Are current fuel reduction strategies successfully mitigating risk of catastrophic wildfire in rural communities in the Kootenay Region of British Columbia, Canada?

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British Columbia Community Forest Association
local people, local forests, local decisions

UBC

Canada Wildfire

British Columbia
BC Wildfire Service

Research objectives

Assess the efficacy of alternative fuel treatments to mitigate extreme fire behaviour and fire effects in the seasonally dry forests of the Kootenay region in southeastern BC.

1) How do different thinning, pruning, and surface fuel load combinations impact fire behaviour and fire effects?

2) Are current fuel treatments successfully mitigating extreme fire behaviour and fire effects?

Study sites in 5 community forests

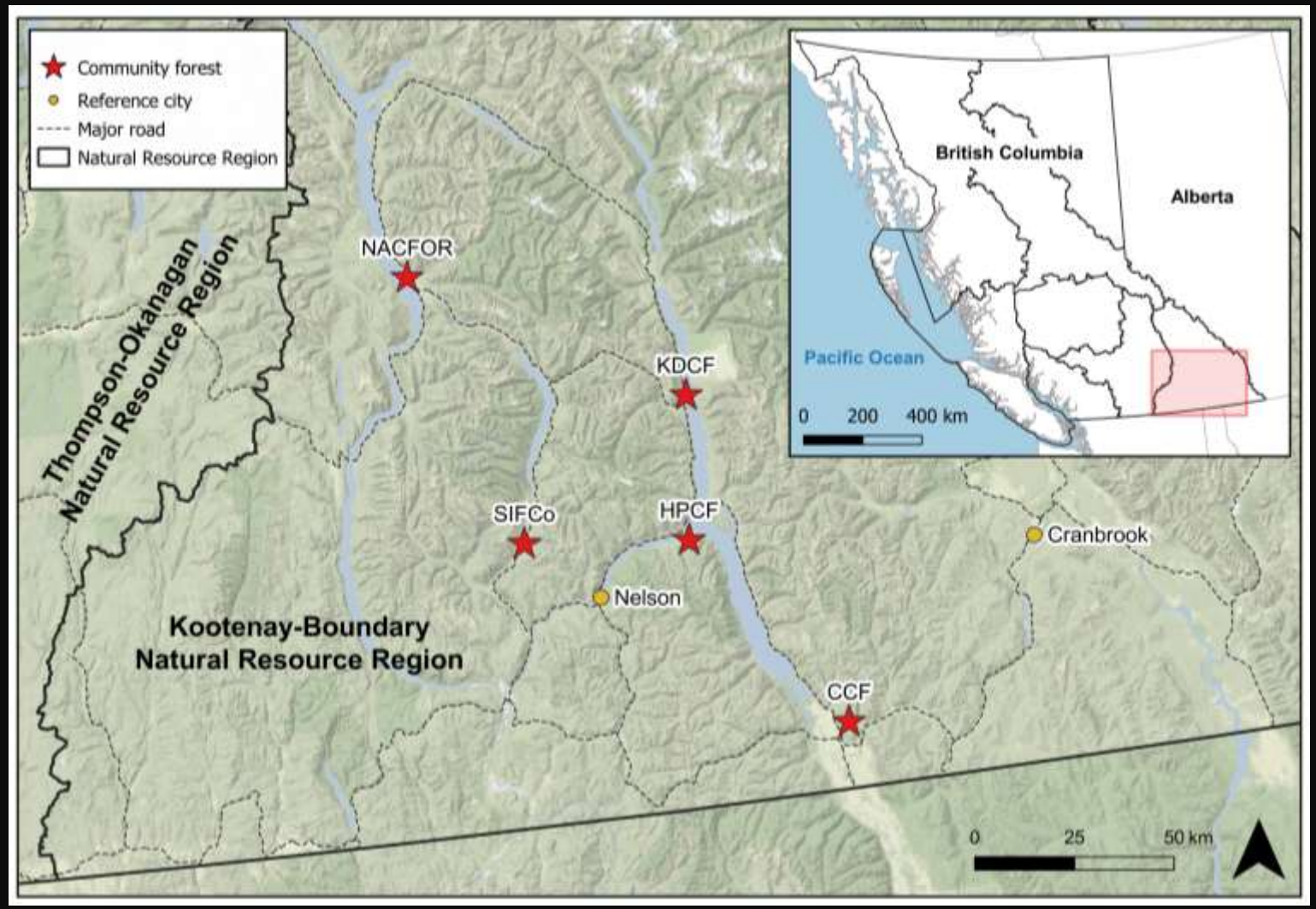
Creston (CCF)

Harrop-Procter (HPCF)

Kaslo and District (KDCF)

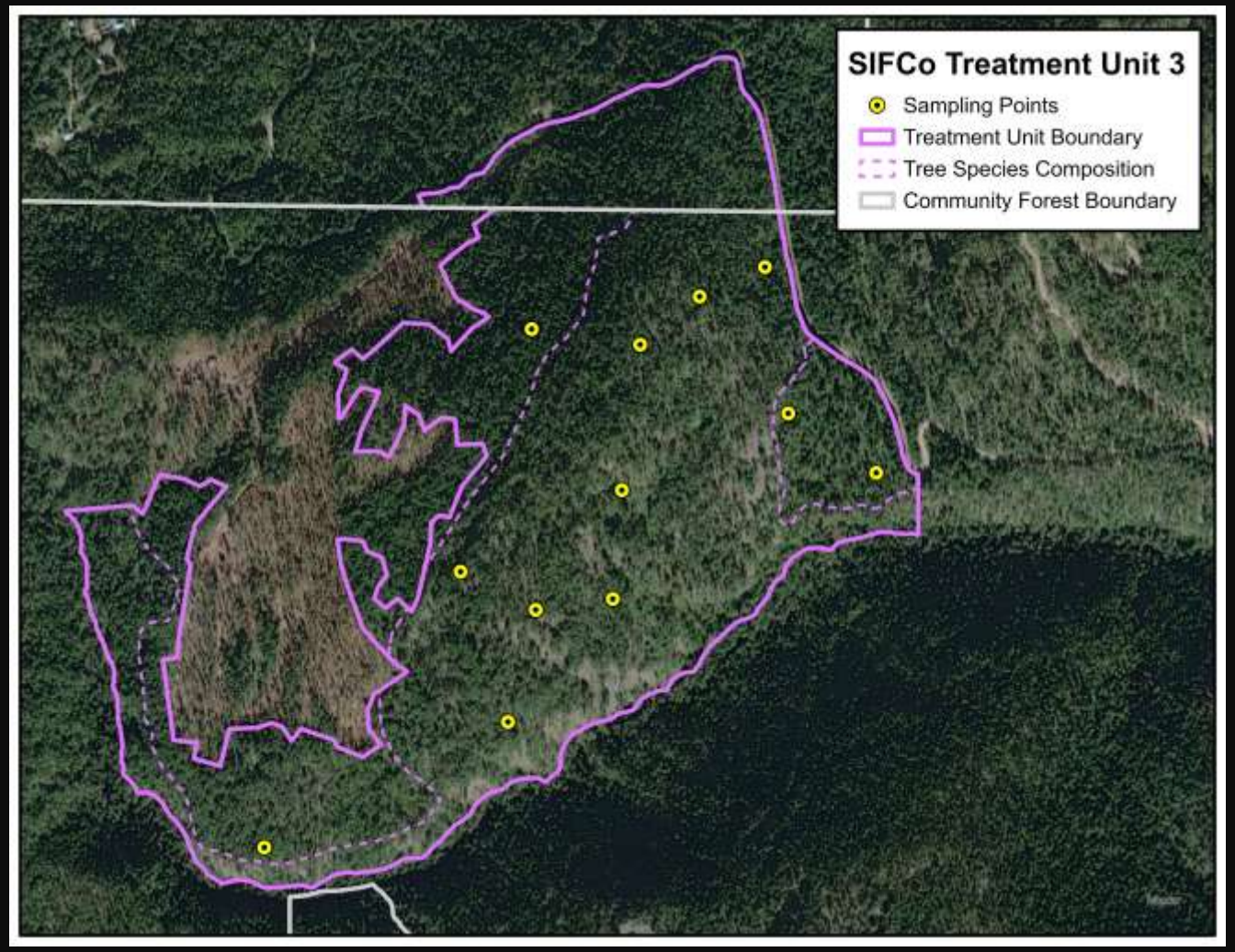
Nakusp and Area (NACFOR)

Slocan Integral Forestry Cooperative (SIFCo)



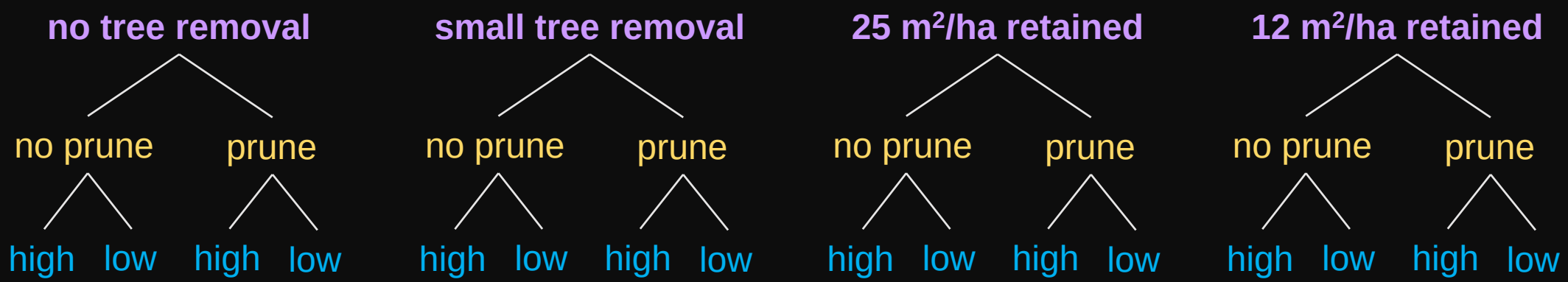
Treatment units and sampling points

- 13 treatment units
- 61 sampling points
- Pre-treatment in 2021
- Post-treatment in 2022



Simulation scenarios

How do different thinning, pruning, surface fuel load combinations impact fire behaviour and fire effects?



Fire behaviour modelling

90th percentile weather conditions

Fuels Management Analyst Plus (FMA, Carlton 2004)

Crown fire potential

- Torching Index (km/h): wind speed necessary to initiate passive crown fire
  - Passive crown fire: ignition of individual or small groups of trees
- Crowning Index (km/h): wind speed at which active crown fire is expected
  - Active crown fire: sustained tree-to-tree crown fire spread
- Higher values indicate a lower potential of passive/active crown fire

Fire severity

- Probability of mortality at an individual tree level

Extremely high values of torching or crowning index

High values (those beyond any possible windspeed that would actually occur at a site) indicate a forest structure that is extremely resistant to passive/active crown fire.

Windspeed threshold: 60 km/h

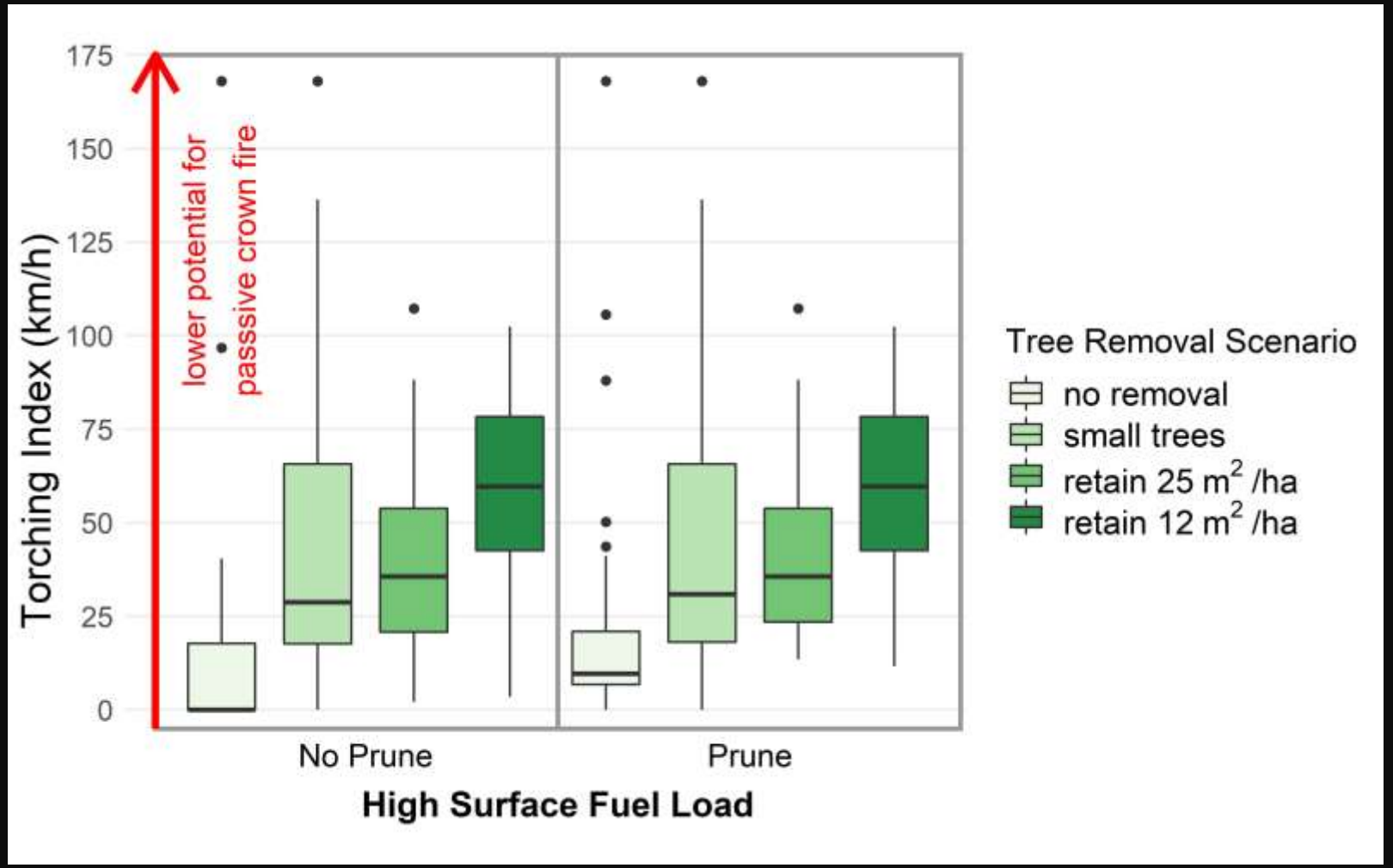
- Torching/crowning index < 60 km/h → passive/active crown fire could occur
- Torching/crowning index > 60 km/h → passive/active crown fire would not occur

Analysis: Torching Index

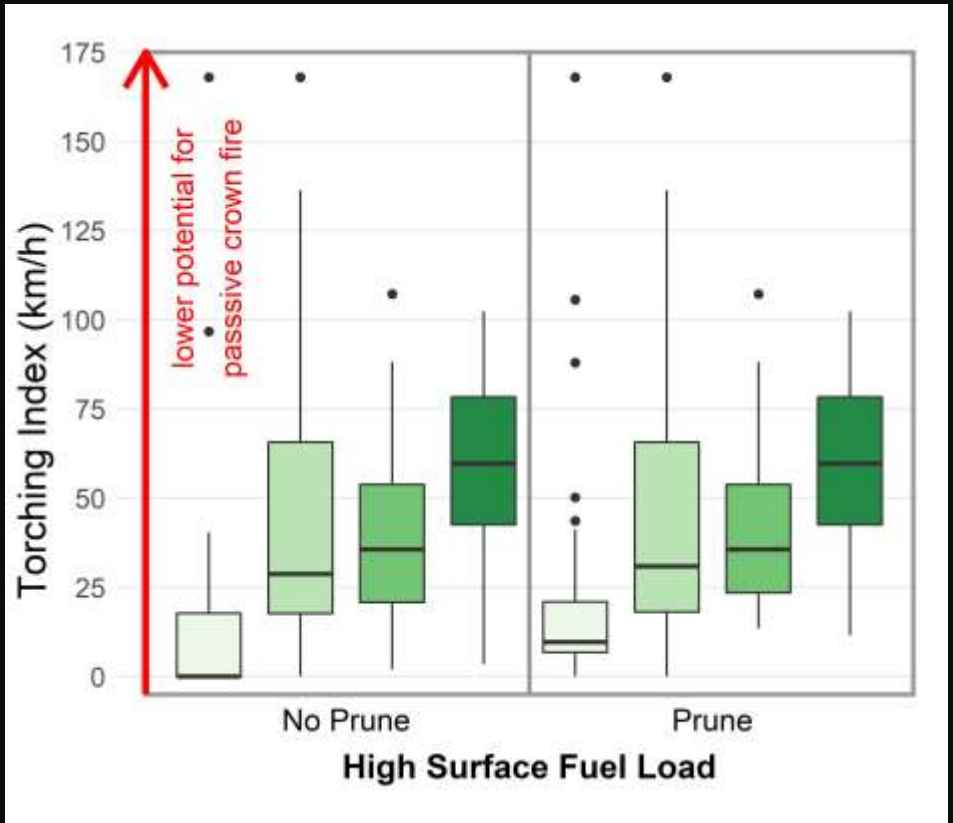
Conditional Truncated Zero-Inflated Negative Binomial Model

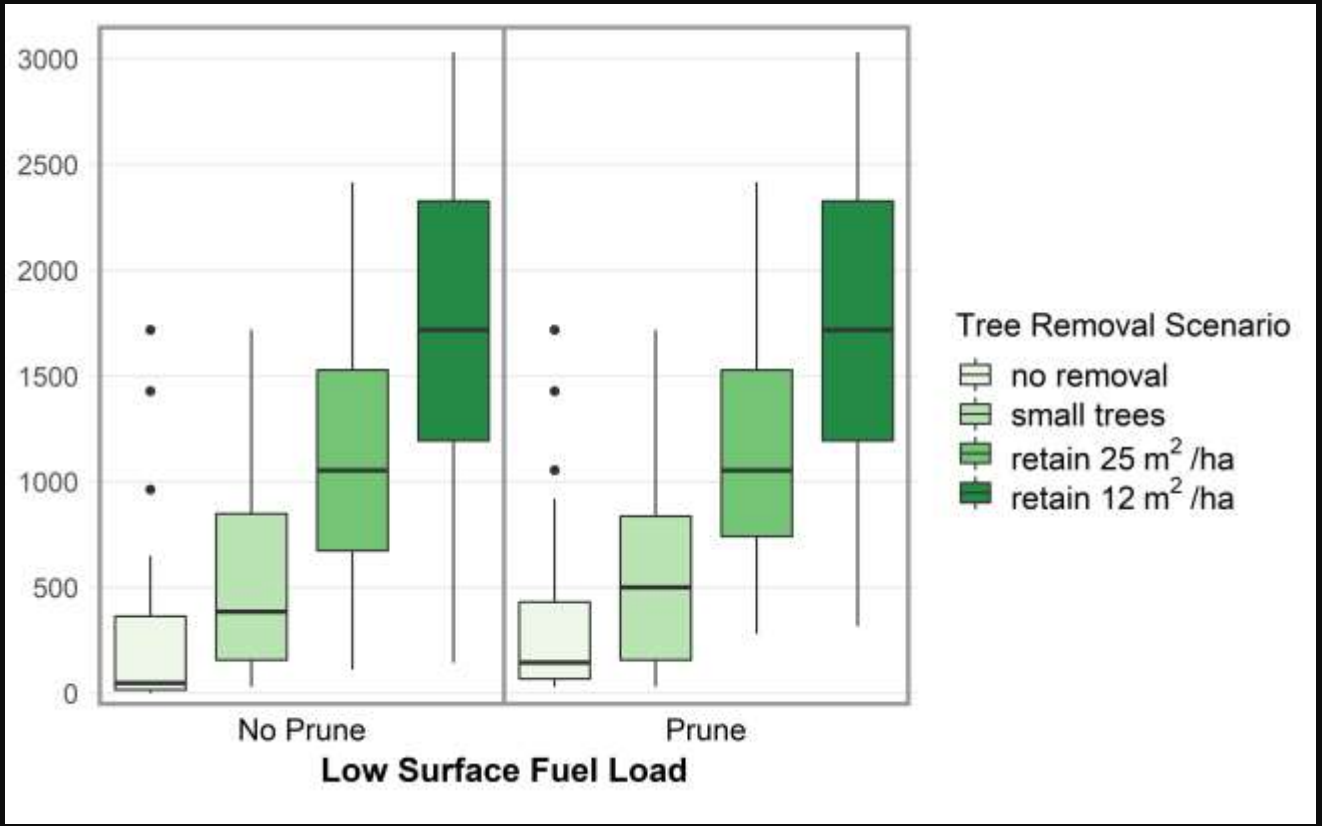
Description	Response variable	Type of model
Based on 60 km/h threshold, could passive crown fire occur?	possible occurrence of passive crown fire (yes/no)	logistic regression
If “yes,” what is the Torching Index?	Torching Index (km/h)	truncated zero-inflated negative binomial

Torching Index:
wind speed necessary to initiate passive crown fire



Torching Index: tree removal and surface fuel load but not pruning

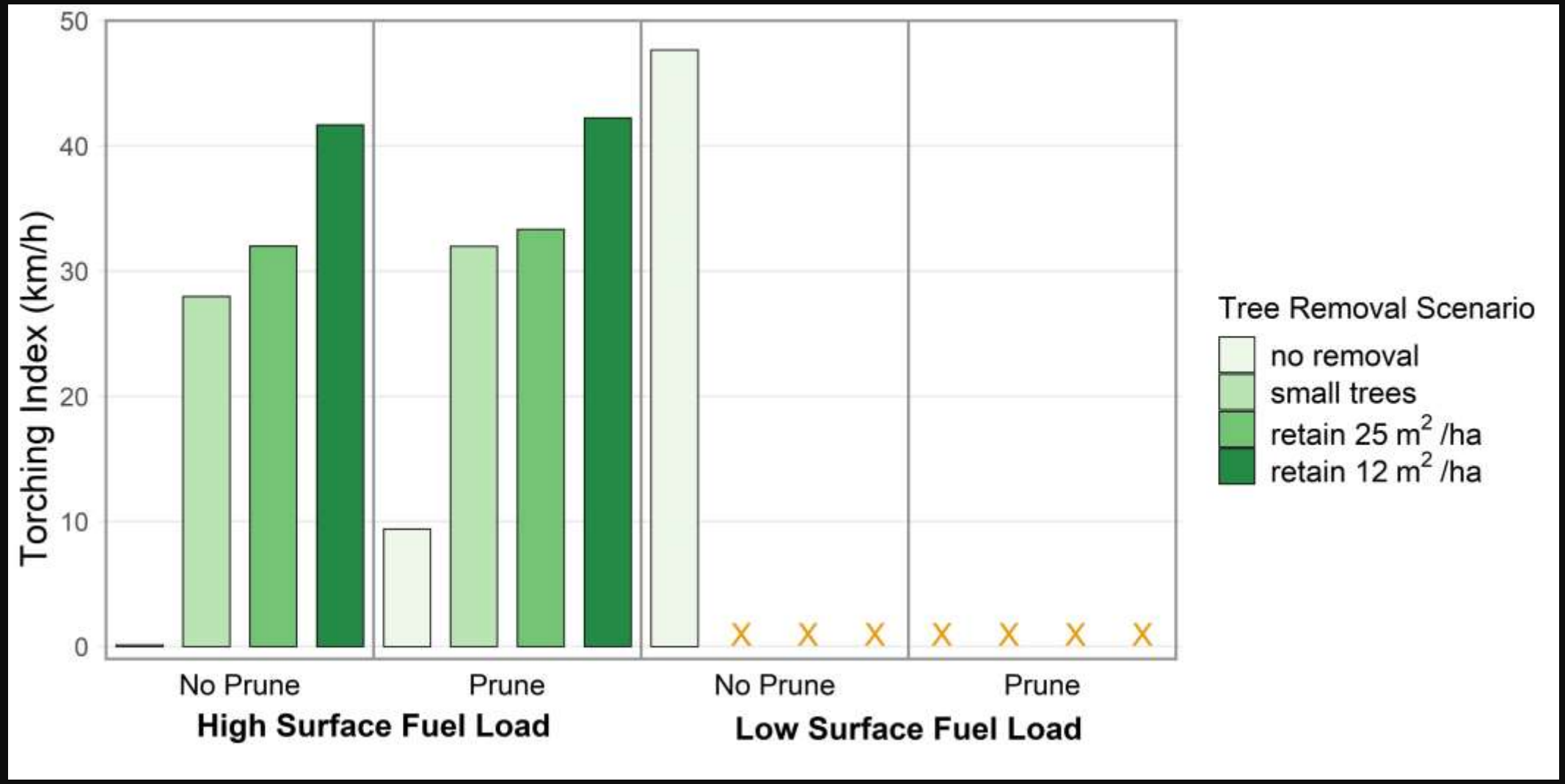




Treatment effect dependent on starting stand conditions

Example starting stand structure scenario:

Torching Index: tree removal and surface fuel load but not pruning

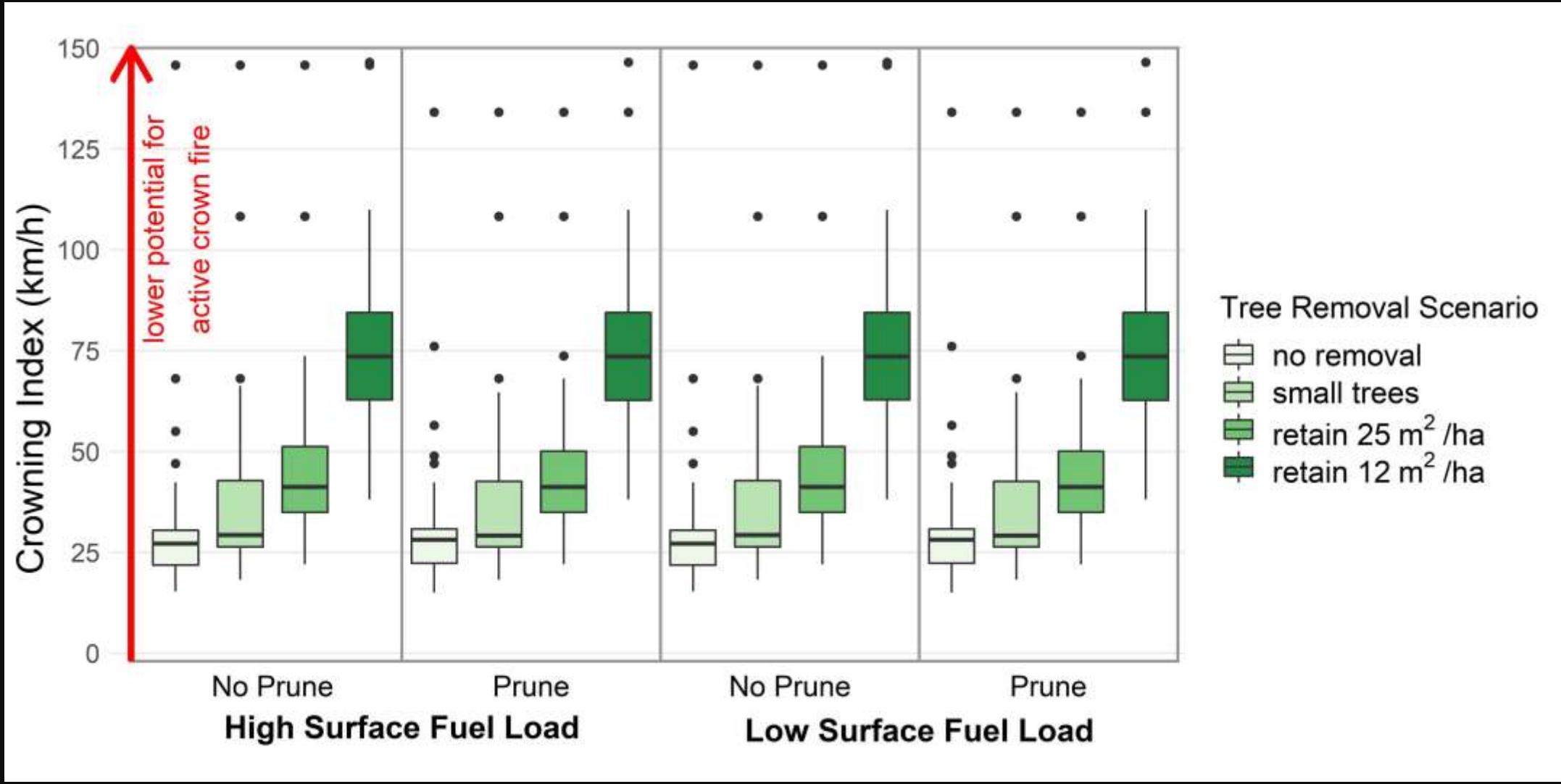


Analysis: Crowning Index

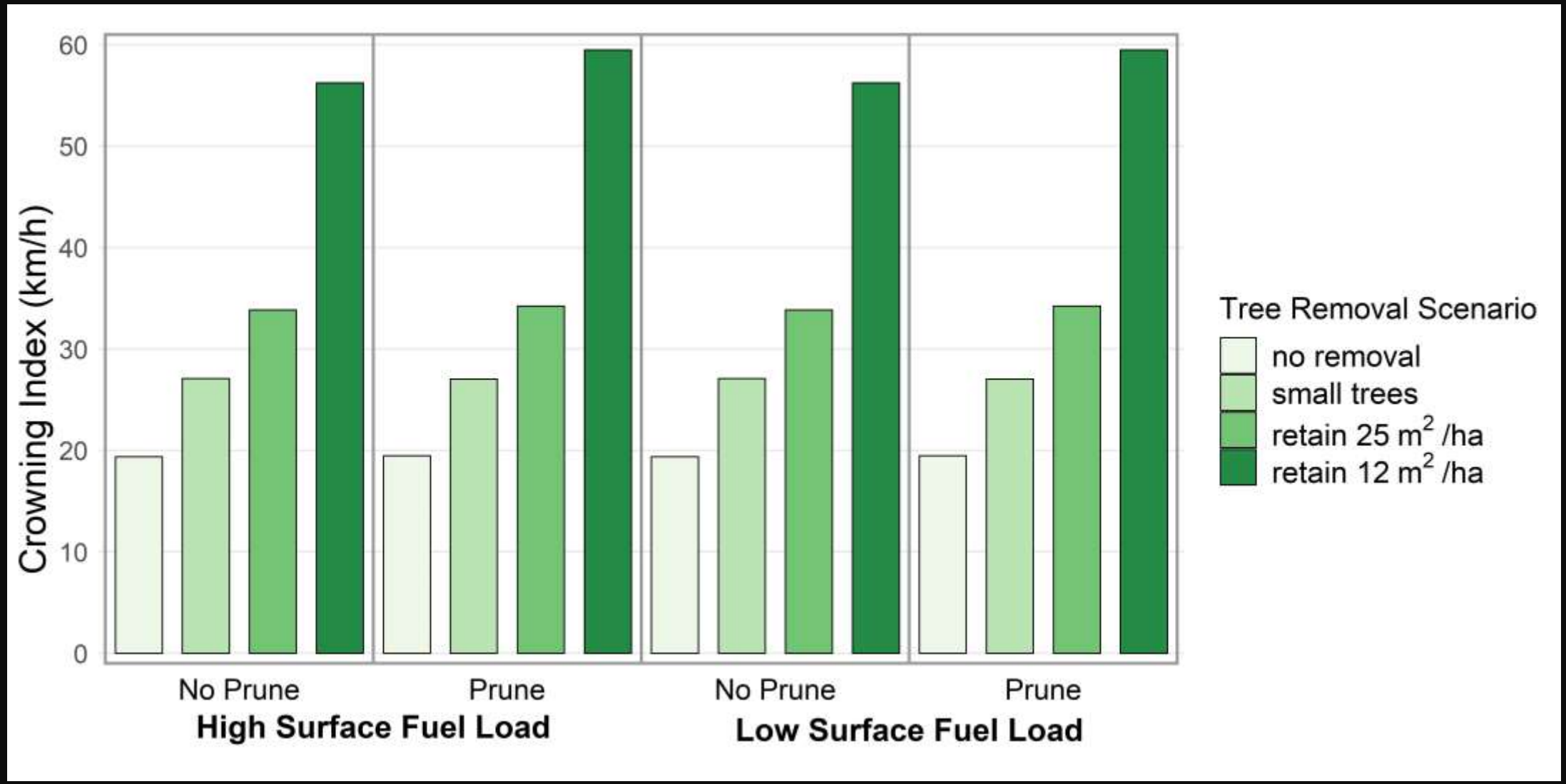
Conditional Truncated Mixed Linear Model

Description	Response variable	Type of model
Based on 60 km/h threshold, could active crown fire occur?	possible occurrence of active crown fire (yes/no)	logistic regression
If “yes,” what is the Crowning Index?	Crowning Index (km/h)	truncated mixed linear model

Crowning Index: tree removal only



Crowning Index: tree removal only

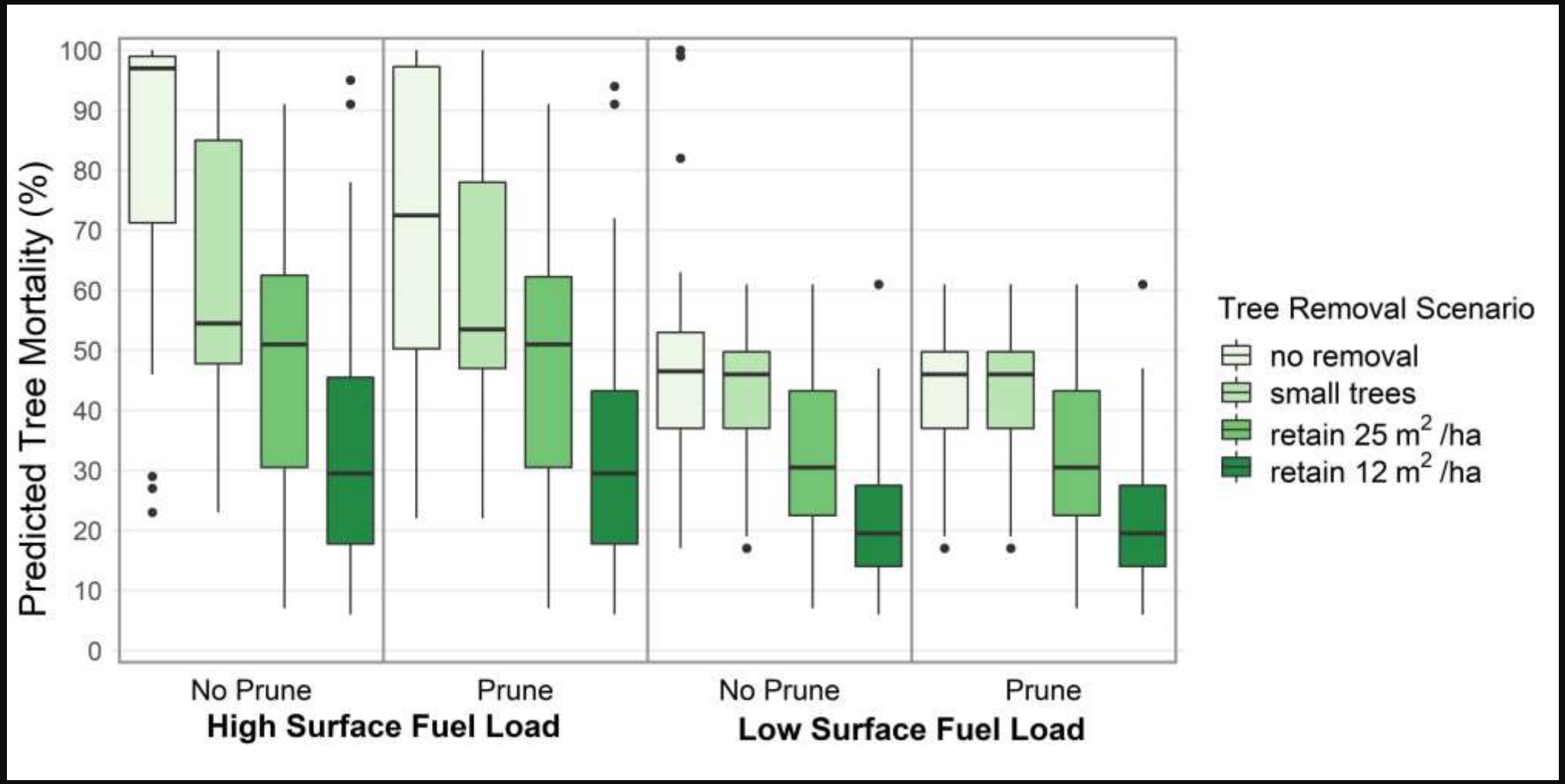


Analysis: predicted tree mortality

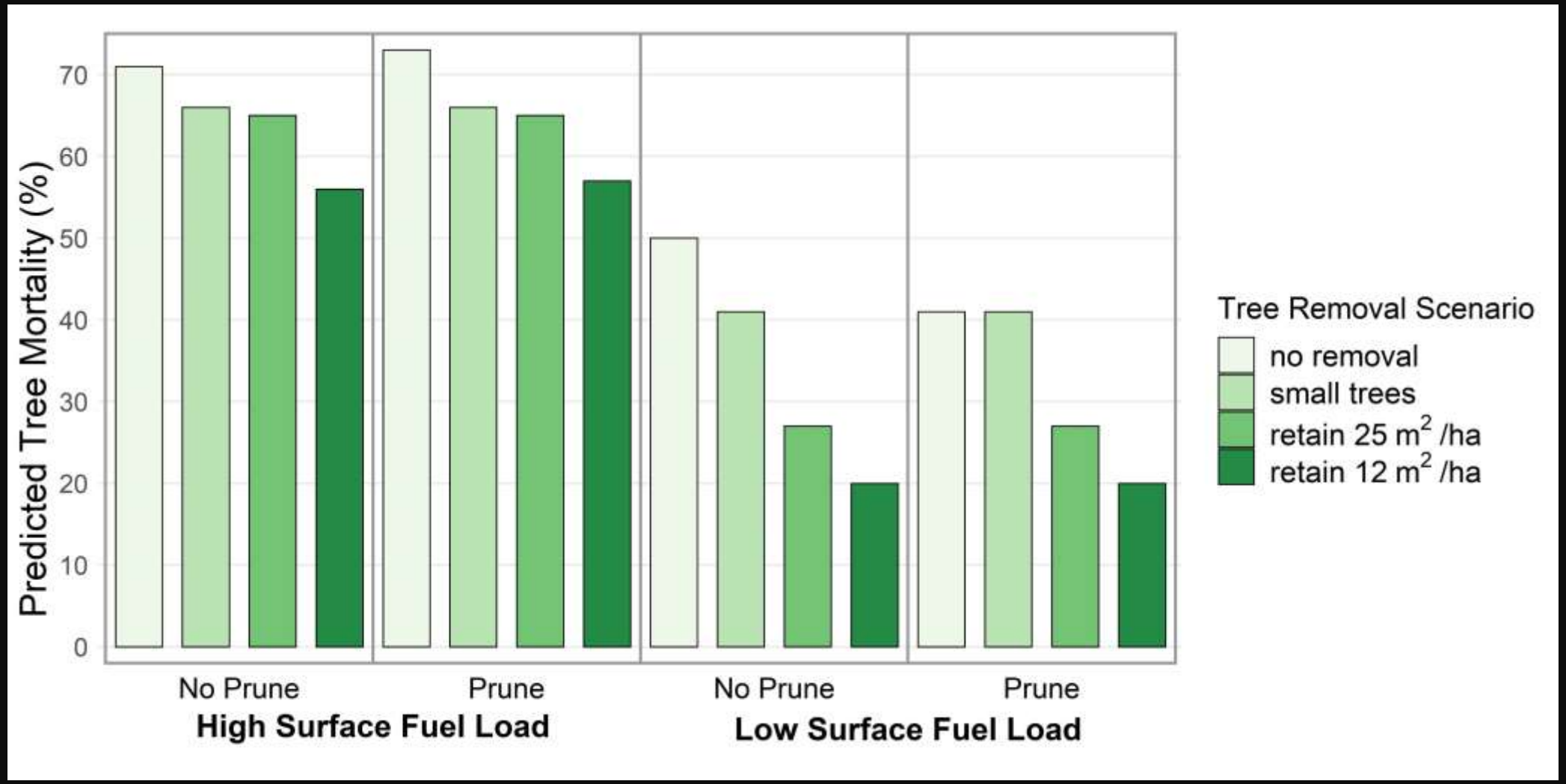
Type of model: logistic regression

Response variable: probability of mortality (bounded between 0 and 1)

Predicted tree mortality: tree removal and surface fuel load but not pruning



Predicted tree mortality: tree removal and surface fuel load but not pruning



Key findings

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3) Pruning to increase live canopy base height had minimal impact on mitigating potential fire behaviour and effects

Key findings

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2) Preferential retention of large, fire-tolerant species led to lower predicted tree mortality

3) Pruning to increase live canopy base height had minimal impact on mitigating potential fire behaviour and effects

4) Ameliorating surface fuel loads successfully reduced risk of passive crown fire and improved remaining tree survivorship

Are current fuel treatments successfully mitigating extreme fire behaviour and effects?

Pre-treatment (2021)

Post-treatment (2022)

(Harrop Procter, BC)

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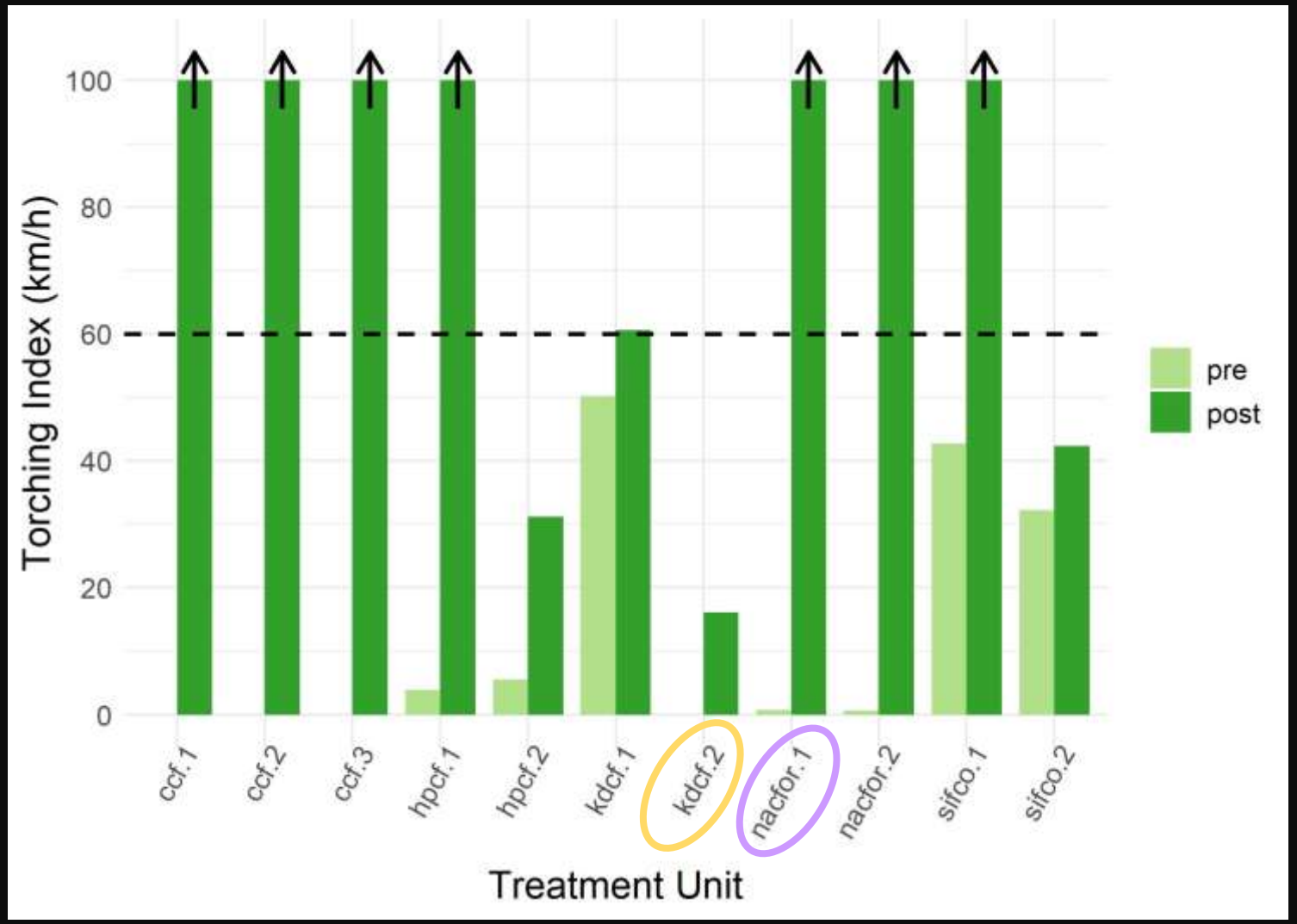
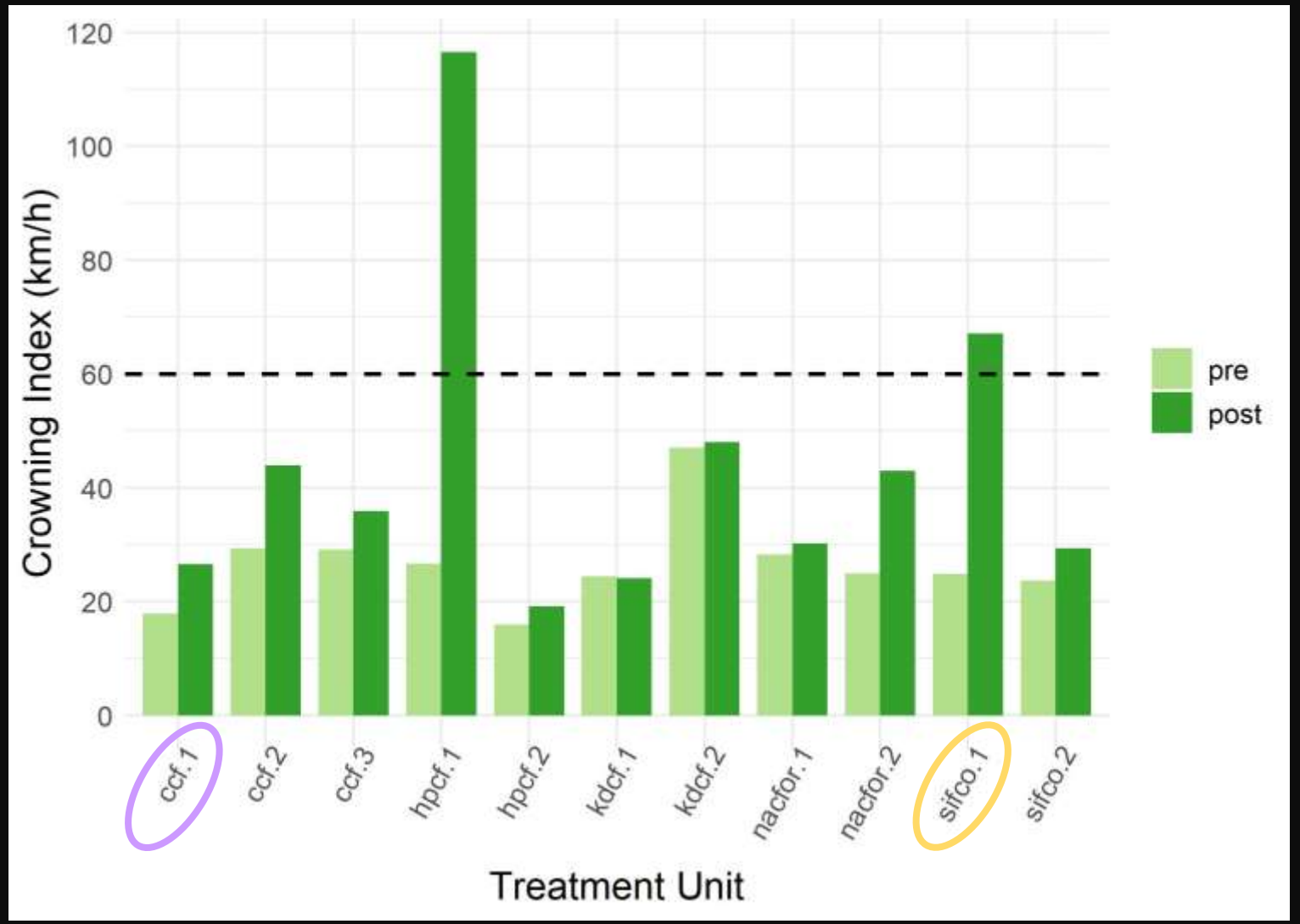
Potential for passive crown fire decreases with treatment



(nacfor.1)

(kdcf.2)

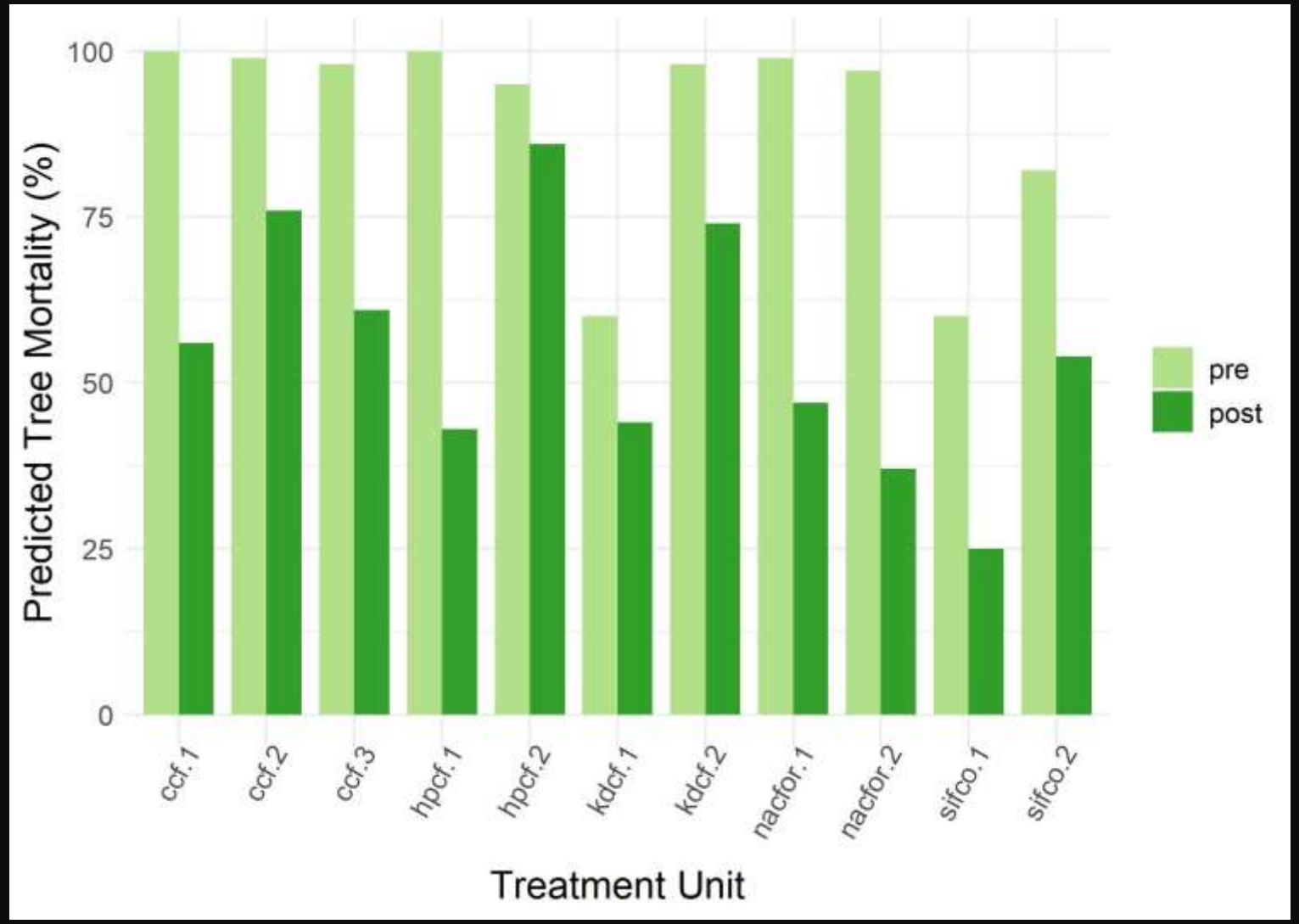
Potential for active crown fire decreases with treatment



(ccf.1)

(sifco.1)

Predicted tree mortality decreases with treatment



Concluding thoughts

Fuels Management Analyst Plus

- Fire behaviour AND effects
- Fire resiliency work


QUESTIONS?

Key citations

Carlton, D. (2004). Fuels Management Analyst Plus Software, Version 3.0.11. Fire Program Solutions, LLC, Estacada, Oregon, USA.

Photo citations

All photos taken by Kea Rutherford.