Ecosystem Change at Whitebark Pine's Northern Limit

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This MSc research on whitebark pine (*Pinus albicaulis*) ecosystems continues the work of the Bulkley Valley Research Centre in northwestern British Columbia (Haeussler 2008). Here, whitebark pine is at the northern extent of its range in the Coastal mountains and is subject to mountain pine beetle (MPB) and white pine blister rust (WPBR). Stresses such as climate change and the effects of fire suppression may also contribute to whitebark pine decline in this region.

Haeussler et al (2009) focused on rare whitebark pine-dominated stands on coarse-textured, nutrient-poor sites. They re-visited sites surveyed by the BC Ministry of Forests (BC-MOF) from 1978-85 to determine how they have changed over time. They thought that a warmer, wetter climate combined with canopy disturbance from MPB and WPBR would increase resource availability such that whitebark pine ecosystems would shift compositionally to resemble common, mesic ecosystems. Preliminary results did not fully support this hypothesis. The climate was warmer after the 1970s, but precipitation was highly variable. There was no uniform shift in understory composition; however, there were interesting differences in understory response between two different whitebark pine ecosystems surveyed: 'Moderately dry/poor' versus 'Dry/poor' (Haeussler et al 2009).

We followed up this preliminary study testing two possible hypotheses: (1) was there a homogenization of forest communities over time through a shift in both types of whitebark pine ecosystems towards a mesic ecosystem composition? or (2) was there a threshold response whereby 'Dry/poor' ecosystems demonstrate resilience to change, while 'Moderately dry/poor' ecosystems are more vulnerable? In 2009 we undertook further re-sampling of old BC-MOF plots in both whitebark pine ecosystems, as well as surveying mesic, non-whitebark pine ecosystems as a reference. Here we present changes in forest structure over time.

Methods

We returned to sites surveyed in 1978-85 and followed the original BC-MOF survey methodology (Luttmerding et al. 1990). We were not always able to relocate the original plot markers so precise relocation was not always possible. However, we navigated as geographically close to the original plots as possible and ensured placement of our plot was in an area with as similar site characteristics as possible. In total in 2007-09 we surveyed 5 'Dry/poor', 4 'Moderately dry/poor' and 5 'Fresh/medium' sites collecting basic mensuration data using prism plots; in the 2007-09 surveys we also used 5.6 m radius plots. Diameter at breast height (DBH) was recorded for live and dead trees in both survey periods.

Results and Discussion

There was significant change in tree species composition and abundance over time. The observed change supports Hypothesis 1. A decrease in live whitebark pine stems has driven these forests to more closely resemble 'Fresh/medium' reference stands (Figure 1). Our results suggest that absolute disturbance intensity was similar in 'Moderately dry/poor' and 'Dry/poor' ecosystem types.

Disturbance in 'Dry/poor' ecosystems decreased the number of large *P. albicaulis*, changing this species from a J-shaped to a unimodal diameter distribution (Figure 1). The decline in smaller live *P. albicaulis* trees is worrying for the conservation of this species, particularly in dry, exposed stands, where it is expected to persist throughout old growth (Keane et al 1990). We did find that *P. albicaulis* seedlings continue to regenerate in the driest stands, suggesting these are the most suitable sites for whitebark pine persistence (Figure 2).

'Moderately dry/poor' ecosystems showed a similar loss of large whitebark pines as well as a decrease in large *A. lasiocarpa* accompanied by a sharp increase in small *T. mertensiana* (Figure 1). There were few small *P. albicaulis* trees in 2007-09; this, combined with the lack of *P. albicaulis* seedlings (Figure 2) suggests whitebark pine may not persist in these ecosystems. The lack of regeneration could be due to shading from the thickening canopy of hemlock and fir and also due to lack of seeds, as Clark's nutcrackers may be less likely to cache seeds in 'Moderately dry/poor' stands (Tomback et al 1990).

Our reference stands also changed over time, primarily through decreasing *A. lasiocarpa* in the canopy. This may have been due to balsam bark beetle (*Dryocoetes confusus*) disturbance, competition with more shade tolerant *A. amabilis* and *T. mertensiana*, or simply that there is a decline in density as stands age.

Disturbance and stand dynamics in whitebark pine ecosystems are complex. Whitebark pine continues to regenerate in 'Dry/poor' ecosystems; however, ongoing disturbance will further decrease its presence in the overstory and canopy recruitment in the future, resulting in a worsening outlook for this rare ecosystem.

Acknowledgements:
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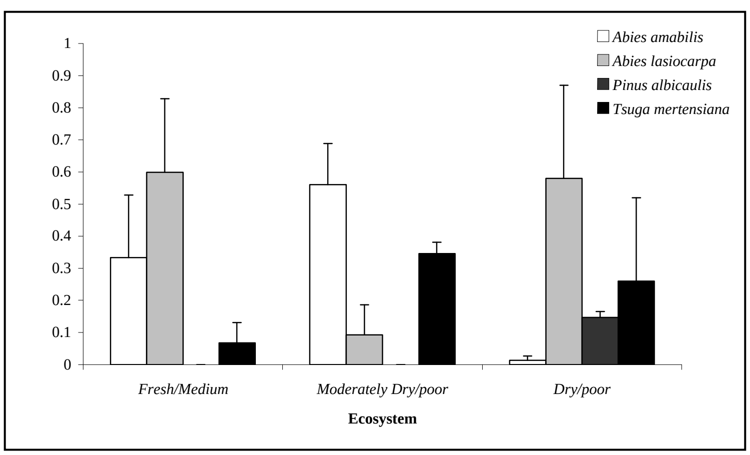

Figure 2 – The proportional number of seedlings/ha for each species by ecosystem type in the 2007/09 surveys

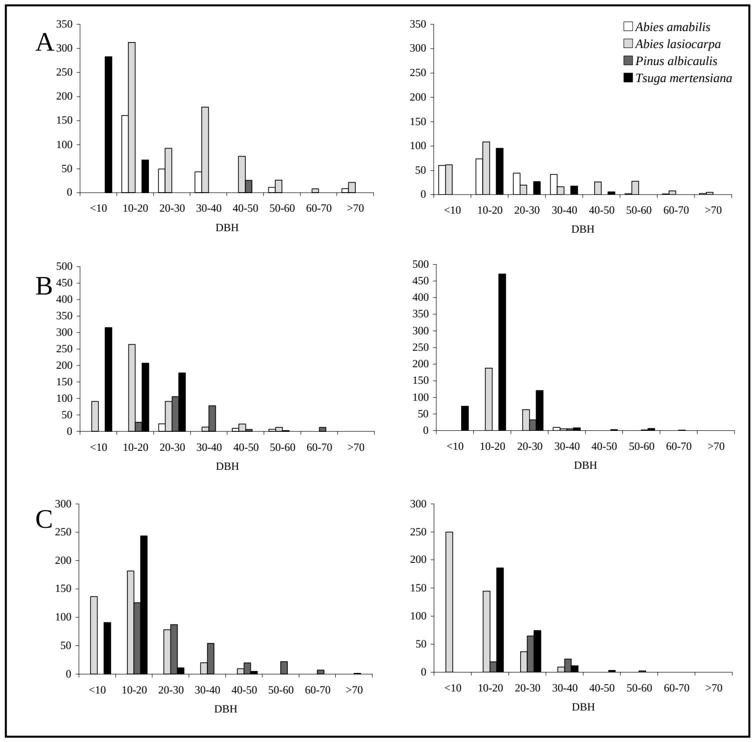

Figure 1 – The number of stems/ha by diameter at breast height (DBH) category for each species in the first survey period (left) and second survey period (right); A) 'Fresh/medium' reference stands; B) 'Moderately dry/poor' and C) 'Dry/poor' whitebark pine ecosystems.

Blister Rust, Fire Exclusion, and the Fate of Sugar Pine

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[Editor's Note:** Although not one of the "High Five" species, sugar pine is a magnificent white pine that is subject to similar threats.**]

Botanical explorers were awestruck by the sugar pine (*Pinus lambertiana)* (David Douglas called it the "most princely" of all pines). It is the tallest and largest pine, attaining heights of 50 to 60 m (165 to 200 feet) and diameters of 90 to 150 cm (35 to 60 inches). Its cones are impressive, reaching lengths of 25 to 50 cm (10 to 20 inches). Sugar pine is also prized for its high quality lumber.

Figure 1. Mature sugar pine at Sequoia National Park. Credit: NPS