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INSECT AND DISEASE HAZARD IN RELATION TO STAND STABILITY: PRINCE ALBERT NATIONAL PARK, SASKATCHEWAN

by J. Petty and E.J. Gautreau

NORTHERN FOREST RESEARCH CENTRE
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Forest Insect and Disease Survey

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CANADIAN FORESTRY SERVICE

DEPARTMENT OF THE ENVIRONMENT

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INTRODUCTION

This report rates the stability of timber stands in Prince Albert National Park on the basis of their susceptibility to decimation by insects and diseases. It has been prepared for use by park planners in conjunction with allied reports on cover types, soils, and fire hazard. Color-coded base maps are used to designate the hazard, and ozalid overlays, prepared by the Forest Management Institute, show the stand types. Full scale maps (1:50,000) accompany the master copy of this report. A color photograph of the base map is included in each of the additional reports. The insect and disease hazard ratings are grouped into four categories: low; moderate; high; and very high. Stands rated in the first two categories are relatively stable, at least as far as insects and diseases are concerned, and are not likely to suffer major damage. The high hazard stands are considered to be vulnerable to insect and disease attack, and the very high hazard ratings are extremely vulnerable. Stands in either of these categories are not likely to stand additional stress without heavy tree mortality.

In addition to the insect and disease hazard rating maps, this report presents a brief history of various organisms within the Park (Appendix A) and a tabular listing of the numerical values of the hazard ratings for each stand type (Appendix B).

Three factors were considered when deriving the insect and disease hazard rating: (1) the organism and its effect on the tree; (2) the tree and its susceptibility to attack; (3) stand composition. Additional factors, such as regenerative potential, and stress, either natural or man-made, are worthy of consideration. They were not included in the present report because of lack of data.

METHODS

The first step in establishing a hazard rating was to determine the important insects and disease organisms in the Park and the extent of their damage. Much of the information was extracted from national punch-card files established by the Forest Insect and Disease Survey and from the Annual District Reports of that organization for the past 25 years.

The forest cover maps of Prince Albert National Park, prepared by the Forest Management Institute, were used to select 32 different stand types. A detailed survey of these stand types was made in August, 1972, to obtain information on insects and diseases, their abundance, distribution and extent of damage. Increment borings of major tree species indicated their general vigor, and observations on regeneration and stress were made in each stand examined.

Numerous insect and disease pests have been recorded in the Park since examinations first began. Many of these have been of minor importance, as they cause little or no damage and pose no threat to the trees. The criteria used to select organisms which affect stand stability were: (1) those common enough to cause appreciable damage; (2) those which were well established and perennial (some disease organisms); and (3) those with a history of causing damage in other parts of the region and capable of doing so in Prince Albert National Park.

HAZARD RATING

For each selected organism, a numerical value was provisionally assigned to each of the following factors: damage caused by an organism; stand composition; and susceptibility to attack.

Damage caused by an organism - The portion of the tree affected and the types of damage caused by an organism were categorized and a simple numbering system assigned. The numbers range from ¼ for damage that has very little effect on the tree to 8 for injury that causes death to part or all of the tree (Table I).

Stand Composition - Because of the method of calculating the rating, mixed stands would automatically receive a higher rating than pure stands unless stand composition was given a weighting factor. A factor of 10 was therefore assigned to pure stands and a 6:4 ratio was assumed for mixed stands, the larger number being assigned to the major species. In this way, mixed and pure stands were placed on a comparable basis.

Stand susceptibility - The susceptibility of stands to attack by organisms is not constant. Stands of mature or over-mature spruce often contain heart rot which weakens the stems and makes the stands subject to blowdown. Bark beetle populations build up in the blowdown and then move to standing trees in the vicinity. This is an example of increased hazard due to high susceptibility to attack. On the other extreme, dwarf mistletoe is an example of decreased hazard. The rate of spread for mistletoe is slow, and since it has been recorded in only one area of the Park, the hazard throughout the remainder of the Park is reduced.

Numerical values ranging from ¼ to 2 (low to high) were assigned to susceptibility to attack, using 1 as an average.

Calculation of the hazard rating - The hazard ratings for each stand type were obtained by calculating the products of the three numbers assigned to the factors for each organism affecting the stand and summing these values

for all organisms in the stand. For example, the hazard for poplar 1 - 3 - 5 (Appendix B) equals the sum of these products for diseases (4 x 10 x 1 + --- 1 x 10 x 1) plus those for insects (1 x 10 x 1 + --- + 2 x 10 x .5). These numerical ratings were then grouped to give four categories of hazard rating ranging from low to very high, which are presented on the color coded base maps (Fig. 1). The numerical values are presented in Appendix B.

DISCUSSION

In this report, numerical ratings for stand hazard attributable to insects and disease have been derived. The various stands could have been rated on a purely qualitative basis, but this would not have been subject to easy modification as subsequent data became available.

The hazard in this report refers to the present stands. If information on reproductive potential for the different stands becomes available this can be included as another factor which could substantially change the ratings. For example, most aspen stands reproduce readily by suckers, if they have sufficient light and are allowed to develop. Consequently, although a high hazard rating has been assigned to mature aspen stands, which is realistic for the present trees, the reproductive potential for most of these stands is probably such that regeneration will replace the trees as they die out. However, if campsites are established in aspen stands, for example, the combination of compaction and sucker damage or removal would probably prevent most of the suckers from reaching tree size. Once the existing trees died out there would be nothing to replace them.

One other point should be stressed. The hazard that has been derived is based on a relatively short history of infestations, or lack

of them. There is always the distinct danger that some organism that has not been included, because it has not been recorded in Prince Albert National Park, could become a major threat under the right conditions For this reason, park wardens should always be alert for new or unusual pests. They may be innocuous, but they may also be a major threat.

This rating is the same as that used for Waterton Lakes National Park in 1971 and only through its use will we be able to determine if modifications or improvements are necessary and, if so, what. Any suggestions that users of this report may have are welcome, so that improvements or modifications can be made in the ratings to agree with the known facts. Only by having a feed-back from the users will it be possible to improve the ratings and thus make them more useful. Also, if there are major changes in stand types the maps should be updated. There is little point in having a hazard rating for a stand that may have been destroyed by a fire for example. This updating does not need to be done annually, but should be undertaken periodically, in order that the maps do not become seriously outdated.

TABLE 1

Damage factors assigned to various types of injury to trees

CROWN			
Damage to foliage -			
No loss of foliage	(a)	injury to a portion of the leaf- leaf able to continue photosynthesis.	0.5
Loss of foliage	(a)	early in the season - tree able to refoliate and carry on photosynthesis.	1
deciduous	(b)	late in the season - photosynthesis has been carried out for most of the season.	1
coniferous	(c)	loss of needles other than current year.	1
	(d)	loss of current years' needles	2
	(e)	loss of current and older needles	4
Damage to buds and twigs -			
	(a)	Twigs deformed, no mortality.	0.5
	(b)	Buds or twigs killed, no mortality of tree but individual branchlets killed, some deformity of tree.	1
	(c)	Buds or twigs killed, mortality of regeneration - important when stand composition changed.	2

Table 1 continued.

Damage affecting crown mass -		
	(a) damage on branches causing deformities and mortality.	2
	(b) damage affecting major portion of the crown mass; structural weakness sometimes result and tree mortality can occur.	4
STEM		
Damage to wood -		
	(a) loss of heartwood, weakens tree structurally in main stem & large branches (usually associated with mature to overmature trees).	2
	(b) loss of sapwood same as (a) above.	
Damage to the cambium -		
	(a) damage in limited areas of cambium causing deformities and some structural weakness.	2
	(b) damage on main stem causing girdling of tree and mortality of host.	8
ROOT		
Damage to root system -		
	(a) damage to root system causing structural weakness.	4
	(b) damage to root collar causing mortality by girdling.	8

Appendix A

Brief histories of a number of insect and disease pests found in Prince Albert National Park.

INSECTS

THE BLACK-HEADED BUDWORM, Acleris variana Fern., is a defoliator that feeds on the current year's foliage of fir and spruce and severe defoliation in successive years could result in growth loss. Low population levels have been general in the Park, but high concentrations of larvae in localized areas has caused severe discoloration to spruce tops in past years. Injury to infested trees is light and the danger to stands is low.

A PINE TUBE MOTH, Argyrotaenia tabulana Free., a needle miner that feeds within webbed needles of the current year's foliage of jack pine. It has not been particularly destructive in the Park but from 1960 to 1962 it severely damaged trees near the southern boundary. Since the cessation of the outbreak the pine tube moth is still present but has ceased to be destructive. Injury to infested trees is usually light and the danger to stands is low.

BIRCH SKELETONIZER, Bucculatrix canadensisella Cham., frequently causes severe skeletonizing of birches over wide areas in the Park. Defoliation occurs towards the end of the growing season which could cause growth loss the following year. Injury to infested trees is light and the danger to stands is low.

THE LARGE ASPEN TORTRIX, Choristoneura conflictana Wlk. and a POPLAR LEAF ROLLER, Pseudexentra oregonana Wshm., are aspen defoliators capable of completely defoliating trees. Defoliation occurs in the spring and early summer and stripped trees releaf in 3-5 weeks. Outbreaks periodically occur in the Park. Severe infestations rarely last more than 2 or 3 years and the overall damage is no more than slight growth loss. The effect is mostly aesthetic. Injury to infested trees is light and the danger to stands is low.

THE SPRUCE BUDWORM, Choristoneura fumiferana Clem., is a defoliator of spruce and fir feeding on the buds and new foliage. It has been a major pest in forested areas of Canada for many years. Prolonged defoliation can cause top kill or tree mortality, but because no outbreak has been recorded in the Park the danger to stands is rated as low.

JACK PINE BUDWORM, Choristoneura pinus pinus Free., is considered to be one of the most important defoliators of jack pine in Central Canada. Extensive and severe outbreaks have occurred in Manitoba and Saskatchewan, but as yet only endemic populations have been recorded from Prince Albert National Park. Tree mortality does not usually occur unless trees have sustained severe attacks for several years. Since there has not been an outbreak in the Park the danger to stands is rated as low.

THE SPRUCE BARK BEETLE, Dendroctonus obesus Mann., attacks mature and over-mature spruce and feeds under the bark of the main stem cutting off the food supply to and from the roots. Infested trees usually die. In 1972 very light mortality was recorded in stands of over-mature

spruce at Crean Lake and Wabeno Lake. Injury to infested trees is high and the danger to stands is high.

EASTERN LARCH BEETLE, Dendroctonus simplex Lec., usually attacks tamarack which have been weakened through defoliation by the larch sawfly or from other causes. Presently this species is not very destructive in Prince Albert National Park. Injury to infested trees is high and the danger to stands high.

THE RED TURPENTINE BEETLE, Dendroctonus valens Lec., is most frequently found attacking jack pine that are in a weakened condition. They are particularly active around logging operations attacking stumps and the bases of trees left in the reserve stand. Low populations were recorded near Wabeno Lake and Crean Lakes. Injury to infested trees is high and danger to stands is moderate.

SPRUCE CONE WORM, Dioryctria reniculella (Grote)., has been reported feeding on the foliage and cones of spruce in Prince Albert National Park. In past years the spruce cone worm has been abundant enough in the Park to cause moderate damage to black spruce tops. Injury to infested trees is light and the danger to stands is low.

LEAF BEETLES, Gonioctena americana Shaef., and Pyrrhalta decora (Say)., feed on poplar, particularly regeneration and saplings. These insects although capable of causing severe defoliation are unlikely to cause permanent injury to the trees. Low populations have persisted in the Park for several years and occasionally moderate to severe defoliation

has occurred in small areas. Injury to infested trees is light and the danger to stands is low.

ROOT COLLAR WEEVILS, Hylobius spp., feed in the root collar zone of jack pine and spruce. They can cause mortality by girdling the tree or the wounds may serve as entry points for root and stem diseases. Weevil infestations in the Park are light and do not seem to be particularly damaging at present. Injury to infested trees is light to moderate and the danger to stands is low.

FOREST TENT CATERPILLAR, Malacosoma disstria Hbn., outbreaks occur at intervals of every 10-15 years. During outbreaks this insect defoliates forests of trembling aspen over large areas. Although aspen is the principal host, they also feed extensively on many other deciduous trees and shrubs. Infestations of tent caterpillar seldom cause mortality of the host trees but they can result in reduced growth and may hasten the deterioration of mature and over-mature stands. An indirect undesirable effect is the presence of large numbers of caterpillars that discourage vacationers from using recreational areas. Injury to infested trees is light and the danger to stands is low.

BALSAM FIR SAWFLY, Neodiprion abietis Harr., is a defoliator of spruce and fir that feeds primarily on one-year-old needles, and for this reason it is not likely to cause notable damage. It has been present throughout the Park but there have been no records of high populations. Injury to infested trees is light and the danger to stands is low.

THE YELLOW-HEADED SPRUCE SAWFLY, Pikonema alaskensis Roh., is a defoliator of spruce that prefers open grown trees such as are found along highways, in campground areas, and in the townsite. The larvae feed on the current year's foliage. Injury to infested trees is moderate, but the danger to stands is low.

TERMINAL WEEVILS, Pissodes spp., infest and kill terminals of young pine and spruce which results in tree deformity. Open growing young trees are most susceptible to attack. As these weevils usually attack scattered, open growing individuals, stands are not likely to be affected. Its presence in the Park has been mainly along roadsides where aesthetic value is most important. Injury to infested trees is light and the danger to stands is low.

POPLAR LEAF MINERS, cause only minor damage in the Park. Some species such as the poplar serpentine leaf miner become numerous enough to cause severe discoloration to trembling aspen. Trees are never seriously damaged but attacked leaves are conspicuous and frequently cause concern. Injury to infested trees is light and the danger to stands is low.

LARCH SAWFLY, Pristiphora erichsonii (Htg.)., is one of the most serious defoliators of tamarack. Periodic outbreaks in Prince Albert National Park have occurred since the 1940's. In past years the damage caused by defoliation has been difficult to distinguish from suppression caused by excessively wet weather which flooded the sites occupied by tamarack. Injury to infested trees is moderate and the danger to stands is moderate.

THE POPLAR BORER, Saperda calcarata Say., attacks living, non-vigorous aspen trees. It destroys heartwood and enhances the decay process, which often results in stem breakage. Much of the aspen approaching maturity is susceptible to borer attack. Infestations are common in most aspen stands of the Park. Injury to infested trees is high and the danger to the stands is also high.

A LOOPER, Semiothisa sexmaculata Pack., periodically causes light foliage damage to tamarack. There has been no record of heavy infestations in the Park although low populations of these loopers have been present for several years. Injury to infested trees is light and the danger to stands is low.

DISEASES

A DWARF MISTLETOE, Arceuthobium americanum Nutt., is a parasitic plant whose principal host in this area is jack pine. Heavy infections cause reduction in height and diameter growth and sometimes results in the death of the tree. Its presence has been detected in the Park near the Buffalo Paddock, but because of the slowness of spread it is not likely to present much of a hazard in the rest of the Park. Injury to infected trees is moderate and the danger to stands is moderate.

ARMILLARIA ROOT DISEASE, Armillaria mellea (Vahl ex Fr.) Kummer., is a rot that attacks the roots and root collars on a great variety of hosts, both coniferous and deciduous. If trees are thrifty they can often overcome attack from Armillaria. However, if the attacked trees have been

subject to stress conditions they are often predisposed to the point where serious injury and death result from an Armillaria attack. Root rot has been found in most areas of the Park but damage so far has been light. As a primary invader, this disease causes moderate injury to infested trees, but as a secondary invader the injury is extreme. However, danger to stands is low under normal conditions.

SPRUCE NEEDLE RUST, Chrysomyxa spp., infects the needles of spruce. Depending on the species of rust, they may attack current year needles or one-year-old needles. Infected needles die, thus depriving the tree of part of its photosynthetic capacity. Needle rusts are probably more important from the aesthetic standpoint than from any loss to the stand. Endemic infections persist throughout the Park and occasionally small areas of severe infections have been recorded. Injury to infected trees is light and the danger to stands is low.

THE PINE NEEDLE RUST, Coleosporium asterum (Diet) Syd., infects one-year-old needles of jack pine. Heavy infections can cause notable needle drop and possibly slight growth reduction. As with spruce needle rusts, the aesthetic value is decreased in years of heavy infections. Only light infections have been recorded in the Park. Injury to infested trees is light and the danger to stands is low.

THE PINE STEM RUST, Cronartium comandrae Pk., infects branches and stems of jack pine in the Park. Stems and branches may be girdled by the fungus resulting in the death of the branch or stem above the canker.

Often rodents chew out the infection but in so doing may girdle the tree and cause mortality. Infections have been recorded in the Park but no severe injury has been seen. Injury to infected trees is moderate, but the danger to stands is low.

SWEET FERN BLISTER RUST, Cronartium comptoniae Arth., a canker disease that occurs on the stems of young jack pine in Prince Albert National Park. The disease damages by its girdling action, and the smaller the tree the more likely it is to be girdled and killed. After the tree has reached a basal diameter of about 3 inches, it is relatively safe. On the whole the disease it not serious in natural stands. Injury to i infected trees is moderate, but the danger to stands is low.

GLOBOSE GALL OF POPLARS, Diplodia tumefaciens (Shear) Zalasky, causes stem and branch galls on trembling aspen and balsam poplar. Crown and boles may be affected by numerous galls on twigs and branches and rough bark on larger limbs and boles. The incidence of branch galls in the Park varied considerably between areas, but nowhere were infection levels high enough to cause severe damage. Injury to infected trees is light and the danger to stands is low.

THE WESTERN GALL RUST, Endocronartium harknessii (J.P. Moore) Y. Hiratsuka., causes globose swellings on the branches and stems of jack pine. Often regeneration and branches of larger trees are killed as a result of the galls girdling them. It has been reported in most areas of the Park but there has been no severe infections. Injury to infected trees is light and the damage to stands is low.

FIR NEEDLE CAST, Sarcotrochila balsameae. (Davis) Korft., causes a needle blight of balsam fir. In Prince Albert National Park this organism causes a snow blight with scattered patches of needles under the snow being invaded and killed during the winter. Even though foliage on lower branches or larger trees may be infected, only seedlings and small saplings are severely injured. Injury to infected trees is light and the danger to stands is low.

THE ARTIST'S CONK, Ganoderma applanatum (Wallr.) Pat. (Sym. Fomes applanatus) causes a white mottled rot primarily on hardwoods. In the Park it is mainly a wound decay fungus in living trees and a rotter of dead material. Injury to infected trees is very light and the danger to stands is very low.

THE TINDER FUNGUS, Fomes fomentarius (Fr.) Kickx., is widely distributed, causing a white mottled rot of birches, poplars and other hardwoods. Although it decays chiefly sapwood and heartwood of dead timber, it occasionally causes heart rot of living trees and also attacks living sapwood. Injury to infected trees is low, and the danger to stands is low.

THE WHITE TRUNK ROT, Fomes igniarius (L. ex Fr.) Kickx., occurs in the heartwood of mature and over-mature poplars. It does not kill trees but weakens them structurally to the extent that they are susceptible to blowdown. This fungus occurs throughout the Park and occasionally small areas of moderate infections have been recorded. Injury to infected trees is light to moderate and the danger to stands is low.

THE RED RING ROT, Fomes pini (Brot. ex Fr.) Karst., is a destructive wood decay fungus that attacks most species of conifers. It is common on mature and over-mature spruce and fir in the Park. It does not kill the trees but weakens them making them subject to blowdown. Injury to infected trees is moderate and the danger to stands is low to moderate.

THE RED BELT FUNGUS, Fomes pinicola (Swartz) Cke., causes a brown cubical rot of the sapwood and heartwood of dead trees. In the Park it is one of the most common destroyers of dead coniferous material but it also causes heart rot in living trees. Injury to infected trees is light and the danger to stands is very low.

HYPOXYLON CANKER OF POPLAR, Hypoxylon mammatum (Wahl) Miller., causes cankers on living aspen poplar. Cankers are mainly on the main stem and enlarge to the extent that the tree is girdled, causing mortality. Trees subject to wounds or under stress are highly susceptible in this area. It is presently well established in much of the southwest portion of the Park. The percentage of infected trees is higher in those stands that have been subject to stress. Injury to infected trees is high and the danger to stands is moderate.

PINE NEEDLE CASTS - There are several species of needle casts which infect and kill needles of jack pine. Infections have been present periodically and in some localized areas the incidence has been high. Some growth loss could result from severe infections but aesthetic value is most notable. Injury to infected trees is light and the danger to stands is low.

THE VELVET TOP FUNGUS, Polyporus tomentosus Fr., is the cause of a red root and butt rot in living conifers. Infection appears to take place through lateral roots and probably spread by root contact. Sporophores develop on the forest floor near the base of an infected tree and usually indicate root infection, but not necessarily extensive development of butt rot. It has been recorded in some areas of the Park but the extent of damage is unknown. Injury to infected trees is moderate and the danger to stands is low.

POPLAR FOLIAGE DISEASES - Foliage diseases occur commonly on poplar causing discoloration and premature leaf drop. Successive years of severe infection could cause growth loss but leaf diseaes mainly affect the aesthetic value of the trees. Typical examples of those found in Prince Albert National Park include: Ciborinia whetzelii (Seav.) Seav., causing ink spot of aspen. Drepanopeziza populorum (Desm.) v. Hohn. causing brown leaf spot of aspen. Melampsora medusae Thum., causing leaf rust of aspen, and Venturia tremulae Aderh., causing a leaf and shoot blight. Injury to infected trees is light and the danger to stands is low.

FIR NEEDLE RUST, Pucciniastrum epilobii Otth., infects the current year needles of balsam fir. Endemic infections persist throughout the Park and occasionally small areas of severe infections have been recorded on regeneration. Injury to infected trees is light and the danger to stands is very low.

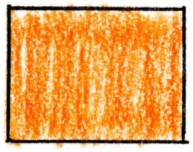
SPRUCE NEEDLE CASTS - Several species of needle cast infect and kill needles of spruce. The disease is easily recognized by the fruiting bodies which appear as small black dots or streaks on the needles. Epidemic infection years appear to occur in cycles and to depend on climatic conditions during the infection period. Injury to infected trees is light and the danger to stands is low.

WHITE MOTTLED ROT, Stereum purpureum (Pers. ex Fr.) Fr., causes a brown heartwood discoloration of birch trees in Prince Albert National Park. This fungus enters the tree through exposed deadwood, growing first in the heartwood and then killing the sapwood. It is not serious in native stands. Injury to infected trees is light and the danger to stands is very low.

APPENDIX B

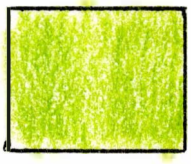
Insect and disease hazard ratings for 32 stand types in Prince Albert National Park (the numbers following some species are the height classes given on the Forest Management Institute cover type maps).

Low



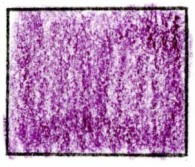
Larch		120
Larch - black spruce		130
Black spruce - larch		132
Black spruce - pine	5	153
White spruce - white birch		154
Black spruce - pine	1-3	161
Black spruce		170
Poplar - white birch		177

Moderate



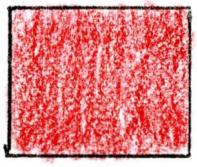
Black spruce - poplar		206
Black spruce - white spruce		209
Pine	5-7	210
Poplar - pine	5-7	235
Pine - poplar	5-7	236
Poplar - black spruce		241
White spruce - black spruce		242
Pine - black spruce		249
Poplar - pine	1-3	251
Pine - poplar	1-3	254
Pine	1-3	260
Poplar	1-3-5	265
White spruce	1-3	265
White spruce - poplar	3-5	277
Poplar - white spruce	3-5	281
White spruce - pine	3-5	283
Pine - white spruce	5-7	293

High

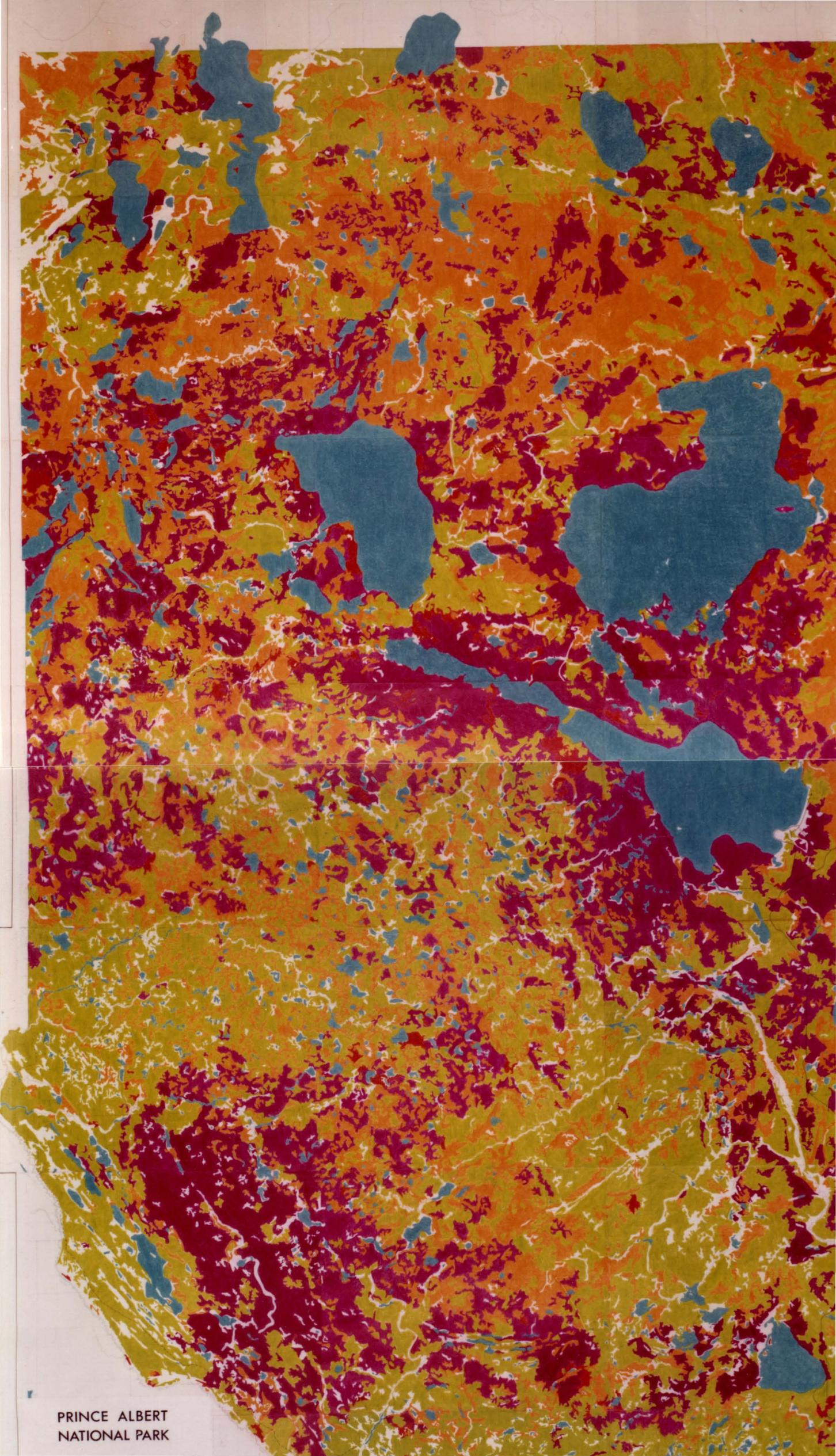


White spruce	5	300
Poplar	7	305
White spruce - balsam fir	7	316
Poplar - white spruce	7	323
White spruce - pine	7	324
White spruce - poplar	7	350

Very high



White spruce	7	410


PRINCE ALBERT
NATIONAL PARK

Contributions of insect pests to the hazard ratings for 32 stand types in Prince Albert National Park.
(see page 3 for explanation of column entries.)

INSECTS	Po 1->5	Po 7	PowS 3-5	PowS 7	PoP 1-3	PoP 5-7	PobS	PowS	P 1-3	P 5-7	PPo 1-3	PPo 5-7	PwS 5-7	PbS	wS 1-3	wS 5	wS 7	wSPo 3-5	wSPo 7	wBbS	wBP 3-5	wBP 7	wBbP 7	wSwS 5	bS	bBPo	bSL	bSP 1-3	bSP 5	bBwS 3-5-7	L	bbS 1->5
Aclaris variana black-headed budworm			2/4/1	2/4/1			2/4/.25						2/4/1	2/4/.25	2/10/1	2/10/1	2/10/1	2/6/1	2/6/1	2/6/1 2/4/.25	2/6/1	2/6/1	2/10/1	2/6/1	2/10/.25	2/6/.25	2/6/.25	2/6/.25	2/6/.25	2/6/.25	2/10/1		2/4/.25
Argyrotaenia tabulana pine tube moth					2/4/.25	2/6/.5			2/10/.5	2/10/.5	2/6/.5	2/6/.5	2/6/.5	2/6/.5							2/4/.5	2/4/.5					2/4/.5	2/4/.5			
Buccalatrix canadensisella birch skeletonizer								1/4/1																1/4/1								
Choristoneura conflictana large aspen tortrix	1/10/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1	1/6/1	1/6/1			1/4/1	1/4/1						1/6/1	1/4/1							1/6/1						
Choristoneura fumiferana spruce budworm			4/4/1	4/4/1									4/6/1		4/10/.25	4/10/1	4/10/1	4/6/1	4/6/1	4/6/ 1	4/6/1	4/6/1	4/10/1	4/6/1						4/4/1		
Choristoneura Pinus jack pine budworm					2/4/1	2/4/1			2/10/1	2/10/1	2/6/1	2/6/1	2/6/1	2/6/1							2/4/1	2/4/1					2/4/1	2/4/1			
Dendroctonus rufipennis the spruce bark beetle				8/4/2									8/4/2				8/10/2		8/6/2			8/6/2	8/6/2								
Dendroctonus simplex Eastern larch beetle																										8/4/1				8/10/1	8/6/1
Dendroctonus valens red turpentine beetle						8/4/.25				8/10/.25		8/6/.25	8/6/.25	8/6/.25								8/4/.25									
Ditylenchus resiculella spruce sawhorn			2/4/.25	2/4/.25									2/4/.25		2/10/.25	2/10/.25	2/10/.25	2/6/.25	2/6/.25	2/6/.25	2/6/.25	2/6/.25	2/6/.25	2/6/.25						2/6/.25		
Conioctena americana American aspen beetle	1/10/1		1/6/1		1/6/1		1/6/1	1/6/1			1/4/1							1/4/1								1/4/1						
Hylobius spp. root collar weevil			8/4/1	8/4/.25	8/4/1	8/4/.25	8/4/.25		8/10/1	8/10/.25	8/6/1	8/6/.25	8/10/.25	8/10/.50	8/10/1	8/10/1	8/10/.25	8/6/1	8/6/.25	8/10/25	8/10/1	8/10/.25	8/6/.25	8/6/.25	8/10/.25	8/6/.25	8/6/.25	8/10/.25	8/10/.25	8/10/.25		
Malacosoma disstria forest tent caterpillar	1/10/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1	1/6/1	1/10/1			1/4/1	1/4/1						1/4/1	1/4/1					1/6/1		1/4/1						
Neodiprion abietis balsam fir sawfly			1/4/1	1/4/1									1/4/1		1/10/1	1/10/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1	1/6/1	1/10/1	1/6/1						1/4/1		
Pikonema alaskensis yellow-headed spruce sawfly			1/4/1	1/4/1			1/4/1						1/4/1	1/4/1	1/10/1	1/10/1	1/10/1	1/6/1	1/6/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1	1/10/1		1/4/1
Pissodes strobi Engelmann spruce weevil			1/4/1				1/4/1							1/4/1	1/10/1			1/6/1		1/10/1	1/6/1				1/10/1	1/6/1	1/6/1	1/6/1		1/10/1		1/6/1
Pissodes terminalis terminal weevil					1/6/1				1/10/1		1/6/1			1/6/1							1/4/1						2/4/1					
Poplar Leaf Miners	.5/10/1	.5/10/1	.5/6/1	.5/6/1	.5/6/1	.5/6/1	.5/6/1	.5/6/1			.5/4/1	.5/4/1						.5/4/1	.5/4/1					.5/4/1								
Pristiphora erichsonii larch sawfly																										2/4/1				2/10/1	2/6/1
Pseudenactra oregonana poplar leaf roller	1/10/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1	1/6/1	1/6/1			1/4/1	1/4/1						1/4/1	1/4/1							1/4/1						
Pyrrhalta decora grey willow leaf beetle	1/10/1		1/6/1		1/6/1		1/6/1	1/6/1			1/4/1							1/4/1								1/4/1						
Saperda calcarata poplar borer	2/10/.5	2/10/1	2/6/.5	2/6/1	2/6/.5	2/6/1	2/6/.5	2/6/.5					2/4/1						2/4/1							2/4/.5						
Xanthotaenia scalaris a looper																											2/4/1				2/10/1	2/6/1

Contributions of disease organisms to the hazard ratings for 32 stand types in Prince Albert National Park. (see page 3 for explanation of column entries).

DISEASE	Po 1-3-5	Po 7	PmS 3-5	PmS 7	PoP 1-1	PoP 5-7	PobS	PowS	P 1-3	P 5-7	PPo 1-3	PPo 5-7	PwS 3-7	PbS	wS 1-3	wS 5	wS 7	wSPo 3-5	wSPo 7	wShS	wSP 3-5	wSP 7	wBsF	wSwS 5	bS	bSPo	bSL	bSP 1-3	bSP 5	bSwS 3-5-7	L	LbS 1-3-5
Arceuthobium americanum dwarf mistletoe					4/4/.5				4/10/.5	4/10/.5	4/6/.5	4/6/.5	4/6/.5	4/6/.5							4/4/.5							4/4/.5	4/4/.5			
Armillaria mellea Armillaria root disease	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/11	4/6/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/10/1	4/6/1	4/10/.25	4/6/.25 4/6/1	4/6/.25	4/6/.25 4/6/1	4/6/.25 4/4/1	4/6/.25 4/4/1		4/6/.25
Chrysomyxa spp. spruce needle rust			2/6/1	2/4/1			2/4/1						2/6/1	2/4/1	2/10/1	2/10/1	2/10/1	2/6/1	2/6/1	2/10/1	2/6/1	2/6/1	2/6/1	2/6/1	2/10/1	2/6/1	2/6/1	2/6/1	2/6/1	2/10/1		2/4/1
Colesosporium asterum pine needle rust					1/4/1	1/6/1			1/10/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1							1/4/1	1/4/1						1/4/1	1/4/1			
Cronartium comandrae pine stem rust					2/4/1	2/4/.25			2/10/1	2/10/.25	2/6/1	2/6/.25	2/6/.25	2/6/1							2/4/.25	2/4/.25						2/4/1	2/4/.25			
Cronartium comptoniae sweet fern blister rust					2/4/1	2/4/.25			2/10/1	2/10/.25	2/6/1	2/6/.25	2/6/.25	2/6/1							2/4/.25	2/4/.25						2/4/1	2/4/.25			
Diplodia tumefaciens globose gall of poplar	1/10/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1	1/6/1	1/6/1			1/4/1	1/4/1						1/6/1	1/4/1							1/4/1						
Endocronartium harknessii western gall rust					2/4/1	2/4/1			2/10/1	2/10/1	2/6/1	2/6/1	2/6/1	2/6/1							2/4/1	2/4/1						2/4/1	2/4/1			
Fir Needle Casts																							1/4/1									
Fomes applanatus artist's conk	2/10/.25	2/10/1	2/6/.25	2/6/.25		2/6/.25	2/6/.25	2/6/.25			2/4/.25	2/4/.25						2/4/.25	2/4/.25							2/4/.25						
Fomes fomentarius tinder fungus	2/10/.25	2/10/1	2/6/.25	2/6/.25		2/6/.25	2/6/.25	2/10/.25			2/4/.25	2/4/.25						2/4/.25	2/4/.25							2/4/.25						
Fomes igniarius white trunk rot	2/10/1	2/10/1.5	2/6/1	2/4/1		2/6/1	2/6/1	2/6/1				2/4/1.5						2/4/1	2/4/1.5							2/4/1						
Fomes pini red ring rot				2/4/1.5		2/4/1.5	2/4/1.5			2/10/1.5		2/6/1.5	2/10/1.5	2/10/1.5		2/10/1	2/10/1.5		2/6/1	2/10/1.5	2/10/1	2/10/1.5	2/6/1.5	2/6/1	2/10/1.5	2/6/1			2/10/1	2/10/1.5		2/4/1
Fomes pinicola red belt fungus			2/4/.25	2/4/.25			2/4/.25						2/10/.25	2/10/.25		2/10/.25	2/10/.25		2/6/.25	2/10/.25		2/10/.25	2/10/.25	2/6/.25	2/10/.25	2/6/.25	2/6/.25			2/10/.25		
Hypoxylon mammatum Hypoxylon canker	8/10/1.5	8/10/1.5	8/6/1.5	8/6/1.5	8/6/1.5	8/6/1.5	8/6/1.5	8/6/1.5			8/4/1.5	8/4/1.5						8/4/1.5	8/4/1.5							8/4/1.5						
Pine Needle Casts					1/4/1	1/4/1			1/10/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1							1/4/1	1/4/1						1/4/1	1/4/1			
Polyporus tomentosus velvet cap fungus			4/4/1	4/4/1			4/4/1						4/4/1	4/4/1	4/10/1	4/10/1	4/10/1	4/6/1	4/6/1	4/10/1	4/6/1	4/6/1	4/10/1	4/6/1	4/10/1	4/6/1	4/6/1	4/6/1	4/6/1	4/10/1		4/4/1
Poplar Foliage Diseases	1/10/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1	1/6/1	1/6/1			1/4/1	1/4/1						1/4/1	1/4/1							1/4/1						
Purcinianstrum epilobii fir needle rust																							1/4/1									
Snow Blight															1/10/1					1/10/1					1/10/1	1/6/1	1/6/1	1/6/1			
Spruce Needle Casts			1/6/1	1/4/1			1/4/1						1/4/1	1/4/1	1/10/1	1/10/1	1/10/1	1/6/1	1/6/1	1/10/1	1/6/1	1/6/1	1/6/1	1/6/1	1/10/1	1/6/1	1/6/1	1/6/1	1/4/1	1/10/1		1/4/1
Stereum purpureum white mottled rot								2/4/.25																2/4/.25							