

## Introduction

Forested catchments yield high-quality drinking water at comparatively low cost, but are susceptible to wildfire. Following fire, elevated erosion rates can contaminate water supplies by increasing delivery of sediment, nutrients, and other pollutants to receiving reservoirs. Subsequent changes in water turbidity, chemistry, and biology may leave it unsuitable for drinking, and treatment may be costly or unfeasible.

Sooke Lake Reservoir (SLR) is a dammed natural lake that supplies municipal water to approximately 350,000 people on southern Vancouver Island, British Columbia. Water supply managers have identified wildfire as the foremost threat to this critical water source.

This study seeks to understand wildfire disturbance dynamics and impacts within the Sooke Lake Watershed (SLW), and how climate change might affect these processes.

Paleoenvironmental records preserved in reservoir sediments are being analyzed to reconstruct the Holocene fire history of the SLW and characterize the regional long-term relationships among climate, vegetation, and wildfire. Furthermore, high-resolution analysis of paleoenvironmental proxies from before, during, and after select ancient fire events will facilitate the study of short-term fire impacts in the SLW.

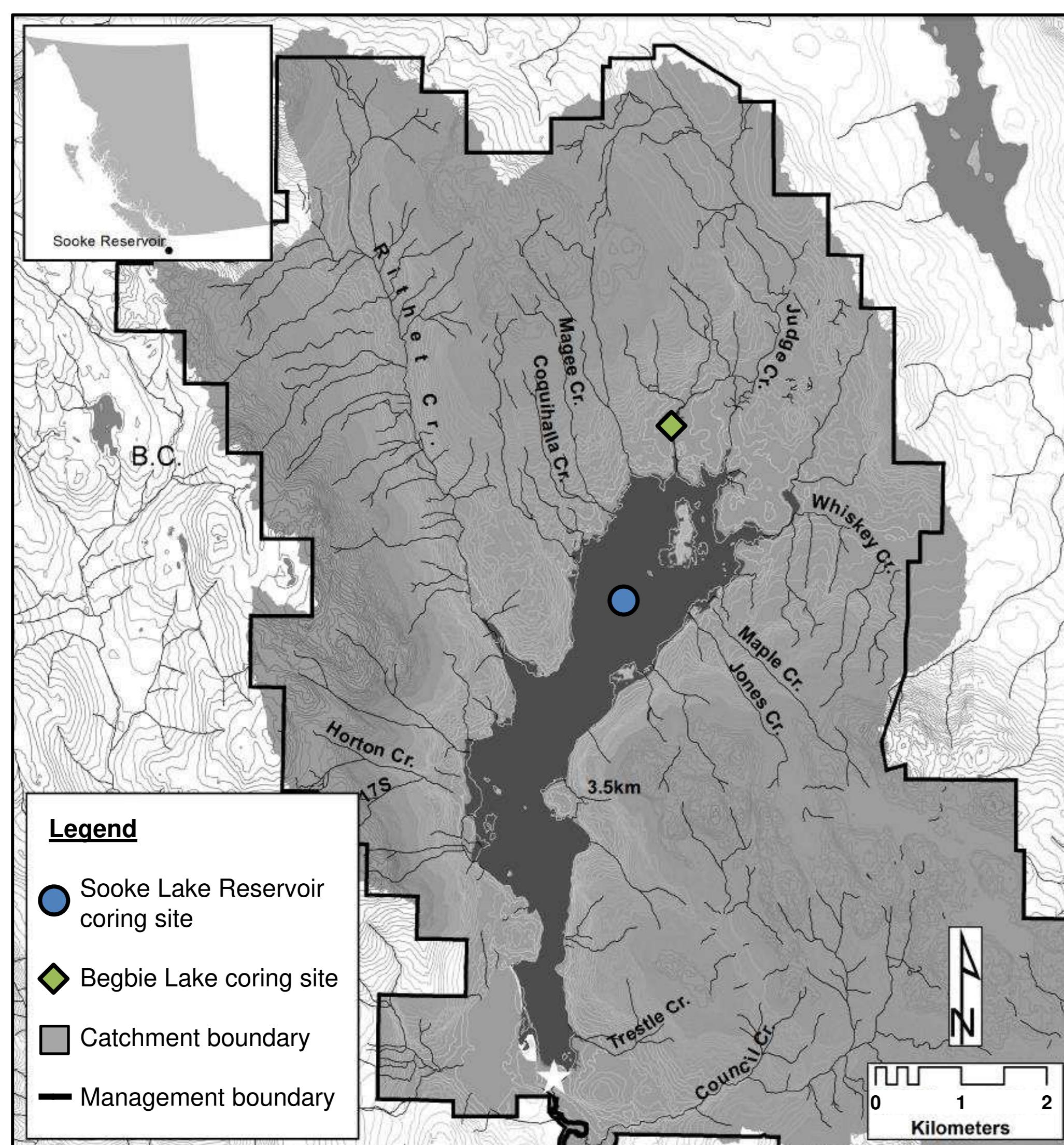


Fig. 1: SLR and watershed with coring locations marked. Adapted from Werner et al. (2015).

## Study Area

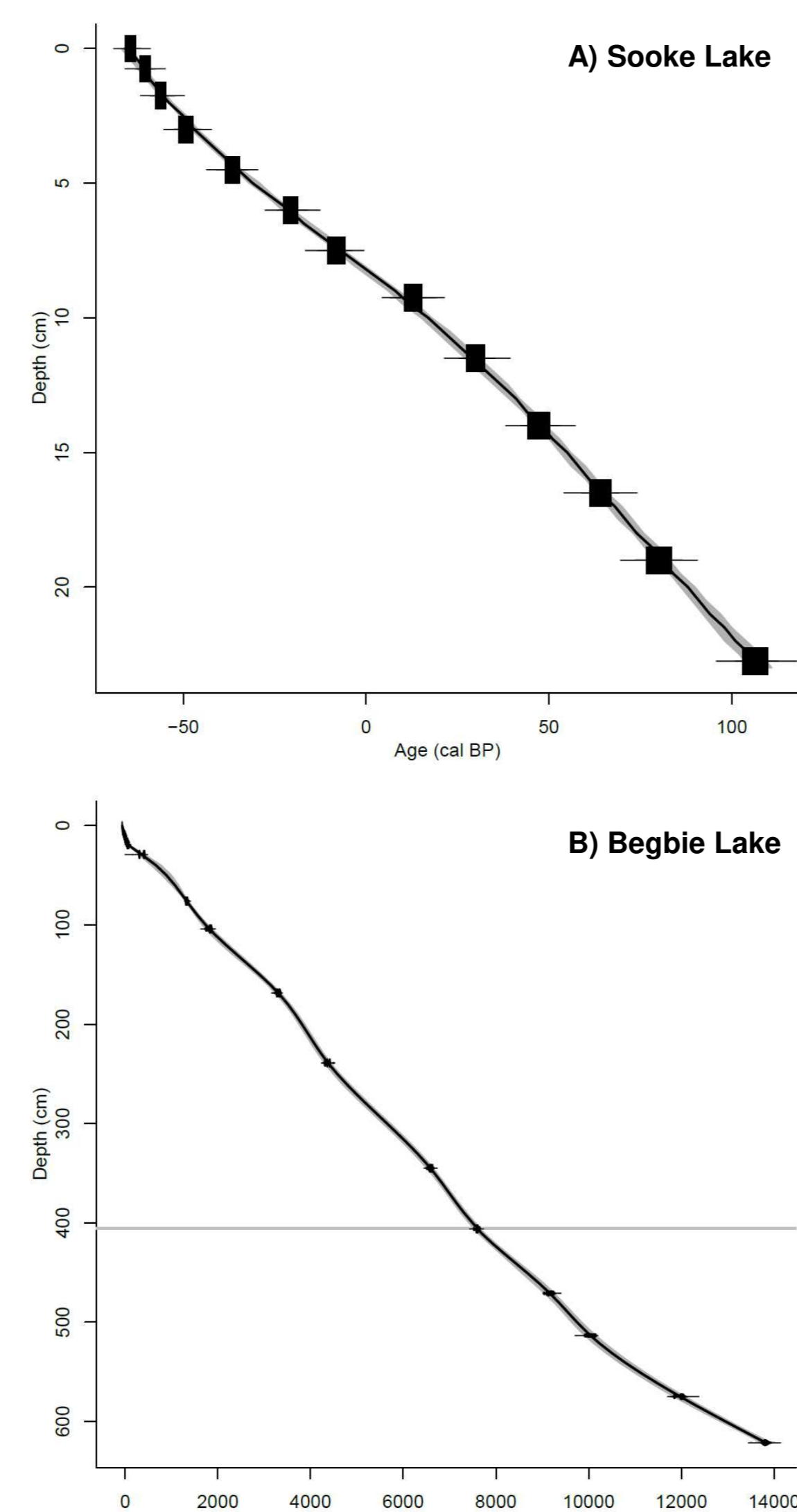
- CWHxm BEC zone: western hemlock, Douglas fir, western red cedar.
- Warm, dry summers and mild winters; mean annual precipitation ~1500 mm.
- Fires are low-likelihood, high-impact disturbance events.
- SLR: 7.35 km<sup>2</sup>, holding capacity of 92.7 million m<sup>3</sup>, max. depth 74 m.
- Begbie Lake: Small lake situated ~300 m north of SLR, connected via a short channel.

## Methods

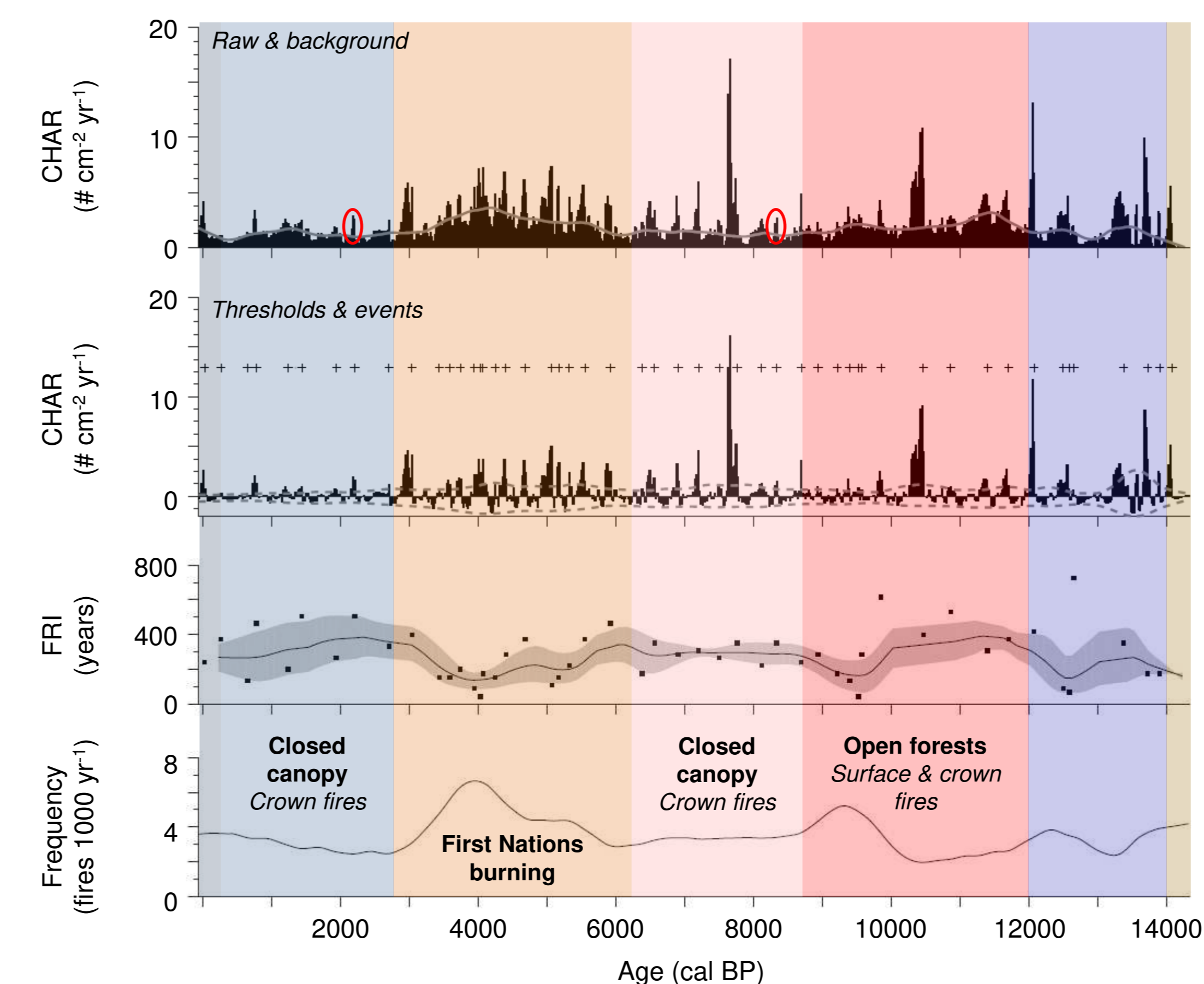
- Sediment cores were collected from SLR and adjoining Begbie Lake.
- Age-depth profiles were constructed using radiometric dating of bulk sediment and macrofossils.
- Cores were sampled at 0.5-1.0 cm (ca. 20-year) resolution and analysed for charcoal, pollen, and magnetic susceptibility to identify fire events and establish long-term climate, vegetation, and fire relationships.
- Three high-severity fire events, defined by concurrent peaks in charcoal and magnetic susceptibility, are subsequently being investigated at higher (2 mm; ca. 4-year) resolution:
  - Event 1: Warm dry Early Holocene (ca. 9900 BP)
  - Event 2: Cool wet Late Holocene (ca. 2200 BP)
  - Event 3: Historical pre-industrial era (ca. 200 BP)
- These events are currently being analysed for a suite of fire impact indicators, including: charcoal, magnetic susceptibility, total carbon (C) and nitrogen (N), C and N isotope ratios, mineral grain size, pollen, and diatoms.
- Combustion analysis and isotope ratio mass spectrometry were used to quantify changes in sediment C and N content and stable isotope fractionation, indicative of fire severity and recovery.
- Grain size will be used to examine fire-induced erosion, while pollen and diatoms will provide a record of terrestrial and aquatic impacts and recovery, respectively.

## Preliminary Results

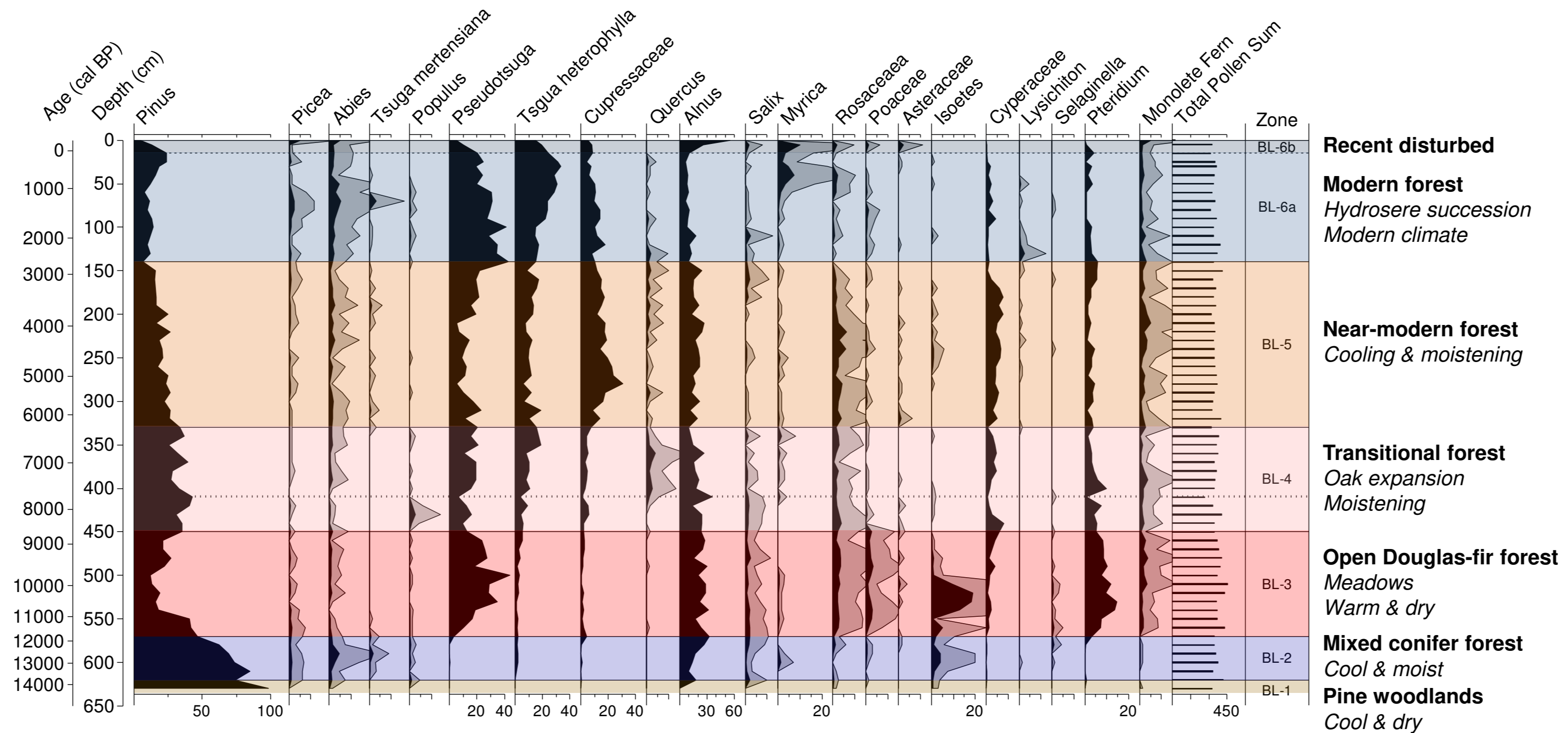
### 1. Age-depth models



### 2. Begbie Lake fire history reconstruction

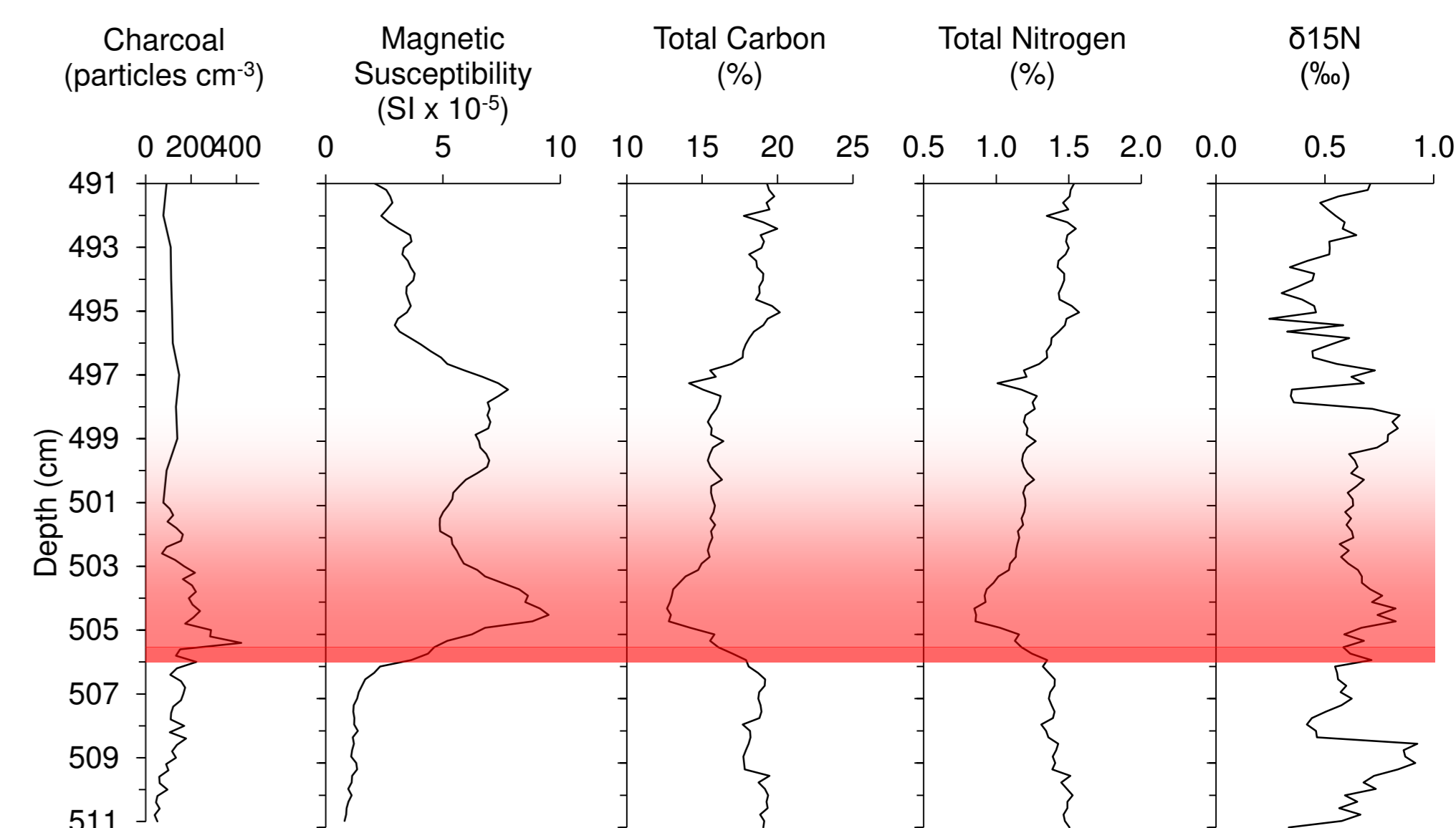


### 3. Begbie Lake vegetation history reconstruction (pollen percentage diagram)

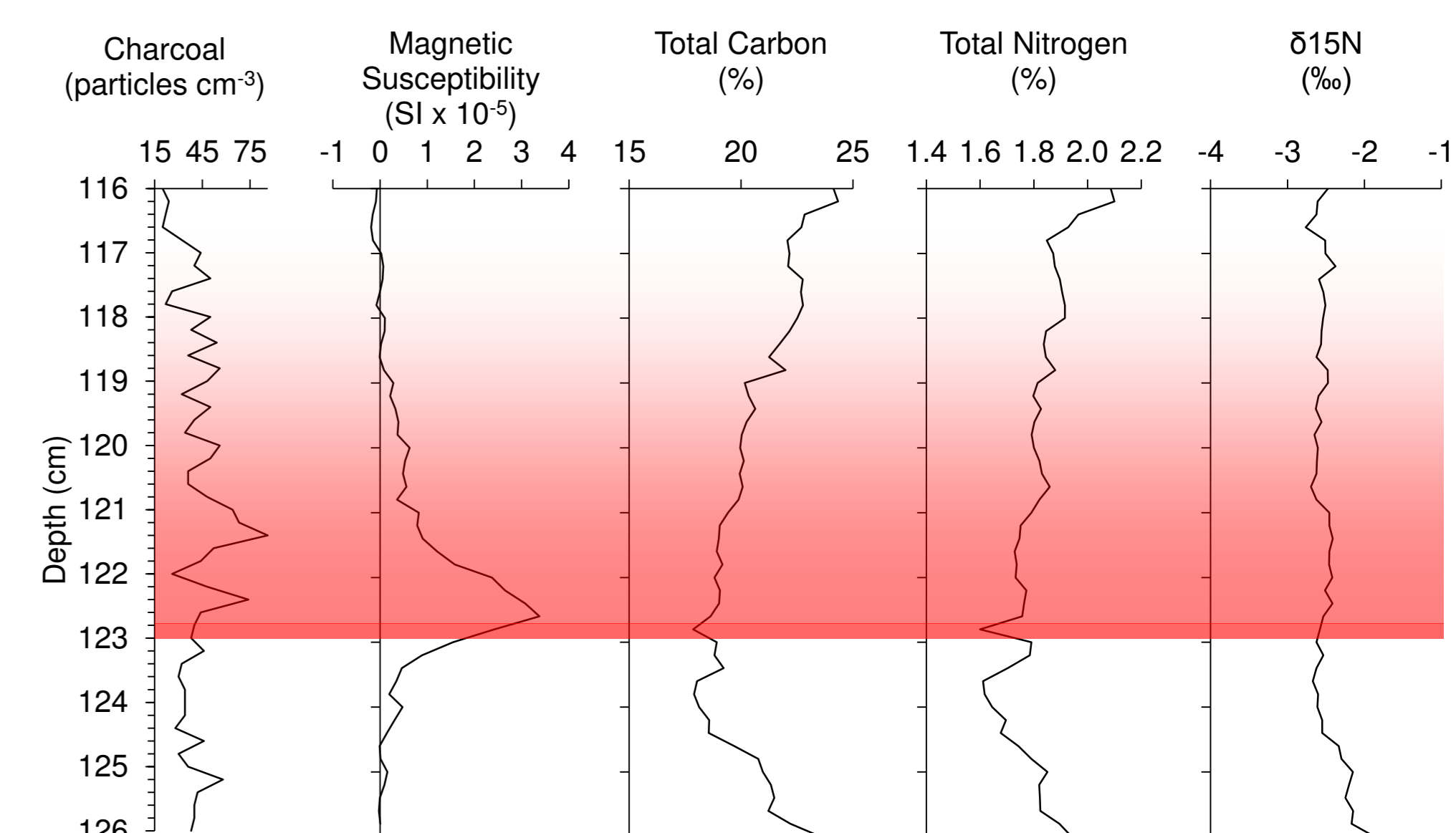


## Preliminary Results Continued

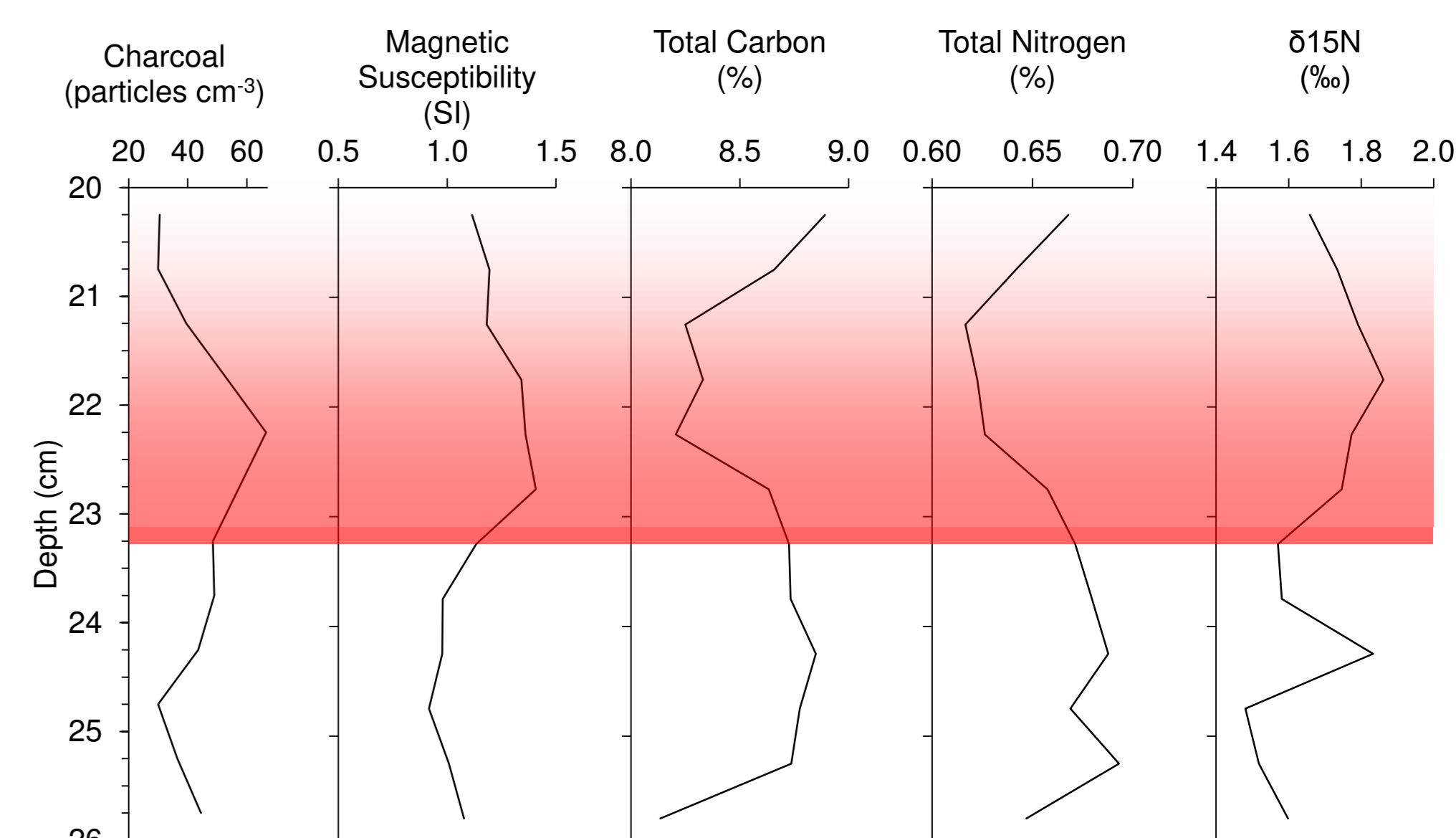
### 4. Event 1 (ca. 9900 BP) fire proxies



### 5. Event 2 (ca. 2200 BP) fire proxies



### 6. Event 3 (ca. 200 BP) fire proxies



## Discussion and Conclusions

- Warm & dry climate with open Douglas fir forests ca. 12-8.5 ka cal BP associated with frequent low-severity surface fires, with intermittent crown fires.
- Modern forest Hydroser succession Modern climate
- Modern disturbance established thereafter, with evidence of Aboriginal burning between 6-2.5 ka cal BP.
- From high-resolution analysis, several proxies record fire event impacts and ecosystem recovery.
- Reduced total C & N post-fire are reflective of destruction of organic matter and/or increased inorganic inputs.
- δ<sup>15</sup>N profiles are less clear.

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