The Case For Fuel Reduction Treatments to Reduce Wildfire Threat in BC's Forests: Does the Evidence Support The Belief?

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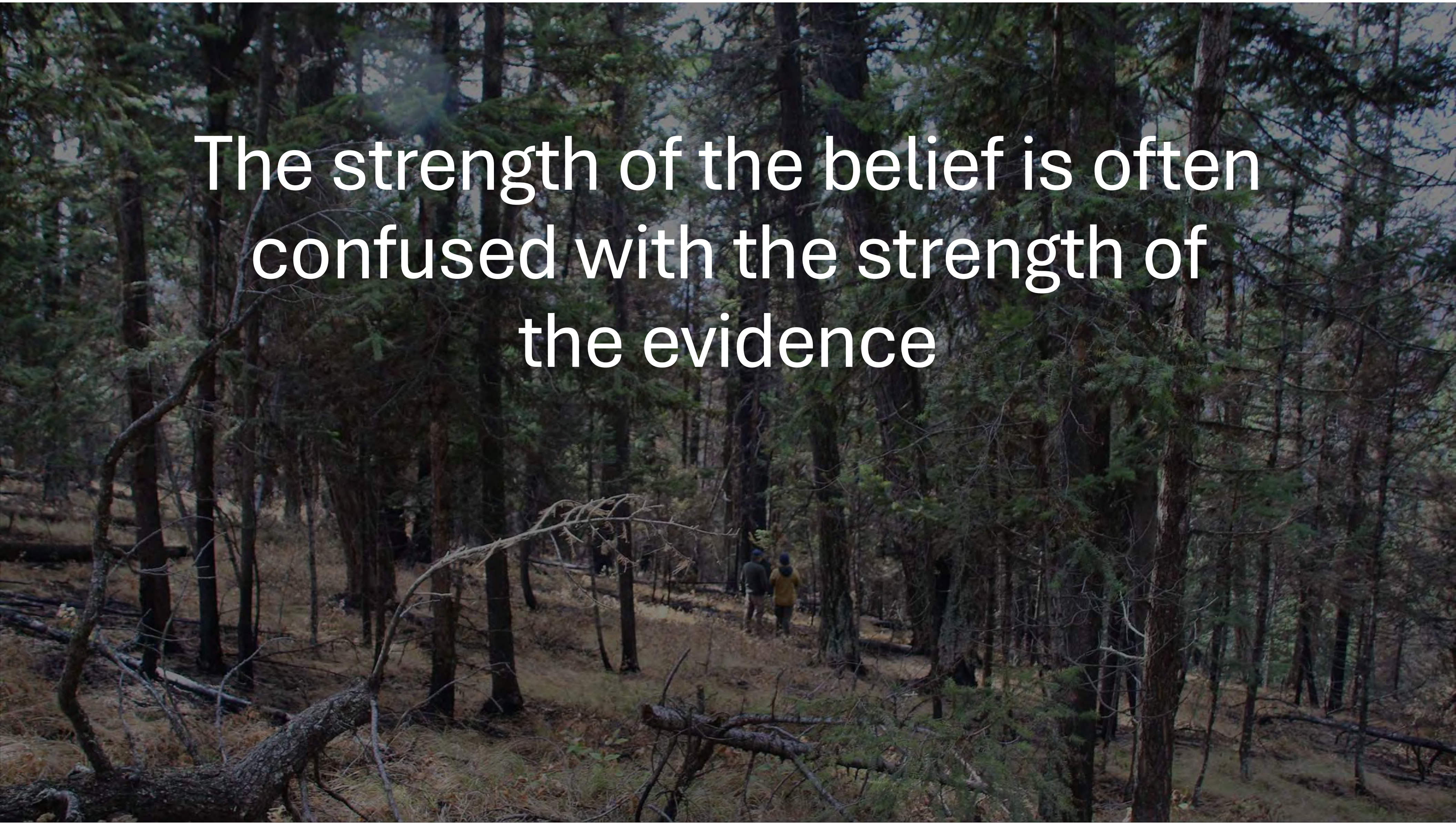
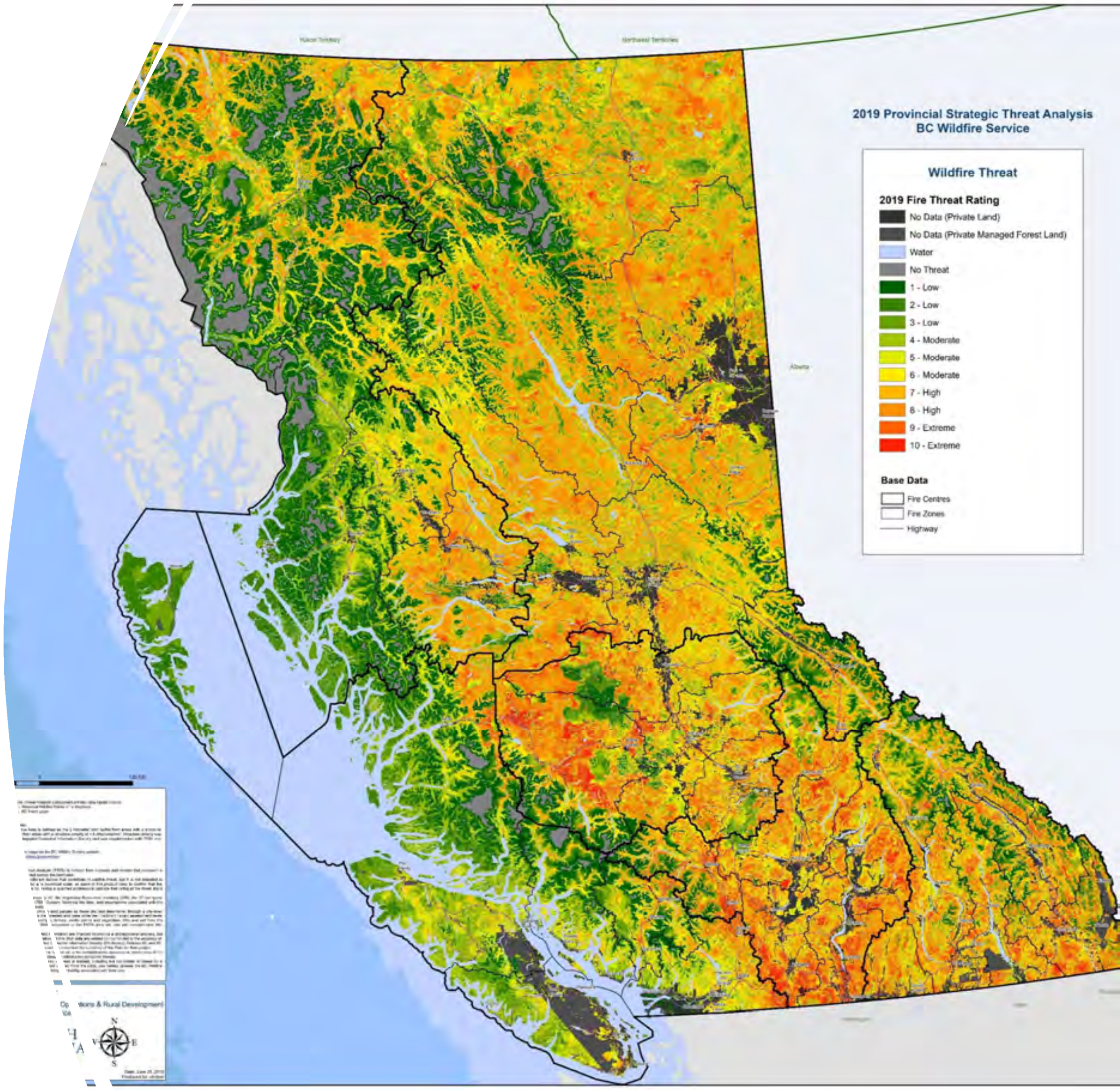
SISCO Winter Worksop – March 2025


The strength of the belief is often confused with the strength of the evidence

So, why am I questioning if the evidence supports the belief?

- Foresters – we believe we can make a difference - mitigate wildfire risk through forest management.
- Public fear about wildfire risk.
- Particularly important as human actions implicated in the cause of the ‘fire deficit’
  - Fire exclusion (wildfire suppression and historic policies)
  - Historic forest management
  - Human-induced climate change



So, why am I questioning if the evidence supports the belief?

- Our beliefs are supported &reinforced by the information we consume:
- BC Forest Practices Board (2023)
  - Requires Landscape fire management to achieve landscape resilience.
- Daniels et al. (2025)
  - Outlies 6 strategies
  - Strategy 3 & 4; Implement landscape fire management to protect communities (wildland urban interface.
- Guidance from BC Forest Professional and BC Wildfire service
  - Implementing fuel management, and
  - Standards for treatments in different fire weather zones.

So, why am I questioning if the evidence supports the belief?

- Prichard et al. (2021) - “there remains confusion in the literature and popular media for the need & efficacy for restorative treatments”
  - Small contingent of scientists that provided counter-evidence and opposing arguments.
  - Partly, viewed as a ‘timber grab” with potential ecological implications - because treatments can involve commercial sale of timber – can be viewed through a lens of conflict.
- Prichard et al. (2021) - “Results in mistrust affect how people perceive the science and it application in support of treatments”
  - Hinder decision-making
  - Weaken public support/raise concerns
  - Leads to a slow pace and small scale of implementation

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Canada's logging industry is seeking a wildfire 'hero' narrative

B.C. and Canadian forestry associations aim to tell a story that places them as the 'hero' in a fight against wildfires. One critic says the strategy is 'mendacious and dangerous.'

Stefan Labbé
Apr 23, 2024 5:00 AM

While its important to believe… need to back it with evidence

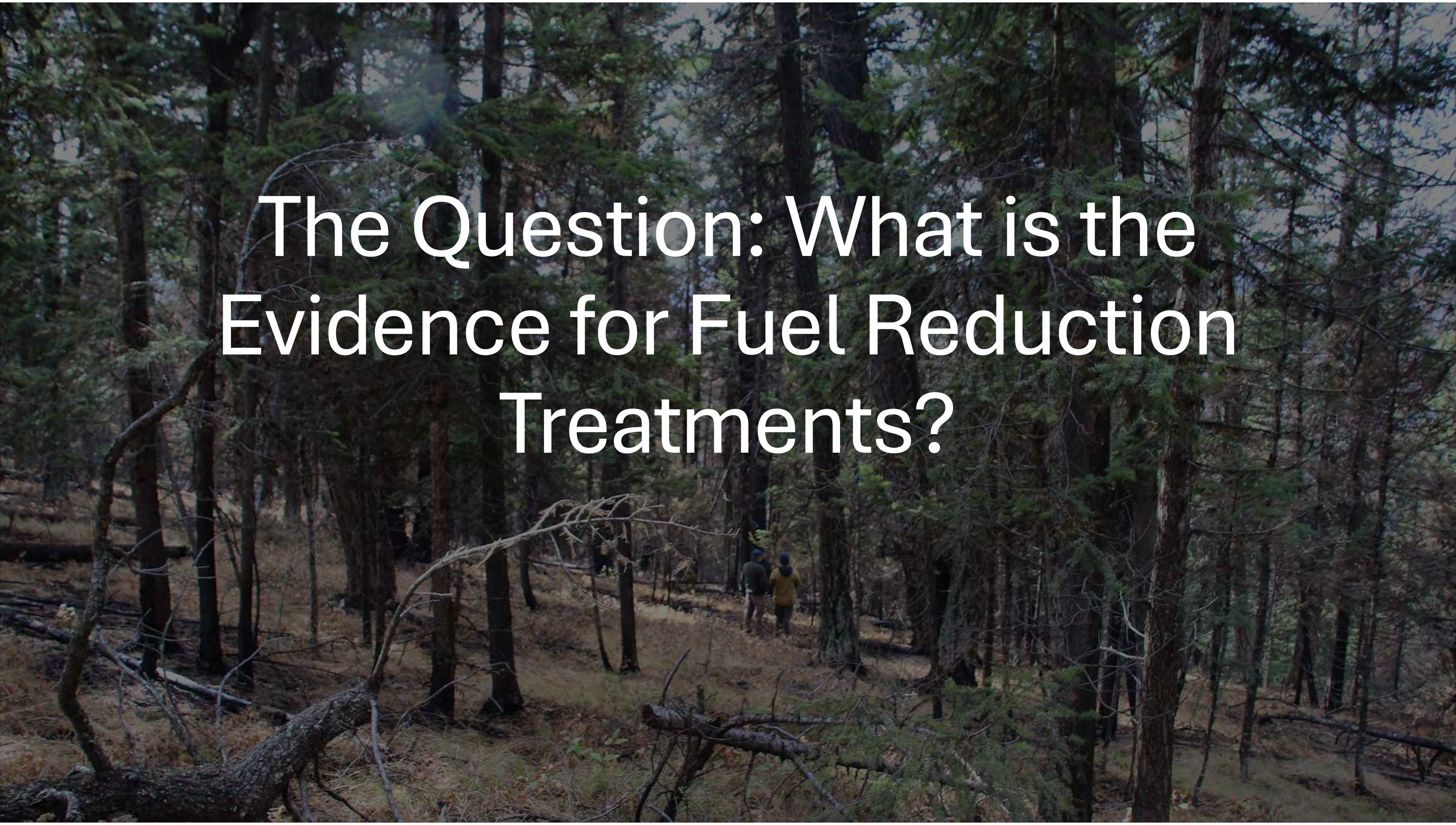
Important that forest professionals can demonstrate:

1) Ecologically appropriate treatments are being applied in the right areas.
2) Gain public trust, and show:
    1) Some certainty that treatments will be effective at mitigating wildfire risk.
    2) Value for $/resources spent.

- In doing so, we can help move forward the appropriate management actions to meet pace and scale of implementation required to met the challenge.

Photo: Forest Enhancement Society website

The Question: What is the Evidence for Fuel Reduction Treatments?



Information Sources Supporting this Discussion

Published literature

- Hessburg et al. 2019. Climate, Environment, and Disturbance History govern resilience of western North American Forests. Frontiers in Ecology and Evolution doi: 10.3389/fevo.2019.00239
- Hessburg et al. 2021. Wildfire and climate change adaptation of western North American forests: a case for intentional management. Ecological Applications, 31(8) e002432
- Hagmann et al. 2021.Evidence for widespread changes in the structure, composition, and fore regimes of western North American forests. Ecological Applications 3198) e02431
- Prichard et al. 2021. Adapting western North American forests to climate change and wildfires: 10 common questions. Ecological Applications 31(8) e02433
- Parks et al. 2018. Analog-based fire regime and vegetation shifts in mountainous regions of the western US. Ecography 41: 910-921,2018 doi:10.1111/ecog.033378

ArcGIS Storymap

- Adapting Western US Forests to Climate Change & Wildfires:https://storymaps.arcgis.com/stories/64f55848f690452da6c58e5a888ff283

Fuel Reduction Treatments

- Fuel Reduction Treatments – Stand-Level interventions that include:
  - **Forest thinning** – reducing canopy bulk density and ladder fuels
  - **Prescribed burning or biomass removal** to reduce surface fuels, including logging slash from thinning event or prior fuel accumulations
- The goal is not to stop the spread and size of wildfires, but reduce wildfire severity – lower flame lengths, surface fire intensity and spread, and a reduction in crown fire potential

Prichard et. al. (2021)

Photo source: ArcGIS Storymap – Adapting Western US Forests to Climate Change & Wildfire

Evidence **For** Fuel Reduction Treatments

Prichard et al (2021) – Question .3 - Can thinning and prescribed burning solve the problem (mitigate wildfire hazard)?

- Thinning alone – “the capacity to mitigate wildfire hazard and severity through thinning alone is not well supported in scientific literature”

(Prichard et al. 2021)

- Without surface fuel reduction & If trees not removed from site – just re-distributes fuels.
- However…some studies show thinning alone can mitigate wildfire severity.
- Reduces ladder fuels and canopy bulk density , which reduces the potential for both passive and active crown fire behaviour.

(Prichard et al. 2021)

In some cases, thinning without prescribed fire is just a rearrangement of fuels and may even increase fire severity. This unit in eastern Washington was mechanically thinned without the use of prescribed fire in 2019, then burned with 100% tree mortality in the 2021 Cedar Creek Fire. Source: Susan Prichard.

Evidence **For** Fuel Reduction Treatments

- "Fuel treatments that modify within-stand structure to remove small trees and surface fuels, while retaining large, more fire-resistant trees and variable stand structure …most appropriate in dry pine, dry to moist mixed conifer forest and oak woodlands.."
- "Across a wide range of sites, widespread agreement that thinning and prescribed burn most effective."

Pritchard et al. (2021)

Evidence **Against** Fuel Reduction Treatments

- Prichard et al . (2021) – “not appropriate for all forest conditions and forest types “

In some mesic forests, mechanical treatments may increase risk of fire

- increase sunlight exposure,
- dry surface fuels,
- increase understory growth and
- increase wind speeds

Evidence **Against** Fuel Reduction Treatments

- Prichard et al. (2021) - Subalpine, sub-boreal and boreal forests - fire regimes in these forests, dominated by moderate and high severity fires and,
- “Application of forest thinning and prescribed fire are generally inappropriate”
- Wildfire severity most affected by:
    - Pre-fire stand structure & previous fires that reduced the size of subsequent fires, and
    - Burned areas <40 years less likely to burn again

The controversy continues....

- Millikin et al. (2024) argued that thinning treatments in the wet coastal forests around Whistler, BC and found:
    - Increased sunlight, snowmelt & windspeed and lower relative humidity in thinned stand – mainly in spring
    - Increases the length of season exposed to increased wildfire risk
- Bruce Blackwell quoted in article as arguing against this approach – stating in 90th percentile conditions – forests will burn – so we need to manage fuels to lower fire intensity near communities
- Phil Burton – retired professor UNBC – suggested the need to look at different approaches.

Cheakamus Community Forest will test out divisive Whistler ecologist's wildfire approach

Rhonda Millikin, issued a cease-and-desist in December from Forest Professionals B.C., says green fuel breaks will be part of pilot study in community forest

Brandon Barrett
Feb 6, 2025 7:45 AM

Ecologist Rhonda Millikin conducting field research in Whistler in 2021. | Photo courtesy of Rhonda

What Does the Evidence Suggest?

Forest types and climatic factors driving forest conditions and wildfire regimes provide a useful framework for where stand-level fuel reduction treatments are appropriate

Seasonally Dry Forests

- Ponderosa pine , Douglas fir, oak woodlands

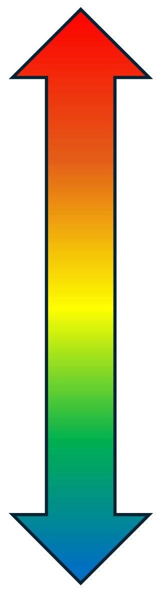
Moist (Mesic) Forests

- Mixed forests – Douglas fir , western red cedar, western hemlock

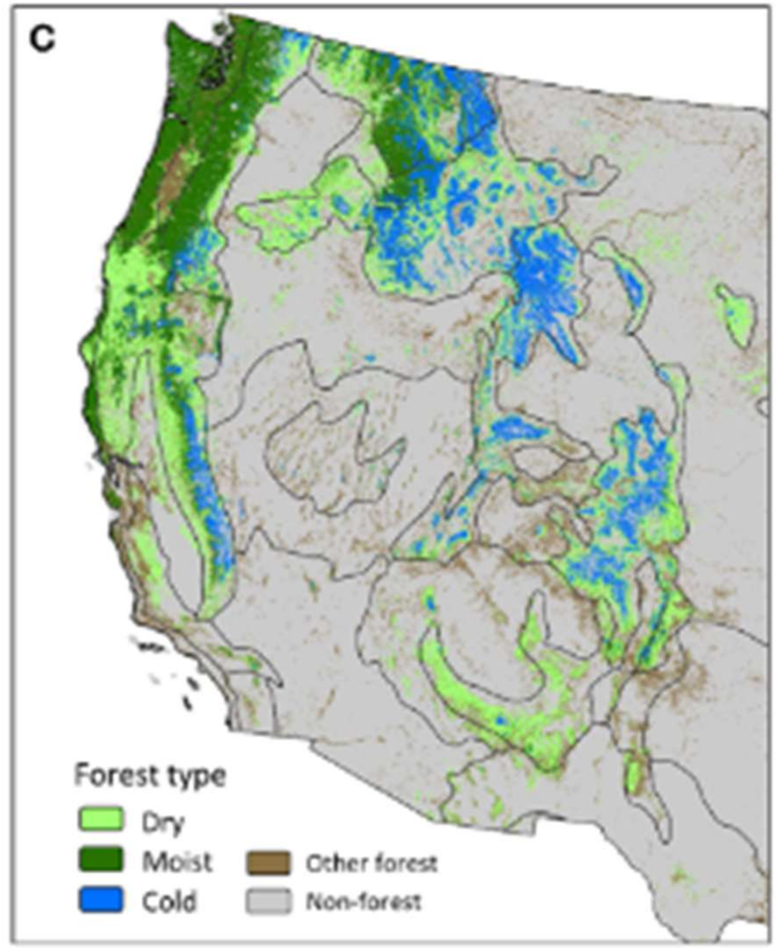
Cold Forests

- Subalpine, sub boreal and boreal
- Lodgepole pine, subalpine fir, spruce dominated stands

Fuel-Limited



Energy (Climate) -Limited



Fuel Limited Vs. Energy Limited

Fuel-Limited

- Exist at the low end of productivity gradient
- Warm-dry climates contribute to area burned indirectly
- Sparse understory vegetation and low tree density can limit surface fuels, fire spread, and flame lengths – difficult to initiate and spread crownfire.
- Fire exclusion allows fuel to build up resulting in more sever wildfire activity.

Energy (Climate)-Limited Forests

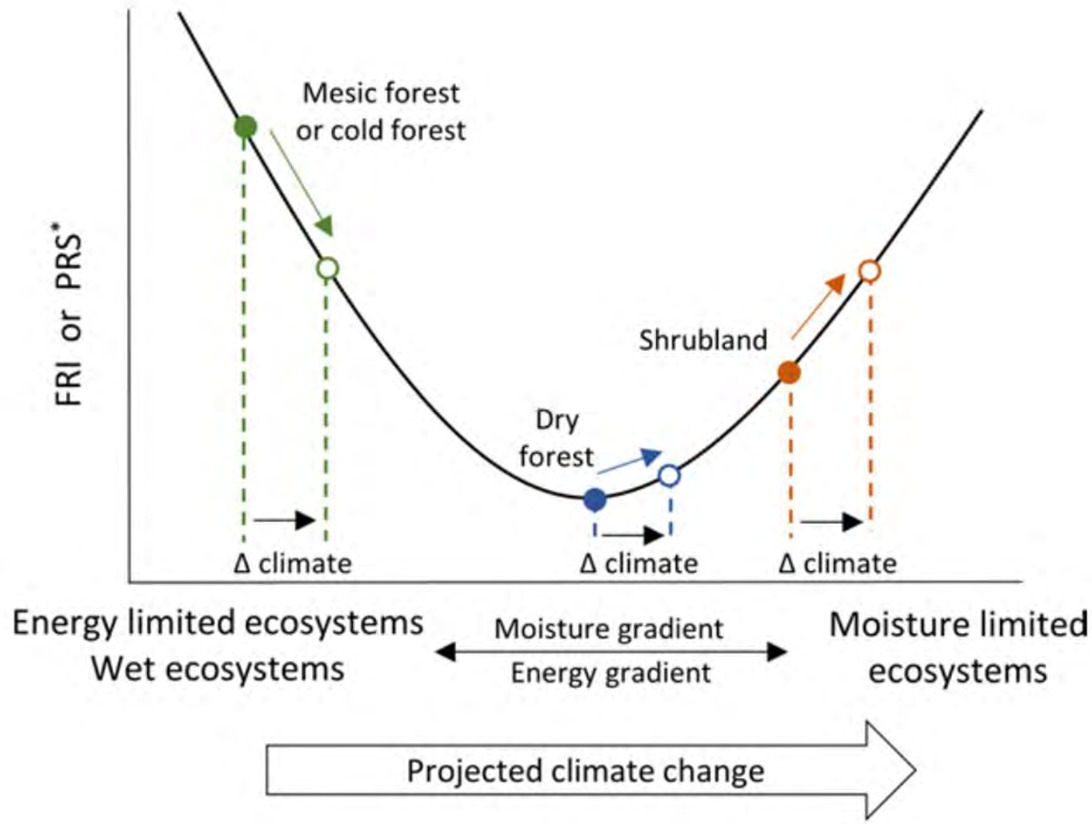
- Weather and atmospheric conditions seldom dry enough for combustion to occur
- Wildfire activity is directly climate-limited through occasional droughts that dry out naturally dense and moist vegetation
- Biomass accumulates over decades to centuries
- Infrequent, more severe wildfires occur

Hessburg et al. (2019)

A Conceptual Model – How the Energy/Moisture Gradient Affects Wildfire Regimes

- Attributes of the fire regime display a 'U-shaped' pattern along a moisture and energy gradient.
- Projected climate change will increase moisture deficits.
- Mesic & Cold forests- wildfires more frequent as moisture deficits increase.
- Dry Forests – less productive and less frequent wildfire fires.

Parks et al. 2018. Analog-based fire regime and vegetation shifts in mountainous regions of the western US. Ecography 41: 910-921,2018 doi:10.1111/ecog.033378



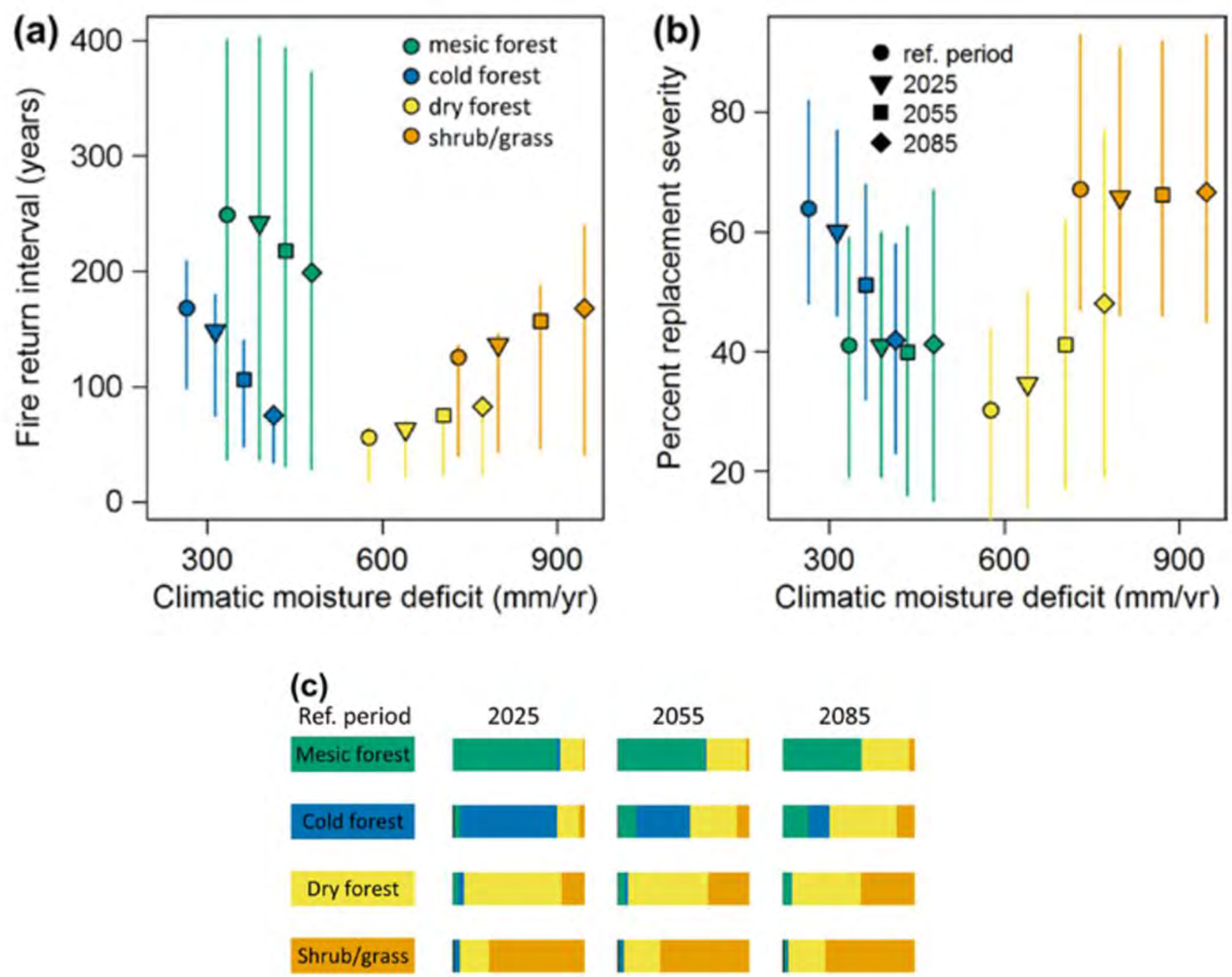
*Fire Return Interval (FRI)- years between fire at a particular point .

*Percent Replacement Severity (PRS` >75% tree mortality)

Changes in Fires Regimes with Climate in Western US Forests

- Modelled results from Western US forests illustrate this.
- Cold and mesic forests- increased fire frequency.
- Dry forests – less frequent, more severe fires.
- CMD of 500-625mm/yr lower limit of forests (Stephenson 1990) – shift to more open, dry forest and shrubland/grasslands.

Parks et al. 2018. Analog-based fire regime and vegetation shifts in mountainous regions of the western US. Ecography 41: 910-921,2018 doi:10.1111/ecog.033378



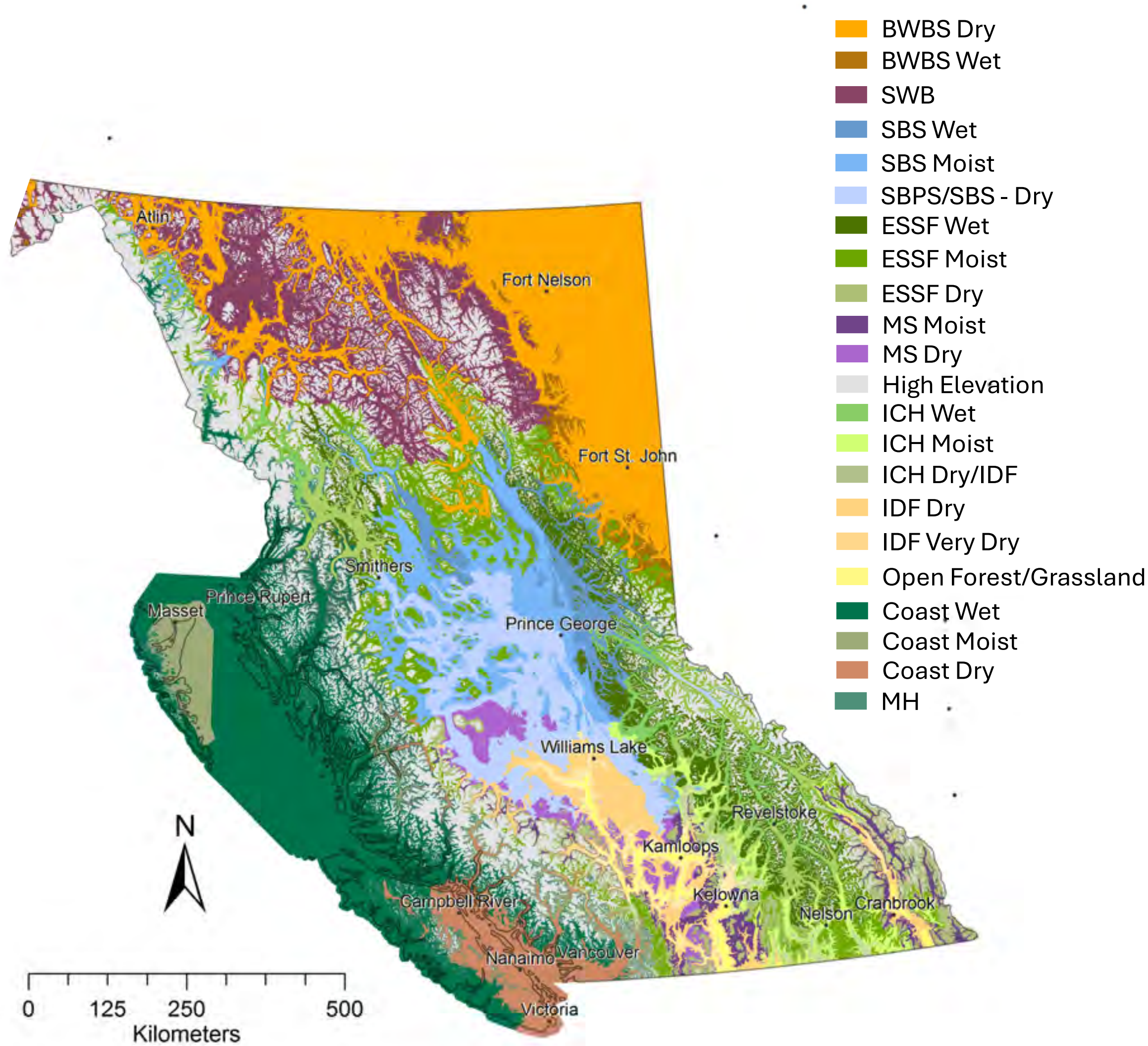
The British Columbia Context

Describing Forest Types, Energy- Fuel Limitation in Forests, and Climatic Moisture Gradients in BC

Mapping out BEC Groups

- 213 BGC subzone variants grouped into 23 groups based on relatively similar:
  - Climate
  - Disturbance processes (NDT)

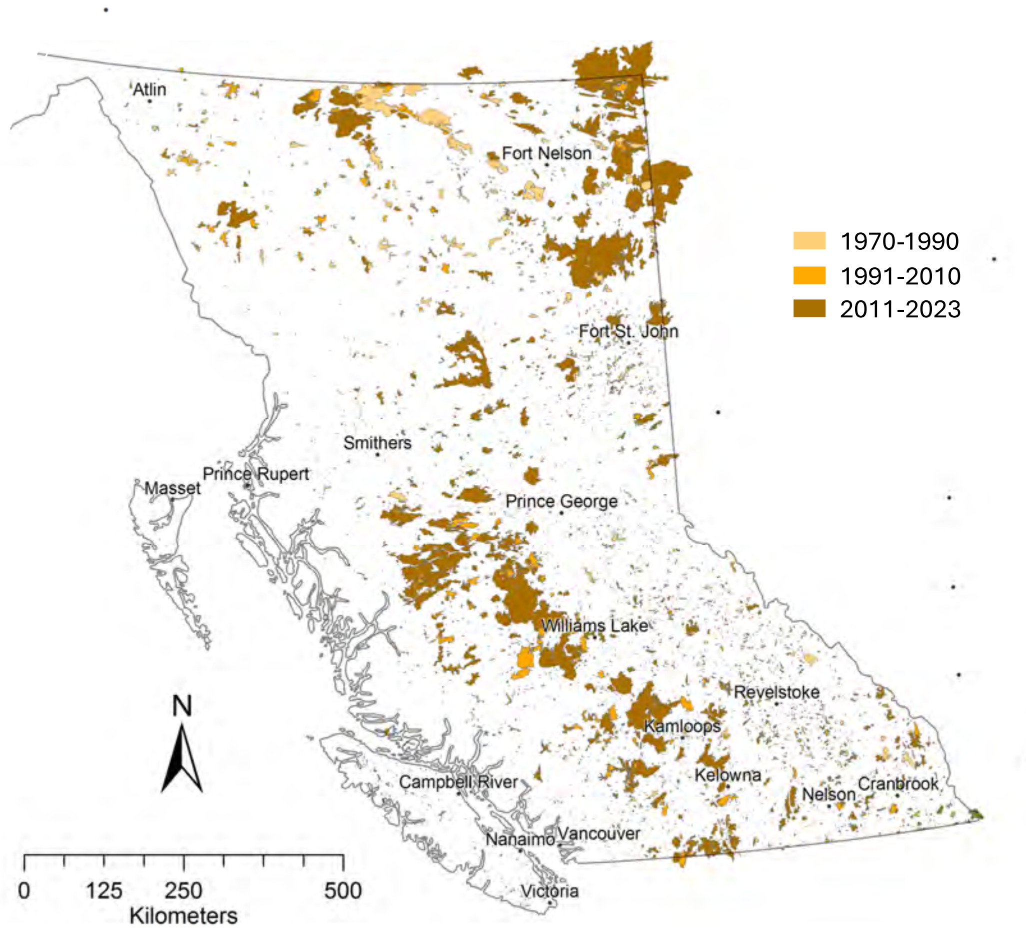
- Example
  - ESSF Wet
  - ESSF Moist
  - ESSF Dry



Wildfires 1970-2023

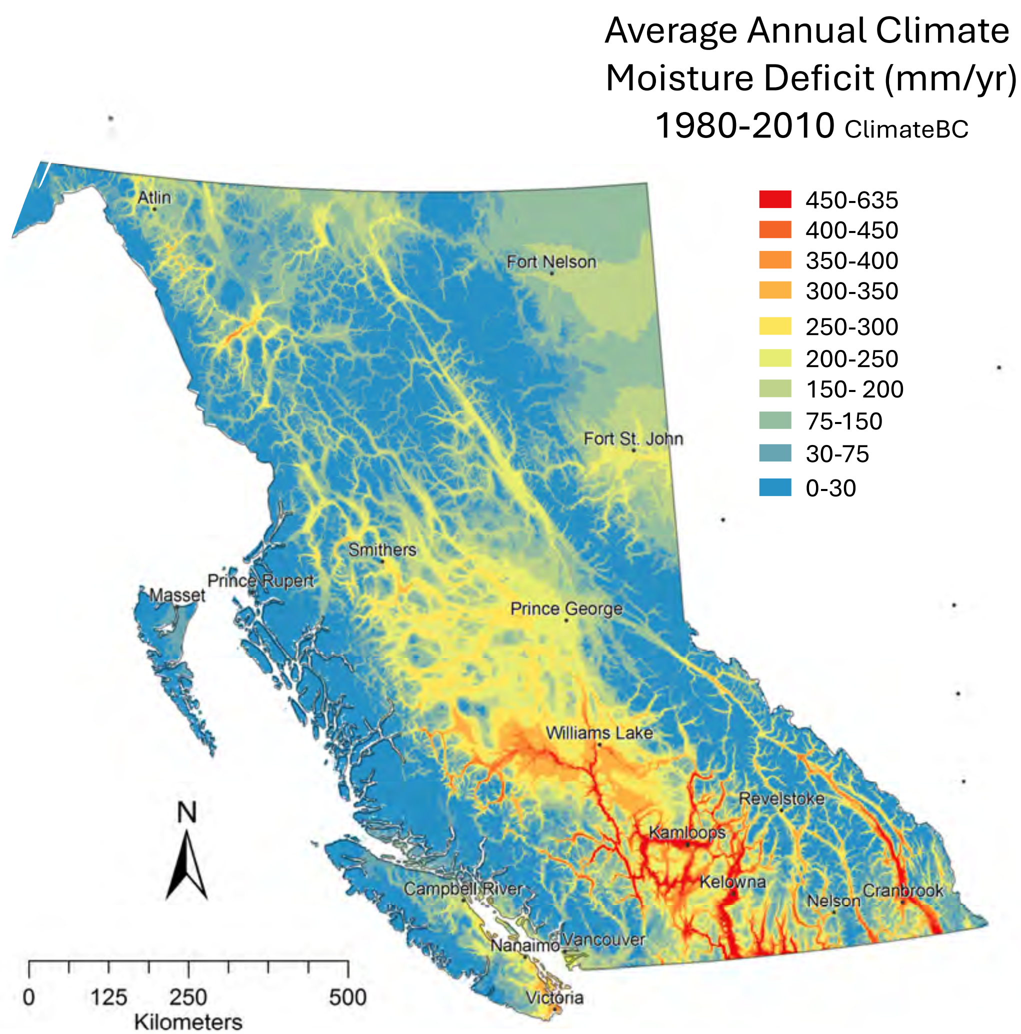
- Used BC Wildfire Service Historic Wildfire Perimeter data from 1970-2023
- Restricted to >1970 as research has suggested fires prior to 1950-60's likely not well documented- particularly in Northern BC
- Calculated burn rate – Percent of each BEC Goup area burned annually
- Calculated area-based* Fire Return Interval (FRI) for each BEC Group

* area-based FRI= Number of years required to burn an area equal to the area of interest.



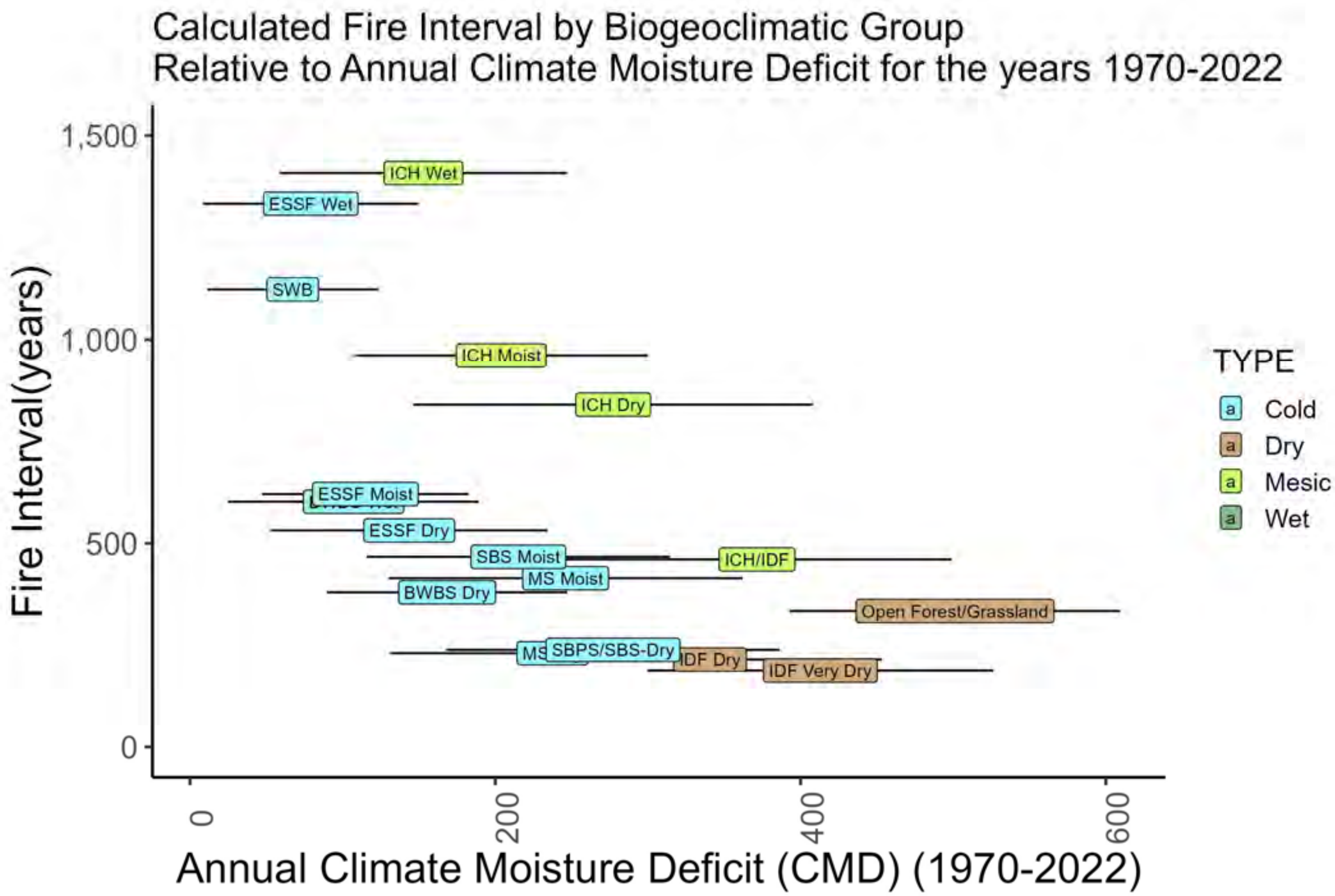
CMD from Climate BC

- Compiled annual climate moisture deficit (CMD) for each year from 1970-2022.
- Summarized to get average and range by BEC Group for the same period.
- Allows comparisons for relationship between FRI over entire period or area burned annually and CMD for each year or averaged over entire period.



Relationship between FRI and Climate Moisture Deficit in BC

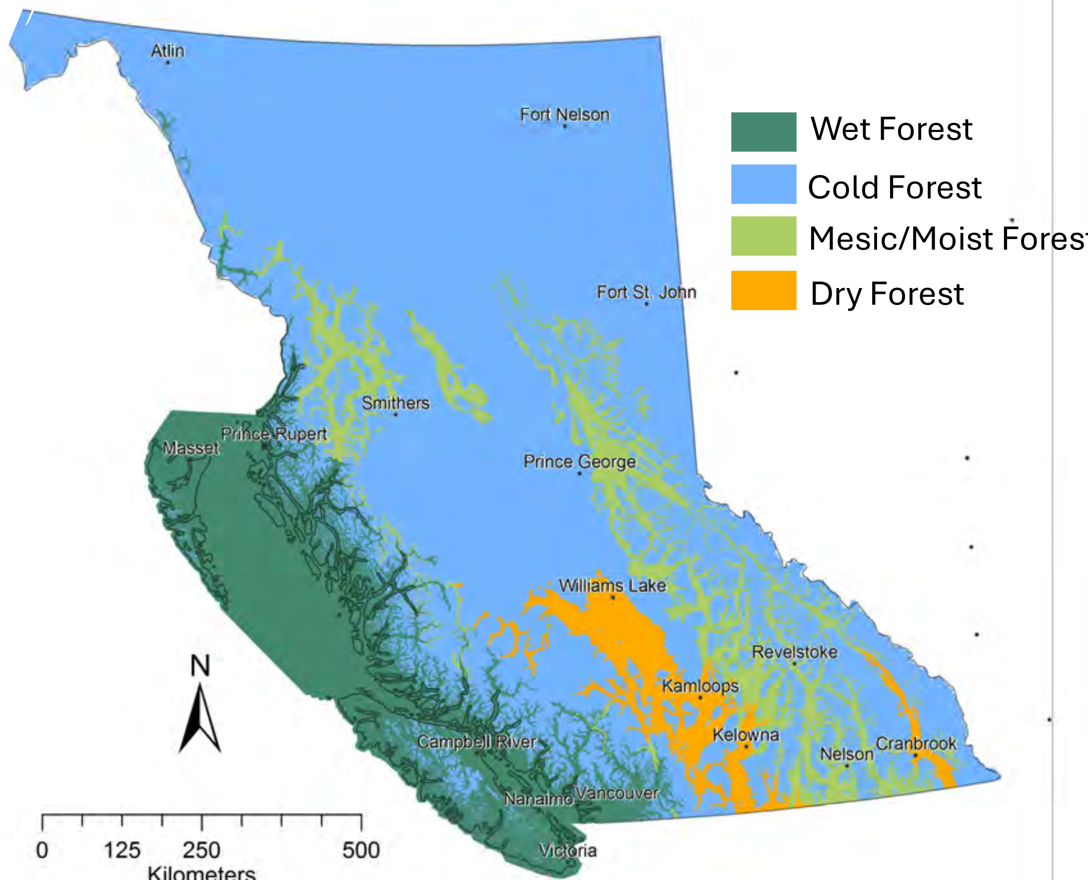
- Each BEC Group was assigned a forest type.
- Forest Types in BC follow a very similar pattern as modelled by Parks et al. (2018).

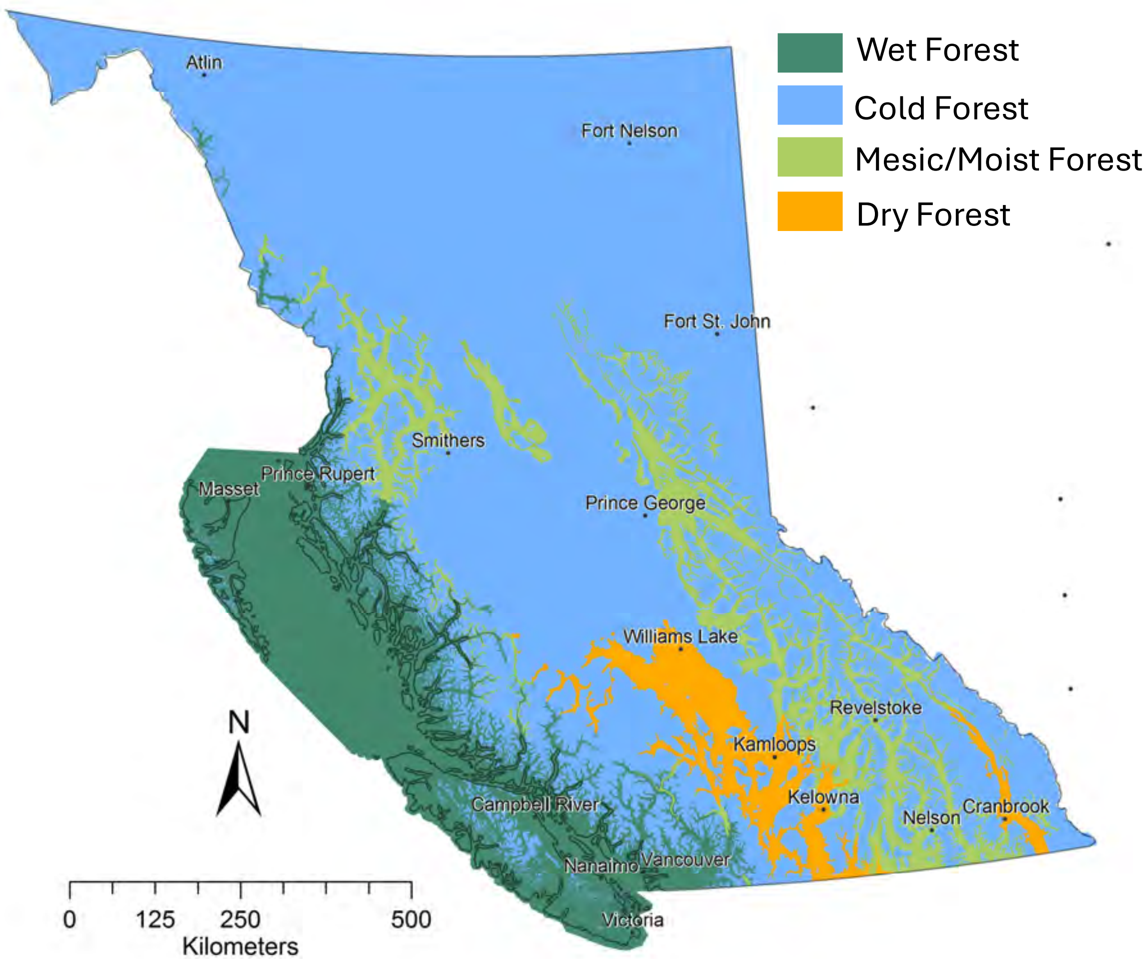


* area-based FRI= Number of years required to burn an area equal to the area of interest.

Forest Types in BC

- Grouped Forest Types using BEC Groups in the following categories
- Dry Forest
    - <400-500mm annual precipitation
- Mesic Forest
    - 500-1,000mm annual precipitation
- Wet Forest
    - >1,000mm annual precipitation
- Cold forest
    - >500mm annual precipitation
    - >40-50% of precipitation falls as snow
    - <3^{o}Celcius mean annual temperature



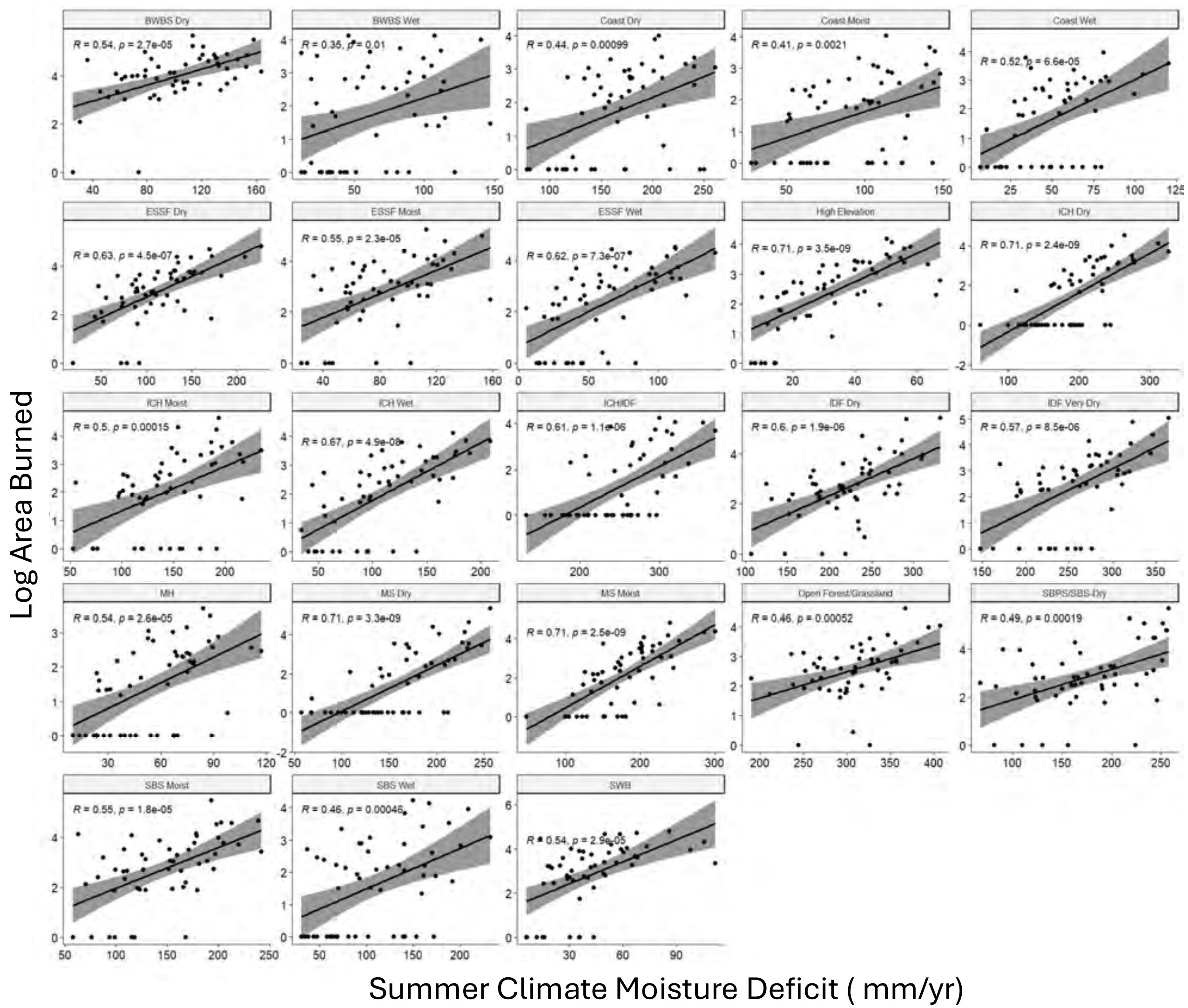


What Does the Evidence Suggest for BC?

- Using forest types as a framework for BC, – stand-level fuel reduction treatments most likely suited to:
  - Open Forest/Grassland (PP and IDFxx)
  - IDF-Very Dry (e.g IDFxh2)
- Several BEC Groups are on the border between cold/mesic and dry forest.
  - IDF Dry (e.g IDFdk1, 2, 3)
  - Possibly dry warm variants of SBS, ICH
- However, projected climate may shift some BEC variants, or sites within a BEC variant to more dry forest type conditions
- **<u>But, it varies….</u>**

Summer Drought and Wildfire in BC

- Summer drought the main variable linked to area burned annually in BC (Parisien et al 2023;Meyn et al. 2010)
  - Consistent with energy limited forest types.
- Comparative analyses shows summer CMD is the single variable most correlated to annual area burned across multiple BEC Groups in the province .



Parisien et al 2023. Abrupt, climate-induced increase in wildfires on British Columbia since the mid-2000s. Communication Earth and Environment https://doi.org/10.1038/s43247-023-00977

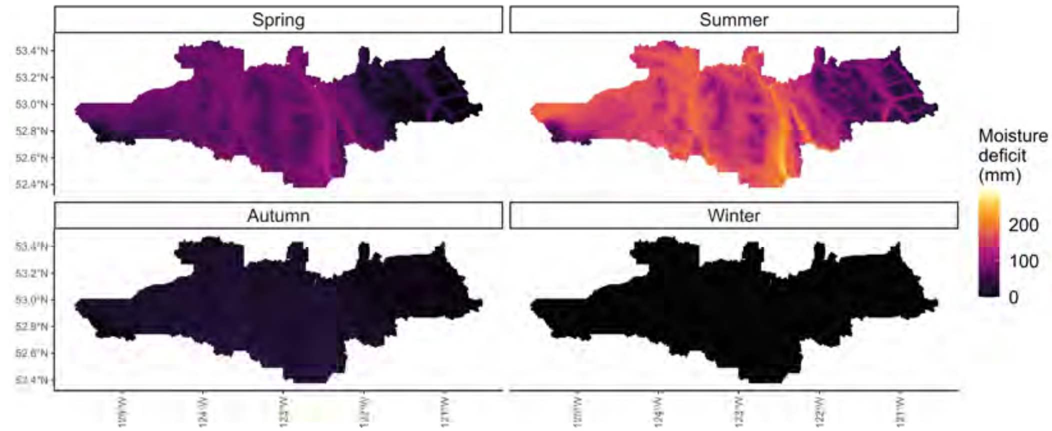
Meyn et al. 2010. Spatial variation of trends in wildfire and summer drought in British Columbia, Canada, 1920-2000. International Journal of Wildland Fire, 19: 272-283.

Projected Climate – Seasonal Changes in Climate Moisture Deficit (CMD)

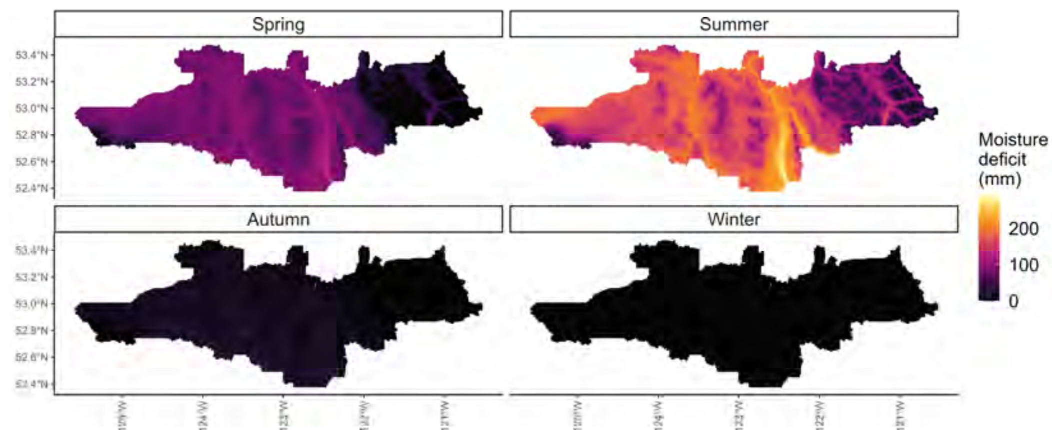
- Projected climate scenarios show that seasonal CMD will vary considerably.
- Example – Quesnel District – spring and summer CMD increase, but variable:
    - between ecosystems within the district,
    - Between districts across the province,

- So, need to be careful not to generalize implementation of landscape fuel management across climatically and topographically diverse landscapes.

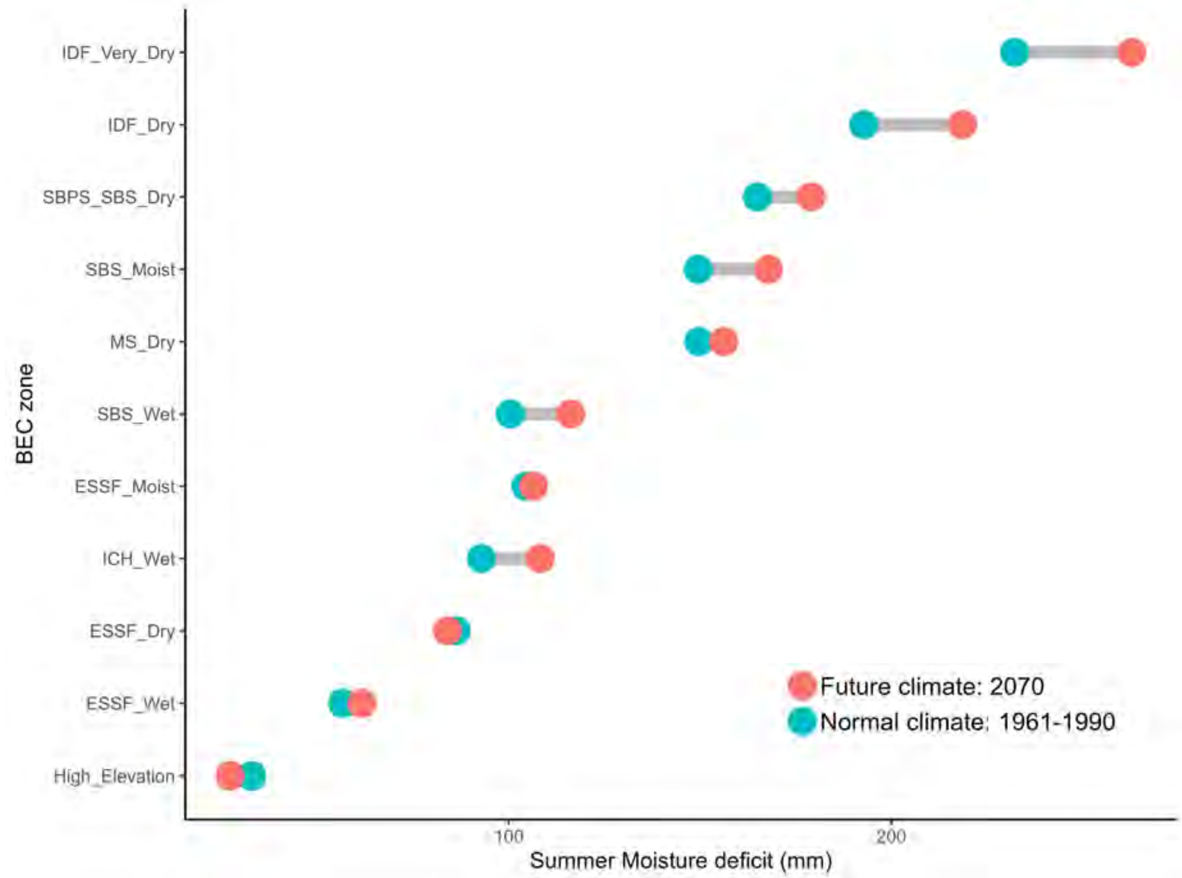
Baseline Normal Period (1960-1990)- Quesnel District



Projected Future Climate (2070) – Quesnel District



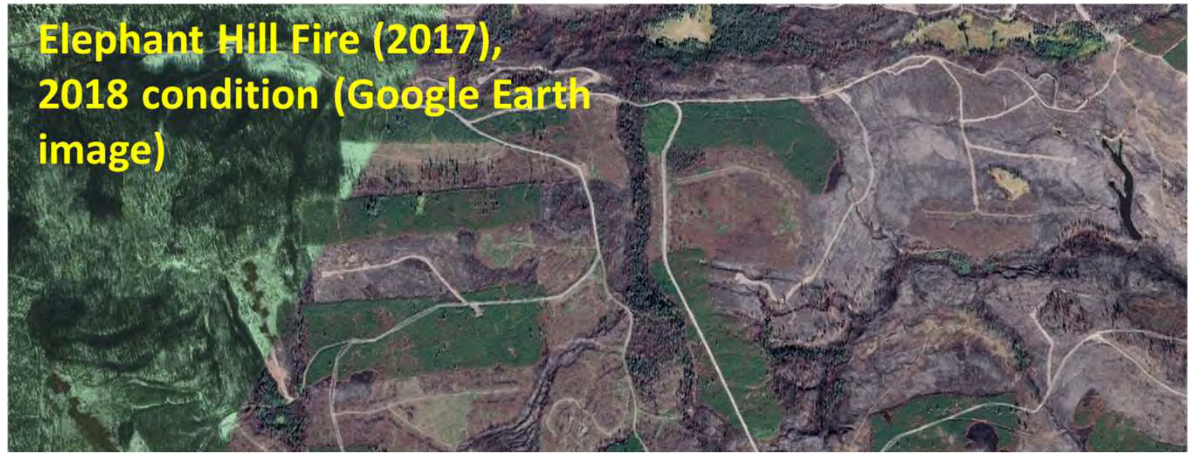
Projected Shift in Summer Climate Moisture Deficit (CMD) – Quesnel District.



- Summer CMD – greatest increase in lower elevation IDF, SBS and SBPS ecosystems.
- While all ecosystems will experience climate effects, many higher elevation cold and wet ecosystems expected to see a relatively minor change.
    - Cold and wet forest types will still be cold and wet.
- A "one-size fits all" approach to landscape fire management is not warranted.

What do we do in the Cold and Mesic Forests that make up most of BC?

- Stand-level fuel treatments still largely promoted.
- Yet, published literature suggests stand-level fuel reduction treatments aren't appropriate in these forest types.
- Evidence points to landscape-level management and creating landscape mosaics of:
    - different aged forests,
    - species compositions, and
    - Topographic fire refugia
- Since 2017, considerable evidence shows that young stands (20-40 yrs old) are more resistant to wildfire – even under extreme fire weather conditions.
- Despite this evidence, this phenomenon largely ignored, un-studied and not discussed in landscape fire management.
- Why? Because it doesn't fit the narrative that promotes stand-level fuel reduction treatments?



Final Thoughts

- In BC, we still have limited understanding of wildfire regimes, climate change effects, and effectiveness of fuel management across climatically and topographically diverse landscapes.
- Most information is based on research in western US, dry forest of BC – results are generalized to BC's forests.
- Confusion & controversy still exist, and likely to continue, on how best to implement fuel reduction & landscape fire management in BC.
- The outcome will be continued:
  - Delay implementation of fuel management
  - Uncertainty in effectiveness of treatments being applied
  - Potential for unintended negative consequences to ecosystems
  - Lack of public trust

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Ecologist Rhonda Millikin conducting field research in Whistler in 2021. | Photo courtesy of Rhonda

A Path Forward….

- Problem can be resolved if fire scientists and forest ecologists in BC collaborate.
- Provide Landscape Fuel Management guidance that is appropriate for the diverse climatic conditions that drives forest types and fire regimes across BC, that includes:
  - Targets for the amount of the landscape in different stand conditions to create fire 'resilient' landscapes.
  - Where stand-level fuel reduction treatments will be most effective based on forest type, site conditions and elements at risk (e.g infrastructure and communities).
  - How to incorporate wildfire refugia information to support creating fire breaks and conservation planning efforts.
  - Ecologically appropriate fuel management recommendations that are inclusive of managing for multiple values:
    - Wildlife habitats
    - Old growth forests
    - Hydrology