

Down the rabbit hole

Herbivore impacts on post-fire boreal forest trajectories may not scale to impact landscape carbon balance

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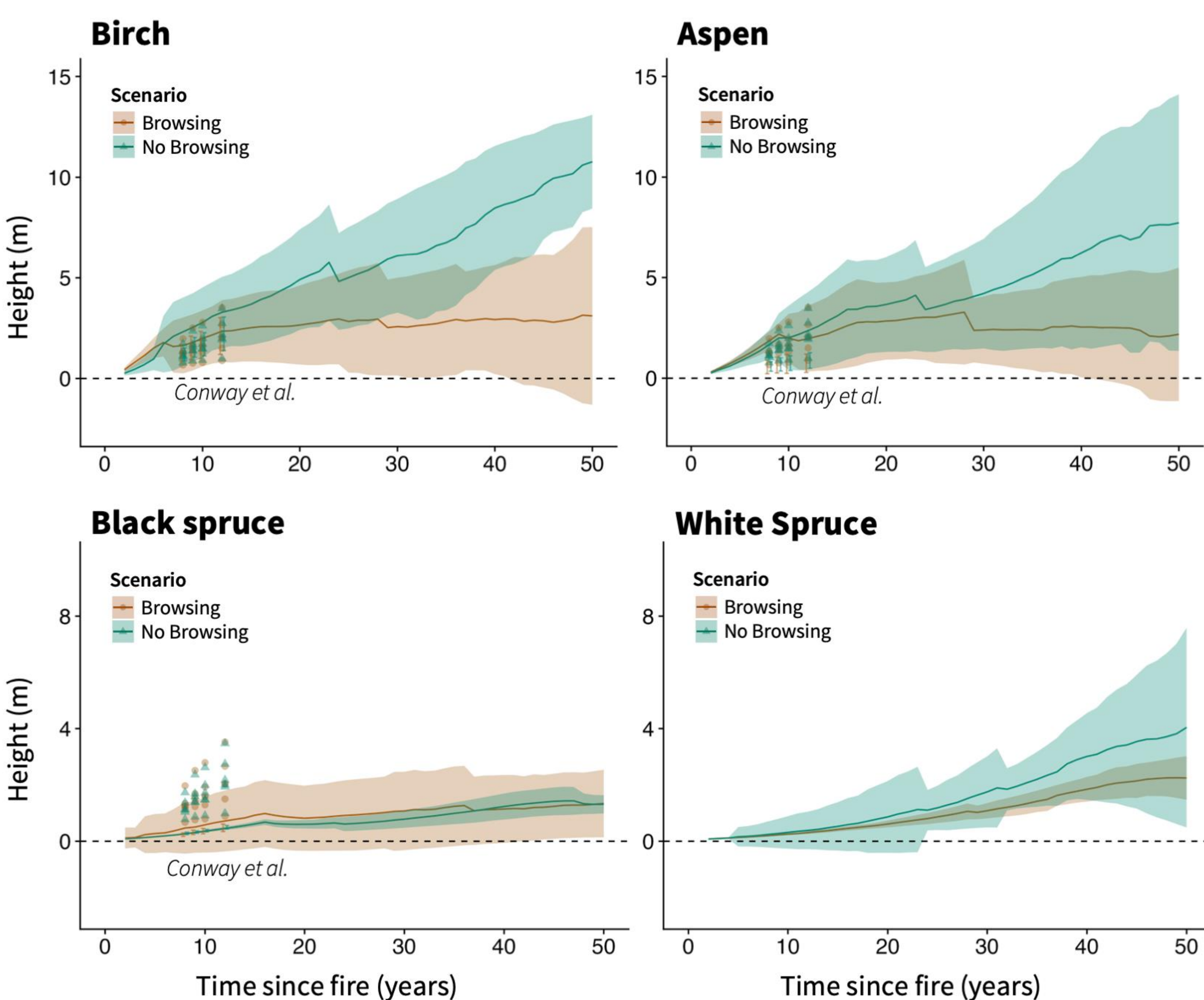


Herbivores modify postfire successional timelines*

* across several decades, at a tree scale, following high-severity fire in boreal forests.

Premise

Increased fire in Alaska shifts boreal forests from conifer to deciduous, leading to questions about future dynamics of carbon storage. Fast-growing deciduous species may leave carbon-rich permafrost vulnerable, but are the preferred forage of herbivores like moose and hare. Can herbivores modify the impact of fire on Alaskan boreal forests at a scale relevant to landscape carbon cycling?



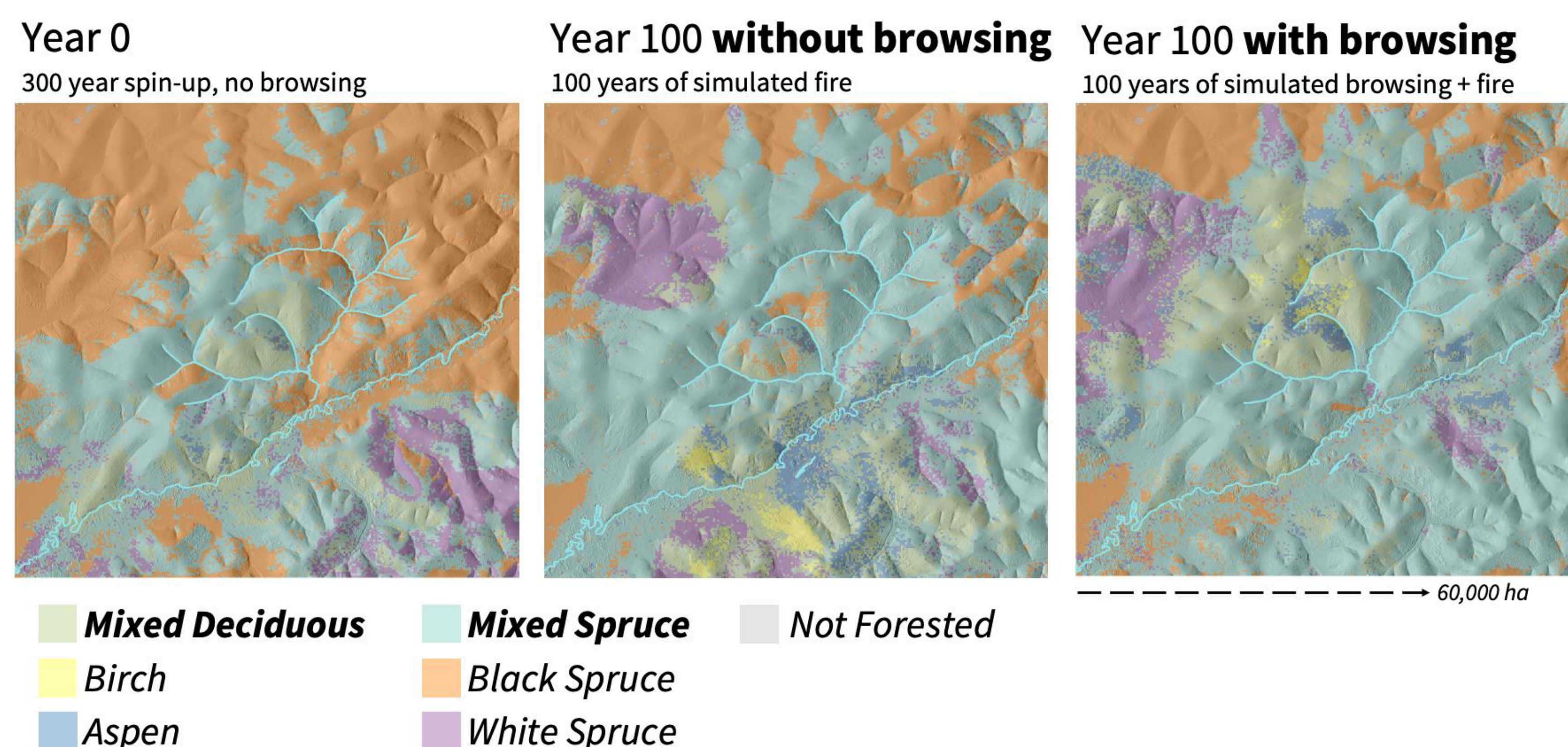
Modeled relationship of age and growth of individuals regenerating after high-severity fire

- Bands = bootstrapped 95% confidence interval of average modeled height of individuals.
- Points are site averages from an empirical enclosure study (Conway et al., in prep)

Browsing modifies the time it takes for deciduous forage species to reach maturity, and the effect is persistent across several decades after fire.

Herbivores do not modify postfire successional trajectories*

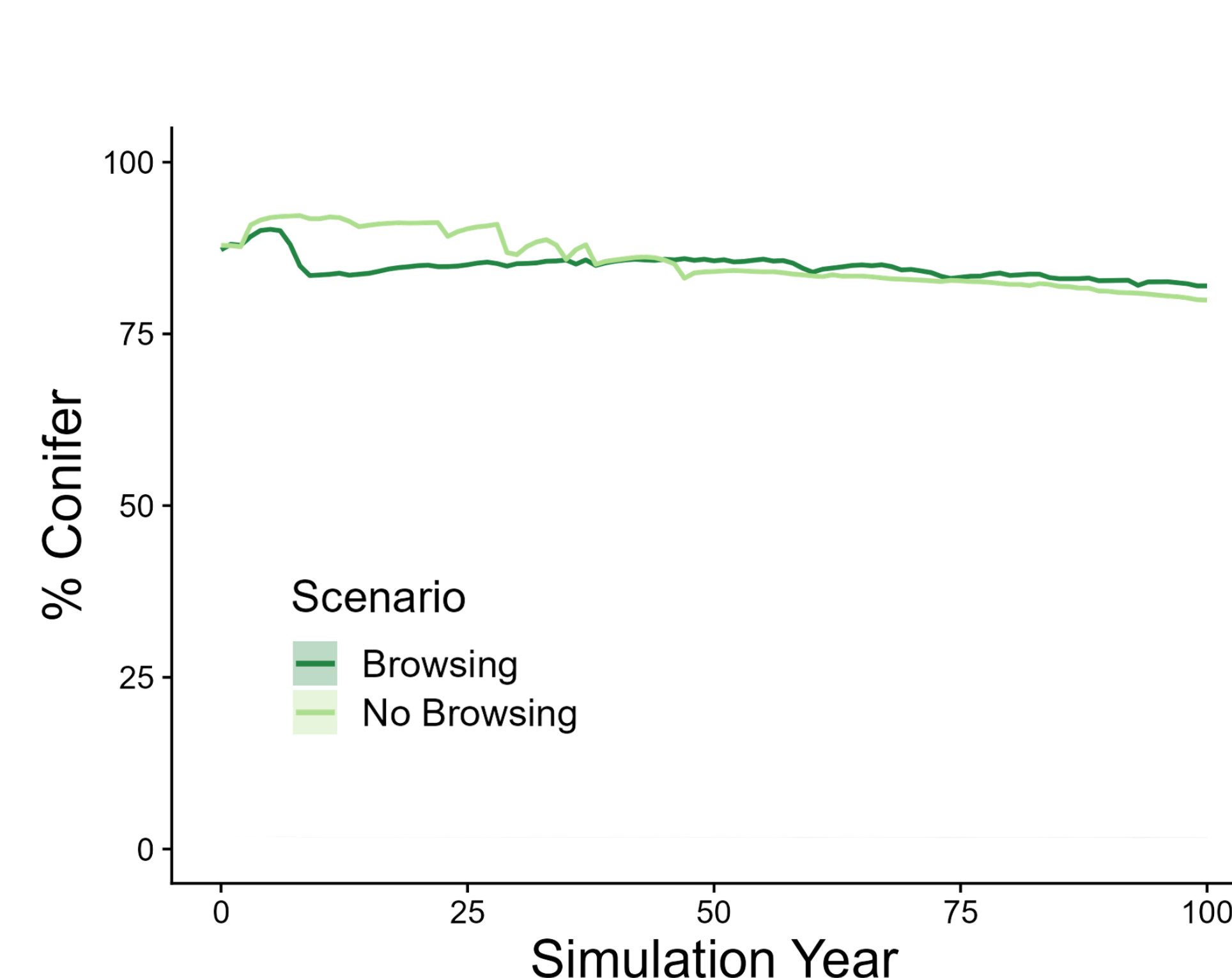
* at a stand scale across millennial in boreal forests.



Species distribution across iLand forest landscape before experiment (left), after 100 years (middle) and after 100 years of simulated browsing (right)

Methods

- We parameterized moose and hare using the biotic disturbance model **Bite**, integrating empirical data from enclosure, behavior and forage studies.
- Using the forest landscape model **iLand**, we simulated fire and herbivory in the Caribou Poker Creek Research Watershed in Interior Alaska.



% of landscape dominated by conifers across the duration of the experiment

- Dominance determined by importance value (IV), calculated as relative proportions of species density and basal area. Dominance set as an IV of 1 or greater.

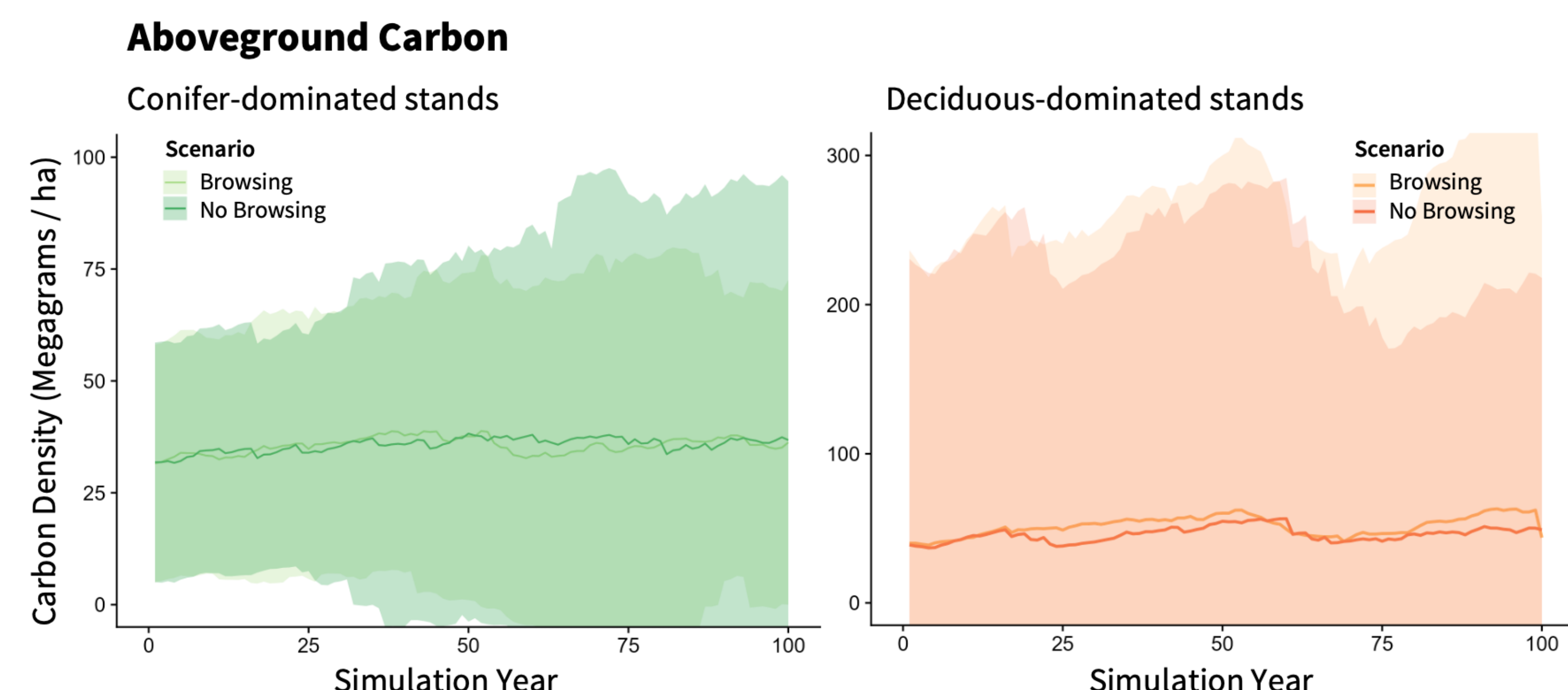
Browsing impacts on height do not appear to manifest in transformational shifts in forest composition from conifer to deciduous across longer time scales.

Herbivores do not modify postfire landscape carbon*

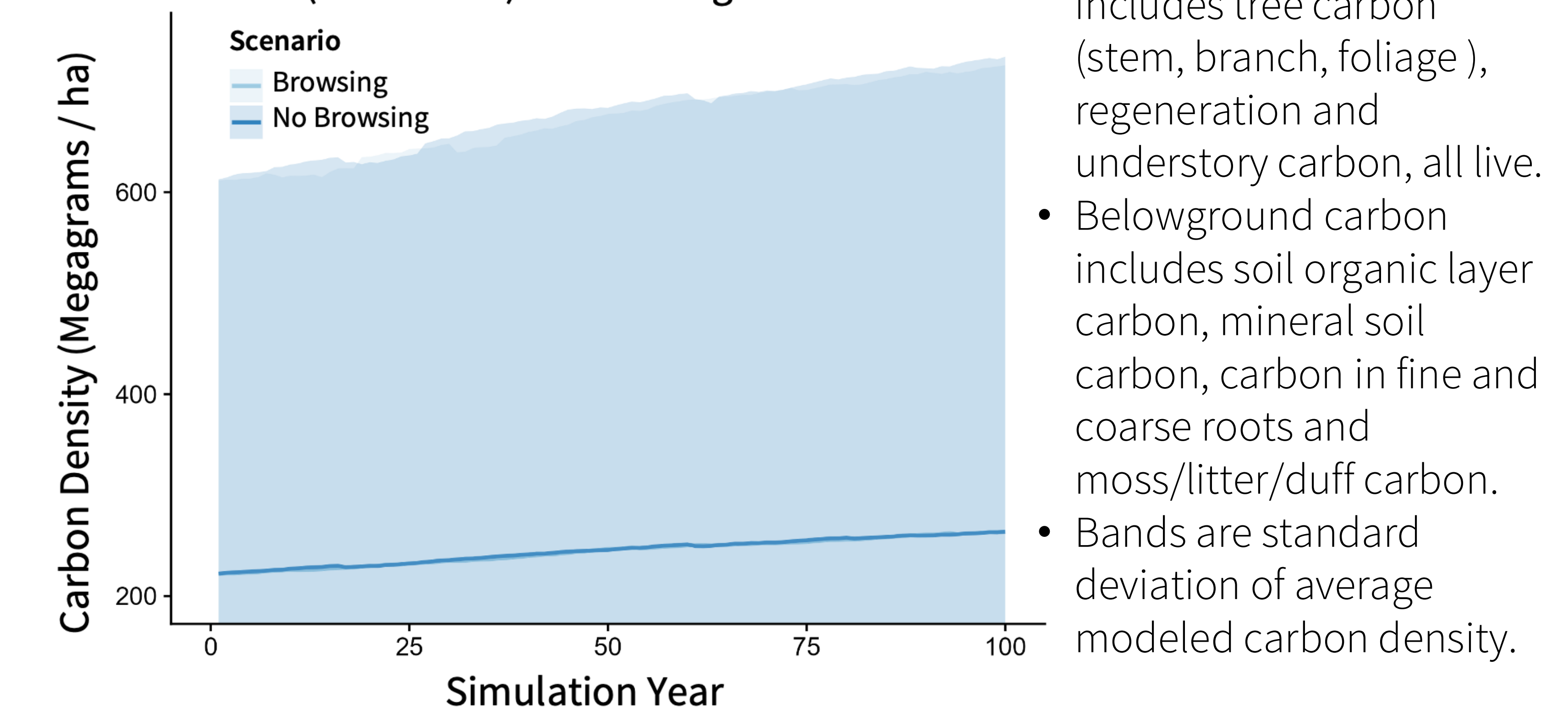
* through direct and indirect impacts on either above- or belowground carbon in boreal landscapes.

Methods (cont.)

- We spun up our model for 300 years to develop a mixed-age, mixed composition forest landscape (see Year 0 map).
- We simulated fire-herbivore scenarios under historic climate (1951-2000), recycled with replacement, and replicated each treatment (*Browsing vs No Browsing*) 10x.



Total Carbon Above (live + dead) and belowground



- Aboveground carbon includes tree carbon (stem, branch, foliage), regeneration and understory carbon, all live.
- Belowground carbon includes soil organic layer carbon, mineral soil carbon, carbon in fine and coarse roots and moss/litter/duff carbon.
- Bands are standard deviation of average modeled carbon density.

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Browsing, while impactful at a fine-scale, does not alter landscape-carbon balance.