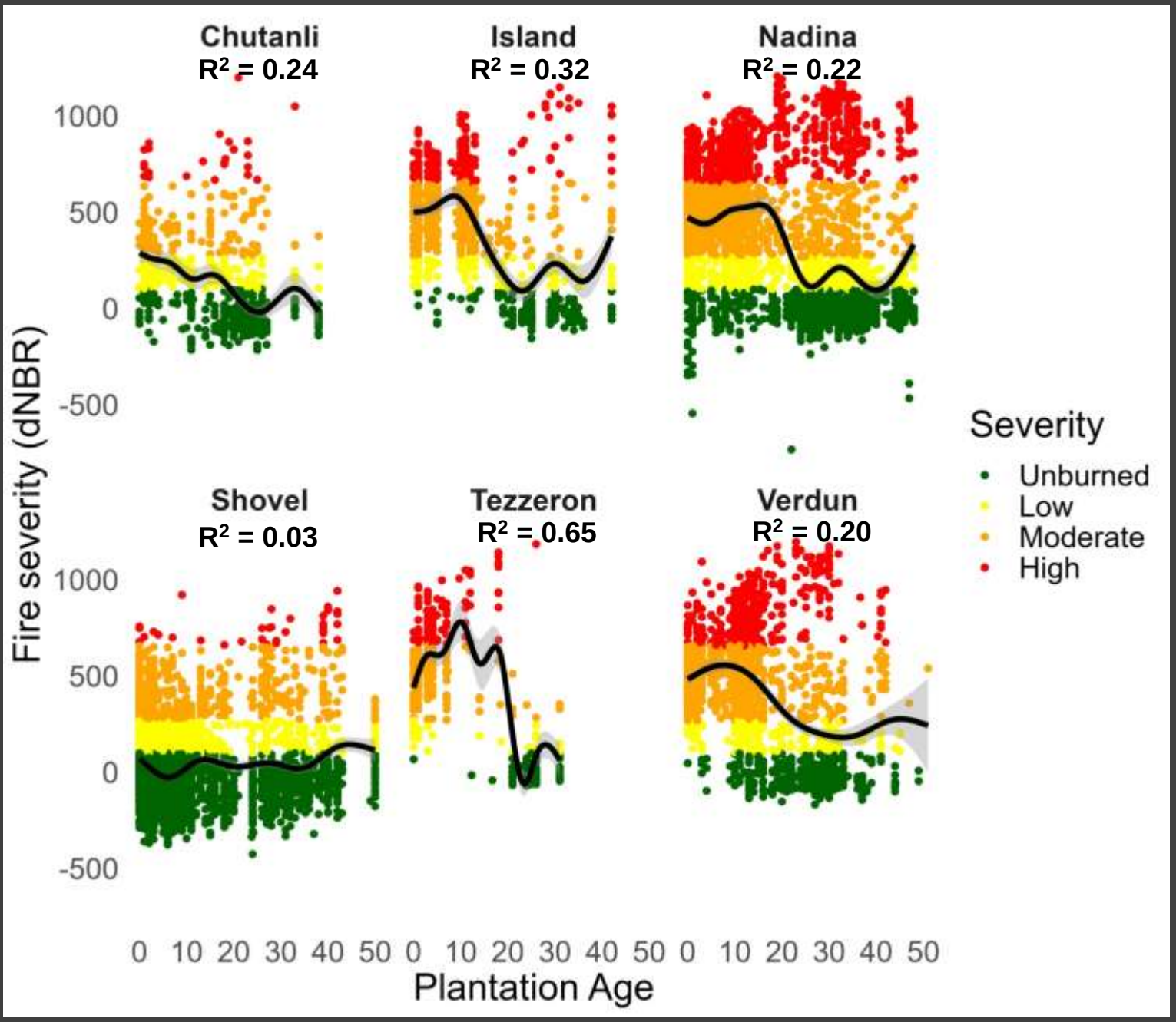


- Forest management was one of the least important predictors of fire severity

1b. Fire severity and stand age



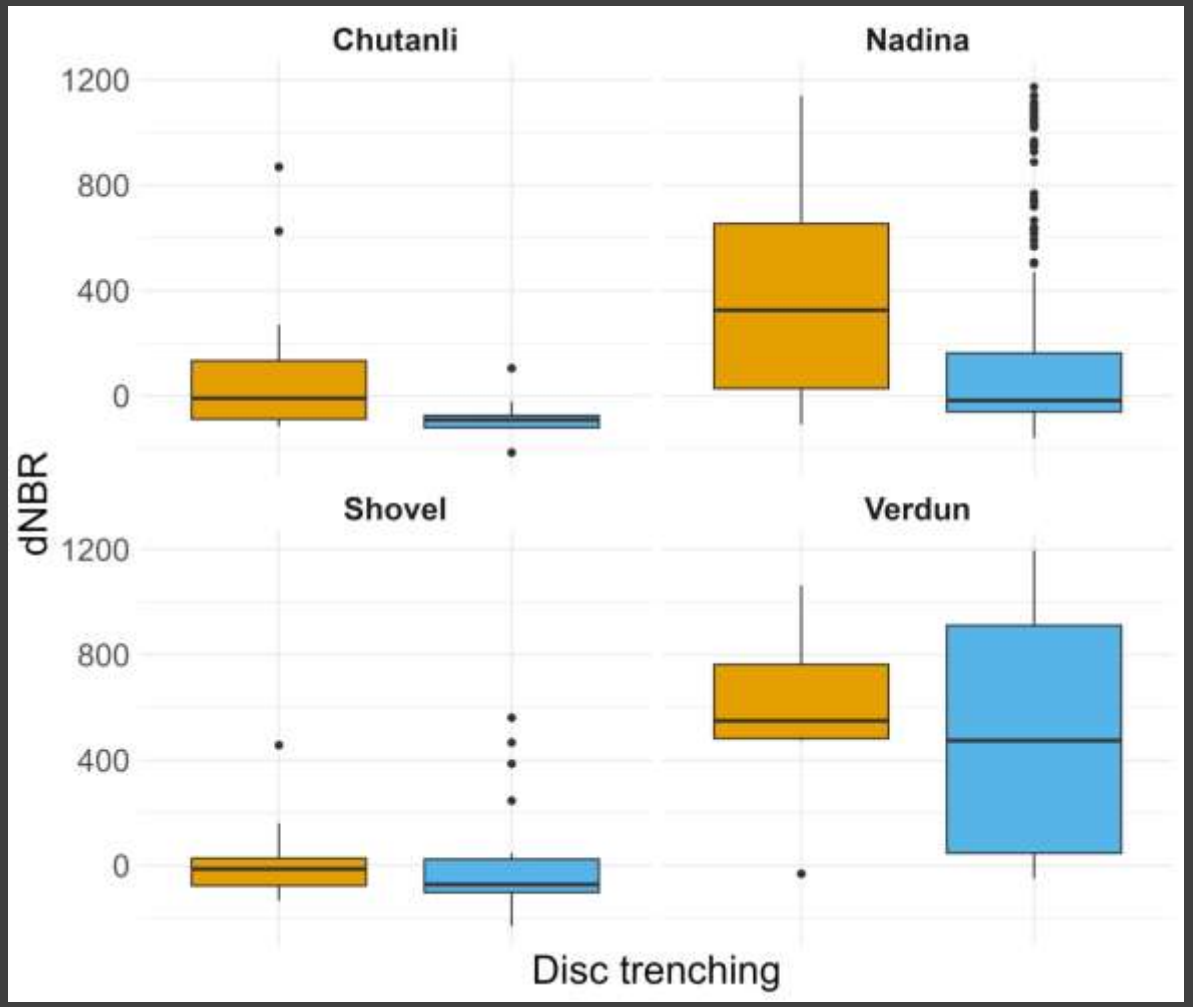
- Generally, higher severity in young (<20 year) plantations
- Decrease in severity ~ 20 years
- Possible increase at ~40 years, but higher uncertainty (low sample size)

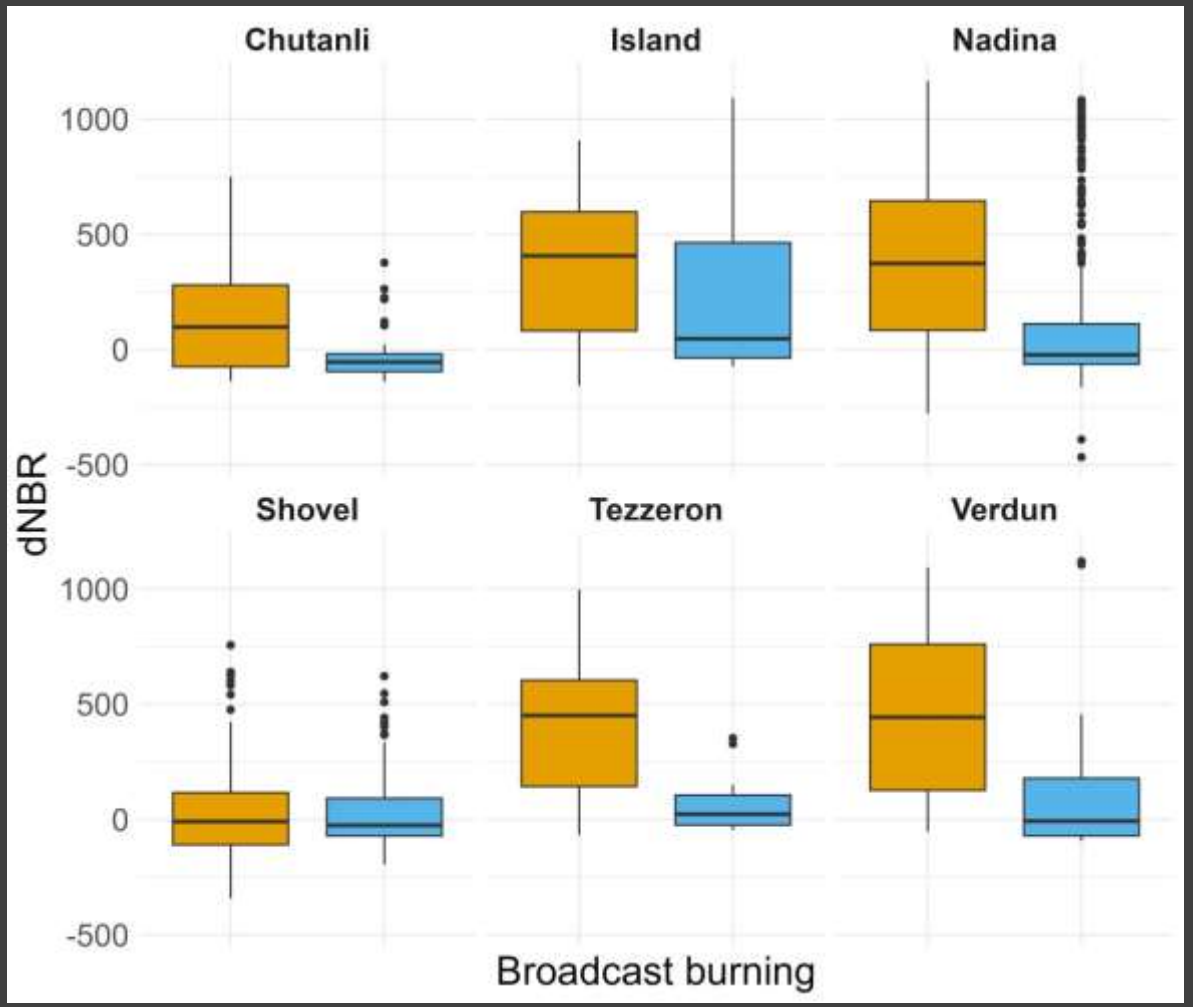


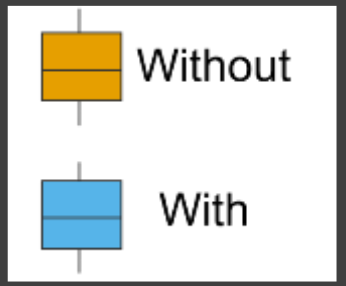
1b. Fire severity and stand age

- Trend in severity with plantation age varied between fires
- Reminder: Only managed forests in this dataset – range of fire severity

2. Site Preparation/silviculture







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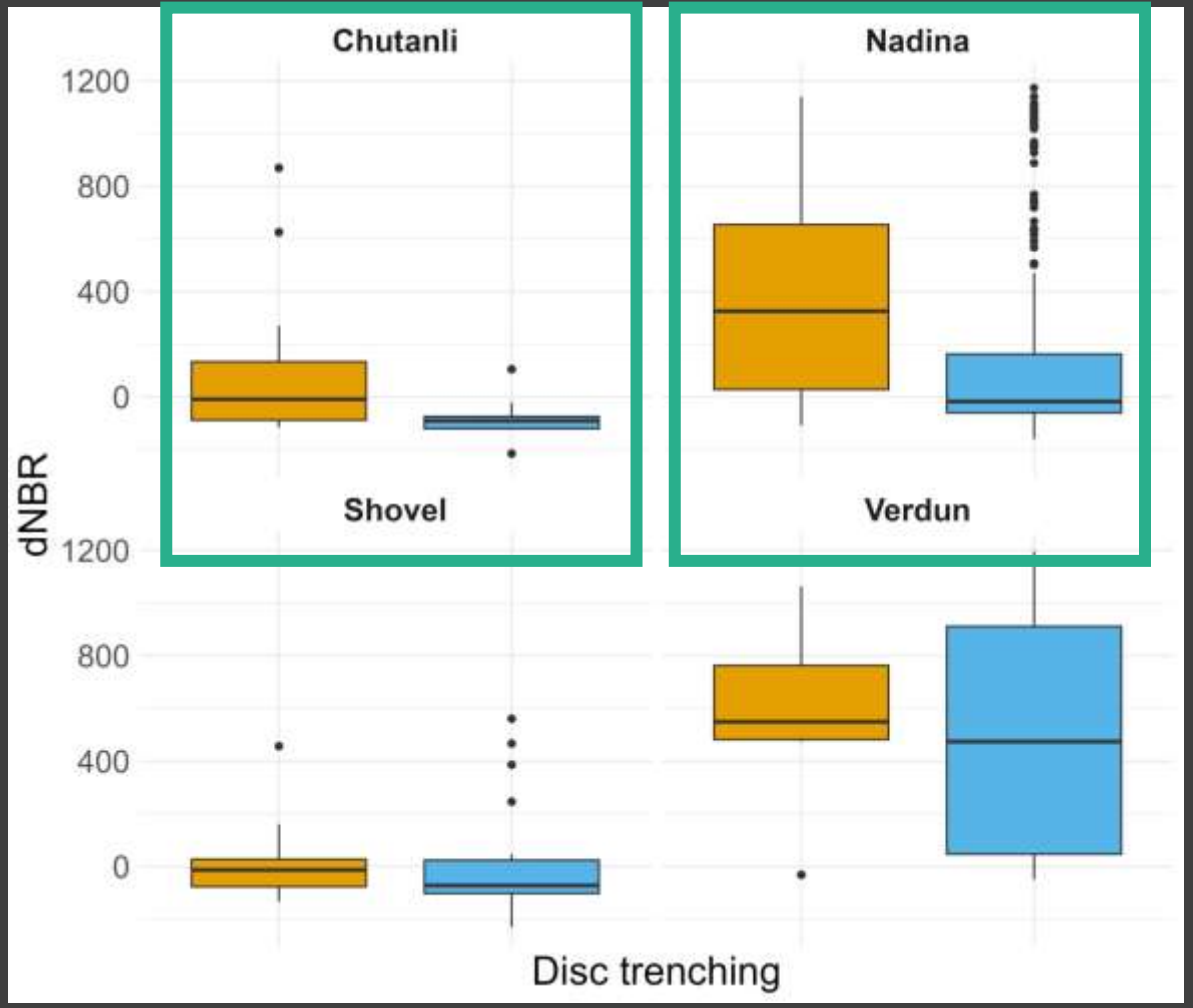

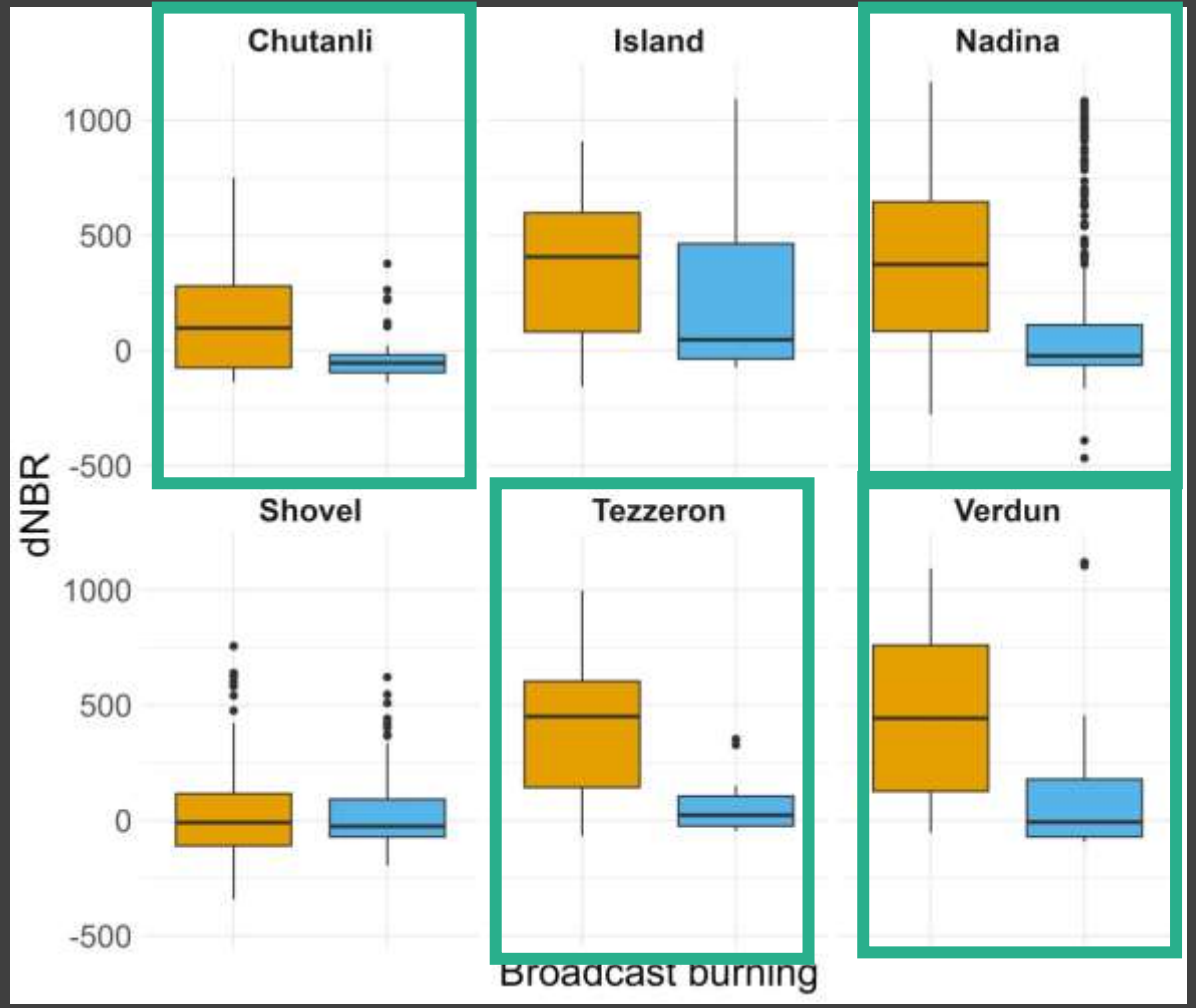

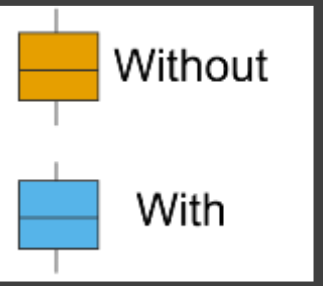

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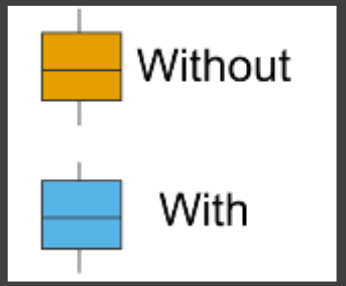

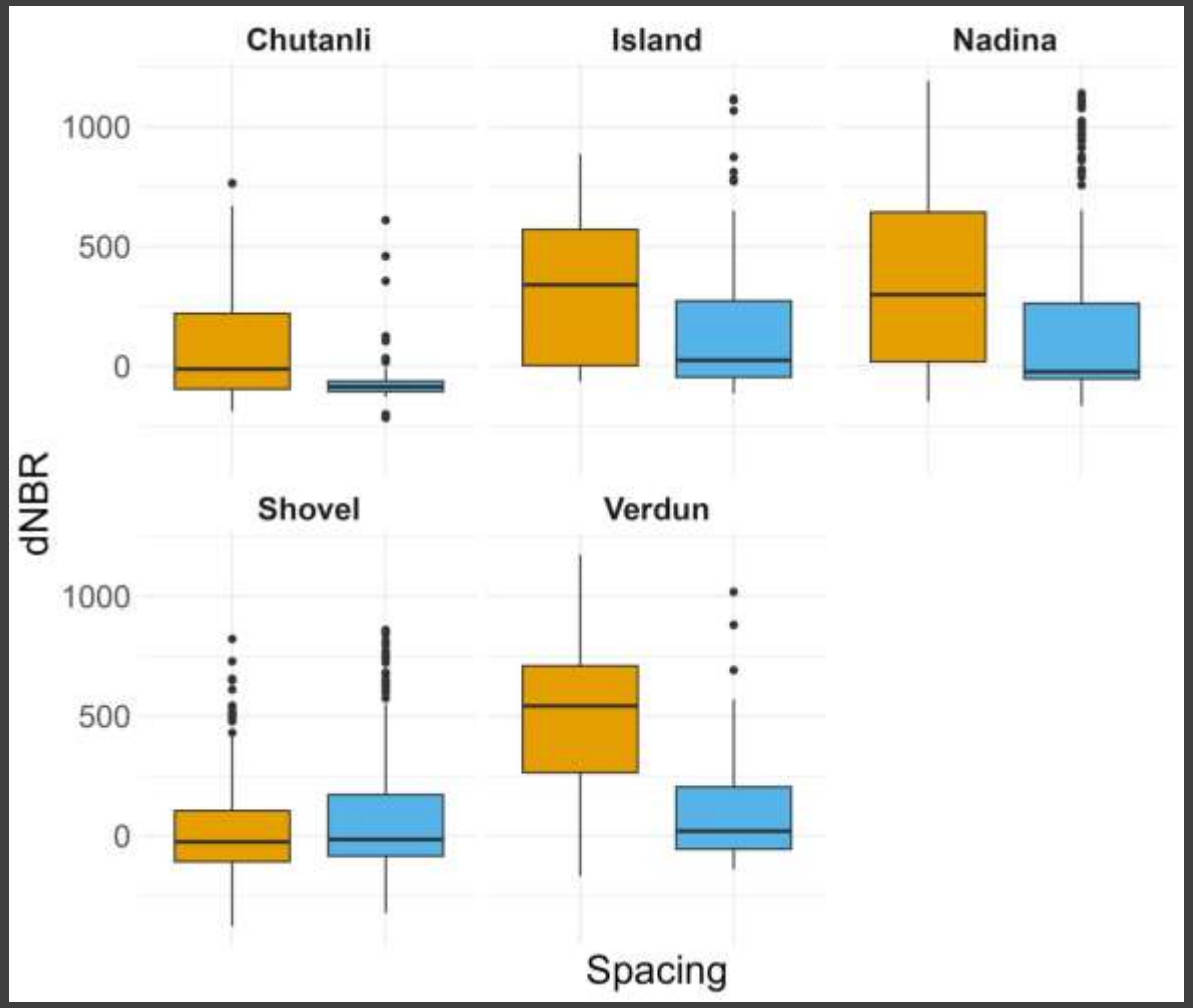

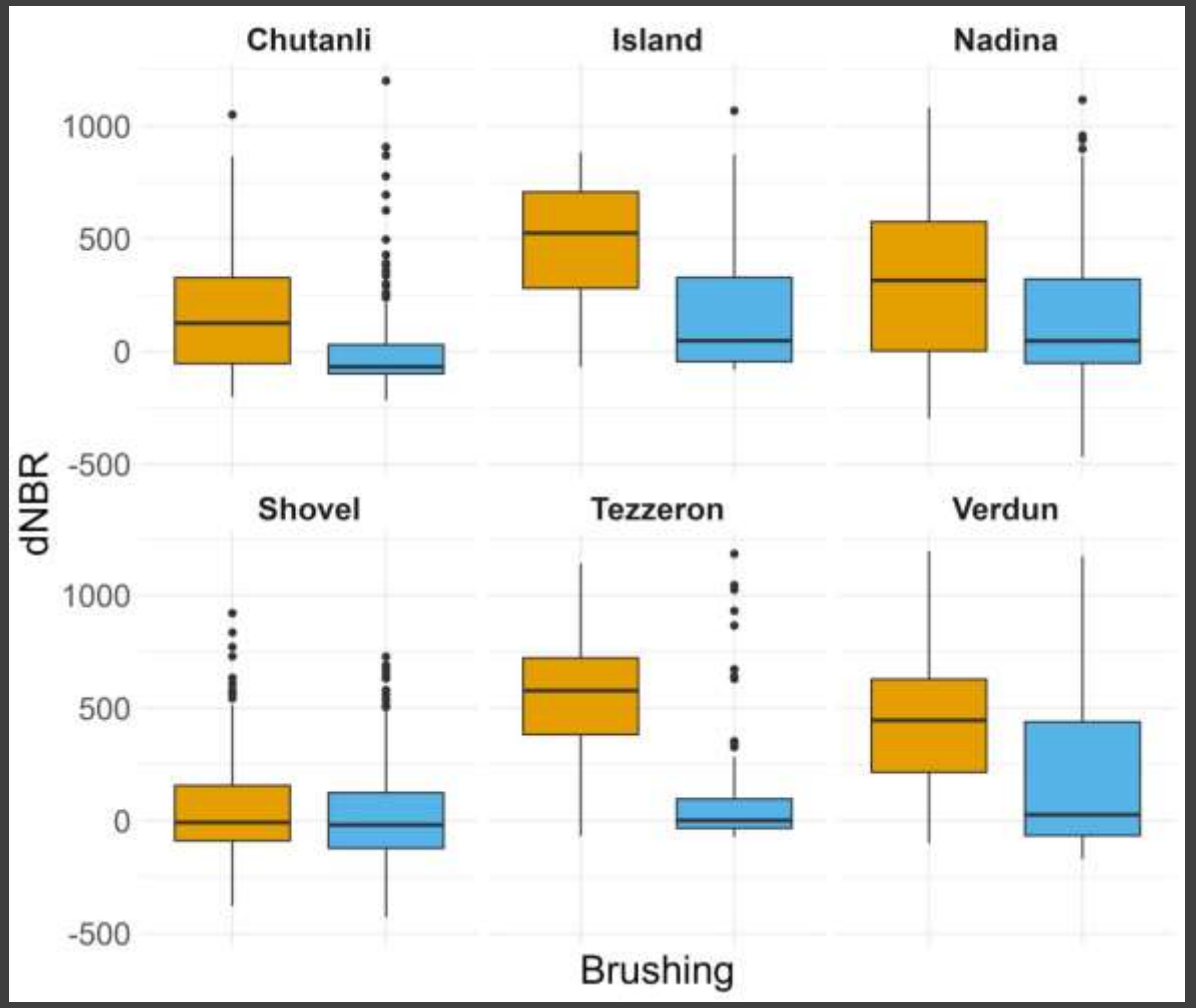

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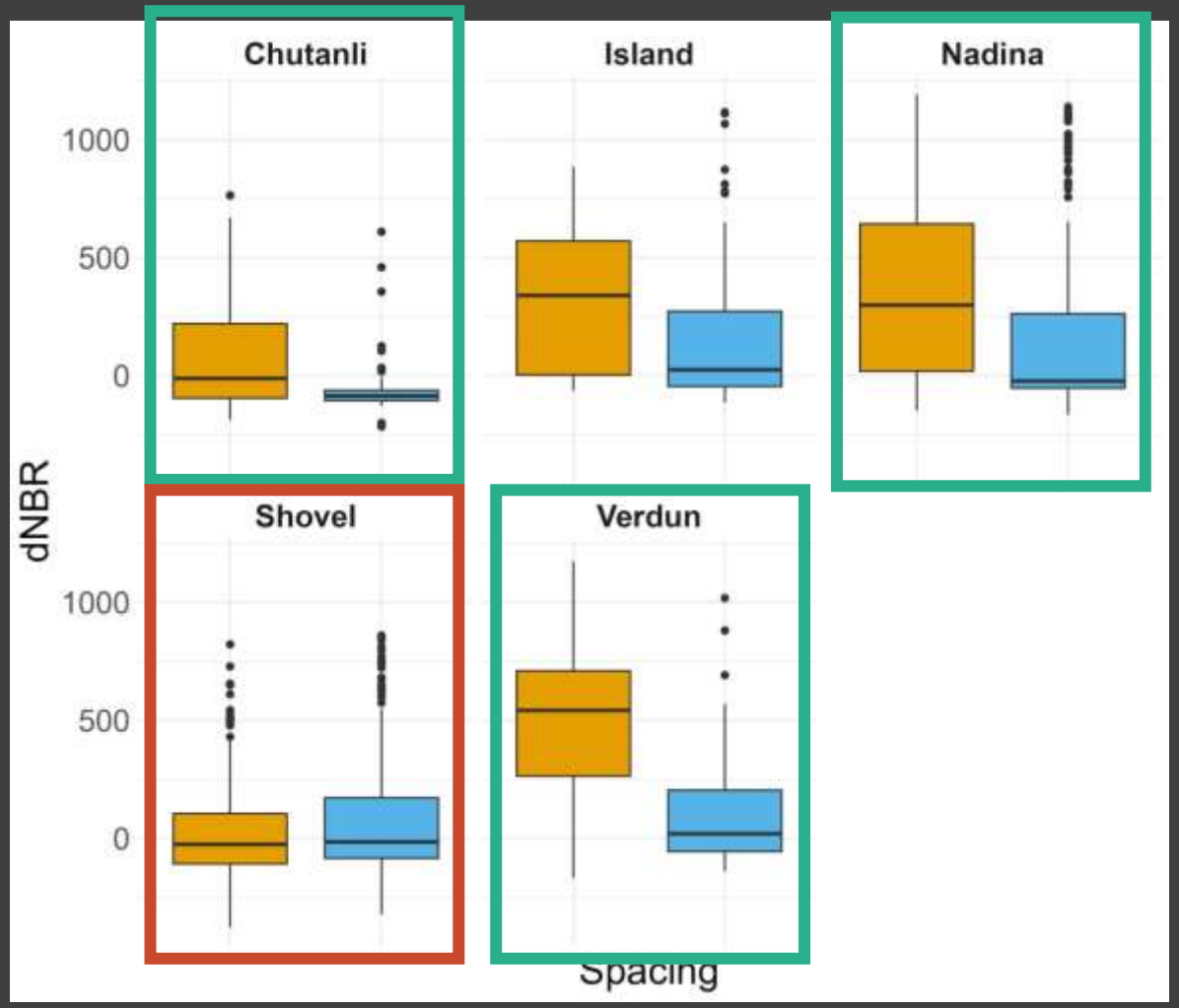
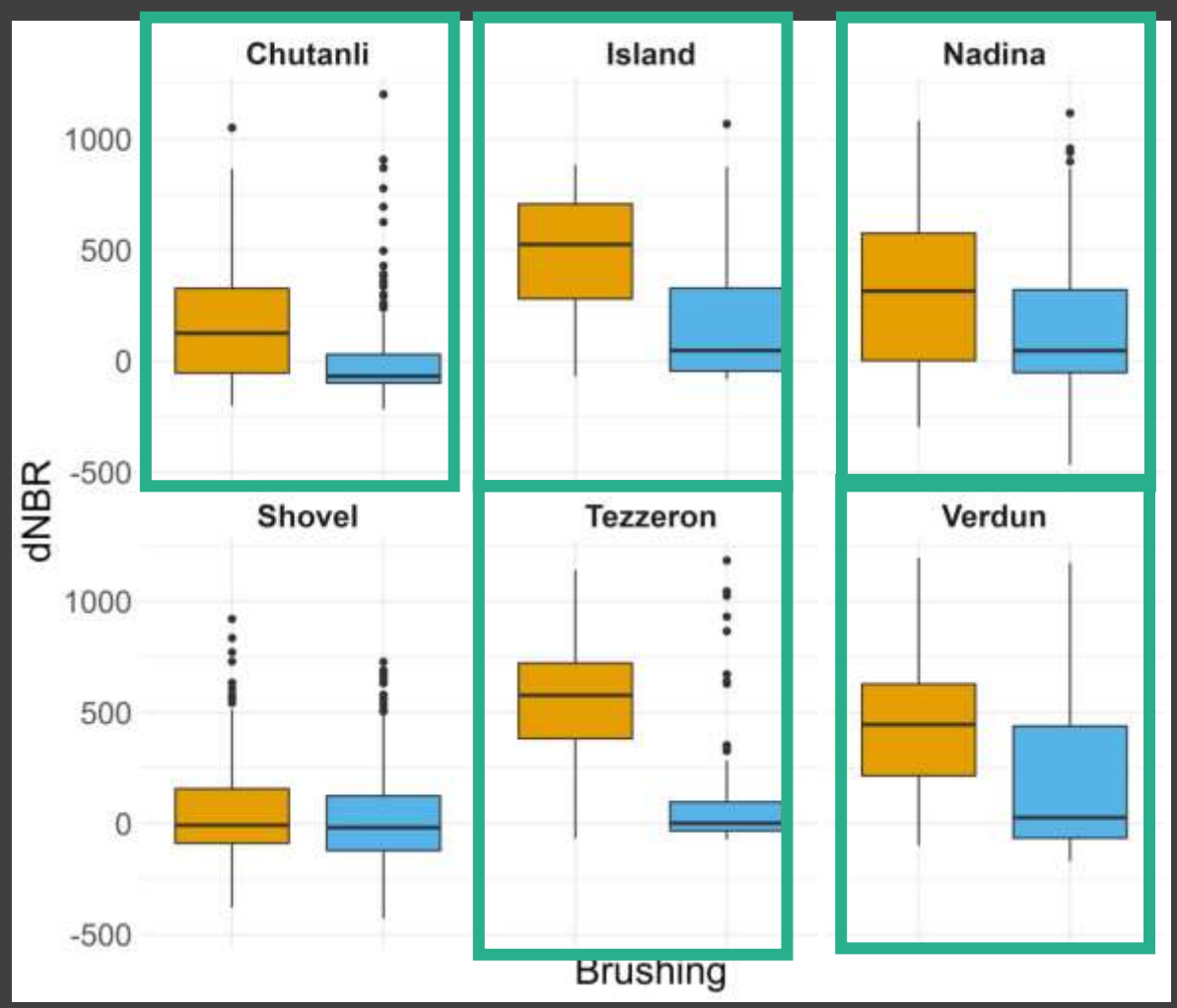
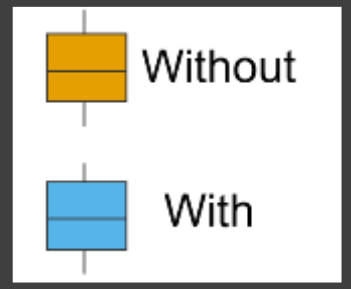






1. Drivers of fire severity in managed forests

- Stand age was the most consistent predictor of managed forests fire severity
  - Even in “extreme” fire conditions, forest state in the sub-boreal can influence fire impact
- Plantations burned at all severities in all fires (unburned, low, mod, high)
- After stand age, space and fire weather, behaviour and spread influenced severity in plantations

1b. Stand age

Fire was less severe in plantations ~ 20 – 40 years

- Young plantations burned at high severity
- Consistent decline in severity (except Shovel) somewhere close to 20 years

Less resistant (higher fire severity)

- Open canopy (solar radiation, wind)
- Ground fuels and ladder fuels close to canopy fuels

More resistant (lower fire severity)

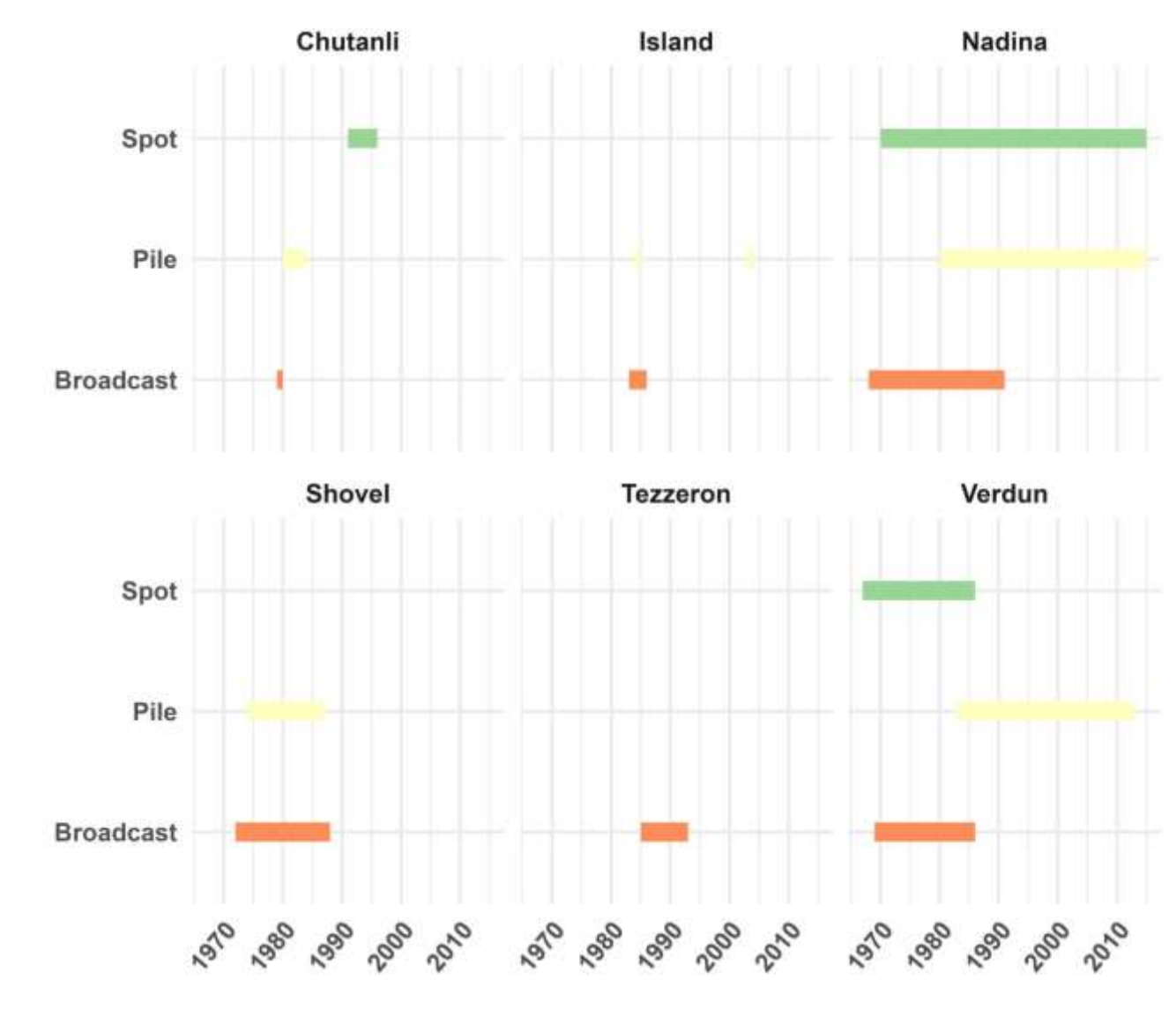
- Closed canopy (cool, moist microclimate)
- Little understory and canopies high off the ground (self-pruning; ladder fuels)

2. Site preparation and silviculture

- Site preparation and silviculture treatments had little influence on fire severity compared to all other drivers
  - Brushing, broadcast burning, and disc trenching may decrease severity
  - Spacing (juvenile) had mixed results

- Many treatments had variable rates of use across all fires – trends could be difficult to detect at landscape scale
- Many treatments are used in combination, so detecting a signal of any one treatment may be challenging
- As treatments change, impacts on fire severity may change as well

2. Site prep and silviculture over time



- Types of debris burning changed over time and varies between fires

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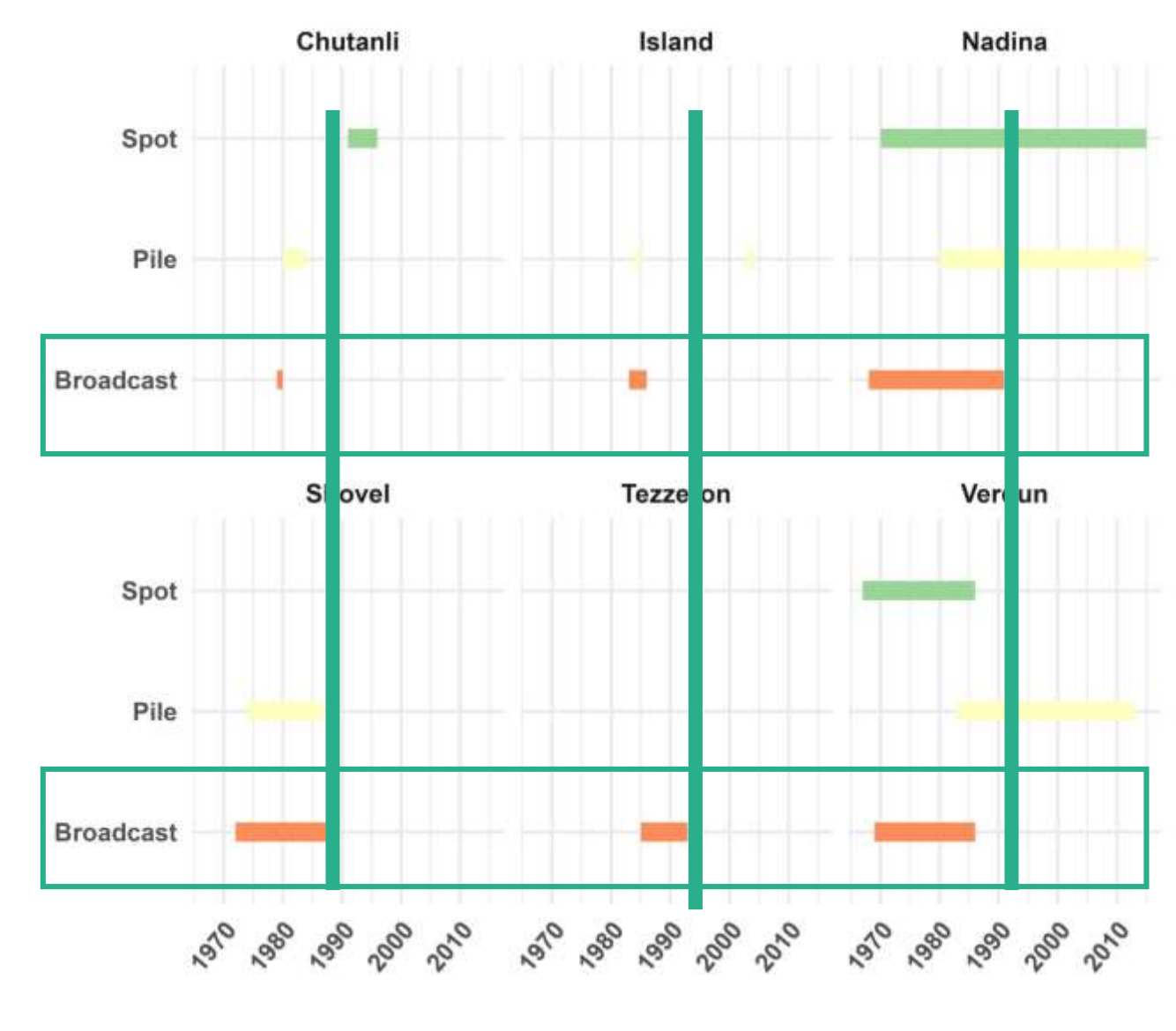

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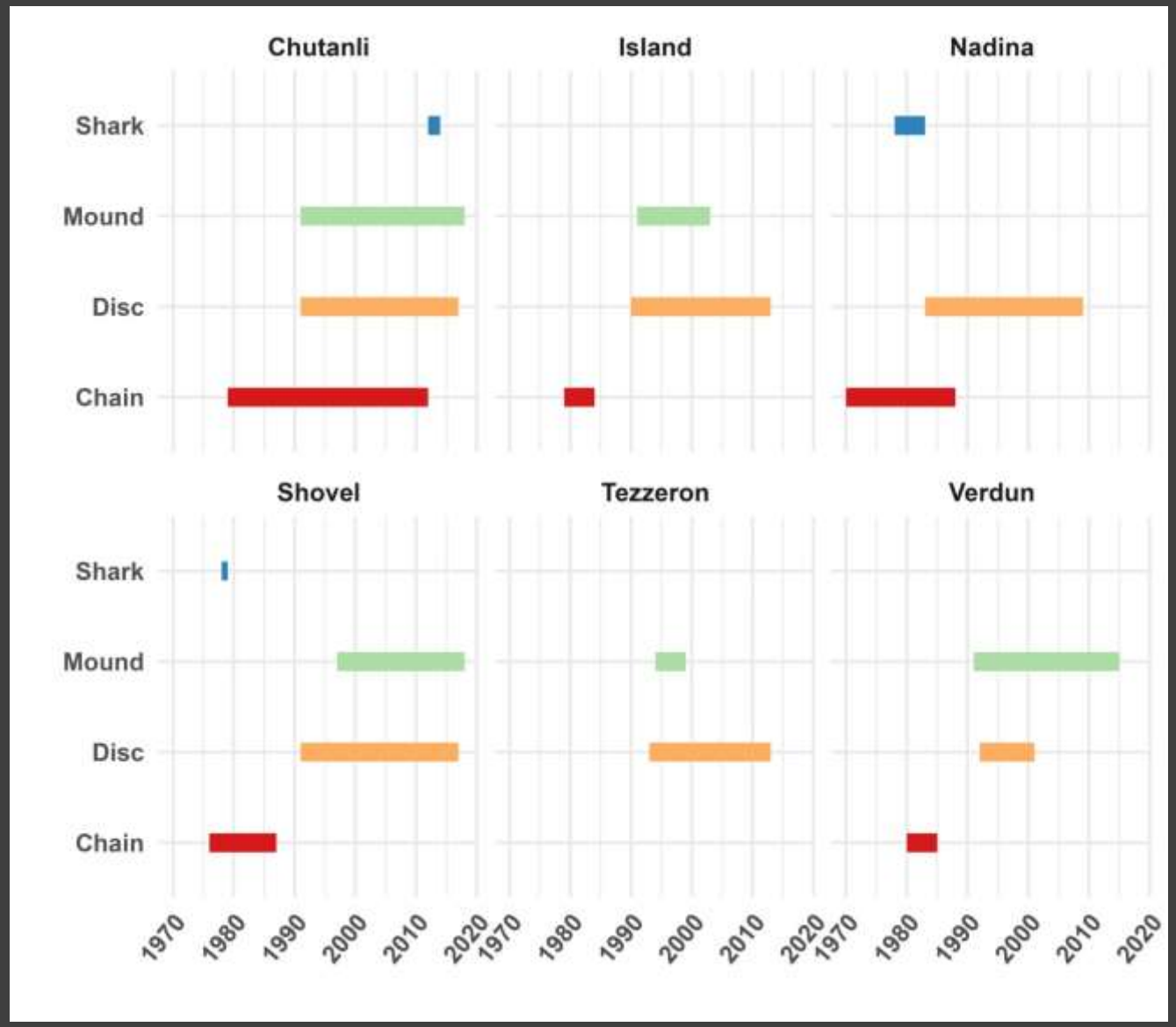

- Types of mechanical site preparation change over time and varied between fires

Study limitations


Photo: I. Farnell

- Limited to crown fire (satellite imagery)
- Fire weather data may not be a right resolution to detect an effect
- Lagged mortality
- Changing forests management practices in the future could change these relationships

Next steps

- Wildfire severity in managed and unmanaged forests in **2017**, **2018**, and **2021**
  - Matthew Hethcoat, Kira Hoffman, Alana Clason, Piyush Jain, Marc-André Parisien, Ellen Whitman

- Wildfire resiliency – Recovery after fire

Forest recovery across fire severity

Kira Hoffman, Ingrid Farnell, Alana Clason

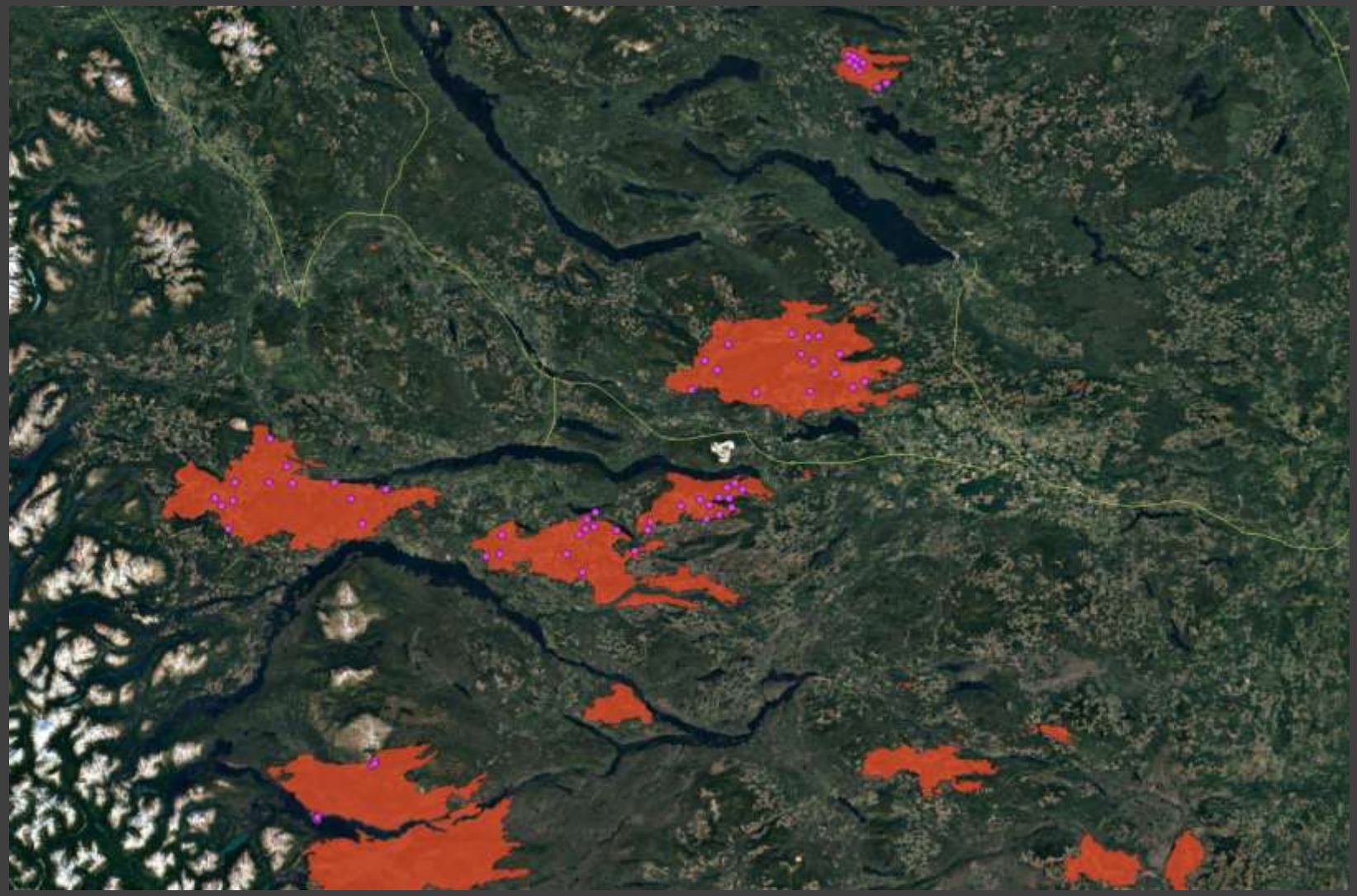

Photo: K. Hoffman

Forest fuels over time since fire

Alana Clason, Ingrid Farnell, Erica Lilles, Jocelyn Biro, Jenn Baltzer, Anne-Marie Roberts and others

Work complete

Carbon

Work underway

Moose Forage

Work underway: Multi-values

- **Biodiversity**
- ***Timber***
- ***Fuels***
- ***Stand structure***

Photos: I. Farnell

Forest recovery after repeat fire

Kira Hoffman, Ingrid Farnell, Alana Clason

Plot FR64 2020 – 55 years since fire

Plot FR64 2022 – 57 years since fire 1st fire, 1 year since 2nd fire