

Linking radial growth patterns and post-disturbance dynamics in boreal old-growth forests driven by recurrent insect outbreaks: a tale of opportunities, successes, and failures

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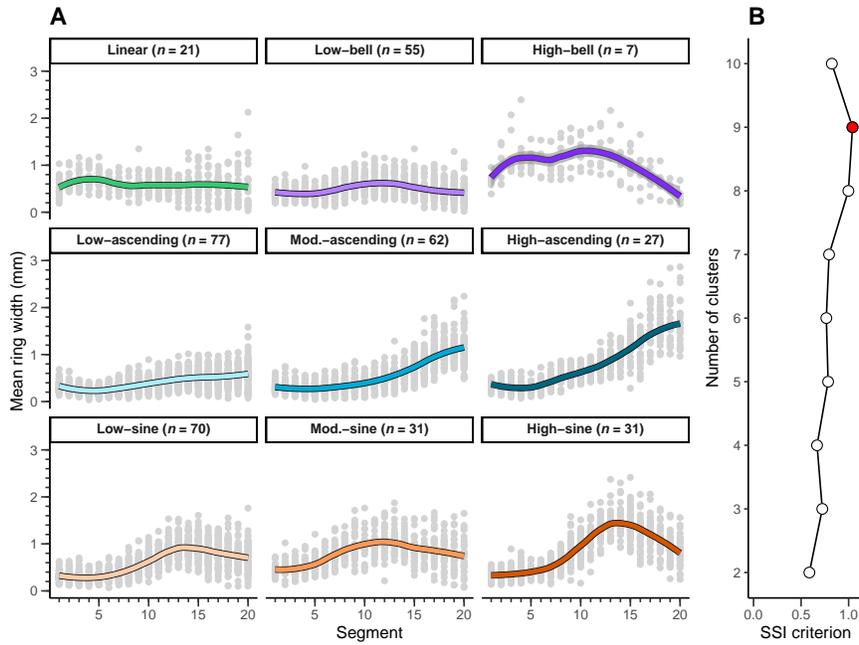
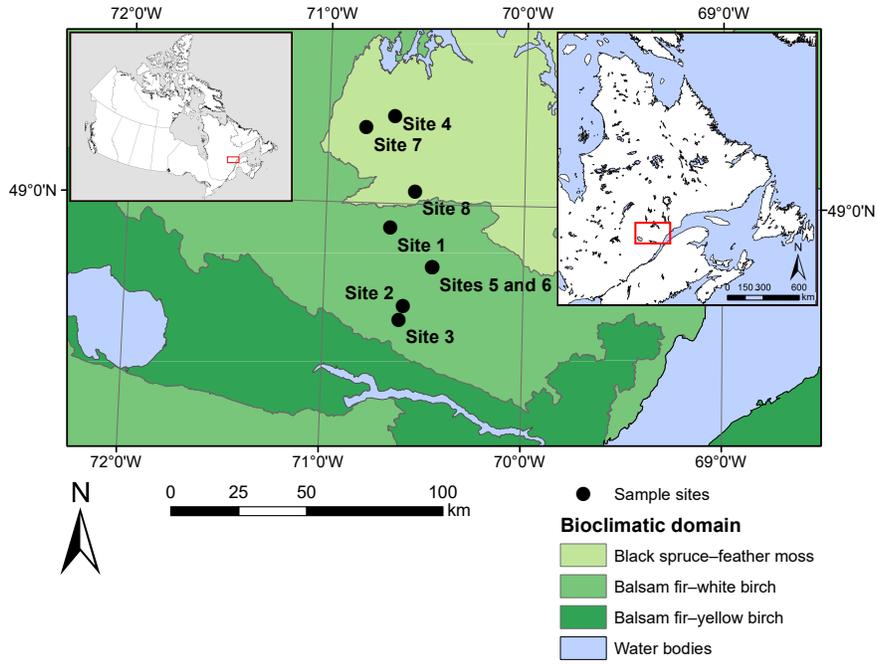
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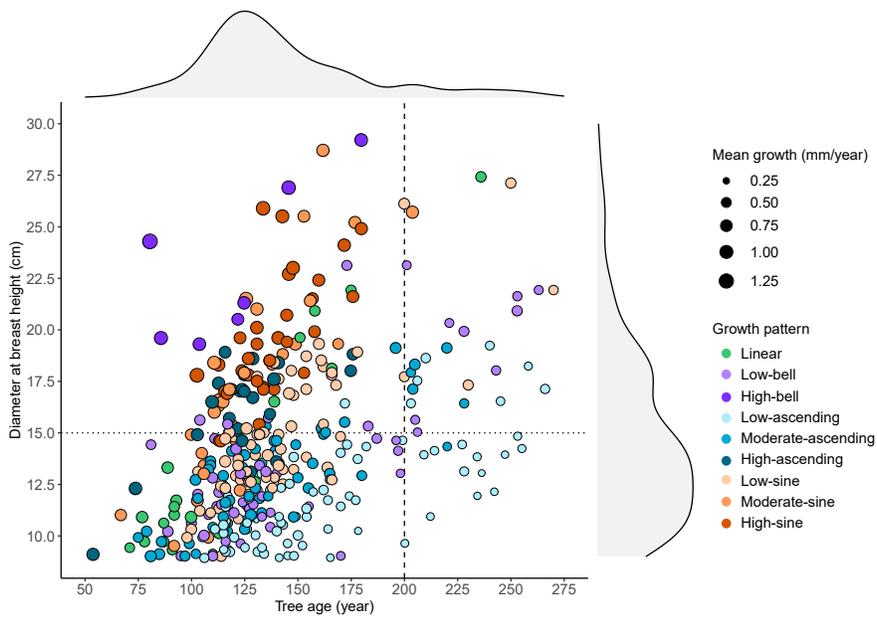
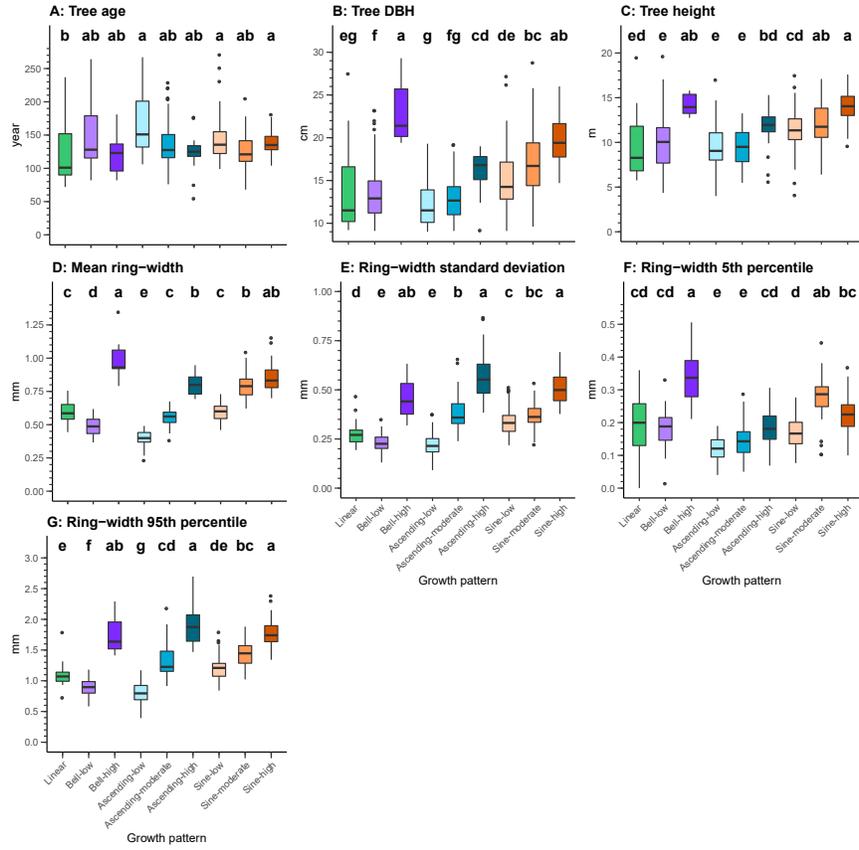
Abstract

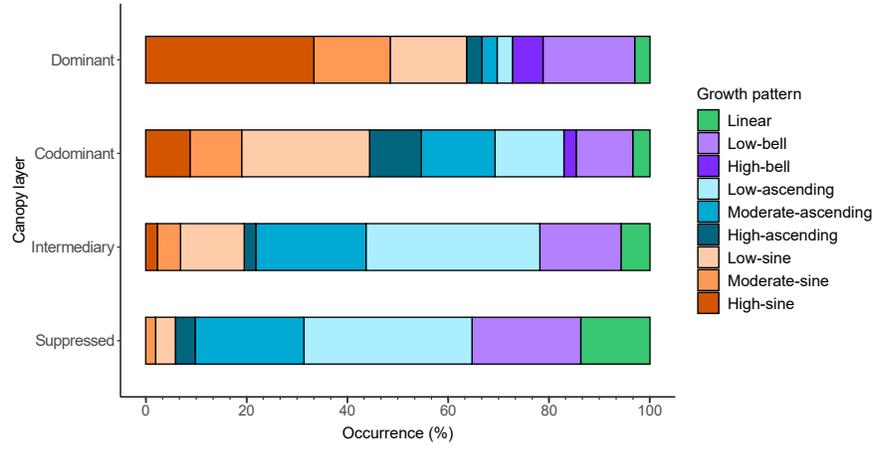
In boreal landscapes, emphasis is currently placed on close-to-nature management strategies, which aim to maintain the biodiversity and ecosystem services related to old-growth forests. The success of these strategies, however, depends on an accurate understanding of the dynamics within these forests. This study aims to reconstruct the disturbance and post-disturbance dynamics in boreal old-growth forests that are driven by recurrent moderate-severity disturbances. We studied eight old-growth forests in Québec, Canada, that has recorded recurrent and moderate to severe spruce budworm (*Choristoneura fumiferana* [Clem.]) outbreaks over the 20th century. To reconstruct the disturbance history and the post-disturbance dynamics of the study sites, we used dendrochronological data and k-means clustering to identify growth releases and growth patterns in the studied trees. We identified nine growth patterns; these patterns represented trees differing in age, size, and canopy layer, and indicated different tree histories. Spruce budworm outbreaks caused recurrent moderate-severity disturbances within the study sites. The canopy gaps created by these disturbances were filled mainly by understory trees, which responded by single and significant increases in radial growth and height. In contrast, overstorey trees had little influence on gap filling; thus, trees were mostly from the dominant and codominant canopy layers. Our study underlines the resistance of boreal old-growth forests to recurrent and moderate-severity disturbances, as understory trees can rapidly fill the resulting gaps. However, trees that are unable to attain the canopy following the disturbance then tend to remain in the lower canopy layers. Therefore, reaching the canopy represents a once-in-a-lifetime opportunity, where success or failure depends on a relatively short window of time. This gap-filling dynamic produces, however, a vertical structure that is often similar to the expected structure in even-aged forests. Our results highlight the efficacy of identifying tree growth patterns to reconstruct stand disturbance dynamics and contribute to developing closer to nature forest management strategies.

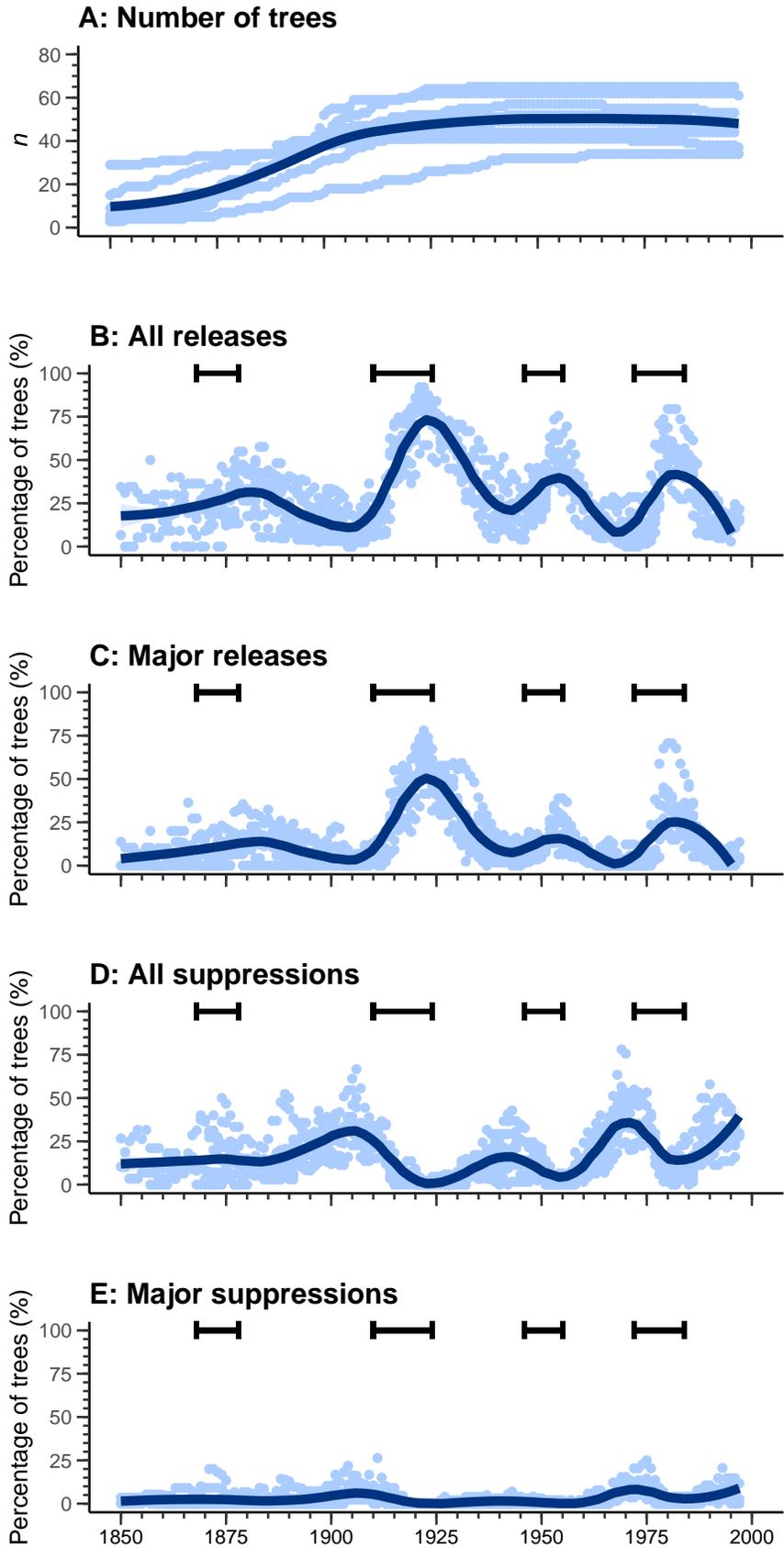
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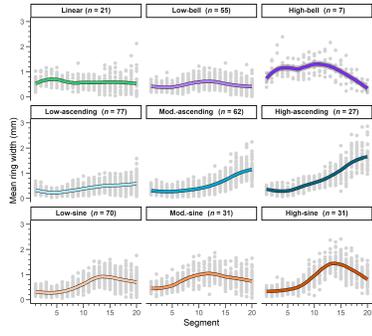








A: Radial growth patterns



B: Tree age, DBH, and annual growth

