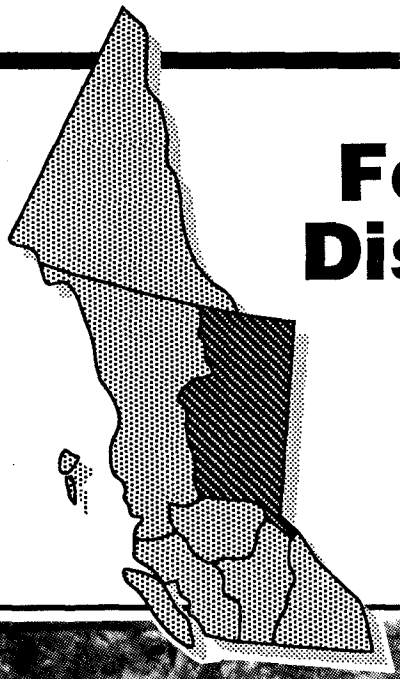
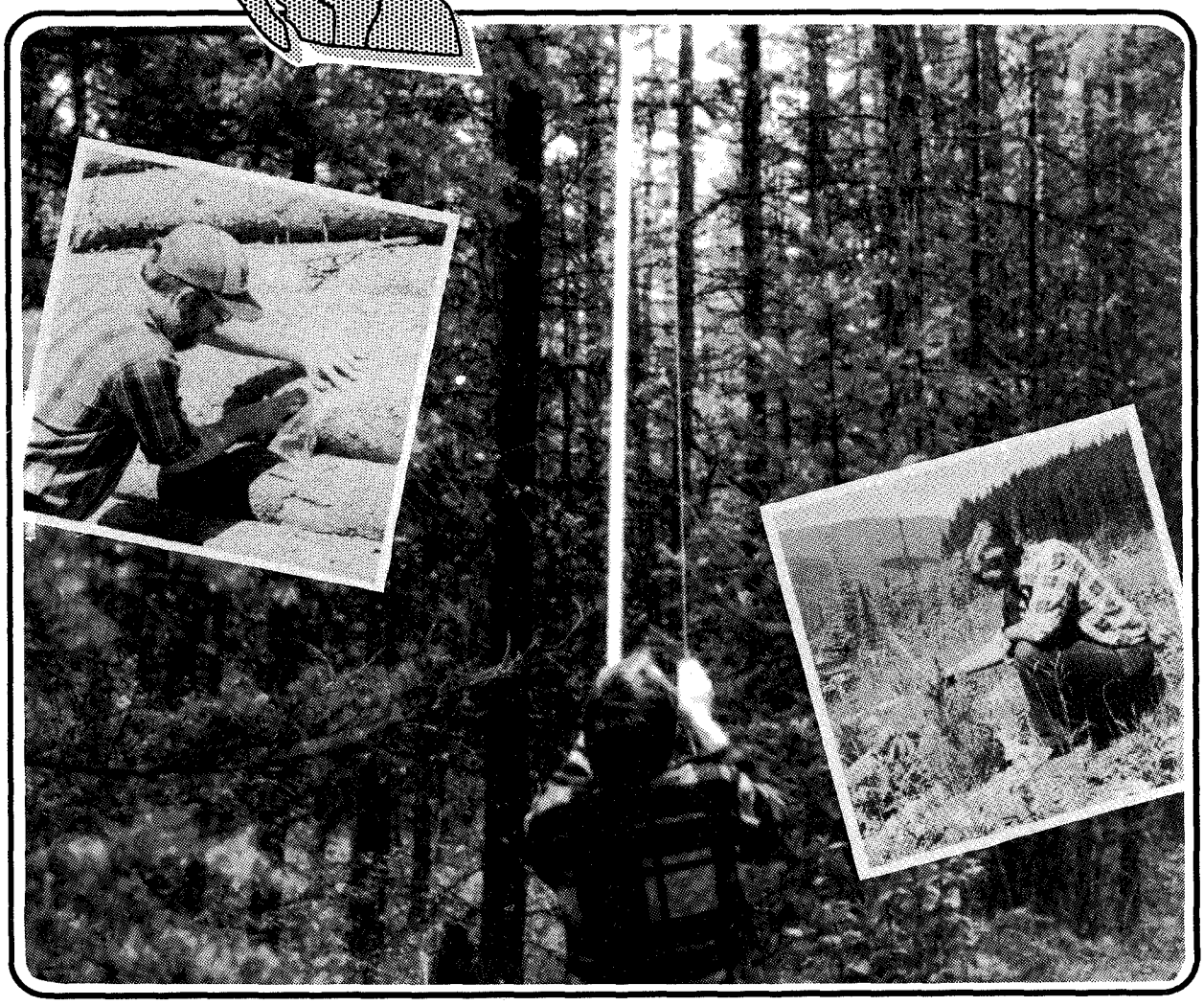


Forest Insect and Disease Conditions

Prince George Forest Region
1990

R. Turnquist & R. Ferris



Forestry Canada Forêts Canada

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APPENDICES

The following appendices are available upon request from:

Forest Insect and Disease Survey
Forestry Canada
506 West Burnside Road
Victoria, B.C.
V8Z 1M5

I. Maps of major bark beetle and defoliator infestations compiled during aerial surveys of the Prince George Region, 1990.

II. Summary of the spruce budworm, gypsy moth and black army cutworm pheromone trapping program, Prince George Region, 1990.

III. Summary of pest problems in provincial parks within the Prince George Region,1990.

IV. A detailed summary of pests of young stands, Prince George Region, 1990.

V. A summary of the joint Canada-Sweden lodgepole pine trials in the Pacific Region.

INTRODUCTION

This report summarizes the findings of two Forest Insect and Disease Survey (FIDS) Rangers during summer field studies in the Prince George Forest Region in 1990. Forest pest conditions are listed by host in order of importance with emphasis given to those capable of sudden damaging outbreaks. Most of the information was gathered through the monitoring of over 25 permanent sampling stations throught the Region; the monitoring of already known or recently reported infestations or disease problems; the detection of pest problems during travels through the Region; annual aerial surveys during which major pest problems were mapped with reference to area and severity; and special projects designed to gain information for ongoing research.

The FIDS field season extended from May 28 to September 26 during which over 200 insect and 130 disease collections were sent to the Pacific Forestry Centre (PFC) for identification or confimation (**Map 1**). Some of these were added to the extensive permanent collections in the PFC Insectary and Herbarium.

The B.C. Forest Service provided approximately 16 hours of fixed-wing and 10 hours of helicopter time, the B.C. Ministry of Parks provided approximately 6 hours of helicopter time, and Industry provided approximately 3 hours of helicopter time for aerial and aerially accessed ground surveys during the 1990 season (**Map 1**). During aerial surveys, bark beetle and defoliator damage has been quantified within damage classes and reference to these classes appear intermittently throughout the report:

Bark beetle mortality classes: light - 10% or less of stand recently killed
moderate - 11-29% of stand recently killed
severe - 30%+ of stand recently killed

Aerial survey defoliation classes:

light - discolored foliage barely visible from the air; some branch and upper crown defoliation

Moderate - pronounced discoloration; noticeably thin foliage; top third of many trees severely defoliated; some completely stripped

Severe - bare branch tips and completely defoliated tops; most trees more than 50% defoliated

Final copies of maps produced during aerial surveys are input into the FIDS in-house geographical information system (GIS). Computer generated copies of these maps are sent to various co-operators after they are digitized into the GIS. All area figures are generated by the GIS. Further copies of digitized maps are available by request through FIDS.

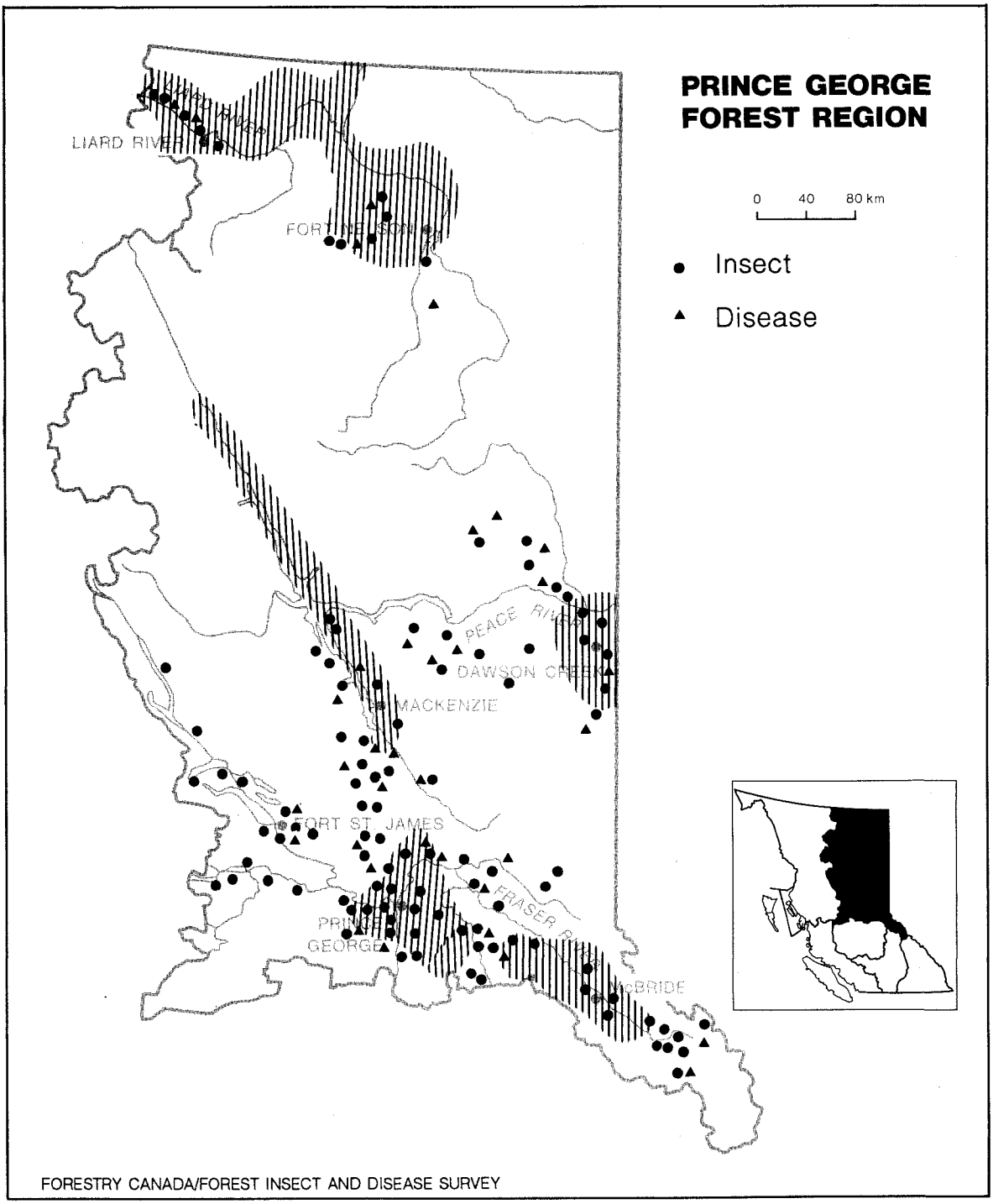
During the field season, correspondance and inquiries with respect to forest pest problems in the Prince George Forest Region can be directed to the Forest Insect and Disease Survey (FIDS) Rangers at:

Forest Insect and Disease Survey, Phone: 963-7238
Forestry Canada
R.R. 8, Site 25, Compartment 8, 963-7394
Prince George, B.C. V2N 4M6

During the remainder of the year, the rangers are based at:

Pacific Forestry Centre, Forestry Canada
506 West Burnside Road, Victoria, B.C. V8Z 1M5 Phone: 363-0600

The Forest Insect and Disease Survey is a Nation-wide network within Forestry Canada with the responsibility of: producing an overview of forest pest conditions and their implications; maintaining records and surveys to support quarantines and facilitate predictions; supporting forestry research with records, insect collections, and herbaria; providing advice on forest insect and disease conditions; and developing and testing survey techniques and conducting related biological studies. Surveys are carried out in both British Columbia and the Yukon, collectively termed the Pacific Region.



Map 1. Location where one or more forest insect and disease samples were collected and areas covered by aerial surveys to map bark beetle and defoliator infestations in 1990.

SUMMARY

Spruce beetle populations increased for the second consecutive year; aerial surveys by the B.C. Forest Service mapped cumulative mortality of approximately 296 500 m3 over 11 160 ha from southeast of Prince George to north of Mackenzie. This is up from the less than 100 ha recorded in 1989. 1990 was a major flight year, and current attacks were recorded in windfall, trap trees and standing green timber. **Eastern spruce budworm** populations increased for the second consecutive year, in this the sixth consecutive year of the current outbreak. The area of recorded defoliation more than tripled to 398 155 ha, up from 123 750 recorded in 1989. Defoliation by mature **two-year-cycle spruce budworm** declined to 8610 ha, from 17 520 ha recorded in 1988, the last major feeding or 'on-cycle' year. The decline was widespread throughout all areas previously infested. No defoliation was seen in the Ospika River Valley, where two-year-cycle budworm populations, which are not synchronized with other populations in the region, were first discovered in 1989. **Tomentosus root rot** was found in windthrown mature spuce from the Weedon Lake area to Manson River, and east to the Kiskatinaw River area. **Spruce weevil** continued to infest and kill young spruce leaders throughout the southern half of the region; an infestation found north of Mackenzie is the most northerly population yet found in the central interior. Populations of the **northern spruce engraver beetle** increased in windthrow and trap trees, and could pose a threat to predisposed or even healthy trees in 1991.

Lodgepole pine mortality due to 1989 **mountain pine beetle attacks** increased to 206 000 m3 over approximately 7875 ha, based on maps supplied by the B.C. Forest Service. Most of the mortality continued to occur in the Fort St. James Forest District. Inceased surveys for the **pinewood nematode** throughout the region were negative. Of the over 1000 samples collected throughout the Pacific Region, only one collection at Watson Lake in the Yukon Territory was positive. **Pine stem rusts** are the major cause of mortality in young stands and are widespread throughout the region. **Root collar weevil, stem rusts, secondary insects** and **microfungi** were found at four lodgepole pine plantations established in 1986 as a **joint Canada-Sweden project**. Further studies on a new species of **pine feeding budworm** were continued north of Prince George.

Balsam bark beetle mortality continued at levels similiar to 1989. **Douglas-fir beetle** populations increased, mortality was mapped over approximately 800 ha, up from 110 ha recorded in 1989. Most of the mortality occured in the Prince George district, with lighter mortality in the Ft. St. James and McBride districts.

No **acid rain** symptoms were recorded at a long term study plot near Averil Lake in this the fifth year of monitering. A total of 28 **young stand surveys** at widespread locations found a variety of diseases and pests; the most common were **stem rusts, root** and **terminal weevils, adelgids** and **environmental damage. Black army cutworm** populations increased; trace to light defoliation of herbacious material was recorded at two locations, and pheromone trap results indicate increasing populations. Recovery from 1989 **winter damage** was assessed at several locations, light current damage was also recorded. **Salt damage**, due

to road applications in the winter, was light and occured mainly in the southern half of the region. **Animal damage** was recorded at several locations throughout the region, the most severe being hare damage to a spaced pine stand north of Mackenzie. Widespread **blowdown**, which occured throughout the region, absorbed increasing bark beetle populations.

Forest tent caterpillar populations increased throughout the region; 193 675 ha of mainly trembling aspen were defoliated, up from 108 290 ha in 1989. No adult male **gypsy moths** were trapped in 43 pheromone-baited traps placed in provincial parks, rest areas or private campgrounds. **Large aspen tortrix** populations increased for the second consecutive year and defoliated trembling aspen over more than 7365 ha, mainly in the northern half of the region. Infections caused by **poplar shoot blights** were widespread in the northern half of the region. Various **birch leafminers and skeletonizers** were active in the southern half of the region. Surveys for **dutch elm disease** in the City of Prince George were negative.

A table summarizing **other noteworthy and minor pests** is included in this report. Several **new host records** were confirmed from collections submitted to the Pacific Forestry Centre, their occurances are noted under the appropriate host.

SPRUCE PESTS

Spruce beetle
Dendroctonus rufipennis

Spruce beetle populations increased for the second consecutive year, cumulative (2+ years) mortality of approximately 296 530 m3 over 11 160 ha (Table 1, Map 2) was mapped, mainly by the B.C. Forest Service, from the Stoney Lake area on the southern edge of the Prince George Regional Boundary to the northern end of Williston lake, north of Mackenzie. This is up from the less than 100 ha mapped during limited surveys in 1989. All of the infestations mapped during aerial surveys were in the Prince George and Mackenzie Timber Supply Areas (TSA's). Infestations ranged from single trees to groups of 30 or more. This year was a major flight year for the beetle, and current attack was found in standing green trees, as well as over 4000 lethal and non-lethal trap trees were set out by the B.C. Forest Service and industry. Additionally, current attack was found in windthrown timber which was blown down in early May, making it prime habitat for spruce beetle.

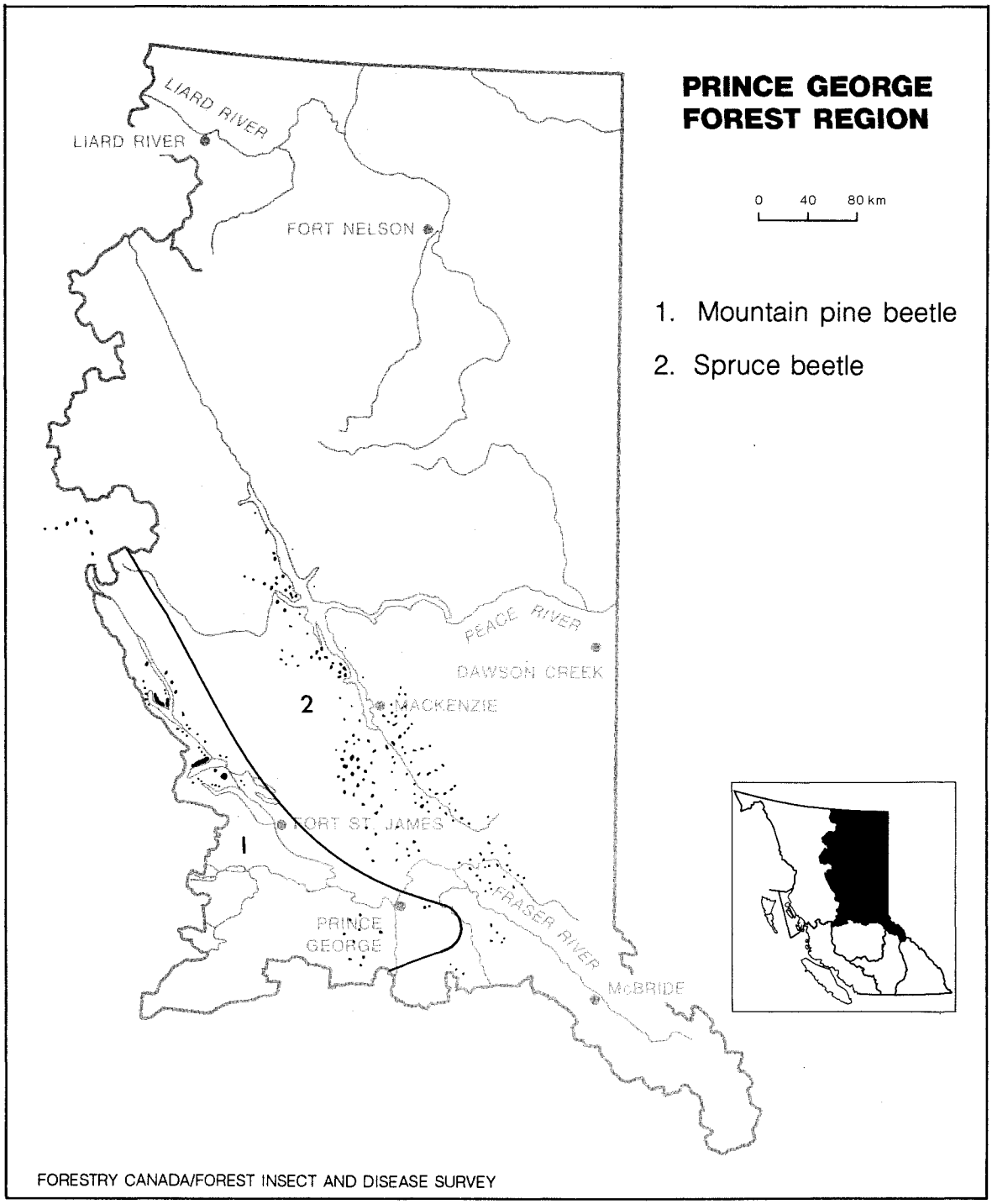
Ground surveys from late June through to mid-September found current attack in trap trees, blowdown and standing green trees from the Summit Lake area north of Prince George to the Manson River area, northwest of Mackenzie and in the Silver Sands Creek area, west of Chetwynd. Additionally, current attack in blowdown was recorded in the Carbon Creek area southwest of Hudson Hope, and in the Kiskatinaw River area, along the One Island Lake Road, south of Dawson Creek.

Table 1. Timber supply area (TSA), cumulative area and volume of white spruce recently killed by spruce beetle, Prince George Forest Region, 1990.

	area (ha)	volume (m^3)
Prince George	3 850	54 865
Mackenzie	7 310	241 665
Dawson Creek	*	*
Regional total	11 160	296 530

* No figures available

An estimated 25% of spruce beetle populations in the Prince George Forest District may be entering a one-year life cycle. Up to third instar larvae were found in the Caine and Alford creeks area in 1990 attacked blowdown and trap trees in early July, and fourth instar larvae and pupae were found in



Map 2. Areas of lodgepole pine recently killed by mountain pine beetle and white spruce killed by spruce beetle, determined by aerial and ground surveys in 1990.

late July and early August in the Hodda Creek and Ant-Carp lakes areas. Callow adults were found in standing green attacked trees in the Weedon Creek and Shaeffer Lake areas in early September. These beetles will complete their life cycle in one year, (rather than the normal two-year-cycle) and fly in 1991. Some populations in higher elevation stands can take up to 3 years to complete their life cycle. Ground surveys, carried out jointly by Forestry Canada, the B.C. Forest Service and the B.C. ministry of Parks, in blowdown in the Bowron Lakes Provincial Park in the Cariboo Region found approximately 20% of beetle populations in that area to be in a one-year-cycle. Populations in the Mackenzie TSA will probably be in a two-year-cycle, although some areas with trap trees in partially exposed southern aspects may have some one-year-cycle populations. Populations in the Dawson Creek TSA, which are generally light, should be in a standard two-year life cycle.

Prince George TSA

Spruce beetle populations in the Prince George TSA are almost all within the Prince George Forest District boundaries. District-wide surveys conducted from late June to mid September found current attack in blowdown and trap trees, and to a lesser extent, standing green trees. Attack densities in 15 cm2 bark samples from blowdown and trap trees averaged 3-4 (range <1 to 6) from Stoney Lake to the Carp Lake area. Ground surveys in September in three locations west of Weedon Lake found an average of 5% current attack in standing green timber (Table 2). Trap trees and windthrown trees in this area were also attacked, indicating high spruce beetle populations. In periods of low populations only windfall and/or trap trees would be attacked, and any current attack in standing green trees would be mostly unsuccessful, i.e. pitched out.

Table 2. Status of white spruce in stands infested by spruce beetle, Prince George TSA, Prince George Forest Region, 1990.

Location	healthy	Percentage of stems current[1]	red	grey	partial
Weedon Creek	88	7	1	1	3
Shaeffer Lake, strip 1	55	7	6	16	16
Shaeffer Lake, strip 2	92	2	0	4	2
average	79	5	2	7	7

[1] Current attack-1990, red attack,-1989, grey attack-prior to 1989, partial/pitchout-1990.

Aerial surveys by the B.C. Forest Service recorded recent faders and older attacked trees from the Summit Lake, Caine and Alford creeks area north to

the Carp, Weedon and McLeod lakes area. These are areas where spruce beetle mortality was first noted in 1989. Mortality was also mapped between Summit Lake and Averil Mountain. A helicopter survey in early August in the Carp Lake Provincial Park area found current attack in blowdown, trap trees and some standing green trees in and adjacent to the Park boundary. Some patches of recent faders were also observed within the park boundary. This year the B.C. Ministry of Parks participated in limited non-lethal trap tree programs in the northeast corner of the park, near Ant Lake. These trees will be removed and a small corner of the park (1-2 ha) is scheduled for logging this winter in an effort to control populations.

Aerial surveys also delineated spruce beetle-caused mortality in all the major drainages associated with the Parsnip River, from Reynolds Creek to Arctic Lake. Some spruce beetle mortality was mapped in this area in 1989. Also included in this area were Wicheeda Lake and Whichika Creek, where significant new mortality was noted. Recent mortality was also mapped in some of the major drainages in the McGregor River system including the Otter-Fontniko-Herrick and Cargill creeks drainages. An aerially accessed ground survey of old and new windthrown timber in upper Jarvis Creek near the Kakwa recreation area found no evidence of current attack in recent blowdown; however, a few larvae and adults were found in older windthrown timber.

Recent mortality was also mapped, in the Everett Creek, and Stoney-Stephen lakes areas, southeast of Prince George. Mortality in these areas was much lower than in areas north of Prince George.

Mackenzie TSA

Aerial surveys in the Mackenzie TSA mapped recent spruce beetle mortality from the Philips Creek area to the Factor Ross Creek area, south of Ingenika arm on the west side of Williston Lake. Areas of severe mortality included the Philips and Blackwater creeks and Manson and Mesilinka rivers areas. On the east side of the lake only scattered, light mortality was mapped fom Mackenzie to the north end of Williston Lake, but damage was more severe south and east of Mackenzie including the Mischinsinlika Creek and Misinchinka River areas, towards Pine Pass.

Ground surveys in the Manson River areas, northwest of Mackenzie, found current attack in lethal trap trees and adjacent blowdown. The number of attacks per 15 cm2 bark sample averaged 2 (range 0-4) in both trap trees and blowdown. Brood assessments in lethal trap trees found living progeny in the upper bole/lower crown areas of these trees, some of which may develop and fly from these trees. In stands where recently attacked blowdown is adjacent to lethal trap trees, a flight will occur in 1992 and further trap tree or logging programs will be needed. Succesful current attack in both non-lethal trap trees and standing green trees was seen in the Blackwater Creek area: some of the populations in partially exposed trees in this area may be entering a one-year life cycle, posing further management problems for this area.

Dawson Creek TSA

Ground surveys in the Dawson Creek TSA found active spruce beetle populations in three locations. At Silver Sands Creek, between Pine Pass and Chetwynd, current attack was found in recent blowdown and standing green timber. Older winter logging in this area left high stumps which are probably responsible for build up of spruce beetle populations. In the Carbon Creek area, light attacks were found in 25% of recent blowdown associated with stand edges. Attacks in this blowdown averaged less than one entrance hole per 15 cm2 bark sample (1-3 attacks per 30 cm of bole length), indicating low populations; however, if this infested blowdown is not removed, spruce beetle populations could build up in this area. Light attacks were also found in recent blowdown in root rot infested areas along the One Island Lake Road near the Kiskatinaw River, south of Dawson Creek.

General

The B.C. Forest Service has proposed accelerated logging in both standing infested timber and areas of infested blowdown, along with follow up trap tree programs as well as removal of existing trap trees, over the next few years in order to control beetle populations and thus reduce subsequent mortality.

Forest insect and Disease Survey will continue to monitor spruce beetle populations in both standing and windthrown trees next year.

Eastern spruce budworm
Choristoneura fumiferana

Spruce budworm populations in the Fort Nelson area increased for the second consecutive year. Aerial surveys recorded defoliation over 398 155 ha (Map 3), mainly in white spruce stands. This was more than triple the 123 750 ha recorded in 1989, and more than ten times the 35 890 ha recorded in 1988. The area affected, as delineated by defoliation classes was: severe - 28 400 ha; moderate - 197 470 ha; light - 172 285 ha. This is the sixth consecutive year of recorded defoliation in this area, and is only the second year that severe defoliation was observed during aerial surveys.

Defoliation in 1990 was recorded in several new areas, and also increased in area and severity in most locations mapped in 1989. New areas of defoliation included the Liard River from the Liard Hot Springs Provincial Park to the Beaver River, and the Muskwa and Prophet Rivers south and west of Fort Nelson. Areas of significant increases were; the Ft. Nelson River and its tributaries from south of Clarke Lake to the Liard River, including the Nelson Forks area; the Liard River and its tributaries from the Beaver River to the Northwest Territories border, including the La Biche River Valley to the Yukon border; and the Kledo and Steamboat Creek areas. The only area where a large increase in defoliation was not recorded was along the Liard River from Coal

River to Liard Hot Springs Provincial Park, where the area and severity of defoliation were similiar to that recorded in 1989.

Top kill and possible whole tree mortality in mature stands was reported in locations that have suffered repeated severe defoliation, particularly along the Liard River near the Northwest Territories border. Top stripping of a metre or more, along with heavy webbing was seen in several stands including the Kledo and Steamboat Creek areas, near the Muskwa River and areas near the Fort Nelson River Bridge, along highway 77. The B.C. Forest Service and Industry reported similiar conditions in several other areas.

Defoliation was particularly severe on understory trees in the Kledo and Steamboat creeks areas. Most trees suffered 100% defoliation of new growth, with older growth also heavily stripped. Top-kill and mortality is beginning to occur in these understory trees. Similiar conditions have been reported in other locations. Young stands adjacent to infested mature stands suffered varying degrees of damage; however, this damage tended to decrease as distance from defoliated mature stands increased. Top deformity and damaged lateral and terminal buds were the most commonly found problems associated with budworm damaged young stands examined in the Kledo and Steamboat Creeks areas.

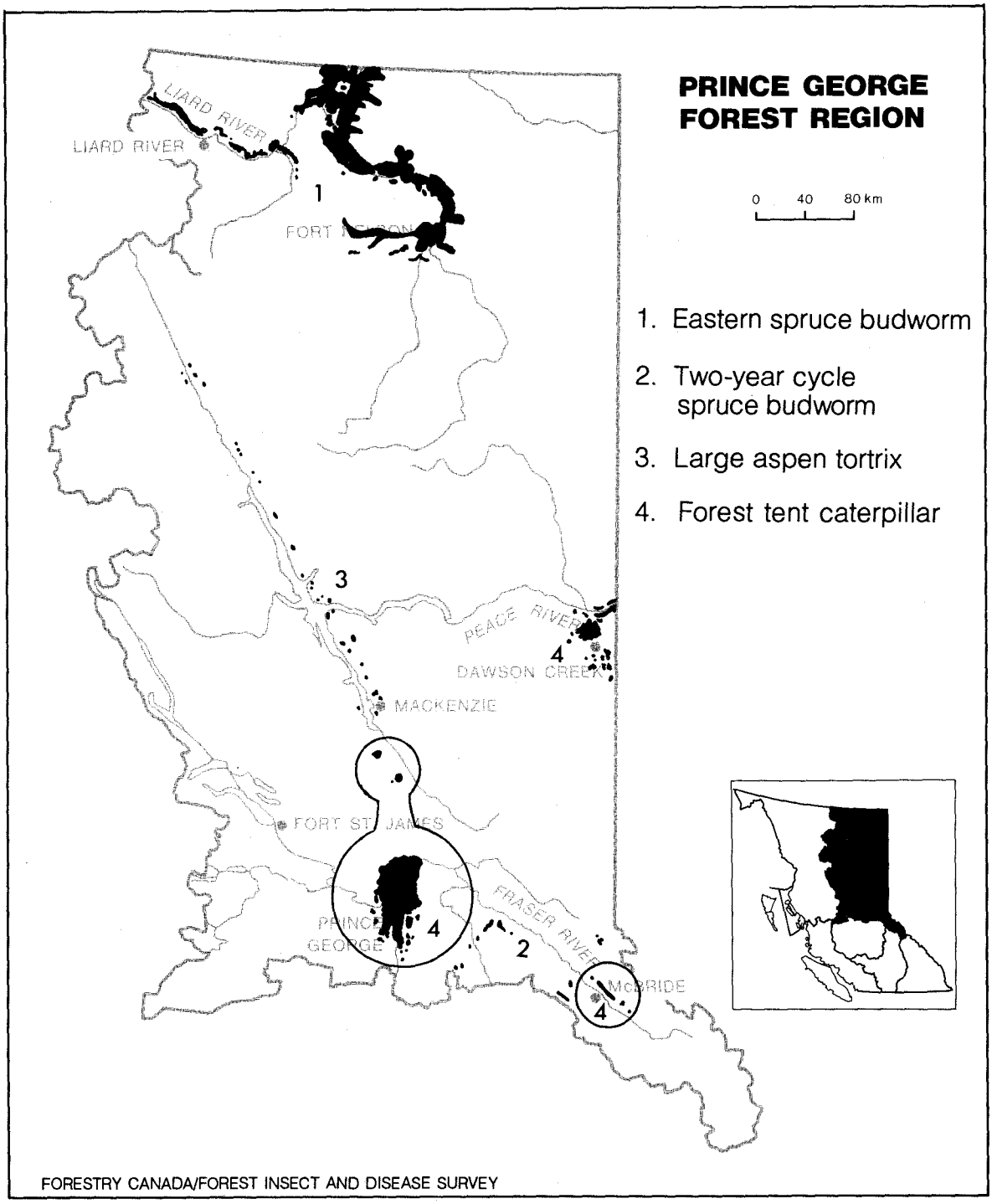
Spruce foliage was examined for egg masses in order to predict budworm populations for 1991. Through co-operation with the B.C. Forest Service, egg mass samples were obtained from three locations; Liard River, Snake River and Clarke Lake. Although only limited samples were obtained, the average of over 400 egg masses per 10m2 of foliage indicates continuing high populations with resulting severe defoliation next year. This is down from the over 1000 egg masses per 10 m2 recorded in 1989, and may indicate reduced populations in these areas.

The high numbers of egg masses from locations north of Ft. Nelson and the low levels of parasitism, (less than 10% from two locations) and disease levels in budworm samples submitted to the Pacific Forestry Centre, indicate that eastern spruce budworm population will continue at high levels in 1991. FIDS Rangers will continue to monitor budworm populations as part of continuing surveys.

Two-year-cycle spruce budworm
Choristoneura biennis

Populations of the two-year-cycle spruce budworm declined in 1990; defoliation of white spruce and alpine fir by mature larvae was mapped over 8610 ha in 1990 (Map 3) less than half the 17 520 ha recorded in 1988, the last major feeding or 'on-cycle' year. Major declines in previously infested areas included; the Bowron River area; Everett-Slim-Tumuch Creeks area; the Stoney Lake area; and the Morkill River area. New areas of infestation were mapped in the Betty Wendle Creek and Milk River areas, southwest of McBride.

Bud sampling conducted in June at six infested stands (Table 3) found an average of 10% (range 5-17%) of alpine fir buds infested, down from an



Map 3. Areas where current defoliation was detected during aerial surveys in 1990.

average of 31% (range 2-80%) in 1989, indicating declining populations with only scattered light to moderate defoliation throughout infested areas.

Table 3. Location, percent buds infested by two-year-cycle spruce budworm and predicted defoliation, Prince George TSA, Prince George Forest Region, 1990

Location	% buds infested,[1] spring 1990	Predicted defoliation, summer 1990
Stephen Lake	17	moderate
Rond Creek	10	light
68 km Bowron-Coal Road	6	light
76 km Bowron-Coal Road	10	light
12 km Tumuch Road	5	light
Everett Creek	11	light
average	10	light

[1] 1-15 light; 16-30 moderate; 31+ severe.

In an ongoing calibration study designed to correlate population levels with subsequent defoliation, pheromone traps were hung and special 25 tree beatings were conducted at two locations. Five non-sticky pheromone-baited traps placed at km 76 on the Bowron Road and km 12 on the Tumuch Road, caught an average of 26 and 130 adult males respectively. No larvae were collected in beating samples at the Bowron Road site, and an average of 1.3 larvae per tree from a 25 tree sample was collected at the Tumuch site. Further study is needed and will be ongoing over the next several years before any correlations can be made between population densities and potential defoliation.

No defoliation was observed in the Ospika River Valley, north of Mackenzie, where defoliation by the two-year-cycle spruce budworm occured for the first time in 1989. Larval collections made by industry personnel in 1989 were reared and identified at the Pacific Forestry Centre. The 'on-cycle' or major feeding year of this northerly population is not synchronized with other two-year-cycle spruce budworm populations in the Prince George Region. Visible defoliation, if any, will occur in 1991.

FIDS will continue to monitor two-year-cycle spruce budworm populations in historically active and newly reported areas in 1991.

Spruce Weevil
Pissodes strobi

Spruce weevil populations were again active in scattered white spruce stands throughout the Region in 1990. Current attack averaged 12% (range 2-19) in seven young stands from the Red Rock Seed Orchard south of Prince George, to Westin Bay on Williston Lake, north of Mackenzie. Spruce weevil attacks were found in a four-year old planted white spruce stand near Angusmac creek, north of Prince George, where an average of 6% of stems were currently infested. In an approximately 10-year-old stand near Westin Bay, north of Mackenzie, 5% of stems were currently infested. This is the most northerly known infestation in the central interior. Spruce weevil was also found infesting approximately 1% of lodgepole pine terminals at the Red Rock seed orchard. Although this is not a new host record, attacks in lodgepole pine are rare.

Multiple tops, loss of the current leader and corresponding radial growth loss are the results of spruce weevil attacks. Repeated attacks can severely retard height growth and alter the form of the tree, reducing its end product value, through crooks and defects in the logs. Leader clipping in conjunction with biological control such as parasite releases are management options that can reduce spruce weevil populations. Red Rock Seed Orchard reduced current attack levels to 2% this year, from 10% in 1989 due to a succesfull leader clipping program.

Tomentosus root rot
Inonotus tomentosus

Tomentosus root rot was found in windthrown mature timber from the Weedon Lake area north to Manson River, and in the Carbon Creek and One Island Lake areas. Surveys in windthrow at cutblock boundaries, road edges and within stands found root rot in an average of 15% (range 10-20) of trees at five locations; Shaeffer Lake-Weedon Creek; Redrocky Creek; Manson River; Carbon Creek, and One Island Lake-Kiskatinaw River area. Surveys for the presence of this root rot in mature stands can usually only detect the rot in windthrown trees as the crown symptoms in standing infected trees are not always reliable.

No evidence of this pest was seen in 28 young stands between 2 and 20-years-old surveyed from south of Prince George to the Buick creek area, north of Fort St. John. The B.C. Forest Service reports a 1-3% incidence in 20 year-old spruce stands surveyed this spring and summer in the Prince George Region.

The affects of infection by this disease are twofold; the direct loss of volume in the stand, and subjecting the trees to stress or causing them to be blown down, thus making them attractive to spruce beetle which, in turn, further destroys the volume in the stand.

FIDS will continue to survey for and report on the occurance of this pest.

Northern spruce engraver beetle
Ips perturbatus

Populations of this engraver beetle increased in the Prince George Region in 1990. Large numbers of suitable host material consisting of both windfall, and non-lethal spruce beetle trap trees were attacked from the Stoney lake area, south of Prince George to well north of Mackenzie, and to a lesser degree, in the Carbon Creek area west of Hudson Hope. Trap trees which were felled partially in the open, to facilitate removal, provided an excellent source of host material. The engraver beetles emerge as adults in late summer and overwinter in the duff, emerging to attack the following spring.

Although this pest is normally a secondary bark beetle, it has, in periods of high populations, attacked the tops of stressed or even apparently healthy trees. The tops of several thousand white spruce were attacked, mainly in the Torpy River area from 1984 to 1986, following population buildups in spruce killed during the last spruce beetle outbreak. Populations declined in 1987 and few attacks by this pest have been noted since then. Populations building in the area between Prince George and Mackenzie could attack tops of living white spruce next year.

FIDS will continue to monitor and report on the presence of the this pest in 1991.

PINE PESTS

Mountain Pine Beetle
Dendroctonus ponderosae

The area of recorded lodgepole pine mortality due to attacks by the mountain pine beetle increased to some 206 000 m3 over approximately 7875 ha (Table 4, Map 2), up from 97 910 m3 over 2805 ha in 1989. These figures are based solely on maps provided by the B.C. Forest Service. Much of this apparent large increase in area and subsequently volume can be attributed to differences in mapping techniques between Forestry Canada's FIDS unit, and the B.C. Forest Service.

Ninety-five percent of beetle caused mortality occured in areas of chronic infestation in the Fort St. James Forest District in the Prince George TSA, many of which remain beyond road access. Mortality increased slightly in the Prince George District, remained static in the McBride District, and declined in the Vandehoof district.

Table 4. Timber supply area (TSA), forest district, area and volume of lodgepole pine recently killed by mountain pine beetle, Prince George Region, 1989.

TSA and Forest District	Area (ha)	Volume (m3)
PRINCE GEORGE TSA		
Fort St. James District	7750	200 715
Prince George District	125	5325
Vanderhoof District	0	0
TSA TOTAL	7875	206 040
MCBRIDE TSA		
McBride District	*	*
TSA TOTAL	*	*
REGIONAL TOTAL	7875	206 040

* No figures available

Fort St. James District

The area of recently killed lodgepole pine increased to 7750 ha, from 2805 ha in 1989, 3415 ha in 1988, and 3845 ha in 1987. The majority of this increase was mapped along the north shore of Trembleur Lake, along the north shore of the Northwest arm of Takla Lake, and north of Takla Narrows on the west side of the lake. Mortality also increased within Tree Farm Licence (TFL) 42, and in the Takla Landing area along Takla Lake.

Increased mortality in TFL 42 was mainly centered in the area between Tarnezell Lake, Trembleur Lake and the Tachie River. Beetle activity increased in the southwestern area of the TFL and scattered mortality was also mapped between the north arm of Stuart Lake and Trembleur Lake including the Starret Lake and Butterfield Creek areas, beyond the TFL boundaries. Some mortality was also mapped on the south shore of Trembleur Lake, West of Tarnezell Creek. Outside the TFL, beetle killed trees were recorded on the north shore of Whitefish Lake and west of Cunningham Lake, and a few patches of mortality were mapped east of the Tachie River in the Kuzkwa River area. Mortality was again mapped along the north shore of Trembleur Lake; along both sides of the Middle

River from Baptiste Creek to Bivouac Creek; along the northwest arm of Takla Lake; and in the Dust and Sinta creeks areas. Mortality in the Dust and Sinta creeks areas appears to be down from 1989 levels. Mortality continued from north of Takla Narrows to the Dominion Point area and in the Ankwill Creek area, on the west side of Takla Lake. On the east side of the lake scattered mortality was mapped from south of Tliti Creek to the White Bluff area. Scattered mortality was also mapped in the Patcha Creek area, north of Bear Lake and the Birdflat and Minaret creeks area along the Sustut River. Some mortality was also recorded along the Skeena River from the Sustut River to near the Slamgeesh River. The area of beetle-killed timber in the Sustut-Skeena area declined, partly due to a vigorous B.C. Forest Service program of pheromone baiting over the past few years followed up with MSMA treatment of attacked trees.

During spring brood assessments, "R" values (ratio of brood to entrance holes) were obtained from C.P. 12, Blk. 23, TFL 42 and Hudsons Bay Creek, just north of Takla Landing. The 'R' values were 5.5 and 6.5 (average 6.0) respectively, indicating increasing populations. This is up from the average values of 4.8 recorded in 1989 and 4.2 recorded in 1988, and shows a trend of increasing populations over the last two years. Early season surveys also examined broods in smaller infestations and in MSMA treated areas. Brood production and vigour was poorer in two smaller infestations (10 trees or less) with few living larvae and many pitch outs or unsuccessfull attacks. In larger infestations, fewer unsuccessful attacks were noted and broods appeared more vigorous and further along in their development. In trees treated with MSMA in 1989, a wide variation from no living brood to apparently healthy larvae and pupae were found. Those trees with healthy broods were very heavily attacked and the girdling activity of the young broods may have prevented the MSMA from translocating along the entire length of the bole.

Fall cruising in two strips in TFL 42 found an average 22% current attack, an increase from the average 14% found in 1989 and the 11% found in 1988. The average percent current attack has been increasing along with the average 'R' value, confirming the spring assessments that mountain beetle populations have been increasing in this District for the past two years. This increase in populations is partially responsible for the increased area and volume figures recorded in 1990.

This year, there was little evidence of 'off-cycle' populations, such as were seen over the past few years in this District. All broods in recently fading (1989-attacked) trees were in late instar larval or pupal stages: normal development for that time of year. In 1989, during spring brood assessments, everything from early instar larvae through to callow adults were found in recently fading (1988-attacked) trees. Brood assessments during fall surveys found most brood in 1990-attacked trees to be in first or second instar, normal development for this time of year. At the same time last year, brood production in currently attacked trees ranged from no brood through to eggs and some early instar larvae. Also, there was no evidence of 'hold-over' broods, or late instar larvae and pupae, in red (1989-attacked) trees. Warm, dry late summer and early fall weather during the past two years has helped most mountain pine

beetle populations regain their normal, one-year life cycle, at least in the south-central areas of the Fort St. James Forest District.

Mountain pine beetle populations in this District appear to be on the rise, and increased mortality will probably be noted next year as a result of these slowly rising populations. The B.C. Forest Service and Industry continue to use pheromone baits in conjunction with Monosodium Acid Methanaearsonate (MSMA) applications, and to a lesser extent, cut and burn operations, on the more remote infestations. Additionally, as road access improves, more infested stands will be accessible to direct control through logging.

Prince George Forest District

Lodgepole pine mortality was mapped over approximately 125 ha in 1990, a slight increase from the 80 ha recorded in 1989, but still down from 255 ha in 1988. Scattered pockets from one to ten red trees in size were mapped from south of Norman creek, through the Bobtail Mountain and Chilako River area to the Fraser River, including the Telegraph Range and Punchaw areas. East of Prince George, some mortality was again mapped along Taspai Creek and a few new areas were recorded south of Purden Lake. Some spots were also mapped northwest of Prince George in the Chief Lake to West Creek area.

Pheromone baited trees were used by the B.C. Forest Service to attract mountain pine beetle in preparation for some MSMA injection, single tree disposal and logging operations. These management options, along with good road access are proving successful in combating beetle populations in the district.

McBride Forest District

No area figures are available for recent mountain pine mortality in this district. Beetle populations appear static, based on personal communication from the B. C. Forest Service. Beetle activity was reported as continuing in chronic areas along Canoe Reach and in the Albreda and Mt. Thompson areas. Some new faders were also reported north of Valemount.

In the Mt. Robson corridor area, the B.C. Forest Service disposed of a total of 230 trees during the winter of 1989-90; 167 at Shale Hill within Mt. Robson Provincial Park, and 63 at Swiftcurrent Creek just west of the park boundary. In 1990, Forest Service probe lines located 97 currently attacked trees at Shale Hill and 105 at Swiftcurrent Creek. These trees will be felled and burned before next May to reduce the 1991 beetle flight in the area. There is still concern that mountain pine beetle could spread from the Robson Corridor through the Yellowhead Pass into Jasper National Park and Alberta.

Logging, along with pheromone baiting and single tree disposal is used to combat beetle populations in this district.

Vanderhoof Forest District

Mountain pine beetle populations in this District continue to decline. A few recent faders were detected by the B.C. Forest Service during aerial surveys in the Francois Lake and Knewstubb Lake areas. Subsequent ground probes by the B.C. Forest Service have identified some 400 trees for disposal (mostly current attack) in these areas. A vigorous disposal program including pheromone baiting followed up by MSMA treatments, logging and single tree disposal has helped reduce beetle infestations.

Pinewood nematode
Bursaphelenchus xylophilus

Sampling of material including logs, trees, and reject lumber for the presence of pinewood nematode increased in 1990. No pinewood nematode was found in a total of 70 wood samples collected from five coniferous species at 22 sites throughout the Prince George Forest Region. The samples, from natural forest stands, logs in mill yards, reject lumber, and decked logs in forested areas, were obtained after examining over 500 logs and standing trees for evidence of insect activity, mainly woodborers, the suspected vector of the nematode. This increase in sampling is due to the threat of further import restrictions against Canadian softwoods, from countries in the European Economic Community.

In 1990 in the Pacific Region, over 1000 wood samples were processed at the Pacific Forestry Centre for the presence of pinewood nematode. Only one positive collection was made, from a white spruce in the Yukon Territory. Since 1980, over 2000 wood and insect samples have been processed and only six positive pinewood nematode samples have been recorded. Forestry Canada will continue to sample for pinewood nematode in 1991 to further support the Canadian position that pinewood nematode occurs only at very low levels in Canada, is non-pathogenic in northern latitudes, and poses little threat to other countries.

Pine stem rusts and cankers
Cronartium spp., *Endocronartium harknessii*, *Atropellis piniphila*

Pine stem rusts and cankers continue to be the most serious pest of young lodgepole pine stands throughout the Region. Young stand surveys (see Multiple Host Pests) found stalactiform blister rust, *C. coleosporiodes* and commandra blister rust, *C. commandrae*, in 17% of young, 2 to 20 year-old stands surveyed, affecting an average of 11% (range 5-23%) of stems. An average of 2% (range 1-4) of stems were dead, 8% (range 4-16) had stem cankers, which usually are fatal, and 3% had branch cankers. Additionally, commandra blister rust was found infecting approximately 5% of five-year-old lodgepole pine in a joint Canada-Sweden lodgepole pine trial at Nation Bay on Williston lake, northeast of Mackenzie. Stalactiform blister rust infected approximately 5% of young trees at Fernando Creek, west of Chetwynd.

Western gall rust, E. harknessii was found in 22% of lodgepole pine stands surveyed, affecting 8% (range 1-15) of the trees. Most of the infections were in the form of branch galls, and as such are not fatal; however,galls on branches, or stems, often kill all growth above the gall through girdling or render the tree susceptible to breakage by snow or wind. Additionally, secondary insects often attack the stem immediately above the galls, further weakening the trees. This rust, again mainly causing stem galls, was also found on approximately 5% of both lodgepole and Scots pine at the Nation Bay lodgepole pine trials, and at Fernando Creek near Chetwynd. Atropellis-caused cankers were also found on approximately 15% of stems in a dense lodgepole pine stand near Fernando Creek.

Various management techniques including the planting of alternate species, to overstocking areas where rusts are common, and spacing infected stands are available to forest managers. FIDS will continue to monitor and report on the presence of these importannt young stand pests in 1991.

Joint Canada-Sweden lodgepole pine trials

The four existing lodgepole pine trial sites established in 1986 in the Prince George Forest Region were examined by FIDS during the course of regular surveys from June to September, 1990. The results of the survey in the fifth plot near Whitehorse are summarized in the 1990 FIDS Yukon report.

The Fort St. James plot, which was examined on June 6 and September 12, remains the most vigorous and has the fewest pest problems of all the Swedish lodgepole pine trials. The plot trees were generally healthy, with good growth. Warrens root collar weevil, Hylobius warreni was found attacking approximately 1% of the lodgepole and Scots pine. The only other problem noted was chlorotic 1989 foliage on Scots pine, possibly caused by a nutrient deficiency. Approximately 10% of the one-year-old foliage was affected on 50% of the trees.

Several diseases were found at the Mackenzie plot which was examined on July 12 and September 20. The following stem diseases and insect problems could contribute to signifigant mortality over the next few years. Commandra blister rust, C. commandrae was found, mainly causing stem cankers, on about 5% of the lodgepole pine; western gall rust, E. harknessii, again mostly causing stem galls, was also found on approximately 5% of the lodgepole pine. Warrens root collar weevil was found on less than 5% of both lodgepole and Scots pine. Approximately 5% of the Scots pine had multiple tops, possibly due to environmental factors such as severe cold and desiccating winds, killing the terminal bud. The same problem was noted on about 2% of the lodgepole pine. Damage caused by a fir coneworm, Dioryctria sp., probably abietivorella was also found in some of the dead terminal buds from the lodgepole pine. Coneworm was also found attacking stems above rust cankers and galls. About 10% of the Siberian larch had multiple tops, bushy form and poor growth, likely resulting from previous years environmental damage and resulting infections by secondary organisms (documented in the 1988 appraisal).

Few pest problems were found at the Fort St. John plot which was examined on June 20. Approximately 75% of the Siberian larch had top die-back, possibly environmentally related. A secondary fungus, Sclerophoma pithyophila, usually associated with stressed trees, was isolated from these trees. This collection represents a new host record. Also, some 5% of the lodgepole pine had multiple tops, possibly due to previous environmental damage. Other agencies have reported western gall rust at very low incidence (<2%) at this site. Surveys in 1991 will concentrate on the presence of this and other stem rusts.

The Fort Nelson plot which was examined on June 19 also had few problems. A few spruce budworm, C. fumiferanae, larvae were found feeding on 1% of the plot trees (Siberian larch and Norway spruce), incidental spillover from an extensive infestation throughout the Fort Nelson area. Approximately 1% of the lodgepole pine had feeding damage caused by the gouty pitch midge, Cecidomyia piniinopis. Western gall rust and, possibly sweet-fern blister rust were also reported by other agencies at this site. Surveys in 1991 will concentrate on the presence of these reported rusts.

A pine feeding budworm Choristonuera n. sp.

Larvae from a new species of pine-feeding budworm were first collected in the Prince George Region near Bear Lake in 1989. Interest in this species originated when the adults appeared in pheromone-baited traps set out in the Bear Lake area in 1987-88. This year, further collections of the larvae were made by Forestry Canada personnel, and a detailed pheromone trapping program was carried out. The budworm was found in natural stands from the Bear Lake area to Windy Point. It has also been found on ornamental pine at the Prince George Agricultural Research Station. No damage has yet been attributed to this budworm which has only been found feeding on male flowers and occasionally, candles, in lodgepole pine. A similiar species in eastern Canada, the jackpine budworm, C. pinus, has caused widespread defoliation. More details will be reported on the identification of this budworm and its potential damage as they are discovered.

ALPINE FIR PESTS

Western balsam bark beetle-fungus complex Dryocetes confusus, Ceratocystis dryocoetidis

Only 35 ha of recent mortality were recorded during limited aerial surveys in 1990, compared to 3900 ha in 1989. This decrease is strictly a reflection of reduced aerial surveys, rather than an abrubt decline in beetle populations. Balsam bark beetle is a chronic problem in most districts in this region, and populations fluctuates little from year to year. Mortality in 1991 is expected to continue at levels similiar to 1989.

DOUGLAS-FIR PESTS

Douglas-fir beetle
Dendroctonus pseudotsugae

Mortality due to attacks by the Douglas-fir bark beetle was mapped, by the B.C. Forest Service, over some 800 ha in 1990, an increase from 115 ha recorded in 1989. Mortality occurred in small, scattered infestations over the southwestern portion of the Prince George District, and was reported at similiar levels to 1989 in the Fort St. James District. An slight increase in Douglas-fir beetle-caused mortality was reported in the McBride District.

Aerial surveys mapped scattered patches containing 1-40 trees from the Bobtail Lake area southeast to Punchaw Lake, and the Blackwater River area from the Nazko River to the Fraser River, including TFL 5. Scattered mortality was also recorded in the Baldy Hughes area, and a few areas along the Telegraph Range. Douglas-fir beetle has been active in the southern part of the Prince George Region for several years, the B.C. Forest Service continues to use trap trees and logging of selected sites to combat this pest.

In the Fort St. James District, Douglas-fir beetle mortality was reported in the Trembleur-Pinchi-Tezzeron lakes area. In the McBride District, small pockets of mortality were reported in the Valemount-Mt. Robson Park-McBride areas.

MULTIPLE HOST PESTS

Acid Rain National Early Warning System (ARNEWS)

The Acid Rain Early Warning System (ARNEWS) plot, located near Averil Lake, northeast of Prince George, was visited three times in 1990. No acid rain damage was recorded, but light infection caused by fir-fireweed rust, Pucciniastrum epilobii was found on alpine fir. Also, two species of microfungi were found on tall blue huckleberry, and one species of microfungus was found on alder in and around the plot (see Other Minor and Noteworthy Pests).

This plot is part of a national system to gather baseline data on the effects of acid rain. The data will be used to quantify changes to forest trees, ground vegetation and soils that might result from acidification of precipitation, or other atmospheric pollutants. A detailed analysis of foliage, soils, growth rates, foliar retention, and general stand condition done every five years, was completed in the 14 other plots in British Columbia this year. No significant changes in soil or foliar chemical content, have been detected yet. Annual monitoring will continue at this plot and fourteen others in British Columbia in 1991.

PESTS OF YOUNG STANDS

A total of 28 planted and natural stands between one and twenty years old were surveyed for pest problems in 1990. The most frequently occurring pests are summarized in table 5.

The most damaging pests encountered were the Cronartium stem rusts, C. coleosporioides and C. commandrae. Although these rusts were found in only three stands surveyed, in the Ft. St. James and Salmon River areas, the damage caused was significant. An average of 2% of stems in these three stands were killed, and an average of 8% of trees had stem cankers, which will probably result in mortality.

Table 5. Summary of pests of young stands, Prince George Region, 1990.

Host	Stands[1] examined	Pest	No. of stands affected	Percent of trees affected		Remarks
				Average	Range	
Lodgepole pine	18	environmental damage	5	21	3-89	causing multiple tops as lateral buds competed for dominance in 1989 winter-damaged stands.
		browse	5	2	1-4	very light feeding damage by ungulates
		Endocronartium harknessii	4	6	1-15	mainly branch galls
		Pissodes terminalis	4	3	2-4	causing leader mortality and multiple tops
		winter flecking	4	43	17-84	causing premature loss of mainly older foliage
		Cronartium spp. rusts	3	10	5-23	average of 2% of stems killed, 8% with stem cankers will die soon

Table 5. (Cont'd)

Host	Stands[1] examined	Pest	No. of stands affected	Percent of trees affected		Remarks
				Average	Range	
		rodent damage	3	5	5-6	feeding mainly associated with tree rusts
		Warrens root collar weevil *Hylobius warreni*	3	2	1-3	causing mortality
		pine-aster rust *Coleosporium asterum*	2	32	25-39	causing moderate infections in lower crown
White spruce	14	environmental damage	10	20	5-54	multiple tops as lateral buds competed for dominance in 1989 winter-damaged stands. Some bud mortality from current winter damage
		adelgids	6	30	5-100	mainly light gall formation by the following: *Adelges cooleyi*; *Pineus similis*; *A. lariciatus*.
		Pissodes strobi	4	11	6-19	causing leader mortality, multiple tops
		frost damage	2	14	4-24	killing lateral flush
		large-spored spruce labrador-tea rust *Chrysomyxa ledicola*	2	63	25-100	severly infecting current foliage

[1] Number of surveyed stands in which tree species comprised >20% of stand

A detailed description of individual stands, by location and host, is available upon request (Appendix IV).

As further emphasis is placed on intensive management, interest in pests of young stands and their impact will grow. FIDS will continue to monitor young stands in the Prince George Region in 1991.

Black army cutworm
Actebia fennica

Black army cutworm populations increased in 1990. Although there was no defoliation of coniferous seedlings observed or reported, light defoliation of herbaceous material was recorded at one location near Weedon Lake, and trace defoliation was recorded at one location near Alford Creek. No defoliation was recorded in the Region in 1989.

A total of 13 multipher pheromone traps were placed at 10 one-year-old prescribed burns from km 50 on the Bowron Road to Hambone Lake, north of Tacheeda Lakes. An average of 220 (range 0-770) adults were caught in these traps, (Table 6) an increase from the average of 84 (range 0-352) adults caught in 1989. Although these figures indicate rising populations, only one location shows potential for significant damage in 1991 (600+ moths/trap indicates significant damage).

Table 6. Location and number of adult males caught in pheromone-baited traps for black army cutworm, Prince George Forest Region, 1990.

Company/Location	No. of traps	No. of adults	Remarks
The Pas			
Peculiar Lake	1	179	no defoliation predicted
Hambone Lake	2	0,770	one trap down, no data. potential for significant defoliation
Weedon Lake	1	203	no defoliation predicted
Alford Creek	2	0,572	one trap down, no data. some defoliation predicted
Lakeland Mills			
Terrapin Lake	1	152	no defoliation predicted
Muskeg River	1	84	no defoliation predicted

Table 6. (Cont'd)

Company/Location	No. of traps	No. of adults	Remarks
Rustad			
Caine Creek	1	124	no defoliation predicted
Alford Creek	1	178	no defoliation predicted
Northwood			
Km 52, Bowron Rd	2	93,372	some defoliation predicted
Carrier			
Hwy 16, east of Penney access road	1	131	no defoliation predicted
average		220	

Monitoring of those sites with defoliation potential, as well as other recent burns and reported outbreaks will continue in 1991.

Winter Damage

White spruce and to a lesser extent lodgepole pine and alpine fir, which suffered winter damage in the form of frozen terminal and lateral buds in 1989, were assessed for recovery in 1990. Recovery took the form of multiple leaders as undamaged lateral buds on trees in the 1-2 metre height range competed for dominance. An average of 35% of young white spruce in 17 stands, 30% of young alpine fir in two stands and 20% of young lodgepole pine in 5 stands had multiple leaders. These trees will suffer from the loss of one year's height and increment growth and may develop slight crooks, although the effects of this will be minimal by rotation age.

Another possible result of this winter damage may be infection of dead tissue by secondary organisms. This might result in more significant leader damage such as dead tops which could produce more serious defects, including poor form, major crook or multiple tops which by rotation age would result in degraded lumber. To date, the only specific examples of this type of infection have been found in exotic species at the joint Canada-Sweden lodgepole pine trials.

Young planted white spruce at two locations north of Prince George suffered damage by late frosts. An average of 14% (range 4-24) of trees had up to 50% of the lateral flush killed by late frost. This is a common phenomenon in the Prince George Region. Birch trees along the Alaska Highway between Prophet River and Fort Nelson also suffered late frost damage. Most of the foliage on all of the trees in this area had a scorched appearance, caused by the interveinal tissue being killed.

Salt damage

Damage to roadside trees by salt, mainly in the form of dead, discolored foliage was light and confined to roadside, sapling-sized trees. Scattered, patchy damage was observed on 30% of the foliage on 80% of roadside lodgepole pine between the Regional boundary near Cottonwood River Provincial Park and Prince George. Occasional patchy damage occured to 40% of the foliage on 80% of the trees between Prince George and Yellowhead Lake in Mt. Robson Prvincial Park. No appreciable damage was noted north or west of Prince George. Damage occurs when the road salt, which is used to help keep highways free from ice during winter months, is sprayed onto roadside trees by snowplows.

Animal Damage

Animal damage, in the form of rodents chewing on rust cankers, hares feeding on young stems, moose and deer browse on young trees, and porcupine damage on all age classes of trees was recorded, mainly in the southern half of the region.

Porcupine-caused damage was mapped over more than 24 ha at several locations, mainly in the Mackenzie Forest District. Porcupine damage was also recorded on 6% of young lodgepole pine in a plantation west of Prince George. Damage, consisting of basal and upper bole and branch girdling is common on all age classes of trees, particularly lodgepole pine; however, similiar damage has also been recorded on spruce.

Rodent damage, mainly in the form of chewing on galls and cankers formed by various tree rusts, affected an average of 6% (range 5-10%) of trees in three young stands. Hares, feeding on the bark of young lodgepole pine caused partial or complete gidling of 40% of approximately twenty-year-old lodgepole pine in recently spaced stand near Westin bay on Williston Lake, north of Mackenzie. Spacing in areas where high hare populations exist tends to provide them with more habitat, i.e. shelter and protection from predators, thus potentially increasing damage in stands already affected by hare feeding.

Light browse damage caused by ungulates (moose and deer) was recorded in 28% of young lodgepole pine stands and a single alpine fir stand in the region. Severe feeding usually causes multiple tops and poor form.

Blowdown

Although no accurate area figures are available, widespread blowdown resulting from high winds in early May and June were observed during aerial and ground surveys throughout the Prince George, and to a lesser degree Mackenzie, Fort St. James and Dawson Creek Forest Districts.

Windthrown trees were observed along stand edges, roadsides and within natural stands. Added to the over 1500 ha of damage recorded in 1989, the additional blowdown has complicated efforts by the B.C. Forest Service and industry to control rising spruce beetle populations. Both spruce beetle and the northern spruce engraver have attacked this widely scattered host material. A further population buildup and resulting attack in standing green timber may occur by next year (see Spruce Beetle and Northern Spruce Engraver Beetle sections of this report).

Blowdown also created access problems into logging areas this spring and clearing was required before many areas could be entered. Logging plans were also affected as industry and the B.C. Forest Service attempt to salvage log as many areas as possible.

FIDS will continue to monitor blowdown and pests associated with windthrown trees next year.

DECIDUOUS TREE PESTS

Forest tent caterpillar
Malacosoma disstria

The area of mainly trembling aspen defoliated by the forest tent caterpillar increased to 193 675 ha in 1990 (Map 3), almost double the 108 290 ha recorded in 1989. In the fifth consecutive year of increased defoliation in the Prince George area, 153 590 ha were defoliated in and around the City of Prince George, up from 103 225 ha in 1989. This was also the seventh consecutive year that defoliation has been recorded in the Peace River area where 35 620 ha of defoliation was recorded this year, up from 4805 ha in 1989. Additionally, defoliation occured, for the second consecutive year, in the McBride area, where 4465 ha were recorded, up from 260 ha in 1989.

Near Prince George, new areas of defoliation included both sides of the Fraser River from Prince George to south of Stoner, and the Chilako River from Hwy 16 to south of Dahl Creek. A large new area of defoliation was also recorded just north of Bear Lake, east of Hwy 97. Defoliation increased and intensified in the Pineview and Airport Hill areas, in the College Heights, Beaverly and Vanaway areas, and in the Kerry-McLeod Lakes area. Defoliation continued, although at lower intensity, from Eaglet Lake to the Isle Pierre area, and north to Summit Lake.

In the Peace River area, patchy defoliation extended from south of Tomslake to the Taylor and Fort St. John areas, and from near Groundbirch east to the Alberta border. The large increases this year were mainly due to new areas of defoliation along the Peace River from the Alberta border to the Taylor area, and a general overall expansion and intensification in aspen stands previously defoliated from Pouce Coupe to Farmington. Several species of deciduous defoliators were active, in addition to the forest tent caterpillar, throughout the Peace River area and contributed, to some degree, to the large area defoliated. Two of the more significant defoliators active in this area were the large aspen tortrix, Choristoneura conflictana, and the Bruce spanworm, Operophtera bruceata. Five other minor defoliators were also commonly found in association with forest tent caterpillar populations in the Peace River area, they are included in Table 8, Other Minor and Noteworthy Pests, found in the last section of this report.

Near McBride, new areas of light to moderate defoliation were recorded, mainly on the northeast side of the Fraser River Valley, from the Small Creek area to near just past East Twin Creek. Defoliation was also recorded in the Castle Creek area for the second consecutive year.

The increase in forest tent caterpillar populations in and around the City of Prince George was predicted by FIDS following egg mass surveys conducted during the fall of 1989. Egg mass surveys completed in the fall of 1990 indicate continued high populations with resulting widespread moderate to severe defoliation in the same areas in 1991. An average of 17 new egg masses (range 2-49) per 10 cm dbh trees were found during egg mass surveys in September 1990 (table 7). Counts greater than 10 egg masses per 10 cm dbh trees usually result in severe defoliation. This average is down from the 1989 average of 38 (range 14-105) and although this indicates declining populations, this years counts are still high enough to predict continued widespread defoliation. In the Peace River area, populations are expected to decline overall; however local increases may occur in the Taylor area, along the banks of the Peace River. Near McBride, relatively low populations are expected to cause continued light defoliation in 1991.

Table 7. TSA, location, dbh, number of new and old egg masses of forest tent caterpillar and predicted 1991 defoliation, Prince George Forest Region, 1990.

TSA and location	Avg. dbh (cm)	Avg. no. egg masses/tree		Predicted defoliation 1991	Ratio of new:old egg masses	Population Status
		new	old			
PRINCE GEORGE						
Hwy 97, 5 km N of Salmon River	10	10	20	severe	1:2	declining
McBride Forest Rd. W of Chilako River	11	21	17	severe	1:1	static
Eaglet Lake	11	11	21	severe	1:2	declining
Hospital Creek, Willow R. area	9	9	9	moderate	1:1	static
Cranbrook Hill, north	9	49	162	severe	1:3	declining
Hoodoo Lakes	12	5	9	light	1:2	declining
Jct. Chief and Nukko Lk. Rds.	9	14	53	severe	1:3	declining
Christopher Rd. Hart Highlands	9	29	12	severe	2:1	increasing
Blackburn Rd., Pineview	10	9	10	moderate	1:1	static
College Heights	9	41	41	severe	1:1	static
Km 2, Fyfe Lk. Rd. near West Lake	11	6	7	moderate	1:1	static
Anderson Road, near Stoner	11	2	<1	light	1:1	static
AVERAGE	10	17	30	severe	1:2	declining

Table 7. (Cont'd)

TSA and location	Avg. dbh (cm)	Avg. no. egg masses/tree new	old	Predicted defoliation 1991	Ratio of new:old egg masses	Population Status
DAWSON CREEK						
South bank, Peace R., near Taylor	9	3	<1	light	3:1	increasing
6.5 km S of Farmington	9	<1	5	nil	1:5	declining
AVERAGE	9	2	6	light	1:3	declining
MCBRIDE						
Km 1.5, McBride Mtn lookout Rd.	10	<1	0	trace	1:1	static
Km 2.5, McBride Mtn lookout Rd.	10	<1	0	trace	1:1	static
AVERAGE	10	<1	0	trace	1:1	static

Expected population levels for 1991 which are based on egg mass counts may be negated due to a viral disease. Nuclear polyhedrosis virus, NPV, was isolated from dead larvae in each of five mass larval collections made from north of the Salmon River to the Pineview area, and a single mass collection made from Castle Creek, near McBride. Additionally, a fungal pathogen, Entomophthora sp. was isolated from the Pineview collection. These diseases have contributed to the collapse of various lepidopteran infestations, and may cause tent caterpillar populations in the vicinity of Prince George and McBride to decline, or collapse.

Forest Insect and Disease Survey will continue to monitor forest tent caterpillar populations in 1991 and a pest report will be issued after early season sampling is completed.

Gypsy moth
Lymantria dispar

No adult male gypsy moths were caught in 47 pheromone-baited traps placed by FIDS throughout the Prince George Forest Region as part of a continuing interagency monitering program. The traps were placed at Provincial Parks, highway rest areas and private campgrounds. A program of trapping and egg mass surveys is carried out by Forestry Canada and the B.C. Forest Service in cooperation with Agriculture Canada to detect the establishment of this potentially serious pest.

Large aspen tortrix
Choristoneura conflictana

Large aspen tortrix populations increased in 1990 when over 7365 ha of light to severe defoliation of trembling aspen was recorded during aerial surveys, from Mackenzie to Fort Ware in the Rocky Mountain trench (Map 3). Additionally, a large undetermined area of moderate to severe defoliation was observed during ground based surveys along both sides of the Alaska Highway, from the Charlie Lake area north of Fort St. John to the Pink Mountain area, and for 50 km along the Alaska Highway in the Steamboat Mountain area, west of Fort Nelson. The B.C. Forest Service also reported defoliation in the Manson Creek area, northwest of Mackenzie. In 1989, defoliation was observed from km 110-220 on the Alaska Highway, north of Charlie Lake, and for 25 km in the Steamboat Mountain area.

No predictive sampling was done, mainly due to the remoteness of the infestations. Historically, large aspen tortrix populations have caused little or no long term damage and have collapsed following one to three years of defoliation. FIDS will continue to monitor this pest in 1991.

Poplar shoot blights
Venturia macularis, V. populina

Poplar shoot blight was common on trembling aspen, balsam poplar and black cottonwood along the Alaska Highway from the Charlie Lake area north of Fort. St. John, to the Coal River area near the Yukon border. While trees of all ages were infected, understory and younger trees were the most severely affected, particularly in the Fort Nelson area.

Trembling aspen was infected by V. macularis while balsam poplar and .ack cottonwood were infected by V. populina. These diseases cause blackening, .lting, and subsequent mortality of young shoots and foliage. Little long term damage has been recorded in mature trees; however, young trees can be disfigured and growth can be severely affected in areas with consecutive years of severe infections. These diseases could have serious impacts on young trees in areas where aspen or cottonwood is being intensively managed.

FIDS will continue to monitor and report on the presence of these and other aspen diseases in 1991.

Birch leaf miners and skeletonizers
Profenusa thomsoni, *Bucculatrix canadensiesella*
Lyonetia sp., *Phyllonorycter* sp.

Various leaf miners and skeletonizers infested birch in ornamental and, to a lesser degree, natural stands in several locations in the region. The ambermarked birch leafminer, *P. thomsoni*, was active in the City of Prince George for the 6th consecutive year, causing widespread moderate damage. This leafminer, which was first detected in Prince George in 1985 was also found damaging birch in the Fort St. James area where it caused, along with the birch skeletonizer, *B. canadensiesella*, mainly light damage, especially around Fort St. James National Historic Park. Two other leafminers, *Lyonetia* sp. and *Phyllonorycter* sp. very lightly infested natural birch stands in the Tacheeda Lakes area, north of Prince George. These leafminers and skeletonizers mainly affect the aesthetic qualities of the trees, and cause little long term damage.

Dutch elm disease
Ceratocystis ulmi

Surveys for dutch elm disease, in the City of Prince George in 1990, were negative. Over 150 ornamental American elms in the 'Millar Creek Addition' area of the City, between Patricia Boulevard and Fort George Park, were examined for symptoms of this disease. Only 3 suspect trees were found during the survey. Samples from these trees found two diseases of elms: a canker, *Tubercularia ulmea*, which is usually associated with stressed trees, and a die-back, *Botryodiplodia* sp., also associated with stress. This last collection represents the first record in the Pacific Region on this host.

Dutch elm disease is a serious pest of native and ornamental elms in eastern North America. One of the potential vectors of this disease, a bark beetle, *Scolytus multistriatus*, has been recovered from pheromone traps in southern B.C., however; the disease has never been found in British Columbia. FIDS will continue to monitor ornamental elms in B.C. for the presence of this disease.

OTHER NOTEWORTHY AND MINOR PESTS

Table 8. Other noteworthy and minor pests

Host and Pest	Location	Remarks
White Spruce		
A bark beetle *Dryocoetes affaber*	Jarvis Creek, Ant Lake, Blackwater Creek	found in blowdown and trap trees
Cooley spruce gall adelgid *Adelges cooleyi*	Prince George Region	common and widespread
Eastern blackheaded budworm, *Acleris variana*	Liard River	associated with eastern spruce budworm
Large-spored spruce-labrador-tea rust *Chrysomyxa ledicola*	Kiskatinaw River, North Cache Creek (km 135 Alaska Hwy)	affecting an average of 65% of foliage in young stands
Spruce engraver beetle *Scolytus piceae*	Jarvis Creek	found in blowdown
Lodgepole Pine		
A needle cast fungus *Lophodermella concolor*	Red Rock Seed Orchard	infecting 10% of foliage on 90% of sapling size trees over 5 ha
Pine-aster rust *Coleosporium asterum*	Salmon River, Chuchinka Creek	light infections on an average of 32% of trees in young stands
Pine engraver beetle *Ips pini*	Boomerang Lake, Kloch Lake	found in blowdown and mountain pine beetle attacked trees
Red ring rot *Fomes pini*	Caine Creek	found in butts of windthrown trees
Alpine Fir		
Fir-fireweed rust *Pucciniastrum epilobii*	Averil Lake, Chuchinka Creek, Manson River	light to moderate infections on all trees in these areas

Table 8. (Cont'd)

Host and Pest	Location	Remarks
Larch		
Eastern larch beetle *Dendroctonus simplex*	Fort Nelson, Dawson Creek	found in trap trees, first B.C. collection in 30 years
Alder		
A leaf spot *Taphrina* sp. possibly ?*occidentalis*	Carbon Creek, Averil Lake (ARNEWS plot)	causing patchy dead spots on the foliage of all alder in these areas
Elm		
Elm leafminer *Agromyza aristata*	Prince George	fifth consecutive year of damage, 20% of the foliage on all of the ornamental elms in the 'Miller Creek addition' were mined
Trembling Aspen		
A solitary leafroller *Epinotia criddleana*	Dawson Creek	associated with other aspen defoliators
Aspen leafroller *Pseudexentera oregonana*	Fort St. John, Wonowon, Dawson Creek	associated with other aspen defoliators
Aspen twoleaf tier *Enargia decolor*	Pouce Coupe, Wonowon, Charlie Lake, Mackenzie	associated with other aspen defoliators
Aspen webworm *Tetralophia apostella*	Prince George, Vanderhoof	An early fall solitary defoliater. Found in forest tent caterpillar damaged stands
Bruce spanworm *Operophtera bruceata*	Fort St. John, Dawson Creek	associated with forest tent caterpillar
False bruce spanworm *Itame loricaria julia*	Pouce Coupe	associated with other aspen defoliators
Poplar canker *Valsa sordida*	Pouce Coupe	collected in forest tent caterpillar damaged stands
Speckled green fruitworm *Orthosia hibisci*	Pouce Coupe	associated with other aspen defoliators

Table 8. (Cont'd)

Host and Pest	Location	Remarks
Willow		
Fir-willow rust *Melampsora abieti-capraearum*	Fort St. James	common throughout this area
Pacific willow leaf beetle *Pyrrhalta decora carbo*	Pouce coupe to Liard River area	common for second year, causing patchy moderate to severe defoliation
Poplar and willow borer *Cryptorhynchus lapathi*	Prince George	common throughout the City
Tall blue huckleberry		
A leaf spot *Exobasidium cordilleranum*	Averil Lake (ARNEWS plot)	affecting all host plants in this area
Hemlock-blueberry rust *Pucciniastrum vaccini*	Averil Lake (ARNEWS plot)	affecting all host plants in this area