Personal Statement

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Substantive Eligibility

- In the context of a warming climate, the necessity of trees in cities is increasing.
- Benefits of city trees:
  - Water retention
  - Urban heat islands
  - Decreased pollution
  - Increased wellness
- With longer seasons, increased heat waves, drought, and pest invasion, city trees could decline.
- In the Greater Vancouver area, trees from all around the continent are planted—from red oaks to birches, sequoias to pines—so understanding how they will respond to increasing temperatures is essential to prevent their decline and eventually replant more resilient species.
- If longer seasons lead to increased growth, this would raise timber value. However, if the relationship is negative, setbacks could be enormous.
- One of the mitigation strategies for decreasing fire risks (in addition to prescribed burns by Indigenous people) is to plant deciduous trees such as balsam poplars and paper birch.

EDI and Indigeneity

- The fact that most trees in cities are planted in wealthy areas and that impoverished, often have less trees
- More access to parks. Paper showing that parks and neighbourhood richness are negatively correlated.
- Provide support to Indigenous communities in BC on which species, from which provenances should be planted to mitigate fire risks and boost biodiversity

Research Statement

In temperate and boreal forests, temperature plays a crucial role in setting the boundaries for seasonal physiological activity. Thus, with rising temperatures from anthropogenic climate change, the climatically possible growing season has lengthened in many ecosystems worldwide by up to 11 days.[?, ?] Plants have tracked this through shifts in phenology—the study of recurring life history events—which are expected to continue with increasing temperatures.[?] In particular, trees have shifted earlier in the spring and may use these extra days to fix more carbon and increase growth during the current growing season.[?, ?] At the same time, fall events in trees (e.g., leaf senescence) have been delayed, but the impacts on their fitness are not well understood. Together earlier spring and delayed fall events are often hypothesized to affect growth in the next growing season. This is rarely tested, however, and tests to date have used adult trees where many co-varying factors make teasing out the effect of longer seasons difficult. Here, I propose an extended season experiment using saplings to mechanistically test this critical hypothesis. My proposed work will provide valuable insight into the regeneration capacity of forests under a warming climate, considering the importance of young trees on forest recruitment.[?]

Research Question: How do extended growing seasons affect tree growth across different species both immediately (in the same year as the extended season) and in subsequent years?

Hypothesis: I hypothesize that an extension of the growing season could modify a tree's capacity to fill carbon and nitrogen storage pools.[?,?] Trees that use this opportunity by fixing more carbon may experience increased growth in the subsequent growing season.[?,?] Thus, species capable of accumulating nutrients after growth cessation while going through leaf senescence might exhibit growth increment in the following growing season.[?]

Chapter 1

Objectives: First, I aim to assess tree species' potential to prolong or stretch their activity schedule. Second, I will determine whether trees can absorb nutrients beyond their theoretical growing season. I will also examine if increased carbon pools translate into greater growth increments in the following growing season. Finally, I will investigate potential variations in these responses across deciduous and evergreen species, to test whether different patterns emerge within these distinct groups.

Chapter 2

Objectives

- how trees grown from saplings (like they are often planted in cities) in an urban Arboretum have their growth affected by their phenology and year climate.

- understand how the phenological events of mature deciduous trees relate to their growth.

- To investigate the impact of manipulated spring and fall temperatures on phenological responses, I successfully conducted experiments in 2024 across seven different tree species under controlled conditions, including species that span both fast and short-life strategies (e.g., *Populus balsamifera*) and slow growth and longer lifespan species (e.g., *Quercus macrocarpa*) and including both deciduous and evergreen species.[?] I used a full factorial design of spring and fall warming with two levels each (control/warmed) resulting in four treatments plus an additional two treatments to test fall nutrient effects, using 15 replicates each for a total of 630 individual trees. Throughout the growing season of 2024, I tracked phenological events weekly from the start of the spring treatments through the end of the fall treatments. During the growing season of 2025, the same measurements will be performed. In fall 2025, after the trees have grown in ambient temperatures for the season, I will assess growth on the individual (total biomass) and the cellular level (number of cells and their characteristics), using dendrochronological methods.

- Phenological observations were conducted for 5 years and tree cookies were collected in beginning of 2023. I measured tree ring width of each cookies.

- A citizen science program was conducted at the Arnold Arboretum of Harvard University since 2015. Thousands of phenological observations have been recorded on 53 trees. For the first time, the phenology of mature trees and its relation to year growth on the cellular level will be assessed. As most of the trees used in this study are planted accross North America, for example,

  - Red maple (Acer rubrum):
  - River birch (Betula nigra)
  - Yellow birch (Betula alleghaniensis)
  - Northern Red Oak

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