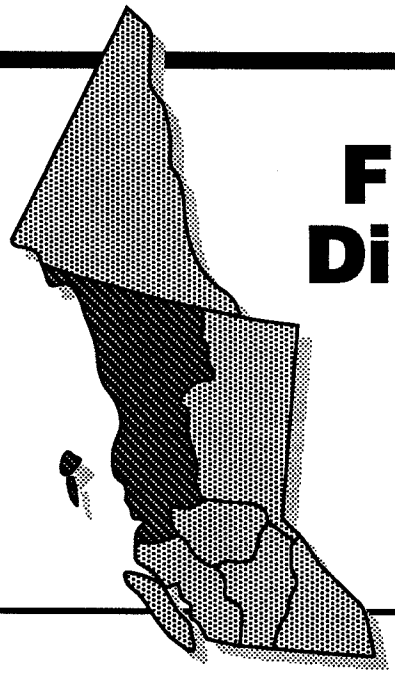
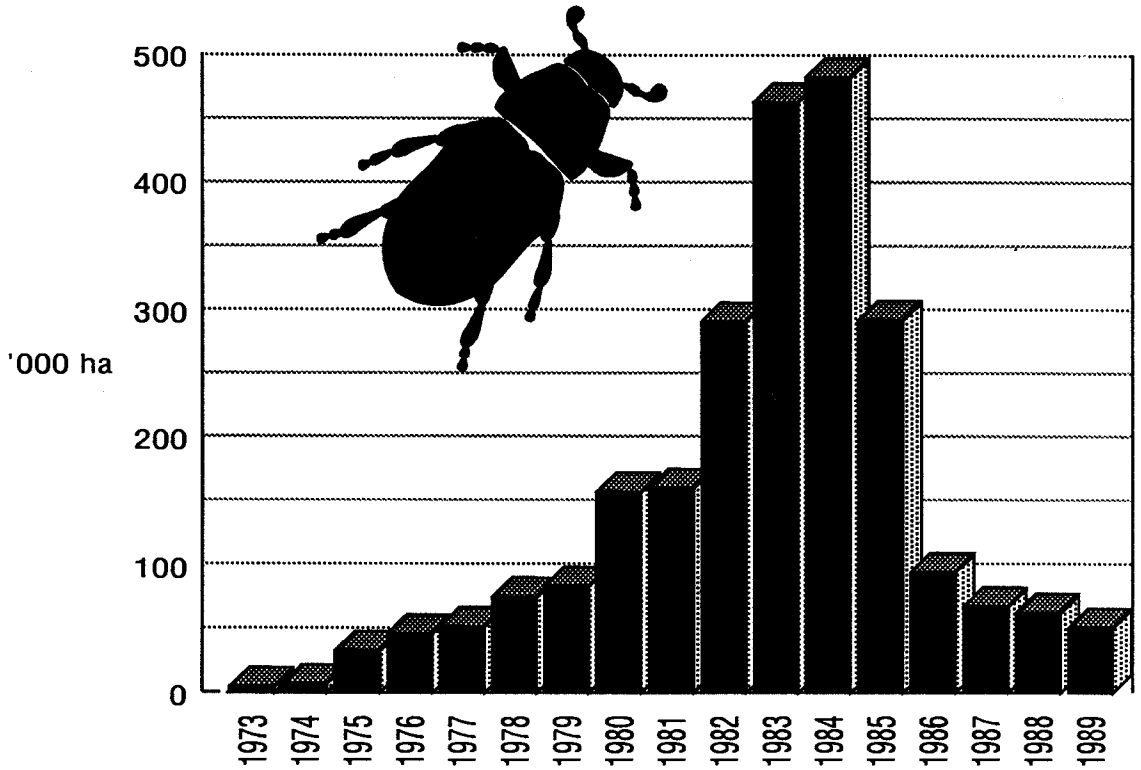


Forest Insect and Disease Conditions

Prince Rupert Forest Region
1989

R. Garbutt & A. Stewart



Mountain Pine Beetle in British Columbia

Forestry Canada
Forêts Canada

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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 1989.

2. Seedling mortality caused by Rhizina root disease, Prince Rupert Forest Region, 1989.

3. Pests of young stands survey data, Prince Rupert Forest Region, 1989.

4. Forest pests in provincial parks, Prince Rupert Forest Region, 1989.

5. Photographs of selected examples of pest damage, including those caused by; Rhizina root disease, Warren's root collar weevil and winter climatic conditions.

INTRODUCTION

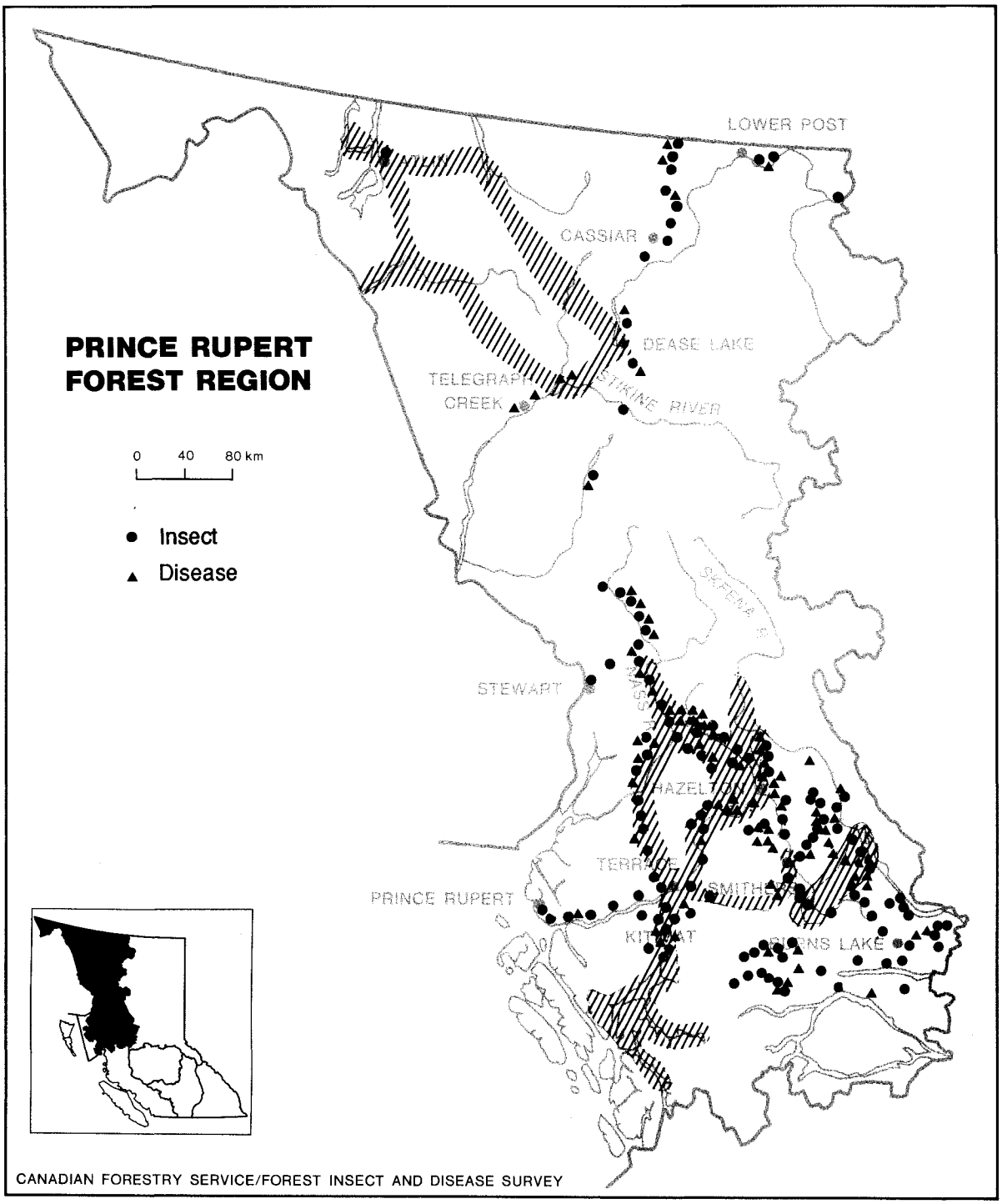
This report outlines the status of forest insects and diseases surveyed in the Prince Rupert Forest Region in 1989 and forecasts some of the pest population trends. Insects and diseases are discussed by host, generally in order of importance and often within the context of a management unit or Timber 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 1989 field season extended from late May to early October. A total of 350 insect and disease collections were submitted by the authors to the Pacific Forestry Centre for identification and verification (Map 1). Ten collections were received from B.C. Forest Service staff throughout the region. In cooperation with research programs at the Pacific Forestry Centre and other institutions, 16 collections were made in 1989. 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 Silviculture meeting 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** - <10% of a stand; **moderate** - 10 to 30%; **severe** - >30%. Biogeoclimatic units are abbreviated to conserve space; in alphabetical order they are:

BWBSe - sub-boreal white and black spruce, cordilleran
CWHws1 - coastal western hemlock, wet submaritime, submontane
CWHws2 - coastal western hemlock, wet submaritime, montane
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
SBSdk - sub-boreal spruce, dry cold



Map 1. Locations where one or more forest insect or disease samples were collected and areas covered by aerial surveys. Prince Rupert Forest Region, 1989.

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

aF	- amabilis fir	rAl	- red alder
alF	- alpine fir	rJ	- Rocky Mountain juniper
bCo	- black cottonwood	sAl	- Sitka alder
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	wrC	- western red cedar
mAl	- mountain alder	wH	- western hemlock
mH	- mountain hemlock	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 October correspondence can be directed to:

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

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

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

Forest Insect and Disease Survey
Pacific Forestry Centre
506 West Burnside Road
Victoria, B.C.
V8Z 1M5 Ph. 388-0600

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 228 670 m^3 of lodgepole pine over 4 440 ha, a decline of 70% from 1988. **Warren's root collar weevil** continued to infest a high proportion of young pine in the Kispiox TSA, but caused little mortality. **Pine needle diseases** commonly infected older and lower crown lodgepole pine needles in valley bottom stands throughout the Cassiar TSA. **Lodgepole terminal weevil** populations declined, causing trace-light damage in four interior stands. Up to 10% of new branch and terminal shoots were crooked by the **gouty pitch midge** in young stands primarily in the Morice and Lakes TSAs.

Spruce beetle-caused white spruce mortality increased significantly, particularly near Morrison Lake in the Morice TSA. In the Skeena, Kitimat and Nass river valleys the **white pine weevil** infested an average of 18% of the terminals in 13 Sitka spruce plantations. Reduced populations of the **eastern spruce budworm** lightly defoliated white spruce in the extreme northeastern portion of the region. **Spruce bud midge** killed Sitka and white spruce buds in young stands in the Kalum, Kispiox and Cassiar TSAs.

Western balsam bark beetle caused light mortality of alpine fir over an estimated 70 000 ha. The **western blackheaded budworm** lightly defoliated primarily alpine fir over more than 70 000 ha in the southern Bulkley and Morice TSAs. **Fir-spruce budworm** pheromone traps caught greatly increased numbers of moths near Kinaskan Lake, though no defoliation was recorded anywhere in the region. Two localized infestations of the **green velvet looper** in the southeast caused light defoliation of alpine fir.

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

Two species of **tent caterpillar** lightly to severely defoliated several deciduous tree species at various locations in the region. **Birch leafminer** and **birchleaf skeletonizer** discolored the leaves of white birch over a broad area near Hazelton. **European birch leafminer** lightly defoliated ornamental birch in Terrace and Smithers and was found for the first time defoliating native white birch near Hazelton.

Mortality caused by **Rhizina root disease** was more severe and widespread, killing seedlings of all species within at least 24 plantations in the southern half of the region. **Black army cutworm** damage was limited to the Kispiox Valley where light seedling mortality was recorded at three locations.

Pests of young stands surveys summarized a variety of damaging agents, mostly disease or climatic.

Winter injury was largely responsible for an increased incidence of **unflushed buds,** primarily in Sitka and white spruce. A late winter storm and localized high winds at other times in the year caused widespread **blowdown.** Cold winter winds caused **branch dieback** in primarily western hemlock west of Meziadin Lake. Newly flushed Sitka spruce foliage was damaged by **frost** in the Kitimat Valley.

High populations of **porcupines**, particularly in western and northern areas, caused increased mortality in primarily young growth western hemlock and lodgepole pine. Shoot clipping by **snowshoe hares** continued to affect young trees in the Cassiar TSA; hare populations are expected to peak in 1990.

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. Fresh log sections were collected to aid research into the incidence of the **pinewood nematode** in B.C. forests. No moths were caught in 45 **gypsy moth** pheromone traps placed in provincial parks, private campgrounds and port facilities throughout the region. Surveys in stands of trembling aspen found nearly 50% to contain **heart rot.**

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 pests.**

PINE PESTS

Mountain pine beetle
Dendroctonus ponderosae

Mortality of lodgepole pine due to the mountain pine beetle declined by 70% to 228 670 m^3 over 4 440 ha in 1989, from 768 400 m^3 over 13 060 ha in 1988 (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. Prince Rupert Forest Region 1989.

Location (TSA)	Area (ha)[1]				Volume (m^3)	No. of trees
	light	moderate	severe	total		
Kalum	1 700	250	0	1 950	110 200	221 100
Kispiox	1 130	503	95	1 730	97 800	196 200
Bulkley	625	0	0	625	17 500	21 000
Morice	60	0	0	60	2 800	2 270
Lakes	75	0	0	75	370	550
Regional total	3 590	753	95	4 440	228 670	441 120

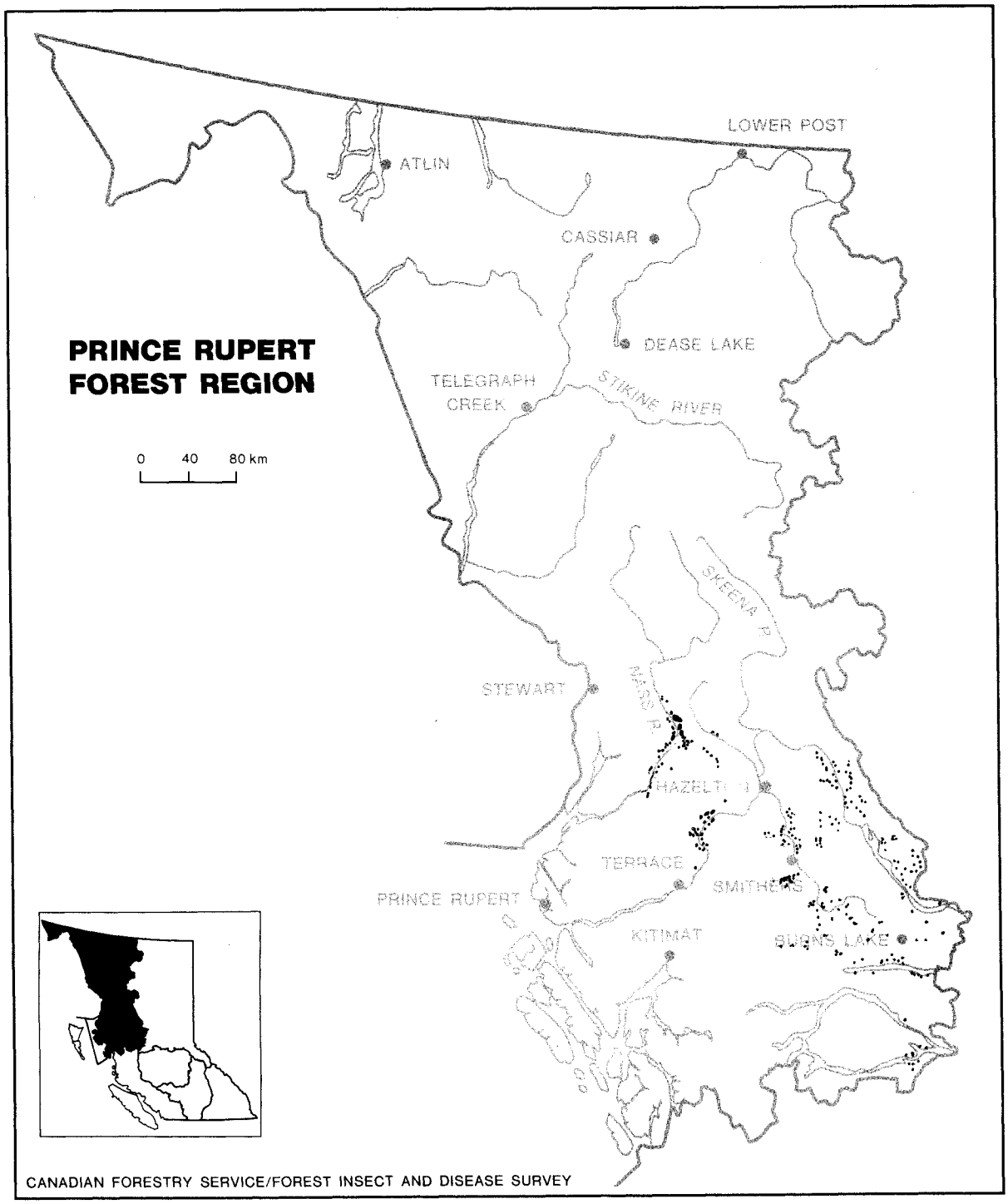
[1]Areas were computed from FIDS aerial survey sketch maps in the Kalum and Kispiox TSAs; the Bulkley, Morice, and Lakes TSAs were mapped by the B.C. Forest Service.

Kalum TSA

The area containing infested timber remained fairly constant since 1988, increasing by only 6%, but the incidence dropped to light in most areas. Most attacks occurred in the Nass Valley from the New Aiyansh area to south of Meziadin Lake, particularly towards the TSA boundary north and west of Cranberry Junction. Scattered patches of attack in the Skeena Valley continued to decline. Throughout the TSA the total volume of infested timber declined by 8% from 1988, while the number of trees attacked increased by 15%, indicating that the chronic outbreaks are spreading into smaller, usually less favorable trees, as hosts become limited.

Kispiox TSA

The area of infested timber declined by 82% to 1730 ha in 1989, the second consecutive year of decline in the TSA. The greatest decline 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 (north of Kitwancool Lake) declined to light incidence.



Mr 2. **Areas containing lodgepole pine recently killed by mountain pine beetle determined by aerial and ground surveys. Prince Rupert Forest Region, 1989.**

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

Bulkley TSA

For the second consecutive year the area of pine mortality declined, covering only 625 ha, compared with 1 020 ha in 1988. The bulk of the decrease occurred in the Telkwa River Valley where mortality declined by 30% to 13 500 m^3, and near Coffin Lake where only a few scattered red trees were mapped in an area where 4 700 m^3 of mortality was recorded last year.

An ongoing infestation on a south-facing hillside overlooking Trout Creek declined to 150 trees from 400 in 1988. Many potentially damaging spot infestations on the valley floor were eliminated by single tree disposal during the 1988-89 winter. North and south of the confluence of Trout Creek and the Bulkley River, increased mortality totalled more than 200 trees. Small spot infestations also increased in number and distribution on the east side of the Bulkley River, particularly along Meed and Reiseter creeks.

In the northern part of the TSA, numerous small spot infestations totalling 90 trees were scattered in the area of Smithers Landing, Torkelsen Creek and the upper Fulton River. Similar mortality, some of which could be attributed to porcupine feeding, was scattered along : the Babine River, 74 trees; the Nilkitkwa River, 222 trees; Nichyeskwa Creek, 163 trees; and Nilkitkwa Lake, 65 trees, in a similar pattern and number as last year.

Morice TSA

Beetle activity in the Morice TSA was similar in intensity and distribution to 1988 with a few notable exceptions. New beetle activity comprising 50 red trees was seen in the Parrott Lakes area and an additional 63 current attacks were encountered during Forest Service probes in the fall. To the south 30 red trees and 26 current attacks were found near the east end of Tekaiziyis Ridge. Along Dockrill Creek near Walcott, a stand containing over 150 red trees and 200 current attacks will be harvested during the winter. A hazard will remain, however, in the more than 200 current attacks, scattered in at least a dozen small pockets north and south of the creek.

Intensive logging virtually eliminated an infestation around Skinhead Lakes, west of Granisle where last year, 1 250 red trees were recorded.

Widespread scattered mortality was again mapped on the east side of Babine Lake, particularly in the Morrison and Hautete lakes area, and near the eastern shore of Babine Lake around Wilkinson Bay. Though the number of infestations was similar to 1988, aggressive salvage logging and single tree disposal programs coupled with intensive pheromone trapping, significantly reduced the number of red trees throughout the area. Reprobes by the B.C. Forest Service in areas treated by single tree disposal in the winter of 1988-89, found many more current attacks than reds.

Lakes TSA

The total number of red trees, as determined from aerial surveys, declined to 550 in 80 separate pockets from 2 800 trees in 150 locations in 1988, due primarily to a combination of salvage logging and single tree disposal. Most of the mortality was scattered throughout the area north of Francois Lake, with concentrations north of Babine Lake to the TSA boundary. B.C. Forest Service fall probes in all infestations north of Francois Lake found a current-to-red ratio of 3:1, a significant increase. Disposal this winter will be concentrated in areas near the south shore of Babine Lake, while salvage logging will address more northern areas, and some spots west of Decker Lake.

Overwintering survival

The regional average reproductive ratio, or "R" value, increased to 5.8 (Table 2) from 4.5 in 1988, indicating better overall brood survival. The general trend was of increasing brood survival from west to east.

Table 2. Overwintering survival of the mountain pine beetle. Prince Rupert Forest Region, 1989.

Location	"R" value[1]	Population status[2]	Remarks
Maxan Lake	11.3	increasing	broods healthy; 30% late-instar larvae, 60% pupae, 10% adults
Trout Creek	10.8	increasing	all brood stages from early-instar larvae to pre-flight adults
20 km NW Decker Lake	8.7	increasing	most progeny as healthy late-instar larvae
Telkwa River	4.0	static	highly variable broods; some trees empty, others full of healthy larvae and pupae
New Aiyansh	3.9	static	limited host availability, low survival in smaller trees
Kitwanga	3.7	static	chronic infestation area, limited hosts
Coyote Creek	2.5	decreasing	declining brood survival in area near chronic outbreak
Sideslip Lake	1.7	decreasing	declining brood survival in area of recent expansion
Regional average	5.8		

[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 up to 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 accessible stands comprised small groups of attacked trees. Successive cool wet summers had delayed brood maturation with the result that some two-year cycling occurred. Progeny that overwintered a second time usually matured in the early spring and flew when temperatures warmed to 15 degrees C. The result was very mixed broods with, in some cases, larvae, pupae and pre-flight adults being found in the same tree.

Fall Surveys

Five stands in the western half of the region were cruised 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 remained fairly constant at 17%, compared to 14% in 1988, and still reduced from levels of 42% in 1987 and 36% in 1986. 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. Prince Rupert Forest Region, 1989.

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	25	42	17	20	3	3	46	31	10	5
Cranberry Junction	46	51	11	17	5	5	15	14	23	13
Kitwanga	53	65	17	13	7	8	8	7	15	8
Sedan Creek	69	80	9	6	0	0	21	14	0	0
Coyote Creek	23	34	31	28	7	7	25	19	14	12
Average	43	54	17	17	4	5	23	17	12	8

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 1.0:1 (range 0.4 to 1.9:1) based on numbers of trees, indicating a constant rate of new attack overall. In the same areas, the C/R ratio in terms of volume was 0.7:1 (range 0.4 to 2.1:1) indicating that beetles were, on average, attacking smaller trees, a situation which could result in lower brood survival.

Forecasts

Due to a reduction in the B.C. Forest Service mountain pine beetle budget, most of the beetle control effort this winter will be directed through salvage logging by industry. Single tree disposal programs have been scaled down significantly and the remote sites, many of which had many more current than red attacks, will remain untreated. As a consequence, substantial increases in the number of red trees can be expected in the Bulkley, Morice and Lakes TSAs in 1990.

Healthy broods in favorable host trees and an increase in the proportion of current-attacked trees in stands cruised indicate that further timber loss will occur at and near existing chronic outbreaks in the Nass and Skeena river drainages. Availability of favorable host trees in mixed stands will remain a limiting factor and should minimize any increases in 1990.

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, weevil-caused mortality was low, with current mortality generally 1% or less. One notable exception was in a six-year-old natural pine stand at km 1 of the Salmon Road, just north of Hazelton, where an additional 10% (15% in 1988) of the trees succumbed this year. Young pine in this area were particularly at risk because of high residual populations of adult weevils in unburned stumps of the previous stand.

Elsewhere in the region, weevil populations remained low with isolated exceptions. Northeast of Burns Lake, three young stands between 5 and 11 years old were surveyed near Helene Lake to quantify earlier observed mortality. The mortality was concentrated in small centres and along fringes, but less than 1% of the trees were affected overall. In young stands designated 00501, 00502 and 00305, 30%, 10% and 3% of the pine were infested, respectively. Mortality will decline as the trees increase in diameter.

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. All infested trees were still living, and there was no significant difference in radial growth increment between infested and uninfested trees.

Many trees in the Date Creek plot (km 9) that were, by external estimation more than 50% girdled, lost a large proportion of their lower crown needles throughout the summer of 1989. Examination of needle samples confirmed that pathogens were not responsible for the needle loss but as yet there is no evidence linking the Hylobius infestation with the needle loss. All plots will be re-evaluated in 1990.

In August, a root collar weevil workshop sponsored jointly by Forestry Canada and the B.C. Forest Service, was well attended by concerned Ministry personnel and industry representatives from throughout the region. The workshop

was led by Dr. Herb Cerezke from the Northern Forestry Centre in Edmonton, who addressed the high rates of infestation by root collar weevils in many plantations in the Kispiox TSA. Though infestation levels were high, even in Dr. Cerezke's experience, his prognosis was encouraging. He emphasized that lodgepole pine is a highly resilient species, and had been shown through his own research to display no decline in either radial increment or height growth until more than 60% of the circumference had been girdled. Two important factors affected the impact of weevils on a young stand; the amount of duff directly adjacent to the trees, and the level of residual weevil populations in stumps in or adjacent to the plantation. A deep duff layer not only moderates the micro-environment at the root collar protecting weevil larvae from climatic extremes, it provides protection and egg-laying sites for adult weevils which live for about four years, laying eggs in the last three. High populations of weevils attacking very young stands, such as the aforementioned site along the Salmon Road, originate usually from adjacent stands or in the stumps of the previous stand where they can survive for up to two years.

Pine needle diseases

Foliar diseases of lodgepole pine increased in northern areas of the region in 1989. 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 and reached high intensity in the Dease River valley, from the Boya Lake area north. Two additional fungi, Phaeoseptoria contortae and Hendersonia pinicola, were collected at moderate to high intensity from representative locations at Cormier Creek and Tanzilla River.

Infections by these needle fungi are usually only significant if severe in intensity and repeated in successive years.

Lodgepole terminal weevil
Pissodes terminalis

Terminal weevil damage to young lodgepole pine declined within the region in 1989. In the most severe infestation, terminals of 6% of the trees were killed near km 24 of the Upper Fulton Road. Only five exit holes could be found in a sample of 10 dead terminals; a reproduction ratio of only 0.5, indicating a continued declining population. Less than 2% of the terminals were infested in plantations at Kitseguecla Lake and km 65 Morice Lake Road, where 18% and 5% of the leaders respectively, were infested in 1988. In other areas including km 4 North Owen Road and km 77 Morice Lake Road, less than 1% of terminals were attacked and samples indicated low success of progeny.

Due to the infrequency of attacks and low reproduction ratios, populations are expected to remain low in 1990.

Gouty pitch midge
Cecidomyia piniinopis

Northeast of Burns Lake, 70% of the 8-year-old lodgepole pine were attacked by the gouty pitch midge at km 28 Hannay Road, opening 00501. Attacks resulted in the crooking of one or more of the new lateral shoots per tree. In

a young pine plantation at CP (Cut Permit) 307 Block 2 off the Walcott Road at km 24, 56% of the trees were infested. Up to 10 branches per tree were infested, and an additional 8% of the terminals were crooked. Between two and three branches had been attacked on 9% of the trees in a nine-year-old plantation at km 4 North Owen Road, where 80% of trees had been attacked in 1988.

Repeated attacks by midges can result in malformation of branches and/or stems, and can sometimes result in the death of new shoots or breakage at the point of attack.

SPRUCE PESTS

Spruce beetle
Dendroctonus rufipennis

Spruce beetle populations are again building in the eastern part of the region, after four years of maintaining near endemic levels. The main areas of current concern, all within the Morice TSA, include: Lamprey Creek, the north end of Morice Lake and the northeastern end of Babine Lake.

Patchy mortality at Lamprey Creek, over an area totalling 40 ha, stemmed from 1984 blowdown. Probes conducted by Northwood Pulp and Timber in the fall of 1989 found a low number of successful current attacks (approx. 10% of existing red trees) along with many strip attacks and pitchouts. Many callow adults, however, remained within the butts of red trees, apparently having reverted to a three-year brood cycle. Woodpeckering of infested trees was reportedly heavy. Northwood plans to divert winter logging into the area and remove all brood-containing trees.

A serious potential hazard is posed by extensive patchy white spruce blowdown between the north end of Morice Lake, and the confluence of Gosnell Creek and the Morice River. Trees over an estimated 400 ha were felled by high winds in the fall of 1989. A residual population of beetles, bred in blowdown from previous years, will attack these fresh trees in the spring of 1990. Part of this area is accessed by road, and accessible timber will be salvaged while still merchantable. Remaining sucseptible trees will be closely monitored in the summer of 1990 to determine attack levels, and hazard to surrounding standing timber.

During aerial surveys in the summer, numerous small patches of spruce beetle-killed trees were mapped near Nakinilerak Lake, Haul Lake and near the northeastern shore of Babine Lake in the extreme northeastern part of the TSA. The infestation near Haul Lake, consisting of 30 ha of scattered mortality was accessed by B.C Forest Service personnel in October. Broods were healthy and will fly in the spring of 1990. Because these sites are helicopter accessible only, a protection system using pheromone baits and lethal trap trees on a large scale will need to be employed to effect control.

Small spot infestations, consisting of less than five attacked trees, were accessed in the Telkwa Valley and near Pimpernel Creek in the Morice Valley. In both cases, trees had been attacked in 1987, and by early June of 1989, most of the progeny had flown. No current attacks could be found.

Vigorous renewed spruce beetle activity in the Carp Lake area of the Prince George TSA suggests that a general rise in populations may be expected within the next few years. Close monitoring of blowdown coupled with the deployment of pheromone traps in hazard areas will serve to monitor populations and preview any changes in status.

White pine weevil
Pissodes strobi

The white pine weevil (previously referred to as the spruce weevil) is a chronic pest of young 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. The incidence of current attack in 1989 averaged 21%, 20%, and 6% at locations assessed in the Skeena, Kitimat, and Nass river drainages, respectively (Table 4). Closer proximity of a young stand to a watercourse appears to increase the incidence of attack, varying within the general hazard of weevil attack in the area.

Table 4. Incidence of current attack by the white pine weevil in sapling-aged stands of hybrid Sitka X white spruce in the Kitimat, Skeena, and Nass river drainages. Prince Rupert Forest Region, 1989.

Location	Stand age	Current weevil attack (percent)	Approx. watercourse proximity (m)
Kitimat River drainage			
Branch 77A Road km 2	15	2	2000
Branch 77A Road km 6	12	3	2000
L. Wedeene River bridge	16	13	30
8 km NW Kitimat	15	35	100
Nalbeelah Creek/Kitimat River	10	48	20
Skeena River drainage			
Hwy. 37, 57 km N Kitwanga	10	2	800
Coldwater Road km 1	15	2	1000
Copper River Road km 24	14	9	20
Williams Creek Road km 4	16	20	100
West Kalum Road km 42	14	43	40
Whitebottom Road km 4	16	45	50
Nass River drainage			
Hwy. 37, 75 km N Kitwanga	14	2	1000
Meziadin Lake	19	10	500

Of particular concern, in reference to the known range of the weevil, are extensive stands of spruce recently planted throughout the Hanna Ridge and Bell-Irving Valley areas, just north of the current known limit of weevil distribution near Meziadin Lake. Also, spruce plantations in rehabilitated

brushed-over sites in the lower Skeena Valley are just west of the current distribution limit in the Exchamsiks River-Salvus area.

With reference to biogeoclimatic zones, areas with chronic moderate to severe levels of current weevil attack (more than 10%) occurred exclusively in the Coastal Western Hemlock zone, mostly in the "wet submaritime" subzone with extensions into the "very wet maritime" subzone in the lower Skeena and Kitimat valleys. The incidence of current attack has remained at or below 10% within the distribution of the weevil in the Interior Cedar-Hemlock zone in the Nass and upper Skeena valleys.

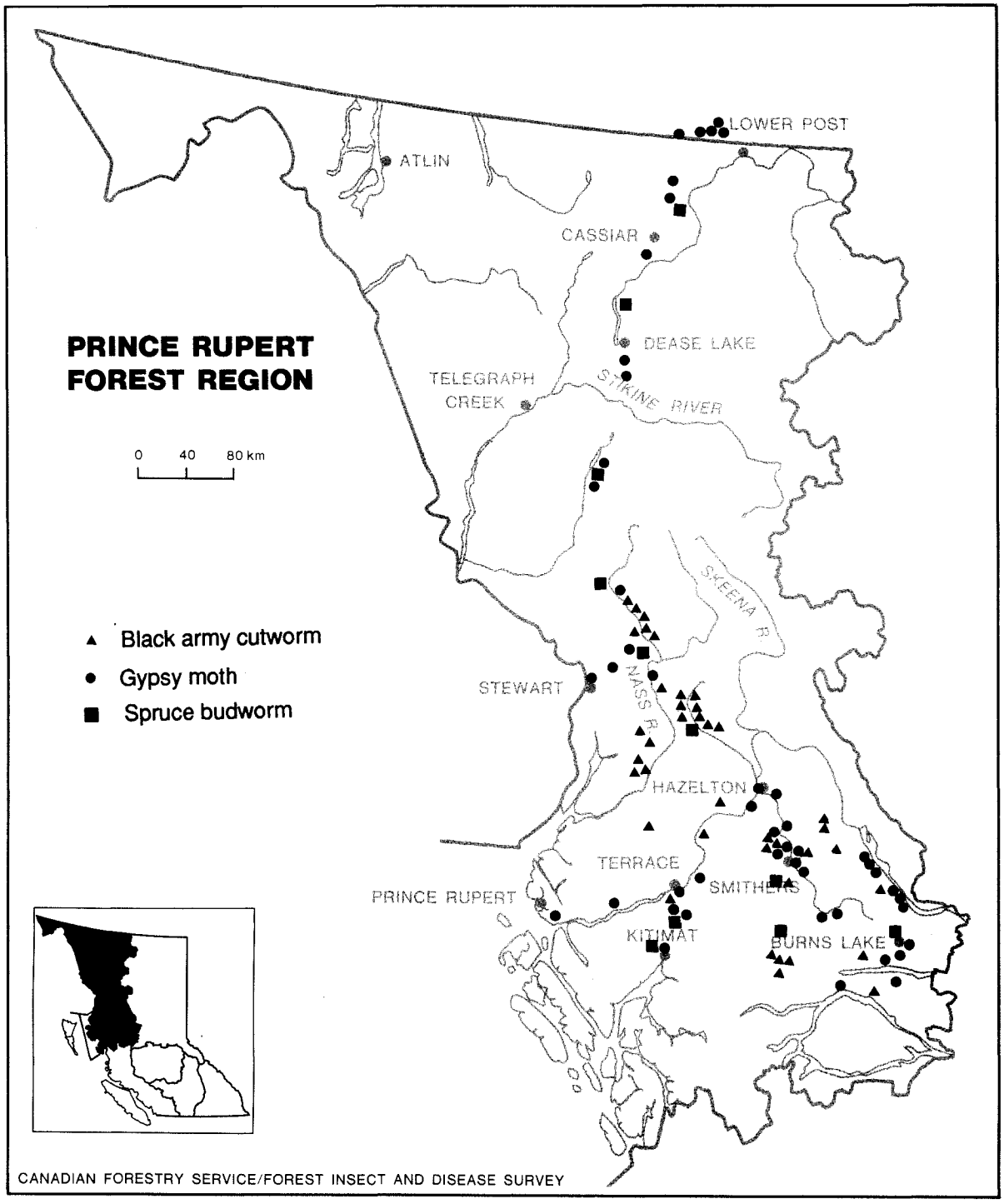
A portion of a Forestry Canada research project on "enhanced clipping" was conducted in the Prince Rupert Forest Region by the B.C. Forest Service in a 4-ha young stand selected by FIDS at Mannix Creek. The trial involved placing clipped infested leaders into barrels with a selectively screened opening to prevent the release of weevils but allow parasites and predators to escape, hopefully boosting natural control. Post-clipping surveys by FIDS found 55 unclipped infested leaders and 8 not clipped low enough, totaling about two percent of the current attack. Although the remaining weevils may compromise the research study, they probably reflect the standards which could be achieved operationally. Further monitoring will be conducted to assess the results of this trial, which may be continued in 1990.

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 the region. The intensity of defoliation declined in 1989; defoliation of current growth observed from east to west along the Alaska Highway was as follows: Liard River Crossing to Smith River - light with patches (several hectares) of moderate; Smith River to Eg Fire - trace to light; west of Eg Fire - no defoliation seen. On Highway 37, trace to light defoliation was noted on sapling-aged regeneration at Blue River.

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 throughout the region (Map 3). North of the Stikine River, high trap catches at Dorothy Creek, averaging 730 moths each (range 550 to 850), and Boya Lake, averaging 3 600 moths (range 3 200 to 4 000), were identified as *C. fumiferana*. The Boya Lake site had also been trapped in 1988, yielding an average of only 3 moths per trap. Branches were collected in late August for counts of egg masses at the trap sites and four other areas across the Cassiar TSA: Coal River, Hyland River, Atlin, and Stikine River . In spite of the high moth catches, no egg masses were found on the foliage from the trap sites; of the additional areas only one egg mass was found, at Coal River near the edge of the declining outbreak in the northeast corner of the region.

Further trapping and monitoring of any defoliation will be conducted in 1990.



Map 3. Locations where one or more pheromone-baited traps were deployed. Prince Rupert Forest Region, 1989.

Spruce bud midge
Rhabdophaga sp.

Chronic infestations of lateral and terminal buds of both Sitka and white spruce continued throughout the region, usually at light to moderate incidence and light intensity. Results from collections in representative young stands are tabulated (Table 9) and discussed in the "Unflushed buds" section, within the context of other agents. Earlier collections will be made in 1990, prior to emergence, to obtain specimens for taxonomic and parasitic assessments.

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 12 900 ha during flights over parts of the region in 1989, and occurred in an additional 57 000 ha throughout the remainder of the region.

During a partial overview flight of the Cassiar TSA, 12 750 ha of scattered mortality was mapped in portions of the Stikine River, Taku River and Atlin Lake drainages, compared with 1 050 ha mapped during a similar flight in 1982. In combination with a 1988 flight over southern and northeastern areas, the area of known balsam bark beetle activity currently totals 16 100 ha in the Cassiar TSA.

In the Kispiox TSA, spot outbreaks totaling 136 ha were mapped in portions of the upper Skeena Valley. No current area figures are available for the Bulkley, Morice or Lakes TSAs due to the limited scope of 1989 aerial surveys. Balsam bark beetle infestations, however, fluctuate little from year to year, and regional area figures reflect largely the totals from 1989 aerial surveys.

Incidences of infestation were low everywhere, affecting less than 10% of trees, and averaging about 1 to 2% in the region. Area figures do not necessarily reflect recent attack levels due to the retention of red needles by dead trees for up to five years following attack.

Salvage of beetle-infested alpine fir through 'Opportunity Wood' sales has been a high priority in the McKendrick Pass area of the Bulkley TSA for the past number of years. A recent increase in the the incidence of red trees in the Walcott-Emerson creeks area of the Morice TSA (13 000 ha in 1988) has led to the implementation of a co-operative program betweem the B.C. Forest Service and Northwood Pulp and Timber to harvest this timber.

An increasing need for information with respect to the biology and habits of the balsam bark beetle is being addressed by research through Simon Fraser University. Further studies concerning the complex of factors predisposing trees to attack will be undertaken by FIDS in the next few years.

Western blackheaded budworm
Acleris gloverana

Light defoliation of the current growth of alpine fir and to a lesser extent white spruce covered approximately 70 000 ha, primarily in the Bulkley and Morice TSAs for the fourth consecutive year (Table 5). The increase in reported area this year (up from 58 000 in 1988) was due primarily to increased activity in the Nadina Lake area, in the upper Telkwa Valley beyond km 23 and along the Chapman Road between Betty and Byron creeks.

Table 5. Estimated area, by location, lightly defoliated by western blackheaded budworm Prince Rupert Forest Region, 1989.

TSA	Location	Area (ha)[1]	No. of larvae[2]	Percent defol.[3]
Bulkley	Hudson Bay Mountain	1 000	52	10
	Telkwa River	500	111	20
	McKendrick Pass	13 000	107	15
	Nilkitkwa	500	322	40
Morice	Morice River	35 700	442	80
	Byman Creek	6 000	304	40
	Nadina Lake	8 000	122	20
	Chapman Road	2 000	60	10
Lakes	Francois Lake	3 300	-	30
Total		70 000		

[1]Area estimates are based on ground surveys since, with the exception of limited areas adjacent to the Morice River, defoliation was light and confined to the understory and lower crowns of overstory trees.
[2]Collected from standard three-tree beating samples.
[3]Current foliage only.

Significant numbers of larvae were also collected at: Topley Landing, 42; Pinkut Lake, 49; 14 km north of Granisle, 56; and Fort Babine, 48. Larval beating samples in alpine fir and white spruce were generally positive for the budworm throughout the sub-boreal spruce biogeoclimatic zone from Footsore Lake (70 km north of Kispiox) to Wisteria (Ootsa Lake).

Egg counts from branch samples collected from five locations indicated reduced defoliation in 1990 (Table 6).

Table 6. Location, number of eggs and predicted 1990 defoliation of alpine fir by western blackheaded budworm, Prince Rupert Forest Region, 1989.

Location	Avg. no. eggs/50 cm branch	Predicted 1989 defoliation[1]
McKendrick Pass	5.7	light
Byman Creek	2.2	trace
Km 19 Nilkitkwa Road	1.4	trace
Km 57 W. Morice Road	2.8	trace
Nadina Lake	1.6	trace

[1]Predication categories are based on infestations in coastal western hemlock:
1-5 eggs - trace defoliation
6-26 eggs - light defoliation
27-59 eggs - moderate defoliation
60+ eggs - severe defoliation

Fir-spruce budworms *Choristoneura* spp.

No significant defoliation attributed to fir-spruce budworms was recorded within the region in 1989.

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 for annual larval counts and defoliation estimates which could be related to the number of male moths captured. Few larvae were collected and only low numbers of moths were trapped, indicating a continuing endemic population with no defoliation expected next year.

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, Burns Lake, and the Bell-Irving River second 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. No defoliation was observed at the trap locations but moth catches were higher than in previous years. At the Kinaskan Lake and Bell-Irving River sites, catches increased from an average of 6 and 25 moths per trap respectively in 1988, to averages of 850 and 118 moths respectively in 1989. At the Burns Lake site with an average of 112 moths, the catch was similar to last year. In spite of the high moth catches, no egg masses were found on foliage collected at the trap sites in late August.

Further trapping and monitoring of any defoliation will be conducted in 1990.

Green velvet looper
Epirrita autumnata

E. autumnata larvae moderately defoliated the current growth of alpine fir over an area in excess of 1 000 ha along the Nado Creek Road in the Morice TSA, and caused light defoliation near Kwun Creek in the Bulkley TSA. The Nado Creek infestation was continuous with a western blackheaded budworm infestation in the Morice River Valley to the north, where Epirrita was responsible for up to 15% of the defoliation attributed to the budworm. The Kwun Creek infestation was visited following the cessation of feeding. Damage was light and patchy and most prevalent on understory and fringe trees.

LARCH PEST

Larch sawfly
Pristiphora erichsonii

Defoliation of tamarack by the larch sawfly was again prevalent. The intensity of defoliation increased in 1989, ranging from light to moderate in southern extents of the host range to moderate and severe farther north toward the Yukon border.

Defoliation of ornamental larch throughout the Terrace area continued, though generally at light intensity, the lowest levels since first collected in 1987. A few small pockets of moderate defoliation persisted in western areas. Nearby, exotic larch plantations in the Nelson River area, remained free of defoliation caused by the sawfly.

DECIDUOUS PESTS

Tent caterpillars
Malacosoma spp.

Two areas in the southwest of the region sustained significant defoliation by tent caterpillars. Valley bottom deciduous growth, mostly black cottonwood and red alder, was moderately to severely defoliated by the western tent caterpillar, *Malacosoma californicum pluviale*, in the Skeena Valley from the Exchamsiks River area to about 3 km east. The same insect lightly defoliated primarily willow in localized infestations at Augier Lake, north of Burns Lake, and along the northwest shore of Babine Lake. In Kitimat, deciduous trees throughout the townsite were moderately to severely defoliated by the forest tent caterpillar, *M. disstria*. In all areas the early season defoliation was followed by a second flush of foliage by mid to late summer.

Birch leafminer and Birchleaf skeletonizer
Lyonetia sp. and *Bucculatrix canadensisella*

White birch over a broad area from New Hazelton west to Keynton Lake were infested by both insects. Discoloration was evident in some stands late in the summer, by which time up to 50% of the leaves were infested. Though the two insect species generally occurred together, *Lyonetia sp.* was more prevalent, causing 80% of the damage.

From historical infestation patterns here and in the rest of the province, the infestation can be expected to intensify in 1990 before collapsing in the next two to three years.

A birch leafminer
Fenusa pusilla

For the third consecutive year, this leafminer lightly defoliated ornamental white birch at Terrace and Smithers. For the first time however, the leafminer was found in native stands mining up to 10% of the leaves on 5% of the birch along the Salmon River Road near Hazelton.

Following its introduction from east of the Rocky Mountains, this insect has become established in native and ornamental stands throughout much of the province. Surveys in the next few years will track any further spread and intensification within the region.

MULTIPLE HOST PESTS

Rhizina root disease
Rhizina undulata

For the second consecutive year Rhizina root disease caused seedling mortality, mainly in the Coastal Western Hemlock and Interior Cedar-Hemlock biogeoclimatic zones. Most of the mortality occurred in 1989 plantations; some additional mortality was also seen in plantations reported damaged in 1988.

The range, incidence and intensity of infections was greater in 1989 than in 1988. Mortality was recorded from 24 plantations (Table 7) and ranged from 1% to 74% (avg. 27%[1]) of planted seedlings. Host species in descending order of frequency of infection, though not necessarily susceptibility, were lodgepole pine, spruce (white, hybrid and Sitka), western hemlock and, for the first time in B.C., western red cedar. On sites with steep slopes or varied terrain, the most mortality was found on the high, drier and warmer parts of the block which were often the areas planted with lodgepole pine.

In the Kispiox TSA, all areas broadcast-burned in the fall of 1988 and planted in the spring of 1989 supported Rhizina root disease infections. In the Kalum TSA, every 1988 burn south of the Spruce Creek area in the Bell Irving Valley was affected; no infections were seen in recent burns farther north. To the east, only two of seven 1989 plantations were affected at the extreme western edge of the Bulkley TSA, one of four examined in the Lakes TSA, and none of six 1988 burns examined in the Morice TSA.

[1]Data were not weighted according to the relative proportion of each species in any one plantation, and include mortality of undetermined cause.

Table 7. A summary of damage caused by Rhizina root disease and other causes in sites burned 1988, planted 1989, Prince Rupert Forest Region, 1989.

Location	Biogeoclimatic zone	Host	Percent seedlings dead[1]	infected[2]	healthy
Kalum TSA					
Hwy 37, 38 km S Meziadin	ICHmc2	lP	69	0	31
		sS	21	12	67
Lavender Creek Road Km 10	ICHmc2	sS	15	14	71
		lP	24	7	69
Km 14		lP	57	16	27
Kwinatahl Road					
Goat River branch	ICHmc2				
Km 0.6		lP	32	12	56
		sS	35	13	52
Km 1.3		lP	61	40	0
		sS	25	25	50
Km 3		lP	55	12	33
Hwy 16, Little Oliver Creek	ICHmc3	lP	14	6	80
		sS	0	3	97
Williams Creek Road Km 16	CWHws2	wH	29	8	63
		wrC	0	0	100
Little Cedar River	CWHws1	wH	54	8	32
Branch 77 Road Km 9 spur	CWHws1	wH	2	2	96
		wrC	13	0	87
Lakelse River Road Km 14	CWHws1	wH	74	6	20
		sS	34	28	38
		wrC	20	0	80
km 8.5 spur		wH	72	2	26
		sS	43	43	14
Kispiox TSA					
Mi. 30 Kispiox CP 342 Block 40	ICHmc3	wS	26	7	67
Nangese Main CP 328 Block 31	ICHmc3	lP	1	1	98
Nangese Main CP 328 Block 33	ICHmc3	lP	3	2	95
Sweetin Main CP 320 Block 14	ICHmc3	lP	2	0	98
Corral Creek CP 347 Block 54	ICHmc3	lP	37	23	40
Corral Creek CP 347 Block 55	ICHmc3	lP	30	18	52
		wS	24	15	61
Bailey Main CP 338 Block 47	ICHmc3	lP	18	12	69
Bush Main CP 331 Block 24	ICHmc3	lP	26	16	58
		wS	8	4	88
Burdick Creek CP 100 Block 8	ICHmc3	wS	2	0	98
		wrC			
Bulkley TSA					
Trout Creek CP 350 Block 1	ICHmc2	lP	35	27	38
		wS	2	2	96
Trout Creek A129943	ICHmc2	wS	4	5	91

Location	Biogeoclimatic zone	Host	Percent seedlings dead[1]	infected[2]	healthy
Lakes TSA Ootsa Lake, Square Lake Road 93F0710008	SBSdk	lP	13	6	81
REGIONAL AVERAGE[3]			27	11	63

[1]Number of dead seedlings includes those confirmed and presumed killed by R. undulata; 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]Seedlings with or without symptoms, with fruiting bodies within 45 cm. These trees are presumed to be infected with the fungus and are expected to die within the next year.

[3]Averages are only a rough indication of overall infection levels due to the high variability of incidence and the unequal representation of each tree species surveyed.

Plantations reported infected in 1988 sustained additional damage in 1989, the greatest being at Guess Creek (CP 321 Block 1) where primarily lodgepole pine mortality increased from 6% to 23%. The limit of colonization by the fungus was probably reached the first year following a burn; most seedlings that died in the second year became infected during the initial colonization period, and succumbed to the disease and/or secondary agents which became pathogenic due to the weakened condition of the seedlings. Secondary fungi identified from dead or dying seedlings included Hyalodendron sp. on lodgepole pine and Sitka spruce, and Rhizosphaera pini on western hemlock, a new host record.

Where they have occurred, mass fruitings of Rhizina in forest situations have always followed 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. As a poor competitor the fungus normally survives for only a few years after the burn, after which it is succeeded by more aggressive fungi.

Observations in currently infected plantations tend to support these remarks, though at Corral Creek, an opening burned in 1986 and first infected in 1987 (CP 314 Block 2), continued to sustain light mortality (+2% of wS) in 1989. The site was replanted in June with lodgepole pine and many of these (+10%) planted adjacent to dead spruce subsequently died during the summer.

As long as sites are burned, the risk of infection by R. undulata will remain. An abundance of fruiting bodies in 1989 has produced enough spores to

infect sites that will be burned in 1990 and probably 1991. Infections are expected to continue at similar or increased levels in 1990, unless drought or other conditions unfavorable to spore germination or mycelial growth occur.

Black army cutworm
Actebia fennica

Current Activity

Cutworm feeding damage was less widespread this year affecting only plantations in the Kispiox Valley. Patchy, primarily light defoliation of white spruce and lodgepole pine seedlings occurred on an 87 ha block, CP 304 Block 2, along the Corral Creek Main. The block had been burned in 1986 and planted in 1987. The seedlings, already two years in the ground, were healthy and resilient and patches which were more than 80% defoliated recovered later in the season through adventitious budding. In an adjacent 1988 plantation, where the region-high number of male moths were trapped on 1988 (avg. 19.4 per sticky trap) light to severe herbaceous defoliation was prevalent but seedlings were, at most, lightly defoliated. Light defoliation of white spruce was recorded in a 1989 plantation, CP 342 Block 40, farther up the Kispiox Valley. This block had been broadcast-burned on August 24, 1988, and the fresh burn immediately attracted female moths which were still actively searching for egg-laying sites. When cutworm feeding commenced the following spring there was, as yet, no herbaceous ground cover, and all feeding was absorbed by the seedlings. Ordinarily, fall burning does not commence until after the adult flight period, and plantations do not become infested for at least a year.

In the Kalum TSA, larval populations were low and no seedling damage was observed. Light defoliation by an unidentified cutworm occurred on deciduous cover, mostly fireweed, in the Bell-Irving Valley.

Forecasts

To aid in forecasting 1990 populations, single pheromone-baited plastic container traps ("Multipher") were placed at 38 locations throughout the region (Map 3). At this stage in the calibration of the pheromone, catches of roughly 500 or more moths per trap are considered significant in terms of potential defoliation for the next season.

In the Kalum TSA, significant moth catches were made at three 1988 burns, all in the Bell-Irving Valley: 2.5 km north of Cousins Creek (1 200 moths); 1 km north of Ritchie Creek (650); and 2 km north of Ritchie Creek (700). Two additional sites in the Bell-Irving Valley were below the 500-moth threshold, as were nine sites further south in the Nass and Skeena river drainages. Of 25 sites trapped in the Kispiox, Bulkley, Morice and Lakes TSAs, only two yielded above 500 moths: CP 350 Block 1 Evelyn Station Road (880), and CP 347 Block 55 Corral Creek (552). At two additional sites the numbers of moths trapped were sufficiently close to the threshold to pose a potential hazard: km 27 McKendrick Pass (461), and km 14.4 Evelyn Station Road (456).

PESTS OF YOUNG STANDS

Surveys of young stands are an increasing priority throughout the region, utilizing a standard format to assess a variety of agents and their impact. Sixty-three sites were evaluated in 1989, ranging from plantations to sapling-aged regeneration. Details of surveys of major pests, such as white pine weevil, Rhizina root disease, etc. are reported in the appropriate host sections elsewhere in the report; this section is an overview of the occurrence of pests surveyed in sapling-aged stands in the region in 1989 (Table 8).

Table 8. Frequency and severity of various pests causing damage within sapling-aged stands[1], Prince Rupert Forest Region, 1989.

Tree condition or pest	Frequency (no. of stands)	Average percent incidence	Range	Severity index[2]	Remarks
Lodgepole pine - assessed in 23 stands					
Pest-free	21	78	27-100	1	
Cronartium comandrae	2	1	1-2	6	recently killed
C. comandrae	5	7	1-21	5	stem cankers
C. comandrae	2	4	4-5	4	branch cankers
Endocronartium harknessii	1	2		6	recently killed
E. harknessii	2	4	2-7	5	stem galls
E. harknessii	7	11	1-58	4	branch galls
Windthrow	1	1		6	
Windthrow (rooted)	3	1	1-2	5	severely deformed
Hylobius warreni	1	12		5	
Atropellis piniphila	1	27		5	
Pissodes terminalis	5	6	1-13	4	
Deer (browsing)	1	2		4	light-mod. tip damage
Stem fork defect	2	28	6-50	4	
Stem crook defect	2	3	1-4	4	
Porcupine	2	5	2-8	4	
Snow breakage	1	8		4	
Snow bending	1	50		3	
Cecidomyiidae	3	12	3-28	2	
Winter flecking	1	100		2	light-mod. intensity
Hare damage	1	100		2	light intensity
Lophodermella concolor	1	67		2	light intensity
Needle disease (unid.)	2	22	13-32	2	light intensity
White spruce - assessed in 15 stands					
Pest-free	15	40	0-100	1	
Hylobius warreni	1	2		5	
Snow bending	1	75		4	
Water	1	16		4	wet feet
Brush competition	1	10		4	trapped in understory
Spruce weevil	1	10		4	
Unflushed terminal bud	10	29	2-65	4	mostly winter damage, some Rhabdophaga

Tree condition or pest	Frequency (no. of stands)	Average percent incidence	Range	Severity Index[2]	Remarks
white spruce, continued					
Unflushed lateral buds	12	26	3-43	3	mostly frost
Spruce budworm	1	26		2	light-mod. defoliation of upper shoots
Hare damage	2	58	54-62	2	trace-light intensity
Spruce bud moth	7	61	25-85	2	very light damage
Spruce gall adelgids	6	12	4-44	2	mostly light intensity
Sitka spruce - assessed in 16 stands					
Pest-free	14	31	2-69	1	
Spruce weevil	13	18	2-48	4	
Unflushed terminal bud	13	9	2-18	3	mostly winter damage, some insect and disease
Unflushed lateral buds	14	47	12-88	2	trace-light intensity
Stem fork defect	11	15	2-33	4	often due to old spruce weevil attack
Stem crook defect	4	10	2-32	4	as above
Snow bending	1	5		3	
Spruce bud moth	12	45	5-100	2	trace-light intensity
Spruce gall adelgid	6	16	3-35	2	trace-light intensity
Frost damage	5	43	9-100	2	trace-light intensity
Western hemlock - assessed in 24 stands					
Pest-free	24	87	20-100	1	
Stem fork defect	3	5	3-6	4	
Stem crook defect	1	3		3	
Winter foliage damage	8	40	6-80	2	light-moderate dieback
Snow bending	1	19		3	
Amabilis fir - assessed in 10 stands					
Pest-free	10	78	9-100	1	
Stem fork defect	1	15		4	
Unflushed terminal bud	3	12	9-15	3	winter damage
Unflushed lateral buds	3	28	9-49	2	trace-light intensity
Snow bending	1	4		3	
Winter foliage damage	2	50	8-91	2	light intensity
Alpine fir - assessed in 8 stands					
Pest-free	7	64	45-100	1	
Deer (browsing)	4	28	3-55	4	often severe in natural regeneration
Unflushed terminal bud	3	33	19-53	3	winter damage
Unflushed lateral buds	2	42	25-58	2	trace-light intensity
Snow bending	2	13	1-25	3	
Stem fork defect	1	1		3	
Pucciniastrum epilobii	1	83		2	moderate intensity
Frost damage	1	50		2	light intensity

Tree condition or pest	Frequency (no. of stands)	Avg. percent incidence	Range	Severity Index[2]	Remarks
Western red cedar - assessed in 12 stands					
Pest-free	12	100	96-100	1	
Stem crook defect	1	4		3	

[1]At least 100 trees sampled per plantation using fixed radius plots at 50m intervals.

[2]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 conditions during the 1989 field season were drier and warmer than normal, except northern areas which were wetter. At Terrace, April to September total precipitation was 31% below normal and mean daily temperatures were 13% above normal. Similarly, at Smithers, representative of the southern interior of the region, precipitation was 21% below normal and temperatures were 14% above normal. However, at Dease Lake, representative of the northern half of the region, precipitation was 17% above normal and temperatures were 23% above normal.

In the preceeding winter several storms with high winds occurred. In late January to early February temperatures in the -10 to -20 C range (Terrace) were accompanied by strong outflow winds of up to 57 km/h for 11 days, causing widespread bud mortality and scattered foliar dessication and dieback.

Blowdown

Storms over the 1988/89 winter resulted in scattered patches of blowdown, both in undisturbed stands and along cutblock and road edges. In the Kalum TSA, damage was most common in the side valleys of the Skeena River drainage, and to a lesser extent, the Kitimat River drainage. Valleys oriented roughly east to west sustained the most damage, particularly Williams, Chimdemash, and Hirsch creeks and parts of the Kleanza and Copper rivers.

Near km 22 of the Upper Fulton Road in the Bulkley TSA, scattered small patches of white spruce, lodgepole pine and alpine fir were blown over for the second consecutive year. In the same area, about 10% of young lodgepole pine in two plantations were partially blown over in the same storm. Though the trees survived, they were leaning severely, and crooks will be formed as new terminal growth resumes the vertical.

In the Morice TSA, scattered individual lodgepole pine and white spruce blowdown was common near Owen Lake, and a localized late summer storm near the north end of Morice Lake caused patch white spruce blowdown over an area estimated at 400 ha. Spruce blowdown has historically been responsible for the most severe spruce beetle epidemics in the province by providing ideal conditions for the beetle to breed.

Unflushed Buds

As large areas of regeneration reach sapling age the occurrence of unflushed lateral and terminal buds is becoming more apparent. More detailed surveys in 1989 confirmed that most of the damage was caused by winter kill and a bud midge, Rhabdophaga sp. (Table 9). Bud kill due to winter damage may have been exaggerated in 1989 due to particularly severe weather from late January to early February. The greatest impact is from unflushed terminal buds, resulting in height loss and stem distortion as lateral branches compete for dominance.

Table 9. Occurrence of unflushed buds in sapling-aged stands and determination of causes from representative collections. Prince Rupert Forest Region, 1989.

Location (south to north)	Host	Percent incidence of unflushed buds[1] lateral[2]	terminal	Remarks
Kitimat R. drainage				
8 km NW Kitimat	sS	73	8	50% insect (Rhabdophaga sp.), 40% winter kill, 10% disease (Cladosporium sp.)
L. Wedeene R. bridge	sS	75	7	
Branch 77 Rd. km 7	aF	9	9	
km 6	sS	26	11	
Branch 77A Rd. km 2	sS	57	10	50% Rhabdophaga sp., 50% winter kill
Coldwater Rd. km 1	sS	88	11	Undetermined mix of Rhabdophaga sp. and winter kill.
Skeena R. drainage				
Lachmach Rd. km 1	sS	43	2	
	aF	0	15	
Kwinitsa Rd. km 2	sS	12	4	Partly due to undetermined disease possibly Ramichloridium sp. first collected here 1988.
Whitebottom Rd. km 4	sS	60	9	Winter kill.
	aF	25	0	
Copper R. Rd. km 24	sS	29	7	
West Kalum Rd. km 39	sS	17	17	
km 42	sS	64	4	
Nass R. drainage				
Hwy 37, 57km N Kitwanga	sS	57	18	
Lavender Ck. Rd. km 10	aF	49	11	Winter kill.
Hwy 37, 75km N Kitwanga	sS	23	3	80% winter kill,20% Rhabdophaga sp
Hwy 37, 124km N Kitwan.	alF	25	19	
Meziadin Lk., 1 km E	wS	44	18	Winter kill.
	alF	58	29	>90% due to winter kill
Cassiar TSA				
Hwy 37, Serpentine Cr.	wS	43	0	
Hwy 37, French R.	wS	25	20	80% winter kill, 20% insect, probably Rhabdophaga sp.
Hwy 37, Blue R.	wS	23	13	
AVERAGES	sS	43	9	13 locations
	wS	34	13	4 locations
	aF	21	9	4 locations
	alF	42	24	2 locations

[1]Incidence refers to proportion of trees affected in the stand.
[2]Intensity of unflushed lateral buds was usually light, <10% of buds per tree.

Winter dieback

Low temperatures and high winds early in 1989 resulted in damage to foliage, stems and buds, mostly in the western half of the region.

In mature stands, dessication and loss of foliage, with tip dieback and bud kill on the most exposed branches, occurred most commonly on western hemlock. East of Meziadin Lake, 6200 ha of moderate to severe defoliation was mapped, the greatest damage occurring in upper to mid crowns and along edges of roads and cutblocks. More sheltered branches were not affected or had dead 1988 foliage and a healthy 1989 flush. In the white spruce and alpine fir components impact was limited to light dieback of older foliage and unflushed buds. Western hemlock, and to a lesser extent Sitka spruce, were also affected in the lower Skeena Valley, generally at light intensity with the greatest impact again at stand edges. Bud and tip dieback was also common throughout the region in the upper crown and exposed sides of deciduous hosts - trembling aspen, white birch, and black cottonwood.

Strong cold February winds killed foliage of young planted and natural lodgepole pine between km 11 and 45 of the Upper Fulton Road, and km 97 and 102 of the Fulton Lake Road. Dieback was limited to needles on the windward sides of branches on the southeast sides of the trees. More than 50% of the trees in both areas sustained some damage, with many losing more than 40% of their needles.

In sapling aged stands the greatest impacts, aside from unflushed buds (previous section), were foliar dieback and stem damage due to snow bending (Table 10). Young stands are particularly susceptible to winter damage because of their openness, especially after brushing and/or thinning.

Table 10. Occurrence of winter damage in sapling-aged stands, excluding bud dieback. Prince Rupert Forest Region, 1989.

Location (south to north)	Host	Condition	Incidence (percent)	Remarks
Kitimat R. drainage				
Branch 77 Rd. km 7	wH	tip dieback	6	trace intensity
Skeena R. drainage				
Lachmach Rd. km 1	wH	foliar dieback	77	moderate to severe in older foliage, some tip dieback
Kwinitsa Rd. km 2	wH	foliar dieback	67	light loss of 1988 foliage
Williams Cr. Rd. km 4	aF	foliar dieback	91	light intensity, older foliage
	wH	foliar dieback	82	light intensity, older foliage
km 4.4	aF	foliar dieback	8	trace to light intensity in older foliage, unthinned stand
West Kalum Rd. km 39	xL[1]	snow bending	23	large stem crooks, cumulative
Nelson R.	xL	snow bending	24	large stem crooks, cumulative

Location (south to north)	Host	Condition	Incidence (percent)	Remarks
Nass R. drainage				
Hwy 37, 57km N Kitwanga	sS	snow bending	5	stem defect
Lavender Ck. Rd. km 10	wH	foliar dieback	30	light to moderate intensity
	aF	snow bending	4	stem defect
Hwy 37, 75km N Kitwanga	wH	foliar dieback	20	light dieback of older foliage
Hwy 37, 124km N Kitwan.	wH	foliar dieback	13	light to moderate intensity
		snow bending	19	stem defect
	lP	snow bending	50	stem defect
		snow breakage	14	
	alF	snow bending	1	stem defect
Meziadin Lk., 1 km E	wS	snow bending	74	stem defect, some breakage
	alF	snow bending	25	stem defect

[1]xL = exotic larch, probably European

Frost

In the Kalum TSA, damage to newly flushed foliage in sapling-aged stands of Sitka spruce was common in the Kitimat Valley, affecting from 9 to 100% (avg. 63%) of trees at four locations assessed. However, the intensity was from trace to light; usually less than 5% of the new flush was killed.

Some frost damage occurs almost every year, particularly in the spring if a hard frost follows budbreak. The tender foliage of newly flushed buds is particularly susceptible to freezing.

MAMMAL DAMAGE

Porcupine

Dieback and mortality caused by porcupines continued at levels similar to 1988, 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, 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.

For the first time, new damage was seen 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, previous FIDS observations and B.C. Forest Service probe lines in several stand types in the Kalum Valley disclosed an overall annual rate of current attack between 1 and 2%. Accumulated impact was variable in young growth exotic larch plantations in the Kalum Valley; at Mayo Creek 77% of remaining trees were dead from the mid-crown up, while only 4% had sustained similar dieback at a Nelson River site. At Serpentine Creek, in the Cassiar TSA, 8% of the stems in a young growth lodgepole pine stand had recently sustained partial stem girdling.

In the northern parts of the Bulkley and Morice TSAs, much of the scattered lodgepole pine mortality mapped during aerial surveys as mountain pine beetle, has been found during subsequent ground probes to have been caused by porcupines. In these and all other areas in the three eastern TSAs, porcupine populations appeared to be increasing.

Factors contributing to high porcupine populations in the last few years include recent mild winters, the trapping of fishers (the main effective predator of porcupines), and pole-sized slash left in thinned stands which provides cover for the porcupine. The silvicultural trend to fewer but heavier thinnings increases the value of remaining stock and the impact of porcupine feeding.

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

Snowshoe hare

Populations of the snowshoe hare have been increasing in recent years and are expected to peak in 1990. At current levels the impact of the characteristic angular clipping of terminal and lateral shoots has remained low. However, increased damage could cause severe stunting in young plantations where seedling growth relies on successful development of relatively few and low buds.

Most of the hare damage seen in 1989 was in the Cassiar TSA. In a 12 year-old stand of white spruce regeneration at Blue River, 62% of the trees had sustained clipping of terminal shoots during high snowpack conditions; lateral shoots were also damaged. A light incidence of damage to shoots of suppressed white spruce was observed in a thinned stand near Serpentine Creek. Young tamarack in the Hyland River area sustained stem damage attributed to hare gnawing; resulting cankers were infected by a secondary fungus, Sirodothis sp.

Vole

Vole populations continued to decline throughout the region. In a single new plantation in the Nadina area of the Morice TSA, 20% of the lodgepole pine were killed by vole clipping; white spruce in the same plantation did not appear to be affected. The return to endemic levels in most areas follows 2 years of seedling damage and mortality during a cyclical peak in the population.

SPECIAL DIRECTED SURVEYS

Acid rain national early warning system (ARNEWS)

As part of a national network, a 10 x 40m plot was established in the Terrace Watershed in 1985 to detect and monitor any impact due to acidic or toxic rain on native trees and indicator plants. Chemical analysis of conifer foliage and soils will be conducted periodically to detect any significant changes.

Annual visual assessments of plot vegetation and pest conditions in 1989 recorded only the same minor pests, at low levels, unchanged from previous years. No symptoms of damage from acid 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 stem sections from recently killed lodgepole pine, white spruce and western hemlock. The nematode is thought to be vectored by secondary insects that normally attack freshly killed trees. Wood boring and engraver beetles that had attacked the wood will be reared and analyzed for the presence of the nematode.

B. xylophilus has caused extensive mortality of native pines in Japan. It was thought to have been introduced to Japan via green wood products imported from North America. In 1984, research was implemented in Canada to address fears expressed by European lumber buyers that the nematode may become introduced to their forests.

Research to date has found very little evidence of the nematode in native B.C. trees.

Gypsy moth
Lymantria dispar

Single gypsy moth pheromone-baited traps were placed and retrieved from 45 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, Agriculture Canada, or 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 Okanagan Valley, Lower Mainland, and Vancouver Island re-emphasize the need for vigilance with regard to this potentially destructive defoliator.

The trapping program will continue in 1990.

Trembling aspen surveys

The profile of trembling aspen as a commercial tree species has recently been raised within the province with the completion of a plant at Dawson Creek which uses aspen as the raw material in the production of 'Oriented Strand Board'.

One of the main limitations of aspen as a commercial species is it's susceptibility to various stem diseases, chief among them being the false timber conk, Phellinus tremulae, and hypoxylon canker, Hypoxylon mammatum. FIDS has instituted surveys in 1989 to examine stands of aspen at widespread locations to gain an overview of their health and some idea of their potential as a crop. Increment cores were taken from 10 trees selected at random at each of six sites and the cores examined for radial characteristics. Heart rot, primarily caused by P. tremulae, was found in trees from all sites, with an average of 45% (range 10-80%) of the trees having lost an average of about 20% wood volume (as determined by percentage of basal area rotten). Further studies detailing various agents of decay in aspen will be conducted in future years.

CHRONIC DISEASES

Several chronic diseases (Table 11) 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 most practical as preventive treatments combined with specific stand management practices during the harvest-regeneration phase or juvenile stand tending.

Table 11. Important chronic diseases. Prince Rupert Forest Region, 1989.

Disease	Host(s)	Location	Remarks
Annosus root rot *Heterobasidion annosum*	aF, sS, wH	southwestern part of region	infecting stumps in thinned stands, spreading to leave trees
Atropellis canker *Atropellis piniphila*	lP	southern half of region	sporadic occurrence of stem deformation, locally severe impact
Comandra blister rust *Cronartium comandrae*	lP	throughout region	particularly damaging in young stands, up to 50% mortality recorded
Hardwood trunk rot *Phellinus ignarius*	tA	throughout region	causing extensive decay in trembling aspen
Hemlock dwarf mistletoe *Arceuthobium tsugense*	wH	throughout host range	widespread, particularly severe in remaining old-growth stands

Disease	Host(s)	Location	Remarks
Lodgepole pine dwarf mistletoe *Arceuthobium americanum*	lP	southeastern part of region	widespread but sporadic in mature stands causing significant growth loss
Red ring rot *Phellinus pini*	sS, wS, wH alF, aF	throughout region	widespread, particularly in old-growth stands
Rust-red stringy rot *Echinodontium tinctorium*	wH	southern half of region	widespread in old-growth stands
Spruce broom rust *Chrysomyxa arctostaphyli*	wS	throughout host range	widespread, particularly in northern half of region
Stalactiform blister rust *Cronartium coleosporioides*	lP	throughout region	particulary damaging in young stands, most common in interior
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 12. Relatively minor damage caused by disease is reported in Table 13.

Table 12. Other noteworthy insects. Prince Rupert Forest Region, 1989.

Insect	Host	Location	Description
An alder leaf beetle *Pyrrhalta punctipennis*	rAl	Prince Rupert to Terrace	patches of light to moderate defoliation common
Alder woolly sawfly *Eriocampa ovata*	rAl	Prince Rupert Kaien Island	patches of severe defoliation continue, first collected 1985
A bark beetle *Hylurgops porosus*	lP	Nilkitkwa Road, km 40	secondary, attacking young trees girdled by rodents
Birch-aspen leafroller *Epinotia solandriana*	tA rAl sAl bCo wB	throughout region	common in most areas, though at light intensity
Conifer loopers *Eupithecia annulata*, *Eupithecia sp.*	wH aF wS	throughout host ranges	increasing occurrence at permanent sampling points though numbers still low
A conifer sawfly *Neodiprion* sp.	wH sS	Skeena River drainage	larval counts continue to increase at permanent sample points, light defoliation of older foliage in some areas
Eriophyid mites *Trisetacus campnodus*	lP	Humphrys Creek	high incidence of infestation in new plantation
Eriophyes calaceris	dM	Burdick Main	common in area, up to 60% leaves infested
Gall mite *Phytoptus sorbi*	Sumac	Seeley Lake Prov. Park	50% leaves infested, all plants

Insect	Host	Location	Description
Giant conifer aphid *Cinara* sp.	lP	Cassiar TSA	common at moderate intensity on older foliage, increased from 1988
		Kitwanga-Hazelton Rd.	localized, 5-60% branches on 70% trees
	wS	Smithers Landing Rd.	localized, all age class roadside trees
Gray forest looper *Caripeta divisata*	wH	Skeena Valley	remaining at endemic levels
Greenheaded spruce sawfly *Pikonema dimmockii*	sS	Nass R. Skeena R.	increasing occurrence at permanent sample points, no defoliation yet
Greenstriped forest looper *Melanolophia imitata*	wH alF sS	Skeena R. Nass R.	sporadic occurrence at permanent sample points, no defoliation
Hemlock engraver *Scolytus tsugae*	wH	Robinson Lake	secondary in root rot-infected sapling
Leaf beetles			
Chrysomela sp.	bCo	Lakelse	patches of high incidence and intensity
		Thornhill	moderate incidence in a forest nursery
Zeugophora sp.	bCo	Thornhill	moderate incidence in a forest nursery
Syneta carinata	wS	Kinaskan Lk.	endemic population
Lodgepole pine beetle *Dendroctonus murrayanae*	lP	Cassiar TSA	returned to endemic levels after build-up caused scattered tree mortality near Cot and Eg fires 1986-88
A pine flower sawfly *Xyela* sp.	lP	E. Palling Rd. Kitwanga-Hazelton Rd. Morice Lk. Rd.	common feeding on staminate cones
A pine needle miner *Coleotechnites* sp.	lP	E. Palling Rd. km 33 and 65 Morice Lake Rd.	light mining activity, reduced from 1988
Poplar and willow borer *Cryptorhynchus lapathi*	W	Skeena, Nass and Kitimat valleys	increased in 1989, dead stems common

Insect	Host	Location	Description
Poplar leafminer *Phyllocnistis populiella*	tA bCo	Cassiar TSA	common at trace intensity
Poplar leaftier *Nycteola cinereana*	bCo	Thornhill	moderate incidence in a forest nursery
Rusty tussock moth *Orgyia antiqua badia*	wH sS alF lP	Skeena River drainage	increasing occurrence at permanent sample points, though still at low intensity
Saddleback looper *Ectropis crepuscularia*	wH	host range	remained at endemic level
Spruce budmoths			
Epinotia radicana	sS wS	throughout host ranges	high incidence though remaining at light intensity on all age classes
Zeiraphera unfortunana	wS	in region	
Z. canadensis	sS		
Spruce engraver *Ips tridens*	wS	Morice Rd. km 33	scattered blowdown heavily infested
Spruce gall adelgids			
Adelges lariciatus	wS	French River	common at light intensity on all age classes
Pineus spp.	sS wS	throughout region	common at trace-light intensity, decreased from 1988
Western hemlock looper *Lambdina fiscellaria lugubrosa*	wH sS alF lP	Skeena River drainage	continues to increase at permanent sample points; no defoliation yet
Yellowheaded spruce sawfly *Pikonema alaskensis*	sS	Skeena River	remaining at low levels
Yellowlined forest looper *Cladara limitaria*	wH wS sS alF aF	throughout host ranges	increasing occurrence at permanent sampling points; no defoliation yet

Table 13. Other noteworthy diseases. Prince Rupert Forest Region, 1989.

Pest	Host	Location	Description
An alder leaf blotch *Mycopappus alni*	rAl	Kitsumkalum Mountain	high incidence though generally light intensity of infection noted late in season
A bark fungus *Apostrasseria* sp.	wS	Corral Ck.	associated with Rhizina root disease on dead seedlings
A black spot disease *Pollaccia borealis*	tA	Stikine R., Boya Lk., Cormier Ck.	light leaf spotting, widespread
Delphinella tip blight *Delphinella abietis*	alF	Nass Valley	infections continued to decline to ambient levels
False morel *Gyromitra esculenta*	lP	Corral Ck., Upper Fulton Road km 50, Nilkitkwa Rd. km 1 and 100, Coal mine Rd.	associated with live and dead seedlings; fruiting body resembles that of *R. undulata*
Fir-fireweed rust *Pucciniastrum epilobii*	alF	Nass Valley	incidence reduced from previous years, few patches of moderate to severe intensity
Juniper shoot diebacks			
Chloroscypha sabinae	dJ	Stikine R.	common at light intensity, new host record
Lophodermium juniperi	rJ	Stikine R.	common at light intensity
A needle blight *Rhizosphaera pini*	wH	Little Cedar River	new host record
Needle rust *Chrysomyxa weirii*	wS	Salmon Rd. km 52	70% 1988 needles infected; localized
A pine needle cast *Lophodermella montivaga*	lP	McKendrick Pass	60% 1988 foliage on 10% trees; localized
A poplar canker *Valsa sordida*	bCo	Weber Ck	stem cankers common on transplanted seedlings
Poplar shoot blights			
Venturia macularis	tA	host range	infections remained light for third year
V. populina	bCo	host range	infections remained light

Pest	Host	Location	Description
Root diseases			
Phellinus sp.	wS	Robinson Lk.	associated with *Hylobius warreni* feeding in young tree
Armillaria sp.	wH	Robinson Lk.	killed single sapling in plantation
Root fungi			
Hyalodendron sp.	lP	Corral Cr., Bailey Main, 40 km south of Meziadin	associated with *Rhizina undulata*; new distribution record
	sS	Little Oliver Creek	
Cylindrocarpon sp.	wS	Bush Main	associated with *R. undulata*
A shoot fungus *Sclerophoma pithyophila*	lP	Elizabeth Lk.	secondary, usually following frost injury
A spruce needlecast *Lirula macrospora*	sS	host range	declined to trace levels
Spruce needle rusts			
Chrysomyxa ledi	wS	Cassiar TSA	infections declined to endemic levels
C. ledicola	wS	Skeena Valley	declined to endemic level
Tar spot *Rhytisma salicinum*	W bCo	host range Keynton Lake	common at light intensity avg. 40% leaves infected on all trees; localized
Winter flecking	lP	Dease Lake km 67 Nilkitkwa Road	environmental damage common on older foliage at light to moderate intensity

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