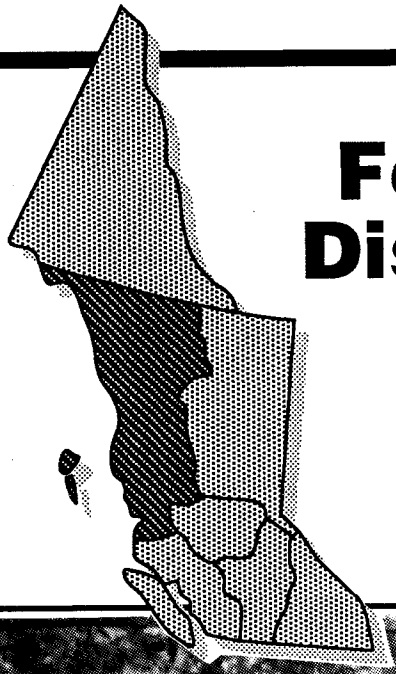
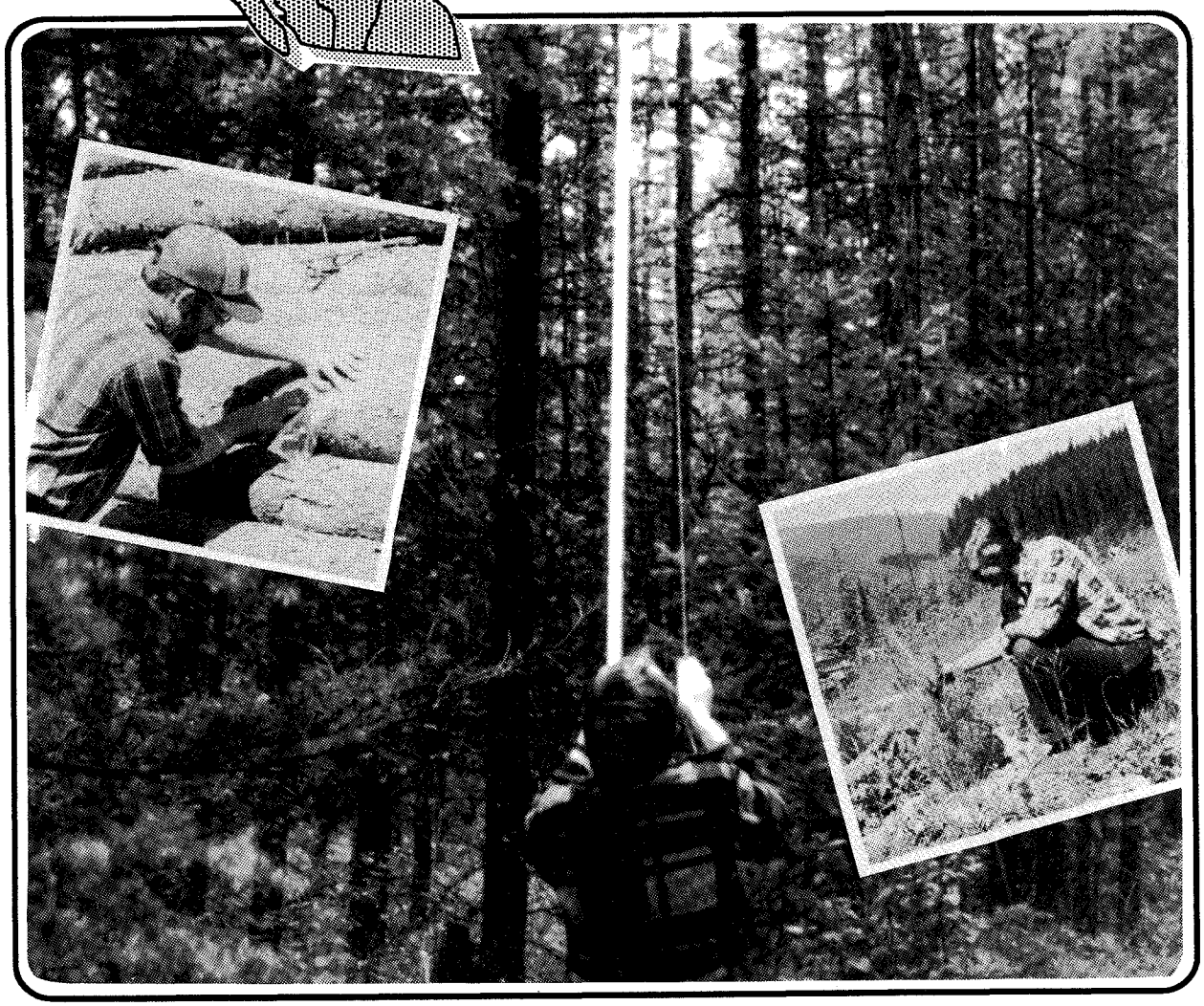


Forest Insect and Disease Conditions

Prince Rupert Forest Region
1990

R. Garbutt & A. Stewart



Forestry Canada Forêts Canada

ADDENDUM

Pine needle diseases

Foliar diseases of lodgepole pine decreased in northern areas of the region in 1990. Pine needle casts, Lophodermella concolor, Leptomelanconium pinicola, and Lophodermium pinastri, commonly infected the older and understory foliage of lodgepole pine in valley bottom stands throughout the Cassiar TSA. Infections were particularly common, though at lower levels than 1989, in the Dease River Valley from the Boya Lake area north, in the BWBSa2 biogeoclimatic zone. Two additional fungi, Phaeoseptoria contortae and Hendersonia pinicola, occurred at low intensity from representative locations at Cormier Creek and Tanzilla River, considerably reduced from 1989. Chronic infections by Elytroderma needle disease, Elytroderma deformans, continued at light to moderate levels in the Hyland River Valley.

Infections by most of these needle fungi are significant only if severe in intensity and repeated in successive years. Infections by Elytroderma needle disease, however, are systemic and gradually reduce the vigor of host trees.

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APPENDICES

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 1990.

2. Pest Report. "Conifer Seedling Mortality Associated with Rhizina Root Disease". FIDS, Prince Rupert Forest Region, 1990.

3. Pest Report. "Summary of Forest Pest Conditions". FIDS, Prince Rupert Forest Region, 1990.

4. Pest Report. "Northern Tent Caterpillar in the Skeena Valley, 1990 Update and Forecast for 1991". FIDS,Prince Rupert Forest Region, 1990.

5. Pests of young stands survey data. FIDS, Prince Rupert Forest Region, 1990.

6. Forest pests in provincial parks. FIDS, Prince Rupert Forest Region, 1990.

INTRODUCTION

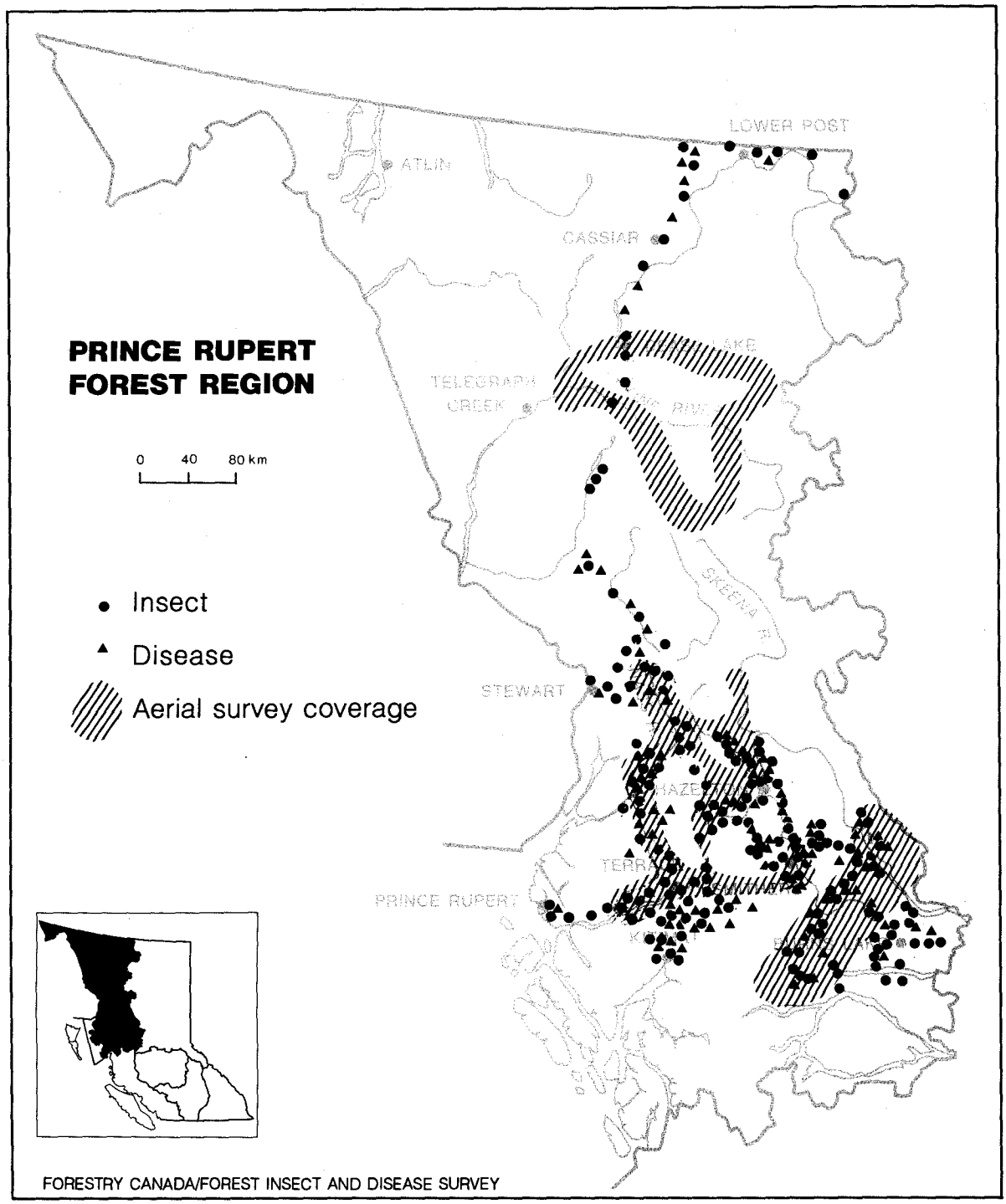
This report outlines the status of forest insects and diseases surveyed in the Prince Rupert Forest Region in 1990 and forecasts some of the pest population trends. Insects and diseases are discussed by host, generally in order of importance and often within the context of a management unit or Timber Supply Area (TSA). The Queen Charlotte Islands are still surveyed by Forest Insect and Disease Survey (FIDS) Rangers in the Prince Rupert Forest Region, but the information is reported in the Vancouver Forest Region report.

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 and extension on 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 1990 field season extended from late May to late September. A total of 420 insect and disease collections were submitted by the authors to the Pacific Forestry Centre for identification and verification (Map 1). Twenty five collections were received from B.C. Forest Service (BCFS) staff throughout the region. In cooperation with research programs at the Pacific Forestry Centre and other institutions, 18 collections were made in 1990. Approximately 180 contacts and on-site pest examinations were made with B.C. Forest Service and industry personnel during the field season. Pest survey data were summarized and presented to the B.C. Forest Service Regional Protection and Silviculture meetings in November, and contributed to provincial and national FIDS reports.

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
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



Map 1. Locations where one or more forest insect or disease samples were collected and areas covered by aerial surveys. FIDS, Prince Rupert Forest Region, 1990.

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	- white bark pine
mAl	- mountain alder	wrC	- western red cedar
mH	- mountain hemlock	wH	- western hemlock
rAl	- red alder	wS	- white spruce

The results of pest surveys in the Prince Rupert Forest Region have been reported by Forestry Canada (previously the Canadian Forestry Service) since 1939. Field stations are currently located in Smithers and Terrace; from May to September 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. 363-0600 (changed from last year)

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 131 350 m^3 of lodgepole pine over 4 130 ha, a decline of over 40% from 1989. **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 increased slightly, causing light damage in three interior stands. A western form of the **red pine sawfly** lightly defoliated twenty year-old lodgepole pine in a plantation near Hazelton.

Spruce beetle populations increased slightly, with current attacks in standing green timber near Haul Lake and in recent blowdown in the Morice River corridor in the Morice TSA. In the Skeena and Kitimat valleys, the **white pine weevil** infested an average of 40% of the terminals in 13 Sitka spruce plantations located in high hazard areas. Slightly increased populations of the **eastern spruce budworm** lightly defoliated white spruce in the extreme northeastern portion of the region. Increased populations of a **spruce gall adelgid** infested white spruce in two plantations near Chapman Lake, and one near Houston.

Western balsam bark beetle caused recent light mortality of alpine fir over an estimated 58 440 ha. **Western blackheaded budworm** declined to near endemic levels after causing four consecutive years of light defoliation of alpine fir and white spruce in the Bulkley and Morice TSAs. Conifer **budworm** populations remained at endemic levels and pheromone trap catches were much reduced from last year.

Defoliation of tamarack by the **larch sawfly** remained similar to 1989, causing light to severe defoliation throughout the host range.

Thirty Douglas-fir were killed by 1989 attacks by the **Douglas-fir beetle** and an additional 310 were currently attacked on the north shore of Francois Lake.

The **northern tent caterpillar** lightly to severely defoliated mostly black cottonwood over 3 233 ha adjacent to the Skeena River west of Terrace, and other hosts in the Wedeene River Valley and in and around Terrace. Deciduous trees in the Kitimat area were lightly to moderately defoliated by the **forest tent caterpillar.** Several **alder defoliators** caused light to moderate damage within the host range. No moths were caught in 50 **gypsy moth** pheromone traps placed in provincial parks, private campgrounds and port facilities throughout the region.

Mortality caused by **Rhizina root disease** was less severe, killing an average of 23% of the seedlings within at least 15 plantations in the southern half of the region. **Black army cutworm** caused light seedling mortality in a plantation near Morrison Lake, and lightly to severely defoliated seedlings in two plantations in the Kispiox Valley and one plantation in the Nass Valley.

Pests of young stands surveys summarized the influences of a variety of damaging agents, including insects, diseases and climatic factors.

High populations of **porcupines**, particularly in western and northern areas, continued to cause mortality in primarily young-growth western hemlock and lodgepole pine. Shoot clipping by **snowshoe hares** remained at low levels despite the expected population peak in 1990. Chronic light incidences of seedling clipping by **voles** were seen in the lower Skeena Valley and population increases in the interior caused scattered seedling mortality in two plantations.

Annual assessments within a plot established near Terrace as part of the **Acid Rain National Early Warning System** showed no symptoms of acid rain damage. Waned lumber and samples from woodborer-infested trees were collected to aid research into the incidence of the **pinewood nematode** in B.C. forests.

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 **other noteworthy 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 recent attacks by the mountain pine beetle declined to 131 350 m^3 over 3 530 ha in 1990, from 228 700 m^3 over 4 440 ha in 1989 (Table 1, Map 2). As in previous years, the highest numbers of red trees were mapped in portions of the Nass and Skeena river drainages within the ICH biogeoclimatic zone.

Table 1. Area, volume and number of lodgepole pine recently killed by mountain pine beetle. FIDS, Prince Rupert Forest Region, 1990.

Location (TSA)	Area (ha)[1]				Volume (m^3)	No. of trees
	light	moderate	severe	total		
Kalum	1 180	62	0	1 240	50 800	99 400
Kispiox	1 070	33	0	1 100	45 200	88 200
Bulkley	800	280	0	1 080	32 450	48 000
Morice	50	0	0	50	1 650	1 330
Lakes	60	0	0	60	1 250	1 500
Regional total	3 160	375	0	3 530	131 350	238 430

[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

The infested area decreased by 36% from 1989, while the incidence continued to decline to light in most areas. Most attacks again occurred in the Nass Valley from the New Aiyansh area to Meziadin Lake, particularly towards the TSA boundary north of Cranberry Junction. Scattered patches of attack in the Skeena Valley continued to decline. Throughout the TSA the total volume of infested timber and the number of trees attacked declined by 54 and 55%, respectively, from 1989, a further indication of the decline of infestations as hosts become limited due to previous years of infestation and logging.

Kispiox TSA

The area of infested timber declined by 36% to 1100 ha in 1990; the third consecutive year of decline in the TSA. The greatest decline again occurred in the Cranberry Junction area due to logging, host depletion by previous years of infestation, and dispersal into new host trees north of the TSA border. Most remaining infestations near the Cranberry River and on the east side of the Cranberry Valley declined to light incidence.

The incidence and area of infestations also declined in the Skeena Valley portion of the TSA, though patches of light to moderate incidence persisted from the Sedan Creek area to the TSA border at Big Oliver Creek. Infestations in the Kispiox Valley declined further to scattered patches of usually only a few trees.

As in the Kalum TSA, the total volume of infested timber and the number of trees attacked within the Kispiox TSA declined by 54% and 55%, respectively, from 1989. The causes of the decline were also similar.

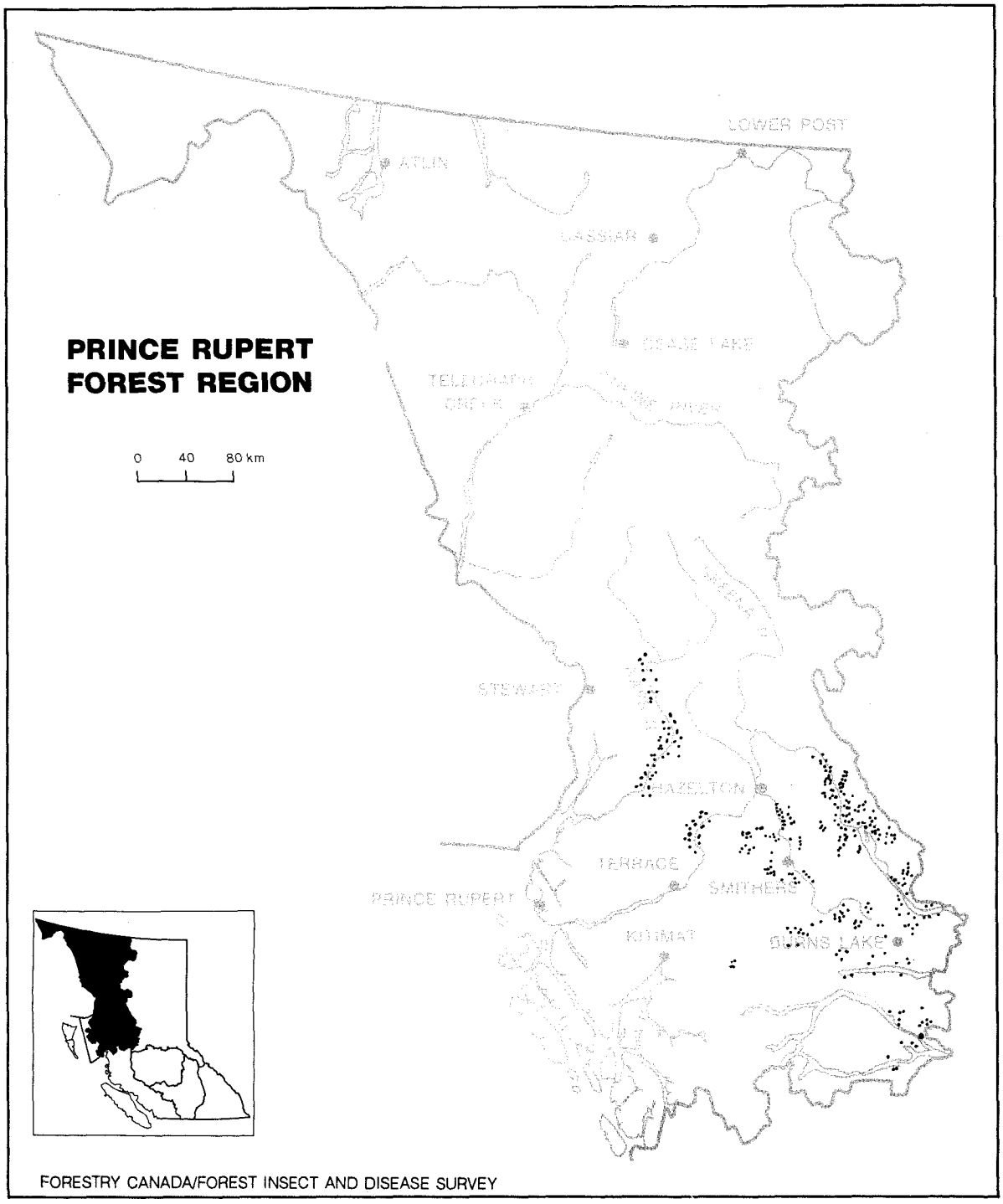
Bulkley TSA

The area containing pine mortality increased to 1 080 ha following increased current attacks last year throughout previously infested stands. Ministry funding for bark beetle control work in the Bulkley TSA was redirected to areas of higher priority and conseqently, planned fall and burn projects for the winter of 1989-90 were not able to be implemented.

As in the past five years, the greatest mortality was in the lower Telkwa River drainage, with losses of 24 000 m^3 of timber; this was 65% of the TSA total. On the north side of the river, intensive pheromone baiting followed by logging, held the beetle in check, resulting in levels of mortality similar to those recorded in 1989. Expanded infestations across the valley at Tenas Creek and three new patches of concentrated attack in an adjacent unnamed creek to the west, totalled over 15 000 red trees. Many smaller groupings of red trees were seen in upper Goathorn Creek (200 trees), in the Coffin Lake area (450 trees), in the McDonell-Sandstone lakes areas and on the east side of the Bulkley River, adjacent to the river and in side-creek drainages such as Lemieux and Deep creeks (scattered small spots numbering between one and ten trees).

In the Trout Creek drainage, an ongoing infestation on a steep hillside ust west of Schippers Creek, which last year totalled only 150 trees, increased o over 300, and an additional 500 red trees were mapped near Kitseguecla Lake. As in 1989, many small spot infestations were scattered in stands in lower Trout and Owens creeks, and across the Bulkley River in Gramophone, Meed and Reiseter creeks.

Farther north in the TSA, expanded and in some areas renewed beetle activity caused widespread spot mortality. South and east of Chapman Lake, where almost no activity was seen last year, over 600 red trees were mapped in infestations ranging between one and 30 trees each. In the upper Fulton River, Bristol Lake and Smithers Landing areas, mortality increased fourfold to over 400 trees, much of which, as in previous years, can be attributed to porcupine feeding, which also continues to increase in mature and immature pine stands throughout the northern half of the TSA. In the Harold Price Creek drainage, beetle activty has remained very light over the past three years. This year, however, 80 red trees were mapped at both Holland Hill and Blunt Creek. Chronic small infestations in the lower Nichyeskwa Creek drainage increased in both frequency and severity to total over 700 trees, as did infestations along the Nilkitkwa River, where totals doubled to 440 trees. The greatest increases however, occurred along the Babine River as far north as Mt. Horetzky, where the 74 trees recorded in 1989 increased to 1800 this year.



Map 2. Areas containing lodgepole pine recently killed by the mountain pine beetle as determined by aerial and ground surveys. FIDS, Prince Rupert Forest Region, 1990.

Morice TSA

Red tree numbers mapped during aerial surveys declined by 40% to 1335, due primarily to an aggressive fall and burn program in early 1990.

In the southern portion of the TSA, chronic small pockets continued to kill trees in the Houston Tommy Creek drainage (88 trees), Owen Hill (35 trees) and near Goosly Lake (38 trees). Infestations in the Parrott Lakes area and along Dockrill Creek, which last year threatened to expand significantly, were eliminated by logging and fall-and-burn operations. Small spot infestations in the McKilligan Lake-China Nose Mountain area totalled 100 trees.

The majority of beetle-caused mortality was again in the Morrison Lake area on the east side of Babine Lake, though here too, timely control efforts served to contain populations, and scattered pockets of red trees on the west side concentrated near Saddle Hill and on the east side near Hearne Hill totalled only 340 trees (range 6-47). New this year was a concentrated patch of 50 red trees on Old Fort Mountain, and two patches of 100 trees each on the east side of the northeast arm of Babine Lake. Near Big Loon Lake, three patches totalled 100 trees and surrounding Natowite Lake, seven patches totalled 90 trees. An infestation at the south end of Tochcha Lake, which last year contained 200 red trees and a similar number of current attacks, was logged over the winter and no further beetle activity was evident this year.

Lakes TSA

The total number of red trees, as determined from aerial surveys, increased to 1500 in 97 separate pockets from 550 trees in 80 locations in 1989. Similar to last year, infestations were small and scattered throughout the TSA, but on average, more trees were killed at each location.

Most of the mortality again occurred north of Babine Lake where red tree counts more than doubled to 420 (range 2-50). Current attack levels in 1989 were sufficiently high that these increases occurred despite the area being specifically targetted for fall-and-burn operations this past winter. On the south side of the lake, eight patches ranged from 3-30 red trees, and additional patches totalling 75 trees were mapped in the vicinity of Augier, Pinkut and Taltapin lakes. Near the western edge of the TSA, just north of the Bulkley River, 120 trees wre mapped in three infestations and patches totalling more than 150 trees were scattered between here and Francois Lake.

The largest single infestation spotted for the first time this year (400 trees), occurred near the eastern end of Ootsa Lake. An additional 2000+ current attacks have been identified at the same location and arrangements are being made to have this block delineated and logged before the next beetle flight.

Overwintering survival

The regional average reproductive ratio, or "R" value, decreased to 4.7 (Table 2) from 5.8 in 1989, indicating lower brood survival overall, but still potentially increasing populations. The general population decline in the west in terms of numbers of red trees or numbers of current attacks, is not clearly reflected in an "R" value, it being a survival ratio and not a measure of overall population.

Table 2. Overwintering survival of the mountain pine beetle. FIDS, Prince Rupert Forest Region, 1990.

Location	"R" value[1]	Population status[2]	Remarks
Telkwa River	7.7	increasing	highly variable: from immature larvae to teneral adults
Kitwanga	6.1	increasing	healthy brood in remaining large hosts
Sideslip Lake	6.0	increasing	healthy brood in remaining large hosts
Maxan Lake	5.9	increasing	mostly ultimate instar larvae
Cranberry Jctn.	3.3	static	limited host availability, lower survival in smaller trees
Trout Creek	3.0	static	mostly pupae
Coyote Creek	2.9	static	limited host availability, lower survival in smaller trees
Sedan Creek	2.9	static	limited host availability, lower survival in smaller trees
Regional average	4.7		

[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:
- ≤ 2.5 - decreasing population
- 2.6-4.0 - static population
- ≥ 4.1 - increasing population

In the Nass and Skeena valleys, populations of the beetle in chronic infestations were limited by host availability and lower brood survival in smaller-diameter trees. Extensive logging and over 20 years of infestation in the Cranberry Junction and Kitwanga-Cedarvale areas has also resulted in dispersion of beetles to less desirable higher-elevation stands and into mixed younger stands to the west and north, again reducing brood survival. Where suitable host trees were found, broods were largely unaffected by parasites and predators, resulting in good survival.

East of the Kispiox TSA, most of the infestations comprised small groups of trees in inaccessible areas and no specific survival information is available. The summer of 1989 was warmer than the average and subsequently promoted the acceleration of brood development in those areas where the cool damp conditions of prior years had caused some retardation. All broods seen in the late spring were healthy and on a normal development timetable.

Fall Surveys

Four stands were cruised in the region to determine current and previous attack levels in terms of the proportions of both volume and numbers of trees affected (Table 3). The average volume of current attack declined to 11%, compared to 17 and 14% in 1989 and 1988, respectively. This was due to a continuing combination of host depletion, predation, and lower brood survival in less favorable trees or sites.

Table 3. Status of lodgepole pine in representative stands infested by mountain pine beetle, determined from fall prism cruises. FIDS, Prince Rupert Forest Region, 1990.

Location	Percentages of stand (volume and number of trees)									
	Healthy		Current		Pitch-out		Red		Grey	
	vol.	trees	vol.	trees	vol.	trees	vol.	trees	vol.	trees
Sideslip Lake	41	56	10	9	6	4	10	9	32	22
Cranberry Junction	37	64	13	10	1	1	18	12	31	14
Coyote Creek	44	59	7	7	6	4	15	12	29	19
Telkwa River	67	78	13	6	0	0	9	6	12	10
Average	47	64	11	8	3	2	13	10	26	16

In the Kispiox and Kalum TSAs, ratios of current to red attack (C/R ratios) in chronic infestations near Cranberry Junction and in the Kitwanga - Cedarvale area averaged 0.8:1 based on numbers of trees and 0.7:1 in terms of volume. This indicates that the beetles are, on average, attacking fewer and smaller trees, which should result in a further decline in the outbreak.

Forecasts

In the Kalum and Kispiox TSAs, chronic infestations near the Skeena and Nass rivers should continue to decline in 1991. Availability of favorable host trees in mixed stands and additional logging will remain limiting factors to beetle spread. Remaining patches of mortality should again be located in the Skeena Valley between the Big Oliver Creek and Kitwanga areas, and in the Nass Valley from the Cranberry River to Meziadin Lake and from New Aiyansh to the Kiteen River.

In the three eastern TSAs, warm summer weather favored brood development and current-to red-attack ratios, though variable (ranging from one-six), averaged more than three. In the Morice and Lakes TSAs, attack levels were low enough that fall-and-burn programs this winter could effectively contain populations within manageable levels.

In the Bulkley TSA intensive logging and host depletion should result in a decline in mortality on the north side of the Telkwa River in 1991, but the trend toward increased attacks on the south side is expected to continue due to the availability of susceptible host. The high number and scattered

distribution of infestations, particularly in the Babine and Nilkitkwa rivers areas, make any control effort both difficult and expensive. Control plans by the BCFS include fall-and-burn treatment of up to 1400 trees in these areas and on remote sites in the Bulkley Valley, followed by MSMA[1] treatment of pheromone-baited trees in the summer of 1991. Barring an unusually cold winter, attacks in the Bulkley TSA are expected to increase significantly in 1991.

Warren's root collar weevil
Hylobius warreni

High populations of root collar weevils continued to feed on 6- to 20-year-old lodgepole pine in planted and natural stands primarily in the ICH biogeoclimatic zone in the eastern portion of the Kispiox TSA. Despite the high incidence of infestation, however, weevil-caused mortality was low, with current mortality generally 1% or less. One notable exception was in a 7-year-old natural pine stand at km 1 of the Salmon Road, just north of Hazelton, where an additional 4% (10% in 1989) of the trees succumbed this year. The accummulated mortality in this stand over the last three years has totalled 29%. Young pine in this area were particularly at risk because of high residual populations of adult weevils in unburned stumps of the previous stand. This existing population quickly attacked the young natural regeneration while the trees were still small and susceptible to girdling by as few as one larva.

Four long-term Hylobius damage assessment plots, established in 1988 in the Kispiox and Bulkley TSAs to monitor the effects of feeding (see Forest Insect and Disease Conditions, Prince Rupert, 1988) were revisited this year and all trees were remeasured. Single trees in two of the plots (Telkwa Hi-Road and Collins Lake) succumbed this year to Hylobius feeding. As in 1989 however, remeasurements failed to show any significant difference in rates of radial growth between trees lightly infested and those severely infested by the weevil. Those trees between 0 and 30% girdled increased in diameter by an average of .65 cm in each of the last two years, while those more than 70% girdled grew an average of .60 cm, a difference of only 1.1%.

Trees in the Date Creek plot (all of which were infested by Hylobius) which last summer dropped a large proportion of their lower crown needles, continued to keep pace in both height and increment growth with unaffected trees and showed no signs of continued decline. It is not known whether the needle loss was related to the infestation.

All plots will be remeasured in 1991. In the final year of the study (1992), percent girdling both in terms of pitch mass coverage and real circumferencial girdling by Hylobius larvae will be assessed to establish the relationship that exists between the two. The effects of screefing and pruning treatments to a sampling of trees at the Date and Trout creek plots will also be evaluated at this time.

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[1] monosodium methane arsenate

Lodgepole terminal weevil
Pissodes terminalis

Terminal weevil damage was less widespread than in 1989 but higher attack levels were found in two stands where significant attack levels have occurred in three successive years (Table 4). Near km 24 of the Upper Fulton Road where 6% of the leaders were attacked in 1989, no recent attacks were seen. Low incidences of attack were found in two additional plantations during young stand surveys (refer to Pests of Young Stands) but populations were not assessed.

Table 4. Incidence of damage by lodgepole terminal weevil and predictions for 1991 populations, FIDS, Prince Rupert Forest Region, 1990.

Location	Percent terminals attacked	Average number progeny[1]	Relative 1991 populations
km 65 Morice L. Road[2]	12	1.4	increasing
km 20 Trout Cr. Road[2]	10	1.0	increasing
km 28 Nilkitkwa Road	5	1.0	increasing
Average	9	1.1	increasing

[1]Counts of numbers of exit holes and teneral adults in each of 10 terminals per site. Previous studies within the region have found that populations increased above 0.62 progeny per terminal (FIDS Report 88-5).
[2]Cumulative attacks have totalled 19 and 30%, respectively, in these areas over the past three seasons.

Levels of parasitism were similar to last year, at 9%. The tips of two infested leaders also contained fir coneworm, Dioryctria abietivorella larvae which had attacked the living buds before weevil larvae had girdled the shoots.

Based upon population assessments, attacks by lodgepole terminal weevil are expected to increase slightly in 1991.

A pine sawfly
Neodiprion nanulus contortae

Increased populations of this pine feeding sawfly lightly defoliated the lower crowns of young lodgepole pine in a 20-year-old stand adjacent to the Bulkley River at Mosquito Flats, in the Kispiox TSA. Feeding was concentrated on about 20% of the branches on 40% of the trees over an area of approximately 100 ha. A standard three-tree beating yielded 175 larvae in late June, but no coccoons could be found in the duff during a follow-up survey in late July.

This is the only sawfly commonly found defoliating lodgepole pine in B.C.; however, most of the records of previous damage originated in more southern locations in the province.

The limited feeding damage sustained this year will not measurably affect the growth of the trees. Populations will be monitored in 1991.

SPRUCE PESTS

Spruce beetle
Dendroctonus rufipennis

Spruce beetle populations continued to build in susceptible stands, mainly in previously infested stands near Haul Lake in the northern part of the Morice TSA, and in scattered forest and fringe blowdown in central and southern parts of the TSA. Since 1989 was the non-flight year of the beetle's (normally) two-year life cycle, attacks were few and scattered. Consequently, no recent mortality was recorded during aerial surveys in 1990. Ground-based surveys concentrated upon locating and evaluating current-attack in susceptible timber.

Near Haul Lake, where in 1989 light mortality (from attacks in 1988) covered 30 ha, a similar number of trees were attacked in 1990. Infested stands were probed by industry in the fall of this year to determine attack ratios and to set boundaries of cutblocks, proposed to allow the harvest of infested timber before the next major flight period in 1992. A total of 105 currently attacked trees were found compared with 108 greys. An additional 22 trees were fading, and contained immature adults, indicating a 20% "off-cycle" population which will mature and fly in the spring of 1991.

Logging road and cutblock fringe blowdown are common targets for spruce beetle attacks and often provide an early indication of building populations because beetles will choose this material over healthy standing trees. Light attacks in blowdown were seen at three locations:

1. Skinhead Lakes near Granisle - Light incidence of relatively small-diameter blowdown beside a road connecting recent cutblocks. Less than 5 attacks per m^2 of bole surface.
2. Nado Road - Situation very similar to above but spruce beetle attacks at an even lighter incidence.
3. Near km 63 West Morice Road - Blowdown extensive over 5 ha adjacent to a recent cutblock. Some large-diameter (50 cm+) spruce very lightly attacked (less than 1 attack per m^2) on undersides.

Most new attacks in the Morice River corridor occurred in scattered inaccessible pockets of blowdown adjacent to previously infested material in the valley bottom. Treatment or removal of these trees will be difficult due to their scattered occurrence, and because much of the corridor has been designated as a special protection zone, thus limiting industrial activity.

Accessible stands will be further sampled in 1991 to determine the potential for spread of infestations into standing timber, and aerial surveys later in the year will view the extent of damage caused by 1990 attacks, as they become become visible through discoloration.

White pine weevil
Pissodes strobi

The white pine weevil (locally known as the spruce weevil) is a chronic pest of young spruce stands in several southern areas of the region and is of particular concern in hybrid Sitka X white spruce, planted extensively in the

Kitimat, Skeena, and Nass river drainages. Infested trees usually lose two years of height growth with each successful attack and often develop stem crooks. Overall incidences of current attack have averaged about 20% per year in the CWH zone of the Skeena and Kitimat river drainages, and 5 to 10% farther north in the Nass River drainage. Proximity of a young stand to a watercourse appears to increase the incidence of attack, particularly within the first 10 to 15 years, varying within the general hazard of weevil attack in the area.

Surveys in 1990 were conducted to determine the occurrence, if any, of "resistant" hosts. Thirteen stands were assessed in areas of the CWH zone where attacks reach and maintain high levels (Table 5). The occurrence of attack did not seem to be limited by host resistance, but appeared to be related to the weevil population as expressed by the level of current attack and how recently attack levels had reached a chronically high level. The most severely affected stands had sustained high levels of attack for at least 2 years; at two such locations none of the original crop trees had avoided attack.

Table 5. Surveys of current and previous white pine weevil attacks in stands of sapling-aged hybrid Sitka X white spruce planted in the Kitimat and Skeena river drainages. FIDS, Prince Rupert Forest Region, 1990.

Location	Stand age	Attack history[1]	Percent of trees currently attacked	Percent of trees without current or previous weevilling
Km 7 Clore R. Rd.	13	recent	46	40
Km 17 Copper R. Rd.	14	recent	24	62
Km 30 Copper R. Rd.	14	recent	35	37
Branch 77 Rd.	14	recent	52	29
Km 7 Coldwater Rd.	16	recent	56	10
Leanto Ck.	18	recent	36	12
Km 0 Coldwater Rd.	18	recent	56	21
Kitimat R./Nalbeelah Ck.	11	established	44	1[2]
Km 4 N. Kitimat Main	14	established	27	20
Km 12 Kitimat R. Rd.	17	established	46	6
Km 32 Copper R. Rd.	20	established	37	5[2]
Km 14 Kitimat R. Rd.	20	established	39	2[2]
Km 31 Copper R. Rd.	22	established	25	10

[1] Stands were rated as to whether high levels of weevil attack (>20%) had started occurring recently (within 2 years) or had been established for longer, reflecting the hazard in the area and the chances of current/previous attack.

[2] The only trees without weevilling in these stands were smaller natural regeneration which had seeded in after stand establishment. All original crop trees had sustained damage.

A portion of a Forestry Canada research project on "enhanced clipping" was conducted in the Prince Rupert Forest Region by the B.C. Forest Service in a 4-ha young stand selected by FIDS at Mannix Creek. The trial involved placing clipped infested leaders into barrels with a selectively screened opening to prevent the release of weevils but allow parasites and predators to escape, hopefully boosting natural control. Post-clipping surveys by FIDS in 1989 found 55 unclipped infested leaders and 8 not clipped low enough, totaling 2 to 3% of the current attack. In spite of this level of clipping intensity, probably reflecting the standards which could be achieved operationally, new attacks in the 1990 field season were estimated by FIDS in June to be in the 30 to 35% range. This was a marginal decrease, if any, from previous years. Considering these continuing high levels of attack and the size to which the trees in the plot had grown, the project was terminated at this site. A new, younger stand meeting the criteria of the project has not yet been found.

Eastern spruce budworm
Choristoneura fumiferana

An outbreak of the eastern spruce budworm, underway since 1985 in northern Prince George Forest Region, again defoliated white spruce in the northeast corner of this region. The intensity of defoliation was slightly higher than levels recorded in 1989. The defoliation gradient observed from the Prince George Region into this region was as follows: Liard River Crossing to Smith River - light with patches (several hectares) of moderate; Smith River to Coal River - trace to light, occasional small patch of moderate; Coal River to Eg Fire - trace with occasional light patch; west of Eg Fire - no defoliation seen. On Highway 37, trace defoliation was again noted on sapling-aged regeneration at Blue River.

In the third year of a study to gain information on the distribution of four species of Choristoneura, sets of six pheromone-baited plastic container traps ("Universal") were deployed throughout the region (Map 3). North of the Stikine River, trap catches at Dorothy Creek and Boya Lake averaging 3 and 104 moths, respectively, were identified as C. fumiferana. These numbers were considerably reduced from average catches of 730 and 3 600 moths, respectively, in 1989; the decline was predicted from egg sampling in August 1989 and supported by larval sampling in June 1990. No defoliation occurred in the trapping areas, both currently or as a result of the unexplained large moth flight trapped in 1989.

Traps were also placed at a new location, the Stikine River, to further define the distribution limit between C. fumiferana trapped from Dease Lake north and the C. biennis/orae mixture trapped from Kinaskan Lake south. Catches were also low at the Stikine River site, averaging two moths per trap. Taxonomic identification of the moths is in progress.

A spruce gall adelgid
Pineus pinifoliae

This gall-forming adelgid is a chronic pest of young spruce throughout the Prince Rupert Region, and as such, is not normally surveyed. This year, however, significant increases in attack frequency occurred in parts of the Bulkley TSA. Near Bristol Lake, 90% of the 2 year-old white spruce in a mixed spruce-pine plantation were infested over 30 ha with an average of 10% (range

1-40%) of the branch tips supporting current P. pinfoliae galls. In another mixed-species stand at Chapman Lake, 20% of the upper crown branch tips on 10% of the spruce were infested. This dramatic rise in the adelgid population has occurred in one year, since there was little evidence in either plantation of attacks in prior years (i.e. old galls). In a 20-year-old mixed spruce-pine-Douglas-fir (exotic) plantation at km 26 on the North Road near Houston, an average of 10% of the growing tips were infested on all of the white spruce. The narrow, ragged crowns of these trees and an abundance of older adelgid galls testified to chronic infestation in this area.

This adelgid is also known as the pine leaf chermid, but its life history differs significantly from its namesake in more southern and eastern areas. P. pinifoliae in other areas requires western white pine to complete its life cycle, whereas this species appears to cycle exclusively on white and Sitka spruce, requiring no (or, an as yet unknown) alternate host. This and other anomalies have led to a full taxonomic review of the genus, a process currently in progress in Ottawa.

Infestation by gall adelgids is not known to have caused any tree mortality in the forest, and is mainly of concern in nursery situations or ornamental plantings. There is, however, evidence of a loss of current growth potential due to the deformation of growing tips. This may become significant if young trees are repeatedly attacked by sustained or increasing populations over successive years.

TRUE FIR PESTS

Western balsam bark beetle complex
Dryocoetes confusus
Ceratocystis dryocoetidis

Active balsam bark beetle infestations in mature alpine fir stands were mapped over a total of 58 440 ha, primarily in the Morice, and parts of the Bulkley and Cassiar TSAs, during overview flights in 1990. Additional infestations estimated to cover over 25 000 ha have been mapped in previous years, primarily in the Cassiar and Bulkley TSAs. New attack incidence was generally low, averaging less than 2% of trees in infested stands. Area figures do not accurately reflect recent attack levels due to the retention of red needles by dead trees for up to five years following attack.

In response to a growing concern over the impact of the beetle in old-growth alpine fir stands, a two-day aerial survey was undertaken this year in late June in the Morice TSA, specifically to map the recent and accumulated older beetle-caused mortality (Table 6). The maps are being used by the Forest Service to priorize harvests in areas most affected by successive attacks by the beetle. Salvage harvests are currently focussing on infested stands in the Shelford Hills and in the Walcott drainage where, in some stands, accumulated mortality (including recently killed red and old grey trees) has exceeded 30% of stand volume. In addition, the West Morice Forest Road is being extended to access infested stands in the Thautil River drainage, west of Houston.

Table 6. Summary of alpine fir mortality in the Morice TSA caused by the western balsam bark beetle complex. FIDS, Prince Rupert Forest Region, 1990.

Location (south-north)	Area (ha)	Description
Tahtsa Reach	4 700	up to 15% grey, scattered reds (2-10%)
Mosquito Hills	4 500	up to 20% grey, scattered reds (avg. 2%)
Shelford Hills	5 900	up to 25% grey, patches of from 1-10% red
Nadina Lake - Morice Lake	3 500	up to 20% grey mixed with 1-5% red
Nadina Mountain	2 900	mostly mixed: 2-20% grey, 2-10% red
Parrott Lakes	1 000	1-5% grey with scattered reds
Thautil River - Houston Tommy Creek	3 000	2-10%, scattered reds, mostly grey
Walcott	17 600	5-30%, scattered reds, mostly grey
Deception Lakes	4 000	up to 30% grey, patches of up to 10% red
Babine Lake	3 800	2-15%, mostly reds
Morice TSA Total[1]	50 900	

[1] An additional 13 300 ha, mostly in the Walcott and southern areas contained only grey trees (1-20%) with no recent attacks.

During a flight over the southeastern quadrant of the Cassiar TSA, completing a three year overview of major drainages throughout the district, 1200 ha of light incidences of mortality due to the balsam bark beetle were mapped. Most of the activity was in the Klappan and Pitman river valleys, raising the total area of known infestation to 17 300 ha across the TSA.

In the Kispiox TSA, spot outbreaks at light incidence totaling 2020 ha were mapped in portions of the upper Skeena Valley, on mid-elevation south-facing slopes from Kitwanga to Woodcock, and on upper slopes along parts of the east side of the Cranberry River Valley. This was the first time outbreaks in the latter two areas had been mapped, and adds to the new areas throughout the region where the impact from this insect is expanding.

Scattered mortality in the Kalum TSA, <1% incidence, was observed in remaining old growth stands in the Bell-Irving Valley, particularly in higher elevation sites southwest of the Bell-Irving Crossing. Attacks are also common at light intensity in valleys towards the northern TSA boundary. Neither of these areas were flown in 1990; estimates were based on ground observations.

Aerial surveys for balsam bark beetle covered only a portion of the Bulkley TSA in 1990. Trace-light levels of recent mortality covered 4300 ha including McKendrick Pass (2800 ha), the Telkwa River Valley (1100 ha) and the Kitseguecla Lake area (400 ha). Since 1986 much of the infested timber from McKendrick Pass has been harvested in an effort to salvage remaining timber values.

No balsam bark beetle aerial surveys were undertaken in the Lakes TSA in 1990.

Western blackheaded budworm
Acleris gloverana

Blackheaded budworm populations declined significantly after four consecutive years of light-severe defoliation of the new growth of alpine fir and white spruce. No defoliation was observed in areas of the Bulkley and Morice TSAs where, in 1989, 70 000 ha of timber was infested. The general population decline was predicted following egg surveys in the fall of 1989.

Early season infested bud counts averaged only 10% (range 4-16%) in June, and in July larvae from standard beating samples dropped 82% to an average of 43 larvae (range 15-83) at five sites, infested in all of the previous four years.

Larval parasitism in mass collections from three locations averaged 34% (range 2.3-85%), mostly by an hymenopterous parasitoid (Braconidae). Given the extreme range in the levels of parasitism from different locations, it is not possible to determine its role in the general decline in budworm populations.

The overall impact of four consecutive years of light defoliation by the budworm has been minimal and, except between km 55 and 60 of the West Morice Road, where some top stripping of understory alpine fir was recorded in 1989, affected stands recovered full growth potential in 1990.

Conifer budworms
Choristoneura spp.

No defoliation of true firs attributed to fir-spruce budworms was recorded within the region in 1990.

To improve and calibrate methods of detecting fir-spruce budworms, sets of five pheromone-baited plastic container traps ("Multipher") were deployed near the Wedeene, Kispiox, Telkwa, and Morice rivers and near Meziadin and Onion lakes (Map 3). Twenty-five marked trees at each site were assessed, using a standardized branch-beating method, for larval numbers which could be later related to the number of male moths captured in the traps. No larvae were collected in 1990. Though the number of moths increased significantly at four of the six locations[2], catches remained at relatively low levels with little possibility of defoliation occurring in 1991.

In a study to gain information on the distribution of four species of Choristoneura, sets of six pheromone-baited plastic container traps ("Universal") were deployed at Kinaskan Lake and the Stikine River Crossing (Map 3). Taxonomic analysis of the moths is in progress; preliminary results indicate a mixture of C. biennis and C. orae at these sites. At the Kinaskan Lake site, moth catches declined from an average of 850 moths per trap in 1989 to an average of only 2 in 1990. The decline, which was predicted by egg samples in 1989, corresponded to a similar decrease in traps farther north where C. fumiferana was the main species trapped (see "Eastern spruce budworm").

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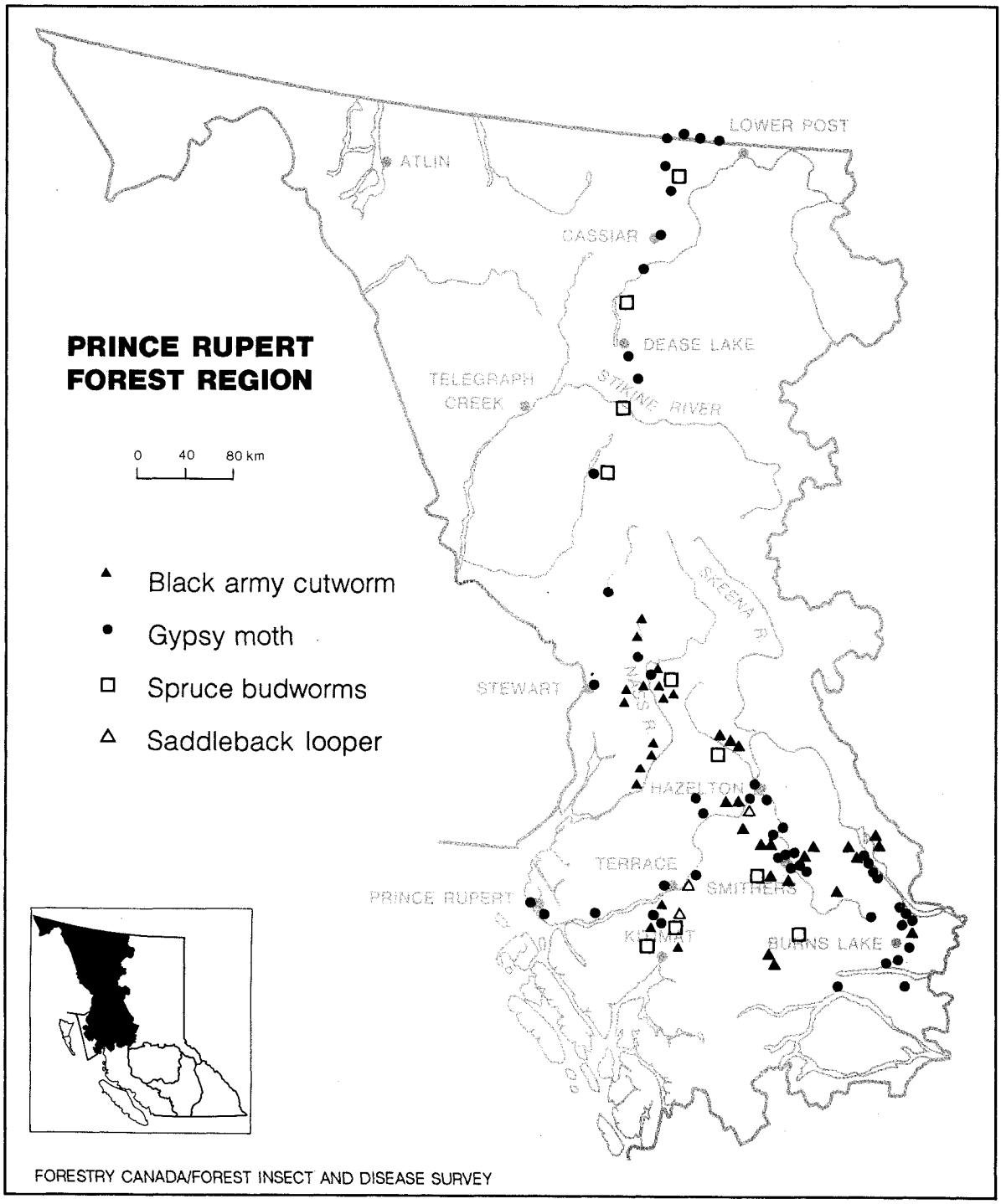
[2] C. orae: from 0 moths in 1989 to an average of 51 and 12 moths at Wedeene River and Onion Lake, respectively, in 1990, and from an average of 5 moths at Cedric Creek in 1989 to 90 in 1990.
C. biennis: from an average of 8 moths in 1989 to 17 in 1990 at Meziadin Lake.



Map 3. Locations where one or more pheromone-baited traps were deployed. FIDS, Prince Rupert Forest Region, 1990.

LARCH PEST

Larch sawfly
Pristiphora erichsonii

Defoliation of tamarack by the larch sawfly in the northern part of the region was again prevalent. The intensity of defoliation remained at the elevated level recorded in 1989, ranging from light to moderate in southern extents of the host range to moderate and severe further north toward the Yukon border.

Defoliation of ornamental larch throughout the Terrace area continued to decline, to trace to light intensity, the lowest levels since the sawfly was first collected in the townsite in 1987. A few small pockets of moderate defoliation persisted in western suburbs. Exotic larch plantations in the Nelson River area remained free of defoliation caused by the sawfly.

DOUGLAS-FIR PEST

Douglas-fir beetle
Dendroctonus pseudotsugae

A single infestation of Douglas-fir beetle recently killed over 30 Douglas-fir on the north shore of Francois Lake. The infestation was first seen in August 1990, by which time an additional 310 trees had been currently attacked. Infestations of Douglas-fir beetle are rare in the region, the last recorded mortality being in 1983 near Pinkut Creek. The beetle normally favours stressed and windfallen tree and attacks healthy mature trees only when populations increase.

Fortunately, the current infestation is located near a road, allowing infested trees to be removed before the next beetle flight, and no recurrence of attack is expected in 1991.

WESTERN HEMLOCK PEST

Saddleback looper
Ectropis crepuscularia

Three sets of pheromone traps were set out in the the ICH zone near Terrace (two sets) and Hazelton, in April, in an attempt to catch male saddleback looper adults. The purpose of the program was to test the efficacy of 12 pheromone formulations[3]. Unfortunately, no moths were trapped and subsequent larval sampling revealed that populations remained at endemic levels. Previous outbreaks of the looper resulted in severe defoliation of hemlock at and near Kitimat in 1960-61 and 1969.

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[3] in co-operation with Dr. J. Millar, University of California, Berkely, and the National Research Council, Saskatoon.

DECIDUOUS PESTS

Tent caterpillars
Malacosoma spp.

Current Activity

Defoliation by the northern tent caterpillar, *Malacosoma californicum pluviale*, continued for a second year in the Skeena Valley. Valley bottom deciduous growth, mostly black cottonwood, was lightly to severely defoliated in the Skeena Valley from the Kasiks River area east to the Shames River area. From an aerial survey in July, the area defoliated in the lower Skeena Valley totalled 3 233 ha, comprising 1 994 ha of light defoliation, 1 135 ha moderate, and 104 ha severe. This was a considerable increase in area from 1989 when defoliation occurred for 3 km east of the Exchamsiks River area, over about 150 ha. Current light to moderate defoliation also occurred in several areas of Terrace, particularly affecting domestic fruit trees.

Farther south, scattered light to severe defoliation of willow and alder observed in the Wedeene River Valley was also caused by the northern tent caterpillar. Defoliation of all deciduous species by the forest tent caterpillar, *M. disstria*, declined to light with occasional moderate patches in the Kitimat area, from moderate to severe levels recorded in 1989.

In all areas, early season defoliation was followed by a second, smaller flush of foliage in mid to late summer. Usually there is very little tree mortality directly attributable to defoliation by tent caterpillars; however, successive years of moderate to severe defoliation will reduce radial growth and may cause branch and twig dieback.

Forecast

Defoliation in the Skeena Valley is again expected to increase in area and intensity in 1991, based on surveys of egg masses conducted in September (Table 7). Levels of disease and parasitism were not assessed in 1990 but are not expected to significantly impact the population at this stage of the outbreak.

Table 7. Predictions of 1991 defoliation by the northern tent caterpillar based on egg mass counts in the Skeena Valley. FIDS, Prince Rupert Forest Region, 1990.

Location (east to west)	Current Defoliation	Tree(s) Sampled	Avg. DBH (cm)	Avg. No. Egg Masses old	Avg. No. Egg Masses new	1991 prediction[1]
Ferry Island	None	bCo	13	0	1	Light
Terrace townsite	Light	apple	11	3	26	Severe
Lakelse River	None	bCo	11	0	1	Light
Shames River	Light	wB	11	5	21	Severe
		bCo	12	1	12	Severe
Esker Creek (SCI bCo nursery)	Light	bCo	11	7	58	Severe
Kasiks River	Light	bCo	11	1	18	Severe
Kwinitsa River	None	bCo	11	0	1	Light
		rA	10	0	0	None

[1]Predictions of defoliation are based on thresholds developed from work with tent caterpillars on inland trembling aspen; 11 or more egg masses per tree of these sizes was indicative of severe defoliation the following season unless significant parasitism or disease intervened. In the Skeena Valley, most defoliation occurred in the overstory bCo component - predictions from the small understory or fringe trees sampled probably represent the minimum defoliation that can be expected overall.

Alder defoliators

Several insects continued to infest alder foliage in the lower Skeena River drainage. An alder leaf beetle, Pyrrhalta punctipennis, occurs throughout the range of alder in this area and caused patches of light to moderate defoliation in the Kwinitsa River area. The European alder leafminer, Fenusa dohrnii, caused patches of light, and occasionally moderate defoliation in the lower Skeena Valley as far east as the Lachmach River area. The alder woolly sawfly, Eriocampa ovata, skeletonized foliage at mostly moderate intensity in and near the Prince Rupert municipal campground for the sixth consecutive year. Chronic occasional patches of light to moderate defoliation caused by the striped alder sawfly, Hemichroa crocea, continued in the Lakelse to Terrace area.

Gypsy Moth
Lymantria dispar

Single gypsy moth pheromone-baited traps were placed and retrieved from 49 locations in the region as part of an ongoing co-operative 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 provicial parks, private campgrounds, major highway rest areas, and port facilities. Recreation vehicles visiting from the east and south, where the gypsy moth is established, are considered the primary vectors in the spread of this insect.

Repeated light catches of male adults in traps in the Lower Mainland, and Vancouver Island re-emphasize the need for continued monitoring; early detection allows the implimentation of a program to eradicate any successful introductions before they become established.

MULTIPLE HOST PESTS

Rhizina Root Disease
Rhizina undulata

For an unprecedented third consecutive year, seedling mortality associated with Rhizina root disease occurred in plantations established the first season after slash burning in the southern half of the region.

Current Activity

Seedling mortality caused by Rhizina root disease in susceptible 1990 plantations averaged 13% (range 1 - 37%) in 15 of 26 sites examined (Table 8), down from an average of 27% in 24 infected plantations in 1989. As in prior years, most of the mortality occurred in the ICH biogeoclimatic zone of the Kalum, Kispiox and western Bulkley TSAs, but this year six of the infected sites were in the drier colder SBS zone in the Bulkley and Morice TSAs. All sites surveyed had been broadcast-burned in the fall of 1989 and planted in the spring of 1990.

Despite overall reductions, the disease expanded it's range into three plantations in the Harold Price Creek drainage in the northern Bulkley TSA, and two near Perow and one near Granisle in the Morice TSA, signalling an increased potential for damage in future burns in the drier inland areas, where only isolated spot infections have occurred in the past. The unusually dry conditions which prevailed in these areas from mid-July to early October may have lessened the impact of the disease by limiting mycelial growth and subsequent fruiting.

Much of the reduction in disease occurrence was due to reduced broadcast burning in 1989, particularly in the Kalum and Kispiox TSAs. Additionally, on some infected 1989 burn sites, planting was delayed until the fall of this year or the spring of 1991, when the disease should be less likely to cause damage. These measures were taken by the BCFS and licensees largely in response to the high incidence and intensity of infections in 1989. Follow-up surveys will be conducted in 1991 to determine the impact of the disease at sites where planting was delayed.

Table 8. Locations and impact of infections by Rhizina root disease on sites burned fall 1989 and planted spring 1990. FIDS, Prince Rupert Forest Region, 1990.

TSA	Location	Biogeoclimatic Zone	Host(s)	Percent Seedlings		
				Dead[1]	Infected[2]	Healthy
Kalum	Nass River Drainage					
	Km 7.5 Kwinatahl Main	ICHmc2	lP	23	11	66
	Km 24 Kwinatahl Main	ICHmc2	sS	37	18	45
	Hwy 37, 8km S Orenda Camp	ICHmc2	sS	26	7	67
	Km 1 Tintina Main	ICHmc2	sS,lP	10	2	88
	Km 13 Windfall Main	ICHmc2	sS	8	3	89
	Bell-Irving River Crossing	ICHvc	sS,alF	18	6	76
	Kitimat River Drainage					
	Km 9 Hirsch Creek N Road	CWHvm	wH,wrC,sS	6	0	94
Kispiox	Burdick Creek CP 105 Blk. 6	ICHmc3	sX,lP	27	3	70
Bulkley	Trout Creek CP 354 Blk. 1	ICHmc2	wS,lP	11	3	86
	Km 14 Chapman CP 81 Blk. 1	SBSmc	lP	2	0	98
	Km 22 Chapman CP 84 Blk. 1	SBSmc	lP,wS	3	0	97
	Km 37.5 Chapman CP 27 Blk.1	SBSmc	lP,wS	5	0	95
Morice	Km 48.5 North Road	SBSmc	lP,wS	12	4	76
	Km 44 North Road	SBSmc	wS	1	0	99
	Granisle (Skinhead Lakes)	SBSmc	lP	1	0	99
REGIONAL AVERAGE				13	4	83

[1]Dead seedlings includes those confirmed and those presumed to have been killed by Rhizina undulata. Confirmation was not possible in many cases because of the difficulty of microscopically identifying the mycelium in direct association with tree roots. Some small percentage of the mortality was probably due to undetermined site and stock factors.

[2]Seedlings with adjacent Rhizina fruiting bodies and showing definite signs of stress. Previous surveys have determined that over 90% of these seedlings will die during their next growing season.

Follow-up assessments

Follow-up surveys were conducted on infected sites during the second year of the outbreak to determine the ongoing impact (Table 9). The incidence of Rhizina fruiting bodies and seedling mortality dropped considerably in the second year; at 8 of the 9 locations, all 1990 mortality was attributed to infections contracted in 1989.

Table 9. Results of follow-up surveys to determine the impact of Rhizina root disease and other causes[1] in sites burned in the fall of 1988 and planted spring 1989. FIDS, Prince Rupert Forest Region 1990.

Location (north to south)	Biogeoclimatic Zone	Host(s)	Stocking (No. trees per ha) 1989 spring	1989 fall	1990 spring[2]	1990 fall[3]
Hwy 37, 38 km S Meziadin	ICHmc2	lP, sS	1 300	620	360	300
Lavender Ck. Rd. km 10	ICHmc2	sS, lP	1 150	920	540	520
km 14	ICHmc2	lP	1 240	540	240	240
Kwinatahl Rd.,						
Goat R. Branch km 1	ICHmc2	lP, sS	1 100	460	340	320
km 3	ICHmc2	lP	1 380	620	380	380
Little Cedar Rd. N. km 3	CWHws1	wH, sS	1 160	540	880	840
Lakelse R. Rd. km 14	CWHws1	wH,sS,wrC	1 350	580	480	460
km 9	CWHws1	wH,sS,wrC	1 180	360	200	200
Hwy 16/Little Oliver Ck.	ICHmc3	lP,wrC,sS	1 180	1 120	1 120	990

[1]Mortality includes seedlings confirmed and presumed killed by Rhizina root disease; confirmation was not possible in many cases because of the difficulty identifying mycelia in direct association with tree roots. A small percentage of the mortality was probably due to undetermined site and stock factors.

[2]Spring 1990 stocking increase at the Little Cedar Rd. site was due to fill planting.

[3]At the Little Oliver Creek site, 8% of recent mortality was attributed to current Rhizina activity; prior to being killed the trees had a healthy 1990 flush and there were new fruiting bodies nearby. The rest of the 1990 fall mortality at this site, and all new mortality at each of the other sites, was a result of infections contracted in 1989.

Management

Mass fruitings of Rhizina in forest situations follow wild fires or prescribed burns since the heat greatly increases the frequency of spore germination and temporarily eliminates competing organisms from the site. Rhizina fruits from early summer through to fall frost, a minimum of four months following a burn. A poor competitor, the fungus normally survives only a few years following a burn, after which it is succeeded by more aggressive fungi.

Rhizina fruiting bodies produced in the late summer and early fall of 1990, though slightly less abundant than in 1989, released spores in more than sufficient numbers to potentially heavily infect nearby sites subsequently burned in the fall. Because of the number of variables involved[4] there is no

[4]Though no spore migration studies have yet been done, infection patterns indicate that levels of inoculum depend upon proximity to a previously infected site (elevation and distance), direction of prevailing winds, relative aspect and topography. Levels of infection depend upon levels of inoculum, the timing and severity of the broadcast burn and temperature and moisture conditions during the growing season.

reliable method to accurately forecast the occurrence or severity of infections, though if the established trend toward range expansion is followed, fruiting bodies can be expected in almost every successful broadcast burn in the southern half of the region in 1991.

While the fungus remains as a virulent threat to newly planted seedlings in broadcast-burn blocks, it significantly increases silvicultural costs by necessitating special surveys and, in many instances, fill plants or even entire block replants. Though seedling mortality should be reduced by delaying planting for six months to a year, such practices will not reduce the incidence of the fungus and will instead re-introduce familiar problems such as increased brush competition and increased risk of damage to newly planted seedlings by the black army cutworm. The only effective means of limiting the occurrence and spread of the fungus may be to further reduce the number of broadcast burns or to limit burning to areas with no recent history of infection. Studies in England have shown that Rhizina spores can remain viable for up to three years. Assuming similar spore viability in this country, it may not be safe to burn blocks adjacent[5] to previously infected blocks for six years[6].

Black army cutworm
Actebia fennica

Cutworm defoliation in recently planted stands increased slightly in 1990, causing seedling damage on three sites and herbaceous defoliation on an additional three (Table 10).

Current Activity

In the Kalum TSA, with one exception, feeding was limited to herbaceous growth, mostly fireweed. An exception occurred in a plantation at km 5 on the Orenda Main where newly planted western hemlock seedlings were completely defoliated, delaying further planting until after the larval feeding period.

Populations were high in two plantations in the Kispiox TSA. At CP 314 on the Corral Main, herbaceous growth was moderately defoliated and seedlings lightly damaged for the second successive year. It is unusual for black army cutworms to attack the same site two years in succession. About 50 seedlings at CP 302 Blk 7 were severely defoliated in June, but a combination of unflushed buds and adventitious budding later in the season refoliated all of the damaged trees (Photos 1 & 2). This small infestation served to dramatically illustrate the resilience of seedlings planted in the first year following a broadcast burn and hence established on a site for a year before cutworm feeding commenced. Seedlings planted in the second year and immediately defoliated to the same degree often suffer a high rate of mortality because they lack the reserves required to regenerate lost foliage.

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[5] Adjacent with respect to the movement of fungal spores. This has less to do with distance than it has to do with prevailing winds and elements of topography, so decisions would be made on a site-specific basis.

[6] The fungus would fruit in years one and two. Burning could then be done with minimal risk in the fourth year following the last fruiting.

Table 10. Damage due to black army cutworm feeding on seedlings and/or herbaceous ground cover on 1988 prescibed burns. FIDS, Prince Rupert Forest Region, 1990.

Location	Area defoliated	Remarks
KALUM TSA[1]		
Km 5 Orenda Main	5 ha	planted 1990. Western hemlock seedlings 100% defoliated - planting halted
KISPIOX TSA		
Bush Main CP 302 Blk 7	1 ha	planted 1989. 50 white spruce 90-100% defoliated - refoliated by September
Corral Cr. CP 314 Blk 6	10 ha	planted 1988. White spruce defoliation very light-moderate herbaceous defoliation. Second successive year
BULKLEY TSA		
Km 27 McKendrick Pass	3 ha	light-severe herbaceous defoliation
MORICE TSA		
Saddle Hill CP 521 Blk 1	30 ha	planted 1990. Lodgepole pine seedlings lightly-severely defoliated - up to 5% mortality

[1]At several other sites in the upper Nass and Bell-Irving valleys, trace levels of cutworm feeding affected only herbaceous ground cover.

A single infestation at km 27 of the Smithers Landing Road in the Bulkley TSA resulted in light-to-moderate herbaceous defoliation. This was the only infestation this year predicted by the number of moths caught in a pheromone trap in 1989 (461).

On the east side of Babine Lake in the Morice TSA, an infestation damaged newly planted lodgepole pine seedlings over approximately 30 ha on CP 521 Blk 1, on the southwest side of Saddle Hill. Though more than 5% of the seedlings were completely defoliated, most of the buds remained undamaged, and later flushed. For this reason, initial seedling mortality was less than 1%. Due to their weakened condition, some additional seedlings may succumb during the winter.

To support ongoing research with respect to the insect and its associated parasites, and to determine the health of cutworm populations, mass larval collections were submitted from three sites in the Kalum and Kispiox TSAs and reared at the PFC insectary. Parasitism averaged 34% from the three sites (range 17-38%) primarily by the larval and pupal parasitoid, Erigorgus sp., similar to the 31% observed within populations in 1989.

Photo 1: June 1990

Seedling stripped by
black army cutworm

Photo 2: September 1990

Same seedling 50% refoliated
due to flushing of undamaged
buds and adventitious growth

Forecasts

To aid in forecasting 1991 populations, single pheromone-baited plastic container ("Multipher") traps were placed at 35 locations throughout the region (Map 3). At this stage in the calibration of the pheromone, catches approaching 600 or more moths per trap are considered significant in terms of potential defoliation for the next season, however seedling defoliation has occurred the season following trap catches as low as 460 moths. Locations where moth catches approached threshold numbers in 1990 are listed in Table 11.

Table 11. Locations where catches of black army cutworm moths in single pheromone traps approached significant levels[1]. FIDS, Prince Rupert Forest Region, 1990.

TSA	Location	No. moths per trap
Kalum	km 2 Orenda Main	550
Bulkley	CP 302 blk 4 McKendrick Pass	572
	CP 301 blk 7 McKendrick Pass	528
	CP 354 blk 1 Evelyn Station Road	493
Morice	Granisle - Skinhead Lakes	537
	CP 451 blk 3 Granisle Hookup	479

[1]Trap catches of 600 or more moths signal a significant risk of infestation on that site the following year (Maher, T.F. 1990. Damage Appraisal and Pheromone Trapping Studies for the Black Army Cutworm in British Columbia. FRDA Rept. 117)

Six trap sites approached threshold values in 1990, compared to seven in 1989. Of the seven in 1989, only three; km 1 and 2 Ritchie Creek (650 and 700 moths respectively) and km 27 McKendrick Pass (461 moths), were infested in 1990, and only trace-light defoliation of herbaceous ground cover was recorded. Two of the six sites (Orenda Main and CP 302 blk 4 McKendrick Pass) will not be planted until the spring of 1991 due, in the first case, to high levels of Rhizina root disease. The impact of defoliation could be greater in these plantations due to the increased risk to seedlings which sustain damage soon after establishment. Trap catches on all sites relative to 1989 catches are summarized by general area in Table 12. All sites that yielded significant numbers of moths in 1990 will be closely monitored in 1991.

Table 12. Summary and trends of black army cutworm pheromone ("Multipher") trap catches. FIDS, Prince Rupert Forest Region, 1990.

Location	Biogeoclimatic zone(s)	Number of locations	Average No. moths (range)	% change from 1989
KALUM TSA				
Skeena/Kitimat rivers	CWHwm/ws1	3	41 (34-50)	-29
Kwinatahl/Lavender roads	ICHmc2	3	131 (65-230)	+75
Nass/Bell-Irving rivers	ICHmc2/vc	8	333 (79-558)	-42
KISPIOX TSA				
Kispiox River	ICHmc3	3	226 (174-325)	-30
Skeena River	ICHmc3	3	116 (58-211)	-03
BULKLEY TSA				
Bulkley Valley	ICHmc2/SBSdk	3	217 (65-493)	-19
McKendrick Pass	SBSmc	2	550 (528-572)	+19
MORICE TSA				
Nadina River	SBSmc	2	91 (85-97)	+27
North-Central	SBSmc	4	395 (230-539)	**+238**
LAKES TSA				
Co-op Road	SBSdk	1	105	+33

PESTS OF YOUNG STANDS

A total of 65 young planted and natural stands were surveyed in the region in 1990. Of the total, 38 were done to evaluate single pests including Rhizina root disease, black army cutworm, Warren's root collar weevil and lodgepole terminal weevil, and are discussed under the specific host or multiple host section elsewhere in this report. Surveys in the remaining 27 stands recorded the frequency of occurrence and the severity of damage caused by all agents, whether biological or environmental. Of 2680 trees examined, 1473 (55%) were pest free; 51 (2%) were either recently killed or life threatened by rodent girdling, root collar weevils or rust diseases of the stem; 451 (18%) had been top-killed by leader weevils or environmental damage and 1234 (49%) were lightly damaged by a range of agents with little or no long term effect. Results of the 1990 surveys are expanded in Table 13.

Pests of young stands surveys, employing a standardized fixed radius plot format, are designed to gather data to build a province-wide young stand pest data bank. The purpose of the data bank is to provide specific pest frequency and severity information using any of a number of criteria including pest, host, region or biogeoclimatic zone, and reflect the overall health and vigour of the young second growth forest.

Table 13. Frequency and severity of agents causing damage in sapling-aged stands, assessed using fixed-radius plots at 50m intervals. FIDS, Prince Rupert Forest Region, 1990.

Pest	No. stands affected	Avg. incidence and range (%)	Severity Index[1]	Remarks
SITKA SPRUCE- assessed in 13 stands				
Pissodes strobi	13	40 (24-56)	4	high hazard areas only
Pineus sp.	5	20 (4-50)	3	light in lower crowns
Zeiraphera spp.	8	45 (5-80)	2	trace-light intensity
Hare	1	27	2	light lateral browsing
LODGEPOLE PINE - assessed in 9 stands				
Cronartium sp.	1	.05	6	recently killed
Cronartium sp.	3	1	5	stem cankers
Cronartium sp.	2	1	4	branch cankers
Endocronartium harknessii	1	1	6	recently killed
E. harknessii	6	1	5	stem galls
E. harknessii	2	1	4	branch galls
Hare	3	1	6	recently girdled
Porcupine	1	6	5	stems partially girdled
Hylobius warreni	1	65	5	avg. 30% girdled
Environmental (cold desiccating wind)	5	6 (2-14)	4	multiple leaders
Atropellis piniphila	1	4	4	stem cankers
Pissodes terminalis	2	3 (1-4)	4	terminals killed
Deer	1	27	4	moderate browsing damage
Coleosporium asterum	3	71 (23-92)	3	5-70% 1. crown needles infected (pre-1989)
Cecidomyia piniinopis	3	13 (2-35)	2	minor crooking of current laterals
WHITE SPRUCE - assessed in 6 stands				
Environmental (cold desiccating winds)	5	18 (12-27)	4	multiple tops
Deer	2	8 (2-15)	4	moderate browsing damage
Hare	2	35 (25-46)	4	mostly multiple tops from shoot clipping
Frost	2	54 (10-90)	3	avg. 20% lateral bud mortality
Pineus sp.	5	22 (1-48)	3	avg. 5% lower crown branch tips
ALPINE FIR - assessed in 1 stand				
Grouse damage	1	27	4	terminal bud feeding

[1]Severity index:
1. pest-free
2. minor damage, minimal impact
3. significant loss of current growth potential
4. net volume loss or loss of significant long term growth potential
5. life-threatening or severely deforming
6. recently killed

CLIMATIC DAMAGE

Weather during the 1990 field season was drier and warmer than normal, overall, for the second consecutive year. At Terrace, precipitation from April to September was 31% below normal, and mean daily temperatures were 16% above normal, both similar to 1989. At Smithers, representative of the southern interior of the region, precipitation was 18% below normal and temperatures were 12% above normal, also similar to 1989. However, at Dease Lake, in the the northern half of the region, precipitation was 0.5% above normal, but drier than the 17% above normal in 1989, and temperatures were 16% above normal compared to 23% above normal in 1989.

Blowdown

Blowdown was greatly reduced from the high levels recorded in 1989. Damage in the region was mostly limited to weakened or newly exposed trees at the sites of previous blowdown caused by severe 1988/89 winter storms.

Winter dieback

Damage to foliage, stems, and buds was greatly reduced in the region from the high and extensive levels recorded in 1989 following sudden winter storms with extreme low temperatures and high winds. Less severe weather in the winter of 1989/90 reduced the occurrence of these diebacks to ambient levels affecting few trees.

The effects of the 1989 damage are still evident, some of which are summarized in the "Pests of Young Stands" section in this report. Affected trees have since grown multiple leaders from the uppermost whorl of laterals; in most cases one will outgrow the others and form the new leader, and normal growth will resume with little long-term effect. In the remaining cases, persistent forks will develop, devaluing the end product. Future surveys will attempt to establish the proportions of both conditions.

Frost

By late summer, frost damage that occurred in early spring was strikingly visible in many young pine plantations in central and eastern portions of the region (Table 14). Though the mechanism is not fully understood, needle-tissue damage is thought to result when a hard frost follows a period of warm weather. During the warm period, trees break dormancy and needles become photosynthetically active. Needle tissues are subsequently vulnerable to being damaged when moisture on the needle surface freezes during a hard frost. When it appears only as black flecks on the needles, this damage is referred to as winter flecking. Severe winter flecking is thought to be the cause of this year's damage.

Table 14. Location and severity of damage to 1989 and earlier needles in primarily young lodgepole pine stands, caused by late winter frost. FIDS, Prince Rupert Forest Region, 1990.

TSA	Location	Area(ha)	Remarks
Kispiox	km 25 Kitseguecla Main	100	lower crowns-40% needles, all trees
	km 12 Kuldo Main	100+	lower crowns-50% needles, 30% trees
Morice	km 26 North Road	Perow Fire	lower crowns-20% needles, 40% trees
	km 13 Morice Forest Road	10	lower crowns-80% needles, all trees
	km 78 Nadina Main	1000+	lower crowns - avg. 20% needles on all age class trees
Lakes	km 13 Maxan Road	2	lower crowns-10% needles, scat. trees

Some damage to new growth occurs almost every spring if a hard frost follows budbreak, since the tender foliage of newly flushed buds is particularly susceptible to freezing. Damage in 1990 was minimal, affecting few trees in managed plantations, a decline from 1989 levels. In the Stewart townsite, frost was the cause of a light-to-moderate dieback of newly flushed alpine fir foliage on trees planted throughout the town, and at Swordgrass Lake north of Kispiox, 20% of the new growth was killed on understory alpine fir.

Near km 71 off the Nadina Main in the Lakes TSA, almost all white spruce seedlings over a 5 ha area lost most of the terminal and lateral buds due to frost. After 5 years, this part of the plantation, resting at the base of a steep north slope, has repeatedly suffered bud loss and dieback due to the cold microclimate. In 1990, the affected area was replanted with lodgepole pine which has proven in other areas to be more frost tolerant.

MAMMAL DAMAGE

Porcupine

Dieback and mortality caused by porcupines continued at levels similar to 1989, particularly in sapling- to semi-mature age classes. Debarking of lodgepole pine was most common in the Kalum Valley and scattered throughout the Cassiar TSA. Western hemlock, and to a lesser extent, Sitka spruce and true firs, were again most severely damaged in regeneration along coastal inlets from north of Prince Rupert to the Stewart area. Smaller areas of activity were observed in regeneration near the Copper River, Williams Creek, and in the Whitebottom Block where lodgepole pine and western hemlock were the preferred hosts, although feeding was occasionally seen on Sitka spruce and true firs.

Porcupine damage is also continuing to build, though still at low levels, in the side drainages of the Kitimat River, affecting Sitka spruce and western hemlock regeneration at Bowbyes Creek, Dahl Creek, and Wedeene River. Although only a few scattered trees are currently affected, expansion through these areas and into the Kitimat Valley could affect extensive tracts of managed regeneration.

Although the damage was scattered and often patchy, current probe lines by BCFS and industry in several stand types in the Kalum Valley disclosed an annual rate of current attack averaging 2.3% (range 0 to 7%). New probe lines in the Copper and Nass river valleys revealed damage levels of from 0.5 to 3% and from 0 to 1%, respectively (K. Derow, pers. comm.).

Scattered patches of recently killed alpine fir natural regeneration were seen in a plantation at km 11 of the Burdick Main in the Kispiox TSA. Within the patches, up to 10% of the fir had been girdled by porcupine feeding. The site had been planted with spruce, but these trees and smaller hemlock (<2m) naturals were not damaged. The successful establishment of a porcupine population within a plantation is rare in this area and was probably fostered by the abundance of unburned landing piles that provided protection and den sites for the animals.

As in prior years, many of the red lodgepole pine mapped during aerial surveys, particularly in the northern Bulkley and Morice TSAs were killed by increasing porcupine populations.

Factors contributing to high porcupine populations in the last few years include relatively mild winters, the trapping of fishers (the main effective predator of porcupines), and pole-sized slash left in thinned stands which provides protective cover.

Active control efforts by the B.C. Forest Service include a program to release and monitor fishers along coastal inlets north of Prince Rupert, and a bounty on porcupines, for registered trappers, in the Kalum Forest District.

Snowshoe hare

Populations of the snowshoe hare have been increasing in recent years and are currently at or near their cyclical peak. However, the impact of the characteristic angular clipping of terminal and lateral shoots has remained low. Increased damage could cause severe stunting in young plantations where seedling growth relies on successful development of relatively few and low buds.

Vole

Voles remain numerous in the lower Skeena Valley, west of Terrace, and damage to young seedlings is chronic. This differs from areas farther inland and at higher elevations in the coastal mountains where the occurrence of damage to seedlings is more cyclical; after two years at low levels, populations are starting to increase again in these areas. Reports from industry of seedling damage were from the Surveyors Creek area (K. Lindsay, pers. comm.) and higher elevation plantations in the Wedeene River and Hirsch Creek valleys (D. Mendel, pers. comm.).

Light damage in the form of girdling of scattered lodgepole pine seedlings was seen in plantations at km 49 North Road and at km 14 (CP 81 blk 10) of the Upper Fulton Road in the Bulkley TSA. These may be early signs of an expanding population that is due to peak in 1991 or 1992. Voles last caused significant seedling mortality in inland plantations in 1987 and 1988.

SPECIAL DIRECTED SURVEYS

Acid rain national early warning system (ARNEWS)

As part of a national network, a 10 x 40 m plot was established in the Terrace Watershed in 1985 to detect and monitor any impact due to air and rain borne toxins on native trees and indicator plants. Chemical analyses of coniferous foliage and soils are being conducted in 1990, and will be compared to baseline figures obtained in 1985 to detect any significant changes.

Visual assessments of plot vegetation and pest conditions are conducted annually; in 1990 only the same minor pests were found, at low levels, as in previous years. No symptoms of damage from acidic or toxic rain were found.

Pinewood nematode
Bursaphelenchus xylophilus

Further support to ongoing research on the incidence and biology of the pinewood nematode was provided by FIDS through the collection of wood samples from recently killed western hemlock, western red and yellow cedars, true firs, and white spruce. In the Prince Rupert Region alone, 135 samples were submitted for analysis, with emphasis on wood borer-attacked logs on landings and in mill yards, and waned green lumber rejected for export. No pinewood nematodes were found in any of the samples. Provincially, a single pinewood nematode was extracted from a sample submitted this summer from Watson Lake in the Yukon.

For the past six years, Forestry Canada has been aiding other agencies wage a holding action against certain countries in the European Community (EC) who want blanket bans imposed against the importation of all green softwood products from this country, allowing entry to only kiln-dried wood products. The root of the problem, the pinewood nematode, has killed pines in Japan on a similar scale as the mountain pine beetle in B.C. However, not only has the nematode been shown to be harmless here, its occurrence is rare, having been extracted from only six of over 2000 softwood samples submitted by FIDS Rangers since 1984, encompassing all commercial species. Extractions and identifcation has been performed at the Pacific Forestry Centre in Victoria.

The woodboring beetles known to vector the nematode are common in B.C. forests, and have recently become the focus of attention. Woodborer activity leaves visible signs in the form of grub-holes in the wood. Upon arrival in Europe, all green forest products are closely examined for the presence of these grub-holes by quarantine inspectors. If any are found, the material is refused entry. Recently both Ireland and Finland imposed blanket import bans, and the future of our greenwood exports to the remaining ten counties of the EC currently hangs in the balance.

To forestall further embargoes and allow forest companies time to increase their kiln-drying capacities without losing their European export markets, a temporary compromise was struck with most EC members to permit import of green products that have been inspected at the millsite and certified grub-hole and bark free. The negotiation of this compromise was possible largely because of continued research by Foresty Canada into all aspects of the pinewood nematode question, from developing survey and extraction techniques to seeking alternative treatments to kiln-drying.

As of January 1992 however, as the EC evolves into a more tightly interlinked economic unit, all member countries will be required to follow uniform import guidelines. Recent developments indicate that after that date, even green lumber that has been certified nematode-free will be banned from the European market.

Additional nematodes

While analysing samples for the pinewood nematode, other nematodes were observed and recorded by taxonomic order (Table 15). Additional nematodes identified from 5 years of sampling in lodgepole pine, up to 1987, are summarized in the 1987 regional report.

Table 15. Additional nematodes identified during extractions for the pinewood nematode[1]. FIDS, Prince Rupert Forest Region, 1990.

Host/ nematode order[2]	No. collections by host status[3]				Distribution
	Healthy	Stressed	Dead		
			with insects	without insects	
WESTERN HEMLOCK	19	8	22	11	
Tylenchida	0	0	6	0	Skeena R. drainage
Dorylaimida	1	0	0	0	Williams Ck.
Rhabditida	2	0	3	0	Skeena & Kitimat River drainages, Smithers
WESTERN RED CEDAR	15	5	8	3	
Tylenchida	0	0	5	0	Skeena & Kitimat drainages
Dorylaimida	1	0	0	0	Minerva Lk.
Rhabditida	1	0	2	1	Skeena R. drainage
AMABILIS FIR	6	0	6	2	
Tylenchida	0	0	5	0	Skeena & Kitimat drainages
Rhabditida	0	0	3	0	Clore R., Chist Ck.
ALPINE FIR	3	1	2	0	
Tylenchida	0	0	1	0	Ningunsaw R.
Rhabditida	0	1	1	0	Snowbank Ck., Bob Quinn Rd.
YELLOW CEDAR	2	2	0	0	
Tylenchida	0	1	0	0	Ridley Island

[1]Extractions and identifications were done at the Pacific Forestry Centre by F. Ring and J. Sutherland.

[2]Nematode orders:
Tylenchida - main group of plant parasitic nematodes
Dorylaimida - plant parasites, virus vectors
Rhabditida - bacteria feeders

[3]Host status categories:
Stressed - trees weakened by decay (5 collections), crown thinning/dieback(5) site disturbance (3), animal damage (2), or climatic damage (1).
Dead - logs, logging slash, or new green lumber that had either been infested by potential insect vectors (wood borers), or was free of insect damage.

CHRONIC DISEASES

Several chronic diseases (Table 16) 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 16. Important chronic diseases. FIDS, Prince Rupert Forest Region, 1990.

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
Atropellis canker *Atropellis piniphila*	lP	southern half of region	sporadic stem deformation, locally severe impact
Cedar diebacks unknown cause(s)	wrC yC	host ranges	long term top-down dieback leading to mortality
Comandra blister rust *Cronartium comandrae*	lP	throughout region	particularly damaging in young stands, up to 50% mortality
Hardwood trunk rot *Phellinus igniarius*	tA	throughout region	causing extensive decay
Hemlock dwarf mistletoe *Arceuthobium tsugense*	wH	throughout host range	widespread, particularly severe in remaining old-growth stands
lP dwarf mistltoe *Arceuthobium americanum*	lP	southeastern part of region	widespread but sporadic, causing significant growth loss
Red ring rot *Phellinus pini*	ss,wS, wH,aF,alF	throughout region	widespread, particularly in old-growth stands
Rust-red stringy rot *Echinodontium tinctorium*	wH	southern half of region	widespread in old-growth stands, decay common
Spruce broom rust *Chrysomyxa arctostaphyli*	wS	throughout host range	widespread, particularly in northern half of region
Stalactiform blister rust *Cronartium coleosporiodes*	lP	throughout interior	particulary damaging in young stands
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	infections widespread in all age classes

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 17. Relatively minor damage caused by disease is reported in Table 18.

Table 17. Other noteworthy insects. FIDS, Prince Rupert Forest Region, 1990.

Insect	Host(s)	Location	Description
Ambermarked birch leafminer *Profenusa thomsoni*	wB	Mosquito Creek	infested an average of 20% of leaves throughout area
Birch leafminer *Fenusa pusila*	wB	Smithers	50% of leaves infested on ornamental trees in townsite
Birch-aspen leafroller *Epinotia solandriana*	tA,wB rAl,sA bCo	throughout region	common in most areas, though at light intensity
Conifer loopers *Eupithecia annulata* *Eupithecia* sp.	wH,aF wS	host ranges	occurrence declined at permanent sampling points
Synaxis pallulata	alF		remaining endemic
A conifer needleminer *Coleotechnites* sp.	wH	host range	remaining endemic
A conifer sawfly *Neodiprion* sp.	wH sS	Skeena R. drainage	larval counts continue to increase at permanent sample points; some light defoliation of older foliage
Fir engraver *Scolytus ventralis*	aF	Kitimat	scattered current and previous attacks in a rural suburb
Gouty pitch midge *Cecidomyia piniinopis*	lP	Bulkley and Morice drainages	trace-light branch crooking in young stands throughout area
Gall mites *Eriophyes parapopuli*	tA	Mosquito Creek	light galling on stems of young trees
Gray forest looper *Caripeta divisata*	wH	Skeena Valley	remaining at endemic levels
Greenheaded spruce sawfly *Pikonema dimmockii*	sS	Nass R. Skeena R. Kispiox R.	increasing occurrence at permanent sample points

Insect	Host(s)	Location	Description
Greenstriped forest looper *Melanolophia imitata*	wH,sS alF	Skeena R. Nass R.	sporadic occurrence at permanent sample points
Green velvet looper *Epirrita autumnata*	alF	Nado Cr.	only three larvae collected in stands lightly defoliated in 1989
Leaf beetles			
Chrysomela sp.	bCo	host range	populations generally low,
Zeugophora sp.	bCo	Skeena R.	occasional small patches of high incidence and intensity
Calligrapha verrucosa	W	Kasiks R.	endemic population, collected for distribution records
Syneta carinata	wS	Kinaskan Lk.	endemic population
Lodgepole pine beetle *Dendroctonus murrayanae*	lP	Cassiar TSA	remaining at endemic levels
Mountain ash blister mite *Phytoptus sorbi*	sAs	Trout Cr.	localized - all leaves severely infested
A pine sawfly *Neodiprion nanulus contortae*	lP	Skeena Valley	slight increase from 1989 though still at low levels
Poplar and willow borer *Cryptorhynchus lapathi*	W	Skeena,Nass and Kitimat valleys	remaining at high levels, dead stems common
Poplar leafminer *Phyllocnistis populiella*	tA,bCo	Cassiar TSA	common at trace intensity
Rusty tussock moth *Orgyia antiqua badia*	wH,sS alF	Salmon R. Road	avg. 25 larvae in positive beating samples
Saddleback looper *Ectropis crepuscularia*	wH	host range	remained at endemic level
Secondary weevil *Pissodes* sp	lP	Burdick Cr. Barrett Lk.	infesting stems of young trees infected with stem rust cankers
Silver fir beetle *Pseudohylesinus grandis*	aF	Kwinitsa R.	infesting trees surrounding a clearcut
Spruce bud midge *Rhabdophaga* sp.	sS wS	host ranges	remaining at light incidence, occasional moderate patch
Spruce budmoths			
Epinotia radicana	sS,wS	throughout	high incidence though remaining
Zeiraphera unfortunana	wS	host ranges	at light intensity on all age
Z. canadensis	sS	in region	classes

Insect	Host(s)	Location	Description
Spruce gall adelgids			
Adelges lariciatus	wS	French R.	common on all age classes, light
Pineus spp.	sS	host range	common at trace-light intensity,
	wS	host range	occasionally moderate
Western hemlock looper	wH	Skeena R.	occurrence declined at permanent
Lambdina fiscellaria lugubrosa	sS	drainage	sample points
	alF		
Yellowheaded spruce sawfly	sS	Skeena R.	occurrence increased at permanent
Pikonema alaskensis			sampling points
		Terrace	severe defoliation of few trees at several residences
Yellowlined forest looper	wH,aF	throughout	occurrence declined at permanent
Cladara limitaria	sS,alF	host ranges	sampling points

Table 18. Other noteworthy diseases. FIDS, Prince Rupert Forest Region, 1990.

Disease	Host(s)	Location	Description
An alder leaf blotch	rAl	Kitsumkalum	patchy occurrence at light
Mycopappus alni		Valley	intensity
Aspen leaf spot	tA	Francois	common on scattered trees
Mycosphaerella populorum		Lake	
A bark fungus	rAl	Salvus	common stem canker, minor impact
Didymosphaeria oregonensis			
A birch leaf spot	wB	Salmon Rd.	all trees in area lightly
Taphrina nana			infested; new host record
Black spot diseases			
Pollaccia borealis	tA	Stikine R.	light leaf spotting, widespread
		Boya Lk.	
		Cormier Ck.	
Ramularia sp	bCo	Cedric Cr.	60% of leaves infected on roadside regeneration; new host record
Delphinella tip blight	alF	Nass Valley	infections remain at endemic
Delphinella abietis		Hazelton	levels
Fir-fireweed rust	alF	Nass Valley	infections remain light
Pucciniastrum epilobii		Dease Lk.	common at light to mod. intensity

Disease	Host(s)	Location	Description
Grouse	alF	Bell-Irving River	occasional bud clipping or hollowing in plantations, up to ±15% incidence
Juniper shoot diebacks			
Chloroscypha sabinae	dJ	Stikine R.	common at light intensity
Lophodermium juniperi	rJ	Stikine R.	common at light intensity
Pine-aster rust *Coleosporium asterum*	lP	Maxan Lk. Trout Cr.	avg. 30% lower crown needles (pre-1989) in young stands
Poplar shoot blights			
Venturia macularis	tA	Burns Lk. Uncha Lk. Ross Lk.	killed shoots of young trees - high incidence in small centres
V. populina	bCo	host range	infections remained light
Spruce cone rust *Chrysomyxa pirolata*	wS	Cassiar TSA	severe infections common in heavy cone crop
A spruce needlecast *Lirula macrospora*	sS	host range	remained at low levels
Spruce needle rusts			
Chrysomyxa ledi	wS	NE Dease Lk. North of Stikine R.	severe infections on current growth patchy light to moderate infections
C. ledicola	wS	Skeena R.	remained at low levels
Tar spot *Rhytisma salicinum*	W	host range	common at light intensity
White pine blister rust *Cronartium ribicola*	wbP	host range	commonly infects branches and stems in subalpine areas