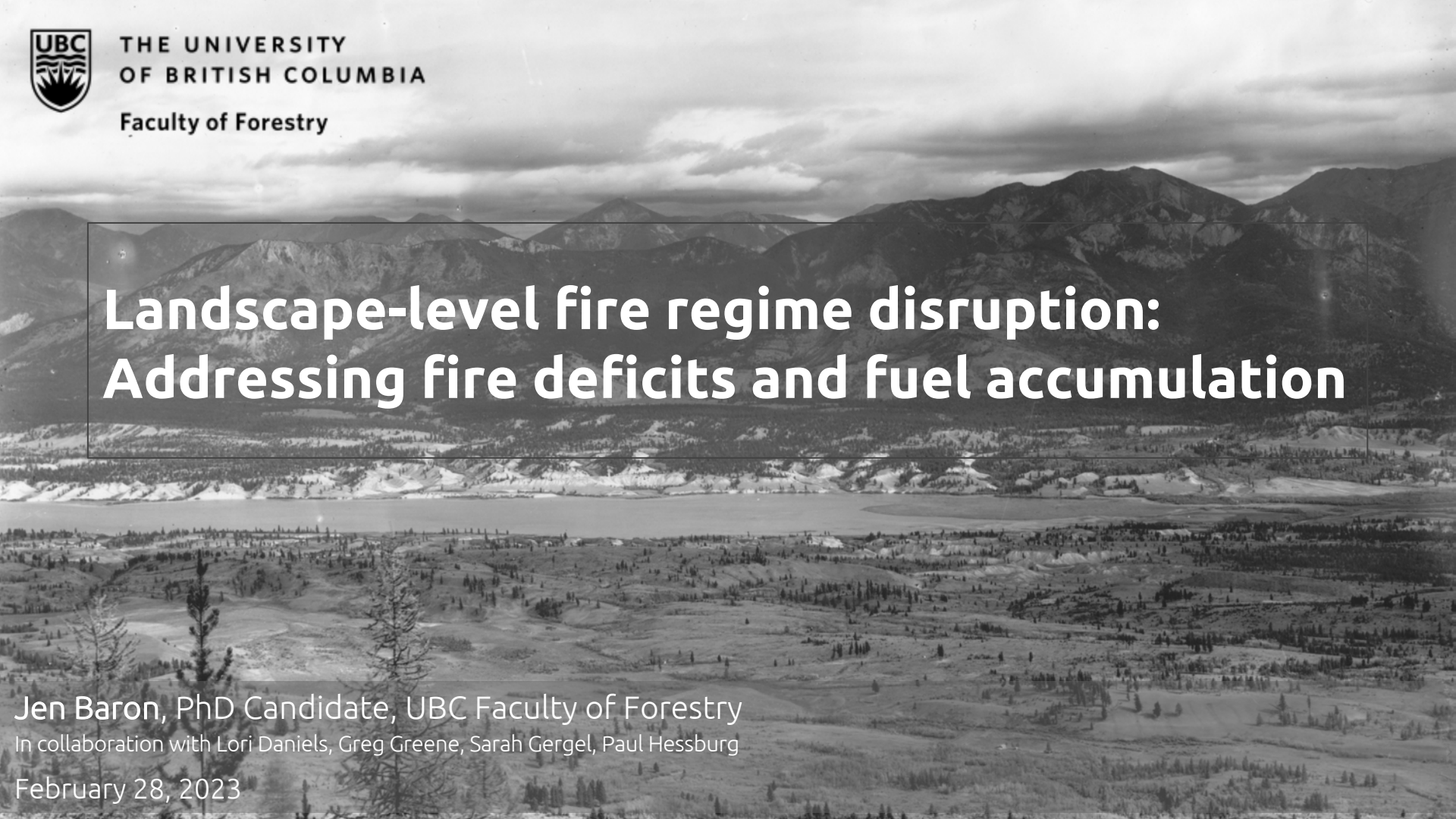

THE UNIVERSITY OF BRITISH COLUMBIA

Faculty of Forestry

Landscape-level fire regime disruption: Addressing fire deficits and fuel accumulation

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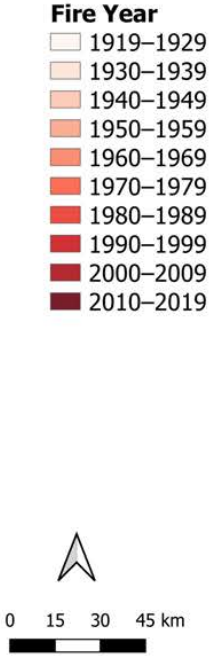
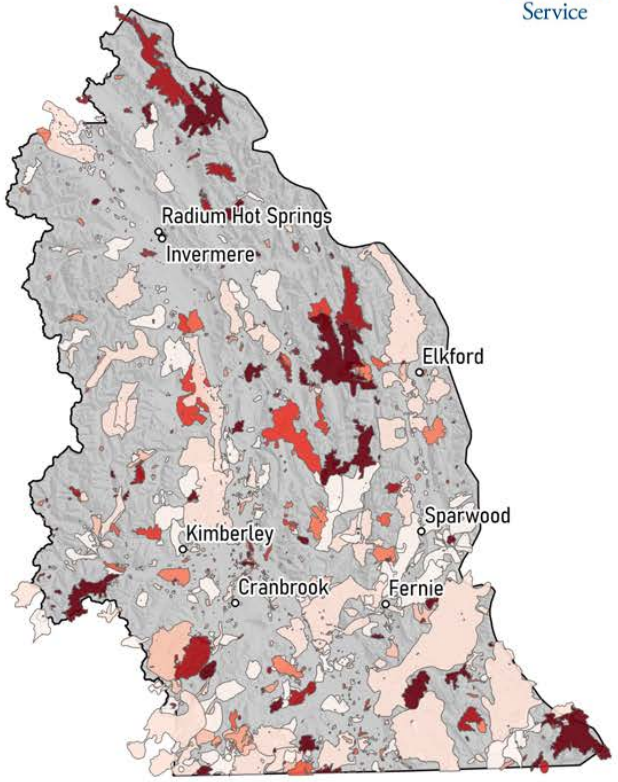
In collaboration with Lori Daniels, Greg Greene, Sarah Gergel, Paul Hessburg

February 28, 2023

Understanding altered fire regimes in southeastern BC





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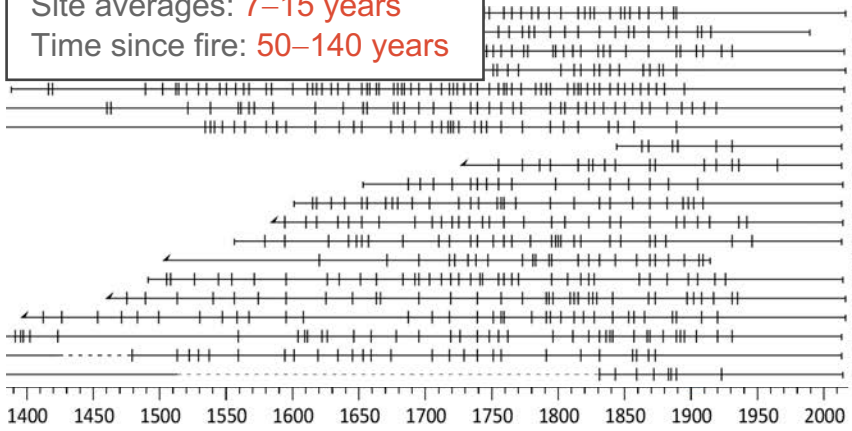
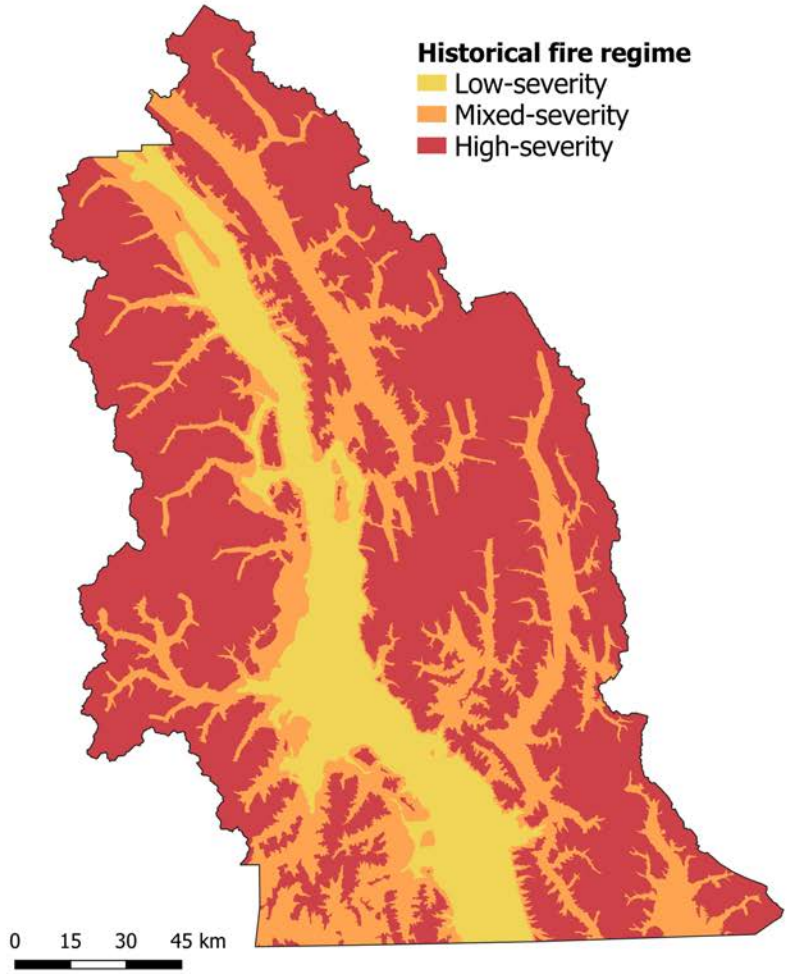
Historically active & diverse Indigenous fire regimes

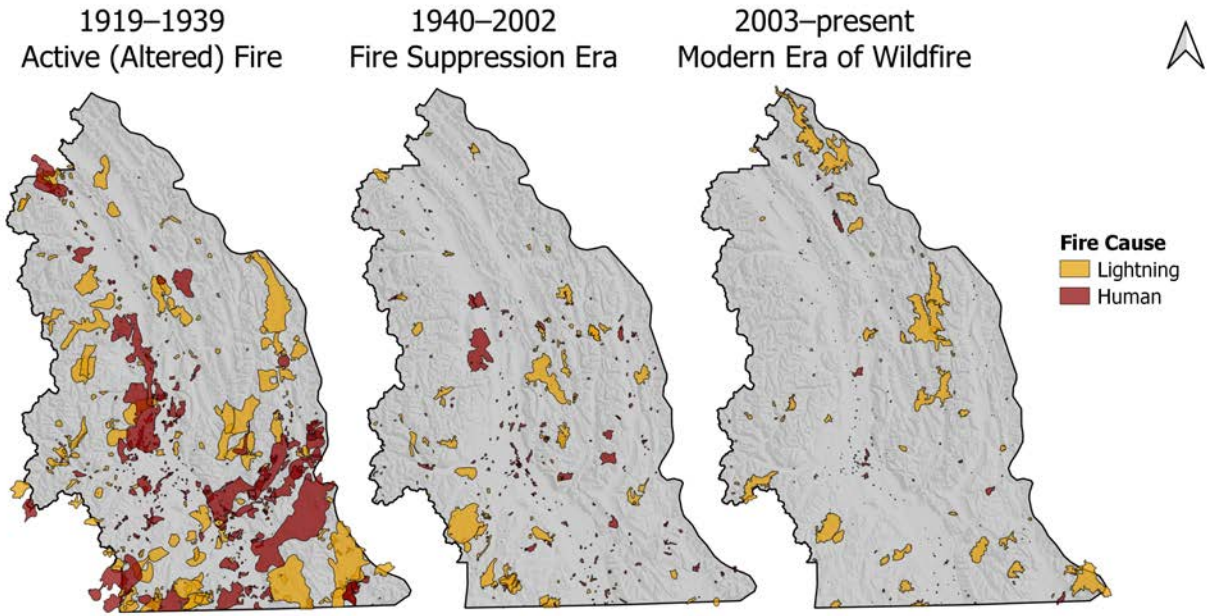
Historical fires (20 plots):
623 fires from 1207–1965
Site averages: 7–15 years
Time since fire: 50–140 years

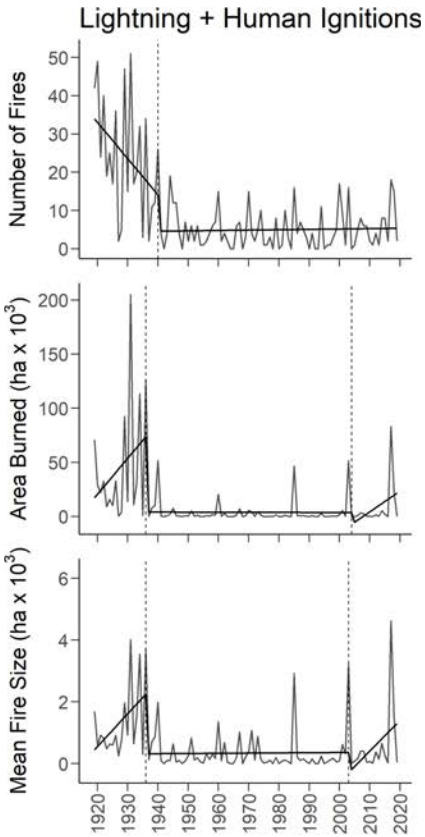




Greene 2021, Chavardès et al. 2021, Marcoux et al. 2013, 2015

1919–2019: 3 phases of fire regime transformation





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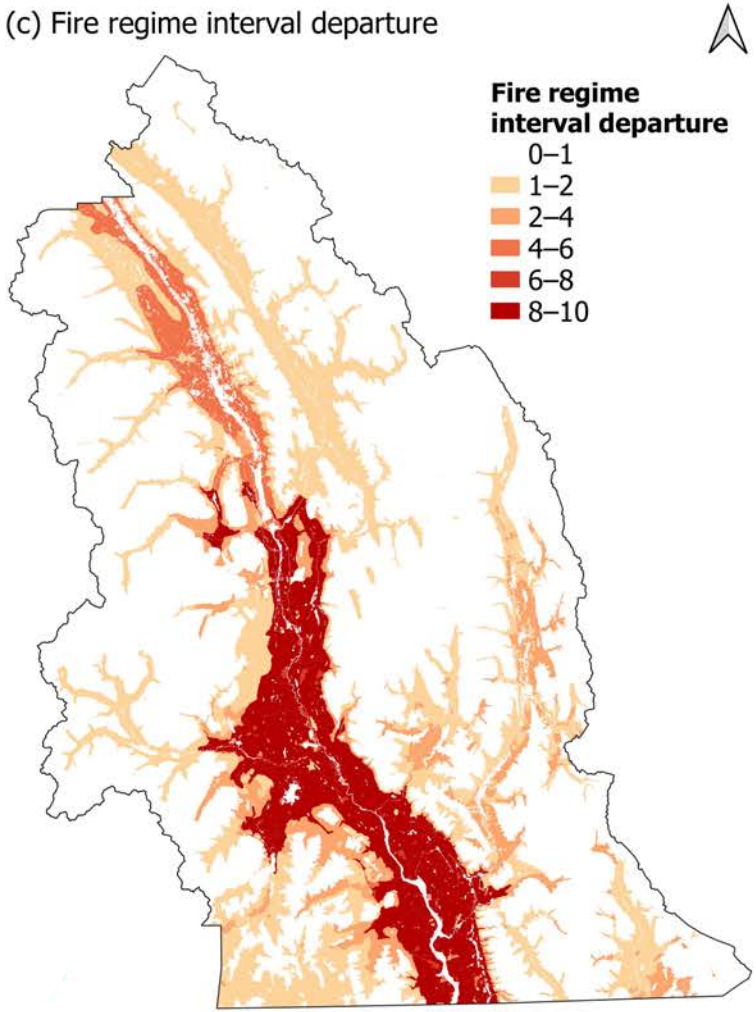
Large fire deficit across fire regimes and forest types

- At least 46.4% of landscape in a large fire deficit
- Dry, low elevation forests experience the greatest deficits (6-10 fires missed)
- Mid-montane forests also highly departed (1-6 fires missed)



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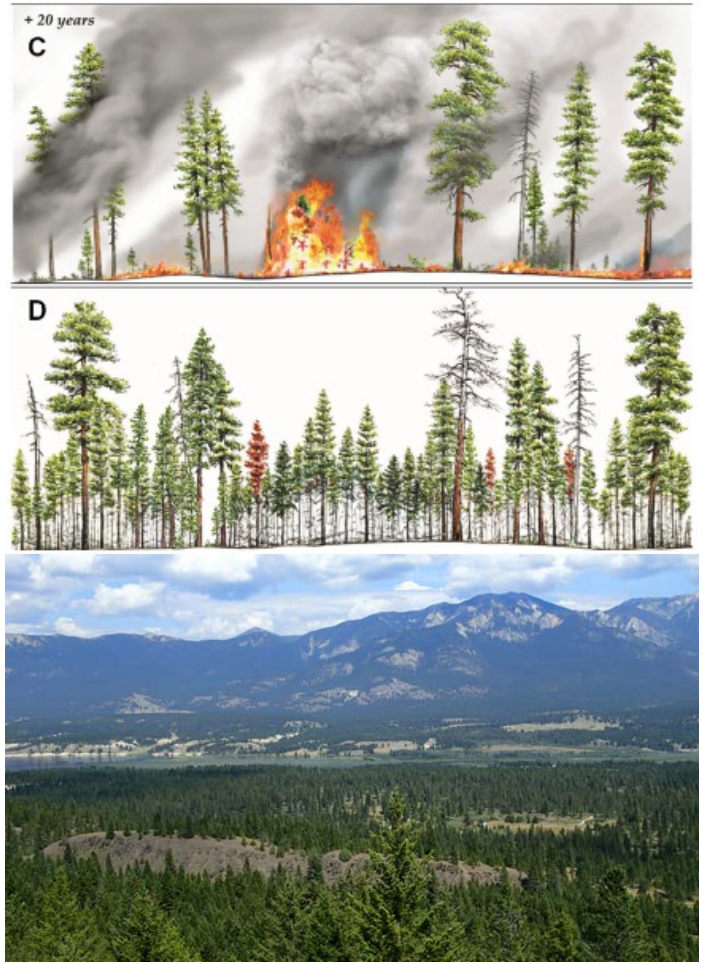
Consequence of fire deficits: Fuel accumulation

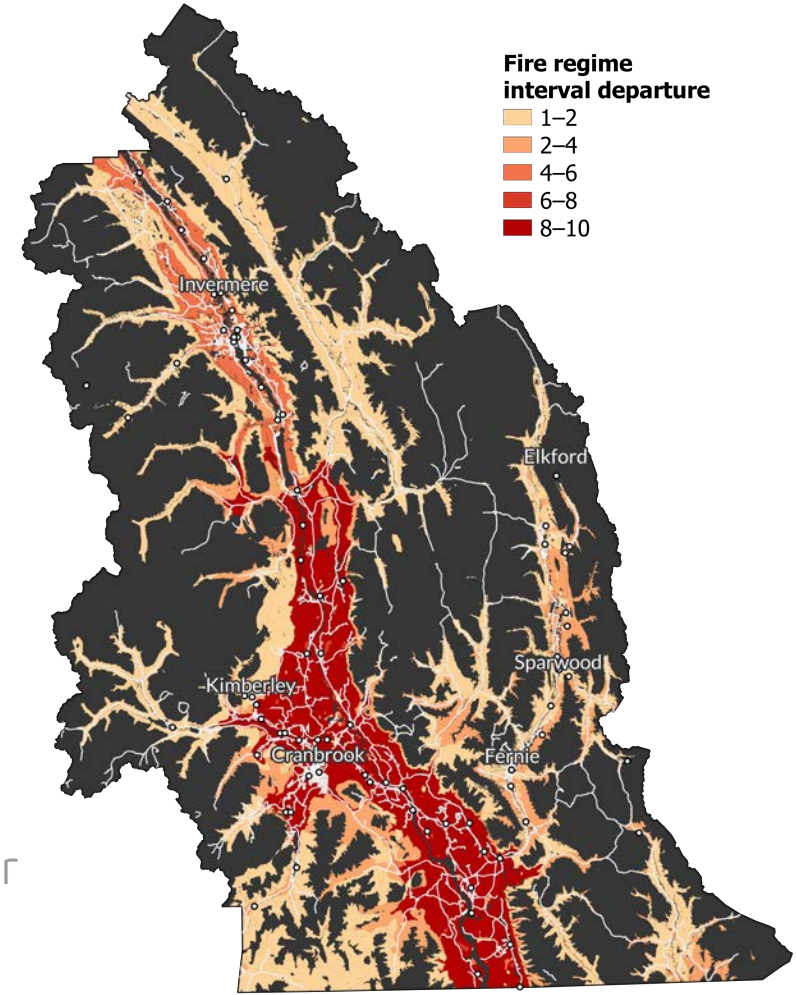
- Altered structure, composition, and spatial pattern of ecosystems
- Large fuel accumulations, fuel ladders, and widespread contagion
- Altered species compositions
- Patchwork mosaic
  → continuous fuels matrix



Hessburg et al. 2019, Hagmann et al. 2021

Fire deficits and fuel accumulation expose communities

- Fire deficits are greatest near communities
- Human ignitions in WUI require quick response
- Lightning ignitions in backcountry threaten escape
- Concern over extreme fire weather and resources



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Linking fire deficits to fuel accumulation

- **Question:** Where are the fuel accumulations on this landscape, and how do they relate to fire deficits?
- Addressing fuel accumulations requires representative, spatially explicit fuels data

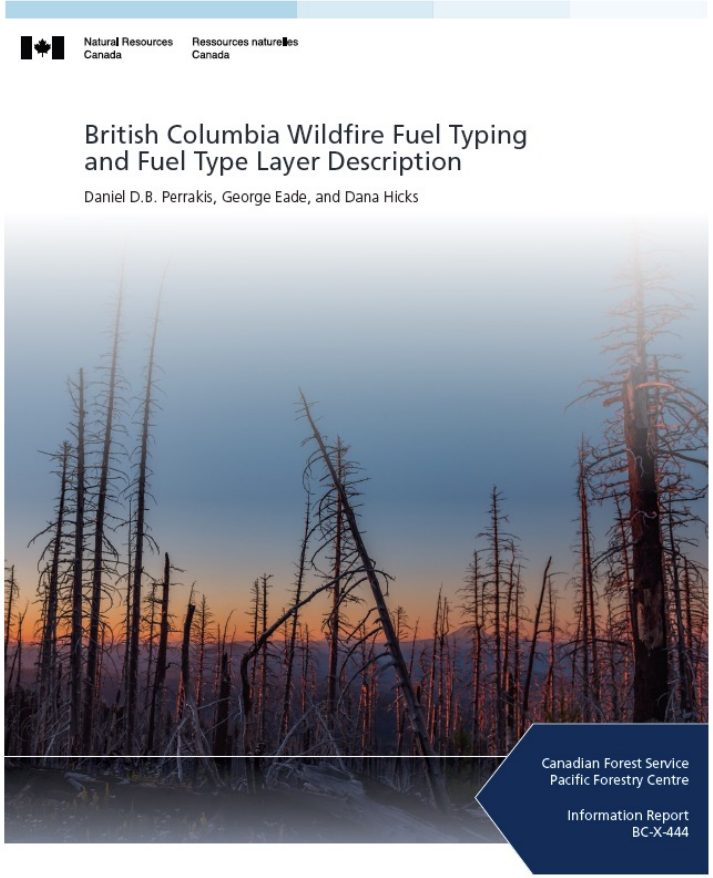
Table 2. FBP System fuel types.

Group / Identifier	Descriptive name
Coniferous	
C-1	Spruce–lichen woodland
C-2	Boreal spruce
C-3	Mature jack or lodgepole pine
C-4	Immature jack or lodgepole pine
C-5	Red and white pine
C-6	Conifer plantation
C-7	Ponderosa pine–Douglas-fir
Deciduous	
D-1	Leafless aspen
Mixedwood	
M-1	Boreal mixedwood–leafless
M-2	Boreal mixedwood–green
M-3	Dead balsam fir mixedwood–leafless
M-4	Dead balsam fir mixedwood–green
Slash	
S-1	Jack or lodgepole pine slash
S-2	White spruce–balsam slash
S-3	Coastal cedar–hemlock–Douglas-fir slash
Open	
O-1	Grass

Baron et al. in-prep, Forestry Canada Fire Danger Group 1992

Characterizing fuels with available data

- Provincial & National Fuels Data (FBP):
  - BCWS Fire Fuel Types
    - Decision tree based on VRI polygons (50 m)
  - CFS CanFG
    - Remote sensing (MODIS), Ag Canada, NBAC (250 m)



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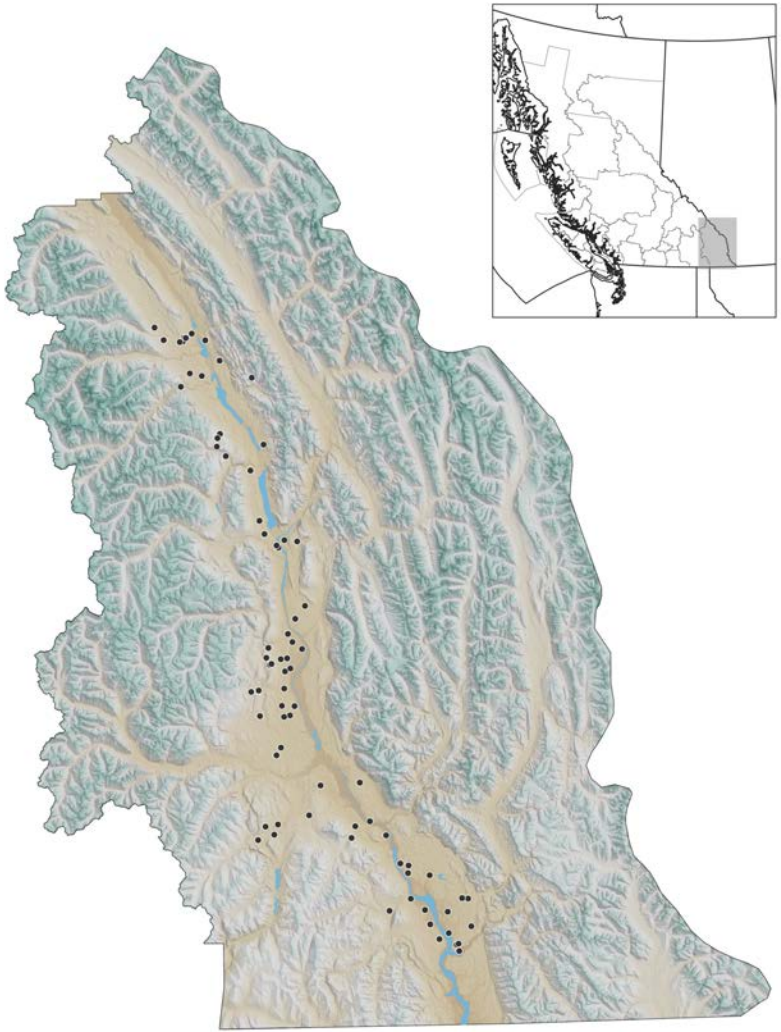
Characterizing fuels: Accuracy assessment

- **Question:** What is the accuracy and applicability of FBP fuel types & data to forest conditions in interior BC?
- Comparisons of BCWS & CFS fuels to:
  - i) Field assessments
  - ii) Sampled conditions



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O1 - Grass


C7 – Ponderosa Pine-Douglas-Fir


C3 – Mature Jack or Lodgepole Pine


C4 – Immature Jack or Lodgepole Pine

Characterizing fuels: Decision tree process

bcwft.py

```
    '''

    def isVegetated(self, inData):
        ## Function determines if inData is vegetated
        if isinstance(inData, pd.DataFrame):
            df = inData.iloc[0]
        else:
            df = pd.DataFrame([inData], columns=self.fldList).iloc[0]
        # print(df) # FOR ERROR CHECKING

        if df.BCLCS_LEVEL_1 == 'V':
            return True
        elif df.BCLCS_LEVEL_1 == 'N':
            return False
        else:
            return None

    def isForested(self, inData):
        # Check if polygon is forested with >=10% crown closure
        if isinstance(inData, pd.DataFrame):
            df = inData.iloc[0]
        else:
            df = pd.DataFrame([inData], columns=self.fldList).iloc[0]
        # print(df) # FOR ERROR CHECKING

        if df.BCLCS_LEVEL_2 == 'T':
            del df
            return True
        elif df.BCLCS_LEVEL_2 == 'N':
            del df
            return False
        else:
            del df
            return None

    def isLogged(self, inData):
        ## Determine if inData is logged
        if isinstance(inData, pd.DataFrame):
            df = inData.iloc[0]
        else:
            df = pd.DataFrame([inData], columns=self.fldList).iloc[0]
        if type(df.HARVEST_DATE) != type(None):
            return True
```

- BC Land Cover Classification Level 1 (BCLCS_level_1): **Vegetated** (V) or **Non-Vegetated** (N); vegetated status is assigned when the total cover of all vegetation and bryoids (excluding crustose lichens) covers at least 5% of the surface area of a polygon[16]
- BCLCS_Level_2: **Treed** (T) or **Non-treed** (N); non-treed is assigned when crown cover of all trees of any size<10%[16]
- BCLCS_Level_3: Designate various categories of broad land cover; used in FTL to designate **Alpine** (A) areas, consisting of rock and ice and very little vegetation cover
- BCLCCS_Level_5: Crown Closure category (**Dense** (DE: 61–100%), **Open** (OP: 26–60%), **Sparse** (SP: 10–25%))[16]
- Species Code 1 (Species_cd_1): species of dominant tree (based on basal area for older stands; stems/ha for very young stands) [17]; e.g. **Pl**, **Fd**, **Sx**
- Species_cd_2: species of 2nd (co-)dominant tree
- Species_pct_1: percentage cover of dominant tree species, based on percent of total area of forest cover within a polygon (Species_pct_1 through Species_pct_6 must add up to 100, regardless of actual canopy cover within a polygon)[16]
- Species_Pct_2: percent cover of 2nd dominant tree species
- Sp1 Height: (Proj_Height_1): projected height, in m, of dominant tree species
- Sp1 Age: (Proj_Age_1): projected age of dominant tree species
- Crown_closure: percentage of plot area covered by tree canopy, used to infer stand density[16]
- BEC_zone_code: Biogeoclimatic Ecosystem Classification zone[18]
- BEC_subzone: Biogeoclimatic Ecosystem Classification subzone
- Harvest_date: year of most recent harvest activity (null if never harvested)
- Earliest Non-Logging Disturbance Type (Earliest_nonlogging_dist_type): category code used to identify disturbances such as insect attack, fire, etc.
- Earliest_non-logging_dist_date: estimated year of disturbance (e.g. year of mountain pine beetle attack)
- Stand_percentage_dead: derived percentage of overstory trees estimated to be dead (new or older snags)
- VRI_live_stems_per_hectare: stand density of live overstory trees/ha
- VRI_dead_stems_per_hectare: stand density of dead overstory trees/ha

Characterizing fuels: Common mismatches

- Interior Douglas-fir dominated
  - Mature, even-aged
  - Immature, infilled
- Post-harvest
  - Selective harvest, regen, & slash
- Mixed-wood
  - Trembling aspen & larch

Baron et al. in-prep

Characterizing fuels: Collaborative research needs

- Expertise
  - On fuel types and fire behaviour, operational implications
- Metadata & Information
  - Changes made to 2018 decision tree
  - Pre- and post-processing + errors