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Forest Insect and Disease Conditions

Nelson Forest Region 1981

H.P. Koot and R.W. Garbutt

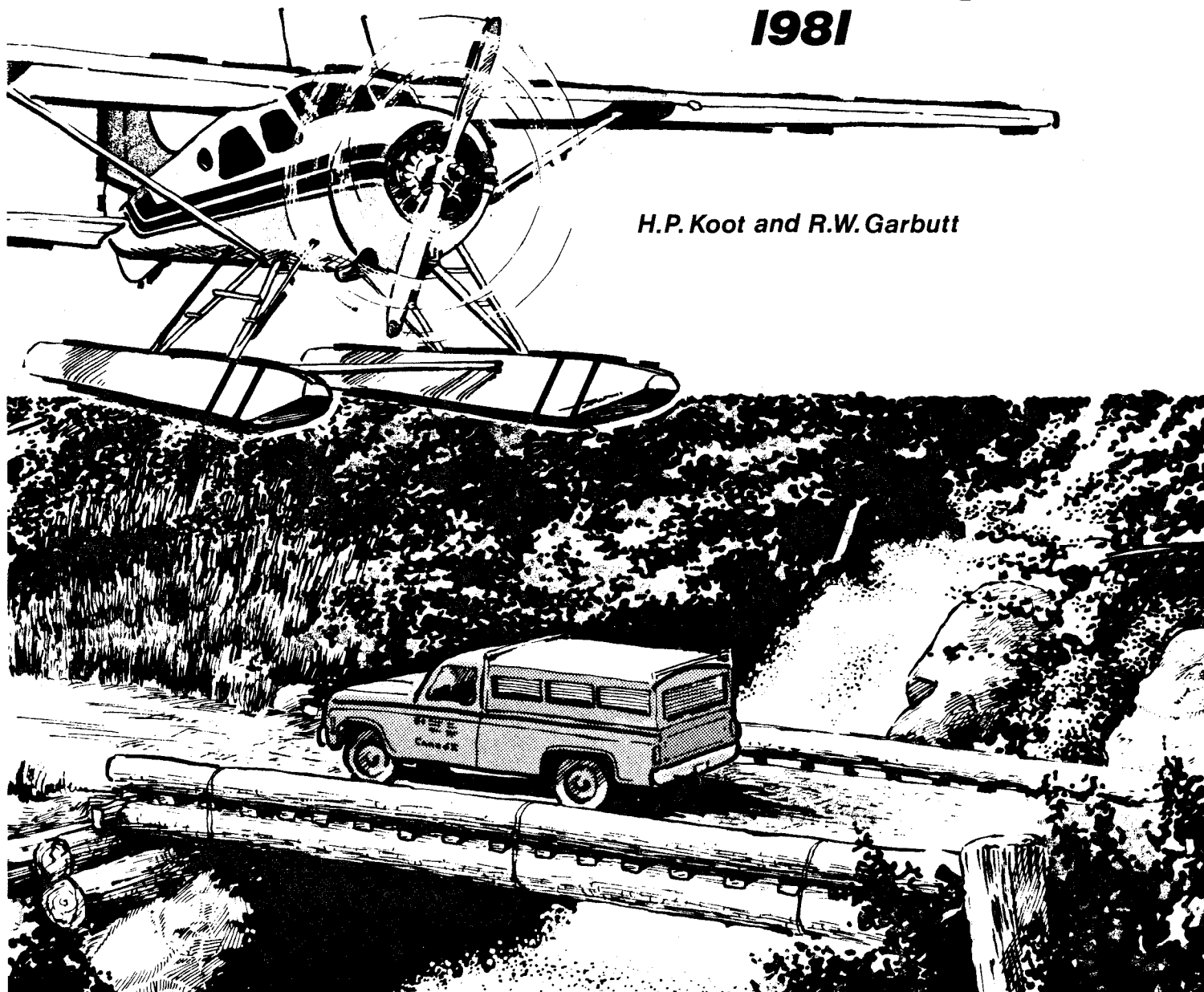


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SUMMARY

This report outlines forest insect and disease conditions in the Nelson Forest Region in 1981 and attempts to forecast future pest population trends with emphasis given to pests capable of sudden damaging outbreaks. Pests are listed by host in order of importance.

Mountain pine beetle, the most damaging pest in the Region, killed 10.5 million lodgepole pine and western white pine in 1981, in 2,424 separate infestations covering 58 790 ha and resulted in a loss of 3 360 000 m³ of timber. The infestation in the Flathead Valley peaked in the last two years and is expected to continue at a greatly reduced level in the upcoming years. All other infestations increased in 1981.

Spruce beetle levels increased dramatically in 1981 to a total of 122 infestations covering 7 993 ha. Beetles attacked 394 200 m³ of timber in 1980 and an additional 56 886 m³ in 1981. In most infested areas a major beetle flight is expected in 1982.

Western balsam bark beetle continued to cause mortality in high elevation sub-alpine fir stands and is commanding greater attention as lower elevation timber supplies become depleted. In some areas up to 50% of beetle attacked trees were infected with Armillaria root rot.

Larch casebearer and larch sawfly populations were low throughout the region in 1981 and only lightly defoliated western larch in isolated areas. Populations are expected to remain at low levels through 1982.

Western spruce budworm defoliation of Douglas fir stands increased near Rock Creek, covering 1 000 ha in 1981, up from 100 ha in 1980.

Douglas-fir tussock moth defoliated an average of 10% of mature Douglas-fir over 20 ha on a golf course near Christina Lake for the first time in 1981.

Armillaria root rot is found in all age classes of most conifer species throughout the Nelson Region but was particularly noteworthy in Douglas-fir plantations and high elevation Engelmann spruce-subalpine fir stands in 1981.

Foliage diseases of conifers responded to the unusually cool moist conditions of spring and early summer to infect and cause widespread discoloration. These diseases included needle cast and needle blight on western larch, a needle cast on lodgepole pine, Sirococcus shoot blight, Rhabdocline needle disease and needle rusts primarily on Douglas-fir, and Elytroderma needle disease on ponderosa pine.

A special survey determined the distribution and infection intensity of Swiss needle cast disease on Douglas-fir at 7 locations in the Nelson Region. A high incidence of the disease was found on older

needles in three samples from wet belt areas only, but no significant damage was attributed to the infections.

Single gypsy moth sex attractant pheromone traps were located in twenty Provincial campsites throughout the Region, but no adults were trapped.

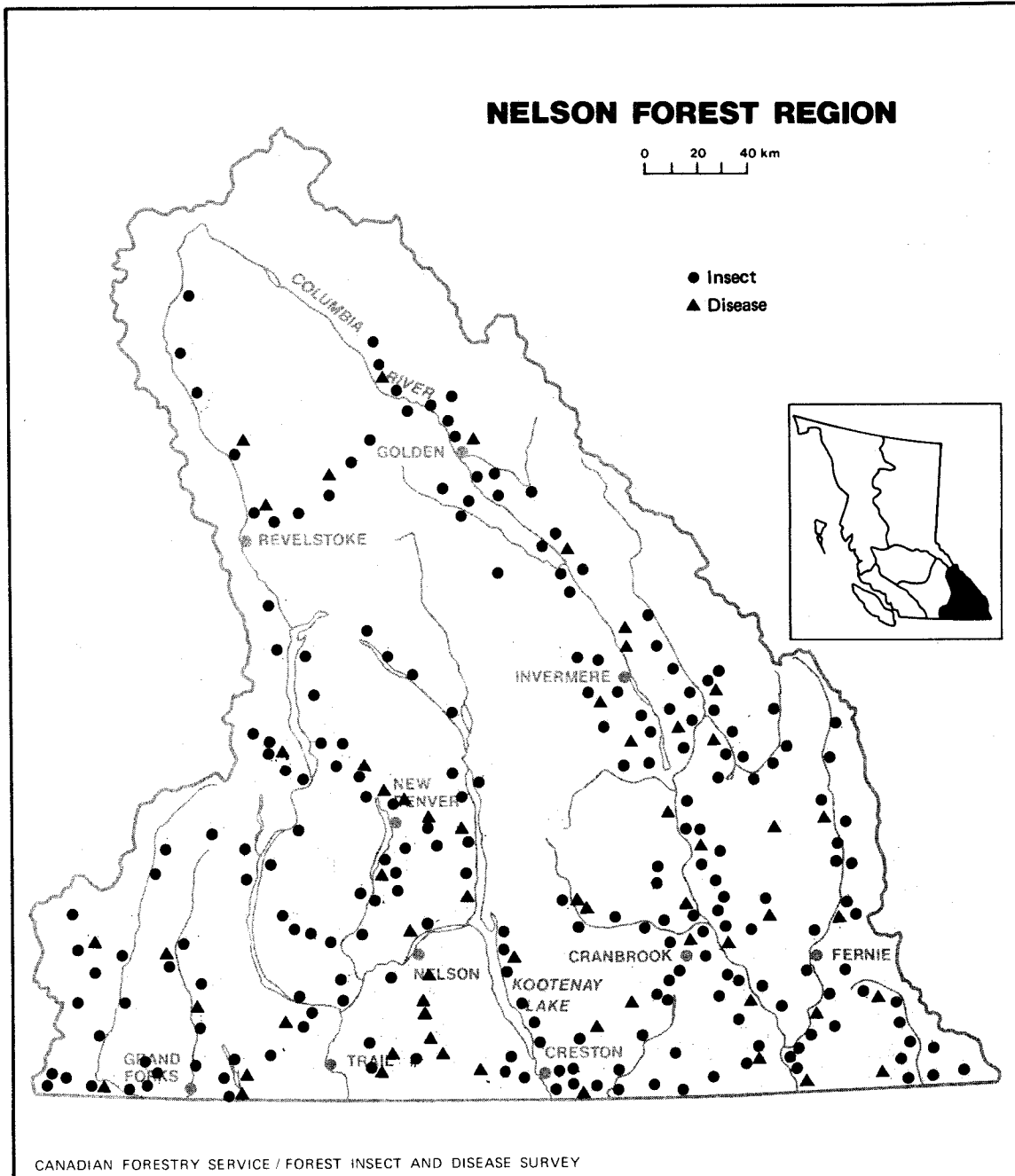
Fifteen Douglas-fir tussock moth traps were set in each of three locations in the West Kootenay to monitor adult male populations. Adults were trapped at all three locations. Both rusty tussock moth and Douglas-fir tussock moth were trapped at Eholt.

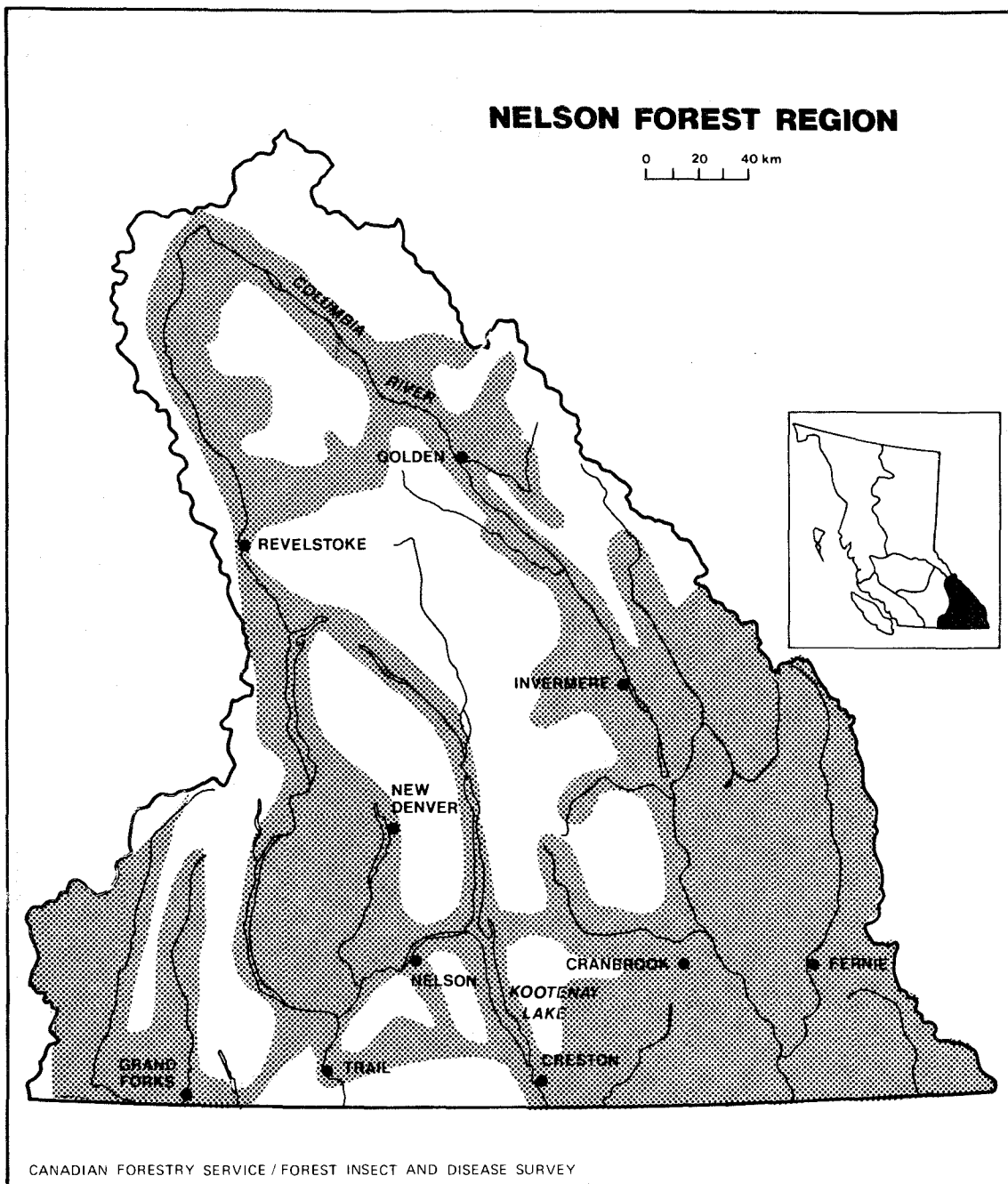
The FIDS field season extended from May 20 to October 9 and included special fall surveys to evaluate mountain pine and spruce beetle damage and larch casebearer populations.

A total of 353 insect and disease collections were submitted to the Pacific Forest Research Centre in 1981 by pest survey officers, and 176 by Provincial agencies, industry and private sources. Locations where one or more collections were made by pest survey officers is shown on Map 1.

A total of 181 field and telephone contacts regarding forest pest problems were made by pest survey officers with B.C. Ministry of Forests personnel, forest industry representatives and private individuals. Forest pest problems were outlined at two meetings of the East Kootenay, and two of the West Kootenay Insect and Disease Control Committees.

A total of 48 hours of fixed wing and 3 hours of helicopter flying time was provided by the Ministry of Forests for aerial observation, mapping and photography of mountain pine beetle and spruce beetle infestations (Map 2).





Map 2

**Aerial Surveys
1981**

Areas Covered By Aerial Surveys

PINE PESTS

Mountain pine beetle, Dendroctonus ponderosae

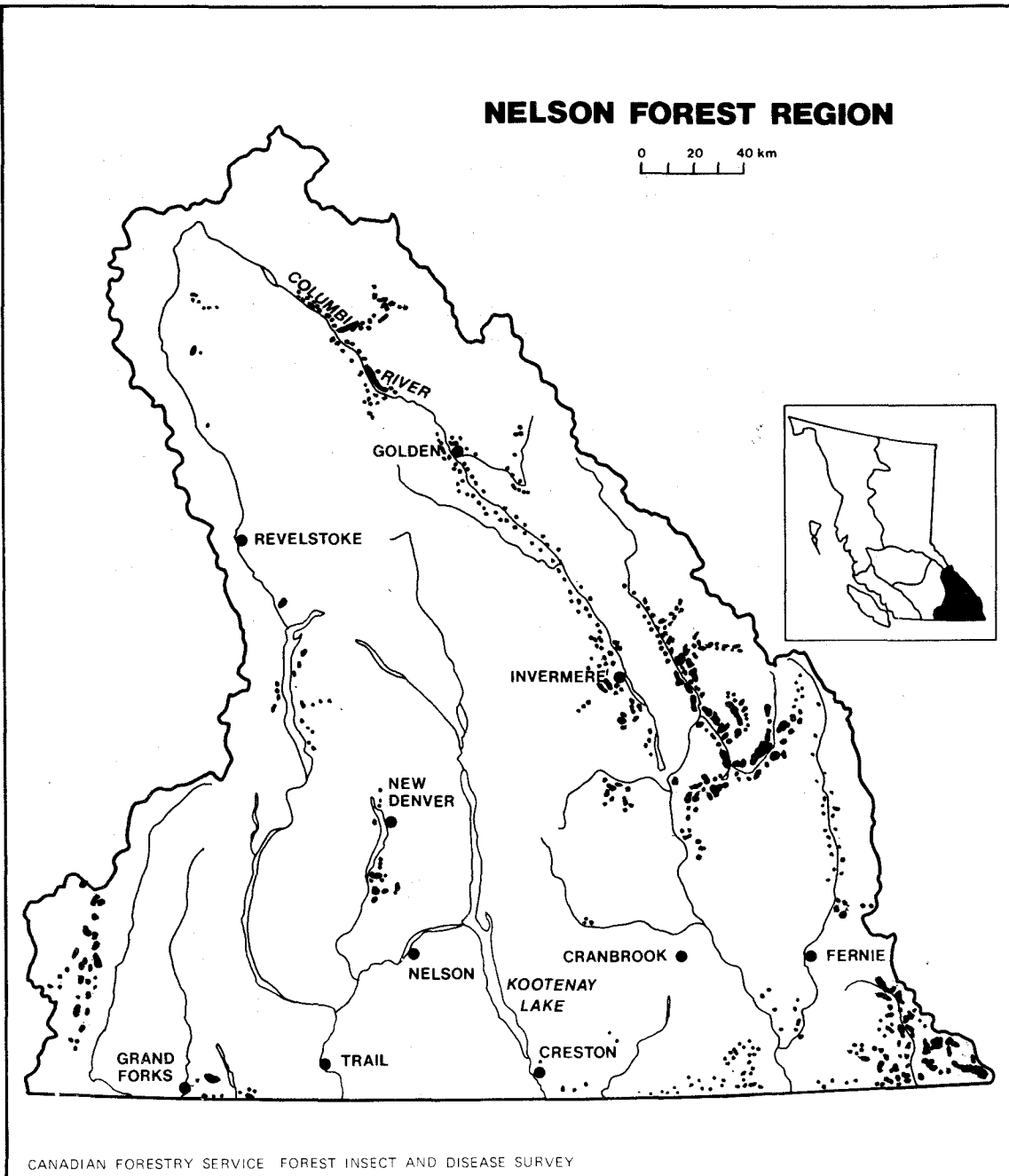
Mountain pine beetle attacked and killed an estimated 10.5 million pine trees over 58 790 ha in 2,424 infestations in 1981 as determined from aerial surveys (Table 1, Map 3), compared to 10 million trees over 33 400 ha in 1980.

Volume losses of lodgepole and white pine totalled nearly 3.4 million m³ in 1981, 85% of which occurred in the Cranbrook (Flathead) and Invermere Timber Supply Areas (T.S.A.). The number of infestations decreased to 2,424 in 1981 from 3,600 in 1980, primarily due to a coalescing of smaller infestations to form continuous areas of tree mortality particularly in the Flathead Valley, White River drainage and Blackwater - Bush Arm areas.

TABLE 1. Number, area and volume of mountain pine beetle infestations by T.S.A. as determined from aerial surveys.
Nelson Forest Region and National Parks, 1981

TSA or Park	No. Infestations	Area (ha)	Number of trees attacked in 1980	Volume (m ³)	
				1980 attack	Grey
Cranbrook	797	22 760	6,045,000	1 330 000	1 908 000
Invermere	766	23 750	3,680,000	1 629 100	140 000
Golden	416	6 300	510,000	290 000	
Revelstoke	73	1 600	2,360	2 600	
Kootenay Lake	50	420	500	550	
Boundary	133	2 000	178,000	62 300	15 000
Arrow	87	1 030	80,000	43 000	
Glacier Park	16	240	1,070	1 000	
Yoho Park	32	330	1,780	600	
Kootenay Park	54	360	2,350	850	
TOTALS	2,424	58 790	10,501,060	3 360 000	2 063 000

In the East Kootenay, major expansions of infestation areas occurred in the Caven-Bloom-Ward creeks drainages in the Cranbrook T.S.A., and in the upper reaches of drainages adjacent to the Flathead River, particularly along the B.C.-Alberta border, and along Morrissey, Lodgepole, Bighorn and Phillips creeks. A substantial portion of the



Map 3

**Mountain Pine Beetle
1981**

Areas of Recent Killed Lodgepole Pine and White Pine
As Determined By Aerial Surveys

lodgepole pine component along the Flathead River has been depleted since the outbreak began in 1977, and now many of the remaining stands are composed of immature, non-susceptible trees. Current attack (1981) was only 2% in two stands assessed in this area. Small spot infestations were common from Sparwood north to Aldridge Creek along the Elk and Fording river valleys. Localized areas of previous infestation have also intensified in stands surrounding Elko and along Linklater Creek.

In the Invermere T.S.A. where infestations continued to expand in most areas of previous damage, there were 766 infestations over 23 750 ha. Areas of notable increase, in the White-Kootenay-Lussier river drainages, where large areas of pine have been destroyed since 1971, include the Lussier River-Whiteswan Lake area, the main White River Valley, the Kootenay River Valley and adjacent Palliser, Alberta and Cross rivers and north in Kootenay National Park. The number of infestations in the Park containing 5 to 300 trees each increased to 54 from 13 in 1980. At Premier Lake near Skookumchuck, a new infestation of 300 pines was noted for the first time. In the Columbia River Valley, major outbreak areas persisted from Findlay-Dutch creeks west of Columbia Lake, north to Spillimacheen, including Toby and Horsethief creeks and the Steamboat Mountain area. Scattered small infestations continued east of the Columbia River between Edgewater and Brisco, and on both sides of the river from Castledale north to Golden.

Infestations in lodgepole and white pine stands in the Golden T.S.A. numbered 416 over 6 300 ha. The most significant expansion in lodgepole pine stands occurred near Golden from McMurdo north to Moberly where the number of localized outbreaks increased from 17 in 1980 to 70 in 1981. Along Columbia Reach south of Bush Arm, many small pockets of previously killed pines coalesced and formed a large area of mortality. Infestations in mixed white pine and lodgepole pine stands also continued near Beaver Canyon, along Bush Arm, Bush River, Valenciennes Creek and along Columbia Reach from Bush Arm to Kinbasket River. Infestations have not expanded significantly towards the B.C.-Alberta border.

Beetle killed lodgepole pine in the Kootenay Lake T.S.A. were restricted mostly to small pockets of 5 to 10 trees each along Hawkins and Freeman creeks, where timely removal of infested pines has kept the spread to a minimum. Small scattered areas of infested white pine were observed along Goat, Kid and Irishman creeks and the Little Moyie River area.

An aerial survey over parts of Yoho National Park recorded approximately 1,800 recently killed mature lodgepole pine in 32 infestations over 330 ha. Most of the infestations were in the Emerald and Otterhead River drainages and near Leancoil.

In Glacier National Park the outbreak expanded to 1,100 mature and overmature white pine in 16 infestations over 240 ha along the Beaver River between Grizzly Creek and the north Park boundary.

Intensity levels remained similar to 1980 in Revelstoke National Park where white pine in several pockets of 2-5 trees each were killed along the Illecillewaet River.

Mountain pine beetle outbreaks, mainly in lodgepole pine stands, intensified in the West Kootenay, particularly in the Boundary T.S.A. where 133 infestations occurred on 2 000 ha. Widespread infestations in the Beaverdell area continued, notably along Arlington lakes, Trapping, Hall, Wilkinson, Ferroux, Ptarmigan and Chenier creeks and spotted along the West Kettle River. Near Grand Forks, significant increases in infestation area occurred along the Canada-U.S. border at Gilpin, and in the Bitter-Alder creeks area, where infestations continued to advance north from the U.S. side. The Moody Creek infestation increased 30% to cover 600 ha.

The number of recently killed lodgepole and white pines in mixed stands in the Arrow T.S.A. increased by an average of 30% to 43,500 trees in 41 infestation areas ranging in size from 1 to 135 ha in Lemon, Chapleau, Springer and Memphis creeks. Elsewhere in this T.S.A., 46 infestations in white pine stands covered 470 ha, primarily along the Halfway River, Vanstone Creek and the east shore of Upper Arrow Lake between Nakusp and Galena Bay.

Infestations in the Revelstoke T.S.A. totalled 73 on 1 600 ha in white pine stands, usually in small pockets of 5-10 trees each, particularly in Downie, French, McCulloch and Bigmouth creeks.

Cruise data from lodgepole pine stands in the Nelson Forest Region indicated that 1981 beetle attack averaged 14% of trees examined, as compared to 13% in 1980, and ranged between 2 and 22%. At elevations above 1 300 M where beetle development was slower the intensification rate was also less.

Precluding any adverse climatic impact, outbreaks are expected to continue in 1982 at levels similar to 1981.

Red turpentine beetle, Dendroctonus valens

Scattered ponderosa pine, 10-20 cm dbh, comprising less than 1% of the stand were killed over 35 ha at Wasa Provincial Park. Most trees were predisposed by mechanical damage or stressed by adjacent driveways and other urban development. Five mature lodgepole pine were killed by the beetle at Kikomun Provincial Park where trees were predisposed by camper-caused injuries. Single scattered ponderosa pine were killed along the St. Mary River near St. Eugene Mission, near Fussee Lake, Elko and Marysville.

European pine shoot moth, Rhyacionia buoliana

Mugho pine transplanted from coastal nurseries to the Hugh Keenlyside Dam viewpoint near Castlegar in 1968, and the Insurance Corporation of British Columbia Claim Centre in Trail in 1978, were uninfested for the third consecutive year.

In 1968 the transport of pine trees and pine foliage from the Vancouver Forest District was prohibited under the B.C. Plant Protection Act. Since then, isolated attacks have occurred in ornamental 2-needle pines in the interior but it has not been a problem in natural stands. The risk of this insect becoming established in native stands is now considered minimal, so this year the long standing quarantine was lifted.

Lodgepole pine dwarf mistletoe, Arceuthobium americanum

Lodgepole pine dwarf mistletoe and western larch dwarf mistletoe, A. laricis infections are common throughout the range of their respective hosts in the Nelson Forest Region. Of 1 055 ha surveyed for mountain pine beetle in 1981 in the Invermere T.S.A., one third of the area contained lodgepole pine mistletoe.

Specific management problems were identified in mistletoe infected lodgepole pine-western larch stands at McKinney Creek near Bridesville and Blazed Creek near Creston. At McKinney Creek, juvenile spaced in 1978, approximately 10% of the residual trees of both species were infected over 10 ha. In addition, four mature western larch heavily broomed from mistletoe infection, remained standing within the spaced stand. In Blazed Creek, juvenile spaced in 1979, lodgepole pine and western larch were uninfected over the 5 ha project area but severely broomed mature western larch in an adjacent stand threatened to spread the infection to the spaced stand.

White pine blister rust, Cronartium ribicola

This disease continues to be the limiting factor in the distribution and vigour of a potentially valuable commercial timber species. Blister rust is epidemic in almost every stand of western white pine throughout the Nelson Region, sometimes associated with attack by the mountain pine beetle. Such was the case on 100 ha between Sharp and Hoben creeks on the west shore of Slocan Lake, in the scattered small (5-20 trees) infestations between Nakusp and Galena Bay, in the lower reaches of Pingston Creek and in approximately 50% of the scattered white pine mortality in the Upper Revelstoke TSA. Blister rust infections were also common in more than 50% of the scattered immature white pine along Hwy. 6 between Rosebery and Nakusp, and along the western shore of Lower Arrow Lake where immature white pine was a minor stand component.

Pine needle blight, Lophodermella concolor

Development of fungal infections on year-old lodgepole pine needles was aided in 1981 by the cool moist weather conditions of spring and early summer. Near Nancy Greene Lake 30% of the branch tip needles on 80% of the young growth pine were infected over more than 1 000 ha. In a 100 ha mixed stand near Hills, 30% of the needles on 60% of the lodgepole were infected. In Howe Creek, 95% of the trees were 50% infected in a 7 ha lodgepole pine stand juvenile spaced in 1978. Along the Bull River, 40% of the needles were infected on 10% of the trees for 18 km.

Elytroderma needle disease, Elytroderma deformans

The 1980 needles of all age classes of ponderosa pine throughout the Kettle Valley from Beaverdell to Greenwood were between 5 and 100% infected by this disease. The most seriously infected stands were in the Rock Creek area where up to 70% of the foliage was discolored on 100% of the trees. Brooming was evident on most trees, indicating that this infection had been active in the stands for some years. Between Grand Forks and Christina Lake 80% of the trees were up to 40% discolored by the disease, however no brooming was evident. In the East Kootenay, Elytroderma disease infected year-old foliage on 70% of the crowns of 80% of the lodgepole pine over 10 ha at the junction of Harvey and Corbin creek roads near Fernie.

Stalactiform blister rust, Cronartium coleosporioides

Stem cankers were observed on 75% of immature lodgepole pine along the Flathead Valley Road near km 80, many of which were killed by mountain pine beetle and engraver beetles (*Ips* spp.). Rodent feeding on these cankers was common throughout the area.

Animal Damage

Rodent feeding on lodgepole pine cankers caused by orange stalactiform rust, Cronartium coleosporioides was common near Km 80 of the Flathead Valley Road.

Rabbit feeding caused significant damage in a spacing and fertilization trial 32 km west of Spillimacheen. Examination of the feeding incidence with regard to spacing densities revealed that rabbits fed on 81% of the examined trees spaced at 3.6 M, 62% of trees spaced at 1.8 M and 12% on trees in unspaced plots (see also Pests of Young Stands). The trees felled during spacing apparently provided needed shelter enabling rabbits to feed freely on leave trees.

Porcupine damage was common over a 100 ha area in middle elevation lodgepole pine near Nancy Greene Lake; mortality caused by porcupine feeding ranged from 1 to 10 trees/ha.

At the 1300 m elevation in Walton Creek, 50% of the trees in a 1 ha dense small diameter lodgepole pine stand were killed by a combination of rubbing damage caused by exposure to winds, and resultant feeding by porcupines attracted by resin flow from the rubbing wounds.

Red belt

Foliage discoloration as a result of winter drying ("Red Belt") occurred on lodgepole pine and alpine-fir over several hundred hectares above 2 000 M on the north slope of Mt. Broadwood along the Elk River south of Morrissey, and in the vicinity of Fernie. This condition occurs in late winter or spring when drying winds rob the foliage of moisture which cannot be replaced because the soil moisture is either frozen or too cold to be conducted upward in the tree.

Snow damage

Damage was common for 6 km along the Bull River in immature lodgepole pine stands with up to 25% roadside trees uprooted and those in the stand bent and broken. Similar damage occurred for 2 km along the Moyie River road near Munroe Lake where approximately 5% of the stand was affected, and along Boyd Creek east of Yahk where up to 40% of the lodgepole pine stems were broken. Similar levels of damage were also noted for 7 km along the North White River.

SPRUCE PESTS

Spruce beetle, Dendroctonus rufipennis

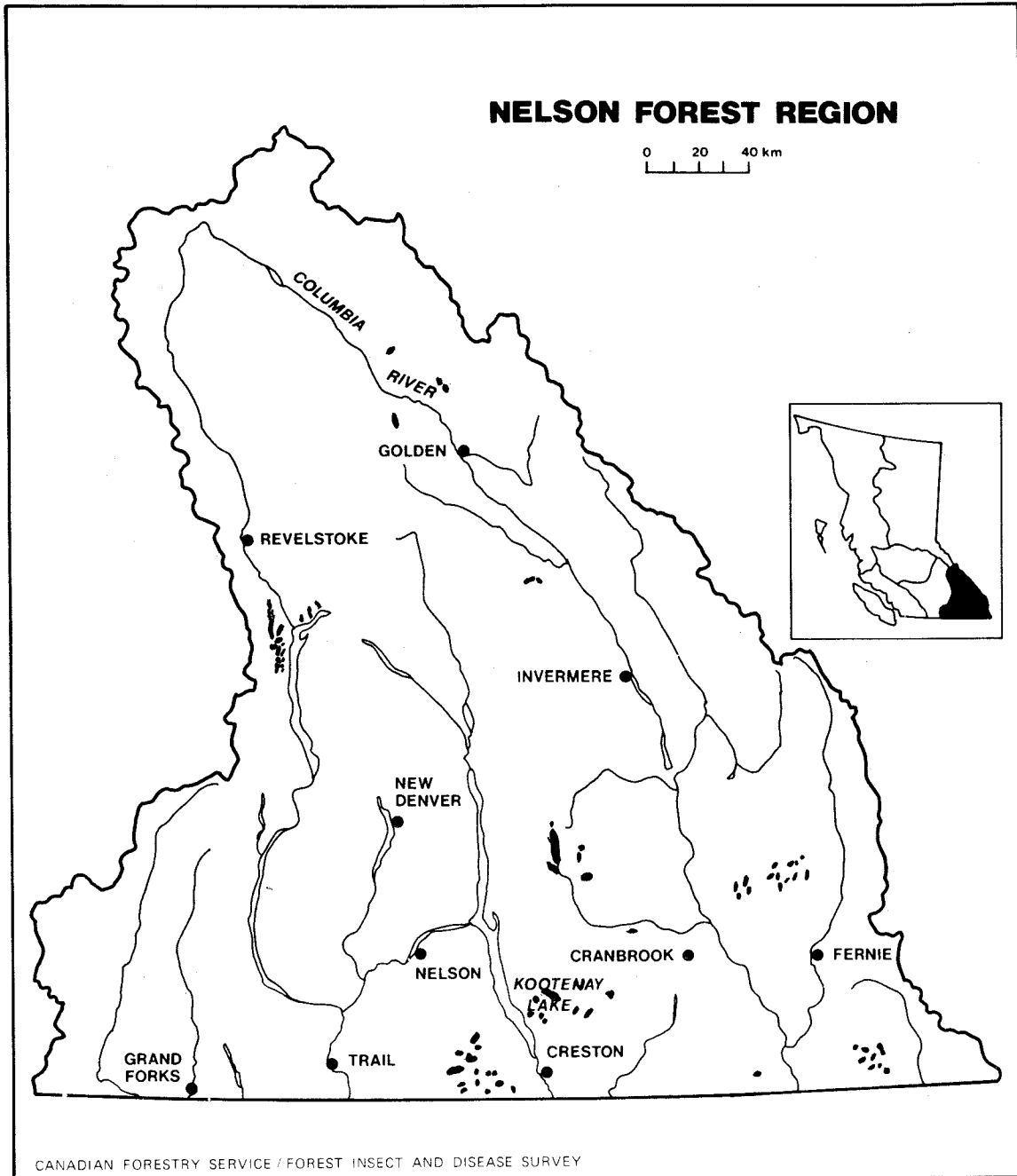
The area of recently killed Engelmann spruce increased almost eight-fold from nearly 1 000 ha in 1980 to 8 000 ha in 1981. Volume loss in 122 infestation areas in the Region was estimated at 450 000 m³ (Table 2).

Table 2. Area and volume by TSA of mature Engelmann spruce recently killed by spruce beetle. Nelson Forest Region, 1981.

TSA	No. Infestations	Area (ha)	Volume (m ³) ^{1/} Under attack	Red Volume (m ³) (1980 attack)	Current Volume (m ³) (1981 attack)
Cranbrook (inc. Top of the World Park)	43	2 934	573 600	126 100	17 200
Invermere	6	60	14 800	3 300	440
Golden	3	114	28 200	6 200	846
Revelstoke	27	2 500	625 000	125 000	18 800
Kootenay Lake	40	2 200	616 000	123 200	18 500
Arrow	3	185	37 000	7 400	1 100
TOTAL	122	7 993	1 894 600	394 200	56 886

Total volume presently attacked: 394 200 + 56 886 = 451 086 m³

^{1/} Total spruce volume in area infested.



Map 4

**Spruce Beetle Infestations
1981**

Areas of Recently Killed Engelmann Spruce, As Determined By Aerial Surveys

In the West Kootenay, the largest infestation occurred in the Revelstoke T.S.A. at Pingston Creek, where 22 infestations occurred on 2 500 ha, up from only 100 ha in 1980. Approximately one third of trees examined near Coursier Lake were either currently attacked or previously killed by spruce beetle in 1979 or 1980. An estimated 2,000 trees in 3 new infestations on 185 ha were killed near Whiskey Point along the northeast arm of Upper Arrow Lake.

Infestations increased dramatically in the East Kootenay in 1981, particularly in the Kootenay Lake (2 200 ha) and Cranbrook (2 934 ha) TSA's.

In the Kootenay Lake TSA, infestations occurred west of Creston in scattered locations ranging in size from 20 to 700 ha from Laib Creek south to the 49th parallel, and also north of Creston along Duck, Arrow, Skelly, Kianuko and Kamma creeks.

New infestations in the Cranbrook TSA were found at: Cabin Creek, 2 200 ha; Upper St. Mary River-Dewar Creek, 84 ha; Meachen Creek, 66 ha; Weaver-Galway creeks, 26 ha; Larch Creek, 37 ha; Wild Horse River-Nicol Creek, 250 ha; Quinn Creek, 146 ha and Bull River, 77 ha. In Top of the World Park, 50 ha of mature spruce were infested.

Small scattered infestations of 1 to 30 ha occurred in the Invermere TSA at the Kootenay River-Raven's Head junction where up to 30% of the stand was attacked, along the Middle Fork White River, Maiyuk Creek and upper Thunder Creek. At Kain Creek west of Spillimacheen, 1,800 stems felled in summer 1980 were heavily infested with the beetle, which originated in heavy slash accumulated during logging in a very decadent spruce-balsam stand. Standing attacked trees were also observed in nearby stands. Approximately 100 trees felled for cones in 1980 at Km 31 Westside Road were also heavily infested.

Infestations in the Golden TSA at Copper and Quartz creeks continued in areas where, because of access problems, salvage logging was not economically practical. However, an experimental lethal trap tree program was initiated in these areas by the B.C.M.F., Golden, to reduce the spruce beetle hazard and also to provide data on the contact herbicide monosodium methanearsonate, commonly known as M.S.M.A., for registration as an insecticide against spruce beetle. Initial sampling of MSMA treated and non-treated trap trees by B.C.M.F. indicated that a high incidence of mortality among larvae and young adults occurred in M.S.M.A. injected trees compared to the untreated trap trees.

A spruce beetle infestation was reported for the first time in the Hope-Goodfellow Creek drainages in reserves that border old logging blocks, but the size and intensity of attack is not currently known.

Spruce beetle infestations were precipitated primarily by individual or small patch windthrow and fringe blowdown associated with logging. Currently active infestations have caused as much as 90%

mortality in mature spruce over some areas, and yet, for all its potential as a tree killer, the beetle is normally a relatively nonaggressive attacker, preferring downed or weakened material to healthy trees. Recommended sanitation and monitoring programs involving annual removal of windthrown trees from cutting boundaries for at least 2 years following logging and road construction would aid in the control and management of this damaging pest.

Assessments of current and previous attack intensity and brood development at Pingston Creek in the West Kootenay and at Nicol Creek in the East showed that only 3%, of the standing green timber was attacked in 1981 while 22% was attacked in 1980. Attempts to reduce the present population by extraction of infested stems and/or with treated or non-treated trap trees, should be implemented before the major beetle flight in May, 1982. If such management action is not taken, significant expansion of infestations may be expected in 1982.

Two-year-cycle spruce budworm, Choristoneura biennis

Spruce budworm larvae consumed about 15% of the 1981 foliage on Engelmann spruce and alpine-fir trees on approximately 300 ha at Glenogle Creek. Similar defoliation intensity occurred at McMurdo, Bugaboo and Redding creeks, where light defoliation also occurred in 1980. No feeding damage was noted along the North Fork of the White River where defoliation had persisted since 1977, causing top stripping and bud mortality.

At Glenogle Creek, the budworm population appeared "off phase" with heavy feeding by late instar larvae in the odd-numbered years (e.g. 1979, 1981) instead of the normal even-numbered years. This "phenomenon" was also reported previously at McMurdo Creek.

Continued light defoliation of "normal" cycle spruce budworm can be expected in spruce-balsam stands defoliated in 1981; including Blaeberry River Spillimacheen River, St. Mary River and tributaries, Sanca Creek and the White River drainage system.

Striped ambrosia beetle - Trypodendron lineatum

This pest attacked Engelmann spruce logs, stumps and windfall, and lodgepole pine logs in Skelly and Kamma creeks near Creston. Samples from logs decked along the Kamma Creek access road indicated a moderate population with an average of 40 beetles/.1 m² of log surface^{1/}. Populations probably increased in 1981 because of an accumulation of windfall spruce logs, associated also with a spruce beetle outbreak. It

^{1/} Low - 0-15 beetles/.1 m² Moderate - 15-50 beetles/.1 m²
High - 50+ beetles/.1 m²

was recommended that the attacked logs remain decked in the area until the beetle emerged to overwinter in the duff, thus avoiding transport of infested stems to the millyard.

A major flight of beetles was encountered on July 25th at Skelly Creek.

Light attacks of <15 beetles/.1 m² were found in log decks and 1980 mountain pine beetle attacked lodgepole pine on Steamboat Mountain in the Invermere TSA.

Spruce Tip Moth, Griselda radicana

Larvae of this insect were found feeding on the opening buds of Douglas-fir in stands along Toby Creek and at the mouth of Horsethief Creek. Up to 60% of new foliage was affected but actual feeding damage was light.

Greenheaded spruce sawfly, Pikonema dimmockii

Severe defoliation (80%) to the lower crown of one 10 metre Engelmann spruce and moderate (30%) defoliation of three smaller spruce was observed at a private residence in Fernie. Similar damage was reported also from a private residence in Cranbrook with little expected long term impact in either area.

Spruce weevil, Pissodes strobi

Weevils damaged approximately 10% of the terminal leaders of regeneration Engelmann spruce at McLeod Meadows and Dolly Varden Creek in Kootenay National Park, and 5% at Hoodoo Creek in Yoho National Park.

WESTERN LARCH PESTS

Larch casebearer, Coleophora laricella

Defoliation continued for the sixteenth consecutive year, but at reduced levels from previous years, when larvae defoliated western larch stands through much of the host tree range in the Nelson Forest Region and southeast portions of the Kamloops Forest Region. No tree mortality has occurred to date.

In the East Kootenay, light to moderate defoliation (10 to 50%) occurred along Summit Creek to Creston Valley, at Rykerts, Arrow Creek, between Jaffray and Elko on the east side of Koocanusa Lake, several miles into Teepee Creek on the west side of the Lake and along the Yahk River. The only noteworthy occurrence of larch casebearer in the West

Kootenay was east of Anarchist Mountain summit and along Johnstone Creek where defoliation was moderate and light respectively. Little damage was observed near Grand Forks where previous defoliation had been severe.

Defoliation intensity was recorded at five permanent sample plots from Thrums to Yahk (Table 3).

TABLE 3. Intensity of western larch defoliation by larch casebearer at five permanent plots.
Nelson Forest Region, 1981

Location	Elevation (m)	Defoliation ^{1/}	
		1980	1981
Thrums	690	light	none
Salmo	660	light	none
Rykerts	660	severe	moderate
Arrow Creek	720	none	none
Yahk	840	none	none

^{1/} Light: 0 - 25% discolored foliage
Moderate: 26 - 50%
Heavy: 51 - 75%
Severe: 76 - 100%

In some areas such as Yahk and Arrow Creek defoliation was associated with infections of larch needle diseases, Hypodermella laricis and Meria laricis, which made precise separations difficult.

Since 1969, small numbers of larch casebearer parasites, Agathis pumila and Chrysocharis laricinellae have periodically been introduced into infested areas. C. laricinellae was introduced into the eastern U.S.A. from Europe in 1930 and into western U.S.A. in 1972, and has since spread into the casebearer population in B.C. outside of local releases. However, the native parasite Diadocerus spp. has had the greatest impact in reducing casebearer numbers east of Anarchist Mountain summit where, in 1981, 68% of pupae in collections taken from the area were parasitized. Elsewhere pupal parasitism by both native and introduced species was recorded at 4 locations: Shuttleworth Creek (Kamloops Forest Region), 42%; Johnstone Cr., 38%; Rykerts, 15%; and Anarchist Mtn (Kamloops Forest Region), 12%. The increased incidence and distribution of parasites combined with a decline in casebearer populations should result in decreased larch defoliation in 1982.

Overwintering larvae from four 45 cm branch samples obtained from each of six permanent plots, to determine population levels and potential for defoliation in 1982, indicated light defoliation at Rykerts

near Creston and negligible or no defoliation in areas assessed elsewhere (Table 4).

TABLE 4. Average number of overwintering larch casebearer larvae per branch and predicted defoliation for 1982 at permanent sample plots.

Nelson Forest Region, 1981

	Avg. no. larvae		Predicted Defoliation ^{1/} 1982
	per 45 cm branch	per 100 fascicles	
Anarchist Mtn.	5	2	Negligible
Thrums	0	0	None
Salmo	0	0	None
Rykerts	38	17	Light ^{2/}
Arrow Cr.	1.5	1	Negligible
Yahk	1.5	1	Negligible

^{1/} Forecasting larch casebearer defoliation in the northern region. (W.H. Ciesla, W.E. Bousefield), progress report, U.S.D.A., Northern Region, #71-33, 1971.

^{2/} Up to 25% foliage discoloration.

Larch Needle Cast, Hypodermella laricis

For the fifth consecutive year needle cast infections severely discolored western larch stands, particularly in the West Kootenay. The most serious infections occurred on 100 ha, 8 km east of Nancy Greene Lake in a pure stand of juvenile larch, where 80% of the needles were discolored on 100% of the trees, and in a large area of mixed Douglas-fir and western larch between Castlegar and Trail, and east to Salmo where 90% of all larch were infected with 20% - 60% of the needles discolored. In the latter area, the larch needle cast infection was mixed with larch needle blight, Meria laricis, a disease displaying almost identical symptoms. Light damage by both diseases affected about 60% of the larch in a widespread area from Salmo north to Nelson and throughout the Slocan Valley, with less than 25% of the needles infected. In the Granby River Valley, less than 10% of the needles were infected on 30% of the trees. Needle cast infected stands in the East Kootenay were recorded in Caven Creek and nearby Gold Creek, where 100% of the larch was 80% discolored (Table 5).

Larch Needle Blight, Meria laricis

For some years this blight has been recorded in western larch stands in northern Idaho and Montana, but until 1981 was not identified in B.C. A high level of infection in the Nelson Forest Region this year however, indicates that the fungus has probably been present here for some time. The cool moist spring and early summer weather enabled a strong inoculum base to develop quickly in larch stands throughout its southernmost range in the Region. Once its presence was suspected, special laboratory techniques required to detect the microscopic fruiting bodies, identified it as the major cause of larch discoloration in the Flathead Valley, near Fernie, in the Yahk Provincial Forest and in the Creston area previously attributed to Hypodermella laricis. M. laricis was found co-infecting larch needles with Hypodermella needle cast over a wide area around Salmo, north to Nelson and throughout the Slocan Valley (Table 5).

Table 5. Location and intensity of larch needle cast, Hypodermella laricis and larch needle blight, Meria laricis.
Nelson Forest Region, 1981

Location	<u>M. laricis</u>	<u>H. laricis</u>	% of larch infected	% needle discoloration
Hills	Yes	No	60	15
Nelson	Yes	Yes (low)	70	20
Salmo Area	Yes	Yes	100	35
Salmo Area	Yes	Yes	60	20
Salmo Area	Yes	No	60	20
Salmo Area	Yes	Yes	60	20
Nancy Greene Lake	No	Yes	100	80
Granby River	No	Yes	30	10
Rykerts	Yes	No	40	10
Kingsgate	Yes	No	60	20
Moyle	Yes	No	10	5
Fernie	Yes	No	100	30
Cross River	Yes	No	-	40
Flathead River	Yes	No		20
Caven Creek	No	Yes	100	60
Gold Creek	No	Yes	100	60

Historically larch needle diseases have been monitored but control measures have not been considered, because infections have rarely caused tree mortality. M. laricis however, may become a more serious problem as an indirect result of mountain pine beetle infestations. To provide for mixed species composition in the next rotation, some beetle killed lodgepole pine stands in the Flathead Valley have been regenerated to western larch, but M. laricis has been identified as the cause of

larch seedling mortality. This problem will be closely monitored in 1982.

Larch sawflies, Anoplonyx occidens and A. laricivorus

These insects were collected from three-tree beatings of larch from Sparwood (33 larvae), on larch previously defoliated by the larch sawfly, Pristiphora erichsonii, Lost Dog Creek (20 larvae), West Side Road at Christina Lake (20 larvae), and Greenwood (55 larvae). They caused no noticeable defoliation and are not considered a problem at present.

Animal Damage

Top killing of two to five metres by rodent (unidentified but suspected to be squirrel) feeding on immature western larch was common throughout the host range, most notably at Roam Creek, Kianuko Creek and Moyie River. This is a perennial problem with the number of dead tops varying annually from single isolated trees to 25 or more in localized areas. No evidence of a canker (Phomopsis pseudotsugae) reported to cause top girdling of larch and other immature conifers was found.

Western larch dwarf mistletoe, Arceuthobium laricis

In Lamb Creek south of Cranbrook, mature western larch left as a seed source following a large (more than 100 ha) logging operation showed evidence of mistletoe infection. Unless removed within a few years following the next seed crop, these trees will infect the understory.

DOUGLAS-FIR PESTS

Douglas-fir tussock moth, Orgyia pseudotsugata

A localized infestation covering 20 ha occurred this year on mature Douglas-fir at the Christina Lake Golf Course. This is the first occurrence of a tussock moth outbreak in the Nelson Forest Region since 1955. Defoliation was limited primarily to the upper crowns and ranged from 5 to 50% on individual trees with an overall average of 10%. Some larval feeding activity was noted in ponderosa pine surrounding the golf course, but no defoliation was evident. The host Douglas-fir type is limited to the golf course area.

An artificial control program, using an insecticide spray may be implemented because of the public and commercial impact of defoliation, and the rash-inducing larval hair of the tussock moth.

Sets of 15 Douglas fir tussock moth (DFTM) pheromone traps were placed at each of three locations: Christina Lake, Eholt and Rock Creek (Table 6). From studies of DFTM population dynamics, the U.S. Department of Agriculture has estimated that 25 or more male moths per trap for the .001% concentration of pheromone indicates an increasing population for the following year. An average of 11 moths were caught in the five .001% concentration traps at Christina Lake and, on the basis of USDA estimates a decrease in populations may be expected in 1982.

Traps located at Eholt attracted an average of 3.3 Rusty tussock moths (averaged from all 15 traps) and 3.6 DFTM, reflecting low endemic populations of both species in the area. At Rock Creek traps attracted an average of 25.6 moths compared with 35.3 from Christina Lake, but drew moths from a much larger Douglas fir type. No defoliation was seen in the area.

TABLE 6. The number of male tussock moths in pheromone traps from three locations.

Nelson Forest Region, 1981

Pest	Location	Avg no. moths trapped per concentration % of pheromone ^{1/}		
		.001% ^{2/}	.01%	.1%
Douglas-fir tussock moth	Rock Creek	8	35	31
Douglas-fir tussock moth	Eholt	0	3	8
Rusty tussock moth,	Eholt	0	3	7
<u>Orgyia antiqua badia</u>				
Douglas-fir tussock moth	Christina Lake	11	44	51
	Golf Course			

^{1/} (Z) -6- heneicosen -11- one pheromone by weight.

^{2/} Five traps of each of three concentrations at each location.

Samples of 91 unemerged male cocoons collected at Christina Lake in September were examined and found to be 68% infected by virus and parasites (Table 7). The most commonly found natural control organism of Douglas-fir tussock moth is the nucleopolyhedrosis virus (NPV). This disease parasite is already established within the population (Table 7), and may multiply rapidly in the coming year. Egg samples gathered in September are currently being reared at PFRC in Victoria to determine viral levels within the population. The results of this study will be available in the Spring of 1982.

TABLE 7. The number and % parasitism of unemerged male Douglas-fir tussock moth cocoons from Christina Lake Golf Course. Nelson Forest Region, 1981.

Number of Cocoons	% of Total	Condition
5	5.5	diseased - NPV
5	5.5	parasitized - hymenoptera sporocytes
8	9	dead adults - unknown causes
29	32	healthy
44	48	parasitized - unidentified Diptera larvae

Western spruce budworm, Choristoneura occidentalis

An infestation of this insect centered at Johnstone Creek near Rock Creek defoliated Douglas fir, and to a lesser extent western larch, for the fourth consecutive year. Defoliation increased to 80% of the new growth in 1981 from 60% in 1980 in the most seriously defoliated area in Johnstone Creek Provincial Park. The infestation area increased from 100 ha in 1980 to over 1 000 ha in 1981, stretching from Rock Creek almost to Bridesville. Only one egg mass was found from 15 trees examined at Johnstone Creek, indicating a probable decline of populations in 1982. Residual pupal cases examined on the same 15 trees, yielded 20 pupae parasitized by an unidentified dipterous fly. This fly parasite and others including the fungi Entomophthora and Sphaerosperme spp. recorded from previous years, was influential in keeping budworm larval populations in check.

Douglas-fir beetle, Dendroctonus pseudotsugae

Winter-logged cold deck trees at Andreen Creek near Invermere were attacked in 1980 and averaged two adults per 225 cm² of bark area. Egg counts averaged 65 per 20 cm of larval gallery, indicating a probable increase in populations for 1982. Approximately 10% of the Douglas-fir stumps for an area of 11 ha around the log decks were also attacked. Several stump attacks also occurred in Canyon Campground near Radium, however, these were later peeled to kill the brood. Similar levels of activity were reported in log decks from Parson to Radium.

Five over-mature Douglas-fir on the west side of Premier Lake were attacked by the beetle. These trees were slowly being weakened by repeated attacks by a localized endemic population.

Armillaria root rot, Armillaria mellea

Armillaria root rot continued to be the most destructive root rot problem in all age class stands of most conifer species in the Nelson Forest Region. Volume losses attributable to the root rot are currently impossible to determine, but it is recognized to be responsible for losses second only to the mountain pine beetle. In some instances Armillaria root rot is considered to be a primary infection agent in trees, predisposing them to secondary agents such as bark beetles and engraver beetles which ultimately cause tree mortality. In mature and overmature sub-alpine fir stands in Jumping Creek near Revelstoke, in Redding Creek and the West Fork of St. Mary River, an undetermined number of A. mellea infected stems were attacked and killed by the western balsam bark beetle in 1981.

In T.F.L. 23 on the west side of Upper Arrow Lake, B.C. Timber halted a Douglas-fir spacing project at three ha, when the plantation was found to be more than 50% infected by Armillaria root rot. In a 10 ha plantation of 6-year-old Douglas-fir on the TFL, 5% of the trees were killed by the root rot.

A. mellea has also been recorded infecting an undetermined number of mature Douglas-fir in Fisherman Creek and Chapleau Creek, in mature western larch stands in Tenderloin Creek, semi-mature lodgepole pine in Lynch Creek, mature and immature sub-alpine fir in Mohr and Arrow creeks and mature Engelmann spruce and western red cedar in Marl Creek.

Rhabdocline needle cast, Rhabdocline pseudotsugae

Low levels of Rhabdocline needle cast infection occurred on individual Douglas-fir throughout the Nelson Region, however, infections of 1981 needles were more widespread and higher in intensity than in 1980. Up to 100% (avg. 40%) of the current year's needles on 100% of the exposed fir were infected for 8 Km along Hwy 3 at Christina Lake. At Fort Steele, needle cast infected 40% of the needles on 50% of the trees over several hectares.

Melampsora needle rusts, Melampsora spp.

On the east and west side of Upper Arrow Lake conifer-cottonwood rust, Melampsora occidentalis was common throughout the range of Douglas-fir. On more than 80% of young trees examined, 25% of the current year's needles were infected. Near Moberly, up to 40% of the new growth on young Douglas-fir was infected with M. medusae. A localized infection covering 5 ha of M. abietis-capraearum infected 5% of the foliage on 10% of the sub-alpine fir area along Lamb Creek. Western larch stands between Yahk and Kingsgate had an average of 30% of the needles infected by M. paradoxa. Although foliage discoloration was often highly visible, permanent damage is unlikely.

Sirococcus shoot blight, Sirococcus strobilinus

This fungus which attacks the phloem layer in the current year's branch tip growth occurs commonly on coastal western hemlock. Its development is favoured by high atmospheric moisture and mild temperatures. In 1981 it was reported for the first time infecting interior Douglas-fir, causing a wilting and die-back of the shoot tips, primarily in the West Kootenay.

At Christina Lake it killed 20% of the new shoots on young fir over 20 ha. The disease was present over a large area in Douglas-fir stands between the Pend D'Orielle River and Salmo, where infection intensities ranged from less than one to 25% mortality of branch tips on 100% of the trees. Up to 20% of the immature Douglas-fir sustained 5-10% branch tip mortality over a widespread area from New Denver, north along Hwy. 6 to St. Leon, east to Kaslo, and from Kaslo north to Meadow Creek and south to Balfour. On the east shore of Kootenay Lake at Lockhart Beach Park, infections occurred on 20% of immature Douglas-fir, killing up to 50% of the new shoots.

Swiss needle cast, Phaeocryptopus gaeumannii

A special survey was conducted throughout the Nelson Forest Region in 1981 for this native Douglas-fir needle fungus. Though there is no historical evidence of significant damage to fir by this disease in B.C., it has become a significant problem particularly in mature Douglas-fir of B.C. provenance, planted in New Zealand, where it was imported either on loose needles, in seed, or on seedlings and where climate and heavy spring rains seem to favour its development. Seven stands were sampled throughout the Nelson Forest Region; New Denver, Kaslo, Champion Lakes, Elko, Cranbrook, Fairmont and Radium. Older needles were infected on samples from New Denver, Kaslo and Champion lakes, indicating a preference for fir growing in areas of higher precipitation on the fringe of the interior wet belt.

A bud blight on Douglas-fir, Dichomera gemmicola

Nearly 100% of the bud flush was aborted on 40% of the immature Douglas-fir over a 5 ha area from this disease in the Blaeberry River.

Frost Damage

Late spring frosts killed up to 80% of the new shoots of mature roadside Douglas-fir at the Christina Lake golf course. Only foliage on exposed sides of trees were affected. Similar damage intensity occurred over an entire plantation of 5-year-old Douglas-fir along Blackwater Ridge.

Snow damage

Snow movement associated with heavy snow pack (2.5-4M) on slopes greater than 20% uprooted an entire Douglas-fir plantation at the 1100 M level near Mica. This slippage resulted from the formation of ice at the interface between snow and ground causing snow to slide over the ice and extract trees whose crowns were bound in it. This condition occurs most frequently when a thaw is followed by refreezing of melted snow at ground level.

ALPINE FIR PESTS

Western balsam bark beetle complex, *Dryocoetes confusus*-*Ceratocystis dryocoetidis*

This pest complex of high elevation sub-alpine fir stands was recorded throughout the Nelson Forest Region, however the most severe infestations occurred in the Revelstoke T.S.A. Longstanding infestations occurred on a high elevation plateau near Nichol's Creek where 20% of the trees were grey (dead for more than 4 years) and less than 1% or approximately 5,000 trees were recently attacked over 1 750 ha. On Bigmouth Creek and a tributary, Louis Creek, 1,000 trees were recently killed over 600 ha and in Jumping Creek, a tributary of the Illecillewaet River, an estimated 10,000 trees were recently killed over 3 000 ha. Scattered mortality occurred in Pingston and Thor creeks where an estimated 1,000 trees were killed over 2 000 ha, much of which was mixed with beetle infested spruce. Personnel from the B.C. Ministry of Forests, pest management group in Revelstoke, launched a major project in 1981, designed to determine the impact of this pest and possible control measures.

Elsewhere in the Region recent attacks killed 300 trees on 10 ha in Chapleau Creek near Slocan 2,000 trees over 1 000 ha in Skelly Creek near Creston and 3,000 trees over 1 000 ha in the upper Blaeberry River just north of Yoho National Park.

In addition to the 32 infestations mapped by aerial survey this year, many more unmapped infestations occurred throughout the range of sub-alpine fir in the Nelson Region. Attacked areas were scattered and normally of small size (5-20 trees). The beetle rarely attacks more than 10 trees/ha in one year.

Fir - fireweed rust, *Pucciniastrum epilobii*

This needle rust on sub-alpine fir affected 5% of the 1981 foliage on 10% of the trees over several hectares at Km. 5, Lamb Creek Road, resulting in premature needle loss.

Brown felt blight, Herpotrichia nigra

This fungus infected 10% of branches of immature sub-alpine fir on 60% of the trees over 3 ha in an alpine meadow at the summit of Mt. Revelstoke Park. This meadow, formerly free of trees, has just recently regenerated to sub-alpine fir. The fungus is common in high elevation snow-covered stands but rarely has a significant impact on regeneration or mature trees.

WESTERN HEMLOCK PESTS

Western hemlock looper, Lambdina f. lugubrosa

Larval populations increased this year with an average of 12.4 larvae per positive beating samples from western hemlock and western red cedar, compared with 3.1 in 1980. Of 48 beating samples taken from these two species, 25% contained hemlock looper larvae. Most of the larvae were collected in beatings near Trout Lake, between Revelstoke and Mica Creek, along Tangier River and at Silver Creek in Mount Revelstoke National Park. Some light defoliation may occur in these areas in 1982, if populations continue to increase as expected.

A hemlock sawfly Neodiprion sp., normally found in association with western hemlock looper, averaged 15.5 larvae in the same beating samples, but is of little consequence as a pest.

Conifer sawflies, Neodiprion, spp.

Conifer sawflies defoliated less than 5% of the old foliage of understory western hemlock along Bostock Creek in Glacier National Park. Sawfly larvae were collected in 34% of all three-tree beating samples from western hemlock and averaged 11.2 larvae per collection. In 47% of all beatings from lodgepole pine the average was 8.5 larvae per collection. Populations are presently at endemic levels and the impact of any additional feeding in 1982 is expected to be minimal.

DECIDUOUS TREE PESTS

Poplar leaf and shoot blights, Venturia spp.

Up to 50% of the leaves on black cottonwood were infected with V. populina for 10 km along Stagleap Creek and South Salmo River on the west side of Kootenay Summit. Up to 75% of the leaves in a 1 ha stand of aspen were infected by V. macularis adjacent to Kikomun Creek Park. Black cottonwood and aspen foliage was up to 80% discolored by V. populina and V. macularis respectively, between Zincton and Retallack.

Birch leaf skeletonizer, Bucculatrix spp.

For the eighth consecutive year, widely scattered stands of white and water birch were infected from Hoodoo Creek in Yoho National Park west to Golden, north from Golden to Donald Station, and south along the Columbia River Valley as far as Invermere. Up to 75% of the leaves were skeletonized, but no lasting adverse affects such as top kill or dieback were noted.

Fall webworm, Hyphantria cunea

Deciduous shrubs including willow, western chokecherry and mountain alder near Rykert's were nearly 50% defoliated by this insect. At Christina Lake and Grand Forks minor defoliation was reported from fruit trees and various deciduous ornamentals. Little long term damage will result from these infestations.

Gypsy Moth, Porthetria dispar

Gypsy moth pheromone traps were located in forested areas throughout the Nelson Forest Region. Twenty traps were placed primarily in the provincial campgrounds, frequented by visitors from outside the Region who are the primary vectors in the distribution of this insect. No moths were trapped at any of the 20 locations. In addition, the Plant Quarantine Branch of the B.C. Ministry of Agriculture, located 133 traps throughout the Nelson Region, again with negative results. Gypsy moth, a major pest in eastern Canada and the U.S.A. is a potentially damaging pest of both deciduous and coniferous trees.

PESTS OF MANAGED SECOND GROWTH STANDS AND PLANTATIONS

A total of nine tended stands in the Region were examined in 1981 to identify and monitor pest problems. Six were juvenile spaced, one was commercial thinned and two were untreated plantations.

A naturally regenerated stand of immature lodgepole pine in the Drift Fire near Spillimacheen was the object of a trial to determine the incidence of pest damage in response to different spacing and fertilization treatments. Three treatments were employed; 1.8 x 1.8 m spacing, 3.6 x 3.6 m spacing and an unspaced control. The most significant damage was debarking of the lower bole by rabbits (Table 8). Increases in damage coincided with increased spacing, probably indicating that rabbits are able to take advantage of increased amounts of slash for cover while feeding.

TABLE 8. Incidence of debarking of young lodgepole pine from rabbit feeding at three different spacings at the Drift Fire near Spillimacheen.

Nelson Forest Region, 1981

Spacing	No. trees Damaged	Debarking Damage		No. trees examined
		Old (pre 1980)%	New %	
unspaced (control)	15	10	1.5	133
spaced 1.8 m.	72	52	72	116
spaced 3.6 m.	<u>81</u>	51	31	<u>97</u>
Total	168			346

Of the 346 trees examined, 13% were infected by western gall rust, Endocronartium harknessii, 2.7% were mechanically damaged, 2.7% were damaged by lodgepole pine terminal weevil, Pissodes terminalis, 1.1% were browsed by deer and 0.3% were attacked by pitch nodule moth, Petrova metallica.

An experiment in hand thinning was carried out in the summer of 1978 in a 35 ha naturally regenerated lodgepole pine stand on the Soo Fire north of Golden. Of 100 trees examined 10% were partially pulled and still growing, indicating that greater care must be taken in the future to completely remove all roots of uprooted trees from the ground. An additional 5% of the trees examined had multiple leaders from animal browsing and environmental causes.

Results of the remaining seven young stand inspections are summarized in Table 9.

TABLE 9. Summary of pest problems in young tended stands.
Nelson Forest Region, 1981

Location	Host	No. Trees Examined	Pest	% Trees Affected	Stand Treatment	Remarks
Beaverfoot River	eS ^{1/}	93	Mechanical injury	5	Commercial thinning 1980	Scars caused by skidding
	alF ^{2/}	4	Mechanical injury	25		
	D ^{3/}	3	Mechanical injury	33		
Blazed Creek	1P ^{4/}	78	Western gall rust, <u>Endocronartium</u> <u>harknessii</u>	42	Juvenile spacing 1979	Extensive dwarf mistle- toe in adjacent mature 1P.
	wL ^{5/}	21				
	eS	1				
Santa Rosa Summit	D	95	Cicada feeding	95	Juvenile spacing 1978	Cankers and/or corky bark at base of stems of all affected trees.
			Douglas fir needle cast, <u>Rhabdocline</u> <u>pseudotsugae</u>	10		
	wL	3	Larch needle cast, <u>Hypodermella</u> <u>laricis</u>	100		
	1P	2	Lodgepole pine needle cast, <u>Lophodermella</u> <u>concolor</u>	100		

(CONT'D)

TABLE 9. (Cont'd)

Location	Host	No. Trees Examined	Pest	% Trees Affected	Stand Treatment	Remarks
Santa Rosa Summit	all species	100	Wind damage and/or browsing	70		Broken tops and double leaders on affected trees, 10 broken tops still partially attached.
TFL #23 B.C. Timber, west side of Upper Arrow Lake	D	100	Browsing and/or terminal boring insect	55	Douglas-fir plantation, 1975	More than 50% of plantation N.S.R. probably due to drought stress.
			Melampsora needle rust, <u>Melampsora occidentalis</u>	100		
			Cooley spruce gall aphid, <u>Adelges cooleyi</u>	12		
			Douglas-fir coneworm, <u>Dioryctria</u> sp.	1		
Howe Creek	1P	93	Snow movement	28	Juvenile spacing, 1979	Affected stems crooked.
	wL	7	Hypodermataceous fungus	100		

TABLE 9. Cont'd

Location	Host	No. Trees Examined	Pest	% Trees Affected	Stand Treatment	Remarks
McKinney Creek	1P	76	Atropellis canker, <u>Atropellis piniphila</u>	29	Juvenile spacing, 1978	
			Western gall rust, <u>Edocronartium harknessii</u>	9		
			Dwarf mistletoe, <u>Arceuthobium americanum</u>	1		
			Basal scars	1		
	wL	24	Dwarf mistletoe, <u>Arceuthobium laricis</u>	25	Juvenile spacing, 1978	One mistletoe infected mature residual.
			Windthrow	4		
White River	1P	100	Root collar weevil, <u>Hylobius</u> sp.	5	Provenance trial, 1976	Affected trees were killed.

- 1/ Engelmann spruce
2/ Sub-alpine fir
3/ Douglas fir
4/ Lodgepole pine
5/ Western larch

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