INSECT AND DISEASE PESTS AND ALLIED PROBLEMS AFFECTING LODGEPOLE PINE IN ALBERTA

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INTRODUCTION

Records compiled by the Forest Insect and Disease Survey over a 25-year period (Anon. 1953-1977) indicate that lodgepole pine, *Pinus contorta* Dougl. var. *latifolia* Engelm., is relatively free of catastrophic insect and disease pests and allied problems along the east slopes of the Rocky Mountains in Alberta. There are a few serious pests, however, and a number of other organisms that cause appreciable localized damage. Some pests are of minor concern only.

Although I shall discuss insects, diseases, and allied problems separately, it should be realized that this is an artificial separation. One often finds individual trees affected by all three types of damage.

I shall not attempt to describe the life histories or taxonomic characteristics of the pests involved, as these are covered in the literature. Papers by Hopping (1962), Nordin (1962), and Davidson and Prentice (1967) are particularly relevant.

INSECT PESTS

Bark Beetles

The mountain pine beetle, *Dendroctonus ponderosae* Hopk., is one of the most serious forest insects in western Canada at the present time (Cerezke 1981, Van Sickle 1982). Historically, this insect has not been considered a problem in Alberta. The only outbreak reported in this province between 1906 and 1965 consisted of an infestation covering 4000 ha in 1940 along the Bow and Spray rivers (Hopping and Mathers 1945, Powell 1966). Selective cutting and cold weather in January 1943 apparently were responsible for terminating the outbreak.

The above outbreak history, when related to research on the effects of climate on brood development and overwintering survival, led researchers to believe that there was little likelihood of the mountain pine beetle's becoming a problem along the east slope in Alberta, even though areas of moderate hazard extend as far north as Jasper on the British Columbia side of the continental divide (Safranyik et al. 1974, Safranyik 1978). In general terms, the hazard map presented by Safranyik et al. (1974) is probably still fairly meaningful, but there is currently an outbreak in southern Alberta in an area to which they had assigned a very low hazard rating.

The Alberta outbreak was first observed at scattered locations along the east slopes between the United States-Canada border and the Carbondale River in 1977, and probably started in 1976 (Wong and Petty 1978). By 1980 it had expanded and intensified: over 79 km^2 were infested and over one million trees had been killed (Hiratsuka et al. 1981). Extensive sanitation cuttings were undertaken by the Alberta Forest Service in late 1980 and in 1981 in an attempt to limit the spread of the outbreak. These efforts appear to have been partially successful. The outbreak has not been arrested, but the amount of spread and population increase are both less than might otherwise have occurred (Hiratsuka et al. 1982).

We still believe that lodgepole pine stands on the east slopes north of the Trans-Canada Highway should be safe from attack by the mountain pine beetle. A combination of cool summers and unfavorable winters is believed to be a sufficient climatic barrier to prevent the build-up of populations. In light of the experience in southern Alberta, however, it is impossible to state categorically that an outbreak will not occur. Sources of infection may develop to the west of the Continental Divide, and these could conceivably initiate outbreaks on the east slopes, provided that suitable climatic conditions (hot summers and favorable winters) occurred simultaneously in both areas.

Several other species of bark beetles attack lodgepole pine, but these are usually of minor importance in Alberta. The lodgepole pine beetle, *Dendroctonus murrayanae* Hopk., sometimes kills trees weakened by fire or the climatic damage known as "red belt." Many of these trees might recover without the beetle attacks. The pine engraver, *Ips pini* (Say), occasionally kills healthy lodgepole pine when beetle populations reach large numbers on slash or other suitable material (Bright 1976, Furniss and Carolin 1977). Usually, however, the insects seem

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to attack only trees that have been weakened by drought or some other cause. Other *Ips* species breed on lodgepole pine slash, but rarely cause a problem with living trees.

Woodborers

A number of woodborers in four taxonomic groups (cerambycids, buprestids, scolytids, and siricids) attack standing lodgepole pine and other coniferous tree species after fires, thus shortening the period during which salvage operations may be conducted. In Alberta, a common woodborer is the white-spotted sawyer beetle, *Monochamus scutellatus* (Say). This species can become a problem during logging operations, especially if summer-cut logs are left in decks for prolonged periods following exposure to ovipositing female beetles. Logs cut during early winter are less vulnerable to attack (Raske 1973). The volume loss in logs destined for use as pulp is less than 5% (Prentice and Campbell 1959), but the borer damage is more detrimental in lumber production (Prebble and Gardiner 1958). The damage is particularly important in logs intended for use as power poles because rigid grading standards allow virtually no sawyer holes (Cerezke 1975).

Weevils

A number of weevils cause damage to lodgepole pine in Alberta. Infestations of Warren's collar weevil, *Hylobius warreni* Wood, are widespread at lower elevations in the foothills and in the Cypress Hills. The feeding damage girdles and kills smaller trees and may provide ports of entry for disease organisms on larger trees (Cerezke 1970a). The numbers of weevils were found to be directly related to tree size, stand age, and duff thickness, and inversely related to stand density (Cerezke 1970a, 1970b). The weevil is considered to be an important insect in thinned and planted young pine stands (Hiratsuka et al. 1981).

The lodgepole terminal weevil, *Pissodes terminalis* Hopping, kills the current year's terminal growth on young trees (Drouin et al. 1963), and the white pine weevil, *P. strobi* (Peck), kills the previous year's terminal growth. Attacks by either species may result in multiple leaders and crooked stems (Johnstone 1981), while repeated attacks may cause the formation of "cabbage-topped" trees of little or no value. Neither species seem to have caused much damage in Alberta, but observations in Ontario (Anon. 1961-1972) indicate that the white pine weevil may become a serious problem in widely spaced plantations. The lodgepole pine weevil also prefers open-grown young stands (Drouin et al. 1963, Furniss and Carolin 1977, Stevenson and Petty 1968), so there is a danger that it may become a more serious pest as thinning of young stands becomes more prevalent. The strawberry root weevil, *Otiorhynchus ovatus* L., has caused heavy losses of coniferous seedlings in nursery beds, but this appears to have been an unusual occurrence (Anon. 1967).

Pitch Twig Moth

The northern pitch twig moth, *Petrova albicapitana* (Busck), and the metallic pitch nodule moth, *P. metallica* (Busck), both attack young lodgepole pine in Alberta (Miller 1978). *P. albicapitana* has a 2-year life cycle (Turnock 1953). Feeding by first-year larvae causes little damage, but second-year larvae sometimes kill the terminals. The feeding damage usually causes the formation of crooked and weakened stems. Turnock (1953) considered lodgepole pine to be particularly susceptible to attack by this insect, but little damage has been reported in Alberta (Anon. 1953-1977, Stark 1957). However, a several-fold increase has been observed in mechanically thinned stands in recent years (Sterner and Davidson 1981). Larvae of *P. metallica* feed more on the cortical tissue than on pith and xylem (Miller 1978). Because both insects are pests of young trees, it is conceivable that they may become more important in the future when large areas of young pine become more common.

Defoliators

The lodgepole needle miner, *Eucordylea starki* (Free.), reached outbreak proportions in the 1940s over an area of about 1200 km^2, primarily in Banff and Jasper national parks (Stark 1954). Little mortality is caused even by prolonged attack, but there is a danger that weakened trees may be vulnerable to attack by the mountain pine beetle (Stark 1954). However, the present mountian pine beetle outbreak has occurred in an area not infested by needle miners in recent years. *E. hiopes* (Free.) reached moderate to high population levels in the Banff area in 1981 (Hiratsuka et al. 1982).

The jack pine budworm, *Choristoneura pinus pinus* (Free.), and the sugar pine tortrix, *C. lambertiana* (Busck), cause top-killing of their hosts. The jack pine budworm is a major pest of jack pine in Manitoba, central Saskatchewan, northwestern Ontario, and the Lake states (Brandt and McDowall 1968, Cerezke 1978, De Boo and Hildahl 1968, Dixon and Benjamin 1963). The sugar pine tortrix has caused heavy defoliation of lodgepole pine in Idaho and Montana (McGregor 1970). Neither species has caused damage to lodgepole pine in Alberta.

Neodiprion nanulus contortae (Ross) has been reported in Alberta (Furniss and Carolin 1977), but has not caused any significant damage. Other defoliators attack lodgepole pine but are of minor importance.

DISEASE PESTS

With the exception of foliar diseases, tree diseases fluctuate less from year to year than forest insects. Any fluctuations are more likely to be spatial or of a long-term nature, often related to stand age and history. Consequently, the information on diseases collected by the Forest Insect and Disease Survey (Anon. 1953-1977) tends to reflect the intensity of effort as much as the importance of a particular disease. In total, however, these records provide a reasonably accurate picture of the importance of the various disease organisms, especially when supplemented by information contained in a number of research papers.

Dwarf Mistletoe

Dwarf mistletoe, *Arceuthobium americanum* Nutt. ex Engelm., is a parasitic plant that principally attacks lodgepole and jack pine in Alberta, causing an estimated annual loss of more than 270,000 m^3 (Baranyay 1970). It is considered to be one of the most destructive diseases of lodgepole pine in Alberta, and affects trees of all ages (Nordin 1962). Studies of factors influencing the damage caused by dwarf mistletoe (Baranyay and Safranyik 1970) show that there are no simple relationships, although volume losses in lodgepole pine are affected by site, duration of infection, and age of stand when first infected. Trees infected when young will not reach merchantable size. Heavily infected trees suffer considerable volume loss, particularly in the upper portions of the crown on dry sites, because height growth is reduced. "Witches' brooms" may be small or nonexistent in dense stands, but are quite noticeable on open-grown or thinned stands (Nordin 1962). Attempts to control the disease by repeated sanitation cutting and pruning were unsuccessful (Van Sickle and Weggitz 1978). Complete removal of infested trees before reforestation is probably the only

practical solution, and the cut-over areas should be relatively large to minimize the amount of reinfection from the residual stand. Baranyay (1970) indicated that mistletoe infection from one parasitized residual in a stand of young trees could spread more than 45 m in 80 years.

Red Stain and Decay

Red stain is the early stage of decay associated with a number of different fungi (Nordin 1962). Forest Insect and Disease Survey records (Anon. 1953-1977) give little indication of its importance because specialized assessment is required. One study conducted in 85-year-old stands near Nordegg, Strachan, and Water Valley revealed that more than 80% of 183 trees were infected with red stain fungi (Nordin 1962). A much larger survey in the upper and lower foothills section of the boreal forest in Alberta indicated that 45% of 2436 trees had red stain, while 7% had measurable advanced decay (Robinson-Jeffrey and Loman 1963). Decay was found to be unimportant in stands less than 100 years old (Loman and Paul 1963). In older stands, most of the decay occurred in a few trees and *Fomes pini* (Thore) Lloyd was the most important trunk-decaying organism. *Peniophora pseudo-pini* (Weres. and Gibson) was associated only with red stain, while *Coniophora puteana* (Schum ex Fr.) Karst. was isolated from brown cubical root and butt rot. Other organisms were associated with root and butt rots.

A widespread root rot, *Armillaria mellea* (Vahl ex Fr.) Quél., sometimes causes mortality in young lodgepole pine stands (Anon. 1954, Baranyay and Stevenson 1964, Nordin 1962). Older stands are also affected, however, and 31% of the trees in a 73-year-old stand of lodgepole pine near Hinton were killed by the disease (Anon. 1964).

Atropellis Canker

The cankers caused by the fungus *Atropellis piniphila* (Weir) Loman and Cash are widespread on lodgepole pine in the foothills area of Alberta, and some stands are heavily infected (Anon. 1960, 1971). Surveys conducted in the Coalspur-Robb area in 1954 and 1955 (Anon. 1955, 1956) showed that over 70% of the pine were infected in an area covering about 325 km^2. Forty to 70% of the trees in an area of 470 km^2 surrounding the heaviest infection were also infected. Smaller areas of moderately to heavily infected lodgepole pine were noted elsewhere on the east slopes (Anon. 1957). The cankers do not seem to kill the trees very quickly, but they and their associated blue-black stain degrade both pulpwood and lumber.

Stem Rusts

Several species of stem rusts attack lodgepole pine in Alberta. Most have life cycles involving alternate hosts, but one species can spread from pine to pine (Ziller 1974). Western gall rust, *Endocronartium harknessii* (J.P. Moore) Y. Hirat., has no known alternate host in Alberta, and is "the most common, most conspicuous, and most destructive stem rust of hard pines in western Canada" (Ziller 1974). It is recognized as being "one of the most important disease problems of man-made and man-assisted, young, hard-pine forests" (Hiratsuka et al. 1981). Damage is compounded by rodents and insects (Wong 1972), which frequently feed on the galls. The disease is widely distributed in Alberta (Anon. 1960).

Stalactiform blister rust, *Cronartium coleosporioides* (Arth.), is also widely distributed in Alberta, and moderate to severe infections on lodgepole pine have been reported at a number of locations (Anon. 1953-1977). These infections have occasionally caused severe mortality among lodgepole pine saplings. Commandra blister rust, *Cronartium commandrae* (Peck), and sweetfern blister rust, *C. comptonae* (Arth.), are both common in Alberta. *C. commandrae* occasionally causes serious injury (Anon. 1960, 1965).

Foliar Diseases

A number of organisms cause needle diseases on lodgepole pine (Hepting 1971). Several needle cast fungi, particularly *Lophodermella concolor* (Dearn.) Darker and *L. montivaga* (Petr.), have occasionally caused moderate or severe damage to lodgepole pine foliage at a number of locations in Alberta (Anon. 1953-1977). The diseases cause foliage discoloration and premature needle drop, but do not affect tree growth unless the infection is unusually severe. Another needle cast disease, *Elytroderma deformans* (Weir) Darker, is known to infect trees systemically and infections survive within the trees, eventually deforming them. The importance of this disease may be underestimated at the present time.

Needle rusts on lodgepole pine are caused by a number of organisms (Hepting 1971), but the western pine-aster rust, *Coleosporium asterum* (Diet.) Syd., is the only species reported to cause infections in Alberta (Anon. 1953-1977). It causes only moderate or minor damage (Ziller 1974).

ALLIED PROBLEMS

In addition to insect and disease pests, lodgepole pine trees are adversely affected by a variety of biotic and abiotic environmental factors. I shall not attempt to discuss all of these, because little information on their overall importance is available, but climatic and mammal damage occur so frequently that a brief discussion is warranted.

Climatic Damage

Drought, flooding, spring frosts, and hail all affect lodgepole pine adversely; damage is usually sporadic, although it may occasionally be extensive. Winter injury of lodgepole pine, commonly known as "red belt", is much more common (Anon. 1953-1977). The exact cause is unknown, but it is generally believed to be due to sudden temperature change in late winter or early spring (Robins and Susut 1974). The damage sometimes occurs in belts along hillsides, hence the name "red belt," but it may also occur in irregular patches. Injured trees usually recover, though they may lose much of their foliage. There may occasionally be extensive mortality, if the climatic damage is severe. Thousands of hectares of lodgepole pine in the upper foothills were destroyed in this manner in 1971, and more than 5000 ha were killed in the Cadomin area alone (Robins and Susut 1974).

Mammal Damage

Several groups of animals damage forest trees (Johnstone 1981). The snowshoe or varying hare, *Lepus americanus* (Erxleben), has peaks in populations approximately every 10 years. Extensive damage to stands of young lodgepole pine have often been observed in areas where there is adequate cover for the hares. Normally, small saplings have been considered to be most vulnerable, because the hares clip off saplings up to 2 cm and girdle those larger than this. It was believed that the trees escaped should be relatively immune to further attack if they escaped damage in one hare population cycle (Sullivan 1980). This is

not always true, however. Some trees more than 10 cm in diameter at the base have been partially or completely girdled, usually just above the ground level. There is some disagreement among various "experts" as to what animal is causing the damage: some claim that it is attributable to porcupines, while others suggest that it is caused by squirrels. I do not profess to be an expert, but I have seen enough circumstantial evidence to convince me that the damage has been done by snowshoe hares. Some people have actually seen them chewing at the trees, but were unable to photograph the event. The extent of damage during the current peak in hare populations has not been adequately assessed, but it seems to be extensive.

Other mammals also cause damage by girdling or browsing on trees or saplings, but are of relatively minor importance. Porcupines, *Erethizon dorsatum* (L.), sometimes damage groups of trees, and meadow voles, *Microtus pennsylvanicus* (Ord), occasionally cause serious damage to trees in young stands, especially if there is extensive cover (Cayford and Haig 1961). Red squirrels, *Tamiasciurus hudsonicus* (Erxleben), frequently feed on rust galls and, in so doing, they sometimes girdle the stems or branches. They sometimes clip leaders or branches as well. Large game animals occasionally browse the tops of trees in young stands.

DISCUSSION

Lodgepole pine grows faster at a relatively wide spacing, and dense stands respond well to thinning, provided it is done when the trees are relatively young. The amount of thinning has therefore been increasing in recent years, as the management of pine stands intensifies. There is no doubt that this practice increases the growth rate if the trees have been too crowded, but unfortunately it is not without a certain amount of risk. Any significant amount of tree mortality between thinning and harvesting may nullify the increased yield that the thinning was intended to achieve, and this mortality can occasionally be appreciable.

Throughout this paper I have noted that there is accumulating evidence that certain organisms seem to be a greater problem in open-grown stands. At the moment, much of the evidence is circumstantial. Future strategy concerning management of young lodgepole pine stands may need to be modified, however, should the trends be corroborated by further observation. Spacing may require modification to achieve some form of compromise that will avoid undue suppression of tree growth without favoring the build-up of pest populations. Adoption of this approach should help to reduce the need for costly pest-suppression measures without seriously affecting ultimate yields.

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