Fuel Treatment Efficacy & Landscape Resiliency Research & Knowledge Sharing Event

February 2023

Acknowledgement and Accountability

The University of British Columbia, where we are gathered today, is located on the unceded ancestral territories of the Musqueam, Squamish and Tsleil-Waututh First Nations.

Through our research and work, we have the privilege of collaborating with and working on the territories of many other Indigenous Nations around the province of British Columbia.

We honour these lands and the people who stewarded them through generations. In doing so, we reflect on how histories of people and place are integral to understanding the modern fire challenge and solutions for our future.

Fuel Treatment Efficacy & Landscape Resiliency Research & Knowledge Sharing Event

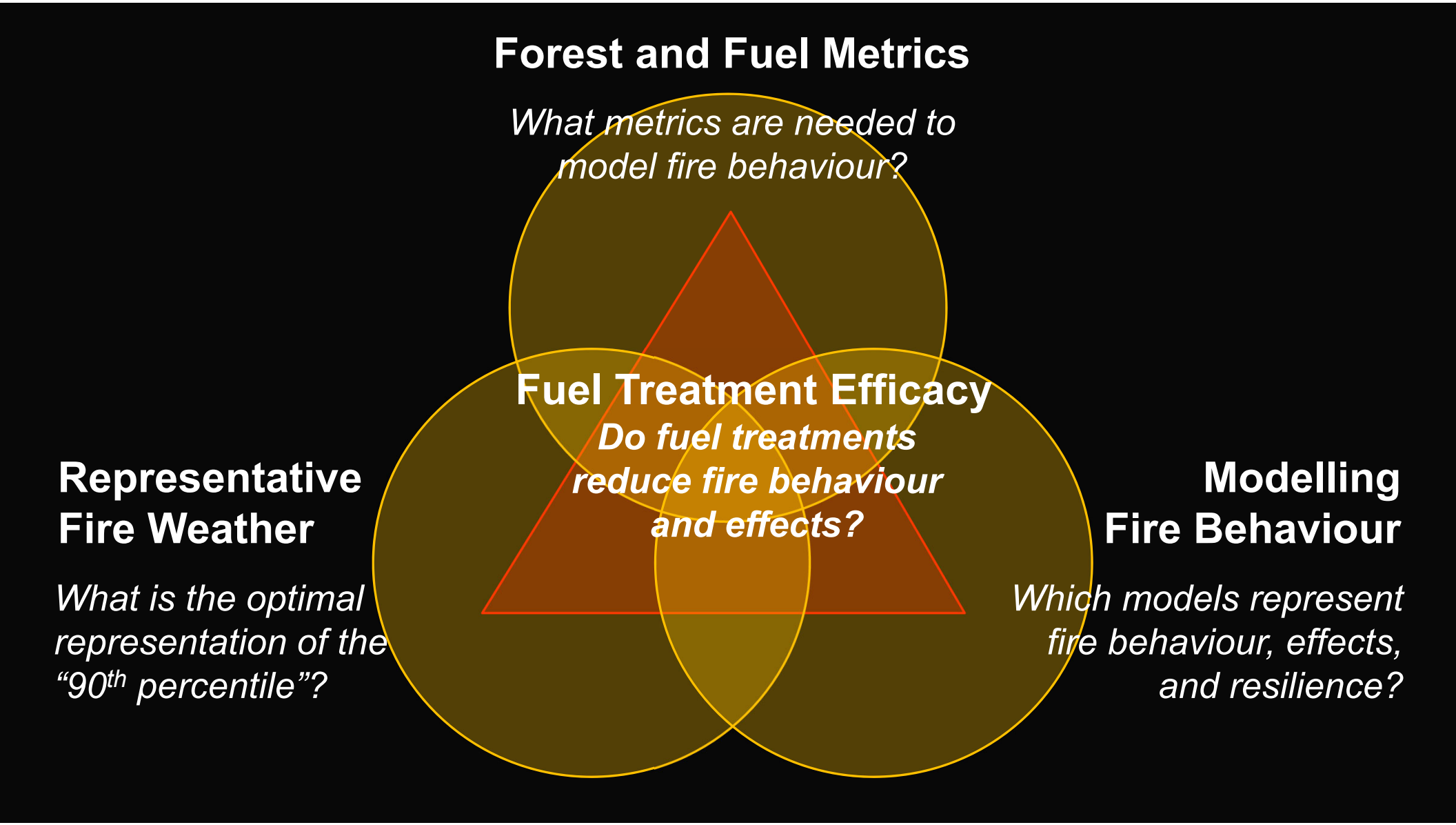
Dr. Lori Daniels, Dr. Greg Greene, Georgina Preston, Kea Rutherford, Jennifer Baron & Jocelyn Laflamme

Forest and Conservation Sciences, UBC-Vancouver & PICS Wildfire and Carbon Project

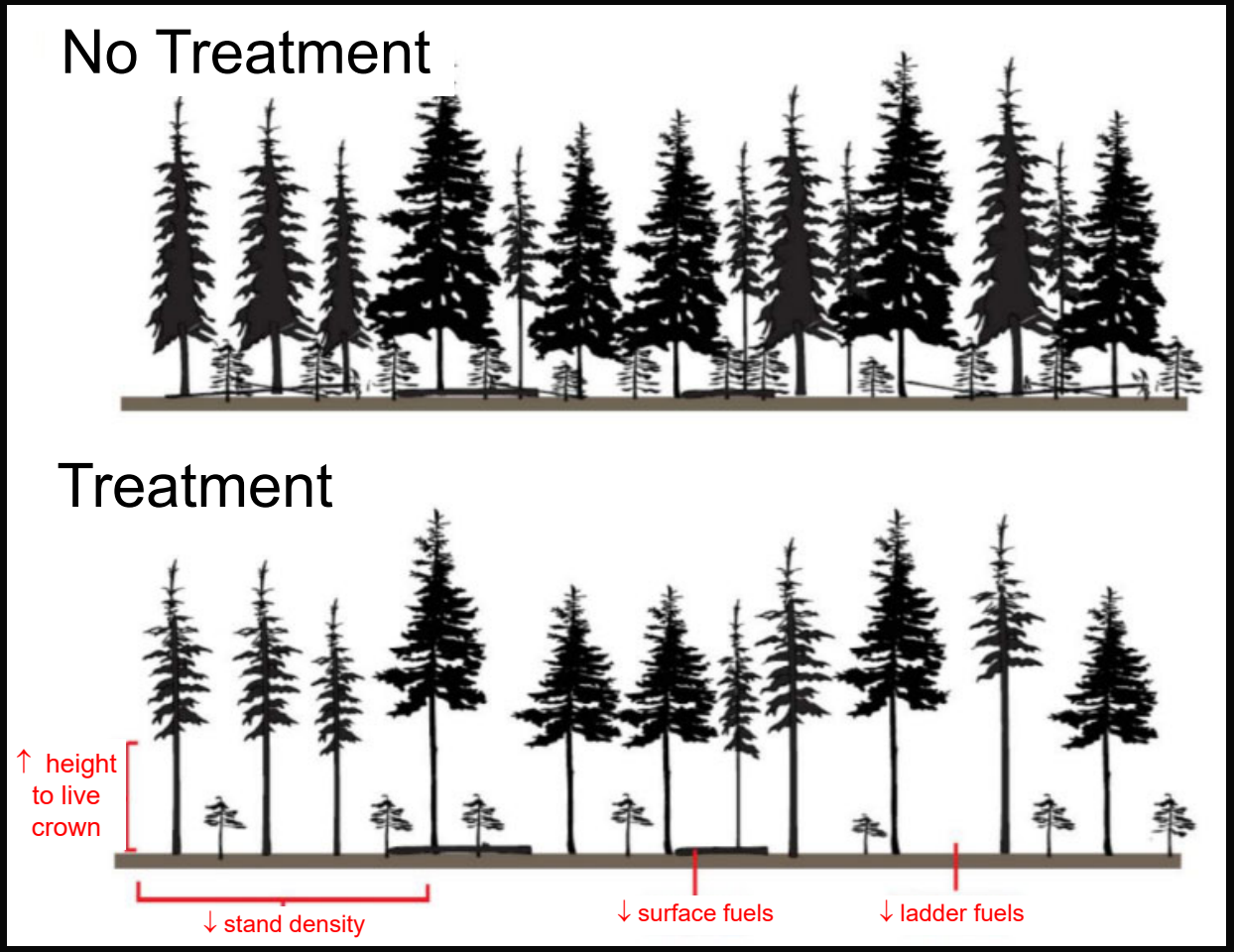
Dr. Kira Hoffman & Dr. Alana Clason

Bulkley Valley Research Centre, Smithers

February 2023


Forest and Fuel Metrics
What metrics are needed to model fire behaviour?
Fuel Treatment Efficacy
Do fuel treatments reduce fire behaviour and effects?
Representative Fire Weather
What is the optimal representation of the "90th percentile"?
Modelling Fire Behaviour
Which models represent fire behaviour, effects, and resilience?

Treatment Goals & Assessing Efficacy



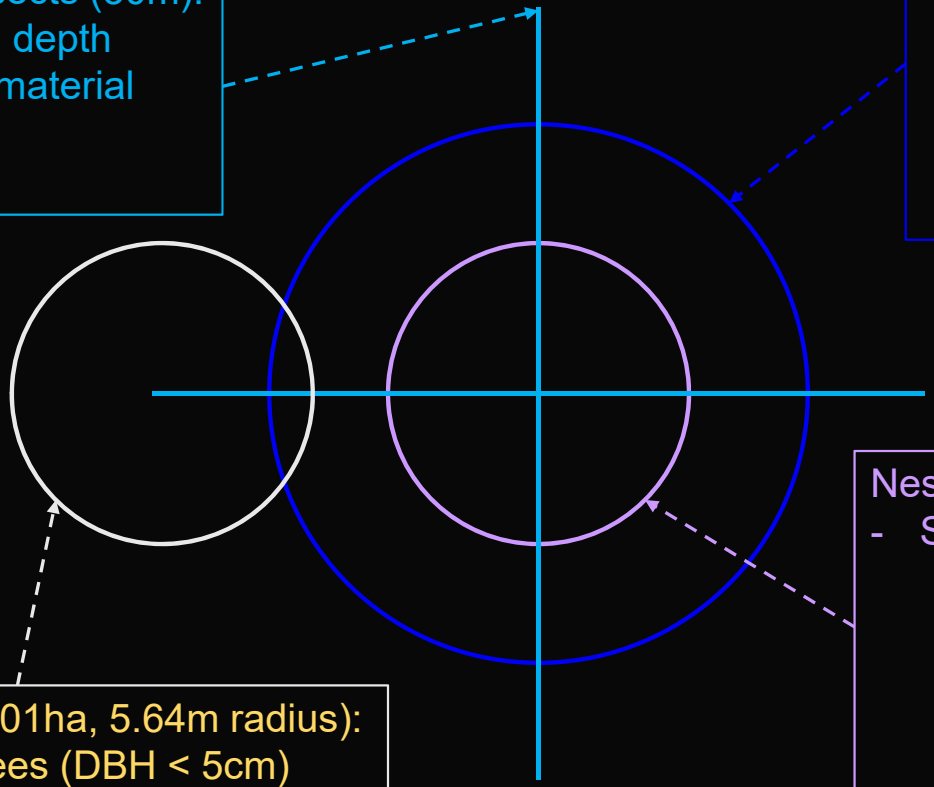
Treatment goals:
- ↓ surface fire intensity
- ↓ active crown fire
- ↑ fire resilience

Fuels mitigation:
- ↓ tree density
- ↑ height to live crown
- ↓ surface fuels

Assessing efficacy:
Field measures +
Fire behaviour models

Field measurements

Perpendicular transects (30m):
- Duff, litter, & fuel depth
- Downed woody material
- Shrubs
- Canopy cover



Large plot (0.04ha, 11.28m radius):
- Large trees (DBH ≥ 12.5 cm)
  - Species
  - DBH
  - Total height
  - Height to live crown base
  - Crown position

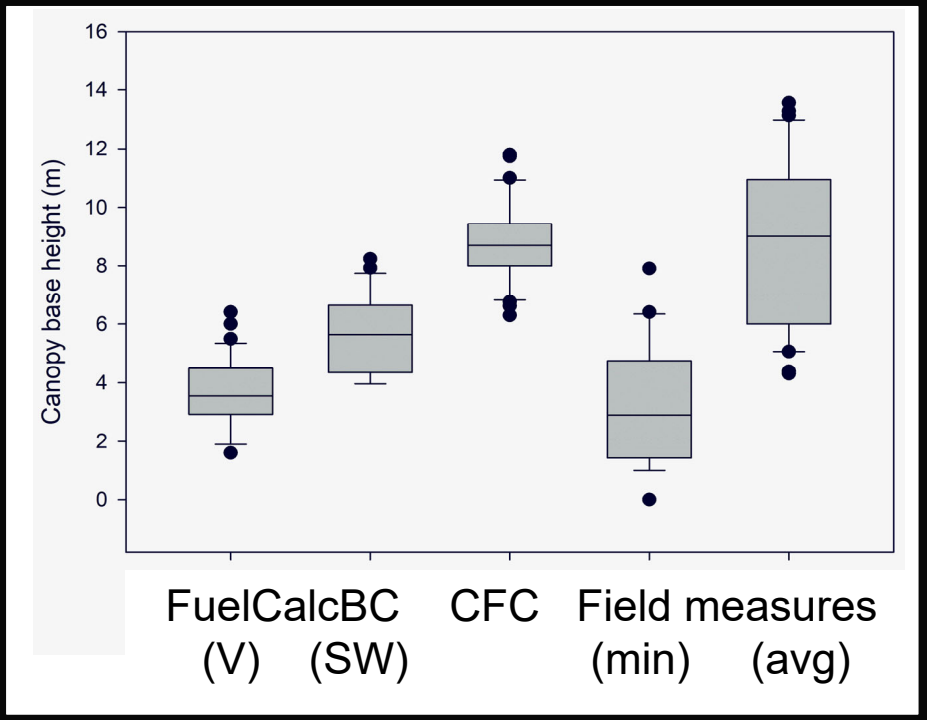
Nested subplot (0.01ha, 5.64m radius):
- Small trees (DBH < 12.5 cm)
  - Species
  - DBH
  - Total height
  - Height to live crown base
  - Crown position

Satellite subplot (0.01ha, 5.64m radius):
- Regenerating trees (DBH < 5cm)
- Plant cover and height

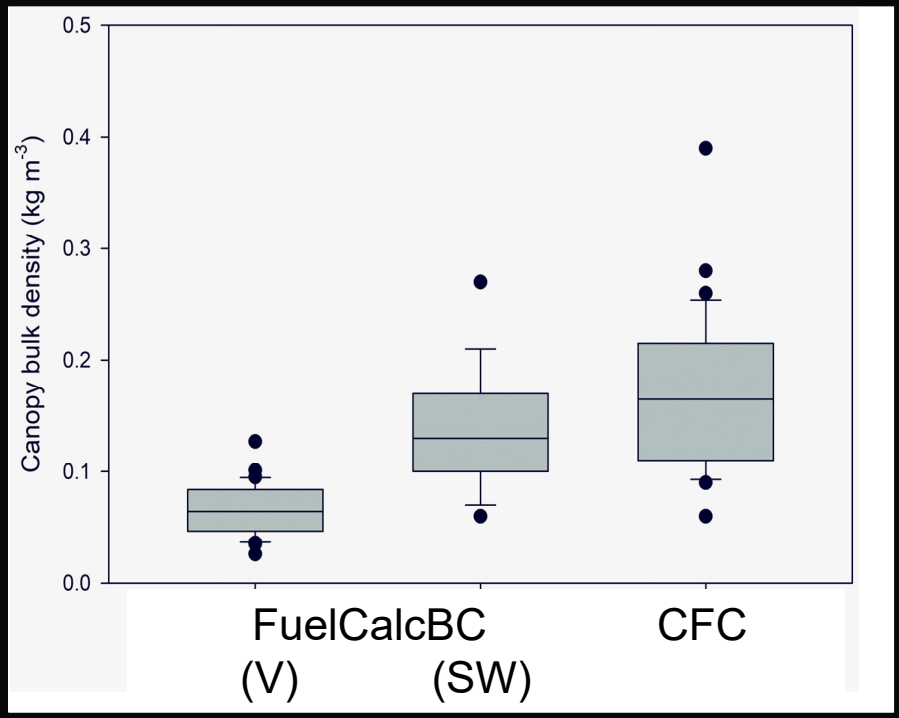
Fuel Metrics

- direct measures, estimate with tools or models

Canopy base height (m)



Canopy bulk density (kg m^3)



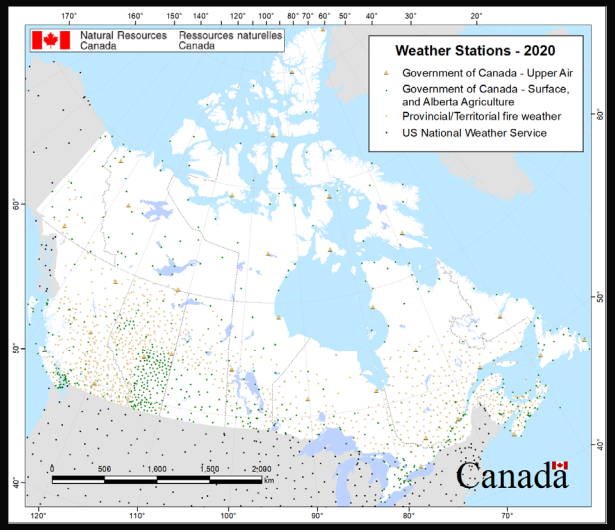
Representative Fire Weather

What is the optimal way to represent the "90th percentile"?

Source of fire weather data?
- ➢ BC stations, NRCan grid

What years are available? reliable? usable?
- ➢ Post 2005

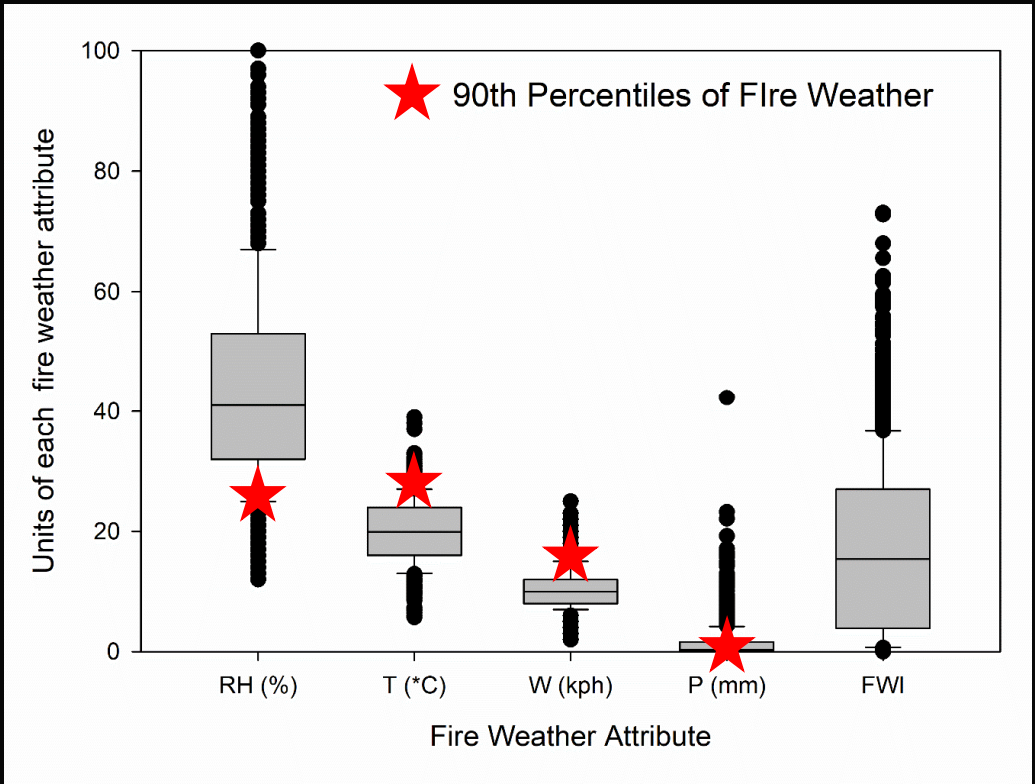
What is the fire season (months + days)?
- ➢ Based on Ecodivisions (e.g. May15–Aug31)



Representative Fire Weather

What is the optimal way to represent the "90th percentile"?

How to derive the 90th percentile?



Standard method:

Calculate 90th (10th) percentiles

90th: T = 25°C, W = 15kph

10th: RH = 27%, P = 0mm

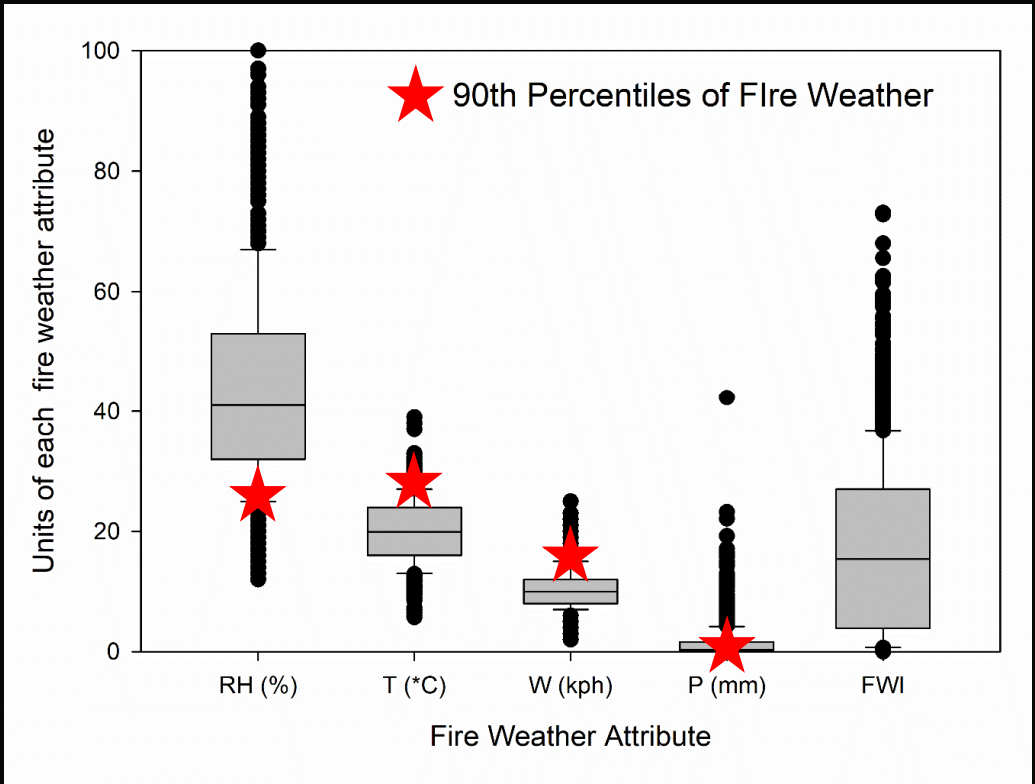
Concern:

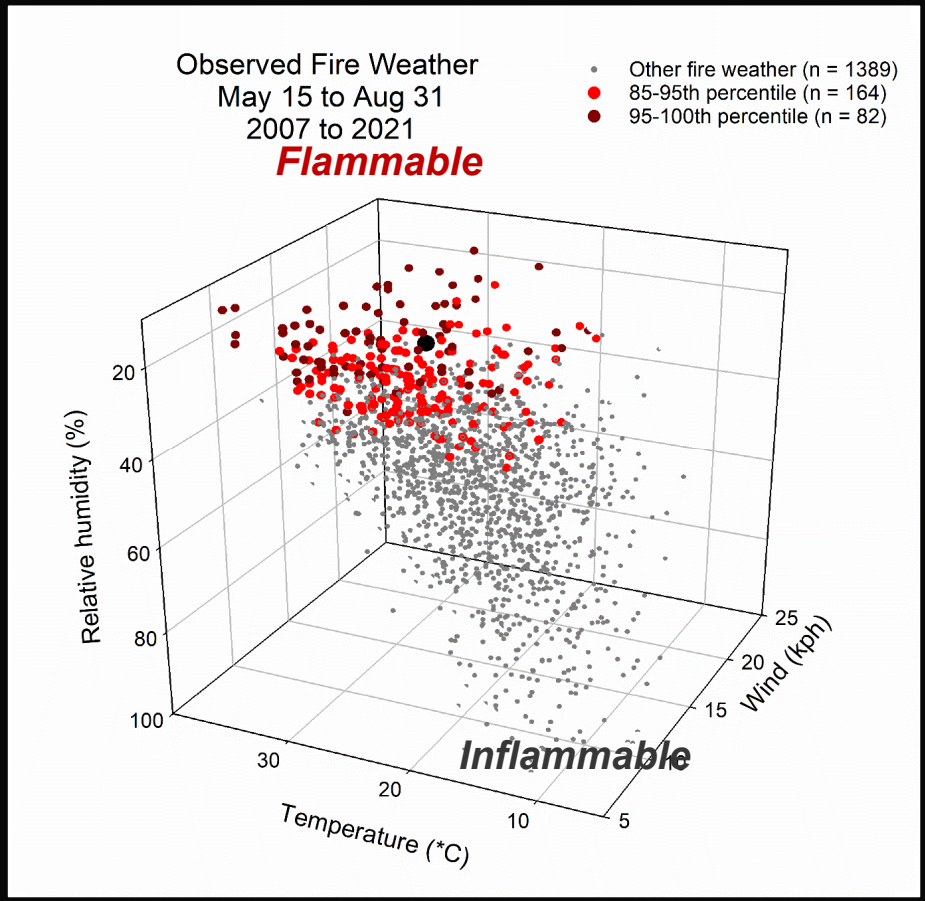
Combination may not exist, resulting indices unrealistic

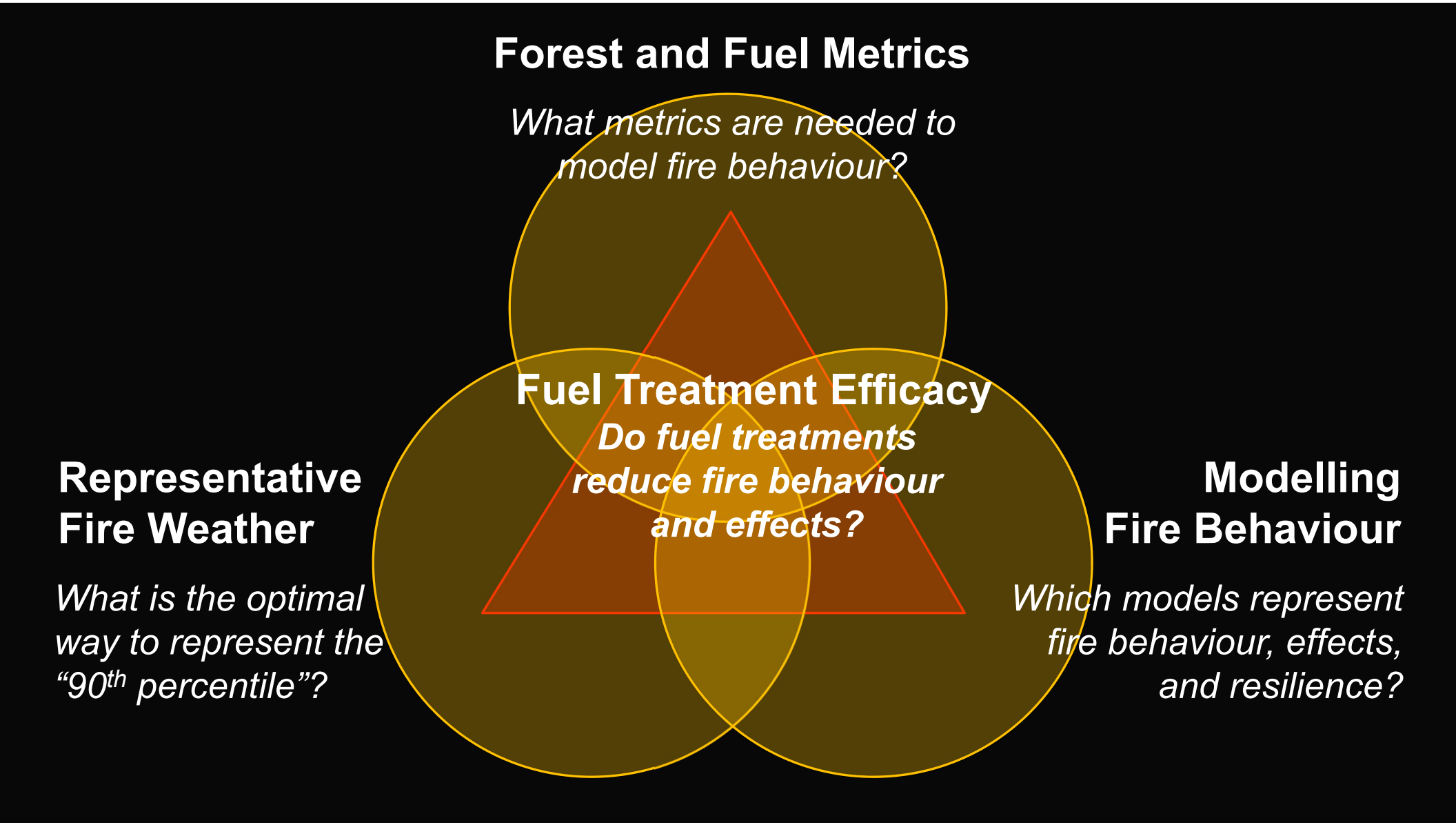
Representative Fire Weather

What is the optimal way to represent the "90th percentile"?

How to derive the 90th percentile?



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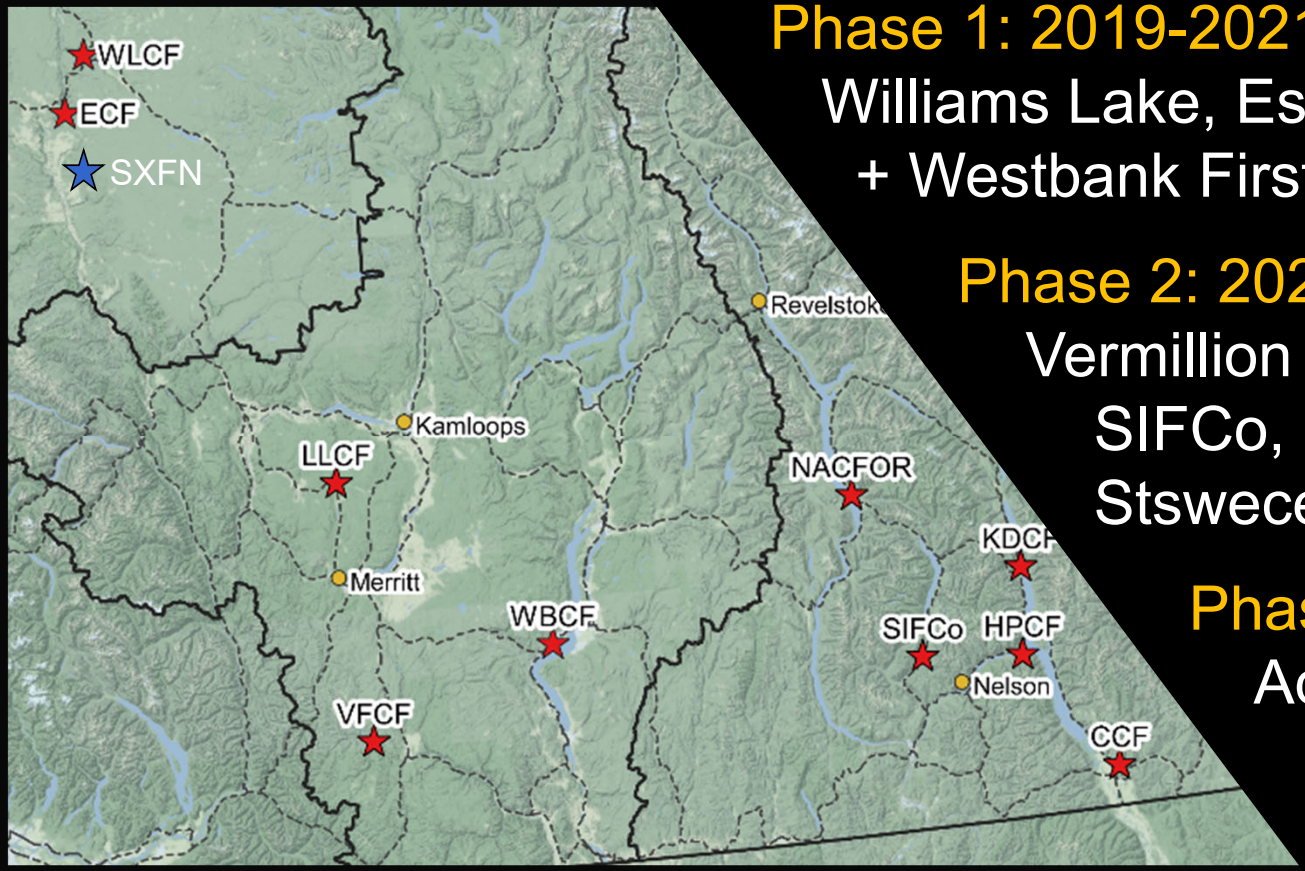
Collaborations: BCWS – BCCFA – UBC – SXFN



Phase 1: 2019-2021

Williams Lake, Esk'etemc, Logan Lake
+ Westbank First Nation CFs

Phase 2: 2021-2022

Vermillion Forks, Nakusp, Kaslo,
SIFCo, Harrop-Procter + Creston,
Stswecem'c Xget'tem First Nation

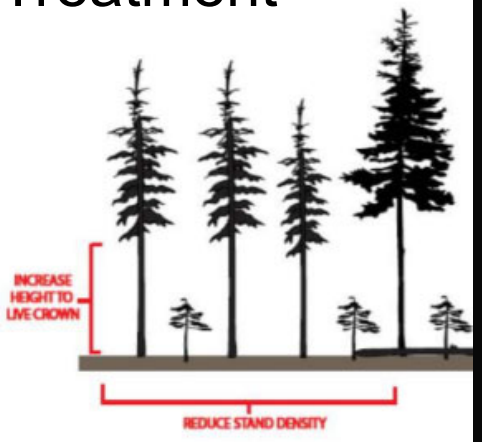
Phase 3: 2023+

Additional Communities
+ WRR Treatments

Assessing Treatment Efficacy: Paired Plots

No Treatment

Treatment



Williams Lake

Logan Lake

Westbank FN

Assessing Treatments: Fire Behaviour Modelling

Topography
- location
- elevation
- slope aspect
- slope angle

Weather
- 90th percentile
- 2007-2021
- T, RH, Rain
- Wind Ninja

Fuels
- stand density, BA, canopy cover, CBH
  - calculate canopy bulk density
- surface wood (<7cm), FF + duff
- grass fuel loads (O1 types)

Surface Fire Intensity Calculator
- calculated vs critical values

Fire Behaviour Prediction System
- surface fuel consumption

Crown Fire Initiation and Spread
- type of fire
- probability of crown fire

Fire Types Predicted by Different Models (n = 178)

Model	Predicted Fire Type	SFI: Crown fire	SFI: Surface fire
FBP	Crown fire	28	9
	Surface fire	39	102
CFIS	Crown fire	34	26
	Surface fire	33	85

73% Agreement
SFI overpredicted crown fire

67% Agreement
both overpredicted crown fire

62% Agreement, both overpredicted surface fire

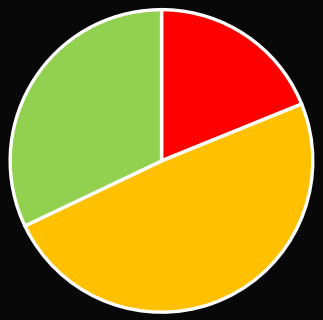
Model	Predicted Fire Type	FBP: Continuous crown	FBP: Intermittent crown	FBP: Surface
CFIS	Active crown fire	0	1	10
	Passive crown fire	4	12	33
	Surface fire	4	16	98

Treatment Efficacy: Fire Behaviour Modelling

CFIS + FBP @ 90th percentile fire weather:

No Treatment

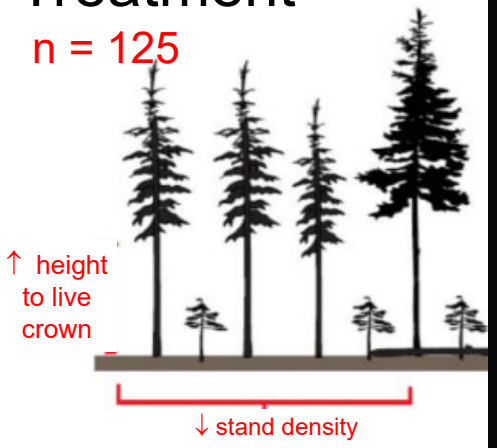
n = 53

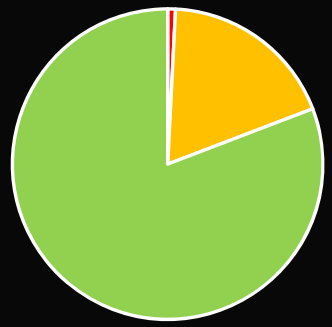


19%	Active crown	29.9 m min^{-1}
49%	Passive crown	13.8 m min^{-1}
32%	Surface fire	3.4 m min^{-1}

Treatment

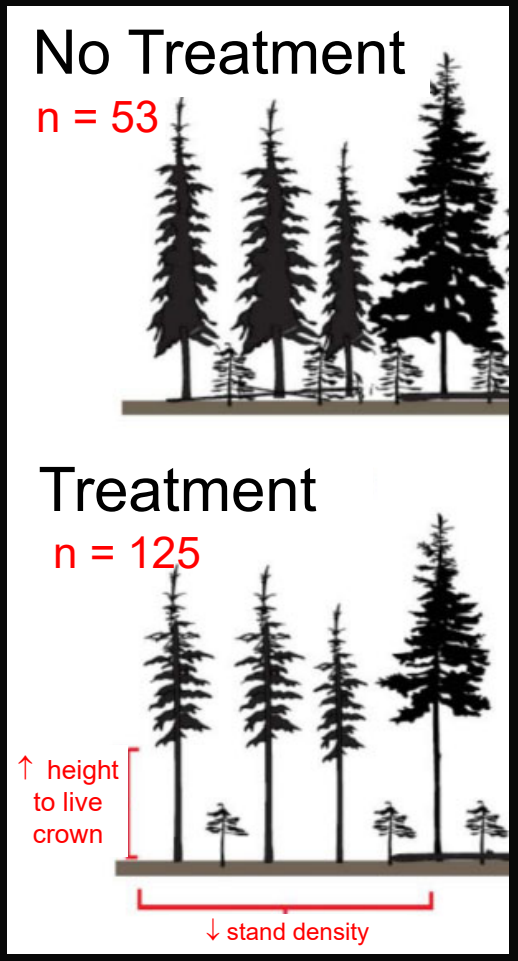
n = 125



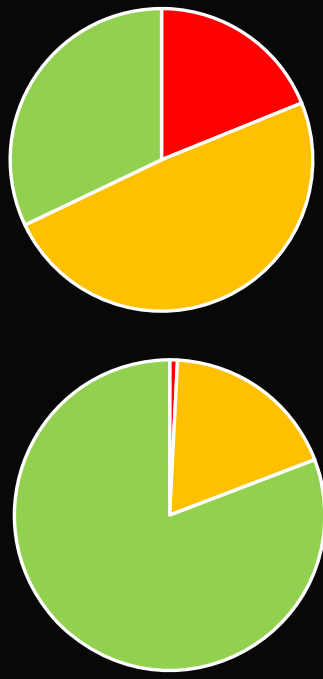


1%	Active crown	32.0 m min^{-1}
18%	Passive crown	13.4 m min^{-1}
81%	Surface fire	8.1 m min^{-1}

Treatment Efficacy: Fire Behaviour Modelling



CFIS + FBP @ 90th percentile fire weather:



Active Crown	Passive Crown	Surface Fire	
240	130	200	Canopy (ha^{-1})
1170	410	770	Subcanopy (ha^{-1})
0.17	0.16	0.14	CBD (kg/m^3)
6.4	5.0	9.0	CBH (m)
700	100	170	Canopy (ha^{-1})
300	240	270	Subcanopy (ha^{-1})
0.10	0.06	0.09	CBD (kg/m^3)
7.3	5.6	10.0	CBH (m)

With treatment, subcanopy tree density decreases, and CBH increases, shift toward surface fire.

Case Studies on Fuels Treatment Efficacy

Daniels

Dry Forests – Williams Lake, Esk'etemc, Logan Lake and Westbank FN Community Forests

Preston

Dry Forests – SXFN Dog and Canoe Creek WUI

Rutherford

Kootenay Mix – Creston, Harrop Proctor, Kaslo, Nakusp and Slocan Community Forests

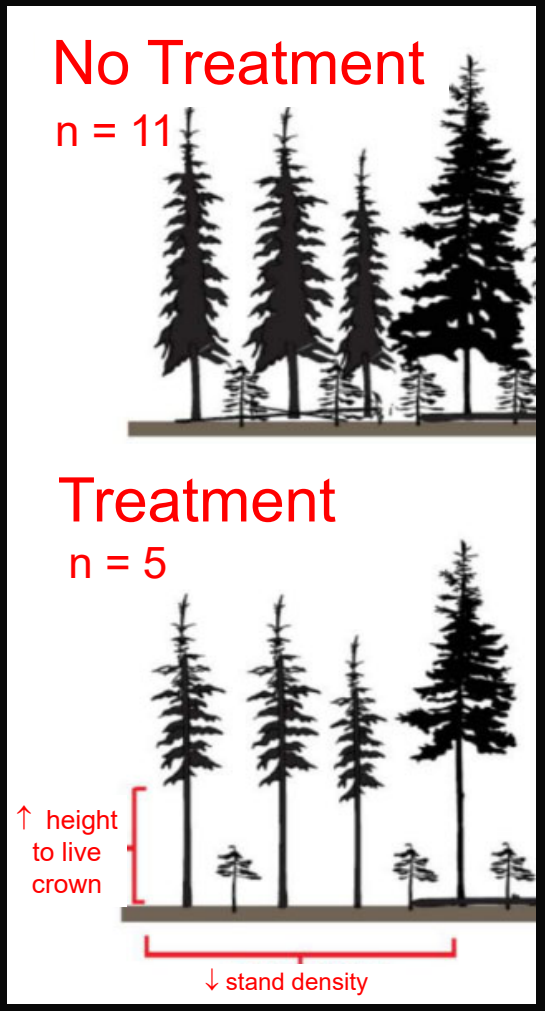
Fuels Mitigation: Are treatments working?

Efficacy: Will a treatment work?

Effectiveness: *Did treatments work when challenged by wildfire?*

(Tremont Creek Fire in Logan Lake, BC, 2021 Source: Garnett Mierau)

Logan Lake: Treatment Effectiveness



Actual > predicted (planned ignition)

76% mortality of 286 trees
94% crown scorch
90% ground scorch to mineral soil (n = 9) = 212 surface impact

Actual < predicted (suppression)

18% mortality of 95 trees
13% crown scorch
73% ground scorch with FF+duff intact (n = 4) = 93 surface impact

To expand research on effectiveness requires:

- Location, year and type of fuel treatments
- Overlay of wildfire occurrence

To reduce wildfire size and severity requires:

- Change at landscape scales and more “good” fire

Take Home Messages

- Treatments are effective for reducing aerial + surface fuels
- Support for proactive fuel treatments and management of dry forests toward resilience

- Fire behaviour modelling indicates efficacy of treatments, consistent with post-fire observations
- Challenges and limitations of current modelling approaches

Next Steps and Future Collaborations

- Assess efficacy: fuel loads, potential fire behaviour, and indicators of forest resilience to wildfires
- Use models that include mortality functions and indicators
- Expand research and modelling on efficacy (forests, treatments, time) and effectiveness (post-fire)
- Refine field protocols for operational use (e.g., Survey123)

Dr. Greg Greene

Dr. Kelsey Copes-Gerbitz

Dr. Lori Daniels

Dr. Kira Hoffman

Dr. Sarah Dickson-Hoyle

Kate Kitchens
(PhD Candidate)

Arial Eatherton
(MSc Student)

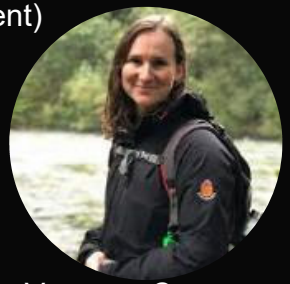
Jen Baron
(PhD Candidate)

Mike Stefanuk
(PhD Student)

Georgina Preston
(MSc Student)

Kea Rutherford
(MSc Student)

Jeremy Greenburg
(MSc Student)



Vanessa Comeau

Dr. Florencia Tiribelli

Gracie Crafts
(MSc Student)

Dr. Alana Clason

Ingrid Farnell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