

Impact of red needle cast on tree growth

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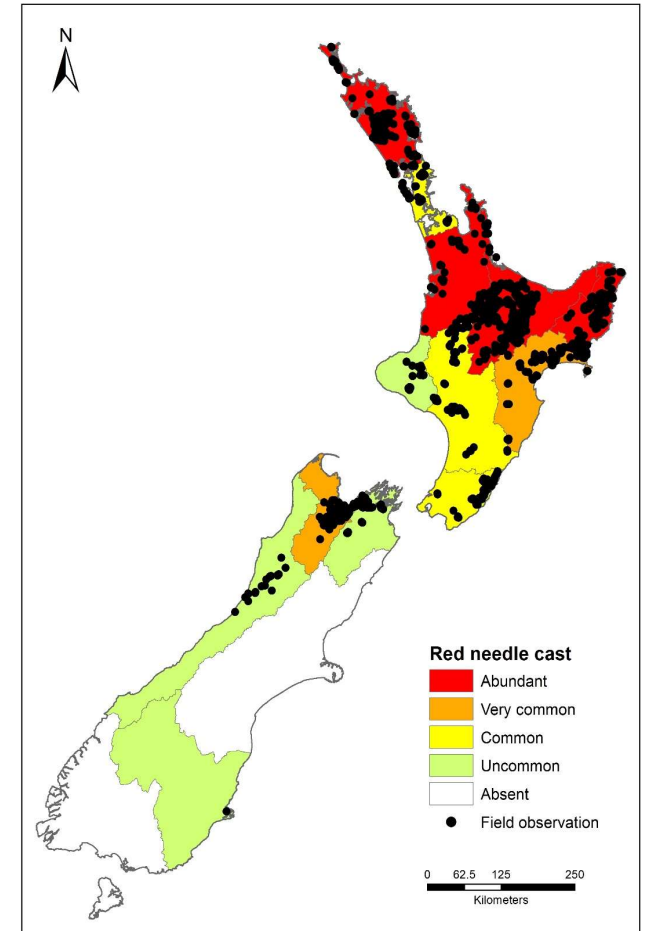


Red Needle Cast

- Caused by *Phytophthora pluvialis* (occasionally *Phytophthora kernoviae*)
- Needle disease of conifer species
- Needles discolor then are cast from the tree
- Detected in 2008 (present since at least 2005)
- Officially described in 2014 (relatively new disease)



- Red needle cast (**RNC**) causes **defoliation** of *Pinus radiata* which leads to **growth loss**





Ltl Acorn

MAX1



060°F

016.0°C

05/20/2021 13:00:03

Why is growth impact important?

- To determine the cost-benefit of management interventions.
- It is common to see needle re-growth after a disease event, but how does this recovery period affect tree growth?
- Do trees fully recover within the needle regrowth period?



Goals and Aims

- What impact does maximum disease severity have on growth loss?
- What is the effect of RNC on multiple years after disease was found?
- What is the predicted growth loss due to RNC in Kinleith?



Previous work

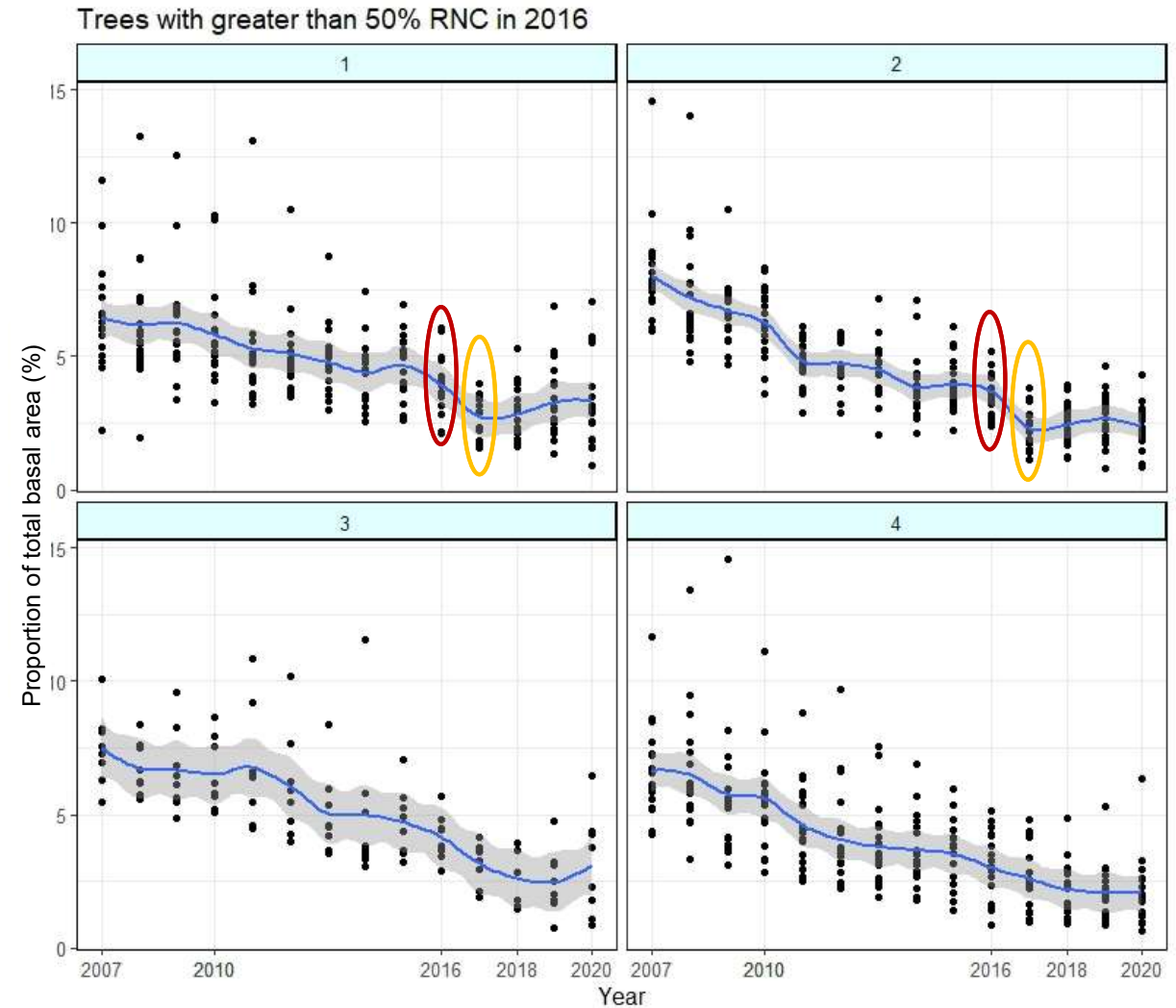
- Previous study by Peter Beets (2013) predicts a **~40% growth loss** in the year immediately following with 10% growth loss in the second year, in Wharerata
 - Observed a **3-year disease cycle** from 2005-2013, which equates to a 16% growth loss for those 3 years
 - Does RNC occur more frequently than every 3 years?
- Maxwells sites 1,2,3 & 5 were cored again at the end of 2022
 - Site 4 was harvested before cores were taken



Results: Raw data

- **77 Trees**
- No control trees (0% RNC) range is 10-95% RNC in 2016
 - Majority of data sits in **60-100%** category
- **Radial growth (mm²)** was determined for each year.

2016
2017



Results: Model

100% RNC vs 0% RNC

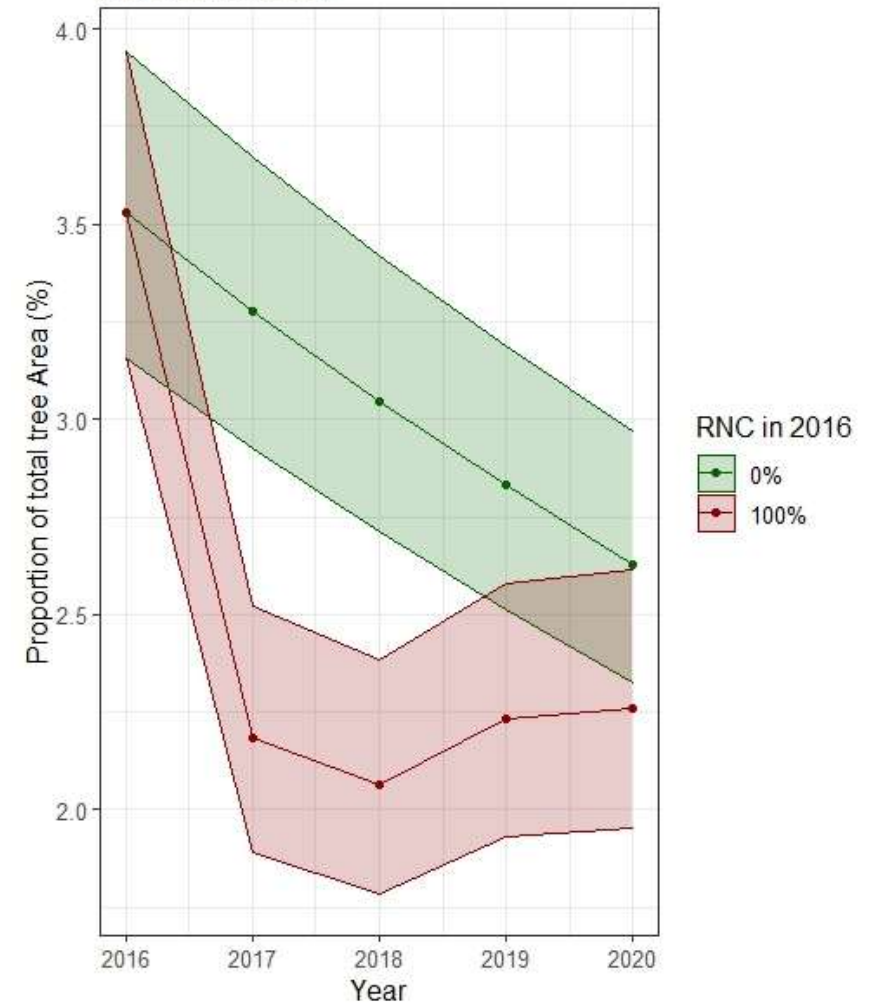
- **26% growth loss for the 4 years after disease year**
- First year 33% growth loss
- Second year 32% growth loss
- Third year 21% growth loss
- Fourth year 14% growth loss
- Fifth...Sixth year?

For **ONE** disease event:

- Cumulative growth loss of **3%** across **whole rotation**
 - Percentage area growth at breast height
 - Greater than four-year recovery period
- **Assumes** no prior infection from 2007-2015

Predicted tree growth

A response to RNC



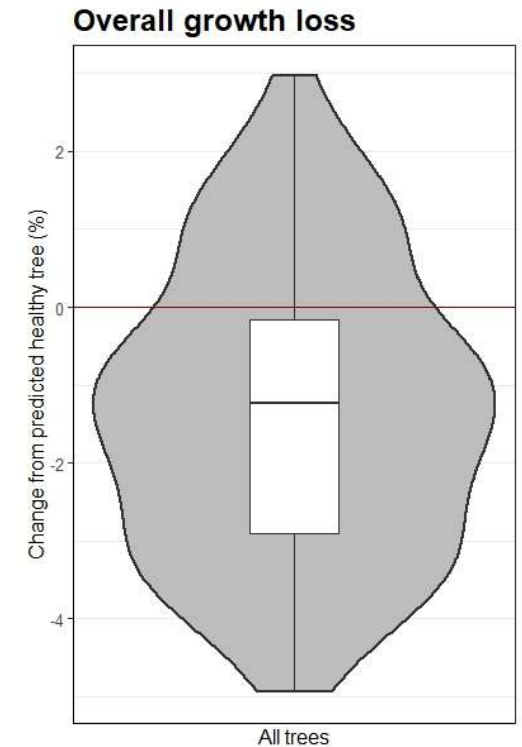
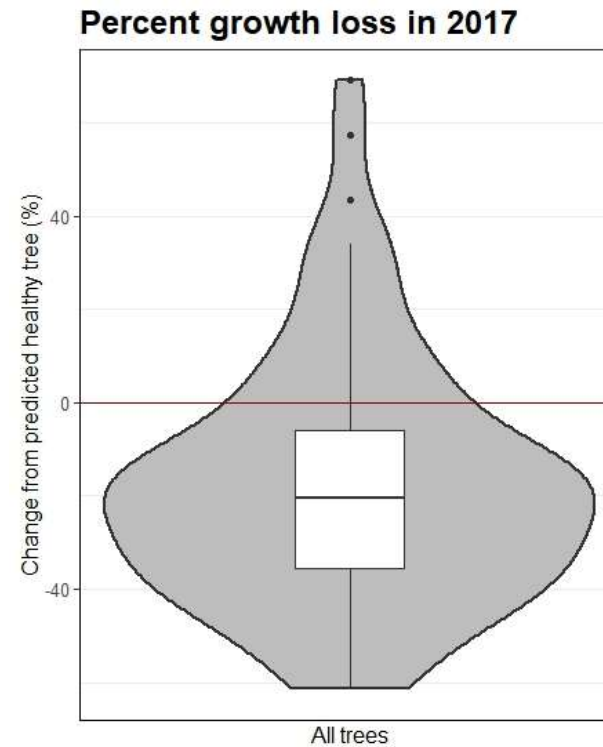
Results: Actual stand growth loss

GAM predictions for 2017-2019 period from 2007-2020 data with actual 2017-2019 values excluded

- Approximately 20% growth loss in 2017
- Assumes that in 2020 the trees have fully recovered

An **average of 1.3% overall decrease** in growth compared to predicted healthy trees

- For the range of **RNC severity actually recorded** from 2016-2020



East Coast

Preliminary wood-core measurements from old Maxwells plots indicate disease events in 2005, 2008, 2011, 2014, 2017 and 2021

- approximately every 3 years
- **6 disease events** spanning approximately half the trees lifespan
- **~8% growth loss** by **extrapolating** Peter Beets work (2013)
 - Not accounting for potential compounding effect



Conclusion

Summary

- Limited disease data available
- Greater than 4-year recovery period?
- Predicted 3% overall growth loss due to maximum infection (Linear Mixed Model)
- Predicted 1.3% overall growth loss due to RNC severity range in Kinleith (GAM)

Future work

- What impact does consecutive disease outbreaks have
 - Every 3rd year?
 - Every year?
- Make sure there is a “no disease” buffer of 5-6 years before and after disease outbreak
- Impact of actual RNC severity due to staggered disease timing
 - We can get the exact peak RNC visual assessment from trail cameras

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