Unravelling the Mysterious Phenomenon of Yellow-Cedar Decline

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Abstract

In this presentation we will report on our research investigating the decline of yellow-cedar. The focus will be on the use of GIS in characterizing the forest decline and investigating the role of abiotic factors. Particular attention will be given to the possible connections between the underlying biophysical factors and the hypothesized climatic mechanism. The use of GIS in interpreting causal factors to predict sites susceptible in the long term will also be discussed.

Background and Relevance

For over two decades, the phenomenon of yellow cedar decline has perplexed researchers. Yellow cedar (*Chamaecyparis nootkatensis* (D. Don) Spach), which ranges from Southern Oregon to Prince William Sound, Alaska, was known to be declining on over 200,000 ha of undisturbed forest in southeast Alaska (Snyder *et al.* 2008). During an aerial survey in 2004, numerous large areas of dead and dying yellow-cedar were identified in coastal locations in B.C. and the nature of the dieback was found to be consistent with the phenomenon in southeast Alaska (Hennon *et al.* 2005).

According to the current leading hypothesis, saturated soils create open, exposed canopies that experience soil warming early in the spring. This warming triggers the yellow-cedars to deharden prematurely, making them more susceptible to freezing injury, which may ultimately lead to fine root mortality and subsequent crown death (Hennon *et al.* 2006). Snow appears to protect yellow-cedar against this potential freezing injury by preventing soil warming (Hennon *et al.* 2006). However, there has been a reduction in the snowpack at lower elevations since the end of the Little Ice Age, which coincided with the onset of decline (Hennon *et al.* 2006). The involvement of a climatic mechanism suggests that cedar dieback may expand if warming trends continue (Beier *et al.* 2008, Hennon *et al.* 2006).

In order to successfully manage this ecologically, culturally and economically important tree species, a more thorough understanding of the mechanisms of decline and the contributing role of climate is needed. The current hypothesis is based primarily on observed associations and research is required to determine whether these relations occur throughout the range of the decline (Hennon *et al.* 2006). Quantifying the distribution and density of the yellow-cedar decline and predicting where the decline will occur in the next few centuries will provide critical information to decision makers. The high value of yellow-cedar wood and the importance of this species in First Nations culture mean that a management strategy incorporating the influence of a warming climate is required. Ultimately, this research may provide insight into the devastating effects that climate change can have on a forest ecosystem.

Methods and Data

The major aims of this research project are to quantify the distribution and density of the yellow-cedar decline in British Columbia, and to evaluate the role of various biophysical factors (e.g., elevation, slope, aspect) implicated in the hypothesis. The project will use a combination of remote sensing and GIS analysis. Forest inventory and forest health datasets, containing known areas of yellow cedar decline, and air photos taken during 2006 and 2007 of the Mid- and North-Coast Forest Districts, have been collected from the Integrated Land Management Bureau. This data will be used to delineate areas of healthy and declining yellow-cedar stands and the biophysical factors will be derived from a Digital Elevation Model of the province. A predictive model will then be developed on the basis of these results to attempt to forecast sites susceptible to decline in the long term. Cross-validation will be performed to evaluate model fitness.

Results

The results of the initial exploratory analysis will be presented, with an emphasis on characterizing the spatial structure of the decline and highlighting any early findings regarding links to biophysical factors. A discussion of the role of the hypothesized climatic mechanism and expected results will be made. Plans for future research will also be shared.

Conclusions

This research focuses on characterizing the density and distribution of declining stands and analysing biophysical associations through the use of remote sensing and GIS. Investigating the underlying abiotic factors and their relationship to the proposed climatic mechanism will lead to a more thorough understanding of the decline of yellow cedars and how this species should be managed in the context of a warming climate. This research is being conducted at University of British Columbia in conjunction with the Ministry of Forests and Range.

References

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