IS CLIMATE CHANGE DRIVING YELLOW-CEDAR DECLINE ON HAIDA GWAII?

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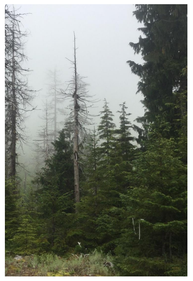
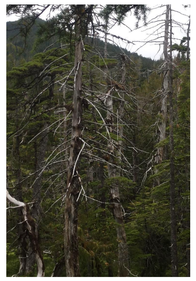
BACKGROUND

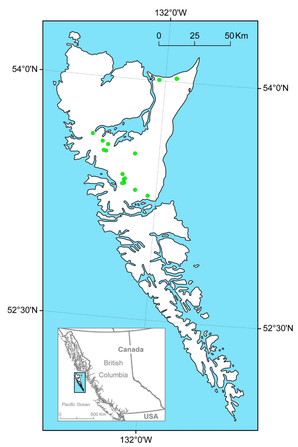
- Yellow-cedar decline is widespread along coastal BC and Alaska and recently became apparent on Haida Gwaii
- The driving factor of this decline is thought to be climatic warming, which has reduced snowpack and exposed fine roots to freezing damage
- This proposed mechanism may not adequately explain the decline in Haida Gwaii due to the temperate climate and ephemeral snowpack
- This research uses dendrochronology to investigate climate as a driver of decline
- Determining the cause of this decline is the first step to resilience





QUESTIONS

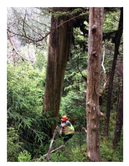
- In targeted forests exhibiting decline, what proportion of yellow-cedar are live (healthy), declining or dead?
- Which yellow-cedar are declining and why?
- Does growth near the outer rings of live, declining and dead yellow-cedar differ?
- How did inter-annual and multi-decadal climate variation in the 20th century influence radial growth of yellow-cedar?
- Can this decline be mitigated through management?



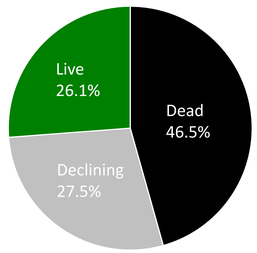
RESEARCH APPROACH

- Targeted areas exhibiting yellow-cedar decline on Graham Island, Haida Gwaii
- Census of all yellow-cedar trees (DBH ≥10cm) in 100 x 20m transects at 15 sites (1016 trees)
- Increment cores taken from 15 healthy live and 15 declining/dead yellow-cedars at each site (450 trees)



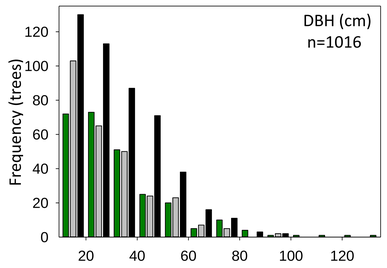


MOST YELLOW-CEDAR DEAD OR DECLINING

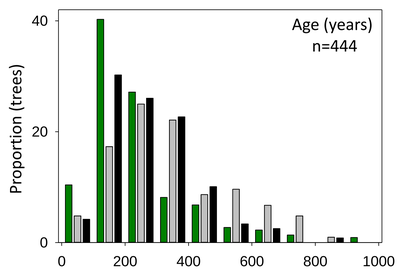


- 1016 trees sampled at 15 targeted sites exhibiting yellow-cedar decline
- 74% of yellow-cedar were declining or dead
- 59 to 86% of trees were declining or dead per site
- 14 to 41% of trees were live, healthy per site

DECLINE ACROSS SIZE AND AGE

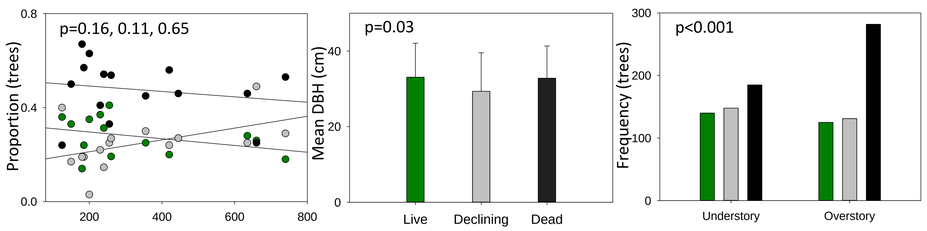


DIAMETER AT BREAST HEIGHT
- DBH range: 10 to 140 cm
- Live, declining and dead trees present across all size classes
- Similar distributions of size for live, declining and dead trees



AGE ESTIMATES
- Age range: 29 to 908 years
- Live, declining and dead trees present across all ages
- Declining and dead trees were not oldest (reaching lifespan) or youngest (self-thinning)

DECLINE NOT DUE TO COMPETITION



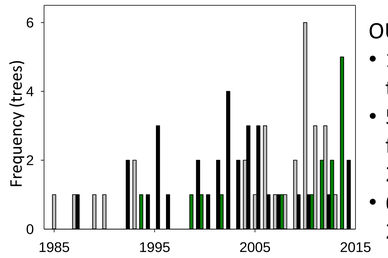
DENSITY (trees/ha)
- Proportion of declining and dead trees does not increase with density
- No evidence of density-dependent mortality

DBH (cm)
- Mean DBH of live, declining and dead trees were similar
- Declining and dead trees were not the smallest
- No evidence of self-thinning

HEIGHT CLASS
- More dead overstory trees and fewer live and declining understory trees than expected by chance
- Opposite to patterns expected due to competition and self-thinning

DEATH AND CESSATION OF RADIAL GROWTH

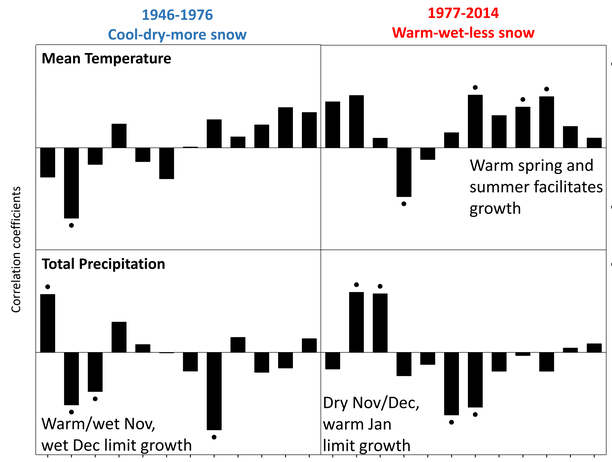
Subset of 357 trees (live:208, declining:80, dead:69)



OUTER RING DATES
- 191 live and 73 declining trees formed rings the year of sampling
- 59 living trees (live or declining) stopped forming rings after 1918, 70% from 2000 to 2014
- 69 trees died after 1852, 42% from 2000 to 2015

SUPPRESSION AT OUTER RINGS
- Decline is visible in radial growth rings before death in many trees
- 13% of live and 46% of declining trees had suppressed outer rings
- For trees which had died 24% had suppressed outer rings

CLIMATE-GROWTH SHIFTS THROUGH TIME



- Spring and summer correlations stronger from 1977-2014 in the warm phase
- Wet springs limit growth
- Precipitation in fall and winter (snow?) has more influence than in the growing season
- If winter precipitation is partly snow, relationships in the winter are consistent with the snowpack hypothesis from Alaska

SUMMARY

- At targeted sites, high proportions of declining and dead trees
- Trees of all ages and sizes are affected, with greater impacts on overstory trees, but not due to competition and self-thinning
- Trees of all status classes show suppression near the outer rings
- Warm temperatures facilitated increasing growth in the 20th century
- Decline in growth associated with low winter precipitation (snow) and warm temperatures, is consistent with the drivers of decline in Alaska
- Improved understanding of snow distribution and persistence in Haida Gwaii is needed to guide management

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