USING LONG-TERM PROVENANCE DATA TO DEVELOP A CLIMATE-SENSITIVE MORTALITY FUNCTION

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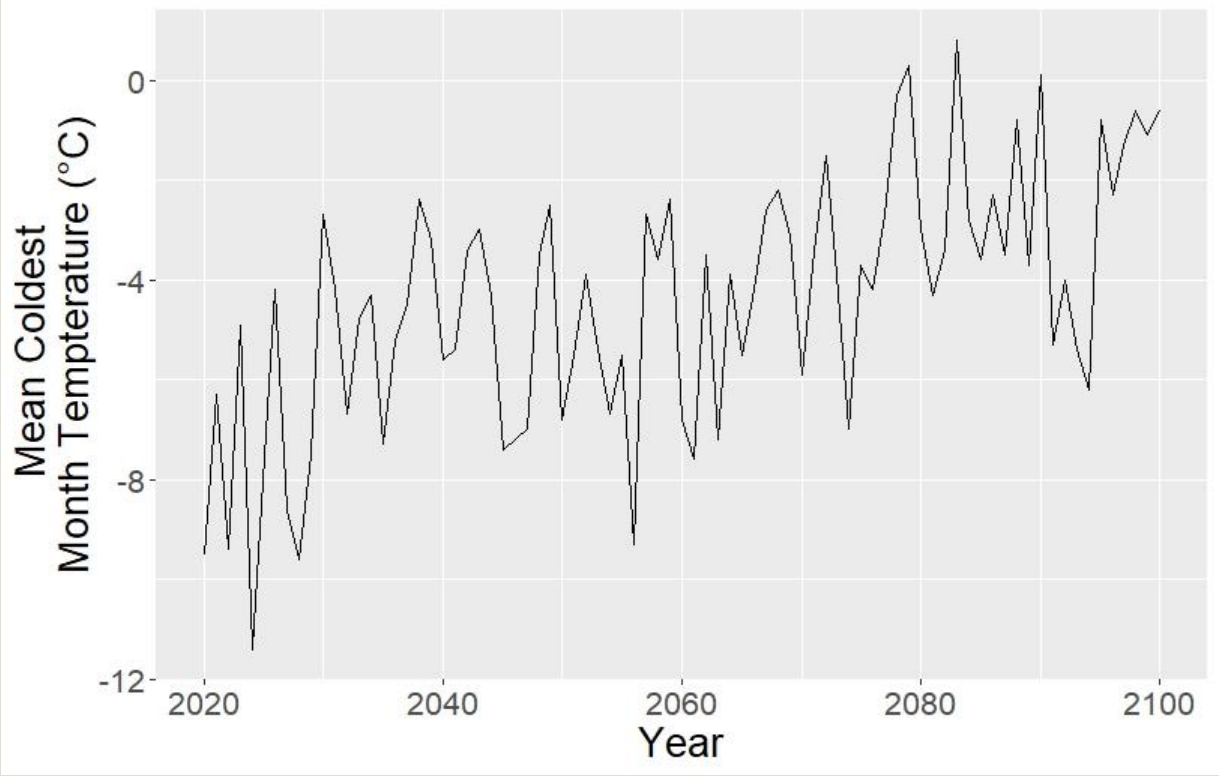
Introduction

- Tree mortality has been increasing throughout western North America.
- Forest yield and productivity may be at risk due to climate change.

Photo: P. Hennon Yellow-cedar decline - Alaska

Photo: Kevin Buxton Drought mortality- Okanagan



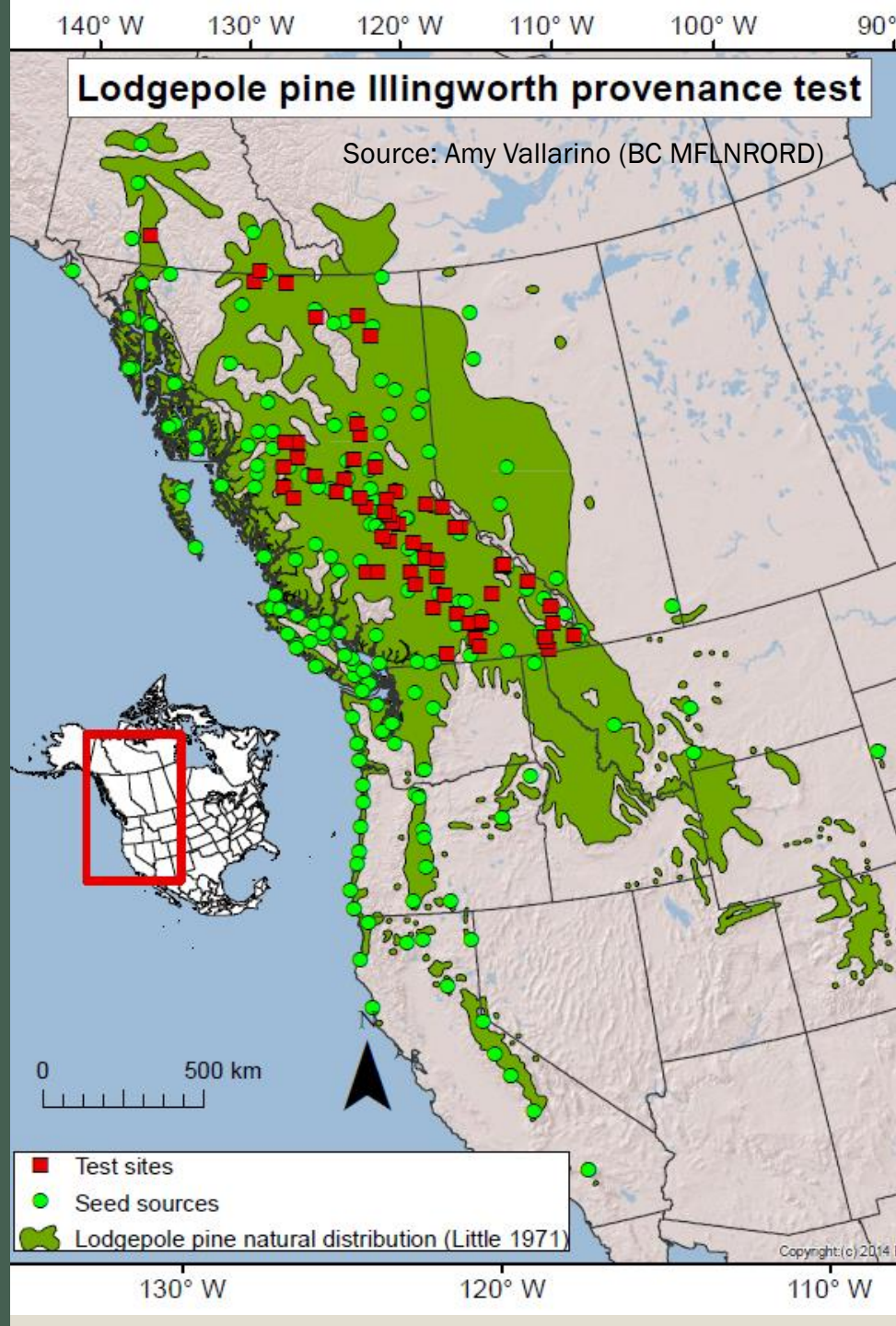
Annual climate predictions for a site in interior BC (Data source: ClimateBC)

Objectives

- Predict how climate change could adjust future mortality rates in lodgepole pine stands.
- Develop methodology that can be linked with the Tree and Stand Simulator (TASS) to simulate future stands.

Methods – Illingworth Trial Data

- 140 populations of lodgepole pine seedlings.
- 60 test sites.
- Planted in 1974.



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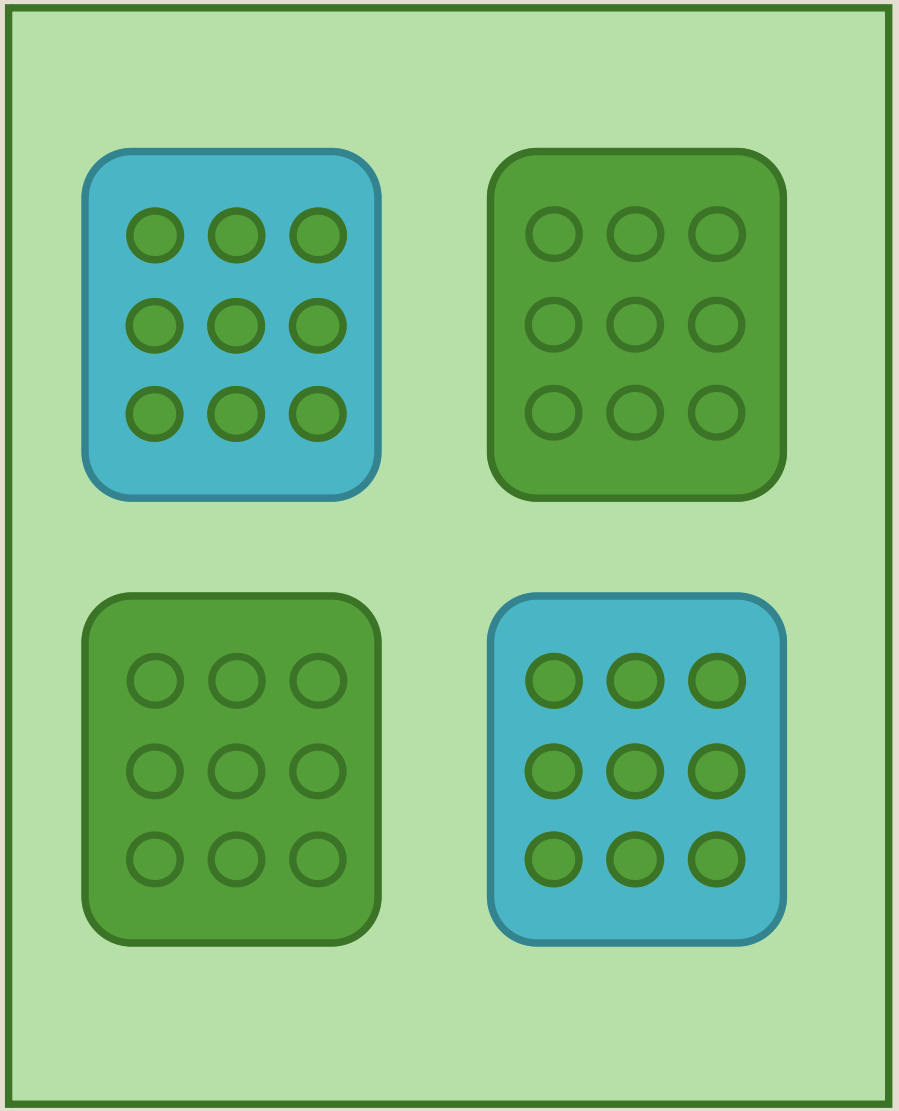
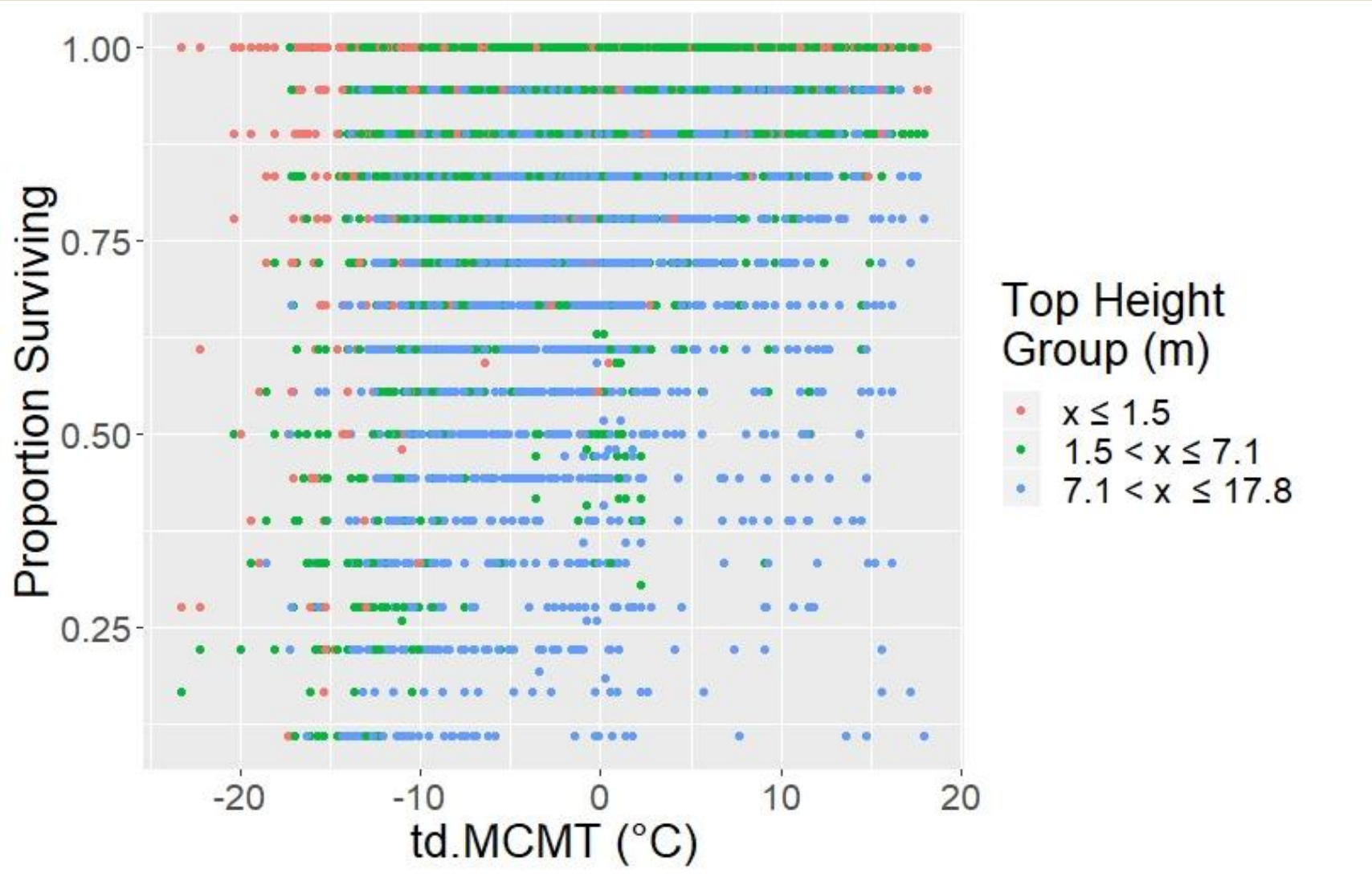


- Randomized block design at each site.
- Two blocks of nine seedlings from each provenance (seed source).
- 3 year old seedlings.
- 2.5 m spacing.
- Sites were re-measured 1, 3, 6, 10, 15, 20, and 32 years after planting.

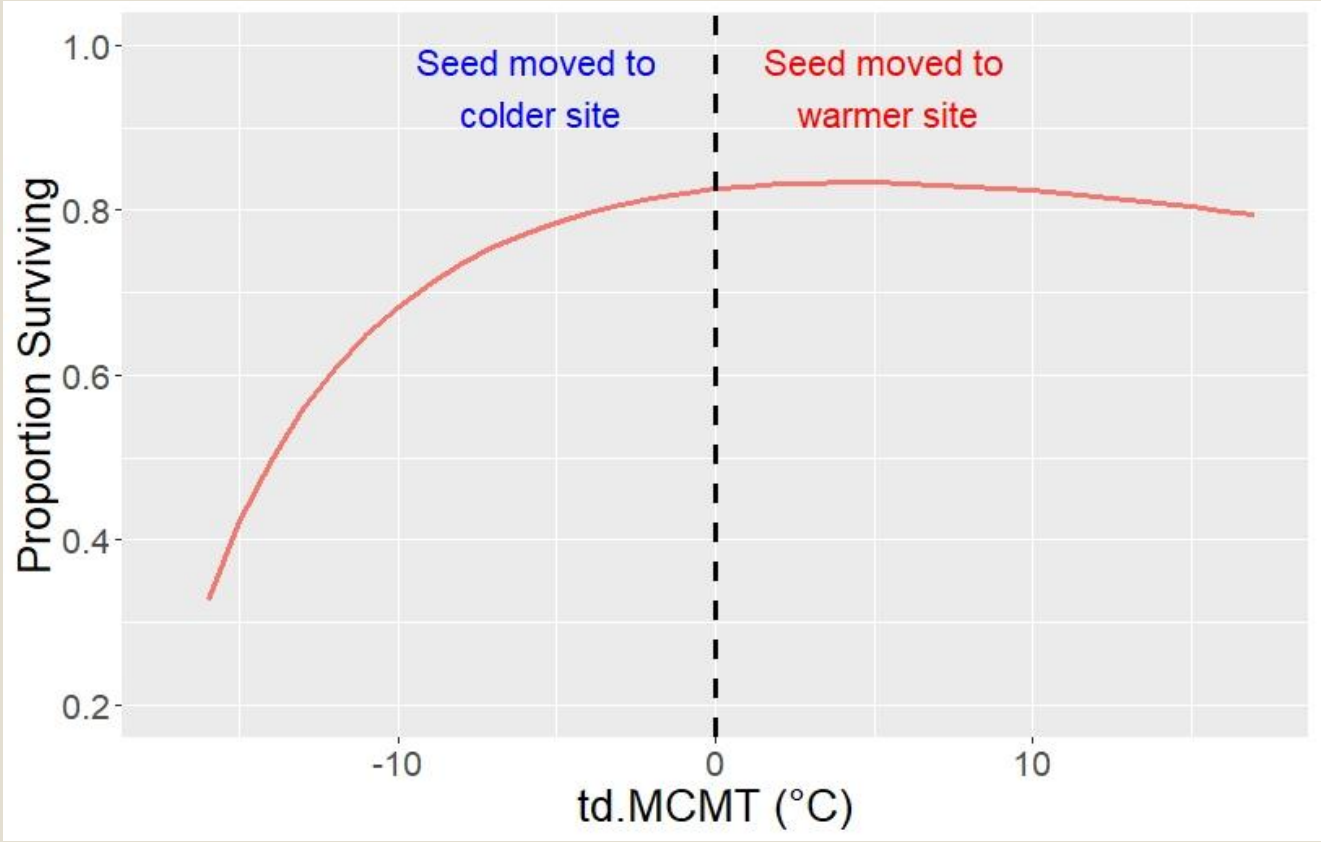
Methods – Illingworth Trial Data



MCMT – Mean Coldest Month Temperature (ºC)
td.MCMT = site MCMT – seed source MCMT

Methods – Transfer functions

- Used to link tree growth with climate or other variables.
- Predict how a seed source would perform at a site based on how the seed source climate differs from the site climate.



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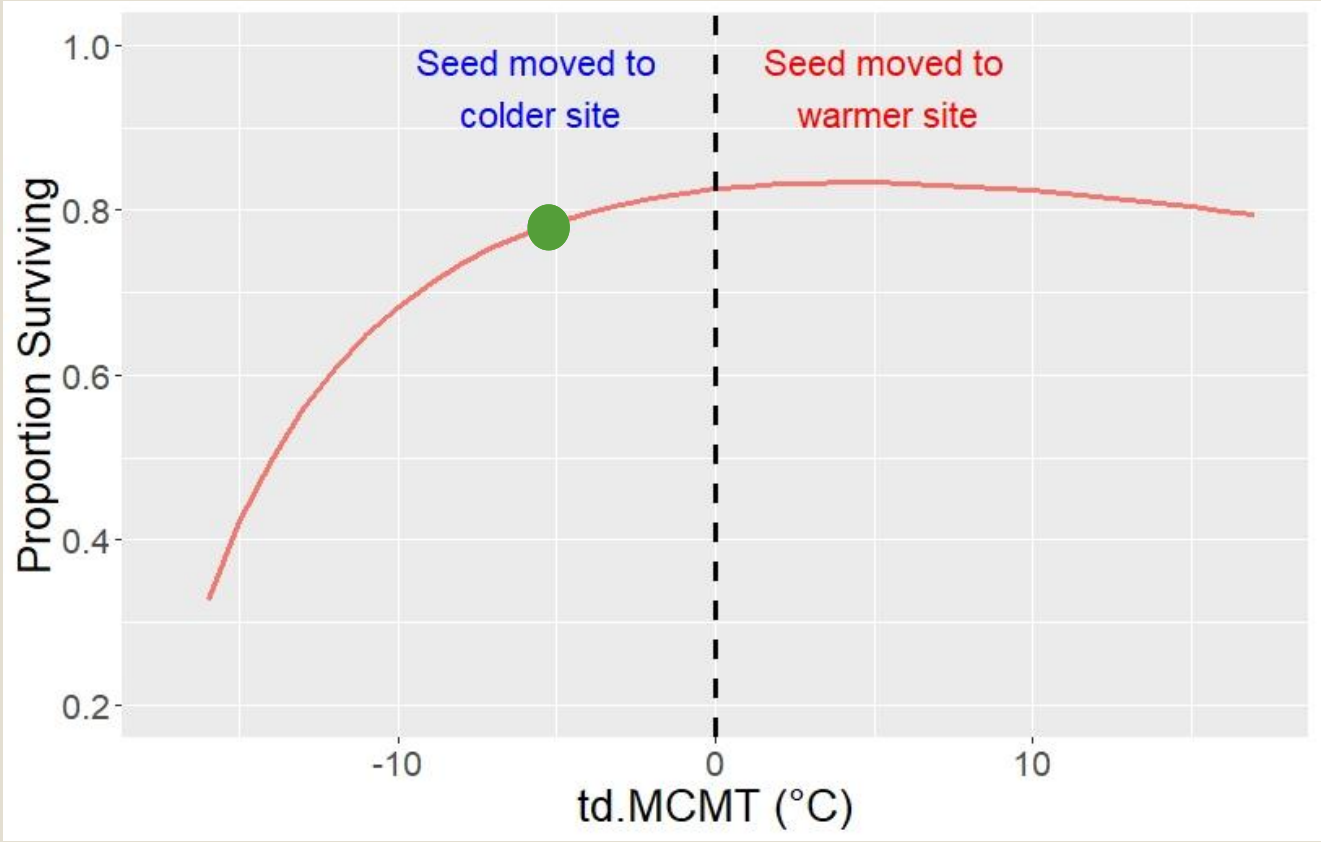

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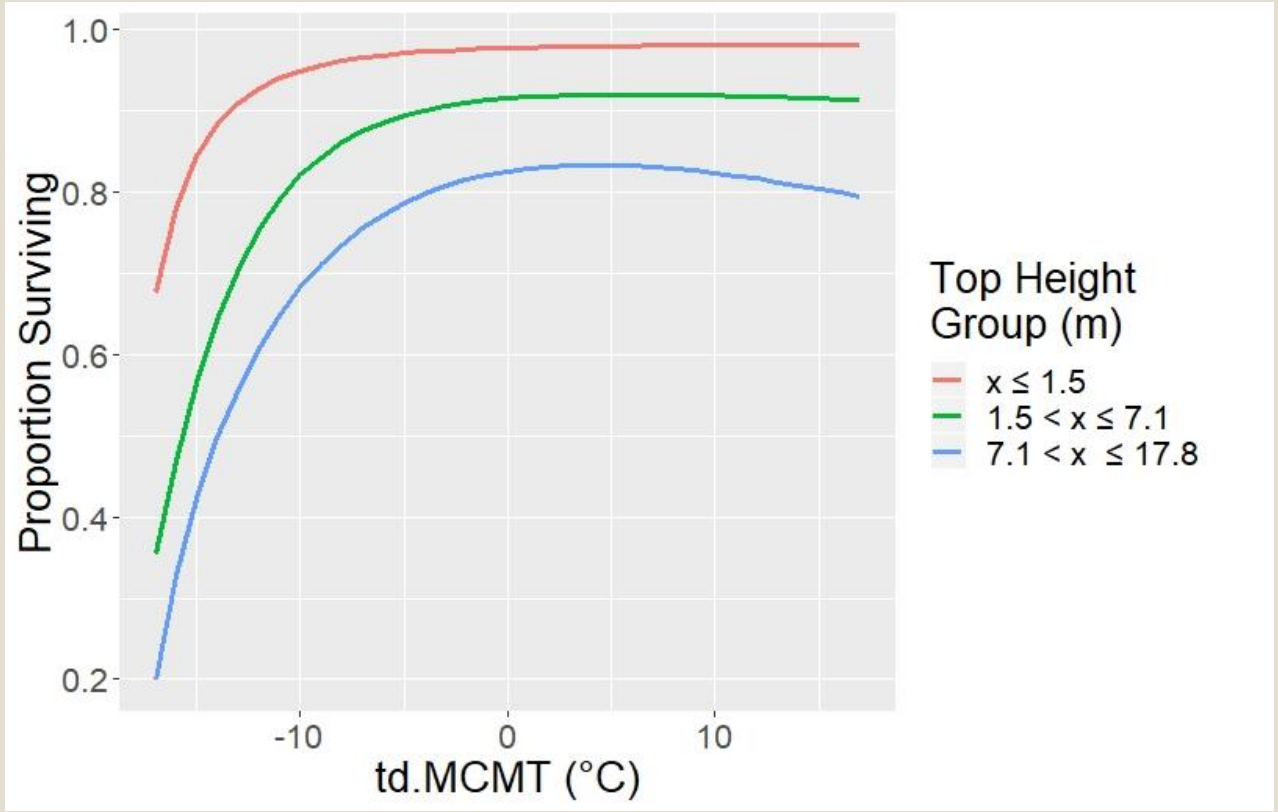
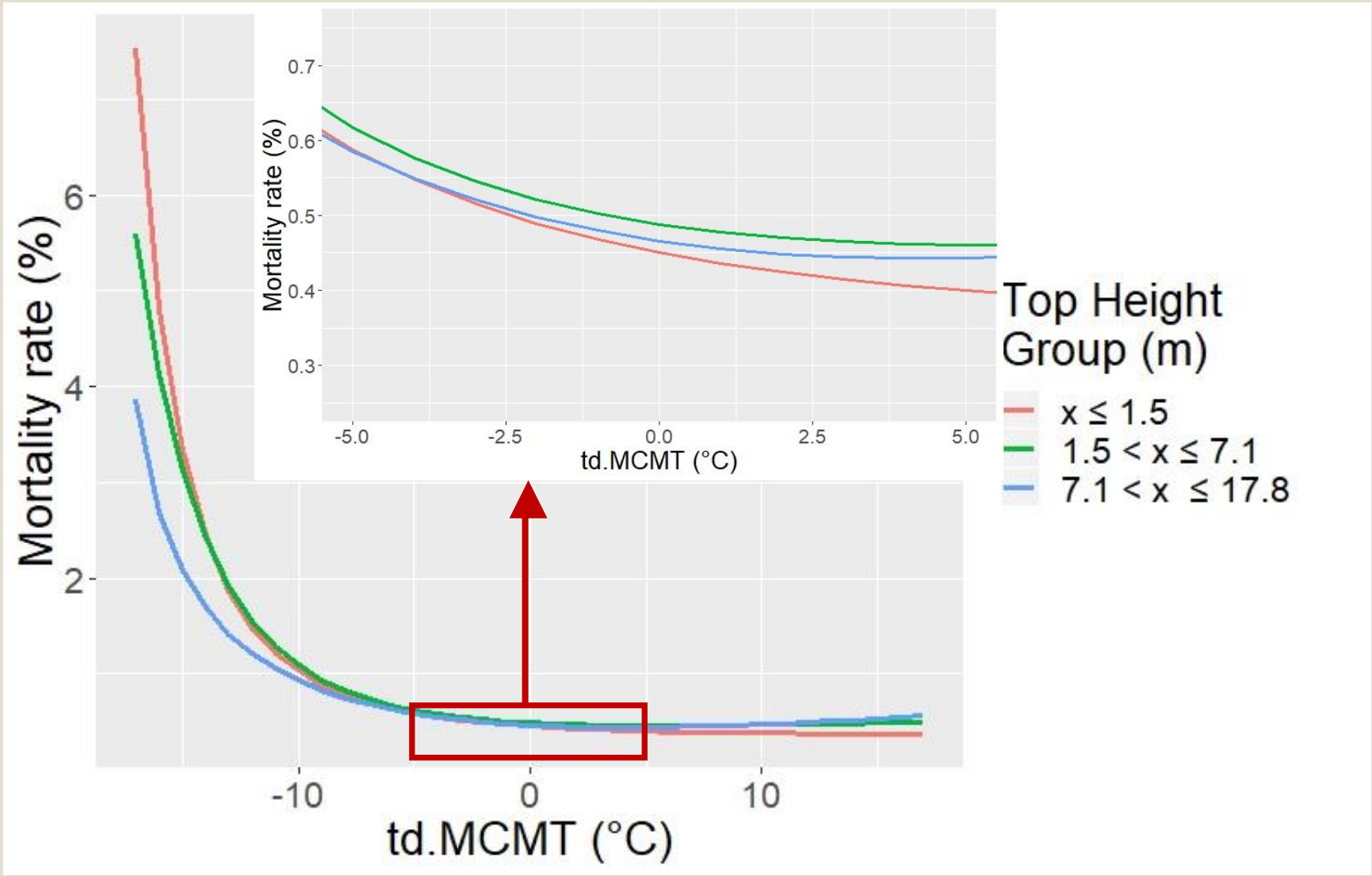
Mortality transfer function

- Models were fit to predict the proportion of surviving trees in each top height group.
- The explanatory variable is mean coldest month temperature (MCMT) transfer distance. (Site MCMT – provenance MCMT).
- These rates were then annualized.



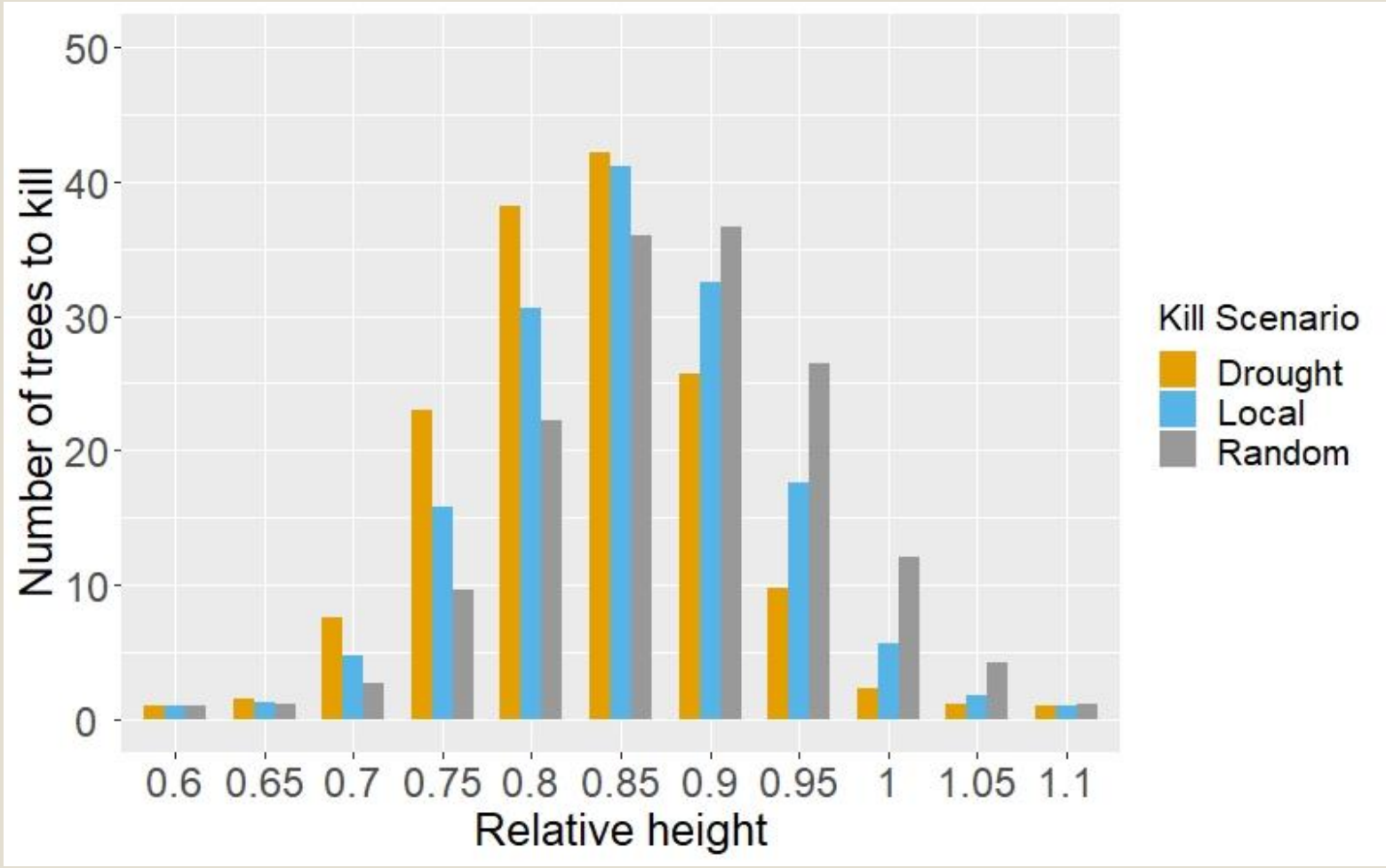
Annual mortality rates



Methods – Kill Selection Function

- Illingworth data were binned into 5 groups based on mean annual precipitation (MAP) transfer.
- We then calculated the cumulative annual proportion of dead trees (CAPD).
- We fit a model to predict CAPD based on the relative height of a tree to the top height of the stand within each MAP transfer bin.

Results – Kill Selection Function



Discussion/Conclusions

- Seed transfer to slightly warmer climates is associated with the lowest mortality rates.
- Mortality/climate relationship may differ from height/climate relationship.
- Smaller trees tend to be disproportionately susceptible to moisture-related mortality.

Next steps

- Work with TASS to link mortality transfer function to simulate stands over time.
- Develop climate-based mortality transfer functions for other tree species.
- Create other climate-based adjustments that are compatible with TASS.

Photo by: Gregory O'Neill

Summary

- We need to be able to manage forests for optimal yield under changing conditions.
- We used large-scale provenance data to link mortality with temperature and precipitation transfer.
- Seed transferred to slightly warmer sites may fare better than seed transferred to colder sites.
- Small trees may be disproportionately impacted by transfer to drier sites.

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