

Drought Analysis Update

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B.C. Ministry of Forests

Northern Silviculture Committee Winter Workshop

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What is drought?

= Water deficit as related to average conditions

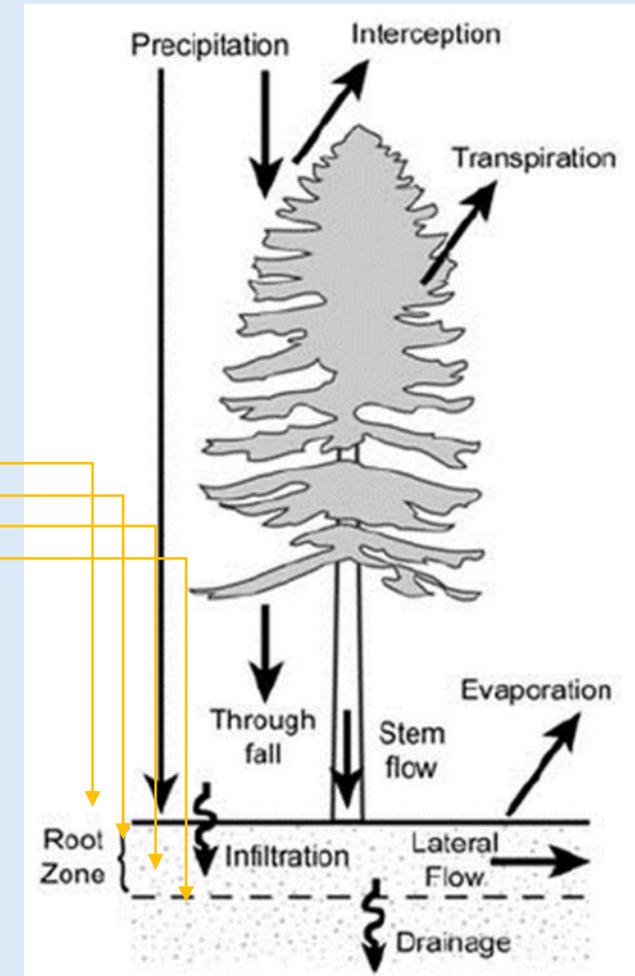
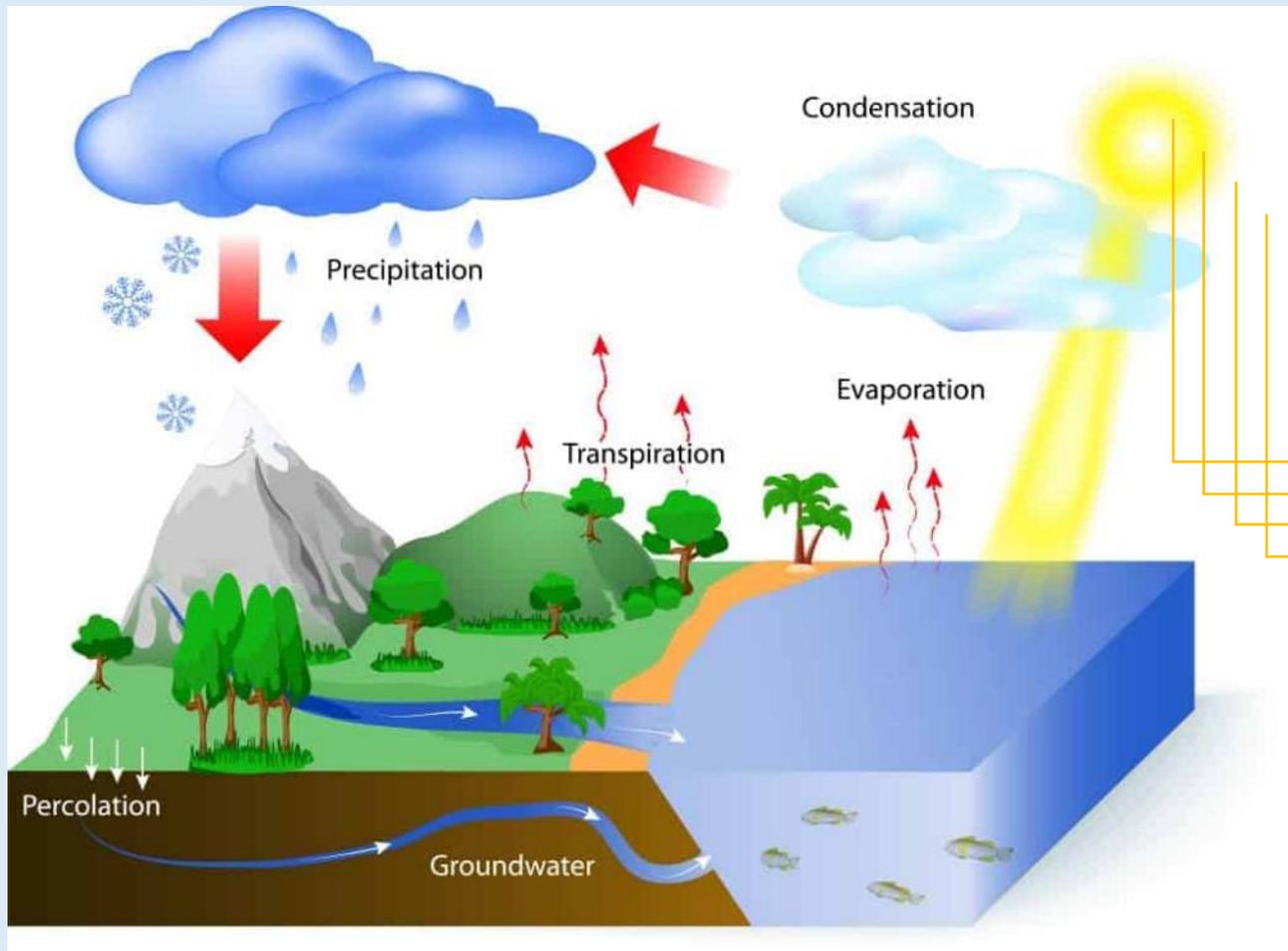
- It is not just absence of precipitation
- It is not just this image 
- It is not just below average precipitation
- It is relative to space and time
 - e.g. drought on Vancouver Island is not the same as drought in a Mexican desert
 - requires an understanding of historical conditions
 - can be expressed in various time scales



- Four types: Meteorological, Hydrological, Ecological, Economic

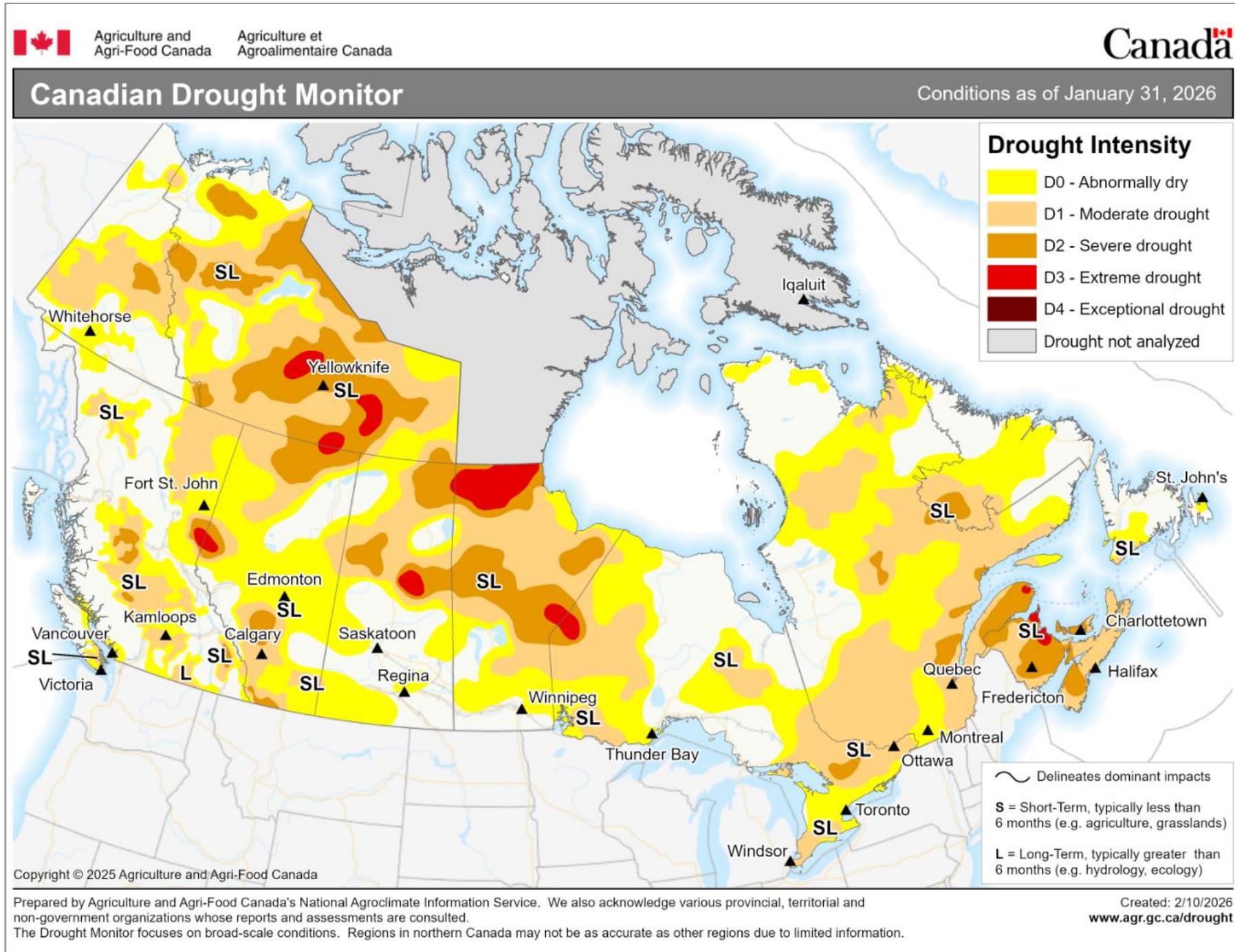
Ecological Drought

- requires an understanding of evapotranspiration
- can occur in the absence of hydrological drought



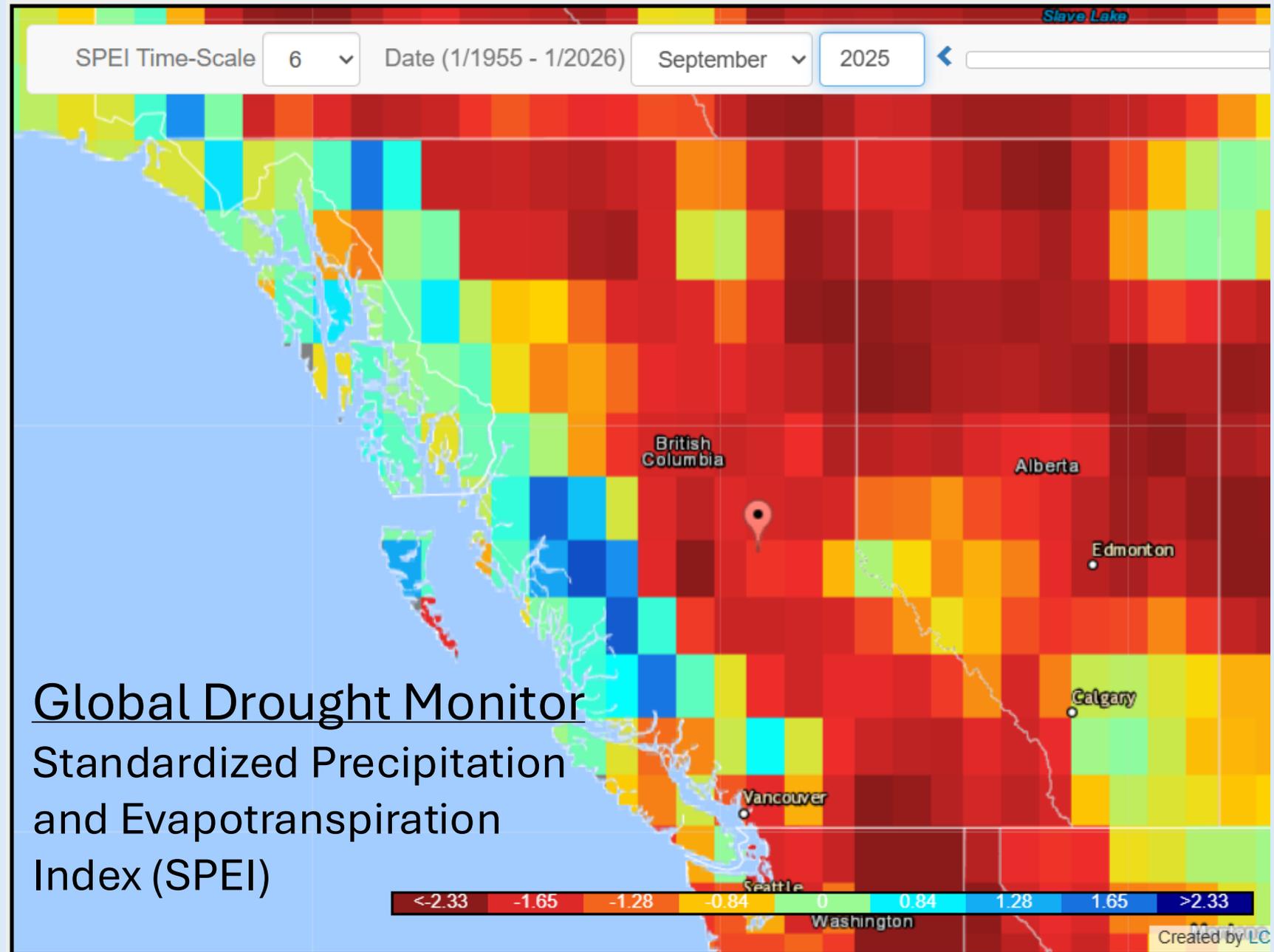
Current Conditions

- Jan 31, 2026
- Parts of the province still in moderate to extreme (Peace) drought conditions
- Underestimation of long-term, cumulative drought



Growing Season (Apr-Sep) 2025

- Much of the interior moderate to severe drought
- Deepening of drought in the Peace
- Cumulative drought central interior
- Dry in the Bulkley Valley

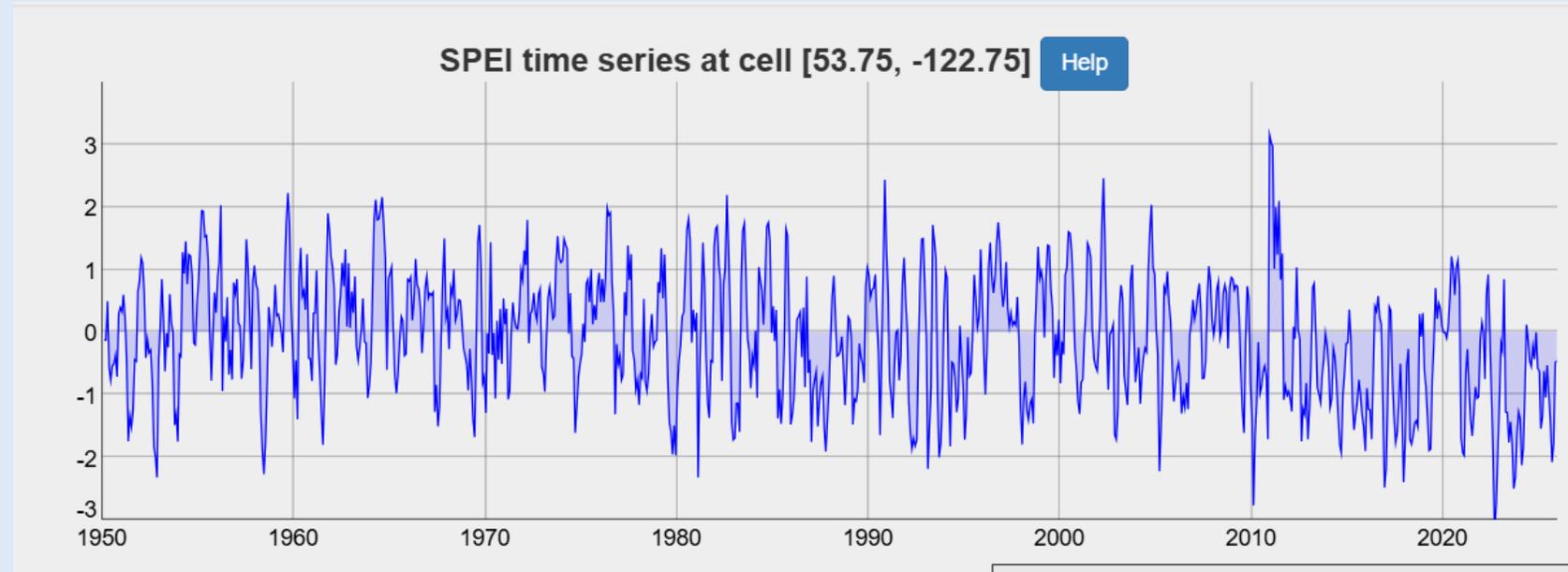


Prince George Area: SPEI 1950 to present

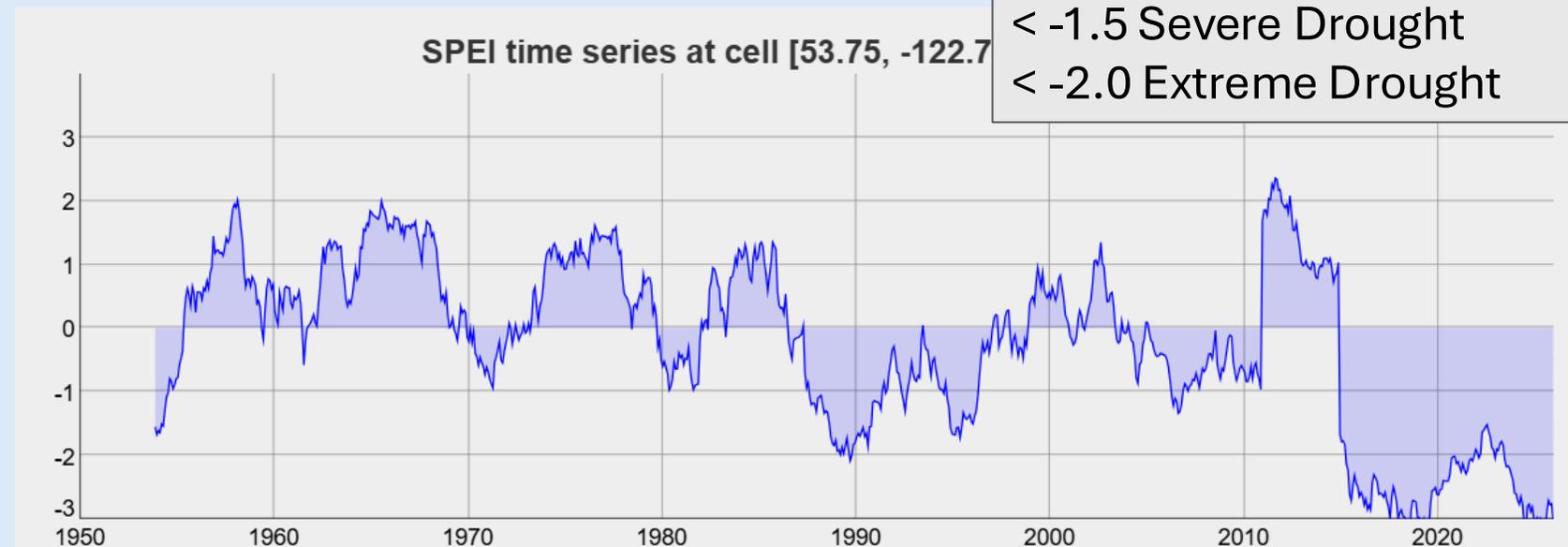
- Increasing moderate to severe drought
- Lack of pluvials (SPEI >1), recovery
- Lowest SPEI-3 month Oct 2022
- Consecutive years of drought, cumulative, extreme conditions

<https://spei.csic.es/map/maps.html#months=7#month=0#year=2026>

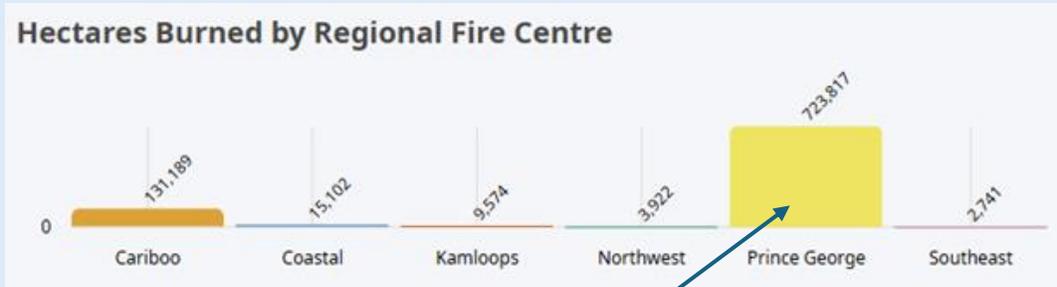
SPEI: 3-month



SPEI: 48-month

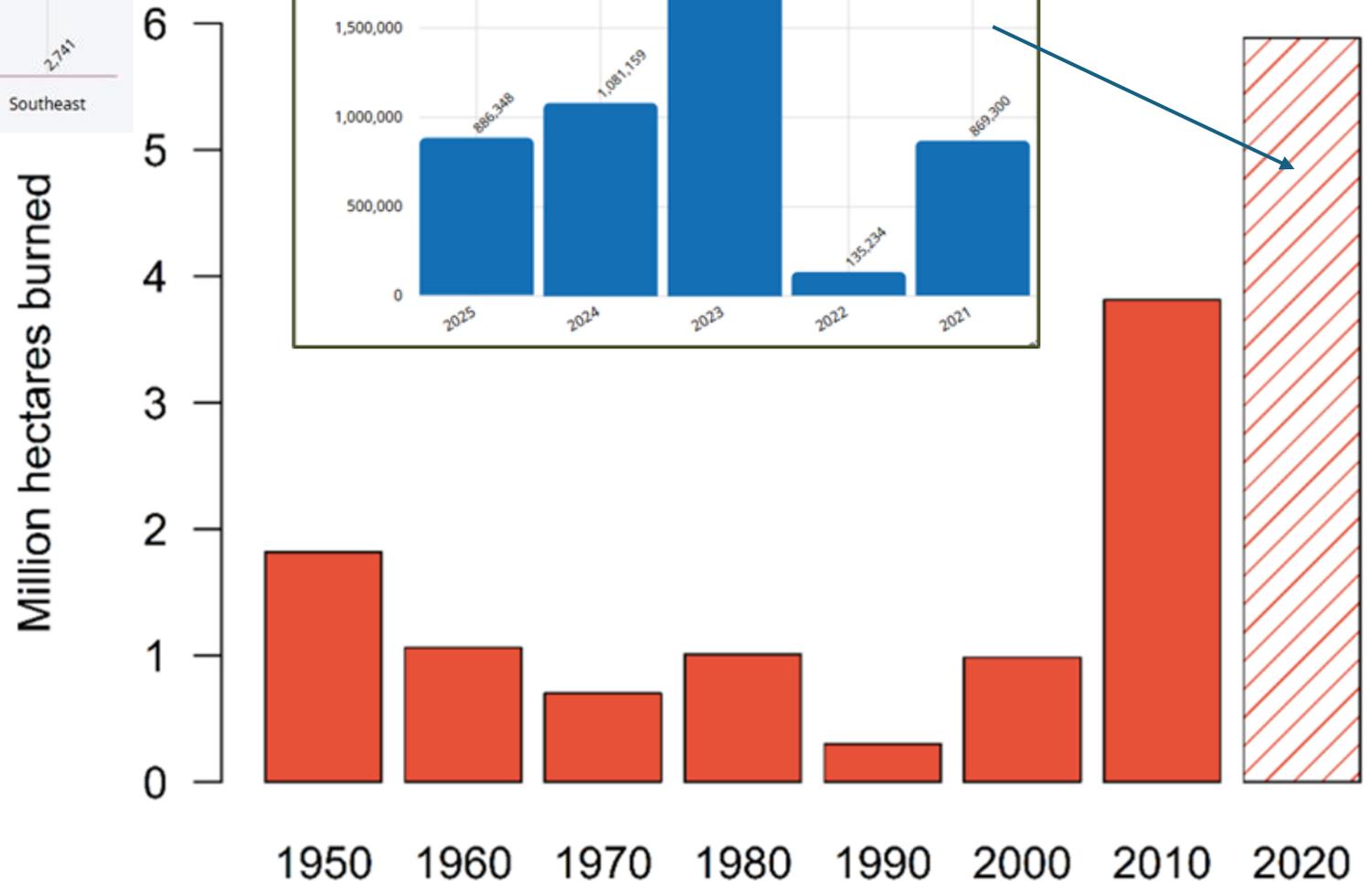
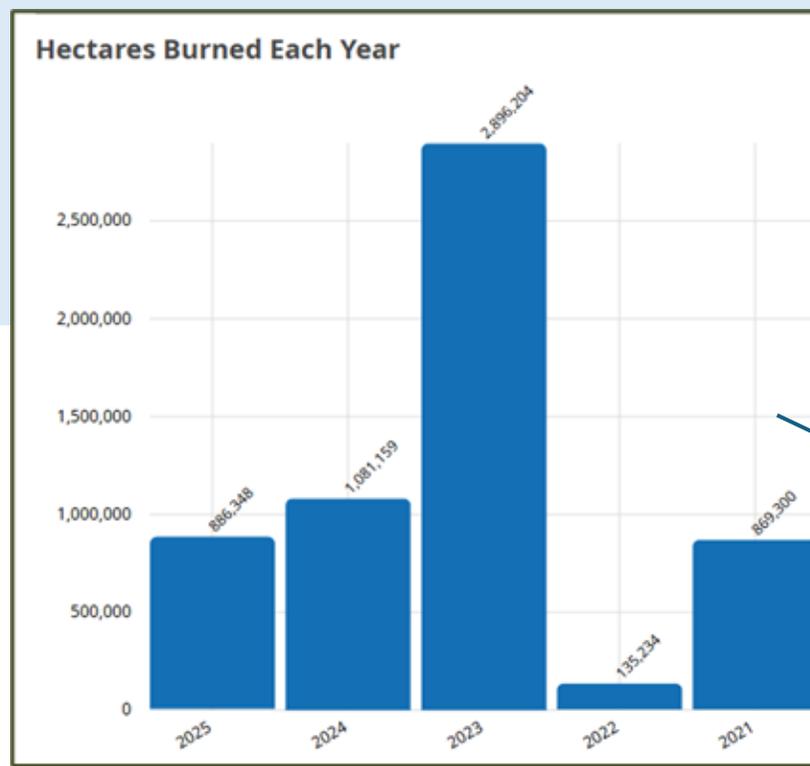


Wildfires



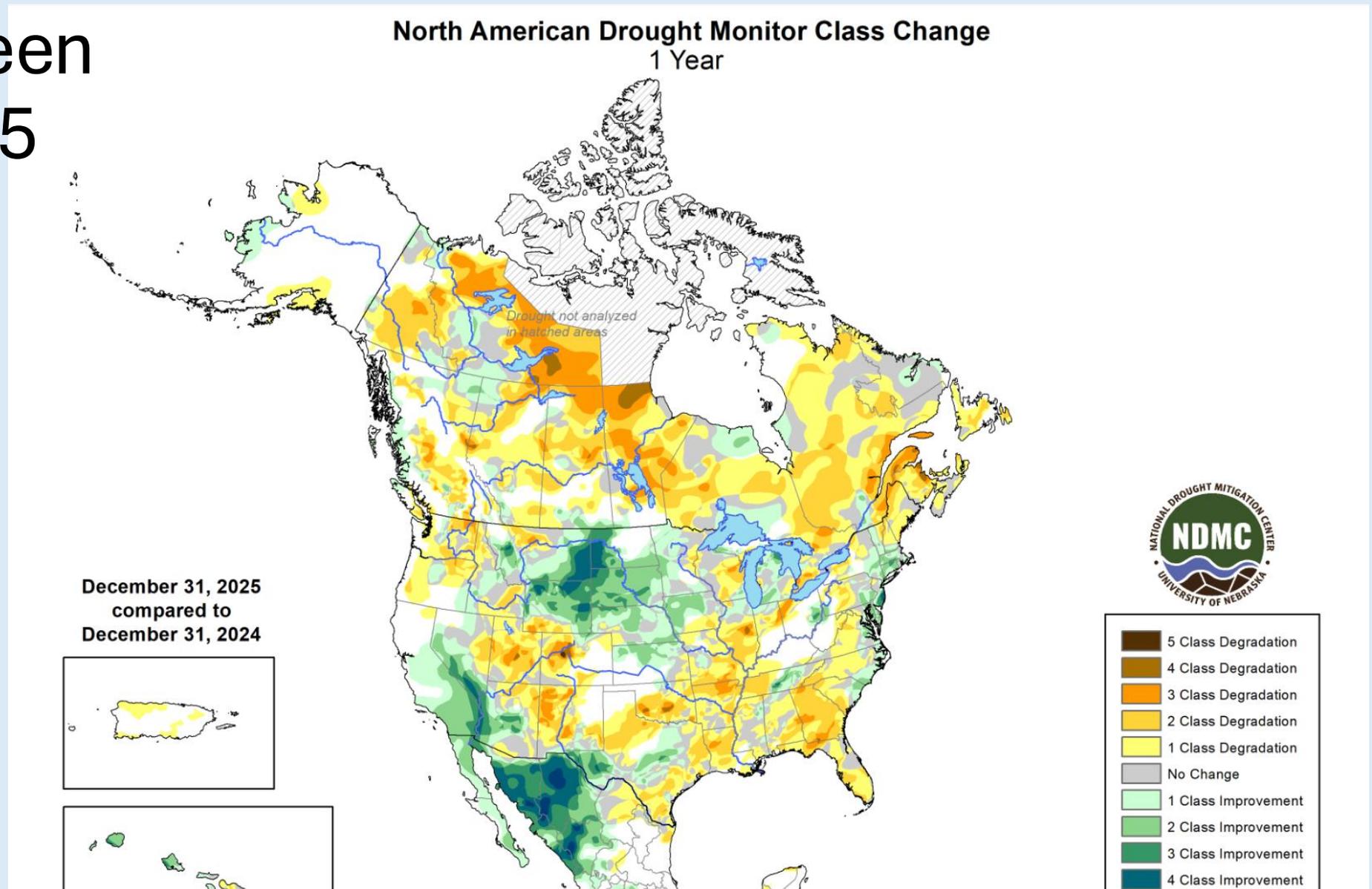
- Most of the fires in 2025 were in the Prince George Fire Centre (Omineca/NE)

<https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary>



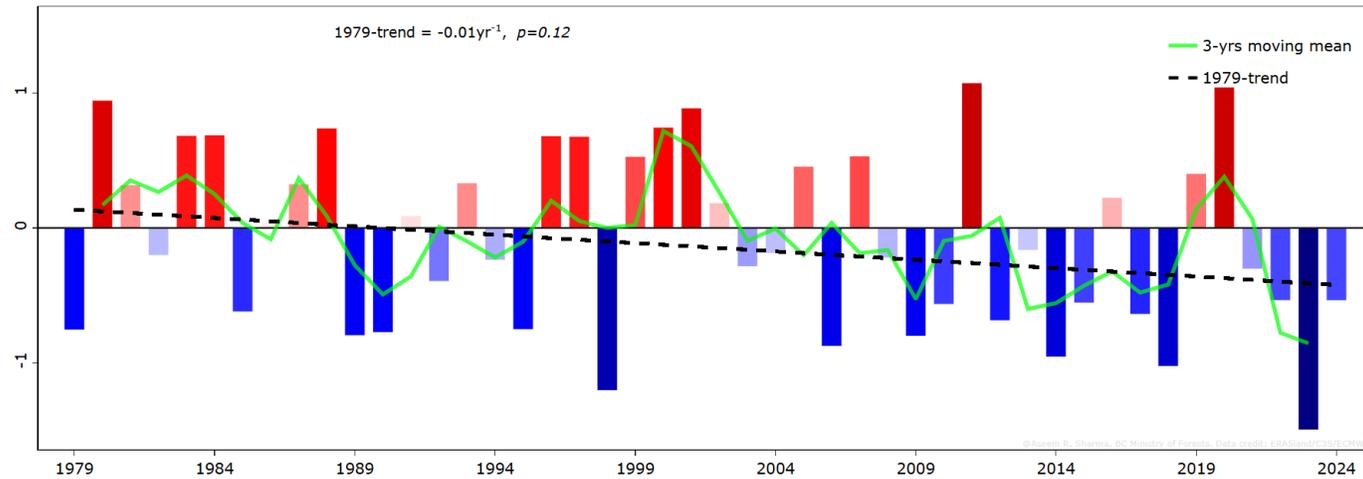
Change between 2024 and 2025

- Parts of interior BC 1-3 class degradation
- Parts of the coast, mountains and the north 1-2 class improvement
- Record breaking December precipitation



BC SPEI Growing Season Trends 1979-2024

BC Standardised Precipitation Evapotranspiration Index(spei_6mon) anomaly (unitless) : September
Baseline: 1981-2010

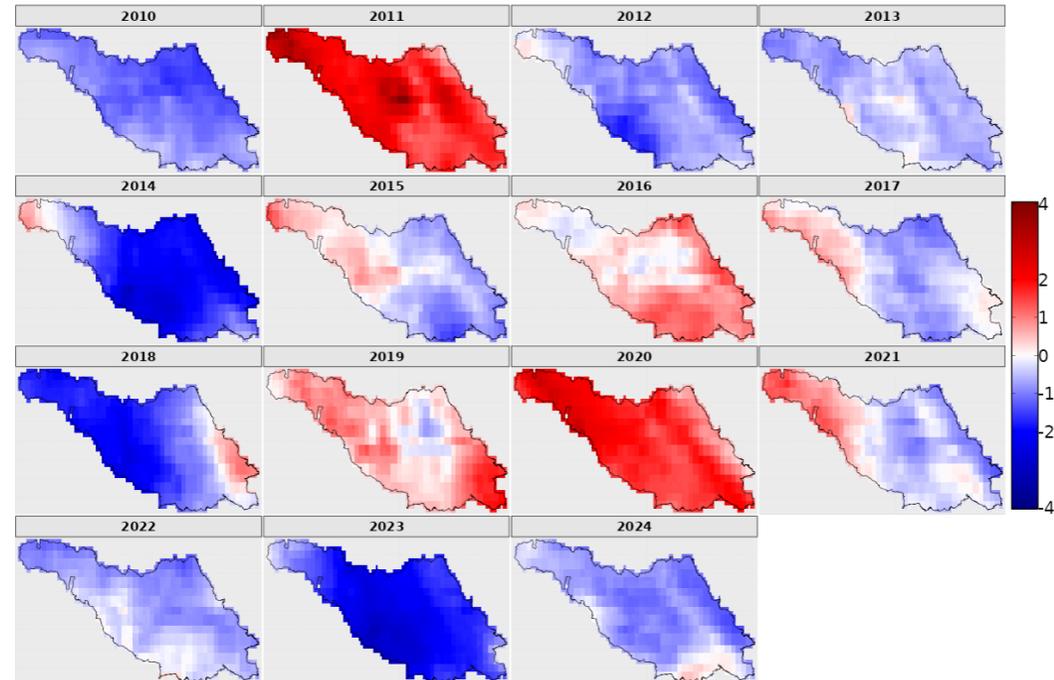


Location Map



Sub-Boreal Interior Ecoprovince

SUB-BOREAL INTERIOR Standardised Precipitation Evapotranspiration Index(spei_6mon) anomaly (unitless): September
Baseline: 1981-2010. [get_region() anomaly over 2010-2024: Mean = -0.3get_unit(), Range = -3.16 - 4.03]



Climate Extremes App

Aseem Sharma

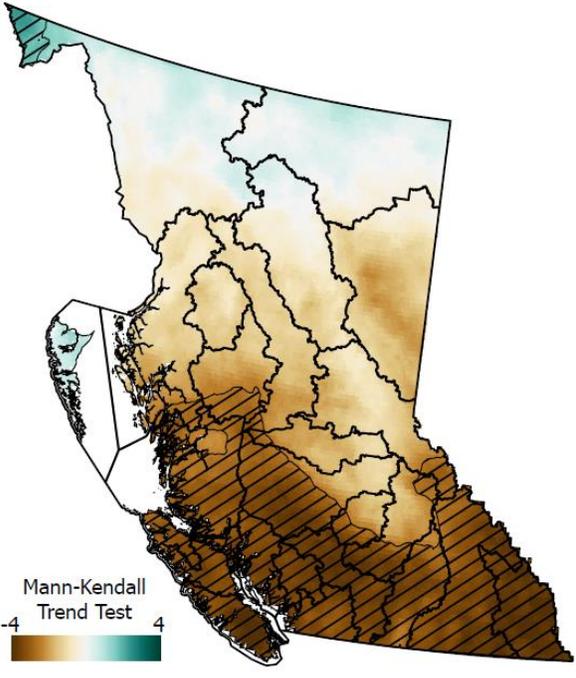
https://bcgov-env.shinyapps.io/bc_climate_extremes_app/

Dark Blue Drought, Dark Red Pluvial

Growing Season Severe Droughts: 2010, 2014, 2018, 2023

SPEI-3 month Seasonal Drought Trends (1950-2023)

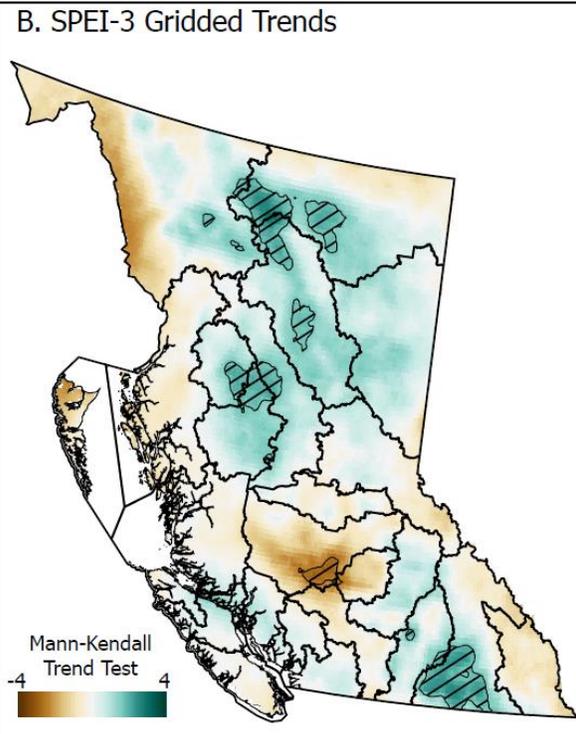
B. SPEI-3 Gridded Trends



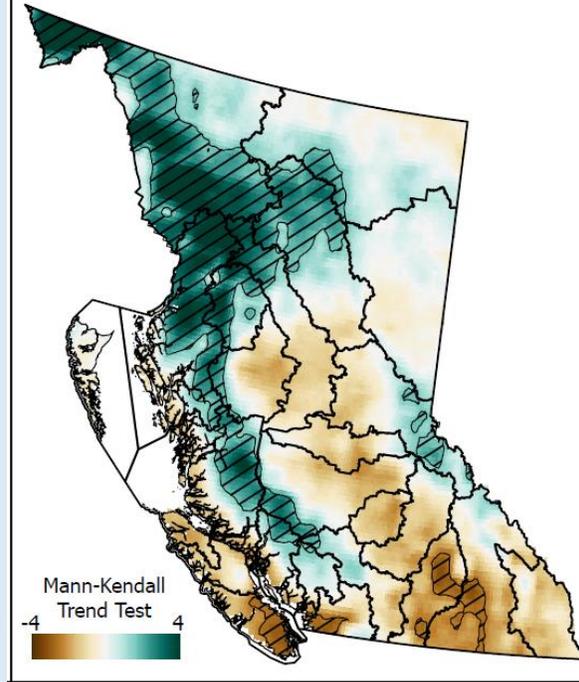
Winter (Dec, Jan, Feb)

BC Drought Atlas
Mood et al. *in prep*

Spring (Mar, Apr, May)



B. SPEI-3 Gridded Trends

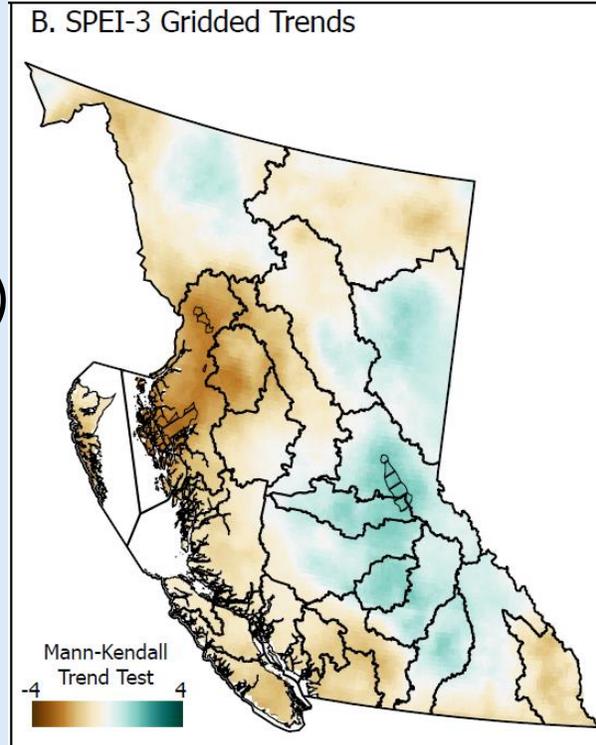


Summer (Jun, Jul, Aug)

Significant Trend
($p < 0.05$)

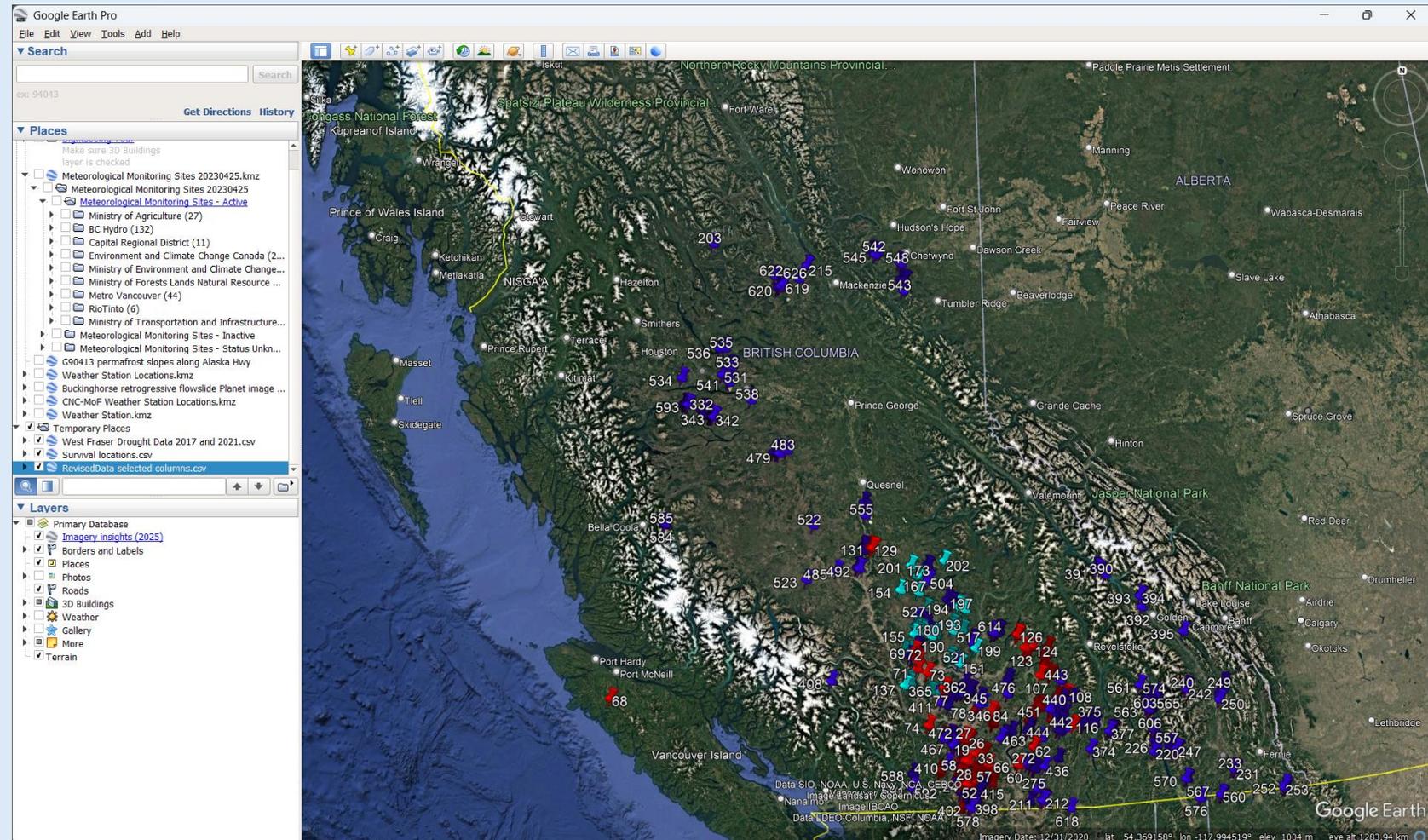


Fall (Sep, Oct, Nov):



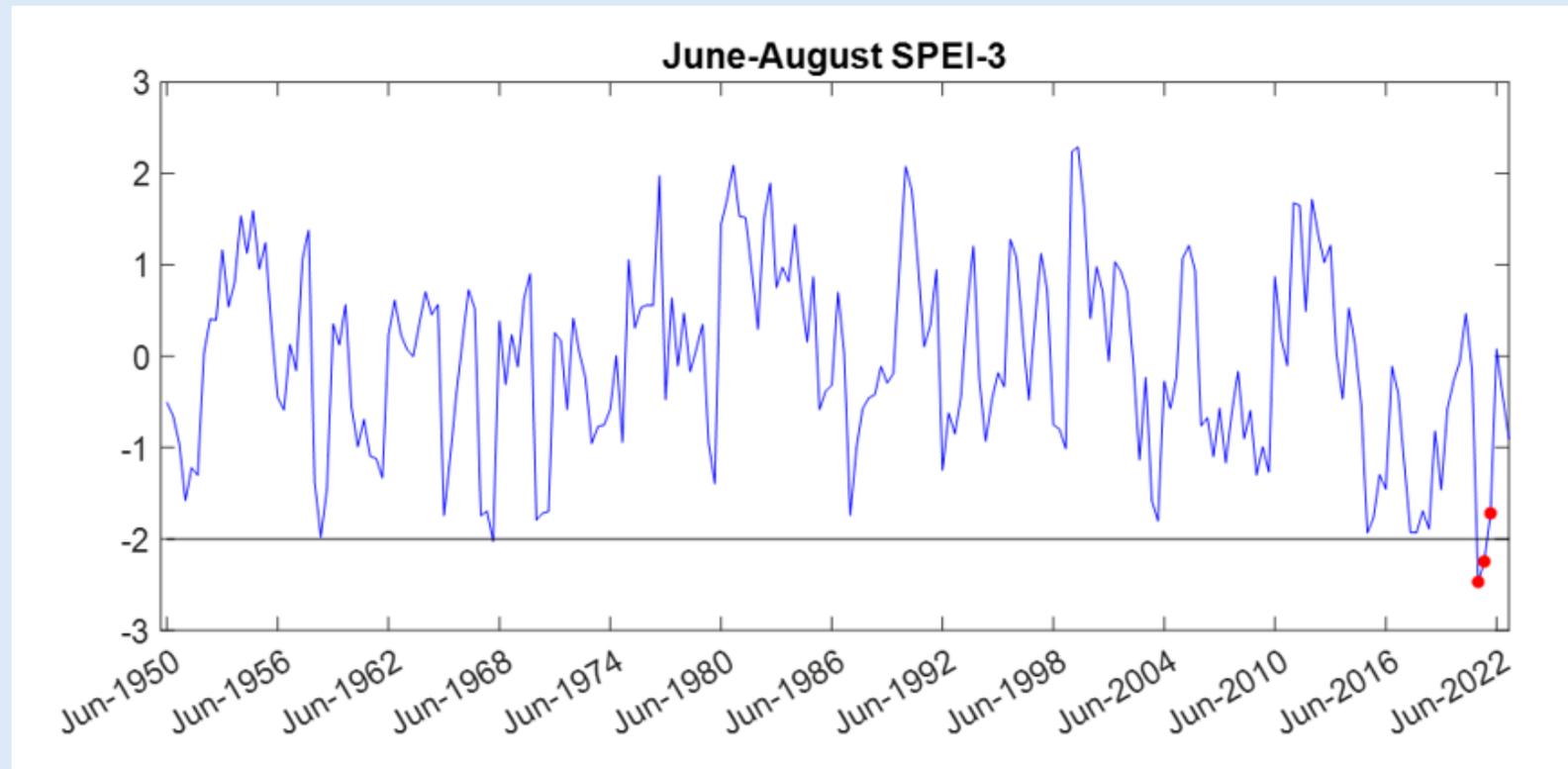
Combining recent observed drought mortality with meteorological drought and climate indicators

- Chief Forester's Provincial Drought Working group: catastrophic drought?
 - MoF, licensees
- Dr. Bob Sagar, Biometeorologist
- Plantation survey data:
 - Observed mortality assumed to be drought
 - 3 datasets
 - 2017-2023
- SPEI
- ForDRAT
- Max temp (2021)
- Soil moisture
- VPD – exploring



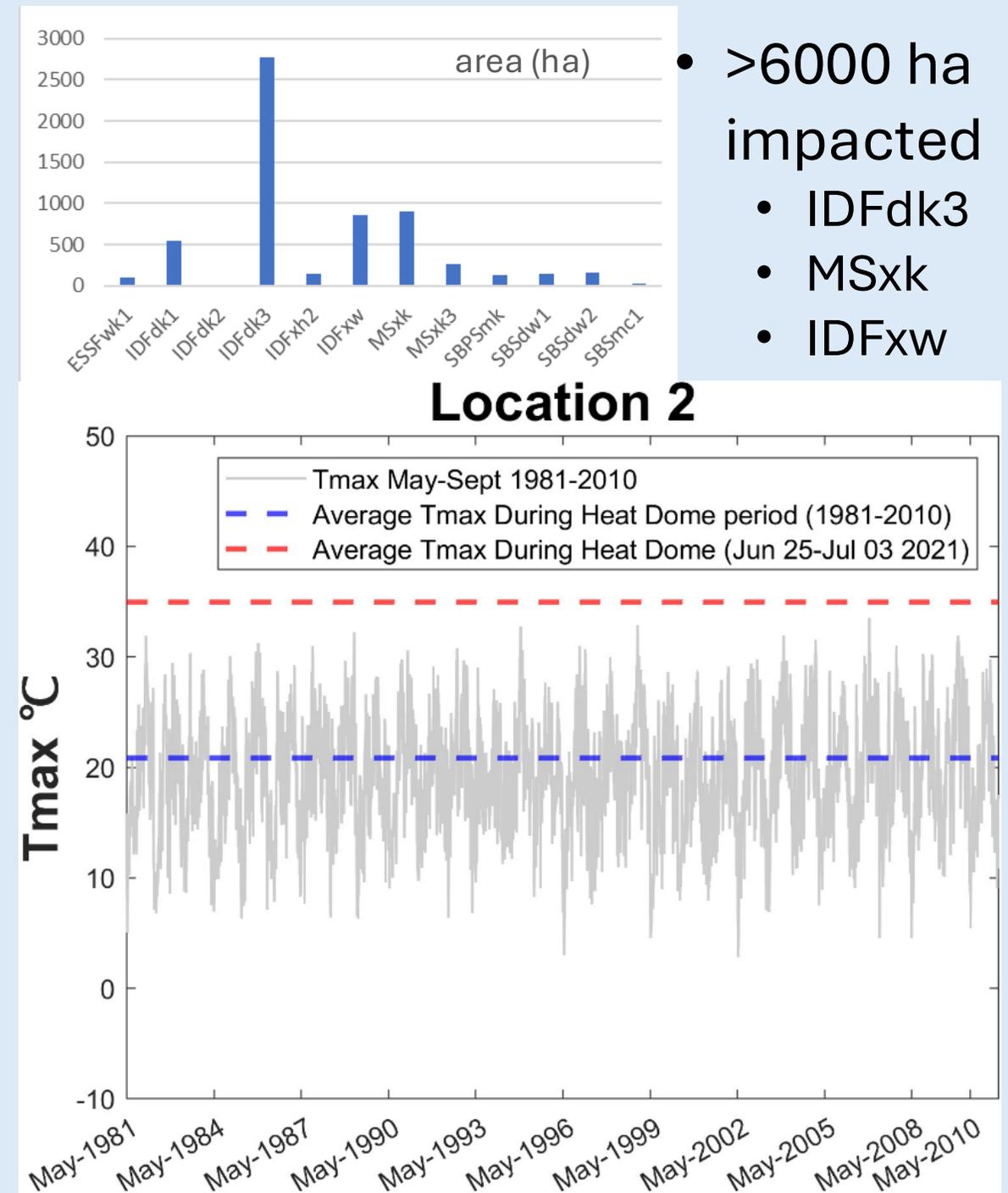
What was done:

1. West Fraser observed drought mortality area impacted: 2017, 2021
 - Without knowing the exact timing of observed drought impacts, multiple SPEI values were explored:
 - SPEI 1, 3, 6, 12, and 24 month values ending in each May, Jun, Jul, Aug and Sep
 - Output: Drought categories during the 2017 and 2021 growing seasons
 - context of 2017 and 2021 drought in long term record (1950-2022)
 - Results: all 70 locations of observed drought mortality and SPEI-6 month or less moderate to severe in year of drought observed
 - Many sites had lowest SPEI on record
 - Most were < -1.5 SPEI



2021 Drought or Heat Dome Extreme Temperatures?

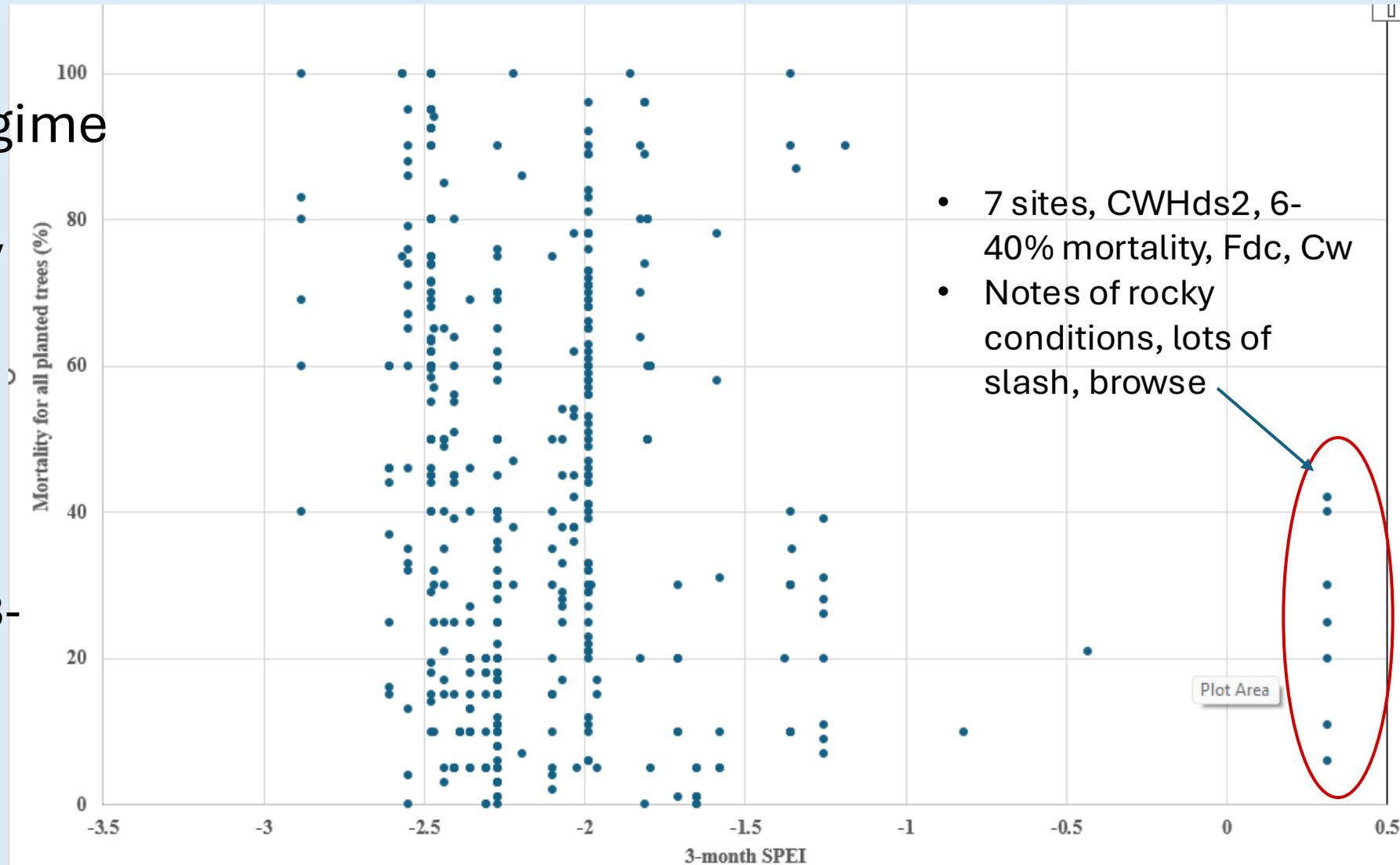
- We don't know: need more analysis
- West Fraser observed mortality in 2021
 - All sites had maximum temperatures during the heat dome that were record breaking
 - 10-15°C above average
 - Timing was terrible
 - Maximum solar radiation
 - Minimum nighttime cooling
 - Sensitive: fresh needles, 1 to 2 years age



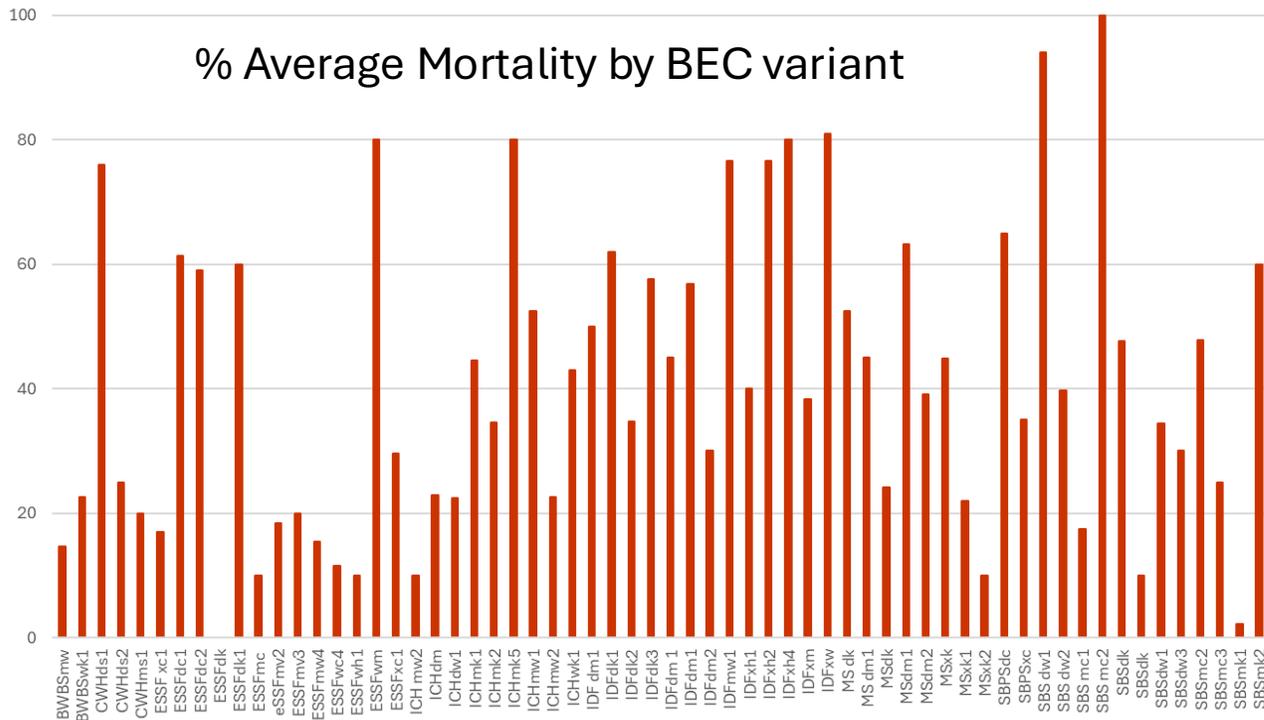
2. Survival data collection spreadsheet, 2021 observed drought impacts

- % mortality, % survival by species
- Interior BC
- BEC variant
- Soil moisture regime

- 420 observations
 - 10 without mortality
- SPEI 1, 3, 6, 12, 24-month from the 2021 growing season
- Majority of observed mortality occurred in conjunction with SPEI 3-mth values < -1.5
- 25 sites with mortality but SPEI ~ -1 , planted just before heat dome?

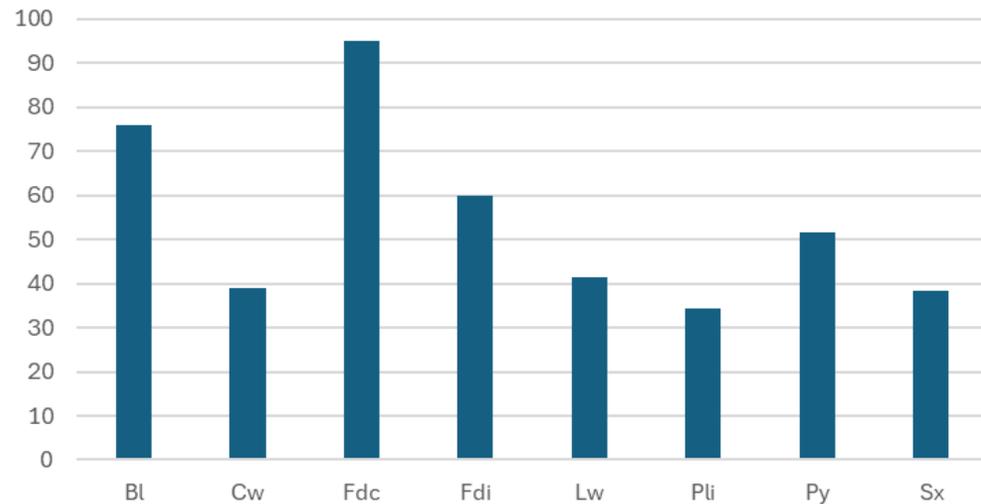


% Average Mortality by BEC variant



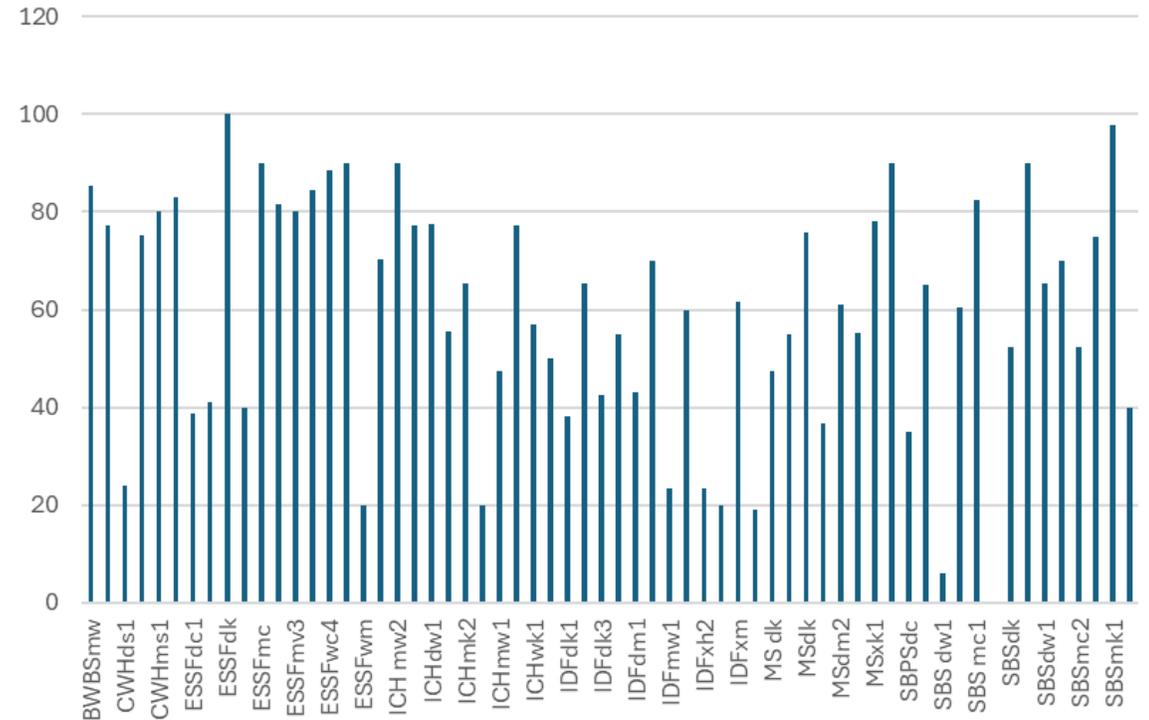
BEC Zone ▾

Average % Mortality



Average of % Survival

% Average Survival by BEC variant



BEC Zone ▾

- 100% mortality occurred:
 - SBSmc2
- >80%:
 - SBSdw1
 - IDFvw

British Columbia Forest Drought Risk Assessment Tool

BEC

IDF dk 3

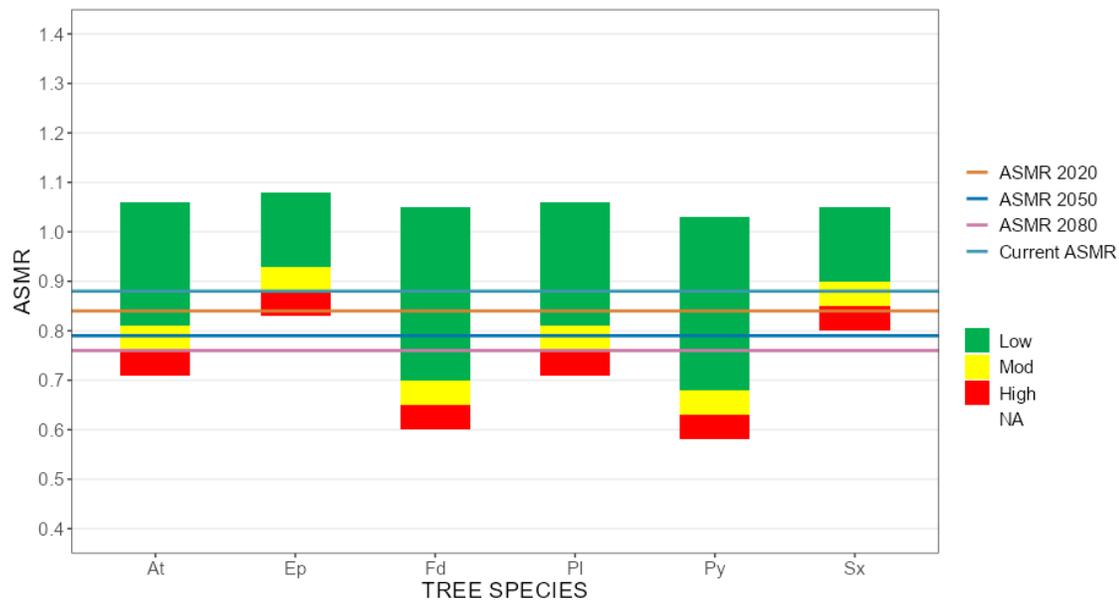
RSMR

4

Tree species

Ep, Sx, Pl, At, Fd, Py

- | Select All | Deselect All |
|------------|--------------|
| Ac | |
| Hw | |
| Bl | |
| Ep | ✓ |
| Cw | |
| Sx | ✓ |
| Pl | ✓ |
| At | ✓ |
| Lw | |
| Fd | ✓ |
| Py | ✓ |



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Edatopic Grid projection

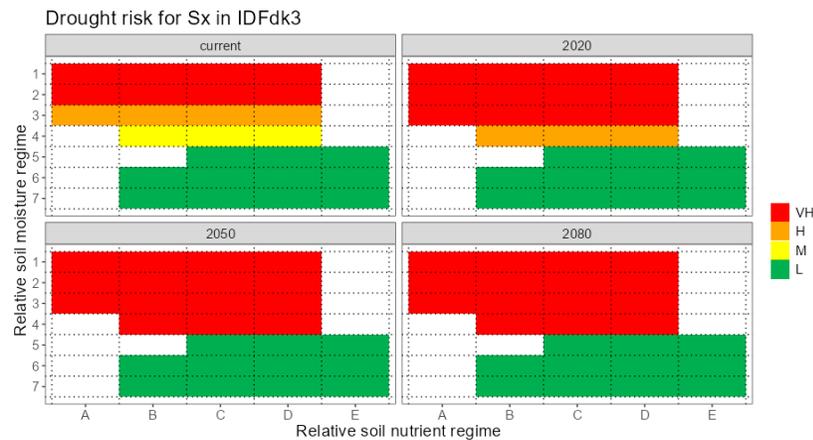
[DeLong et al., 2022](#)

[DeLong et al. 2019](#)

[Foord et al., 2017](#)

[BC Data Catalogue](#)

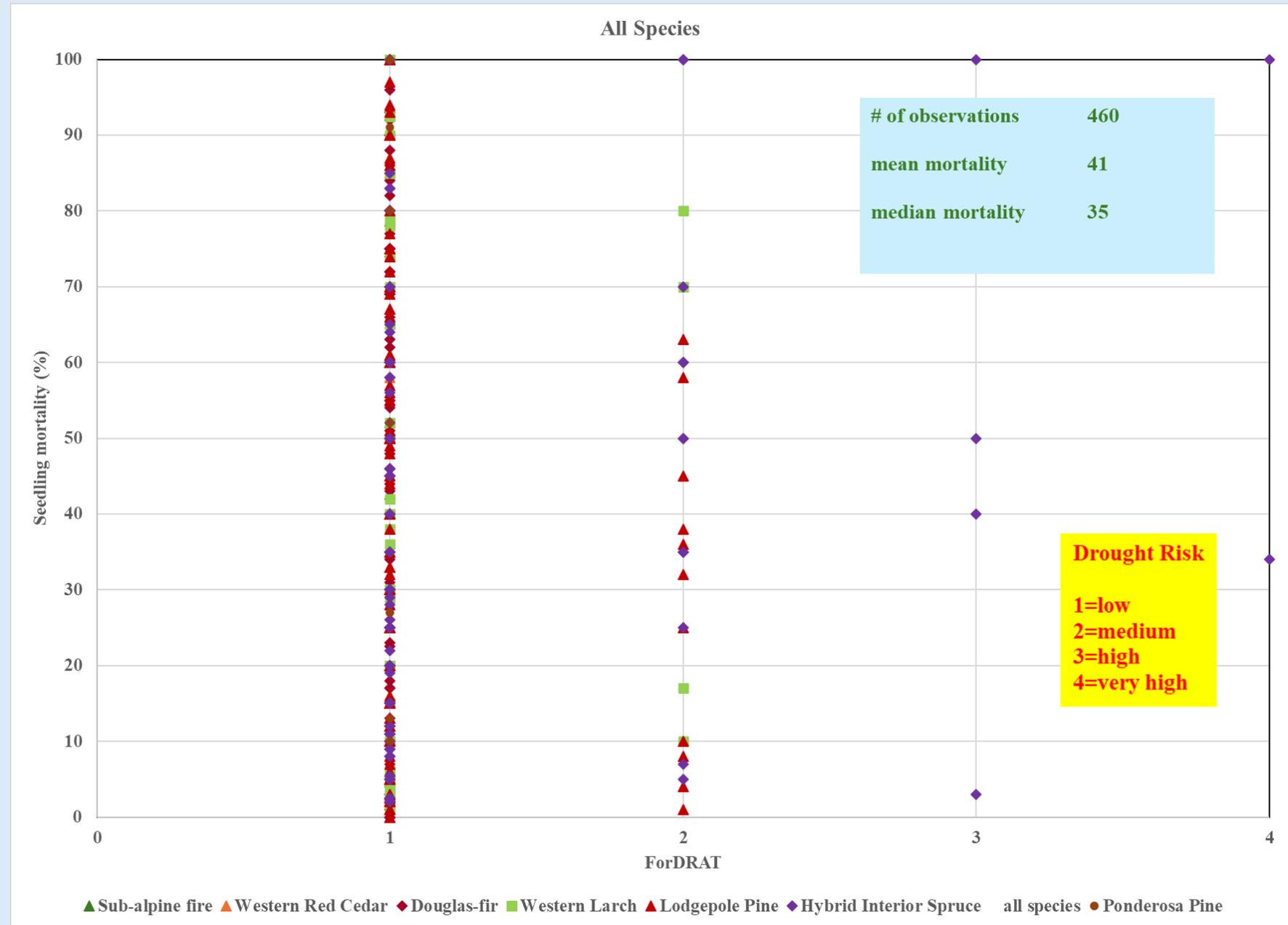
<https://github.com/bcgov/forDRAT>



[Download PDF](#)

ForDRAT

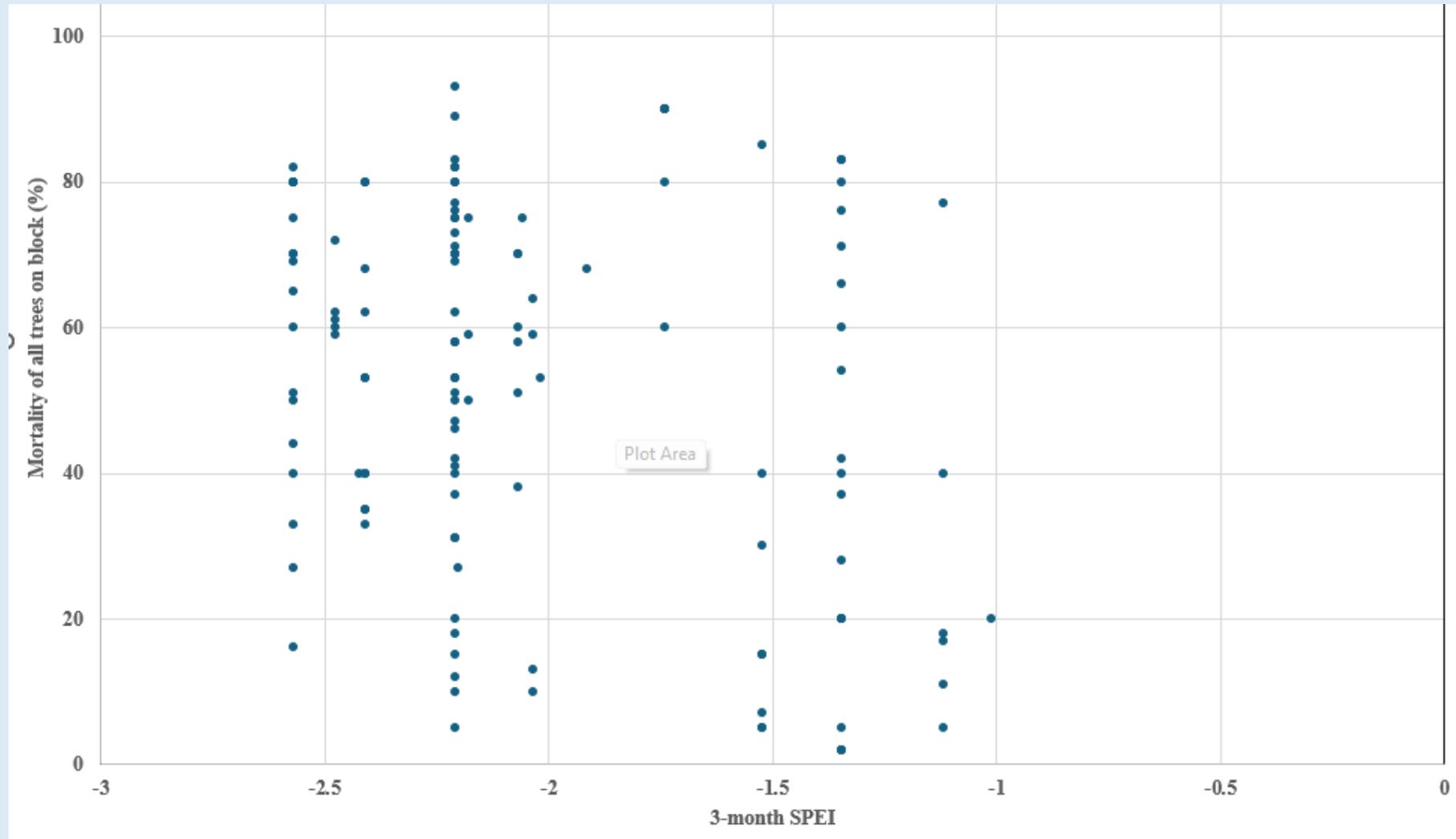
- Mortality occurred mostly in low ForDRAT risk
- ForDRAT developed for mature age classes
- Serves as a check that drought mortality impacts unexpected?



3. Revised data spreadsheet, 2017-2023 observed drought impacts

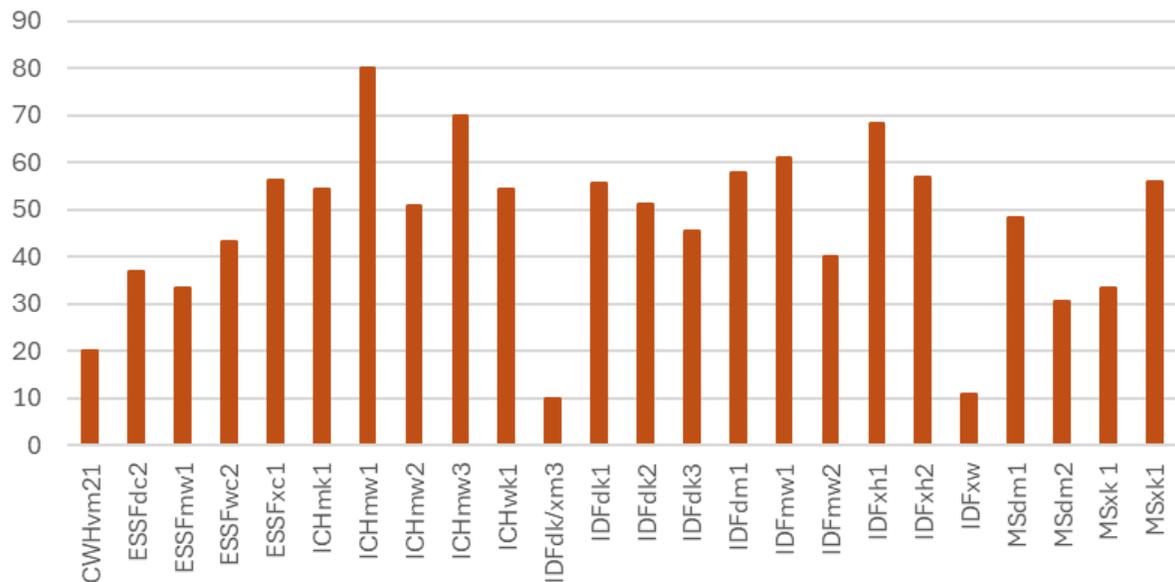
- mostly southern interior
- planting dates

- 128 observations
 - all had mortality
 - 64% below min stocking standards at survey
- SPEI 1, 3, 6, 12, 24-month from observed drought mortality
- Majority of observed mortality occurred in conjunction with SPEI 3-mth values < -1.5



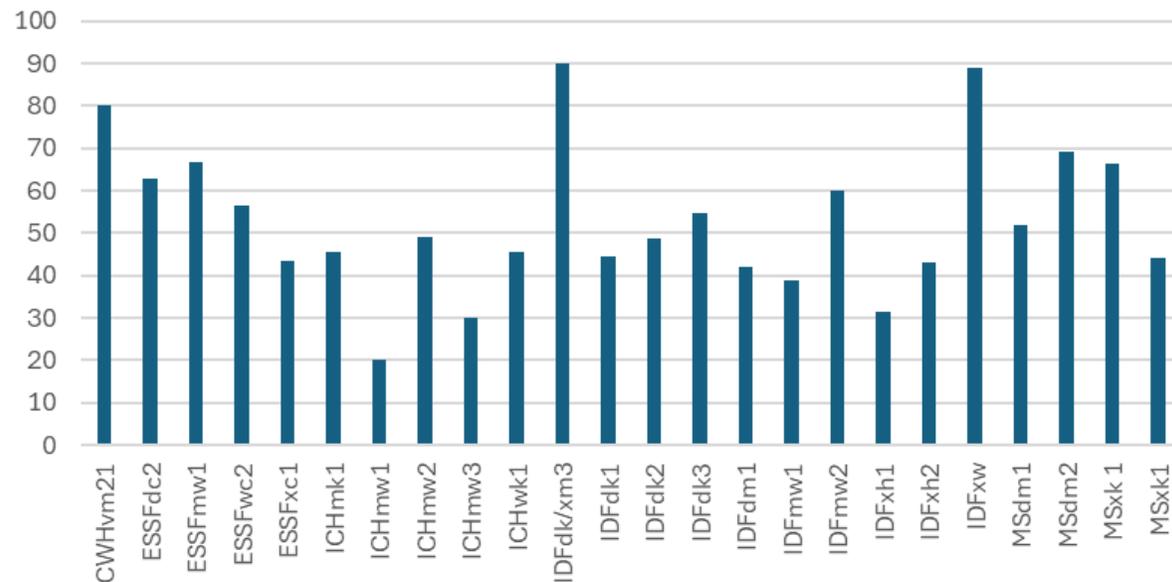
Average of % Mortality

% Average Mortality by BEC variant



Average of % Survival

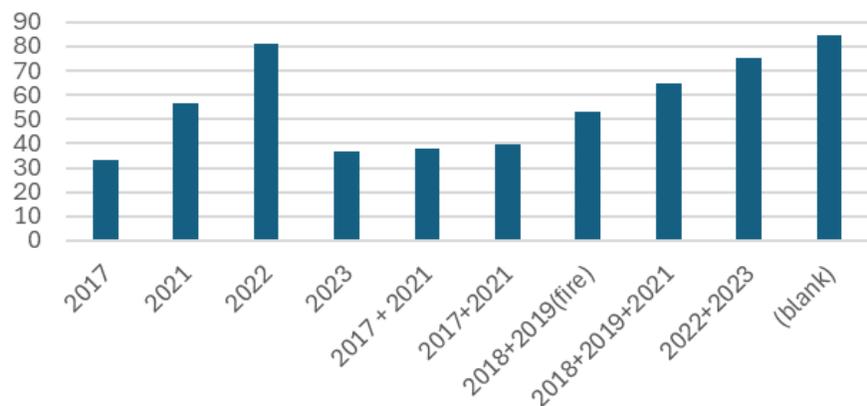
% Average Survival by BEC variant



BEC ▾

Average of % Mortality

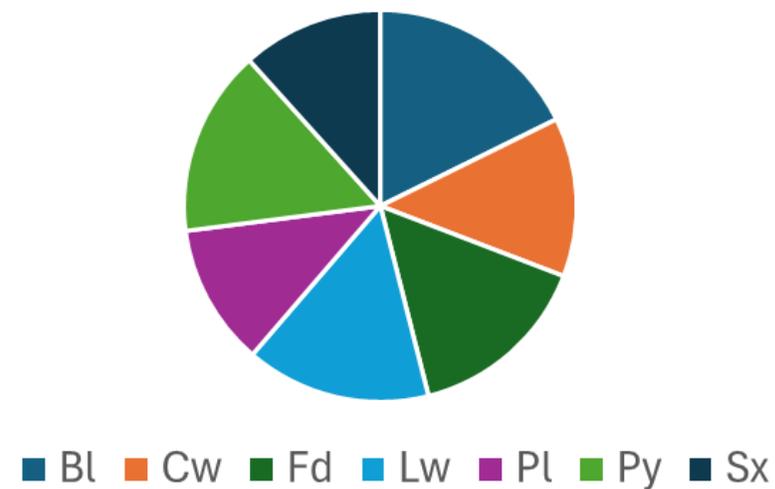
% Average Mortality by Year



Year of Drought Event ▾

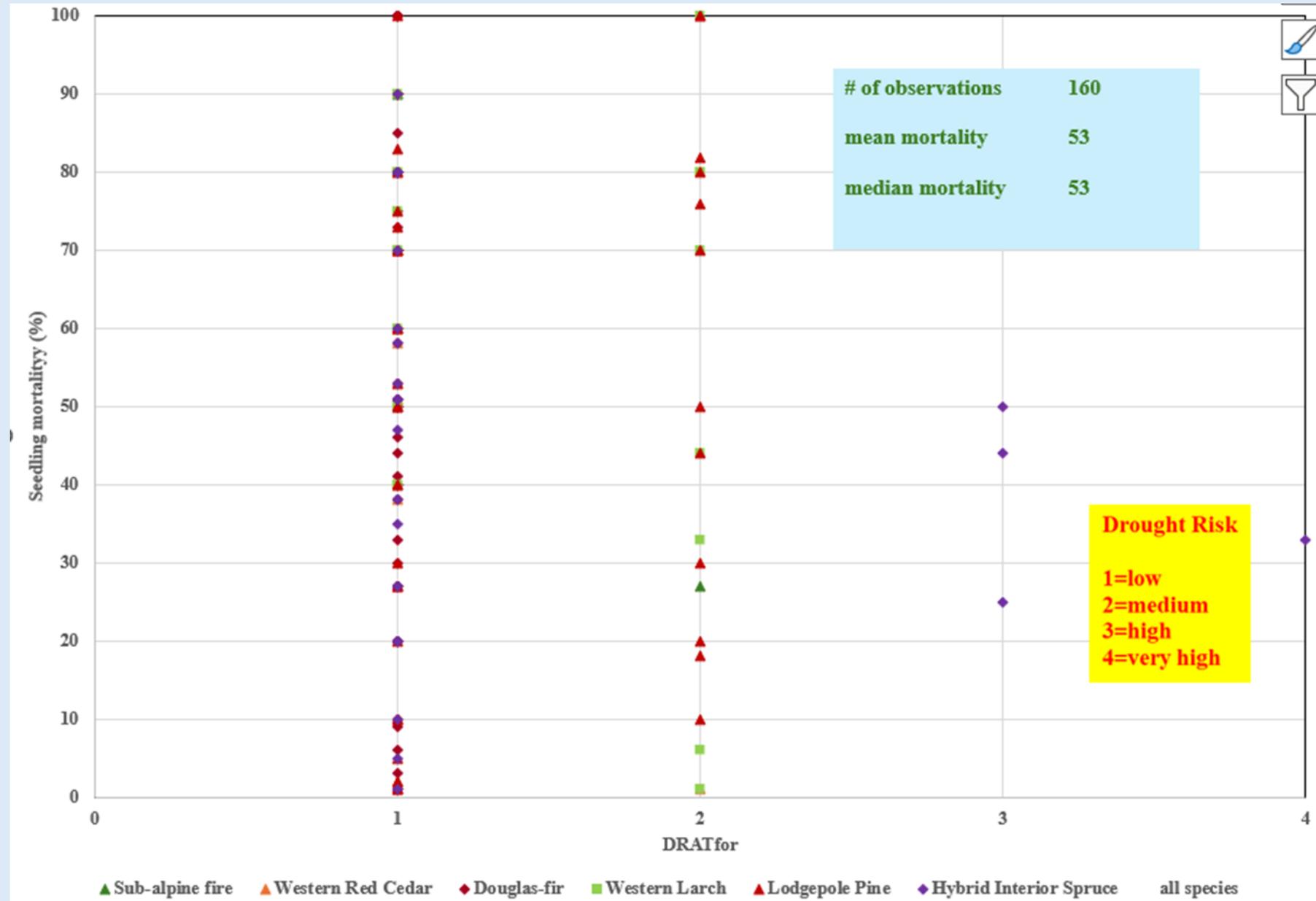
- >60% average mortality:
 - ICHmw1
 - ICHwk1
 - IDFxm1
 - IDFmw1

Average % Mortality by Species



ForDRAT

- Mortality occurred mostly in low ForDRAT risk, some moderate
- Serves as a check that drought mortality impacts unexpected?
- Fd all low risk
- Lw low, moderate
- Pl low, moderate
- Sx low, high
- Bl low, moderate
- Cw low



Observed drought and timing of SPEI drought

- West Fraser Drought Impacts 2017 and 2021
 - All areas of observed drought occurred during moderate to extreme SPEI values
 - Lowest SPEI 1-month (to highest): Jun, Jul, Aug, Sep, May
 - Lowest SPEI period (to highest): 3-month, 1-month, 6-month, 12-month, 24-month
 - Frequency of max month of drought: Jun (30), Aug (18), Jul (15), Sep (6)
- Survival Data collection, 2021
 - Most areas of observed drought occurred to moderate to extreme SPEI values
 - Lowest SPEI 1-month (to highest): Jun, Jul, May, Aug, Sep
 - Lowest SPEI period (to highest): 3-month, 1-month, 6-month, 12-month, 24-month
 - Frequency of max month of drought: Jul (244), Aug (98), Jun (72), Sep (3), May (2)
- Revised Data collection, 2017-2023
 - All areas of observed drought occurred during moderate to extreme SPEI values
 - Lowest SPEI 1-month (to highest): Jun, Jul, May, Aug, Sep
 - Lowest SPEI period (to highest): 3-month, 6-month, 1-month, 12-month, 24-month
 - Frequency of max month of drought: Jul (56), Jun (45), Sep (27), Aug/May (1)

Conclusions and next steps

- SPEI <-1.5 associated with observed drought mortality
- Most mortality occurred with SPEI <-1.5, 6-mth or less
 - Only one site with SPEI-12 month <-1.5, shorter SPEI ~-1
 - Less that 6-mth SPEI shown to correlate with 15 cm soil moisture data from MoF silviculture trials
- Few exceptions of mortality occurring in absence of SPEI <-1.5, or no mortality occurring with SPEI <-1.5.
- Max SPEI drought months: Jul, Jun, Aug
- Some testing with ForDRAT showed mostly observed drought was unexpected
- More work is needed:
 - Temperature and/or solar radiation induced mortality
 - Drought at time of planting (preliminary: yes, but also after)
 - SPEI and soil moisture measurements (preliminary: 15 cm soil moisture relates SPEI <6-mth)
 - Vapour pressure deficit

Extra

Why drought in recent years?

1. Natural Climate Variability:

- Negative phase of Pacific Decadal Oscillation
 - Overall dry conditions plus hotter summers

2. Climate Change:

- Increased temperature, increased evapotranspiration
- Decreased snow and ice
 - Feedbacks further increase temperatures
- Changes to jet stream
 - Precipitation moves north, prolonged periods of warm and or dry conditions
- Marine Heat Waves
 - Block precipitation from land

3. Land-use Change:

- Forest removal or thinning changes the hydrologic regime and regional climates
 - Decreased snow cover, soil moisture, overall water storage
 - Feedbacks increased temperature, evapotranspiration, overall water storage
- Increasing wildfires also changes hydrologic regime and regional climates

