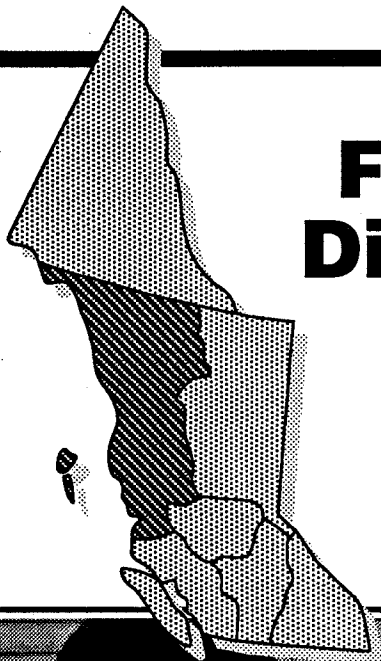
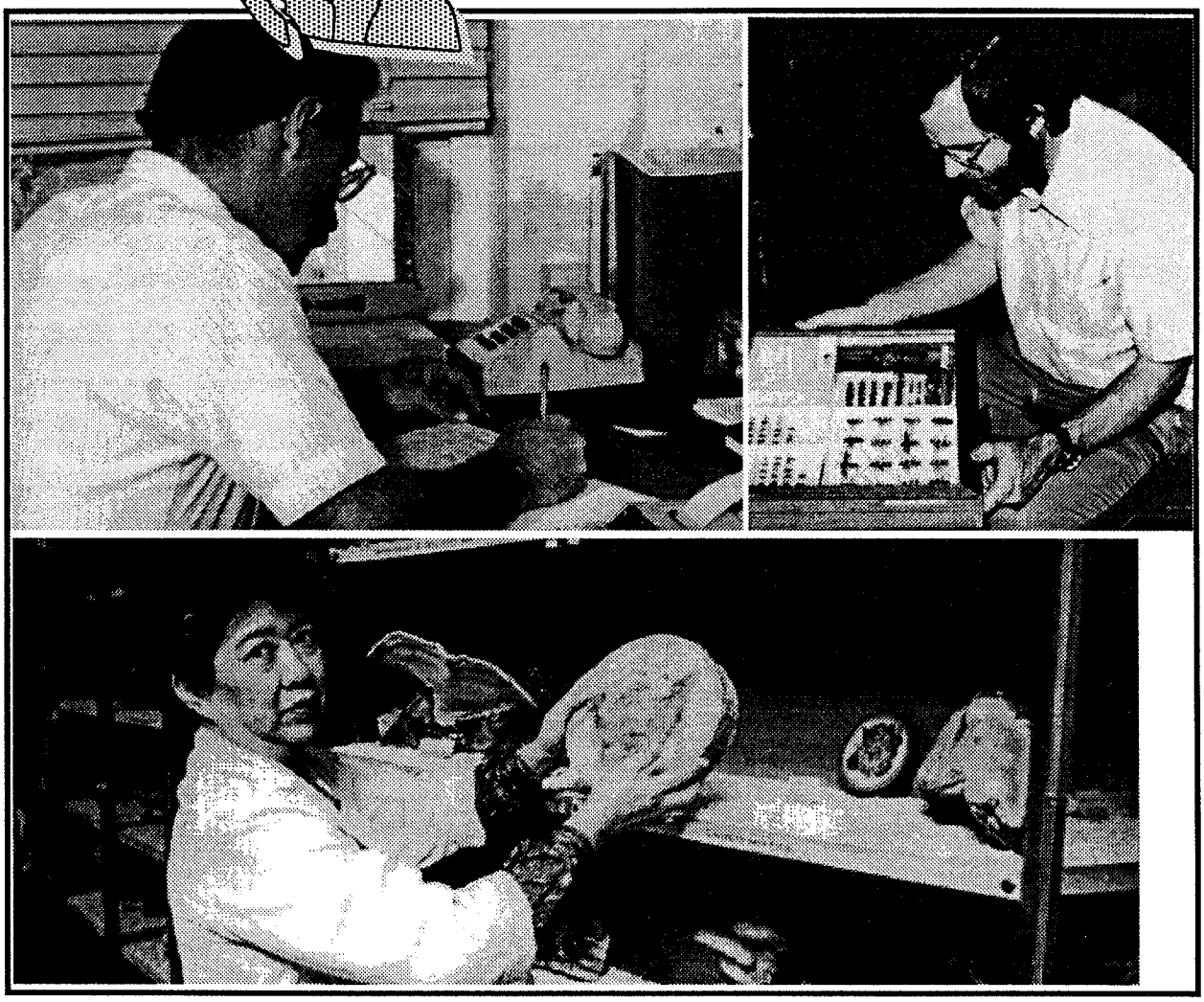


Forest Insect and Disease Conditions

Prince Rupert Forest Region
1991

R. Garbutt & J. Vallentgoed



Forestry Canada Forêts Canada

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The following appendices are available upon request from the Forest Insect and Disease Survey, 506 West Burnside Road, Victoria, B.C., V8Z 1M5.

1. Pests mapped during aerial surveys. Prince Rupert Forest Region, 1991.

2. Pest Report. "Summary of Forest Pest Conditions". Prince Rupert Forest Region, 1991.

3. Pest Report. "Northern Tent Caterpillar in the Kalum Forest District 1991 and Forecast for 1992". Prince Rupert Forest Region, 1991.

4. Pests of young stands survey data. Prince Rupert Forest Region, 1991.

5. Forest pests in provincial parks. Prince Rupert Forest Region, 1991.

INTRODUCTION

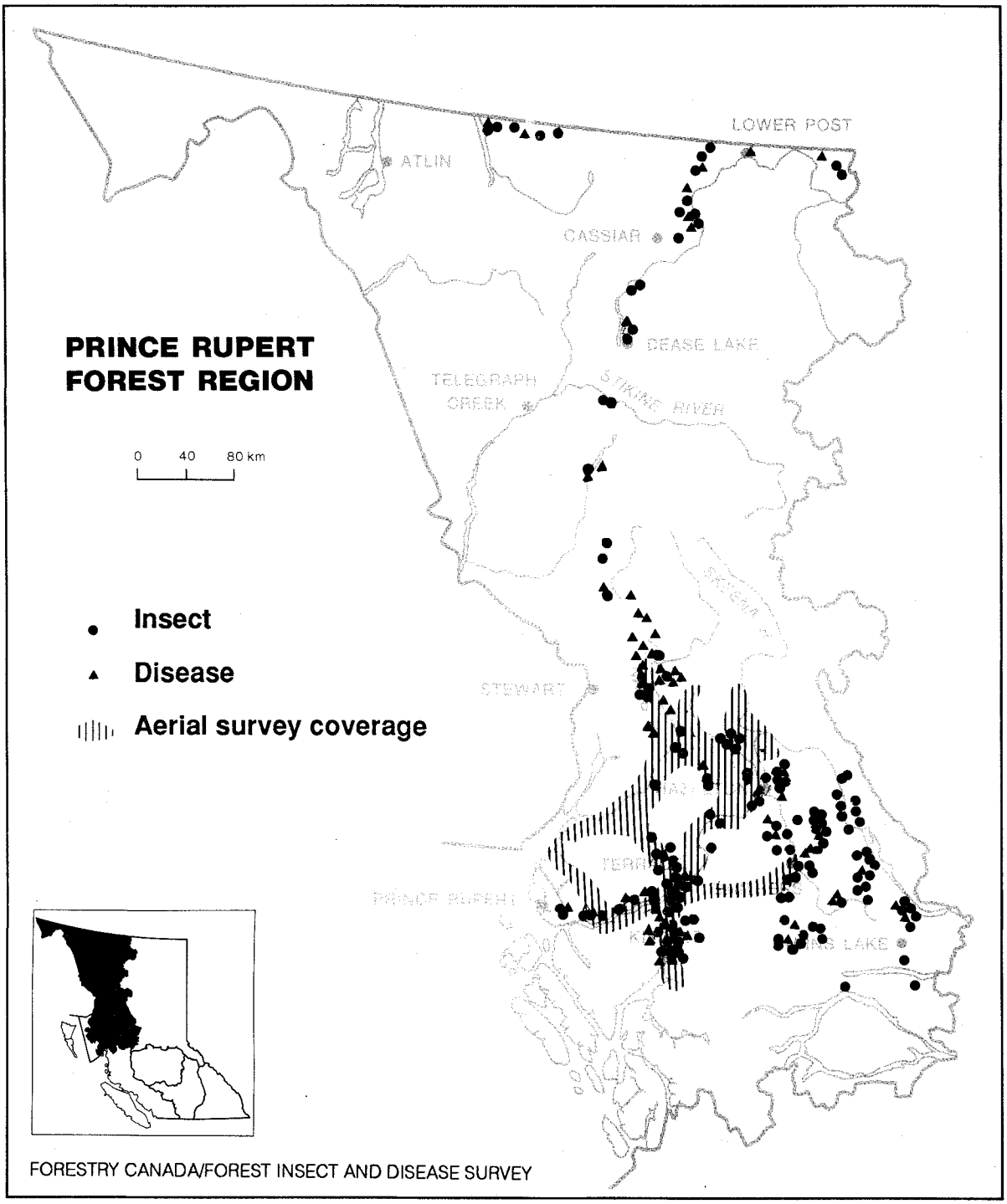
This report outlines the status of forest insects and diseases surveyed in the Prince Rupert Forest Region in 1991 and forecasts some of the pest population trends. The results of pest surveys in the Prince Rupert Forest Region have been reported by Forestry Canada, Forest Insect and Disease Survey (FIDS) since 1939. Pests are discussed by host, generally in order of importance and often within the context of a management unit or Timber Supply Area (TSA). The Queen Charlotte Islands and the Yukon Territory were also surveyed by FIDS Rangers in the Prince Rupert Forest Region, but pest information for the Queen Charlottes is reported in the Vancouver Forest Region report, and for the Yukon, in a separate FIDS report entitled "Forest Insect and Disease Conditions, Yukon Territory, 1991".

FIDS is a national unit within Forestry Canada with the responsibility of: (1) producing an overview of forest pest conditions and their implications, including predictions when possible; (2) maintaining records and surveys to support quarantines; (3) supporting forestry research with records, herbaria and insect collections; (4) providing advice, technology transfer and extension services with respect to current and historical forest insect and disease conditions; (5) developing and testing survey techniques; and (6) conducting related biological and impact studies. The cooperation of provincial, industrial, municipal, and academic establishments is essential for the effective fulfillment of these mandates and is greatly appreciated.

The 1991 field season extended from late May to mid-October. A total of 360 insect and disease collections were submitted by the authors to the Pacific Forestry Centre (PFC) for identification and verification (Map 1). Twenty collections were received from B.C. Forest Service (BCFS) staff throughout the region, the Queen Charlotte Islands and the Yukon. In cooperation with research programs at the Pacific Forestry Centre and other institutions, 17 special collections were made in 1991. The B.C. Forest Service provided 9.5 hours of fixed wing and 2 hours of helicopter flying time to conduct aerial surveys and on-site pest examinations. Pest survey data were summarized and presented at the annual Forest Health Committee meeting in early January of 1992, and contributed to a national FIDS report.

Throughout this report, incidences of aerially observed bark beetle mortality are defined as follows: **light** - 1-10% of a stand; **moderate** - 11 to 29%; **severe** - 30%+. Biogeoclimatic units are often referred to in the report in their abbreviated form to conserve space; in alphabetical order they are:

CWHws1 - coastal western hemlock, wet submaritime, submontane
CWHwh1 - coastal western hemlock, wet hypermaritime, submontane
CWHvm - coastal western hemlock, wet maritime
ICHmc2 - interior cedar-hemlock, moist cold, upper Nass Basin
ICHmc3 - interior cedar-hemlock, moist cold, lower Nass Basin
ICHvc - interior cedar-hemlock, very wet cold
SBSmc - sub-boreal spruce, moist cold
BWBSe - boreal white and black spruce, cordilleran



Map 1. Locations where one or more forest insect or disease samples were collected and areas covered by aerial surveys, 1991.

In tables the common names of trees are abbreviated to nationally used conventions; in alphabetical order they are:

aF	- amabilis fir	rJ	- Rocky Mountain juniper
alF	- alpine fir	sA	- Sitka alder
bCo	- black cottonwood	sAs	- Sitka mountain ash
bS	- black spruce	sS	- Sitka spruce
D-fir	- Douglas-fir	tA	- trembling aspen
dJ	- dwarf juniper	W	- willow
dM	- Douglas maple	wB	- white birch
lP	- lodgepole pine	wbP	- whitebark pine
mAl	- mountain alder	wrC	- western red cedar
mH	- mountain hemlock	wH	- western hemlock
rAl	- red alder	wS	- white spruce
		xS	- hybrid Sitka x white spruce

Field stations are currently located in Smithers and Terrace; from May to October correspondence can be directed to:

Forest Insect and Disease Survey
Box 2259
Smithers, B.C.
V0J 2N0 Ph. 847-3174

Forest Insect and Disease Survey
Box 23
Terrace, B.C.
V8G 4A2 Ph. 635-7660

For the remainder of the year, FIDS Rangers are located at the Forestry Canada headquarters for the Pacific and Yukon Region:

Forest Insect and Disease Survey
Pacific Forestry Centre
506 West Burnside Road
Victoria, B.C.
V8Z 1M5 Ph. 363-0739

Additional copies of this report and copies of other publications such as provincial and national pest survey overviews, forest pest leaflets, and regional forest pest histories can be obtained from the Forest Insect and Disease Survey at the above address.

SUMMARY

Mountain pine beetle killed an estimated 81 160 m^3 of lodgepole pine over 5 835 ha, a decrease of 38% from 1990. **Warren's root collar weevil** continued to infest a high proportion of young pine in the Kispiox TSA, but caused little mortality. **Lodgepole terminal weevil** populations decreased slightly, causing light damage in three interior stands. **Pine needle diseases** caused the loss of year-old and older needles in stands at various locations mainly in the northern part of the region. Four species of **pine stem diseases** were found at widespread locations during young stand surveys and special high elevation surveys to gather rust spores for research. The **northern lodgepole needleminer** lightly infested young pine near Granisle.

Light incidences of current attack by the **spruce beetle** continued in the Morice TSA, in the Morice River corridor near the confluence with the Thautil River, and near Haul Lake, in the north. In the Skeena and Kitimat valleys, current attacks by the **white pine weevil** remained high, affecting an average of 17% of the young spruce in nine stands, and recent increases in attack were seen in the Kispiox Valley. **Two-year-cycle spruce budworm** lightly defoliated mature white spruce and alpine fir in the Harold Price Creek drainage. As in 1990, the **eastern spruce budworm** lightly defoliated white spruce in the extreme northeastern portion of the region.

Chronic infestations of **western balsam bark beetle** caused light mortality of alpine fir over an estimated 58 440 ha. **Western blackheaded budworm** lightly and moderately defoliated alpine fir, near Bare Loon Lake in the proposed Chilkoot Trail National Park in the extreme northwest, and caused trace defoliation of white spruce at Kinaskan Lake Provincial Park. **Fir-fireweed rust** lightly to severely infected the current needles of alpine fir at widespread locations within the region. **Conifer budworm** populations remained at endemic levels and pheromone trap catches were much reduced from last year. **Delphinella tip blight** killed the emerging current growth of alpine fir at three locations in the southern part of the region.

The incidence of **true heartrots** was surveyed in two western hemlock stands in the Kalum TSA.

Defoliation of tamarack by the **larch sawfly** declined significantly in 1991, causing trace-to-light defoliation in the northeastern portion of the region.

Damage caused by **Rhizina root disease** declined significantly with only trace levels of seedling mortality recorded in two plantations in the Bulkley TSA, though fruiting bodies were common in mainly unplanted recent broadcast burns in the western part of the region. Damage caused by **black army cutworm** feeding was less severe than last year with trace seedling defoliation recorded in two plantations and light to moderate herbaceous defoliation in seven others. Pheromone trap catches indicate increased populations in 1992.

In **pests of young stands** surveys, 36% of trees were affected by a variety of damaging agents, including insects, diseases and climatic factors in a total of 44 young stands, including seven tree species and ranging in age from 2 to 54 years.

Lodgepole pine and white spruce **blowdown** over more than 4000 ha in Tweedsmuir National Park was burned in September to re-establish wildlife corridors and decrease the risk of spruce beetle attack and wildfire. Various forms of **winter damage** caused by cold temperatures and high winds affected many tree species in widespread locations throughout the region. **Hail** damaged many species of deciduous trees and shrubs just north of Smithers.

High populations of **porcupines**, particularly in western and northern areas, continued to cause mortality primarily in young-growth western hemlock and lodgepole pine. Chronic incidences of seedling clipping by **voles** were seen in the lower Skeena Valley, and population increases in the interior caused light-to-severe seedling mortality in seven surveyed plantations, and mostly light damage in some others. Light incidences of cone stripping by **squirrels** were common, primarily in the extreme north.

The **northern tent caterpillar** lightly to severely defoliated mostly black cottonwood and willow over 4 261 ha adjacent to the Skeena River from Terrace to Kasiks River and in the Wedeene River Valley. **Birch leafminers** discolored white birch foliage over approximately 1000 ha along Highway 37, south of Bob Quinn Lake. **Alder defoliators** caused light to moderate damage at several sites. No moths were caught in **gypsy moth** pheromone traps placed in 49 locations, primarily in provincial parks, private campgrounds and port facilities throughout the region. **Willow leaf beetles** defoliated willow spp. at widespread locations in the southern half of the region.

Annual assessments of vegetation within a plot established near Terrace as part of the **Acid Rain National Early Warning System** showed no symptoms of acid rain damage. To aid a wood pasteurization project initiated to support ongoing **pinewood nematode** research, woodborer-infested material was assessed at a number of locations in the Kalum TSA. A biennial vegetation inspection sponsored by Alcan Aluminum in the Kitimat area found spot occurrences of mainly trace-light suspected **fluoride damage** on a variety of ornamental and native species.

Important **chronic diseases**, which vary little annually but cause significant growth loss and mortality, are tabulated at the end of the report, as are **other noteworthy insects** and **diseases** which include low populations of significant pests and pests which cause only minor damage.

PINE PESTS

Mountain pine beetle
Dendroctonus ponderosae

Mortality of lodgepole pine due to attacks by the mountain pine beetle declined by 38% to 81 160 m^3 over 5 835 ha in 1991, from 131 350 m^3 over 3 530 ha in 1990 (Table 1, Map 2). The highest numbers of red trees were mapped in portions of the Nass and Skeena river drainages within the ICH biogeoclimatic zone of the Kalum and Kispiox TSAs, though here too, mortality was much reduced from last year. High numbers of surviving brood following the relatively mild winter of 1989-90, resulted in greatly increased numbers of red trees in the Morice and northern Bulkley TSAs.

Table 1. Area, volume and number of lodgepole pine recently killed by mountain pine beetle. FIDS, Prince Rupert Forest Region, 1991.

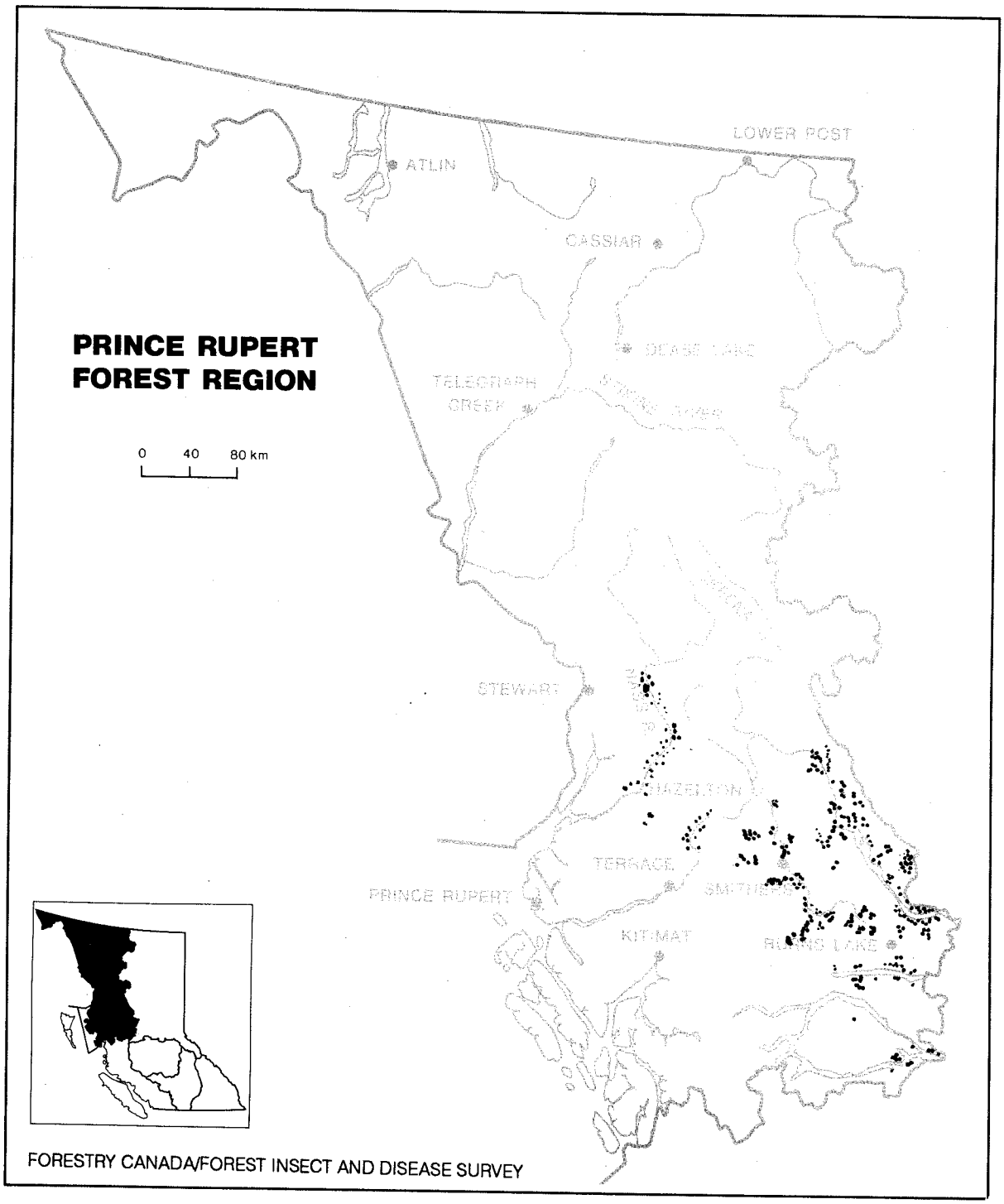
Location (TSA)	Area (ha)[1]				Volume (m^3)	No. of trees
	light	moderate	severe	total		
Kalum	1 110	110	25	1 245	22 900	57 140
Kispiox	420	35	20	475	9 200	23 000
Bulkley	2 090	100	130	2 320	32 860	42 400
Morice	1 500	0	70	1 570	14 700	11 850
Lakes	190	0	40	230	1 500	1 900
Regional Total	5 310	245	285	5 840	81 160	136 290

[1] Areas were computed from FIDS aerial survey sketch maps in the Kalum and Kispiox TSAs. The Bulkley, Morice, and Lakes TSAs were mapped by the B.C. Forest Service with the areas and impacts calculated by FIDS.

Kalum TSA

Mountain pine beetle infested 1 245 ha in the Kalum TSA in 1991, unchanged from 1990. The total volume of timber affected and numbers of trees infested were 57 140 m^3 and 22 900 respectively. The volume affected in the TSA declined by 55% and the number of trees by 42%.

Attacks continued in the Nass Valley, with increasing activity noted only on the north side of the lower Nass River in the Shumal Creek area. Infestations continued at similar levels to last year in the Aiyansh area and north along the Nass River Valley to north of the Sideslip Lake area. Small pockets of infestation continued north along highway 37 to approximately the Nass River crossing. In the pine flats along the Nass River east of Meziadin Lake, the area infested decreased slightly with activity somewhat more scattered over a broader range. Attack along the Skeena River decreased to almost nil in the district, although scattered attack continued just north of the TSA boundary.



Map 2. Areas containing lodgepole pine recently killed by the mountain pine beetle as determined from aerial surveys, 1991.

The lack of available host, due to previous years of attack, and management through harvesting limited the opportunity for expansion in most areas where current attack continues.

Kispiox TSA

Mountain pine beetle infested 475 ha in 1991, down from 1 100 ha in 1990; the fourth consecutive year of decline in the Kispiox TSA. The volume affected was 9 200 m^3, an 80% decline from 1990, while the number of trees affected was 23 000, a decline of 74%.

In the Cranberry River area, many infestations were reduced to spot areas of from 5 to 20 trees, due primarily to host depletion and harvesting. The area under attack near the TSA boundary south of Footprint Lake decreased overall an estimated 50%. Timely harvesting has reduced host availability and beetle populations in this area. A major decline also occurred along the Skeena River between Kitwanga and Cedarvale. In this area spot infestations of up to 10 trees were recorded where up to 60 ha areas were under attack in 1990. This is primarily due to host depletion. In the Coyote Creek area south to the TSA boundary at Big Oliver Creek, populations persisted at static levels.

Bulkley TSA

Red tree counts as determined from B.C. Forest Service (BCFS) and FIDS aerial surveys in July declined by 12% to 42 400 trees, but infested area more than doubled to 2 320 ha. The increase in recorded area was due primarily to variations in mapping technique. Most of the decrease occurred in the Telkwa River Valley where numbers of recently killed trees declined to 33 000 trees from 38 300. Despite the decline, the Telkwa infestation, as in the previous six years, accounted for the majority of beetle kill within the TSA (78% of the trees, 70% of the volume). Continued intensive salvage logging and host depletion has effectively limited the beetle to leave strips and environmemtally sensitive areas. Across the river opposite Pine Creek, numerous small patches containing from 10 to 200 red trees occurred along the edge of the ridge, and further south near Tenas Creek, larger patches totalled over 6000 trees.

Infestations along the Bulkley River and side creeks were far less numerous than last year, with significant patches occurring only in Deep Creek (150 trees), Reiseter Creek (85 trees), and Gramophone Creek (110 trees), and along both sides of the river from the Smithers Airport to Trout Creek (250 trees). Thirty-six small infestations totalling 320 trees were scattered in the upper Copper River-McDonell Lake area. An ongoing small infestation on a south-facing hillside above Trout Creek declined to 100 trees from 300 last year, and around Kitseguecla Lake over 400 trees were killed in groups numbering between 1 and 50 trees.

Mortality in the upper Fulton River area increased, with patches containing up to 100 trees near Bristol Lake (210 trees) and Holland Hill (200 trees), and mortality in the Smithers Landing area totalled about 230 trees. Between Smithers Landing and Fort Babine, scattered mortality, some of which could be attributed to porcupines, totalled over 100 trees.

Beyond the north end of Babine Lake a total of 4800 red trees were recorded, an increase of 2000 trees over last year. Most of these attacks

occurred along the major water courses including: Nichyeskwa Creek, 555 trees; Nilkitkwa Lake, 1435 trees; Nilkitkwa River, 1035 trees; and Babine River, 825 trees.

Morice TSA

High current attack levels in 1990, resulted in an almost ninefold increase in the number of red trees to 11 850 in 1991. In the Morice River drainage, infestations in the Owen Hill area increased to over 600 trees, from an estimated 35 trees last year, and in the Houston Tommy Creek area to over 600, up from 85 last year. New this year were infestations near McBride Lake (150 trees), Lamprey Creek (100 trees), Owen Lake (120 trees) and Buck Flats (100 trees). Renewed beetle activity caused mortality on the north side of the Morice River opposite km 35 on the Morice Forest Service Road, (750 trees), along the northeast side of Parrot Lakes (240 trees) and in the Walcott area, (330 trees). In these areas, tree mortality recorded in 1989 was reduced in 1990 by fall-and-burn operations, but in those trees that escaped detection, beetle populations were able to build to well above the 1989 levels. Significant increases were also seen in the China Nose Mountain area (340 trees) and near Sunset Lake (490 trees).

Further north, increased mortality between Chapman and Tanglechain lakes totalling 460 trees probably resulted from beetle migration from nearby pockets of infestation in the adjacent Bulkley TSA. Additional scattered pockets of red trees were seen in the Fulton River (80 trees), Granisle (20 trees) and Topley Landing (50 trees) areas.

The east side of Babine Lake with its larger diameter pine and a climate moderated by large bodies of water, has historically been the area of greatest mountain pine beetle hazard. This year was no exception as nearly 60% of the mortality within the TSA occurred on the east side of the Lake, and, despite MSMA[1] treatments and active "snip and skid" logging operations to remove broods, the relatively mild winter of 1989-90 had allowed for the survival of a high proportion of remaining broods with the result that red tree counts were dramatically higher than last year. Almost all areas infested last year contained 3-5 times as many red trees in 1991. At the south end of Tochcha Lake, over 600 red trees were recorded in an area where salvage logging was thought to have eradicated the population. Some of the more notable areas of mortality were: (from south to north) Nose Bay, 460 trees; Hagan Arm, 300 trees; Natowite Lake, 560 trees; Old Fort Mountain, 560 trees; West Main, 770 trees; and the west side of Morrison Lake, 2150 trees.

Lakes TSA

The total number of red trees, as determined from aerial surveys, increased to 1900 in 166 separate pockets from 1500 trees in 97 locations in 1990. As in previous years, infestations were small and scattered throughout the TSA, averaging less than one hectare in size.

On the north side of Babine Lake, 540 trees were killed in 41 small infestations, ranging in size from 3-100 trees. On the south side of the lake 190 red trees were mapped in 30 patches, and 14 additional pockets in the vicinity of Augier, Pinkut and Taltapin lakes totalled 150 trees. Near the

[1] Monosodium methane arsenate

western edge of the TSA, just north of the Bulkley River, 120 trees were mapped in 10 infestations, and patches totalling nearly 300 trees were scattered between there and Francois Lake. Some of the greatest increases occurred north and south of Francois Lake where 180 and 200 red trees were mapped respectively.

Only a few red trees remained at the east end of Ootsa Lake where last year a single infestation of more than 400 red trees and over 2000 current attacks was removed by logging. However, a single new patch of 100 red trees was seen on the north side of Euchu Reach as well as 10 additional smaller patches, mostly along the shores of Tetachuk Lake.

Population assessments - Spring

The regional average reproduction ratio or "R" value decreased to 3.8:1 from 4.7:1 in 1990 (Table 2).

Table 2. Overwintering survival of the mountain pine beetle. FIDS, Prince Rupert Forest Region, 1991.

Location	"R" value[1]	Population status[2]	Remarks
km 18 West Main	7.8	increasing	progeny development mixed: 25% of trees with some live adults and early instar larvae.
New Aiyansh	4.6	increasing	variable woodpeckering and high overwintering mortality.
Sideslip L.	4.2	increasing	only one entrance hole per sample, woodpeckering, large brood, but relatively poor survival.
km 22 Morrison Main (east Babine)	3.8	static	highly variable: 25% samples contained no brood; remainder ranged from 2-46 larvae.
Coyote Cr.	2.9	static	woodpeckering, poor overwintering survival.
Cranberry R.	1.9	decreasing	woodpeckering, poor overwintering brood survival.
Telkwa River	0.5	decreasing	larval galleries either very short or non-existent.
Regional average	3.8	static	

[1] "R" value = an average ratio of the numbers of brood in 225 cm^2 bark samples vs. the number of beetle entrance holes.

[2] Interpretation of "R" values:
- $\leq$2.5 - decreasing population
- 2.6-4.0 - static population
- $\geq$4.1 - increasing population

In the Kalum and Kispiox TSAs, primarily the Nass and Skeena river valleys, brood survival was variable from increasing populations at New Aiyansh to decreasing populations at a Cranberry River site. In most areas, numbers of grays predominated and infestations were in small pockets. In many samples, numbers of entrance holes were few, averaging only 1.2 per sample overall. This indicated a relatively low attack level in 1990. Woodpeckering was common and overwintering brood survival was often poor, even at sites with increasing populations. Increasing population levels often related more to low levels of previous attack then to the health of the brood. Over 20 years of infestation and extensive logging have tended to disperse these aging beetle populations. Movement into increasingly mixed stands of increasingly smaller diameter have also affected populations. Woodpeckers have been common and active at all sites but in numbers, insufficient to seriously impact brood survival at infestation levels. Parasites and other predators have also been largely ineffective in controlling beetle activity.

In late December and early January (1990-91), interior areas experienced back-to-back periods of cold weather, during which temperatures averaged -30^{o} C., or lower for a total of over two weeks. The weather was apparently cold enough to kill over 90% of the overwintering early instar larvae in most areas in the Bulkley, Morice and Lakes TSAs. In the same areas however "R" values ranged from 0.5 in the Telkwa River Valley to 7.8 on the West Main near Morrison Lake. Since survival sampling is done at breast height on each tree, the values only reflect the situation at that level. At the West Main plot, the sampling level was below the winter snowline. Much of the surviving brood below the snowline, though healthy and plentiful was, for undetermined reasons, retarded in development, being only in first or second instar in June. Survival above the snow level was virtually non-existent.

Fall Surveys

During a fall cruise in the pine flats east of Meziadin Lake, only two partial current attacks were found, over 30% of the trees were gray and less than 50% of pine was healthy, indicating a substantial reduction in the number of red trees expected for next year.

The lack of available host material, continued logging, and relatively low numbers of surviving brood in aging beetle populations are general limiting factors affecting beetle spread in 1992. Overwintering conditions may further negatively influence populations.

In the eastern TSAs, probes done in the fall to assess current attack levels have uniformly indicated declines in beetle populations. In the Bulkley TSA a current-to-red ratio of less than .5:1 indicated significant declines in the area with even lower levels of attack being recorded in infestations in the Bulkley Valley. In the Morice TSA, probes done by industry and Forest Service in the Fenton/Owen, Dungate/China Nose and Tanglechain Lakes areas, found ratios of current-to red-attacks averaging less than .5:1. October population assessments on the east side of Babine Lake in infested stands on the West Main and near Morrison Lake found that broods in the lower boles of the trees had not completed their development during the summer but remained in the trees as pupae and young adults. They will overwinter and emerge to attack new trees after the snow melts in late May or early June of 1992. Considering the low levels of current attack in the area, (as low as one current for ten reds) this "hold-over" population may represent the bulk of the surviving population. A

pre-cruise analysis in a stand in the Telkwa River Valley which experienced high overwintering mortality (spring "R"= .5), found no current attacks.

Forecasts

Along the Nass River, in the pine flats at Shumal Cr. and adjacent drainages, a continued resurgence of beetle activity could occur depending primarily on the age and size class of pine stands. Through the rest of the Kalum and Kispiox TSAs, chronic infestations in the Skeena and Nass river Valleys should continue to decline.

Consistent low levels of current attacks coupled with continued fall-and-burn treatments and ongoing salvage logging efforts will result in a significant reduction in the number of red trees in the Bulkley, Morice and Lakes TSAs in 1992. The mild conditions experienced so far during the winter of 1991-92 however, will probably enhance the survival of remaining broods, and populations in the interior TSAs could rebound quickly with increased current attacks during the summer.

Beetle populations will be closely monitored in 1992.

Warren's root collar weevil
Hylobius warreni

Chronic infestations by this insect in lodgepole pine and to a lesser extent hybrid and white spruce stands throughout the southern half of the region continued, mainly in the ICH biogeoclimatic zone.

Six of 35 young stands with a major pine and/or spruce component surveyed throughout the region in 1991 were found to be infested by weevils (Table 3).

Table 3. Location and incidence of infestation by the Warren's root collar weevil. FIDS, Prince Rupert Forest Region, 1991.

TSA/Location	Biogeoclimatic Zone	Tree sp.	% Trees infested
Kakum			
Thunderbird Main	CWHws1	lP	<1
Kispiox			
Suskwa River	ICHmc3	lP	26
Sammon Lake	ICHmc3	lP	13
Andimaul Creek	ICHmc3	lP	35
Bailey Main	ICHmc3	lP	100
		xS	14
Lakes			
-E- end Burns Lake	SBSmc	lP	2

Most trees (90%+) showed no signs of growth loss or stress as a result of the weevil feeding. In the 8 to 10-year-old plantation along Thunderbird Main south of Terrace however, occasional randomly distributed chlorotic pine were noted throughout the stand. When examined all were found to be partially girdled by the weevil.

Apart from direct feeding damage, there is strong evidence which suggests that H. warreni feeding provides an entrance court for diseases, most notably the root diseases Armillaria ostoyae and Inonotus tomentosus. During young stand surveys in 1991, two young hybrid spruce in two separate stands in the ICH biogeoclimatic zone were killed by A. ostoyae. Both trees had been previously attacked by H. warreni. During an I. tomentosus study conducted in the Prince George Region (H. Merler, 1983) all middle-aged spruce infected with the disease were found to have scars at the root collar from H. warreni attacks.

Lodgepole terminal weevil
Pissodes terminalis

Attacks by the lodgepole terminal weevil declined in all stands where minor infestations were reported in 1990. At 20 km of the Equity Mine Road in the Morice TSA, 9% of the young naturally regenerated pine were recently attacked over approximately 300 ha. The ratio of living progeny to exit holes in each infested leader was .7:1, indicating a declining population. In a chronically-infested stand at 65 km of the Morice Lake Road only two recently killed leaders were found, neither of which contained any living progeny. Other stands infested in 1990 were all but free of attacks in 1991.

Adult weevils attack the base of elongating terminal shoots where they lay their eggs. Developing larvae then feed within the cambium of the new shoot killing it back to the upper whorl of branches.

Primarily old weevil damage was seen in an average of 7% of the pine in 5 of 19 young stand surveys in which pine of a susceptible age occurred. Older damage was most often denoted by a minor crook in the stem where a single lateral quickly assumed dominance. In some cases (<20%), two laterals competed for some years before one assumed the dominant position, and in these cases resultant severe crooks can result in some degrade at rotation. In rare cases following weevil attacks (<5%), competing laterals develop into forks which persist until maturity.

Pine needle diseases
Lophodermella concolor, Scirrhia pini

Discoloration of lodgepole pine foliage caused by the pine needle cast fungus, Lophodermella concolor, affected an average of 40% (range 10 - 80%) of the 1990 needles in northern areas along Hwy 37 for 5 km, north of Boya Lake, and again farther north between Wheeler Lake and French Creek. An average of 40% of 1990 needles were killed in young and middle-aged roadside stands along the Alcan Highway from the Yukon border, south to Irons Creek. The same disease in association with Hendersonia pinicola (which is thought to parasitize L. concolor) infected 50% of the 1990 needles on lodgepine throughout the area of Ross Lake Provincial Park, near Hazelton. Red band needle disease, caused by Scirrhia pini, infected an average of 10% of the lower crown needles over 10 ha in a young stand near Luno Creek, also near Hazelton.

Pine stem diseases
Cronartium coleosporioides, C. comandrae, C. ribicola, Atropellis piniphila

Stalactiform blister rust, C. coleosporioides is the most commonly occurring form of stem rust in the southern portion of the region and continues to be one of the most common causes of mortality in plantation lodgepole pine. During young stand surveys throughout the region this year, however, the disease was found at low incidence only in 5 of 19 susceptible stands, and only two of the infected trees had been killed (see "Pests of Young Stands").

Comandra blister rust, C. comandrae is also commonly found infecting the stems and branches of young lodgepole pine. This year it was found cankering 10% of the stems of leave trees in a recently spaced stand just north of Dease Lake. Most of the cankers had been fed upon by rodents, probably porcupines, and the trees were partially, and in some cases entirely girdled. In most instances however, aecia characteristic of the fungus were still visible around the edges of the feeding. If the fungal infection has not progressed too far toward girdling the host, canker feeding by the rodents may be of benefit to the tree by helping to eradicate the infection. Tree death can be hastened however in cases where the rust canker has largely encircled the stem and the rodent feeding entirely girdles the tree. Examples of both situations occur regularly in infected stands but it is not known whether the rodents have an overall beneficial or detrimental effect on stocking.

White pine blister rust, Cronartium ribicola, infects only five needle pines and has been found in all (5) stands of whitebark pine, Pinus albicaulis examined in alpine areas in the Bulkley and Morice TSAs. Cankers have been found on more than 50% of the trees examined. The disease has become economically very significant within the province in the 80 years since its introduction from Europe. It is now the single factor limiting the cultivation of western white pine as a valuable commercial timber species in southern coastal and interior wet belt areas. Strains of C. ribicola on whitebark pine have been collected in the past few years to aid genetic research ongoing at PFC, aimed ultimately at developing western white pine resistant to infection by the rust.

Atropellis canker, caused by A. piniphila, a fungus that infects the stems of young lodgepole pine, affected an average of 7% of the trees in 5 stands between the ages of 39 and 55 (see "Pests of Young Stands"). Infections rarely kill the trees but often cause large fasciations that substantially weaken and deform the stems, rendering them susceptible to breakage by wind.

Northern lodgepole needleminer
Coleotechnites starki

This needleminer lightly infested young-growth lodgepole pine and young roadside regeneration over an area in excess of 500 ha, 25 km north of Topley in the Morice TSA. An average of 10% of the needles were infested on all trees with the majority of damage concentrated in the upper crowns. A small mass collection was reared at PFC to determine levels of parasitism and disease. Six percent were parasitized by Hymenoptera, 39% emerged as adults but most (55%) died of unknown causes.

No important infestations by this insect have been reported since the 1950's when a large outbreak in the Rocky Mountains of Alberta resulted in significant increment reduction, but no tree mortality. Since this insect has a two-year life cycle and will be in an early instar larval stage throughout 1992, no visible damage is expected until 1993. At current population levels, long term damage will be negligible.

SPRUCE PESTS

Spruce beetle
Dendroctonus rufipennis

For the fifth consecutive year no significant spruce beetle activity was recorded within the region. The only mortality occurred in the Morice TSA in two minor infestations totalling 160 ha in area.

The larger of the two infestations, at Haul Lake near the northeast end of Babine Lake, has caused light mortality over 150 ha. The area had been probed earlier in the season by industry and pheromone baits hung in infested pockets. Probes near the perimeter of two of the proposed cutblocks in June verified that the baits had contained the bulk of the population within the block boundaries. The majority of the population matured in the fall of 1990 and flew in May of this year. About 50% of the progeny from 1990 attacks had cycled in one year, emerging in the spring of 1991. Three cutblocks totalling about 175 ha have been approved for logging this winter. This will remove more than 90% of the beetle population and greatly reduce the hazard.

A helicopter-accessed June probe of the small infestation on an island in the Morice River near the confluence with the Thautil River, found a few red-and current-attacks. Broods in the red-attacked trees appeared healthy but were comprised of almost equal numbers of larvae, pupae and callow adults. A later, more detailed probe by a Forest Service crew found that 48% of the spruce over an area estimated at 10 ha had been attacked. A breakdown of the attacks by attack year was as follows:

pre-1989 attacks	- 13%
1989 attacks	- 15%
1990 attacks	- 12%
1991 attacks	- 8%

The consistency of attacks every year suggests that significant segments of the population have in the past cycled in one, instead of the normal two years. The infestation lies within a "special protection corridor" extending for one kilometer on both sides of the river, set aside to preserve wildlife, recreational and aesthetic values along the river. In the event that spruce beetle populations show signs of significant increase, restrictions placed on activities within the corridor will limit control options to such labour intensive means as manual debarking, a method used to control an infestation beside the Haines Road in 1983. To this point however, relatively low beetle populations have not warranted control action.

Spruce beetle populations, particularly along the Morice River will be closely monitored in 1992.

White pine weevil
Pissodes strobi

The white pine weevil (spruce weevil) remains a chronic pest in young spruce stands in a number of areas in the region. Of particular concern are Sitka spruce and hybrid Sitka x white spruce planted extensively in the Kitimat Valley and the lower Skeena and Nass river drainages. Current attack averaged 17% (range 0 to 58) in nine young stands from north of Kitimat to the Meziadin Lake area (Table 4). At a Wedeene River site, 58% of spruce were currently infested while at a Nalbeelah Creek site only 4% of trees, mostly younger natural regeneration, remained healthy after years of continued attack.

Table 4. White pine weevil in the Kalum TSA. FIDS, Prince Rupert Forest Region, 1991.

	Percent			
Location	Current attack	Previous attack	Healthy	Spruce in stand
Wedeene R #1	58	25	17	55
Nalbeelah Cr.	37	59	04	--[1]
Mannix Cr.	35	47	18	--
Hall Cr.	11	44	44	20
Hanna Cr.	05	03	92	--
Kitanweliks Cr.	05	02	93	--
Hall/Wesach crs.	00	50	50	03
Wedeene R. #2	00[2]	02	98	19
Thunderbird Main	00	08	92	27

[1] only spruce weevil assessed, no stand information available.
[2] stand was assessed early, current attack may have shown later in the season.

The continued re-attack by the weevil in a number of areas has resulted in stands dominated by spruce with very poor form; including bushiness, multiple crooks and tops and limited height increment. This has prompted the selection of alternate hosts as crop trees in a number of spacing projects over the last few years. In young, spaced stands at Hall and Wesach creeks, spruce was left as crop trees only where no other suitable host was available; these few remaining spruce were near 50% attacked.

The decision to plant spruce in the northern part of the TSA was in some part predicated on the assumption that climatic conditions were to severe to support significant spruce weevil populations. At Hanna and Kitanweliks creeks, in the Meziadin Lake area, current attack was estimated at about 5%. The northerly progress of the weevil has been reported as far as the first Bell-Irving River crossing. Walkthrough surveys in this area and at Skowill Creek were negative. Weevil distribution in the Prince George Region occurs to approximately 56 degrees N. latitude, nearly identical to that in the Prince Rupert Region.

Concern has been expressed that the weevil's range may extend northward and become a serious pest in that part of the TSA as well as spill into the Cassiar TSA. Infestations in the Meziadin area occur in the ICHvc zone, which continues as far as the Iskut River north of Bob Quinn Lake.

Weevil activity in the ICH zone in the Kispiox TSA has recently intensified within the Kispiox River drainage, where infestations were seen in two young stands for the first time. In a 21-year-old hybrid spruce plantation at Sammon Lake, patches of up to 20% 1990 attack were found. There were, however no telltale symptoms of prior damage and, despite the obvious success of these attacks (with up to 50 chip cocoons and emergence holes on attacked leaders), no signs or symptoms of current attacks. This stand will be re-examined in 1992 to determine the health of weevil populations in the area. In a 15 year-old mixed spruce-lodgepole pine stand near Elizabeth Lake, approximately 2% of the spruce component was currently attacked. In the Suskwa River drainage a 21 year-old hybrid spruce stand has sustained a population of weevils for about 5 years. The stand was manually brushed in 1989 to eliminate competition, mainly from trembling aspen which had overtopped the conifers. A young stand survey in July found 10% of the trees to have been attacked, but all attacks had occurred prior to 1990. It is not known whether the brushing may have influenced the weevil population. All of these stands will be closely monitored for increases in attack levels that could signal that the spruce weevil was becoming an important pest within the ICH zone as well as the CWH, where historically, most of the damage has occurred.

Farther east in the SBS biogeoclimatic zone, attacks were rare, limited to occasional patches in young stands adjacent to rights-of-way and water courses. Most notable of these occurred adjacent to Goathorn Creek near the km 2 bridge, in the Bulkley TSA, and on the flats beside the Morice River near km 50 in the Morice TSA, where in young open-growing white spruce have suffered chronic attacks by spruce weevils for at least four years. Over 50% of the trees in both areas have been attacked, and many have been repeatedly attacked with the result that the trees are becoming stunted and deformed. In both areas however, attacks have been confined to areas of less than 10 ha, and no attacks have been seen in other susceptible stands.

Two-year-cycle spruce budworm
Choristoneura biennis

This insect lightly defoliated alpine fir and white spruce in a mature stand over approximately 1000 ha, 45 km north of Chapman Lake in the Bulkley TSA. Many understory trees in the same stand were moderately to severely defoliated. This was the first recorded budworm infestation in the Prince Rupert Region since 1983, when defoliation was mapped over 153 000 ha and spanned three TSAs, and the first infestation in this general area since the early 1960's.

The infestation was confined to a narrow elevational band between about 800 and 850 meters, accessed from km 5 of the Toughy Road. Damage was limited to branch tip defoliation and the stripping of up to 3 meters of the tops in the mature trees, but many understory trees were moderately to severely defoliated, and a few were completely stripped. Because the infestation was discovered in mid-July near the end of the adult flight period no information on larval populations is available. In the fall, standard branch samples were collected

from 10 trees within the infestation and numbers of egg masses counted. The potential for future infestations was estimated using a standardized sampling method involving the number of budworm egg masses found on $10m^2$ of foliage. A count of 148 eggs/m^2 of foliage indicated moderate defoliation in the next feeding year (1993).

The principle habitat of this species of budworm is mature forests of Engelmann and white spruce and alpine fir. The insects spend the first year of their two-year life cycle as early-instar larvae, first mining the buds then feeding on the current foliage. During the second year mid- and late-instar larvae feed on the foliage during the spring and early summer before pupating in late June. During outbreaks, extensive areas of forest have been completely defoliated by the maturation feeding of larvae in the second year. With the decline of continuous areas of mature and overmature timber, infestations have become less frequent.

The infestation will be re-evaluated in the spring of 1992 when infested bud counts will be made.

Eastern spruce budworm
Choristoneura fumiferana

An infestation of eastern spruce budworm in the extreme northeast corner of the region which began in 1986, continued in 1991. Primarily light defoliation of white spruce was continuous from the south edge of the Eg Fire to the Prince George regional boundary. Within this area some smaller patches of moderate defoliation were also seen. The damage was slightly greater than the mainly trace defoliation reported in 1990, but was still primarily confined to new growth, with patches of top stripping, especially in understory trees. No defoliation was noted and no larvae were collected in three-tree beatings along the northern end of Hwy. 37, where trace defoliation was reported last year.

The infestation forms the western flank of a much larger infestation that has defoliated large areas in the Liard and Fort Nelson river drainages in the Prince George Region, stretching into the Northwest Territories and the Yukon. This year, defoliation in the Prince George Region increased threefold to nearly 400 000 ha. Limited egg mass sampling in the Fort Nelson area has indicated that budworm populations will remain high in 1992.

Eastern spruce budworm defoliation within northern stands in the Prince Rupert Region has been largely confined to current growth in the upper crowns and historically has had little effect on the growth or vigour of the trees. Population monitoring will continue in 1992.

TRUE FIR PESTS

Western balsam bark beetle complex
Dryocoetes confusus
Ceratocystis dryocoetidis

During aerial surveys in the southern half of the region recent alpine fir mortality due to attacks by the balsam bark beetle was mapped in stands over

48 145 ha. Most of the mortality, as in previous years occurred in the Morice TSA; in the Walcott, Shelford Hills and Mosquito Hills areas. Chronic balsam bark beetle infestations have caused unsalvaged losses of thousands of cubic meters of timber and, in some areas, the loss of over 30% of the total stand volume. The Forest Service and forest companies have recently revised some of their harvesting plans to direct more effort into the harvesting and salvage of timber in some of the more severely affected areas.

In the Telkwa River Valley in the Bulkley TSA, balsam bark beetle infestations expanded to over 6000 ha from 1000 ha in 1990. The infestation now runs in an almost unbroken band along the north side of the valley above 750 m elevation, from Pine Creek west to Telkwa Pass.

Western blackheaded budworm
Acleris gloverana

Alpine fir over an area in excess of 1000 ha were lightly-to-moderately defoliated by blackheaded budworm along the lower slopes of Mount Harvey on the west shore of Bare Loon Lake in the Chilkoot Pass area. The infestation is located within the proposed Chilkoot Trail National Park. Insect identification was made from larvae sent to PFC by park staff, and the area of defoliation estimated from photographs.

Blackheaded budworm caused intermittent trace defoliation in white spruce over an estimated 10 ha at the Kinaskan Lake Provincial Park. Fall egg sampling averaged 3.6 eggs per standard branch sample. A range of 1-26 eggs per sample indicates light defoliation; feeding activity is expected to continue in 1992 at trace to very light defoliation levels.

Trace budworm defoliation of the current growth of white spruce and alpine fir was seen at km 19 of the Nilkitkwa Main, a remnant population of that which caused light defoliation over large areas in the Bulkley and Morice TSAs for four years until 1990. Larval sampling was negative for the presence of budworm in all other areas in the region.

Populations of budworm in the Kinaskan Lake area will be closely monitored in 1992. Despite its remote location, the proposed park status of the Chilkoot Pass area may prompt ground-based surveys to assess the budworm population in June, and if high populations persist, aerial surveys will be undertaken in the late summer.

Fir-fireweed rust
Pucciniastrum epilobii

Infection of current foliage on true firs by the fir-fireweed rust continued and was widespread from north of the Van Dyke area to north of the Bell-Irving River in the ICH biogeoclimatic zone. At Taft Creek, current growth was severely infected on all two-meter alpine fir natural regeneration in an estimated 200 ha spruce plantation area. At Skowill Creek 100% of young true firs were moderately infected over approximately 40 ha. At the first Bell-Irving River crossing 61% of planted seedlings and natural regeneration saplings were moderately infected in part of an 87 ha plantation. Roadside regeneration was also moderately infected in patches in the Meziadin River area

and at Meziadin Lake Park. Farther east in the interior SBS zone, up to 100% of the current needles on 80% of the regeneration alpine fir were infected over a broad area north of Chapman Lake. Similar damage along with light infections in the lower crowns of overstory trees was seen in and adjacent to a plantation near km 45 of the Nilkitkwa Road. Lighter infections were widespread throughout the host range in the interior.

Very recently, the rust has become of particular concern to local forest companies. Both amabilis and alpine fir are candidate species for plantations; industry foresters have reported serious damage to stock in several plantations. Surveys in October of two small plantation areas near Oweegee Creek were negative for the disease. As the rust attacks only current year's foliage it has generally been considered a minor pest causing little damage, growth loss potential or mortality in natural stands. Severe infection in new plantations could mean the loss of most of the foliage and growth potential. Information is currently not available on what effect repeated severe infection might have on growth potential of seedlings, or their ability to survive and compete.

Conifer budworms
Choristoneura orae, C. biennis, C. fumiferana

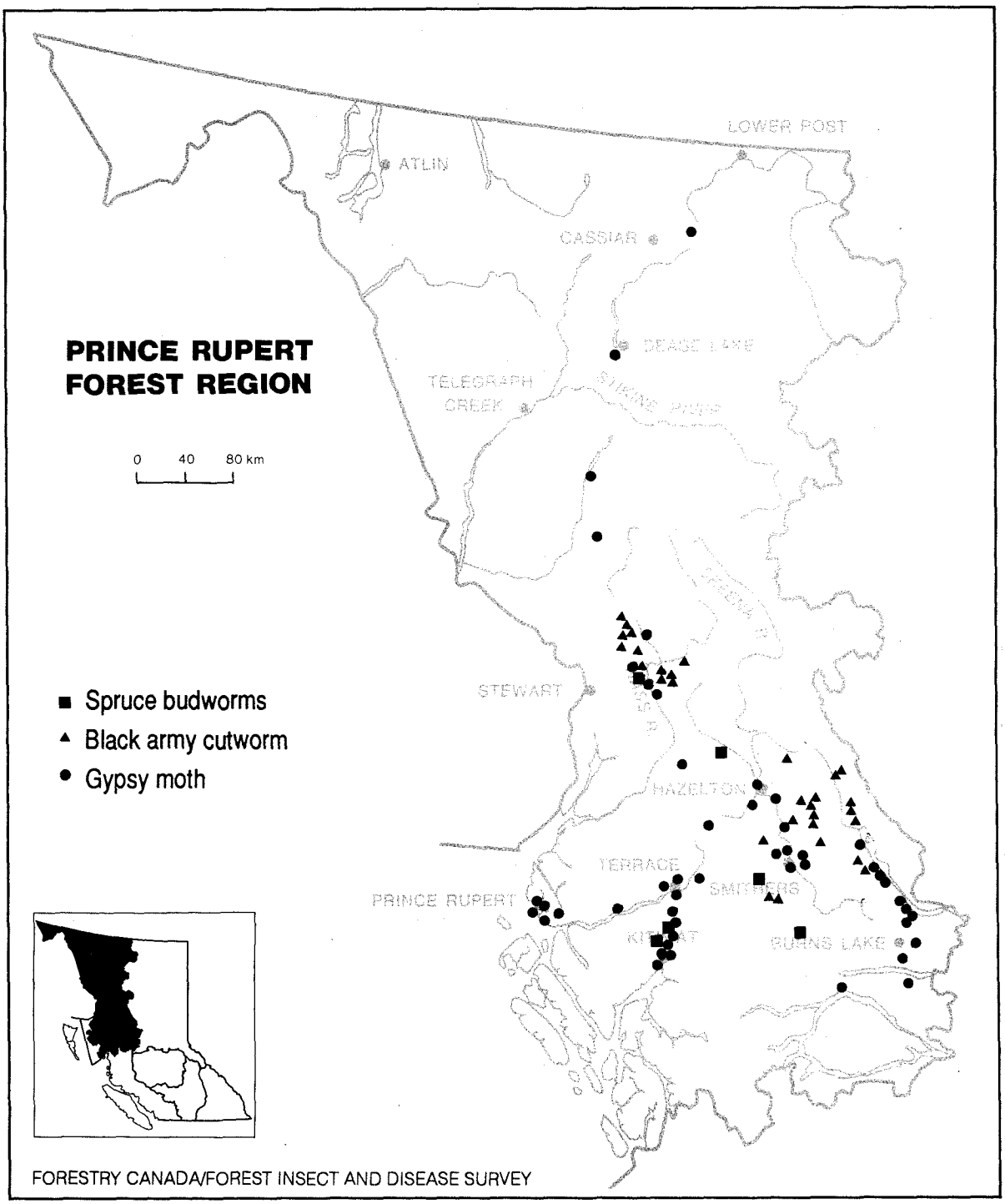
No defoliation was recorded at any of the six fir-spruce budworm, (C. orae) calibration plots in the region in 1991 (Map 3).

As part of a province-wide research program to improve methods of early detection of budworm outbreaks, sets of five pheromone-baited plastic container traps (multipher) containing baits specific to the fir-spruce budworm were deployed near the Wedeene, Kispiox, Telkwa, Morice rivers and near Meziadin and Onion lakes. At the Kispiox River site, an additional five traps contained a bait attractive to the other three indigenous budworm species (C. fumiferana, C. occidentalis, C. biennis). Twenty-five marked trees at each site were assessed for defoliation and larval numbers (using a standardized three-branch-beating method). These could later be related to the number of male moths captured in the traps. No defoliation was noted at any site. A total of five larvae and an average of 24 adults per trap were caught at Meziadin Lake in 1991 (where none were found in 1990); sampling was negative at Wedeene River and Onion Lake this year, where 1990 adult catches averaged 51 and 12 respectively. No larvae were found in beatings and no adults were trapped at the Kispiox and Telkwa river sites, similar to last year and no larvae or adults were found at the Morice River site following catches averaging 90 moths per trap in 1990. The absence of adults in this area in 1991 suggests the budworm population to be the two-year-cycle spruce budworm, C. biennis.

The low conifer budworm populations at all of the sites indicate that no defoliation will occur 1992. The calibration studies will be continued in the coming year.

Delphinella tip blight
Delphinella abietis

Newly-flushed buds of alpine fir were killed by this chronically occurring tip blight at light intensity in a number of locations within the region. For 20 km south of Van Dyke along Highway 37, 10% of the trees lost up



Map 3. Locations where one or more pheromone-baited traps were deployed, 1991.

to 100% of the new flush. Similar damage occurred along the Blunt Main near Moricetown, an area of chronic infection. At Pendleton Bay on Babine Lake 30% of the trees lost 50% of the tips.

Delphinella tip blight kills only the newly-flushed current foliage and causes negligible long-term damage. Repeated severe tip kill will limit or eliminate the addition of new foliage likely resulting in a reduction in growth increment.

WESTERN HEMLOCK PESTS

True heartrots
Echinodontium tinctorium, Phellinus pini

The chronic true heartrots caused by, E. tinctorium (Indian paint fungus) and P. pini (red ring rot) infected 32% and 19% of hemlock respectively, in two surveys in the Kalum TSA. These heartrots are considered to be responsible for the bulk of the several million cubic meters of annual timber volume loss due to decay caused by root, butt, and trunk rotting fungi in B.C.

Indian paint fungus was recorded in a survey at Pine Flats in the upper Nass River area. Of the 32% of western hemlock infected in this lodgepole pine-western hemlock stand, 21% of trees had more than one visible conk per stem. Two or more conks often indicate an unmerchantable tree. At Onion Lake, red ring rot affected 19% of western hemlock, mostly in pockets, along a 500 m survey strip. Fruiting bodies of this fungus indicate 2.5 m of decay of heartwood above and below the conk where stands are less than 100 years old. Where stands are over 400 years old, decay can be expected to extend from 12 m above the top conk to 12 m below the lowest conk.

The incidence and amount of decay of these diseases is primarily related to stand age. Little damage is recorded in younger trees but rapid increases are noted after approximately age 90. The host condition preference differs somewhat: as the site index increases, amount of E. tinctoruim decay decreases while amount of P. pini increases with increasing site index. Access to heartwood is also different; P. pini spores appear to germinate on wounds and branch stubs, E. tinctorium gains access through very small branchlet stubs on the upper surface of living shade suppressed branches. A latent stage of over 50 years may follow in E. tinctorium before conditions such as increased light in the stand reactivates the fungus whereupon it moves from the branch to the trunk.

Both types of decay are found in many areas in the region. Overall provincial loss estimates of 30% gross volume of mature and over-mature western hemlock to E. tinctorium, and 10% gross volume of hemlock, pines, spruces and Douglas-fir, to P. pini in affected interior stands[2], indicate that these chronic pests are sufficiently important to warrant management. Indian paint fungus caused decay is reduced where branchlet stubs callous over in less than two years. Silvicultural activities to promote rapid diameter growth would

[2] Forest Pest Leaflet # 55, "True Heartrots of British Columbia" by D.E. Etheridge and R.S. Hunt.

facilitate early callousing of stubs. To break the chain of infection, older regeneration and leave trees from previous stands should be removed as these will often be infected. With both types of decay, pathological rotation is estimated to be within 150 years. Harvesting well prior to this age would be the most effective means of realizing maximum volume recovery.

EASTERN LARCH PEST

Larch sawfly
Pristiphora erichsonii

Defoliation of tamarack by larch sawfly declined significantly throughout its range in the northern part of the region. No damage was reported on ornamental larch in the Terrace area.

Roadside stands along northern stretches of Highway 37 were examined for egg niches in mid-June. Less than 1% of examined new shoots were crooked with a high of 2% near the French Creek crossing. The stands were re-examined in early July following egg hatch and it was estimated that the existing population would be capable of light-moderate defoliation of understory trees but the overstory would sustain only light damage. A late-season visit was not possible this year.

MULTIPLE HOST PESTS

Rhizina root disease
Rhizina undulata

Seedling mortality associated with rhizina root disease declined dramatically in the region. In the west (Kalum TSA), predicted infection at Oweegee Creek (CP 17.5) was estimated at 2% of seedlings affected, at Ridge Main (BK 108-11) 1% infected and at Oweegee Creek (CP 17.1) there was no evidence of infection. Of the 12 blocks burned in the fall of 1990, only these three were planted. Predictions were based on the proximity of fruiting bodies to seedlings (late summer plantings precluded direct signs of infection by late September). In interior plantations, infection levels have been lower than in the Kalum TSA. Of 20 sites slash burned in 1990 (17 of which were planted in the spring of 1991), only trace levels of fruiting bodies and <1% associated seedling mortality were seen at two sites: Trout Creek (CP 354.2), and km 26 Upper Fulton Road (CP 084.2). These low levels of seedling damage are in contrast to the average 13% mortality on 15 plantations in the region in 1990.

Examinations were completed in late July-early August and again in late September-early October to help support information on fruiting period. Of the infected blocks (Table 5), one was severely affected by root disease throughout, three were moderately affected and the remaining eight were lightly affected. Fruiting bodies were noted on five sites in July compared to all 12 later in the season, with severity index, on average, increasing one level over that period.

Table 5. Locations and severity of Rhizina root disease in 1990 slash burns surveyed twice during the 1991 field season. FIDS, Prince Rupert Forest Region, 1991.

Biogeoclimatic zone/ Location	Survey date		Slope	Aspect	Burn	Severity[1]	
	1	2	%		Sev.	JUL.	SEPT.
ICHmc2							
Orenda Main(Bk. 205-8)	Jul.30	Sept.26	5-50	S.W.	MOD	1	2
Orenda Main(Bk. 011-2)	Jul.30	Sept.26	0-80	S.W.	MOD	0/1	1/1
Orenda Main(Bk. 011-3)	Jul.30	Sept.26	5-70	S.W.	LT/MOD	0	1
Balsam Lane(Bk. 204-7)	Jul.30	Sept.26	0-80	Var.	MOD	1	3
Maple Rock(Bk. 012-3)	Jul.31	Sept.26	flat	--	LT	2	2
Windfall(Bk. 102-4)	Jul.31	Sept.25	0-30	E.S.E	LT/MOD	0/1	1/2
Trout Cr.(CP 354.2)[2]	Jul.27	Oct.6	<10	N.W.	MOD	0	1
ICHvc							
Ridge Main(Bk. 108-11)[2]	Jul.31	Sept.26	0-100	S.W.	LT/MOD	0	1
Surveyors Cr.(CP 2.2)	Jul.31	Sept.27	0-100	E	LT/MOD	0	1
Bowser Main(CP 13.1)	Jul.31	Sept.27	0-20	E+W	LT/MOD	0	2
Oweegee Cr.(CP 17.5)[2]	Aug.1	Sept.27	0-10	Var.	MOD	0	1
SBSmc							
km 26 Upper Fulton[2]	Jul.18	Oct.8	flat	--	MOD	0	1

[1] Severity:
0=No fruiting bodies
1=Rare to occasional fruiting bodies
2=Common fruiting bodies
3=Numerous fruiting bodies throughout

[2] planted: Trout Creek, km 26 Upper Fulton - planted May 1991, <1% mortality. Ridge Main, Oweegee Creek - planted August 1991, 2% and 1% seedlings respectively affected.

Other features were examined in this limited sample size to help determine preferred infection conditions. Slope did not appear to influence infection rates, with flat areas to 100% slopes equally affected. Where aspect was variable, east to north slopes had notably fewer fruiting bodies. Several east facing blocks were overall less affected than southwest facing blocks, however, these were in the ICHvc biogeoclimatic zone as opposed to the ICHmc2 or ICHmc2/ESSFi transition zones for the southwest facing sites. Zonal differences may have had a greater impact then aspect.

Previous losses to Rhizina undulata have prompted some changes in management strategy. A dramatic overall reduction in broadcast burning significantly reduced the activity of this root disease fungus. The decision to reduce burning was to a large degree influenced by past high levels of infection. Many blocks, especially in the wetter more westerly biogeoclimatic zones, were not planted the first season after burning. Some planting after the beginning of August was possible if other conditions permitted; attack severity was generally evident by this time. Results of surveys in three late summer plantations seem to confirm that the risk could be assessed relatively early and

losses reduced while still allowing stock to become well established in the first season.

Little is known of the reasons behind the steady decline in frequency of the disease in recently burned sites over the past two years, or of the possibility that high levels of infection could recur. The alteration of management practices has certainly reduced the incidence of seedling mortality, but the decline in the occurrence of fruiting bodies goes well beyond this. Infection levels in many areas were low or nonexistent in recent burns adjacent to earlier burns that were severely infected in the previous two years, particularly in the ICHmc2 and SBS biogeoclimatic zones. Though the past two years have been drier than normal, declines have also occurred in areas where drought was not a factor.

Surveys to monitor the incidence and severity of occurrences of this disease will continue in 1992, as well as further studies designed to elucidate some of the elements affecting its occurrence.

Black army cutworm
Actebia fennica

Current Activity

Black army cutworms caused trace levels of seedling defoliation in two plantations and patchy, trace-to-severe defoliation of herbaceous ground cover at an additional seven, all of which had been planted. In 1990, in contrast, cutworms defoliated seedlings in four plantations (three severely), and damaged herbaceous cover on a single additional site.

In the Kalum TSA, of nine areas checked where moths were trapped in 1990, feeding damage on seedlings was noted in only two areas (Table 6); at River Road (Km 3.2) and Orenda Main (Km 2). Trace to light patchy feeding on herbaceous growth (mostly fireweed) was also noted at these sites as well as four other sites. In three areas checked, no black army cutworm was noted. Of the six plantations in the Bulkley and Morice TSAs that yielded high moth counts in the fall of 1990, light defoliation of herbaceous ground cover was noted on three; two in McKendrick Pass in the Bulkley TSA, and one on the Granisle Hookup in the Morice TSA.

Table 6. Numbers of black army cutworm adults trapped in 1990 where subsequent cutworm feeding damage was recorded in 1991. FIDS, Prince Rupert Forest Region, 1991.

TSA/location	1990 trap counts	1991 damage
Kalum		
River Road (km 3.2)	150+	2% of seedlings slightly damaged, light, patchy herbaceous feeding
Orenda Main (km 2)	+/-550	<1% of seedlings partly damaged, trace herbaceous feeding
Vandyke Camp (7.5 km S.)	330	light, patchy herbaceous feeding
Bell-Irving R.	400	trace herbaceous feeding
Maple Rock (Tintina Cr.)	+/-400	trace herbaceous feeding
Meziadin Junction	220	trace herbaceous feeding

(Cont'd)

Table 6. (Cont'd)

TSA/location	1990 trap counts	1991 damage
Bulkley		
CP 302.4 McKendrick Pass	572	trace-light herbaceous feeding
CP 301.7 McKendrick Pass	528	patchy mod-severe herbaceous feeding
Morice		
CP 451.3 Granisle Hookup	479	trace-light herbaceous feeding

Forecasts

To aid in forecasting 1992 populations, single pheromone-baited plastic container ("Multipher") traps were placed at 30 locations throughout the region (Map 3). Locations where moth catches approached or exceeded threshold numbers are listed in Table 7.

Table 7. Locations where significant[1] black army cutworm moth catches were made in single "Multipher" traps. FIDS, Prince Rupert Forest Region, 1991.

TSA/Location	No. of moths	Infestation potential in 1992
Kalum		
Orenda Main (CP 011.2)	502, 326[2]	low-moderate
Oweegee Cr. (CP 17.1)	494	low-moderate
Kispiox		
Gail Creek Small Business	650	moderate
Bulkley		
CP 535.2 Nilkitkwa Road	648	moderate
CP 354.1 Trout Creek	600	moderate
CP 526.1 Goathorn Creek	525	low-moderate
CP 525.7 Goathorn Creek	455	low
CP 535.1 Nilkitkwa Road	401	low
CP 031.1 Upper Fulton	400	low
Km 4 Keulsh	370	low
Morice		
CP 316.7 Chapman Lake (east side)	1167	high
CP 522.1 Saddle (Leaky Boat) Lake	750	moderate-high
CP 451.2 Granisle Hookup	700	moderate
CP 503.3 Morrison Lake	435	low
CP 434.2 Skinhead Lakes	399	low

[1] From the trap results so far obtained province-wide, approximate hazard levels have been worked out. Moth catches of 350 to 600 indicate a low to moderate potential for infestations to develop, while areas with over 600 moths, the potential is moderate to high.

[2] two traps.

In the Kalum TSA only two areas show potential for infestations, these are in CP 011.2 on Orenda Main and in CP 17.1 near Oweegee Creek. Black army cutworm is not expected to be a problem elsewhere in the TSA in 1992, and with the reported continued reduction in broadcast burning, this trend is expected to continue. In the eastern TSAs 13 of 19 trap sites yielded trap catches higher than the low threshold of 350, and of these, 6 had more than 600 moths. These numbers are significantly higher than the 1990 trap catches when only six were higher than 400 moths, and the highest was 572.

Increased pheromone trap catches indicate an increased overall risk of seedling defoliation in the spring of 1992. All sites that yielded high moth counts in the fall of 1991 will be revisited in the spring of 1992.

PESTS OF YOUNG STANDS

A total of 44 young stands were surveyed for the incidence and impact of damaging agents which, in addition to insects and diseases, ranged from winter cold through a variety of large and small mammals. Most of the stands, both planted and natural, were selected for examination on the basis of having been treated in 1989 under the first Forest Resource Development Agreement (FRDA). The treatments as well as the biogeoclimatic location of the stands are summarized in Table 8.

Table 8. Listing of treatments and biogeoclimatic location of young stands treated in 1989 under FRDA 1 and surveyed for the incidence of pests. FIDS, Prince Rupert Forest Region, 1991.

Treatments	No. stands	Biogeoclimatic zone	No. stands
mechanically brushed/weeded	10	SBSmc	9
spaced	9	SBSdk	4
fertilized	4	ICHmc3	6
herbicide and plant	4	ICHmc2	3
spaced/fertilized	3	ICHvc1	1
fill planted	3	CWHws1	5
mech. site prep., plant	2	CWHvm	3
hazard abatement (burn piles)	1	CWHwh1	3
		BWBSe	2

Of 3905 trees from seven species examined during the surveys, 2467 (63%) were pest free. Because the criteria were different than those normally used to select a young stand for examination the age range of the various stands was much greater than normal; 10 of the stands, planted in 1989 were two years old, 21 were between 8 and 25 years old and 5 were 39 years and older. As forest stands age their susceptibility to different pests changes, and this is

reflected in the incidence of, for example, vole damage, which is normally limited to seedlings, contrasted with the incidence of Atropellis canker, which is seldom recognized in lodgepole pine trees younger than 30 years. A breakdown summary of the percentage of trees in each of six damage categories is shown in Figure 1.

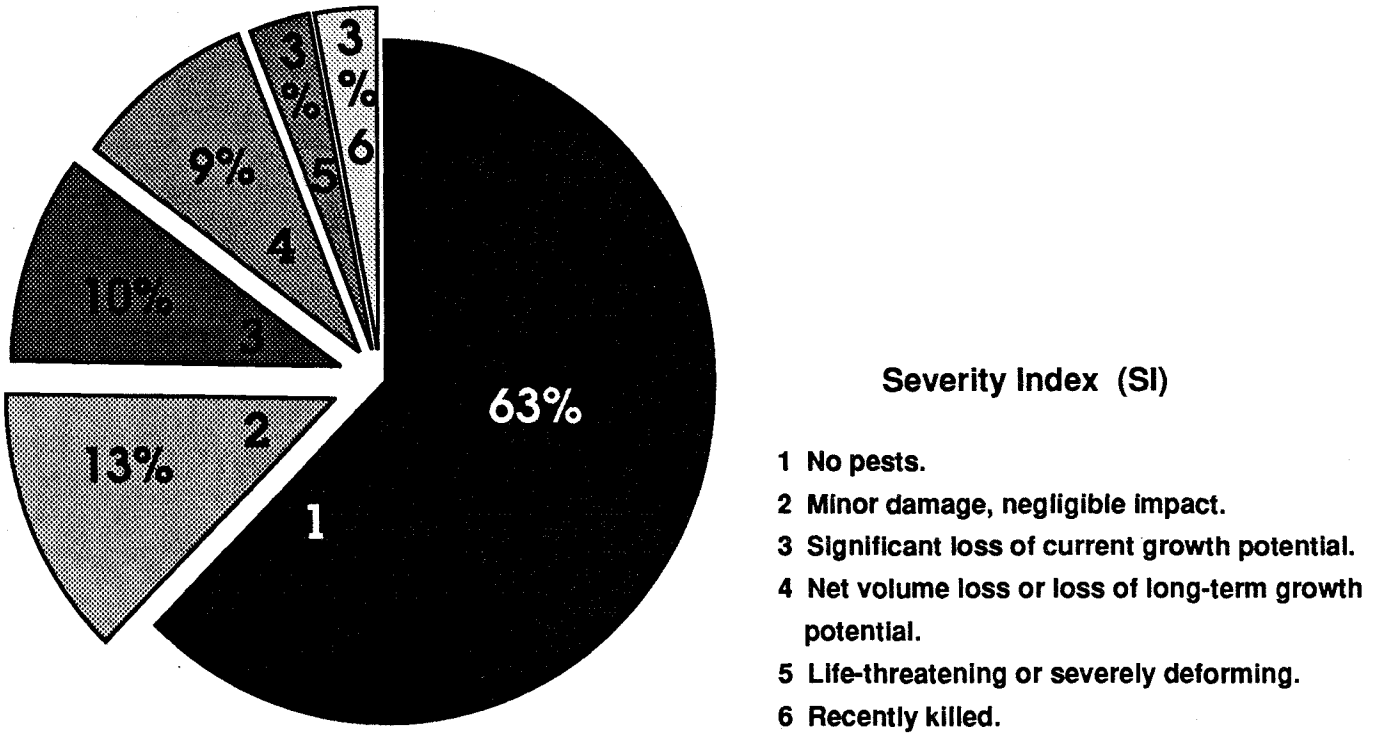


Figure 1. Percentage of 3905 trees of seven species in each of six severity classes (defined above) determined during surveys of 44 young stands. FIDS, Prince Rupert Region, 1991.

A summary of the most damaging and frequently occurring pests by tree species is contained in Table 9.

Table 9. Frequencies of the most damaging and commonly-occurring pests encountered during surveys of 44 young stands surveyed in 1991. FIDS, Prince Rupert Forest Region, 1991.

Lodgepole pine: surveyed in 27 stands, 1582 trees, 1088 (67%) pest free

Most damaging pests				Most common pests		
Pest	#stands	#trees	SI	Pest	#stands	#trees
Cronartium spp.	2	2	6	*E. harknessii*	13	49
blowdown	1	9	6	*H. warreni*	6	31
Endocronartium harknessii	1	2	6	environmental (winter)	8	43
Hylobius warreni	2	4	6	*P. terminalis*	5	33
hare	2	2	6	*A. piniphila*	5	18
E. harknessii	10	22	5	hare	6	25
H. warreni	6	27	5			
Cronartium spp.	4	5	5			
hare	3	3	5			
environmental	4	7	5			
brush competition	4	13	5			
Pissodes terminalis	5	33	4			
Atropellis piniphila	5	18	4			

Western hemlock: surveyed in 23 stands, totalling 775 trees, 570 (74%) pest free

Most damaging pests				Most common pests		
Pest	#stands	#trees	SI	Pest	#stands	#trees
blowdown	1	1	6	frost	10	100
vole	1	1	6	physical damage	7	28
bear	1	1	5			
dwarf mistletoe	1	1	5			
vole	3	9	4			
snowpress	2	5	4			

Sitka/hybrid spruce: 20 stands, 473 trees, 205 (43%) pest free

Most damaging pests				Most common pests		
Pest	#stands	#trees	SI	Pest	#stands	#trees
voles	3	11	4/5	environmental	10	62
Pissodes strobi	6	79	4	*P. strobi*	6	79
environmental	10	62	3/4	*Pineus pinifoliae*	7	66

(Cont'd)

Table 9. (Cont'd)

Alpine fir: 20 stands, 441 trees, 250 (57%) pest free

Most damaging pests				Most common pests		
Pest	#stands	#trees	SI	Pest	#stands	#trees
blowdown	1	1	6	winter damage (top/branch/tip dieback)	9	51
deer browsing	4	7	5			
winter (top/branch dieback)	4	16	4	physical damage	4	32
physical damage	4	32	4	*Pucciniastrum epilobii*	3	28
brush competition	1	3	4			
vole	1	2	4			
site? (chlorosis)	1	1	4			

western red cedar: 14 stands, 237 trees, 123 (52%) pest free

Most damaging pests				Most common pests		
Pest	#stands	#trees	SI	Pest	#stands	#trees
planting stress	1	1	6	vole	2	51
vole	2	51	5/6	physical damage	2	7
snowpress	1	4	4	cedar flagging	2	6

White spruce: 13 stands, 288 trees, 202 (70%) pest free

Most damaging pests				Most common pests		
Pest	#stands	#trees	SI	Pest	#stands	#trees
brush competition	2	9	5	environmental damage	6	35
environmental damage	6	35	3/4			

Black cottonwood: 4 stands, 109 trees, 29 (27%) pest free

Most damaging pests				Most common pests		
Pest	#stands	#trees	SI	Pest	#stands	#trees
unknown causes	2	57	6	unknown causes	2	57
vole	1	9	4	vole	1	9
				Mycosphaerella populorum	2	6

Table 9 lists only pest damage that has implications for more than the current year (ie SI = 4 or higher). Much of the damage encountered during the survey fell within the SI = <4 category, and as such was considered minor. The SI characterizes the damage caused by a particular pest, rather than the pest itself. The severity of damage may depend on population levels, as in the case of defoliating insects, or their point of location on a tree, as with Cronartium spp. rusts, where the consequences of stem cankers are more severe than branch cankers. A breakdown of the relative frequency of the different damage categories is contained in Figure 1.

An ever increasing "need to know" concerning the distribution and incidence of various pests and the severity of the damage they cause will ensure the continued emphasis on standardized young stand surveys in the future.

CLIMATIC DAMAGE

The winter of 1990-91 was highlighted by two back-to-back periods of cold weather in late December and January, when temperatures in the northern and eastern (east of the Kitwanga area) parts of the region remained below $-30^{o}C$ for a total of over two weeks. Temperatures were sufficiently cold to kill the foliage and buds of trees in some areas as well as some mountain pine beetle broods (see mountain pine beetle section).

Weather conditions during the 1991 field season were warmer and slightly drier than normal. At Terrace, the mean daily temperature from June to September was .8 degrees above normal and total precipitation was 9.2 mm below normal.

Blowdown

During overview surveys in the western part of the region, 700 ha of blowdown was mapped in 45 areas. In the North Coast TSA, scattered areas of blowdown were noted near the mouths of the Khutzeymateen and Nass rivers and areas in between. In the Kalum TSA, scattered areas of blowdown were noted from the mouth of the Kemano River and Kemano in the south, through the Upper Kitimat River, Hai Lake, Tseax Crater areas, the Vetter and Zolzap creeks areas (where salvage logging was in progress), to numerous small patches near Greenville. Intensity of the damage varied from scattered trees in some stands to almost continuous sheets in others. In all areas western hemlock seemed to be the most affected although true firs and spruce were also involved.

Strong southwest winds in three successive years resulted in a patch of continuous blowdown covering more than 4000 ha, just south of Eutsuk Lake in Tweedsmuir Provincial Park. The blowdown area stretched from the base of Nadedikus Mountain, just east of Tesla Lake, and ran northeast astride the Chezko River almost to Mink Lake. But for a patch of mature white spruce at the southeast end, most of the affected timber was immature lodgepole pine. The site was examined by representatives from a number of concerned agencies, including the Ministries of Forests, Parks, and Environment, in the early summer

to determine the impact of the damage and to consider treatment alternatives. The damage caused three major concerns: an increased potential for wildfire posed by the dead timber; the spruce beetle infestation hazard posed by the mature spruce blowdown; and the impenetrable barrier to the passage of wildlife in a historically important wildlife corridor. These concerns led to the decision to attempt a controlled burn of at least part of the area in September, subject to weather conditions. Fortunately the weather was ideal, and the whole area was successfully burned in mid-September with minimal fringe damage.

Winter damage

Every year a wide range of winter-induced damage is seen on a variety of tree species (Table 10).

Table 10. Locations, severity and the nature of damage caused by a range of winter-related agents. FIDS, Prince Rupert Forest Region, 1991.

TSA/Location	Species	Age	Cause	Description
Cassiar				
-S- of Boya Lake and Wheeler Lake to French Creek	lP	30+	red belt	1990 needles lost on an elevational band between 800m and timberline
Kispiox				
Km 6 Nangeese Main	lP	8	wind	cold, desiccating wind killed 30% of the needles above 1m
Km 7 Gail Creek	alF	1	frost	90% terminal and 50% lateral buds killed
Km 2 Andimaul Creek	lP	15	winter flecking	avg. 30% needles discolored in lower crowns of 60% of the trees
Bulkley				
Km 30 McKendrick Pass	lP	6	wind	cold desiccating wind killed upper crown needles, primarily on the south side of the trees
Moricetown	alF	all age classes	late frost	up to 90% newly flushed needles killed on 20% of the trees
Morice				
Km 28 North Road	wS	24	frost	10% of the trees lost up to 100% 1990 and older needles - some bare branches

Damage is often seen as a continuous band of red foliage as in "red belt", a common phenomenon affecting lodgepole pine, usually on high elevation south facing slopes. Though the damage mechanism is not known, the evidence suggests that it occurs during periods of rapid thaw when transpiration of water through the needles occurs. This water given up by the needles cannot be replaced by the roots which remain frozen, so the needles become desiccated and die. Another phenomenon called "winter flecking" occurs in all species of conifers. Again the exact mechanism which results in the damage is not clearly understood, but the spots of necrotic tissue are thought to result from light reflecting off the snow, lensing through water or ice droplets.

Hail damage

A hailstorm in early July caused the partial defoliation of several deciduous tree species as well as fireweed and soopalallie for 1 km beginning at 9 km of the McKendrick Pass Road, near Smithers. Black cottonwood, trembling aspen, willows and white birch lost an average of 60% of their foliage during the storm. In addition, small lesions resulting from the impact of the hailstones were seen on many of the tender new shoots. The long term effects of the damage however will be negligible.

MAMMAL DAMAGE

Vole

Beginning in the summer of 1990 and continuing into the summer and fall of 1991, high vole populations caused conifer seedling damage in a number of plantations at widespread locations, particularly in more westerly parts of the region (Table 11).

Table 11. Locations and assessment of seedling damage caused by voles from the summer of 1990 to the fall of 1991. FIDS, Prince Rupert Forest Region, 1991.

TSA/Location	Year Planted	Species Affected	Description
Kalum			
Salvus (012)	1990	wrC/wH/xS/lP	40% attack overall (20% mortality); in wrC, 50% attack (31% mortality); 90% trees with protective "Vexar" tubing.
Salvus (014)	1990	wrC/wH/xS	15% attack overall (5% mortality); in wrC 29% attack (12% mortality); aF unaffected; "Vexar" tubing throughout.
Oweegee Cr. (CP17-5)	1991	xS/aF	28% attack in xS, primarily branch clipping, 3% mortality.

(Cont'd)

Table 11. (Cont'd)

TSA/Location	Year Planted	Species Affected	Description
Kalum			
Oweegee Cr. (CP17-1)	1991	xS/aF	10% attack in xS, 2% mortality, aF unaffected.
Bell-Irving R. Crossing	1989	xS/alF/wH	21% scarring or missing terminals, primarily in spruce.
Meziadin R. Main	1989	xS	minor feeding noted, one dead seedling found.
Cranberry R bridge	----	tA/W/lP	for .4 km along Hwy 37, 50%+ mortality in spots, seedlings and saplings to 1.5 m affected.
Meziadin R. - Bell-Irving R.	----	Shrubs	occasional roadside spot severe damage noted.
Nass R. (016)	1990	bCo	most stock missing, 51% mortality in remainder, identification difficult, voles, snowpress, ungulates, brush; all may be involved.
Nass R. (014)	1990	bCo	65% mortality in remaining saplings, causes as above.
Shirlaw Lk. (CP17-6)	----	---	not planted to date but rodents noted in brush/slash.
20 km north of Meziadin Lake	1989	lP/alF/wS	up to 50% of trees of all species killed by clipping, majority of remainder clipped higher on the stem and/or defoliated.
Kispiox			
Clifford Main CP 318 Blk 2	1988	wS	20% trees with clipped terminals and/or laterals, 50% additional were lightly-severely defoliated.
Clifford Main CP 337 Blk 22	1990	lP	80% seedlings clipped and killed immediately following planting in the summer of 1990.
Bulkley			
McKendrick Pass CP 302 Blk 3	1989	lP/wS	10% of trees damaged, 2% killed by clipping and remainder with light-severe needle loss.
McKendrick Pass CP 301 Blk 7	1990	lP	1% of seedlings clipped, 5% defoliated with up to 90% needle loss.
McKendrick Pass km 24	1990	lP	overall 5% of seedlings up to 90% defoliated in small scattered patches.
Morice			
-E- Babine Lake CP 550 Blk 3	1990	lP/wS	20% of seedlings clipped and killed additional 50% with defoliation and/or terminal clipping damage.

In the Kalum TSA chronic vole populations continued to cause seedling mortality in the lower Skeena Valley, west of Terrace. Populations also increased elsewhere with damage recorded and reported widely over the district. At Salvus, west of Terrace, 21% of seedlings were dead with overall 40% of seedlings attacked. Western red cedar was most severely affected with 31% mortality in 50% affected. A second Salvus plantation had 15% of seedlings affected with 29% of western red cedar attacked of which 12% were dead. Amabilis fir representing 41% of the stocking was unaffected; cedar represented 43% of seedlings. At both sites damage was considerable despite some replanting and the use of "Vexar" tubing to protect nearly 100% of the seedlings. Snowpress appeared to have knocked over many of these barriers allowing easy access for the rodent. The addition of stakes at each seedling should stabilize barriers to improve protection over the coming winter. Voles were still common at these sites in the fall. At Oweegee Creek CP17-5 and 17-1, planted after July, 28 and 10% of spruce seedlings were laterally or terminally clipped. Mortality was 3 and 2% respectively from basal clipping. Damage appeared most pronounced in conjunction with areas of brush, the brush areas were also most notable for vole populations during the summer, prior to planting. Amabilis fir, a minor component at both sites, was little affected by survey time in late September. At the Bell-Irving River crossing site, 21% of seedlings were partially girdled or clipped with 30% of spruce severely scarred and only 9% of alpine fir affected. At a Meziadin River mainline spruce plantation, where Rhizina undulata was a serious pest in 1990, minor clipping and basal scarring was noted with only one dead seedling found in a walkthrough survey. The roadside damage in the Cranberry River bridge area showed severe damage in all three hosts attacked. Lodgepole pine was killed by basal girdling. Some trembling aspen and willow to 1.5 m tall were almost completely stripped. Similar roadside damage in small spots was noted in the Meziadin River to Bell-Irving River area mainly in willow. The black cottonwood plantation failures adjacent to the Nass River involved vole activity. Due to advanced degeneration of most host material which could still be found on the sites, it was not possible to determine the extent of vole culpability.

Industry reported seedling damage primarily in the general area from Nass and Meziadin Rivers to the Bell-Irving River, including one spruce plantation failure attributed to vole activity. Reports also included concern over black cottonwood in the Skeena River drainage and indicated damage in gullies and grassy areas as far north as Durham Creek in the Cassiar TSA.

During spring surveys, signs of winter vole activity in the form of shallow tunnels in the duff and groups of small burrow entrances at the base of stumps were evident in all age class stands in the Bulkley and Morice TSAs. However, no animals were seen and no evidence of recent feeding damage could be found. The same was true of affected areas in the Kispiox TSA where most of the feeding damage apparently occurred in 1990. It appears that populations peaked in the fall of 1990 in these areas and, with the onset of winter, the high numbers could not be sustained, and the population collapsed. An expected recovery of vole populations during the summer of 1991 failed to materialize and no further damage was reported.

Indications from the 1986-87 infestations were that lodgepole pine was a preferred candidate species for vole activity with up to 45% mortality recorded. In pine-spruce or spruce stands, spruce was sometimes also severely affected in

patches, with 15% mortality recorded in one plantation. Current surveys indicate that where western red cedar, western hemlock and true firs represent substantial components in the stand, cedar is by far the preferred species and where both spruce and true firs are planted, alpine and amabilis fir suffer little damage.

Populations have increased for a second year since the 1987 outbreak. Currently the traditional cycling attributed to voles may be influenced by relatively mild winter conditions and the continued increased extent of logged-over forest land. These may create ideal conditions for cyclic peaks to climb higher than might otherwise be anticipated and for populations to persist at chronically high densities for several years.

Vole populations in interior TSAs following the general collapse are expected to follow historical precedents and stay low for the next few years. Milder coastal conditions coupled with a richer food source will probably allow populations in the west, particularly in the Salvus area, where damage has occurred in each of the last three years at least, to continue in 1992.

Porcupine

Porcupine damage was recorded over 720 ha in 50 infestations in the Kalum and part of the North Coast TSAs, during aerial overview surveys. Light attack was mapped over 680 ha in 12 infestations, moderate in 30 ha in 2 areas and 10 ha of severe damage in 36 mostly spot areas. In the North Coast TSA porcupine damage consisted of an estimated 160 ha of light attack in three areas and 11 areas of spot severe attack consisting of 5-20 trees each, all in the Khutzeymateen River drainage. In the Kalum TSA, areas of attack were noted along the Nass River at Kwinyarh and Chemainuk creeks, and in the Kalum Valley at the south end of Lava Lake, near Sand Lake, between Mayo and Nelson creeks and at Alice, Luncheon and Erlandsen creeks.

At Luncheon Creek an estimated 1% recent mortality was noted over approximately 100 ha in a dense stand of 10-25 cm dbh western hemlock and amabilis fir. Up to 50% top kill and scarring was noted in spots due to repeated years of feeding activity. At Erlandsen Creek, over an approximately 25 ha area, 10% recent attack was noted with up to 40 cm dbh amabilis fir completely girdled. Both true firs and hemlock were affected including patches up to 50% top kill over several years. At the south end of Lava Lake, an estimated 30% of 15-30 cm lodgepole pine were girdled or partially girdled over a one ha area of dense young growth. Hemlock and cedar at this site were not affected. Adjacent 3-5 m lodgepole pine juveniles were also affected but less than 5% overall. Partial old and new feeding damage totalling 10% was also noted in trembling aspen in two approximately five ha areas near Sedan Creek.

In a porcupine damage survey in a young stand at Shames Creek, where feeding damage was noted through much of the drainage, 42% of western hemlock, amabilis fir and spruce were affected including 33% top kill (Table 12).

Table 12. Porcupine damage in a young plantation at Shames Creek. FIDS, Prince Rupert Forest Region, 1991.

Host	# trees assessed	Healthy		<50% girdled		>50% girdled		100% girdled		Total Affected	
		#	%	#	%	#	%	#	%	#	%
wH	116	75	65	2	2	7	6	32	28	41	35
aF	76	15	20	5	7	7	9	49	64	61	80
xS	64	59	92	0	0	1	2	4	6	5	8
Total	256	149	58	7	3	15	6	85	33	107	42

Amabilis fir was the most severely damaged at this site, with 80% of trees affected including 64% top kill, compared to western hemlock with 35% attack and 28% top kill and 8% attack with 6% top kill for spruce. A clear preference was shown for amabilis fir over spruce and hemlock; dominant trees over intermediate and smaller trees, and feeding in the top one half to one third of the crowns over feeding lower on the boles. With at least 9% repeat attacks noted in this 15 year-old stand, continued and increasing damage is likely, possibly resulting in NSR.

Dieback and mortality caused by porcupines continues, particularly in sapling to semi-mature age classes in true firs, western hemlock, lodgepole pine and spruces in the region. Probe lines by BCFS staff in the Kalum TSA in affected areas indicated increasing overall attack averaging 2.3% current attack in 1990 compared to 1.3% in 1988. Aerial survey results and ground surveys at Shames Creek and other areas in 1991 also indicate a possible continuing expanding problem. Porcupine has been considered a serious pest for many years, and with relatively mild winters and increasing areas of forest falling within the condition parameters preferred by the porcupine, active control measures including expanded surveys clearly need to continue.

Squirrel

Reddened branch tips on young lodgepole pine characteristic of damage caused by squirrels, were seen intermittently in roadside stands from just north of Dease Lake to the Yukon border. The most severe damage, affecting from 1 to 10 branches on all young trees, occurred in the uniform pure young pine type surrounding Boya Lake. Similar, though much lighter damage affecting less than 10% of the trees was seen in a 16 year-old naturally regenerated stand at km 20 of the Equity mine road, south of Houston, and in a 15 year-old plantation near Nose Bay on the east side of Babine Lake.

The damage was caused by squirrels stripping off the immature cones from near the tips of the branches. In the process the branch tips were effectively girdled, turning red early in the following growing season.

The damage seems to occur intermittently and, as yet, has had no observable long term growth impact.

DECIDUOUS PESTS

Northern tent caterpillar
Malacosoma c. pluviale

Current Activity

Defoliation by the northern tent caterpillar continued for the third consecutive year in the Kalum TSA. The area of defoliation recorded during an aerial survey totalled 4261 ha, an increase from the 3230 ha mapped in 1990, and included 1334 ha light, 1840 ha moderate and 1087 ha severe defoliation. Deciduous growth, primarily black cottonwood, but also trembling aspen, willow, white birch and fruit trees, was lightly to severely defoliated. Feeding damage again occurred throughout the Skeena Valley from the Kasiks River area east to the Shames River area, and this year expanded further east to encompass most of the Terrace area. Along the Skeena River, the intensity of defoliation was slightly reduced.

The overall increase in area and severity occurred in the infestations in the Wedeene River drainage, where feeding by the northern tent caterpillar continued for at least the second year and was mapped over approximately 1380 ha of which over 1000 ha was severe defoliation primarily on willow. Spot infestations causing minor damage were also noted in the Meziadin Lake area, primarily on willow. The forest tent caterpillar, M. disstria, recorded in the Kitimat area in 1990, was not noted during surveys.

Early season defoliation was again followed in most areas by a second, smaller flush in mid-late summer. There is usually no tree mortality directly attributable to defoliation by tent caterpillars, with the exception perhaps of occasional young saplings after repeated severe attacks. Successive years of severe defoliation will reduce radial growth and may cause branch and twig dieback and, in the Prince George Region, has been reported to cause some mortality in overmature stands on poor sites.

Forecast

Defoliation in the Skeena Valley is expected to continue at light to moderate levels over a similar area in 1992. In the Terrace area itself, severe defoliation is expected in some areas; in the Wedeene Valley severe defoliation can also be expected. Predictions are based on egg mass surveys conducted in the fall (Table 13). Diseases in larval populations were not noted and are not expected to significantly impact on populations at this time.

Table 13. Predictions of 1992 defoliation by the northern tent caterpillar based on egg mass counts in the Kalum District. FIDS, Prince Rupert Forest Region, 1991.

Location	Host	Avg. DBH (cm)	Avg. No. Egg Masses old	Avg. No. Egg Masses new	1992 Pred. Def.[1]
Kasiks R.	bCo/willow	11	1	3	LT
Exstew R.	bCo	12	<1	5	LT/MOD
Shames R.	tA/rA	11	0	2	LT
West Terrace	tA/wB	10	4	20	SEV
South Terrace	tA	10	2	6	MOD
East Terrace	tA	10	3	19	SEV
Wedeene R.	tA/willow	9	1	10	SEV

[1] Predictions are based on the number of egg masses by tree diameter that will cause complete defoliation (from thresholds developed in work on forest tent caterpillars on tA).

DBH	# egg masses
2.5	2
5.0	5
7.5	9
10.0	11
12.5	14
15.0	19

Control

Management from a forestry perspective is generally not required as feeding is limited to deciduous species and causes little direct mortality. The increased interest in certain species, especially black cottonwood and trembling aspen and the concern with fruit trees and as a public nuisance, may warrant control in some situations. Egg masses can be readily detected and removed during fall and winter months. Early instar larval colonies are also readily evident and easily destroyed. Once larvae begin to disperse (just prior to pupation), control is more difficult. Control can provide relief for the current year, however, adults will readily migrate from outside a control area and lay egg masses ready to hatch the following year.

A birch leafminer
Lyonetia sp

White birch along Hwy. 37 near Echo Lake (south of Iskut) were moderately defoliated by a birch leafminer over an area of approximately 1000 ha. An average of 30% (up to 80%) of the leaves were damaged. The infestation was confined to a narrow pass between 700 and 800 meters in elevation, which lay within the ICHvc biogeoclimatic zone. Within the pass, white birch grew in an

almost pure stand. Further information regarding the health of the population is not available since the insect had completed its life cycle by the time the damage was discovered.

Farther south, leafminer infestations have caused chronic defoliation in white birch stands, sometimes running for more than 10 successive years. Despite this, little significant lasting damage has been noted. Little is known however of the effects of such repeated defoliation in the harsher environment of northern stands. The area will be resurveyed earlier in 1992 to determine the specific identity of the pest and the health of the population.

Gypsy Moth
Lymantria dispar

No moths were caught in single gypsy moth pheromone-baited traps placed at 49 locations in the region as part of an ongoing cooperative program to detect any introduction of this pest into B.C. (Map 3). No moths have been caught to date in the region in traps placed by FIDS, or in additional traps placed by Agriculture Canada and the B.C. Forest Service.

Trapping was focused in areas frequented by travellers, such as provincial parks, private campgrounds, major highway rest areas, and port facilities. Visitors in recreation vehicles carry egg masses from central and eastern areas of the continent, where the gypsy moth is established, and are considered the primary vectors in the spread of the insect.

Repeated light catches of male adults in traps in the Lower Mainland, and Vancouver Island and the discovery in Vancouver of egg masses of the closely related and even more threatening Asian gypsy moth re-emphasize the need for continued monitoring. Early detection allows the implementation of a program to eradicate any introductions before they become established.

Willow leaf beetles
Pyrrhalta punctipennis, P. decora carbo

A willow leaf beetle, probably P. punctipennis, lightly to moderately defoliated willow in scattered patches along highway 37 from the Onion Lake area to north of Lakelse Lake. This is the first report of notable activity by this pest since infestations were recorded in the same location as well as along the Skeena and Kalum rivers in 1987. Farther east, P. decora carbo caused mostly moderate defoliation of roadside willows over broad areas of the Skeena, Kispiox and Bulkley valleys within a 30 km radius of Hazelton.

SPECIAL DIRECTED SURVEYS

Acid rain national early warning system (ARNEWS)

Annual monitoring of the ARNEWS plot in the Terrace Watershed near Deep Creek continued in 1991, to identify changes in vegetation and tree vigor

possibly related to aerial pollutants or acidified precipitation. Assessments of plot trees, off-plot trees, regeneration in subplots and ground vegetation were done as part of this survey. Monitoring of long-term foliar development and changes in foliar conditions of 10 tagged and photographed branches per host also continued. A three-tree larval monitoring site has also been established adjacent to the plot.

In assessments of plot vegetation and pest conditions, very little change was found from previously recorded survey results. No symptoms of aerial pollutants or acidified precipitation were noted. Minor incidence of broken tops, stem cankering and galling, traces of sapsucker damage and Cheilosia burkei, a bark maggot, were found in the plot. One larva of the species Gabriola dyari was identified from the three-tree beating in western hemlock adjacent to the plot. Monitoring will continue in 1992.

Pinewood nematode
Bursaphelenchus xylophilus

To meet pinewood nematode-free certification requirements for wood products destined for much of Europe, testing in wood pasteurization was initiated. This method of treatment is being assessed as a potentially more cost effective means of meeting export requirements than kiln-drying. To provide material for testing, several log decks and blowdown areas in the district were examined for the presence of woodborers. Assessments also provided information which continues the expansion of the database on the distribution, host preference and prevalence of various woodborers throughout the province, especially those considered vectors of the nematode.

At River Road in the Meziadin area, 30 alpine fir were diagnosed as being heavily infested by woodborers. Rearing is currently in progress and to date Monochamus scutellatus has been identified. In western hemlock blowdown at Hai Lake, there was no evidence of woodborer damage other than ambrosia beetle. At Bolton Creek in old, decked amabilis fir, 100% of examined logs contained larvae of the woodborer Leptura sp. At Skeena Sawmills, no frass was noted in a 100 log western hemlock random sample from log decks. Melanophila drummondi was identified from 10% of bark samples at this site and in amabilis fir, 25% of logs were woodborer infested. Rearing is in process and identification is pending.

Fume damage: Fluoride

A two day vegetation inspection sponsored by Alcan Aluminum of Kitimat as part of their ongoing fluoride damage monitoring program was completed in early August. On the first day, under the expert guidance of Dr. L.H. Weinstein of Boyce Thompson Institute for Plant Research at Cornell University, numerous sites were examined. Sites visited included areas from the main plant entrance, through the Kitimat community to approximately 10 km north in the Little Wedeene River drainage. Sites were generally in what has been described as the fume path of the smelter stacks. From mosses and lichens to conifer species were assessed for fluoride-like damage symptoms.

The most severe damage observed was on a single Mugho pine in front of the main office building. The top 25% of the crown was dead, consisting of bare branch tips or browned foliage. The remainder of the foliage was either brown tipped or had brown margins. Browned tips and/or margins on foliage of any susceptible host is suspect; Mugho and Scots pine are considered particularly sensitive to fluorides. Browning of leaf tips was noted on willow at a number of locations. Scouler willow is considered a good indicator for fluoride damage. Browning of western red cedar foliage also occurred at a number of sites, although cedar is generally considered to be less sensitive than several other local conifer species. In cedar, damage was light, scattered and seemed to be episode-specific; most older foliage and late season current foliage remained unaffected. The fact that some cedars were affected while others on the same site were not may have been due to genetic variability. Crown form in the cedar throughout the area also appeared to be affected, with a generally tight and close cropped appearance (rather then open and sweeping), much like some ornamentals. An unconfirmed report resulting from planting of cedar both inside and outside the area of influence seemed to confirm the hypothesis. Seedlings were reported to grow normally away from the Kitimat area but formed a tighter crown under the influence of the smelter's fume path.

Overall fluoride-like damage was reported to be generally similar in extent and somewhat reduced in severity from the 1989 inspection and much reduced from earlier assessments. No extensive damage occurred on any species; at some sites damage was nil to virtually nil.

CHRONIC DISEASES

Several chronic diseases (Table 14) are important in the region in terms of damage and losses, but are not usually surveyed because they are perennial and fluctuate little from year to year. Management of these diseases is usually most practical as preventive treatments combined with specific stand management practices during the harvest-regeneration phase or juvenile stand tending.

Table 14. Important chronic diseases. FIDS, Prince Rupert Forest Region, 1991.

Disease	Host(s)	Location	Remarks
Annosus root rot *Heterobasidion annosum*	aF,sS wH	southwestern part of region	infections in thinned stands spreading to leave trees
Cedar diebacks unknown cause(s)	wrC yC	host ranges	long term top-down dieback leading to mortality
Hardwood trunk rot *Phellinus igniarius*	tA	throughout region	causing extensive decay

(Cont'd)

Table 14. (Cont'd)

Disease	Host(s)	Location	Remarks
Hemlock dwarf mistletoe *Arceuthobium tsugense*	wH	coastal stands	widespread, particularly severe in remaining old-growth stands
Lodgepole pine dwarf mistletoe *Arceuthobium americanum*	lP	southeastern part of region	widespread but sporadic, causing significant growth loss
Spruce broom rust *Chrysomyxa arctostaphyli*	wS	throughout host range	widespread, particularly in northern half of region
Tomentosus root rot *Inonotus tomentosus*	wS lP	throughout interior	growth loss, windthrow and mortality in old-growth, increased young stand mortality
Western gall rust *Endocronartium harknessii*	lP	throughout region	stem galls often cause death of young trees by girdling or breakage

OTHER NOTEWORTHY PESTS

Insect populations fluctuate from year to year; in any one year populations of some potentially damaging pests are sufficiently low that little damage is reported. Occurrences of such insects are reported in Table 15. Relatively minor damage caused by disease is reported in Table 16.

Table 15. Other noteworthy insects. FIDS, Prince Rupert Forest Region, 1991.

Insect	Host	Location	Description
A bark beetle *Hylurgops* sp.	lP	Augier Lake	secondary attack of young trees stressed by root disease
Bladder gall mite *Eriophyes* sp	wB	Babine Lake	90% leaves infested on single trees
Birch leafminer *Fenusa pusila*	wB	Smithers	50% leaves infested on ornamental trees in townsite

(Cont'd)

Table 15. (Cont'd)

Insect	Host	Location	Description
A blister mite *Phytoptus sorbi*	mountain ash	Kitimat valley	common light attack, causing leaf discoloration and blisters
A blotch miner *Micrurapteryx salicifoliella*	wB	Babine Lake	trace-light damage
Conifer aphid *Cinara* sp.	wS	km 11 McKendrick Pass	50% fringe trees killed over 1.5 km - chronic infestation
Cottonwood leaf beetle *Chrysomela* sp.	bCo	Babine Lake	10% leaves skeletonized
Cottonwood leafmining beetle *Zeugophora* sp.	bCo	Date Creek	20% leaves on 50% trees
Fir engraver *Scolytus ventralis*	aF	Kitimat	one current, six scattered previous attacks
Gall midge *Aphidoletes* sp.	wS	Boya Lake	found preying on *Adelges lariciatus* and *Pineus pinifoliae*
Gouty pitch midge *Cecidomyia piniinopis*	lP	Bulkley and Morice river drainages	trace-light branch crooking in young stands throughout area
Horntails *Hyles gallii*	fireweed	Goathorn Cr. Chapman Lk. Wolverine Cr.	light-severe defoliation of fireweed in 1990 spruce/pine plantations. No seedling dam.
Poplar-and-willow borer *Cryptorhynchus lapathi*	-W	Kitimat, Nass, Skeena valleys	common throughout, stems and branches killed in willow clumps.
Poplar leaffolding sawfly *Phyllocolpa bozemani*	rAl	Kitimat, Terrace	occasional folding of leaf margins.
Spruce budmoths *Epinotia radicana*, *Zeiraphera unfortunana*, *Z. canadensis*	sS wS sS	throughout host ranges in region	commonly infesting buds of all age classes though at light intensity

(Cont'd)

Table 15. (Cont'd)

Insect	Host	Location	Description
Spruce gall adelgids *Adelges cooleyi*	wS	Houston	common infesting ornamentals
Adelges lariciatus	wS	French River	common at light intensity on all age classes
Pineus pinifoliae	sS wS	host ranges	common at trace-light intensity, occasionally moderate
Pineus similis	wS	Babine Lake	80% branch tips infested on single tree
Pineus sp.	sS	Thunderbird Main	common, small populations.
Twig beetle *Pityophthorus* sp.	lP	Nilkitkwa	secondary attack on stressed or recently killed trees

Table 16. Other noteworthy diseases. FIDS, Prince Rupert Forest Region, 1991.

Pest	Host	Location	Description
Armillaria root disease *Armillaria ostoyae*	xS	Kispiox R. Suskwa R.	scattered mortality of young plantation trees
An aspen leaf spot *Marssonina brunnea*	tA	Boya Lake	light localized infections
A foliar disease *Linospora tetraspora*	bCo	Nass River	common throughout area
A leaf spot *Mycosphaerella* sp.	yC	Diana Lake	new host record
A leaf and shoot blight *Kabatina thujae*	yC	Diana Lake	related to common dieback in area

(Cont'd)

Table 16. (Cont'd)

Pest	Host	Location	Description
Poplar leaf spots *Mycosphaerella populorum*	bCo	Pendleton Bay	common on scattered individual trees
M. populicola	bCo	Moricetown, Shames, Hall, Moore creeks	lightly infected the needles of roadside trees
Poplar shoot blight *Venturia macularis*	tA	Burns Lake, Kinaskan Prov. Park	killed shoots of young trees -high incidence in small centres
Snow blight *Phacidium abietis*	alF	Meziadin R.	35% of fringe trees moderately infected over 5 ha.
Spruce broom rust *Chrysomyxa arctostaphyli*	sS	Kinaskan Prov. Park	32% of park trees infested, also generally common.
Spruce-Labrador-tea rust *Chrysomyxa ledi* var. *ledi*	wS	km 40 North Road	100% current growth infected on all trees over 1 ha