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Young Stand Pest Survey of Eight Stands in the Sundre Ranger District, Bow-Crow Forest

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Introduction

In 1990-91, premature-needle-drop was observed in some young lodgepole pine stands in the Sundre Ranger District of the Bow-Crow Forest by Alberta Forest Service (AFS) staff. Forestry Canada was requested by the Alberta Forest Service to investigate the cause of the needle loss, how much damage had been done, and to survey the stands for other insect and disease problems. The following is a report on the tree health and pest conditions within some selected stands in the Sundre Ranger District.

Methodology

Eight young stands in the Bow-Crow Forest were selected by Mr.R. Smee of the AFS. These stands were considered to be typical of the type of damage that had been observed in 1990-91 and was of concern to the AFS. The stand locations are shown in Fig.1 and stand histories are shown in Table 1. In June of 1992, K.I. Mallett (Forest Pathologist) of Forestry Canada conducted a pest survey of these stands to determine the pests present, their incidence, and the health condition of the trees. The young stand pest survey was developed by Forest Insect and Disease Management System and Survey unit of Forestry Canada and is outlined in Amirault and Pope (1989). The survey procedure is being used to assess the health of young stands in the prairie provinces and Northwest Territories.

The survey was conducted by establishing a series of fixed area plots (40 m^2) within each of the eight stands chosen by the AFS. Number of plots and the total number of trees examined is shown in Table 2. In most sites, eight plots were established 50 m apart except in site 90-1 where 20 plots were established so that several of the small cut blocks would be sampled and 90-3 where 7 plots were established. Trees within the plots were assessed for their health condition: healthy, declining and dead, as well as for signs and symptoms of insect and disease. Trees were rated healthy if they appeared to be vigorously growing. Trees that had reduced height shoot growth, reduced needle length, sparse foliage, and/or abnormal coloration of the needles were rated as declining. Trees were rated for needle cast damage by examining the tree from all sides and rating the loss of needles on a 4 point scale where 0 = no needle loss, 1 = light to moderate (10% - 25%), 2 = moderate to severe (25% - 50%), 3 = severe (>50%). Samples of foliage thought to have needle cast symptoms were brought back to the Northern Forestry Centre for identification of the causal organism.

Figure 1.

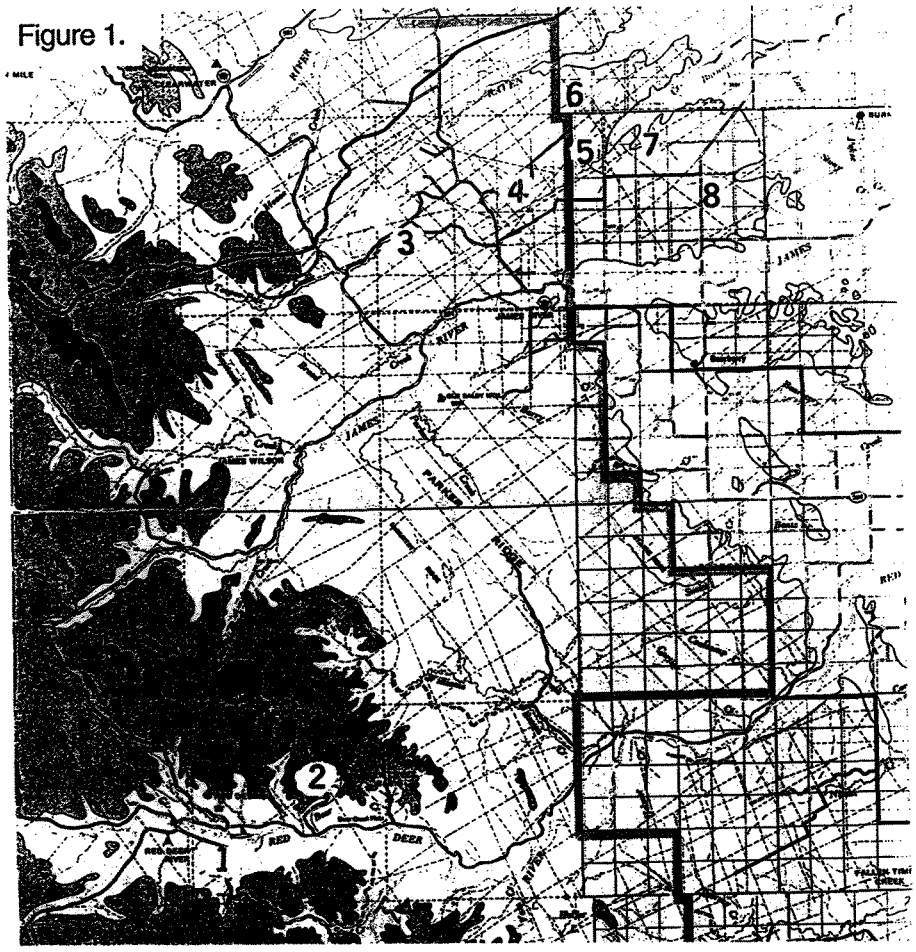


Table 1. Lodgepole pine stands surveyed for pest conditions

Site	Age	Silvicultural Treatment	Location
92-1	24	Thinned & Fertilized	9-8-31-9-W5
92-2	18	None	4-23-31-9-W5
92-3	28	Drum Thinned	13-17-34-8-W5
92-4	25	Thinned & Fertilized	9-22-34-8-W5
92-5	18	None	13-30-34-7-W5
92-6	25	Thinned	6-34-7-W5
92-7	3	None	29-34-7-W5
92-8	5	None	13-14-34-7-W5

Table 2. Health conditions of eight young stands in the Sundre Ranger District

Site	No. of Plots	No. of Trees Examined	Per cent Healthy	Per cent Declining	Per cent Dead
92-1	20	Lp 129 Sw 2 Total 131	52.7 100	45.7 0	1.6 0
92-2	8	Lp 125 Sw 2 Total 127	60.0 100	34.4 0	5.6 0
92-3	7	Lp 107 Sw 1 Sb 5 Total 113	50.5 100 100	36.4 0 0	13.1 0 0
92-4	8	Lp 92 Sb 335 Total 427	93.5 100	6.5 0	0 0
92-5	8	Lp 186 Sw 5 Total 191	55.9 100	37.1 0	7.0 0
92-6	8	Lp 76 Sw 3 Sb 2 Total 81	73.5 100 100	17.3 0 0	9.2 0 0
92-7	8	Lp 106 Sw 1 Total 107	95.3 100	4.7 0	0 0
92-8	8	Lp 303	96.4	3.6	0

Results and Discussion

The results of the survey are depicted in Figs. 2-3. Figure 2 shows the health condition of all the trees in each of the stands. Figure 3 shows the health condition of just the lodgepole pine. White and black spruce were found on some sites (Table 2). All spruce trees examined were healthy, although some had tops which had been browsed. Lodgepole pine was the only species to show any damage. There were a significant number of declining trees in Sites 92-1, 92-2, 92-3, 92-5, and 92-6 (Table 2, Fig.2). Pests found in the young stands and their incidence are shown in Table 3. Needle cast, western gall rust, lodgepole

Figure 2.

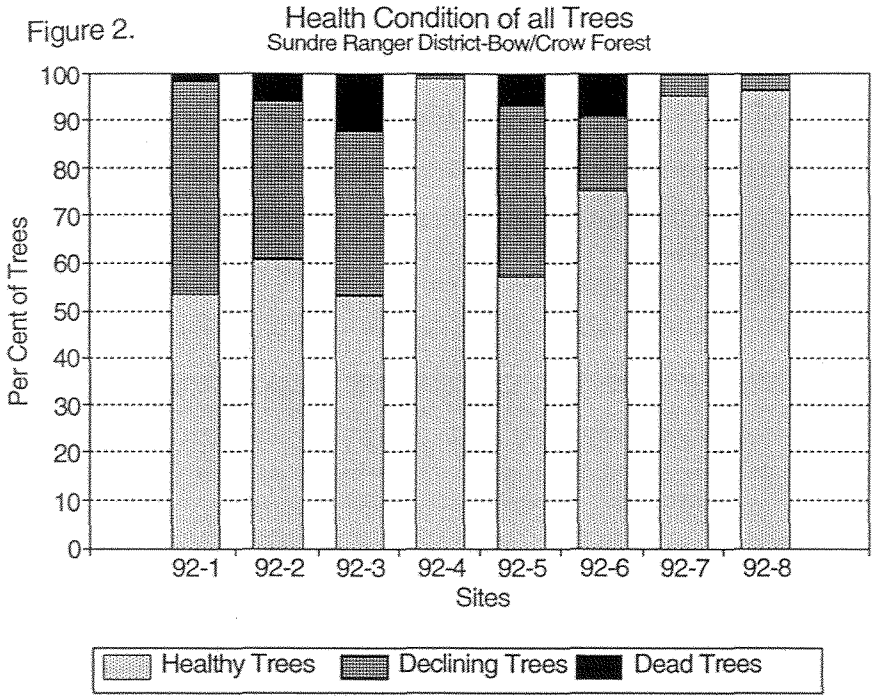
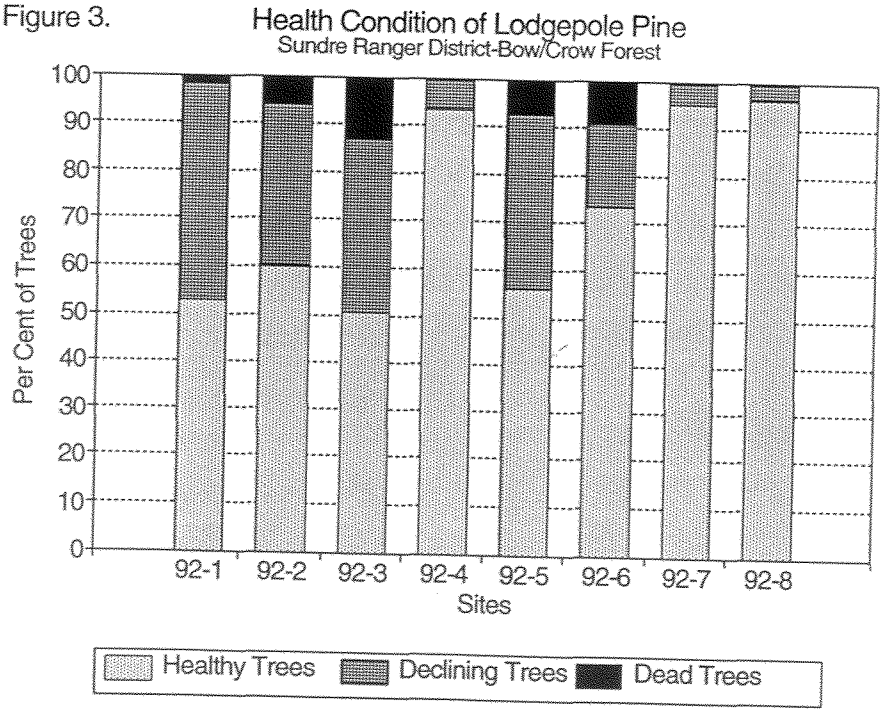


Figure 3.



pine terminal weevil, Armillaria root rot and Atropellis canker were the major pests found in the survey. Pest incidence was very low in sites 92-7 and 92-8, which is probably related to the young age, 3- and 5- years-old, of these trees.

Figure 4 shows the pests that were attributed to be the cause of the declining trees state of health. Needle cast was the primary pest associated with declining trees at Sites 92-1, 92-2, and 92-5. Trees that had both needle cast and western gall rust were classified separately in the analysis however, it is probable that needle cast was the primary reason for the trees state of health at these sites. At site 92-3 Atropellis canker was the principal pest associated with declining trees and at 92-6 most of the declining trees were suppressed.

Figure 5 shows the pests associated with mortality. Armillaria root disease caused the most mortality at sites 92-2, 92-5, and 92-6. At site 92-1 Armillaria root rot and Western gall rust caused equal amount of mortality and at 92-3 Atropellis canker was the greatest cause of mortality. Amirault and Pope (1989) surveyed young lodgepole pine stands in the Edson, Whitecourt and Grande Prairie forests and found Armillaria root disease was the greatest cause of mortality in the Edson and Whitecourt Forests but not in the Grande Prairie forest. In the Grande Prairie forest western gall rust was responsible for the greatest amount of mortality. Root collar weevil was also responsible for significant amounts of mortality in the Whitecourt and Grande Prairie forest but not in the Edson forest. Needle cast was not recorded as a significant pest in Amirault and Popes' report.

Needle cast incidence was greatest at sites 92-1, 92-2, 92-3, and 92-5. Two needle cast causing fungi were found Lophodermella concolor (Dearn.) Darker and Elytroderma deformans (Weir) Darker. Lophodermella concolor was found at sites 92-1, 92-2, and 92-5 and E. deformans was found at 92-1 and 92-3. Both of these species have been found on lodgepole pine growing on the eastern slopes of the Rocky Mountains in the past. Elytroderma needle cast was noted in stands in the Bow-Crow forest in 1960 and 1963 (Emond 1962, 1964). Severe needle cast defoliation caused by L. concolor was noted in the Burnt Timber Creek area in 1969 (Smith 1970). Lophodermella concolor is found throughout North America (Hunt et al 1987). It is found on lodgepole, jack, and Scots pines. Hunt et al 1987 have noted that outbreaks of needle cast caused by this fungus are common in B.C. particularly in the southeast portion of the province. Elytroderma deformans is found in western North America. It infects both lodgepole and jack pines.

Figure 4.

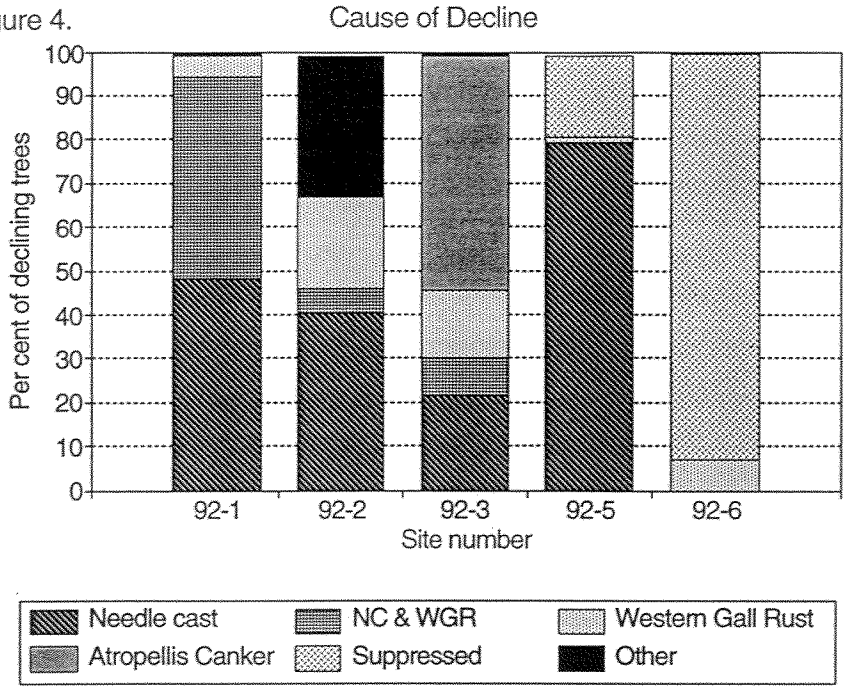


Figure 5.

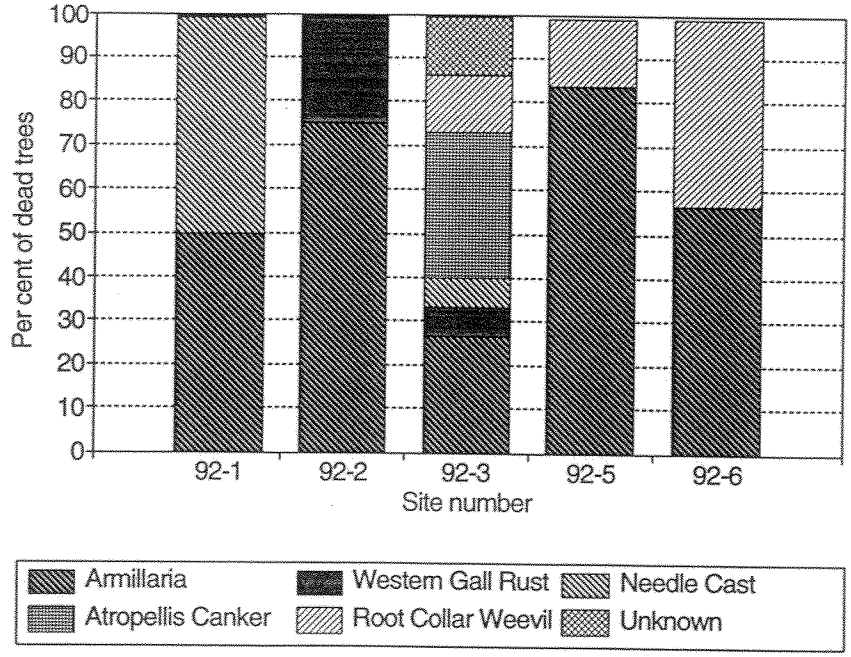


Table 3 Incidence of Disease and Insect Damage in Eight Lodgepole Pine Stands

Pest	Site Number 92-1	92-2	92-3	92-4	92-5	92-6	92-7	92-8
Needlecast[1]	62.8	21.6	16.8	3.2	44.1	0	0	0
Western Gall Rust[1]	40.3	33.6	6.5	8.7	3.2	13.2	0	0
Lodgepole pine Terminal Weevil[1]	2.4	1.6	0	2.2	6.3	3.9	0	0.3
Dead terminal	18.3	3.1	0	1.2	0	1.2	0	1.0
Pitch Blister Moth[1]	0	.08	0	4.3	1.6	1.3	0	0
Armillaria Root Rot	0.8	4.7	4.4	0	5.8	7.4	0	0
Mechanical/ Browse	3.1	7.1	1.8	2.8	1.6	2.5	3.7	3.7
Needle Rust	0	2.4	0	0	0	0	0	0
Atropellis Canker[1]	0	0	35.5	0	0	0	0	0
Cinera aphids	0	0	0	0	1.0	0	0	0
Root Collar Weevil[1]	0	0	1.8	0	1.6	0	0	0
Chlorotic foliage	0	0	0	0	0	0	0	0.07

[1] As a percentage of pine trees only

A needle cast index was prepared by averaging the needle cast ratings given in the field (Table 4). This was done using all trees in the stand and only those affected by needle cast. Site 92-1 had the highest needle cast index of all sites when the index was based only on affected trees. It had the smallest index when based only upon needlecast affected trees. This is because there were a greater number of trees

affected by needle cast at 92-1 but the trees were not as severely damaged as at the other sites. At all of the sites trees with little or no needle cast could be found next to trees with severe needle cast indicating that there are probably resistant genotypes in these stands.

Table 4 Needle Cast index for lodgepole pine trees in the Sundre Ranger District

	92-1	92-2	92-3	92-5
Total Trees	0.97[1] (± .91)[2]	0.39 (± 0.78)	0.44 (± 1.01)	0.8 (± 1.06)
Affected Trees	1.58 (± 0.61)	1.61 (± 0.72)	2.5 (± 0.83)	1.89 (±0.77)

[1] 0 = no needle loss, 1 = light to moderate (10% - 25% needle loss), 2 = moderate to severe (25%-50% needle loss), 3 = severe (>50% needle loss).

[2] Standard Deviation

No measurements of growth loss were made although height growth was observed to be reduced on some trees that had moderate to severe defoliation. Thinning does not seem to have an apparent affect on the incidence of needle cast, as two of the thinned sites 92-1 and 92-3 and two of the unthinned sites 92-2 and 92-5 had high incidence of needle cast. There was a low incidence of needle cast at the other thinned sites, 92-4 and 92-6. The high incidence of needle cast at 92-1 and 92-3 was probably related to conducive environmental conditions, susceptible host genotype, and high needle cast pathogen inoculum load. Needle cast was not found to be a significant cause of mortality at most sites except at 92-1, and 92-3. If defoliation were to continue some of the trees that were rated as declining could die. There was no evidence of secondary insects such bark beetles colonizing the declining trees yet.

Needle cast caused by L. concolor is suspected to cause loss of increment growth although no studies have been done to demonstrate this (van der Kamp and Hawksworth 1985, Hunt et al 1987). A study in Britain on Corsican pine trees that had been defoliated by L. sulicgena concluded that there was a 59% reduction in stem volume growth over a period of 12 years (Mitchell et al 1976). Elytrodera needle cast can cause volume loss (Childs 1968, Hunt 1978). This disease is of some concern because not only can it cause premature needle loss, it can also grow systemically within the trees causing deformity. Trees that are infected with E. deformans do not always show needle loss every year for reasons that are not understood. No studies have been done in Canada to determine volume loss in lodgepole pine.

Western Gall Rust was prevalent in 92-1, 92-2, 92-3, and 92-5. It caused tree mortality in 92-3 and 92-5 and was associated with declining trees in 92-2 and 92-3. Figure 6 shows the frequency of Western gall rust at the 8 sites and the proportion of galls found on stems to those found on branches only. Trees killed by western gall rust had main stem galls. Sites 92-1 and 92-2 have a high proportion of trees with main stem galls; therefore, there is potential to have further mortality caused by Western gall rust at these two sites. Not all trees that have main stem galls are killed but many of these surviving trees will never become crop trees.

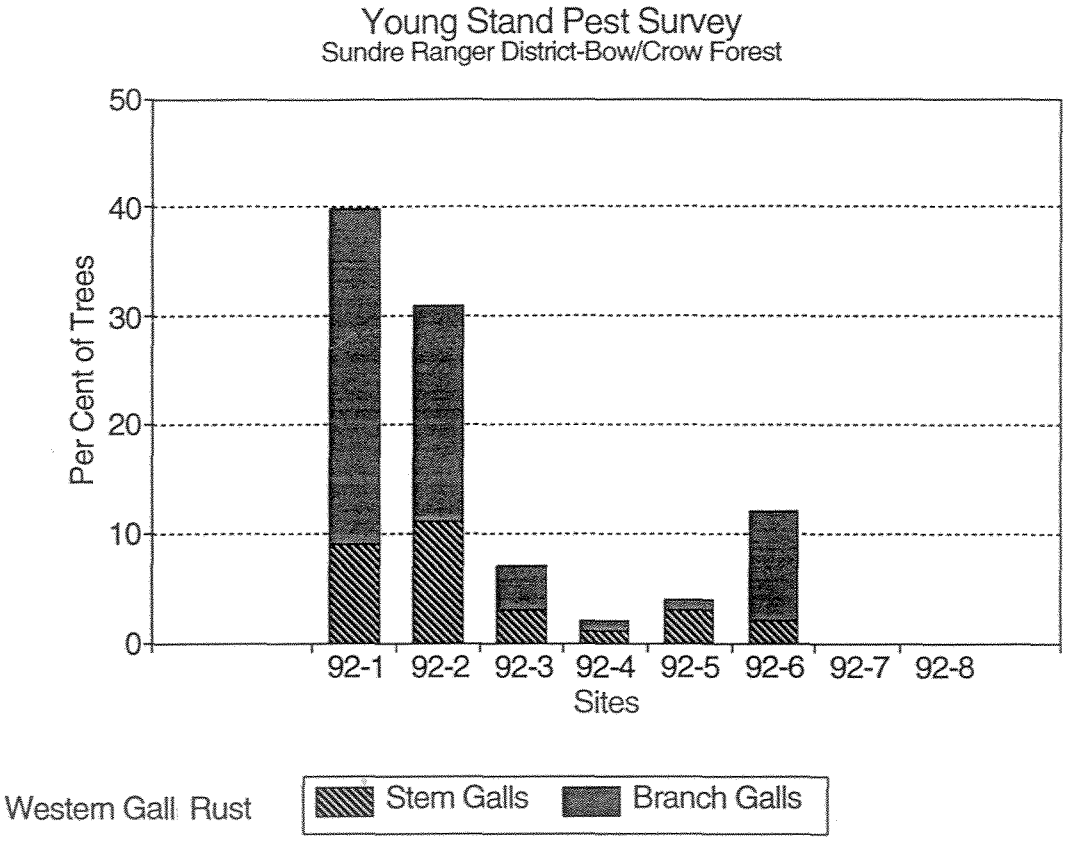
Lodgepole pine terminal weevil (Pissodes terminalis Hopping) was found at all sites except 92-3 and 92-7. Lodgepole pine trees were found that had old dead terminals, these may be old damage caused by the terminal weevil although this could not be determined during the survey.

Armillaria root rot was found in 92-1, 92-2, 92-3, 92-5, and 92-6. It was responsible for high amounts of mortality in all 5 sites. It was not found in the plots in 92-7 but was observed in the stand. No large disease centers were observed in any of the sites.

Atropellis canker caused by the fungus Atropellis piniphila (Weir) Lohman & Cash was found only at 92-3. It was responsible for a large portion (33%) of the mortality at this site and is associated with a large number of the declining trees. Atropellis canker is found throughout the eastern slopes of the Rocky Mountains and has been noted in this area before (Stanek et al 1973). Mortality due to this disease has been reported as high as 31% (Baranyay et al 1973). Nevill et al 1989 found that Atropellis canker reduced the volume of infected trees by 7.9% and reduced the volume of Standard or Better lumber up to 40%.

There was generally a low incidence of mechanical or browse damage in all of the sites. Chlorotic foliage was found on young trees in site 92-8. This was attributed to winter injury. Porcupine damage was found on several trees in site 92-2.

Figure 6.



Western Gall Rust

Conclusions

1) In sites 92-1, 92-2, 92-3, and 92-5 there were a large number of damaged trees. A significant number of these may die in the near future.
2) Needle cast disease was prevalent in these stands and was, except for 92-3, responsible for a large proportion of the damage to the declining trees.
3) High needle cast incidence did not appear to be related to thinning of the stands as two of the sites that had been thinned showed low incidence of the disease. In contrast two sites that had not been thinned had high incidence of needle cast.
4) At sites 92-2, 92-5, and 92-6, Armillaria root disease was the principal cause of mortality.
5) At site 92-3, Atropellis canker caused damage in the form of mortality and probable growth loss.
6) High incidence of main stem gall infections by western gall rust in sited 92-1 and 92-2 will likely lead to increased mortality by this disease.

Recommendations

1) These stands should be surveyed again in the near future to determine mortality rate.
2) A study on the affects of needle cast on growth of lodgepole pine should be conducted.
3) The extent and severity of Atropellis canker in the Teepee Pole Creek area should be investigated to determine losses and the affect on inventory.
4) There are currently no chemical or silvicultural control options for needle cast. Given the high rainfall that this area experienced in 1992 there could be a high incidence of needle cast in these stands next year. The stands should be monitored for excessive mortality with the view that restocking may have to take place.

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