# Summary Report for
# Jean Lake White Pine Blister Rust Assessment

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**Background**

White Pine Blister Rust is caused by the *Cronartium robicola* fungus and has infected white pine trees throughout North America (David, Berrand and Pike, 2012). This fungus was brought over from Europe on seedling stock to North America at the turn of the century and has led to many white pine tree fatalities. An important alternate host to this fungus are ribees species, which can facilitate the infection of the fungus to the white pine tree (David et al., 2012).

As a result of failing white pine populations, in the 1960`s a large scale and long-term experiment was proposed by Cliff and Isabelle Algren in order to secure a future seed source that is more tolerant to white pine blister rust. They proposed to collect cones of pine trees exhibiting signs of blister rust resistance along the North shore of Lake Superior and the Boundary Water Canoe Area Wilderness. Later that decade, the Quetico-Superior Wilderness Research Foundation, USDAFS (United States Department of Agriculture and Forest Service) and the University of Minnesota agreed to start a trial area with a high incidence of blister rust infection in order to test and breed white pine trees with a higher resistance to the fungus (David et al., 2012). In Tofte Minnesota, they set up an 8.9 ha area where they planted eastern white pines originating from 22 sites from both the Boundary Water Canoe Area Wilderness and the north shore of Lake Superior as well as some trees from a 23rd site in North Wisconsin (Merrill et al., 1984). This site is now the largest genetically diverse source of potentially resistant eastern white pine in North America. Until the 1980`s, the trees were monitored and assessed for white pine blister rust and resistant trees were selected.

In 1989, the *Tall Pines Research Project* was conducted as a result of concerns that human activity and influence had altered natural forest succession in Quetico, including logging, disease, fire, and fire suppression (Pringle, 1989). Some of this disturbance included the logging that occurred in Quetico between 1900 and 1946, as well as human induced fires and overall fire suppression that has inhibited natural pine regeneration (1989). This study was to find out the corrective action needed to protect white pines and the quantity/quality of white and red pine in Quetico (Pringle, 1989). A proposed solution was planting trees developed by Clifford and Isabelle Algren in order to promote more blister rust resistant pine trees in Quetico. Hence, with support of the Quetico Foundation, in May 1990 a total of 600 white pine seedlings were planted at 14 different plots in Quetico Provincial Park near the shores of Jean Lake and Quetico Lake (Pringle, 1990). In 1992, additional plots were planted in Jean Lake, Quetico River, Quetico Lake and Beaverhouse (Pringle, 1992). The plots were tended to and assessed for survivability shortly after planting, but since the mid 1990`s the assessment and tending of most of the plots had been forgotten.

## Objective

The objective was to locate white pine blister rust resistant trees that were planted on Jean Lake in 1990 and perform standardized assessment on these trees. The assessments of the trees were completed according to the specifications of the protocol developed by the area forester (Renee Perry) and Bridget Antze (MNR technician). Assessment will help determine the resistance level of the trees to White Pine Blister Rust. The stands were surveyed for the presence of blister rust, indicators of tree health, overall shrub, herb and competitor presence and the trees ability to grow.

The goal of this report is to provide a preliminary analysis and summary of the data collected in 2016 for the assessment of white pine blister rust resistance of the white pine trees that had been planted in the 1990's for the *Tall Pines Reseach Project* (Pringle, 1990 and 1992). All of the data that was collected in 2016 for this purpose were located on Stanton Bay Road, Control Plot 957 and Jean Lake.

## Methods

Plot locations on Jean Lake were estimated from aerial photography as well as the hand drawn maps from the initial plantings of the plots (Pringle, 1990 and 1992). The Quetico Foundation crew and the Stewardship Youth Rangers (SYRs) worked together to find and assess the resistant white pine blister rust plots that had been planted in 1990. Using the estimated GPS coordinates of the sites and overall comments of the location of the plots from the initial plantings, they were able to track down seven plots (D2-D8) on Jean Lake. The collected data was summarised and briefly assessed, but a larger analysis comprising of the rest of the white pine blister rust data is needed to come to more conclusive findings of white pine resistance of the planted pines. Further, the severity of blister rust was classified from 1-4 (1=dead from blister rust, 2=active canker, 3=inactive canker and 4=no blister rust). The health (vigor) of the tree was commented upon, but not given a classification based on a scale which proved problematic for data analysis. The health of the tree, without assessing blister rust, was then deduced from the comments of each tree and then classified from 1-3 (1=dead, 2=compromised health and 3=no apparent health issues).

***Table 1.*** List of major research equipment used for plot assessments on Jean Lake.

| | | | | | |
|---|---|---|---|---|---|
| Ruler | Map | Compass | Plot cord | Data sheet | Flag Tape |
| SEM stick | GPS | Clipboards | Lumber crayons | Measuring tape | D tape |
| Plot protocol sheet | | | | | |

***Table 2.*** Work table of hours and days worked for white pine blister rust assessment on Jean Lake.

| *Work crew* | *# people* | *Total Days* | *Hours (7.5hours/day)* | *Person days* |
|---|---|---|---|---|
| SYR | 5 | | 150 | 20 |
| QF research crew | 4 | 4 | 120 | 16 |
| *Total* | *9* | *4* | *170* | *36* |

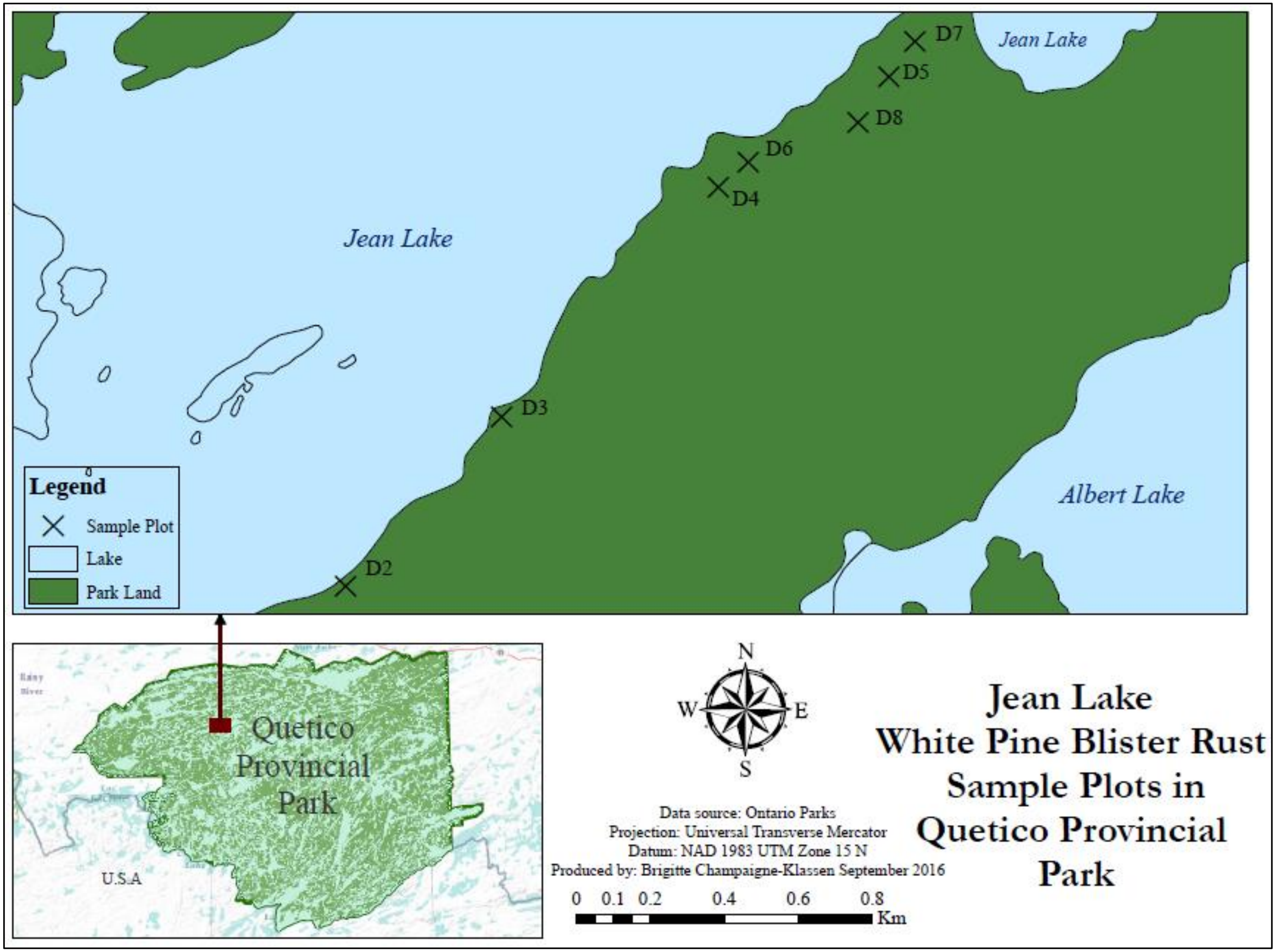


***Figure 1***. Map of white pine blister rust assessment plot locations on Jean Lake.

## Results

In the plots sampled, few white pine trees exhibited signs of white pine blister rust. Only three trees, 2 in plot D2 and 1 in D7, were classified with blister rust out of the 168 total white pine trees assessed. The total average diameter (cm) of all measured trees was 11.27. There were 10 trees that were dead from unknown causes that seemed to be another reason than blister rust, while most of the trees (90.5%) had a severity class of 4 (no signs of blister rust) (figure 3a), and 82% had a vigor class of 3 (no apparent health issues) (figure 3b). Plots D2-D8 were the only plots sampled due to time constraints in the field.

***Table 3***. Summary data of results collected from Jean Lake white pine blister rust resistant plots.

| *Plot ID* | *Tree count* | *Average Diameter (cm)* | *Severity Class* | | | | *Vigor* | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | *1* | *2* | *3* | *4* | *1* | *2* | *3* |
| D2 | 24 | 13.39 | 2 | 2 | 1 | 19 | 6 | 3 | 15 |
| D3 | 27 | 8.67 | | | | 27 | 2 | 2 | 23 |
| D4 | 25 | 12.58 | | | 3 | 22 | 1 | 3 | 21 |
| D5 | 20 | 11.48 | | 1 | 1 | 18 | 1 | 3 | 16 |
| D6 | 12 | 12.22 | | 2 | 1 | 9 | | 3 | 9 |
| D7 | 35 | 9.63 | 1 | 2 | | 32 | 1 | 2 | 32 |
| D8 | 25 | 12.43 | | | | 25 | 2 | 2 | 21 |
| **Total** | **168** | **11.27** | **3** | **7** | **6** | **152** | **13** | **18** | **137** |

Using Baye`s theorem, the probability that the death of a tree was caused by blister rust among all the sampled plots was estimated to be 18.8% (equation 1). This probability was calculated using the collected data for plots D2-D8 (table 3). Using this type of approach is a preliminary step to data analysis, as more data is required to achieve more conclusive results. Bayesian statistics can be a useful tool to interpret and estimate the probability of certain ecological mechanisms, which can be useful to complement the analysis and summary of collected data.

***Equation 1.***

$$P(A|B) = p(B|A) * \frac{p(A)}{p(B)}$$

$$P(dead\ tree|blister\ rust) = p(BR|dead) * \frac{p(dead)}{p(BR)}$$

$$= \frac{3}{13} * \left[ \left(\frac{13}{168}\right) / \left(\frac{16}{168}\right) \right]$$

$$= 0.18756$$

$$= 18.76\%$$

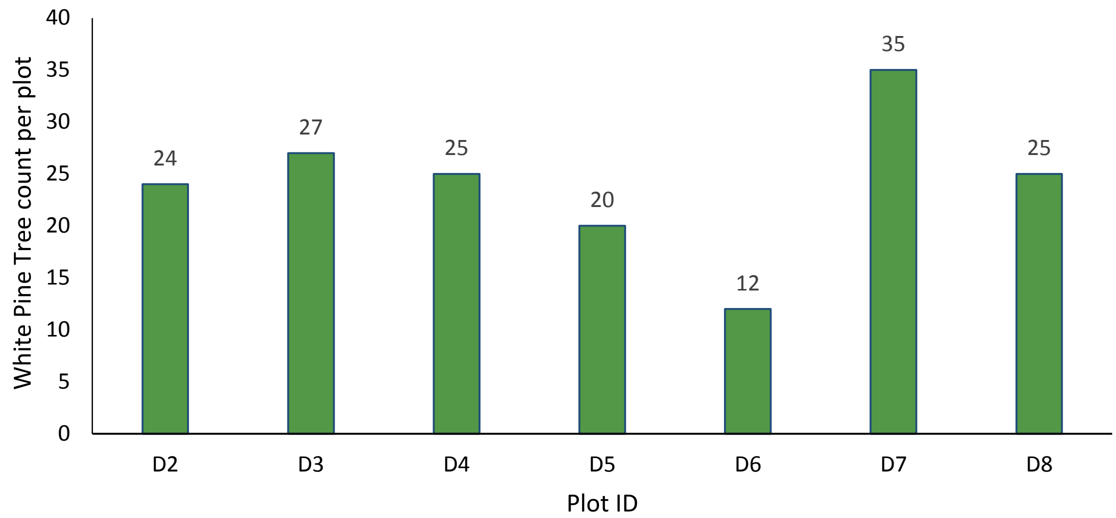


***Figure 2***. Amount of white pine trees per plot in Jean Lake.

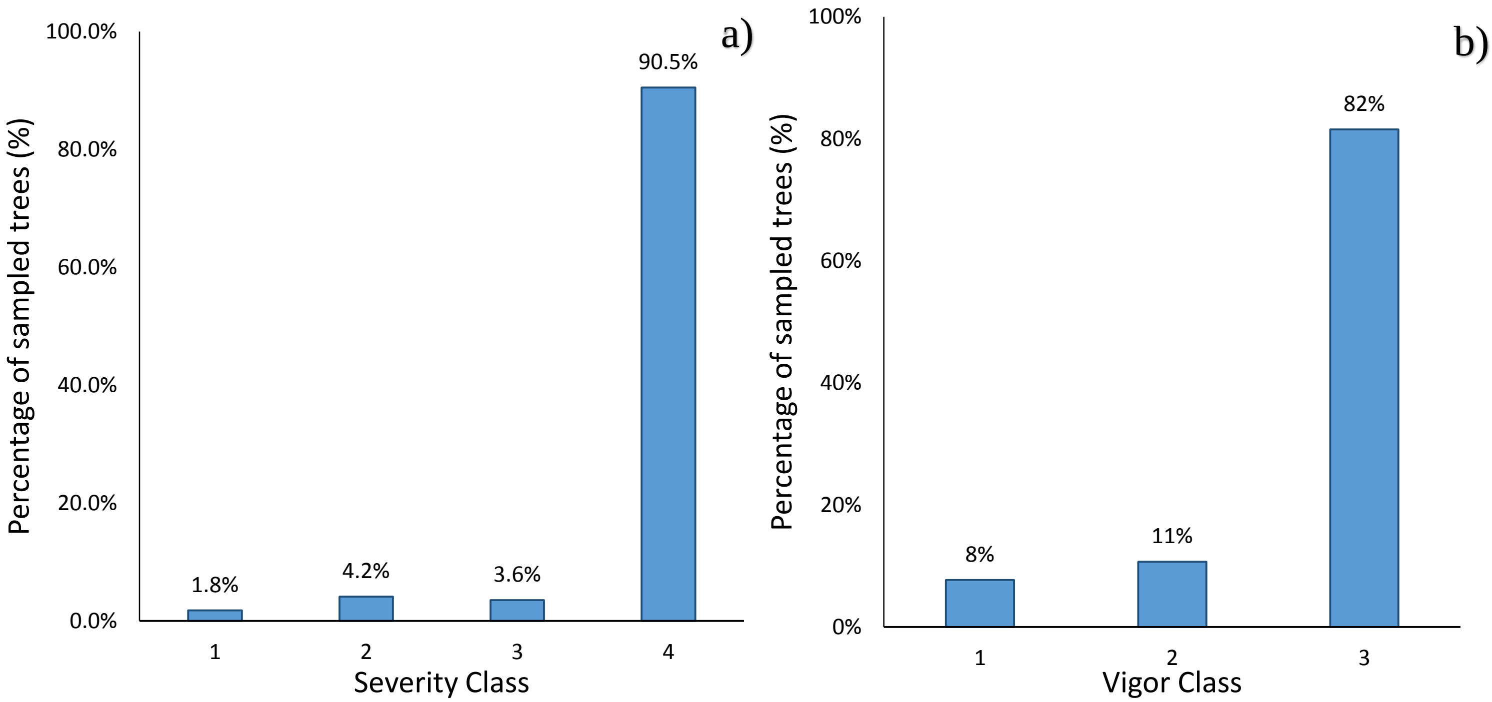


***Figure 3***. A) *Percentage of assessed white pine trees according to severity of blister rust classification (1=dead from blister rust, 2=active canker, 3= inactive canker, 4=no blister rust) among in all 168 white pines through plots D2-D8 in Jean Lake. B)* Percentage of assessed trees according to vigor class (1=dead, 2=compromised health, 3=no apparent health issues) among in all 168 white pines through plots D2-D8 in Jean Lake.

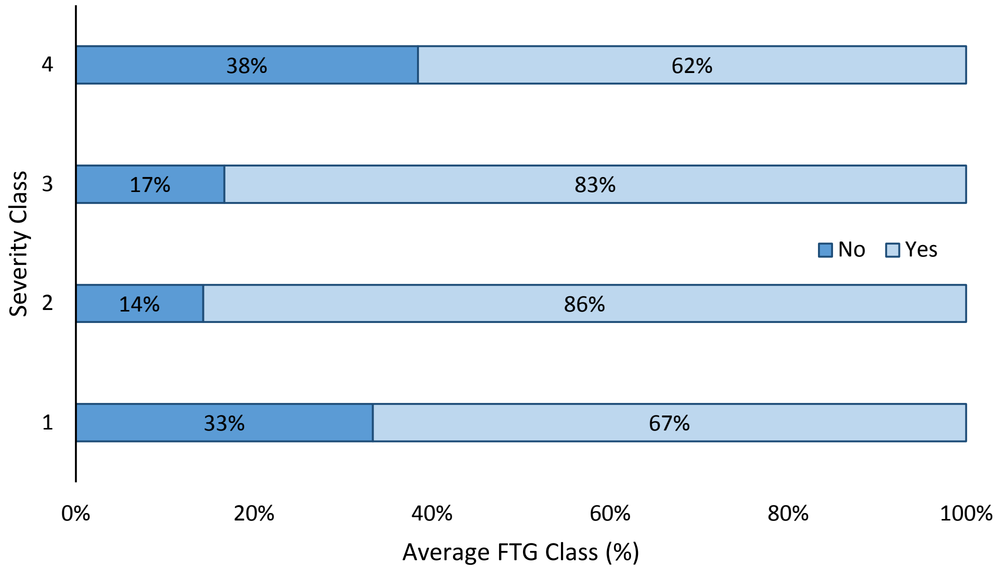


***Figure 4.*** Percent average free to grow classification (FTG) (yes or no) of white pine according to severity class (1-4).

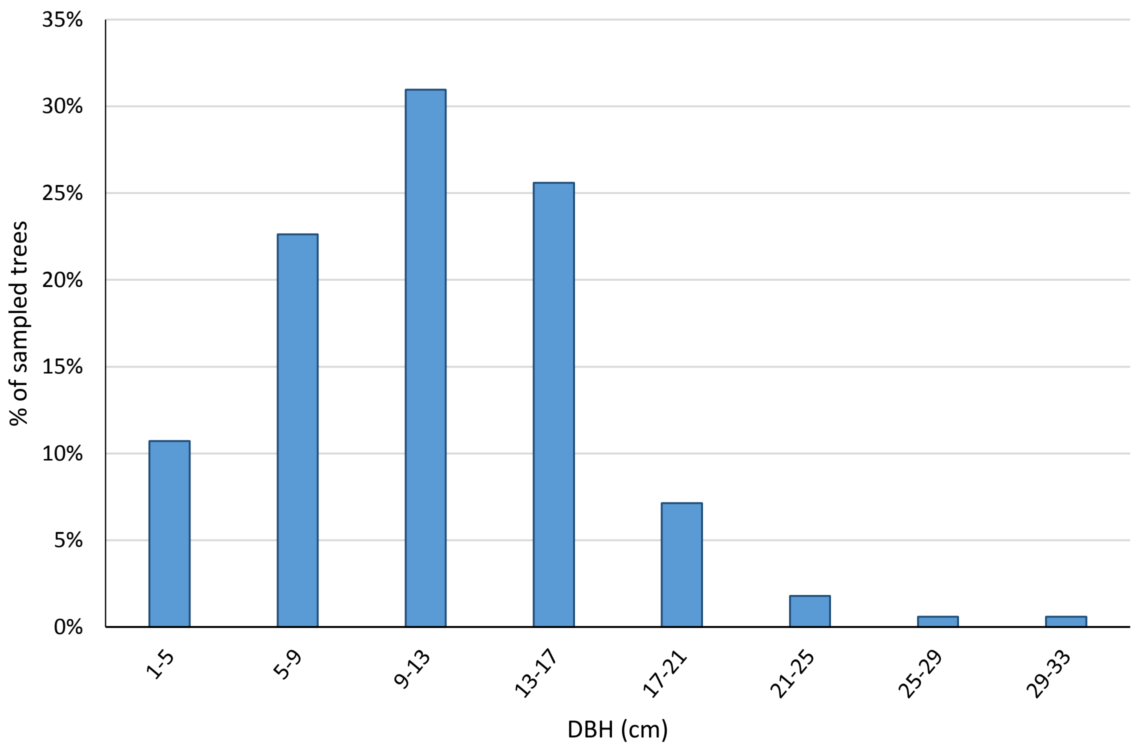


***Figure 5***. Diameter at breast height (DBH) (cm) distribution of white pine in all sampled plots in Jean Lake.

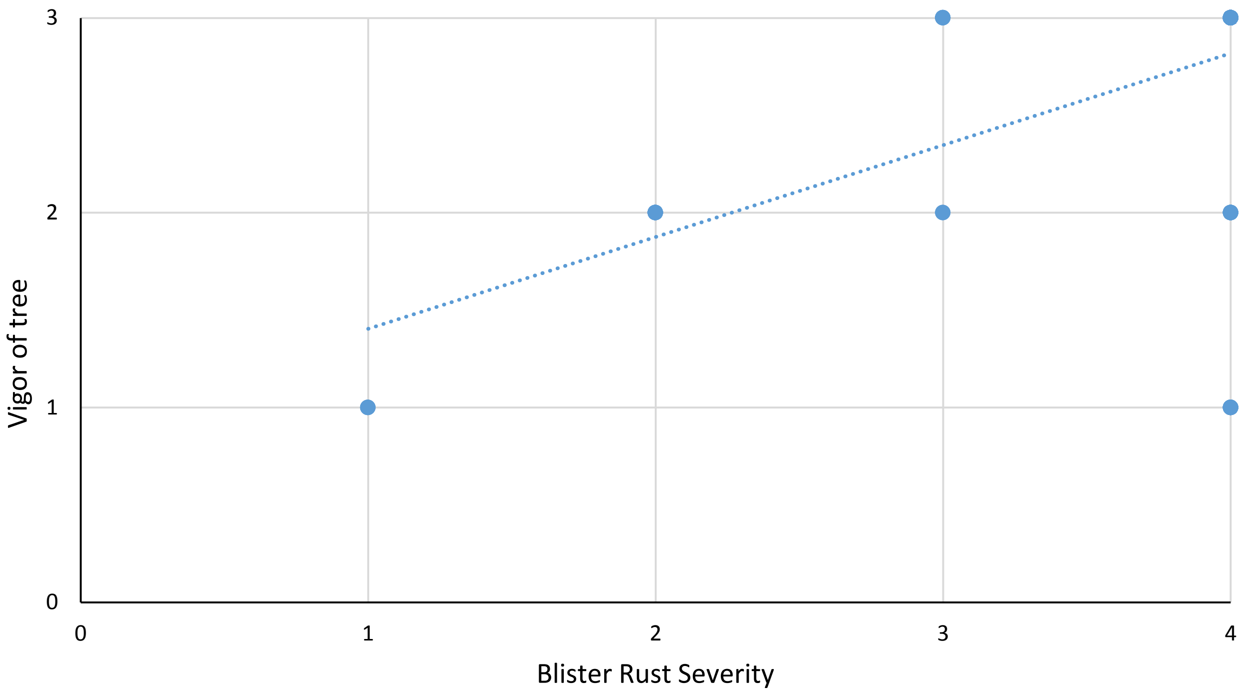


***Figure 6.*** Severity of blister rust (1-4) compared to vigor of tree (1-3) for white pine among all sampled plots in Jean Lake.

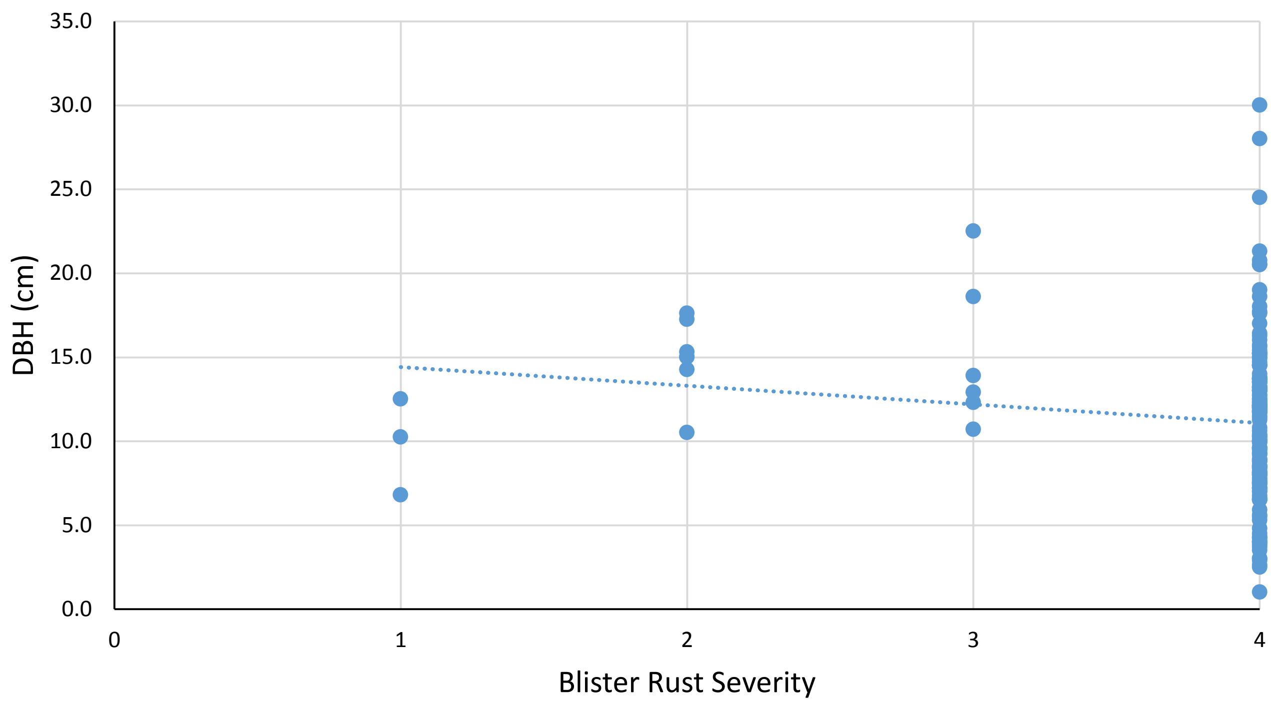


***Figure 7.*** Severity of blister rust (1=dead from blister rust, 2=active cankers, 3=inactive cankers, 4=uninfected) compared to DBH (cm) for white pine among all sampled plots in Jean Lake.

While comparing the severity of white pine blister rust and the vigor of the tree (figure 6), it was found that the death of a tree was not always contingent on the presence of blister rust. Trees were classified as being dead while having blister rust, as well as dead with no signs of blister rust. Overall, the assessed trees had low incidences of blister rust presence and most trees exhibited no apparent health issues, as is shown in figure 3; 90.5% of all sampled trees on Jean Lake had no signs of blister rust and 82% of the sampled trees had no apparent health issues. Additionally, most of the trees were free to grow, meaning that they were well-spaced and not under canopy; 67% of the trees with blister rust and 62% of the trees that had no presence of blister rust were free to grow (figure 4). A relationship between the free to grow status of the tree and blister rust is unlikely, yet an analysis of all the collected data from Stanton Bay, the control plot as well as Jean Lake is needed to come to more conclusive results. Further, there is no significant relationship between the severity of blister rust and the diameter of the tree (figure 7).

## Recommendations

In the data collection, the method of scoring blister rust severity was emulated from David et al. (2012) with a classification of 1-4, 1 being dead from blister rust and 4 being uninfected. However, the vigor of the tree should also be collected, as was done by David and colleagues (2012), during BR assessment to avoid confusing between BR severity and tree vigor.

A comprehensive review of all the collected white pine blister rust data is required to come to conclusive results. Comparing the different plots across Quetico that had been planted, including the plots along Stanton Bay road and the control plot (957), would allow for a more complete and comprehensive analysis of the collected data. This will also enhance our understanding of the resistance to white pine blister rust of the 'tolerant' white pine tree plots from the early 1990's. The plots from Stanton Bay and Plot 957 were recently assessed by MNR employees with the help of the Quetico Foundation research crew in June and July 2016. In Stanton Bay, 25 plots were assessed and in the Control Plot 13 plots were assessed.

## Works cited


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