Condition and Health of Whitebark Pine in the Blue Mountains of Northeastern Oregon

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Introduction

Whitebark pine is a keystone species, regulating snowmelt, preventing soil erosion, and providing an important food source for seed-eating birds and mammals. In the Greenhorn, Elkhorn, and Wallowa Mountains in northeastern Oregon, whitebark pine occurs in small, disjunct island populations at elevations above 2300 meters (Fig. 1). Forming both mixed and nearly pure stands, whitebark pine will often be succeeded by the more shade-tolerant subalpine fir if fire does not intervene.

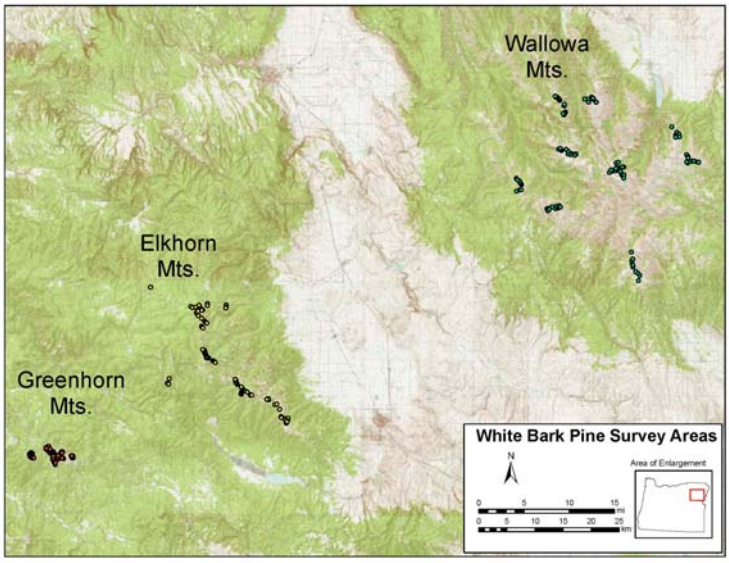

Fig. 1. Location of whitebark pine survey areas (Elkhorn, Wallowa, and Greenhorn Mts. in northeastern Oregon (U.S.A.).

From 2002-2005, field surveys were conducted to assess trends in the condition and health of whitebark pine populations, specifically: (1) the amount and severity of white pine blister rust within and among populations, (2) the degree of mortality from whitebark pine blister rust and other causes across age classes, and (3) the amount of stand regeneration. Tree-ring data were also obtained to assess demographic and recruitment patterns within and among species, and to evaluate the frequency and severity of growth suppression events.

Survey Methods:

In the Greenhorn Mountains, whitebark pine and associated conifer species were surveyed in 153 plots in 30 stands using modified Common Stand Exam (CSE) procedures. Circular 0.04 ha plots were established to sample all whitebark pine (alive and dead) greater than 10 cm DBH; 0.01 ha plots were used to sample seedlings and saplings. In the Elkhorn and Wallowa Mountains, 200 transects (46 m x 9 m) were established following survey methods developed by the Whitebark Pine Ecosystem Foundation. Only whitebark pine trees were assessed in the transects.

Within each plot or transect, increment core samples were taken from the first live standing whitebark pine tree per diameter group (n=8 classes). In the Greenhorn Mountain plots, core samples were obtained from associated species in addition to whitebark pine. Tree ring analysis was completed by J. King (Lone Pine Research, Bozeman, MT).

Survey Results

Of the 4464 whitebark pine surveyed in the three areas, a total of 595 (13%) were dead. Mortality was highest in the Greenhorn Mountains (24%), and lowest in the Elkhorn Mountains (8%) (Fig. 2). The principal cause of mortality, especially among the older trees, was attributed to a mountain pine beetle epidemic that occurred in northeastern Oregon during the 1970's (Fig. 3). White pine blister rust accounted for approximately 15-21% of the observed mortality (Fig. 3), most of which was in the younger age classes (data not shown).

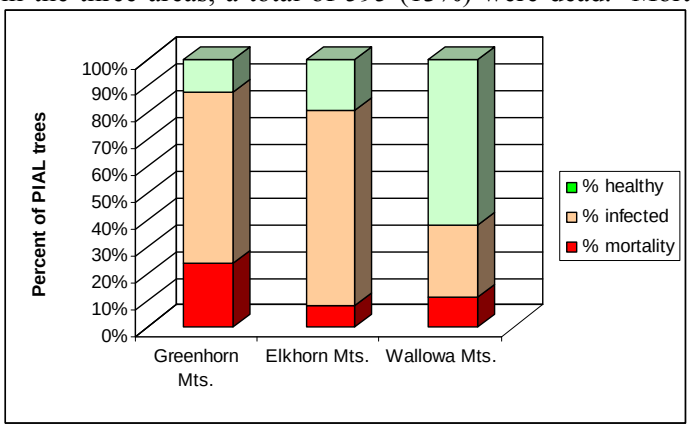

Fig. 2. Percentages of sampled whitebark pine in the Greenhorn Mts. Elkhorn Mts., and Wallowa Mts. that were healthy, infected with white pine blister rust, or dead

The prevalence of blister rust in live trees was extremely high in both the Elkhorn and Greenhorn Mountains, where infection rates were 73% and 64%, respectively (Fig. 2). In contrast, only 27% of the trees in the Wallowa Mountains were infected. In all areas, the majority of the infected trees (>75%) had either bole cankers or branch infections located within 15 cm of the bole (blister rust severity rating = 3).

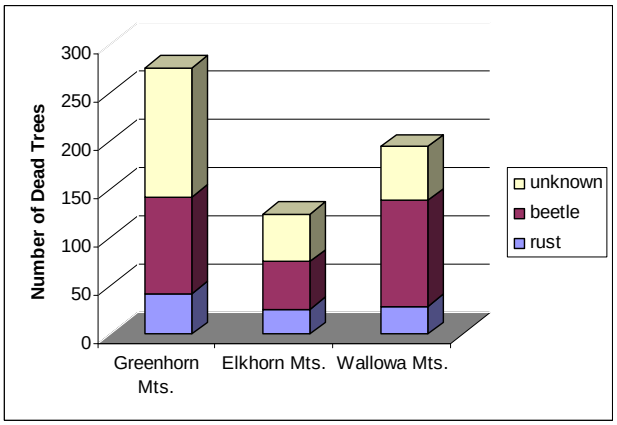

Fig. 3. Whitebark pine mortality in the Greenhorn Mts., Elkhorn Mts., and Wallowa Mts as attributed to mountain pine beetle, white pine blister rust, or unknown causes

In each study area, a number of whitebark pine exhibited pronounced growth suppressions in the period following ca. 1980 (e.g., Fig. 4 for Greenhorn Mts.). The cause is unknown, but not likely linked to climate because not all sampled whitebark pine had reduced growth during the same time period. Also, in the Greenhorn Mountains, where associated species were analyzed in addition to whitebark pine, growth suppressions were not entirely synchronous among species as would be expected if climate were a controlling factor (Fig. 4).

The oldest living whitebark pine occurred in the Wallowa and Elkhorn Mountains, where a number of trees pre-dated the 1600's (Fig. 5a, b). The oldest (>500 years) and slowest growing (>100 years per inch of radius) living whitebark pine trees occurred in the Wallowa Mountains.

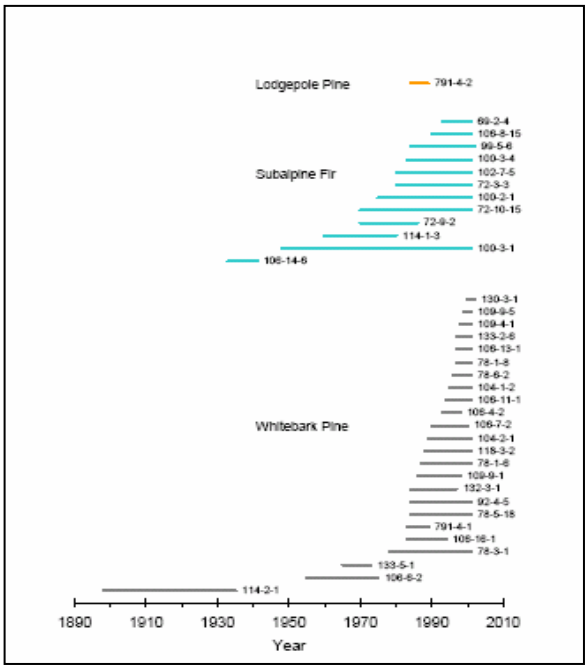

Fig. 4. Timing of tree-ring growth suppression in whitebark pine and associated species in the Greenhorn Mts. Each horizontal line represents a period of distinct growth suppression in an individual tree.

Tree ring analysis revealed several episodes of diminished whitebark pine recruitment and a recruitment peak ca. 1940-1960 (Fig. 5, 6, 7). There was a close coincidence between recruitment pulses and periods of past climate warming (J. King, pers. comm.). These results, combined with the highly synchronous recruitment pulses across the three sampling areas, suggest that regional climate is strongly controlling recruitment patterns.

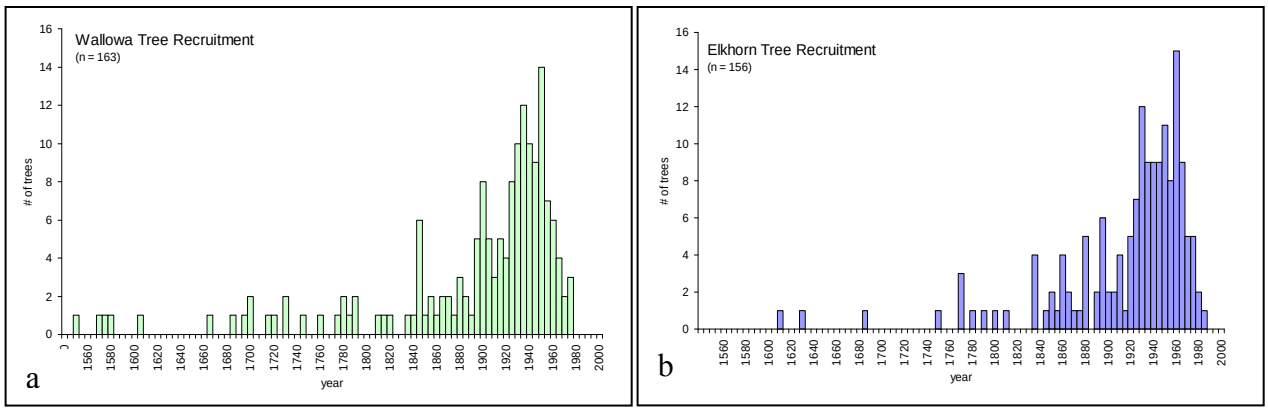

Fig. 5. Whitebark pine recruitment dates in the (a) Wallowa Mts., and (b) Elkhorn Mts.

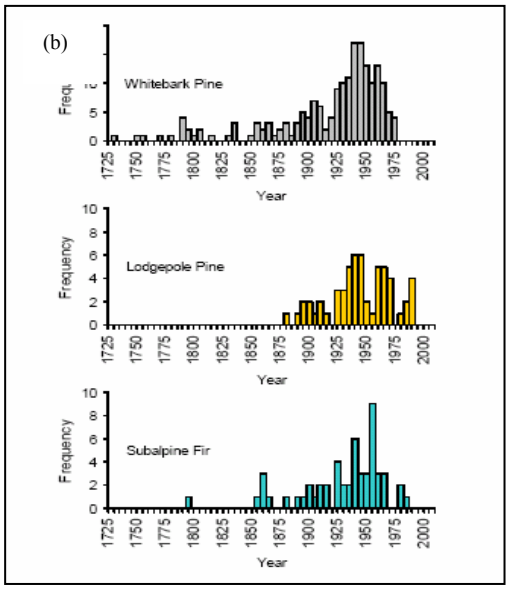

Fig. 6. Recruitment dates for whitebark pine and associated species in the Greenhorn Mts.

Discussion

Information from the 2002-2005 surveys provide reference conditions from which to assess changes in the status of whitebark pine in northeastern Oregon. While data analysis is still ongoing, our impression is that whitebark pine is seriously threatened by white pine blister rust, particularly in the Greenhorn and Elkhorn Mountains. Several measures have been taken to protect and conserve the unique populations occurring in these areas, including: (1) cone collections for blister rust resistance screening at Dorena Genetic Resource Center, (2) a regeneration trial and an outplanting project in the Greenhorn Mts., and (3) mechanical treatments in the Greenhorn and Elkhorn Mts. to reduce competition and to create openings for whitebark pine regeneration (see related abstract, this proceedings). Additional work will be accomplished as resources become available.

Acknowledgments: Funding for this work was provided by the USDA Forest Service, Forest Health Protection Program.