An Investigation Into Tree Damage in the Whitecourt Forest

File Report NOR-1109-03

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July 6, 1992

<u>CONFIDENTIAL</u>

Background

Forestry Canada Forest Insect and Disease Management Systems and Surveys staff were requested by the Alberta Forest Service to investigate the cause of damage to lodgepole pine and black spruce trees in the area of TWP-59-R-17-W of 5.

In April of 1992 Alberta Forest Service protection personnel brought some lodgepole pine from the Whitecourt Forest to the Northern Forestry Centre for examination. The trees severe loss and discoloration of the remaining last year's needles. The foliar symptoms were typical of needle cast disease but no fruiting bodies were found. The symptoms could have also been caused by winter or pollution injury.

In May of 1992, J. Moll (Forest Protection Officer, Whitecourt Forest) collected and submitted red and green foliage samples from 35 year-old lodgepole pine located in LSD 10-26-58-18-W5. The needles were first examined for evidence of needle cast fungi and then analyzed for foliar nutrient (elemental) concentration. No needle cast fungi were present on the submitted needles. All macro nutrients were in "normal" concentrations for lodgepole pine.

On June 15 Dr. D.G. Maynard and I accompanied J. Moll, A. Sproule of the AFS and G. Branton of the Alberta Newsprint Company on a tour of the affected area. We examined trees growing in the area alone the route shown in pink in figure 1. Trees showed differing degrees of injury in some locations in other locations every tree was affected. Many of the lodgepole pine had lost their fourth and third year needles. Last years needles were turning or had turned red in color. The current years growth appeared unaffected but on many trees the needles were stunted. In some locations tree height growth was obviously reduced over that of previous years. No needle cast fungi or insects were found on the lodgepole pine needles. Black spruce trees had lost many of their older needles. Three and four year old needles were turning a magenta color. On some black spruce trees the needle cast fungus Isthmiella crepidiformis Darker was found on a few needles. On other trees displaying the same foliar symptoms no needle cast fungi were found. Roots of affected and dead lodgepole pine and black spruce trees were examined. There was no evidence of root decay fungi. At one locations the root collar weevil Hylobius warreni

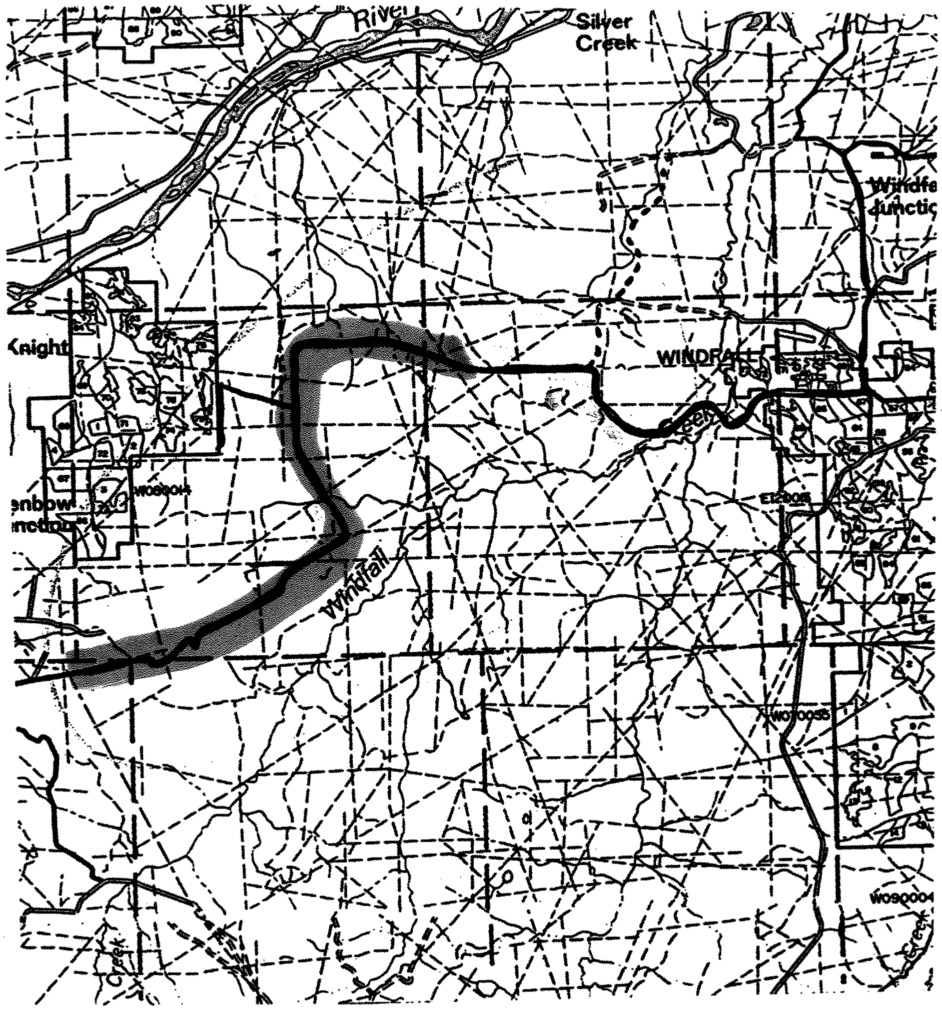
Wood was found on some young lodgepole pine. Foliage samples were collected from black spruce and lodgepole pine trees and brought back to the Northern Forestry Centre for nutrient analysis. A soil sample was collected from one location and analyzed for pH, electrical conductivity and chlorides.

Analysis of the foliage is shown in Table 1, Sample 1. All macronutrients in the black spruce are within "normal" concentrations except sulfur which is above normal (normal = 1000 ppm $\pm$ 250-300 ppm). Lodgepole pine foliar nutrient concentrations were in the normal range. Soil pH, electrical conductivity, and chlorides were normal.

Table 1. Some foliar nutrients from black spruce and lodgepole pine trees (in mg/kg).

Sample 1.	P	S	Mg	K	Ca
black spruce #1	1123	1961	857.9	4693	6687
black spruce #2	917.3	2011	1084	2106	13609
lodgepole pine	854.3	1163	891.3	2071	3557
Sample 2.					
black spruce #3	1528	1685	967.5	4136	7694
black spruce #4	1609	2122	1304	4222	8060
lodgepole pine #2	1943	1437	952.8	5310	2945

Figure 1. Location of tree damage in the Whitecourt forest.



Another trip was made to the affected area on June 24, 1992 by Dr. H.F Cerezke (Forestry Canada) and myself. We travelled the same route as marked in Figure 1. Lodgepole pine trees and black spruce trees were examined at several different sites along the route. No disease or insects were consistently found on affected trees. The affected trees occupied a wide variety of sites. Damage appears to be greatest in the lower elevation sites although damage was noted on several slopes. The damage was not consistent with winter injury, late spring frost damage or drought. Disks were taken from a 35 year-old lodgepole pine for tree ring analysis. The disks indicated that growth had been reduced over the past 20 years. Foliar samples were taken for foliar nutrient analysis. The results of these analysis are shown in Table 1, Sample 2. The black spruce foliar sulfur concentrations were elevated. The lodgepole pine sample also showed an elevated sulfur level. The source of the elevated sulfur in the foliage is uncertain. There is a sour gas processing plant in the nearby vicinity (SW-15-59-18-W5) and the foliar symptoms are consistent with those produced by sulfur dioxide fumigation (Malhotra and Blauel 1980). Hogan and Wotten (1984) found that black spruce growing near a smelter in Flin Flon Manitoba and subjected to sulfur dioxide had elevated sulfur concentrations in their foliage but that jack pine did not. This may explain the difference in the black spruce and lodgepole pine in the damaged area in the Whitecourt forest.

Conclusions

Two species of trees, black spruce and lodgepole pine have been found with varying levels of defoliation over a large area. In some locations the defoliation is extreme and trees are dying. The damage in the affected area could not be attributed to an insect or a disease and is not consistent with a climatic type of injury. There were elevated levels of sulfur in the foliage of black spruce and some lodgepole pine. The symptoms on the black spruce and pine are consistent with those caused by sulfur dioxide fumigation injury. The evidence suggests that the damaged trees may have experienced sulfur dioxide fumigation; however, further investigation is warranted.

Recommendations:

1. The AFS contact Alberta Environment and Chevron Oil to obtain information on sulfation stations and possible fumigation events from the Chevron sour gas plant located at SW-15-59-18-W5.
2. Foliage from different tree and shrub species from within and outside damaged area be sampled and analyzed for sulfur concentration.
3. Soils from different sites within and outside the damaged area and be sampled and sulfur concentrations be determined.

References

Hogan, G.D.; Wotton, D.L. 1984. Pollutant distribution and effects in forests adjacent to smelters. J. Environ. Qual. 13:377-382.

Malhotra, S.S.; Blauel, R.A. 1980. Diagnosis of air pollutant and natural stress symptoms on forest vegetation in western Canada, Can. For. Serv. North. For. Res. Cent. Edmonton, Alberta. Inf. Rep. NOR-X-228.