

# **Forest Pest Conditions in the Pacific and Yukon Region**

## **A Mid-Season Summary**

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## SUMMARY

The status of major forest pests currently active in the Pacific and Yukon Region up to mid-July are highlighted. A more comprehensive report will be completed later in 1989, after aerial and Fall surveys. More emphasis will then be given to pests of young stands, collections of decays and increment cores of trembling aspen, the search for new strains of B.t., selection of woodborer sample sites, and collection and photographs of display and demonstration material for 'Open House' in 1990.

Widespread discoloration and some foliage loss of many species of conifers, as a result of the colder than normal temperatures in late January - early February, was the major **climatic factor** since the last report. Overwintering mortality of bark beetles was insufficient to significantly reduce their overall impact in mature stands, and other forest insect populations were largely unaffected by climatic factors this year.

Large areas of susceptible mature pine in five forest regions are again threatened by **mountain pine beetle** which overwintered with only minimal mortality. Increased numbers of mature ponderosa pine were killed in the Kamloops and Nelson regions by increased **western pine beetle**, occasionally with mountain pine beetle, and by **turpentine beetle**. Stem attacks by **ambrosia beetles** increased in pine beetle infested trees, but **pine engraver beetle** populations declined. Lodgepole pine near Pemberton and Boston Bar in the Vancouver Region were lightly defoliated by **pine needle sheathminer**, but there was no evidence of larval feeding at previously infested stands in the Kamloops and Nelson regions. Infection of year-old foliage on lodgepole, ponderosa, and white pines by native **needle diseases** was common in the southern half of the province for the third consecutive year.

The severity and area of defoliation of Douglas-fir in the southern interior by **western spruce budworm** declined in the Thompson River drainage in the Kamloops Region, but continued at levels similar to 1988 in the Okanagan Valley, near Pemberton, and in the eastern part of the Cariboo Region. **Douglas-fir tussock moth** larvae, but no defoliation, were present in natural stands in the Kamloops Region for the first time since 1985. Larvae were present on ornamental conifers at two urban locations in Kamloops for a second year. The number of mature and overmature Douglas-fir killed by **Douglas-fir beetle** increased for the third consecutive year in the Fraser River drainage in the Cariboo Region, and in the East Kootenay, near Pemberton, and near Fort St. James. **Western false hemlock** looper populations increased significantly in parts of the Kamloops Region, but there was no visible defoliation.

Alpine fir and spruce in the Liard and Fort Nelson river drainages in northeastern British Columbia were defoliated by **eastern spruce budworm** over more widespread areas than in 1988, some for the fifth consecutive year. Early instar larvae of **2-year cycle budworm** infested new buds of alpine fir and spruce in previously defoliated stands in eastern parts of the Prince George Region and in the northeastern part of the Cariboo Region, but did not continue in the northern part of the Kamloops Region. Mature **"off-year" cycle budworm** larvae defoliated new alpine fir and spruce shoots in remote high elevation stands in the Nelson Region. **Balsam woolly aphid** was collected for the first time near Qualicum and Port Alberni on Vancouver Island, but both sites were within the quarantine zone. **Balsam shoot boring sawfly** increased in true fir stands near

Powell River in the Vancouver Region and at East Arrow Creek near Creston in the Nelson Region, killing terminal and lateral shoots of immature and mature trees. The number of mature grand fir killed by **fir engraver beetle** increased significantly in the Pend-d'Oreille River drainage in the West Kootenay.

**Spruce beetle** remains at generally endemic levels in mature spruce stands in the interior, for the seventh successive year.

**Western blackheaded budworm** populations are expected to decline further on the Queen Charlottes, but continue to defoliate stands on northern Vancouver Island for the third consecutive year. **Hemlock sawfly** populations remain high in parts of Graham Island in the Queen Charlottes and defoliation of western hemlock is expected.

Discoloration of western larch by **larch casebearer**, mostly in the southern part of the Nelson Region, was generally only very light and similar to the previous two years. **Larch sawfly** populations declined in previously defoliated stands near Grand Forks in the Nelson Region, but increased in tamarack in the southwestern part of the Yukon Territory and on ornamental larch at Terrace. New infection of western larch by **needle diseases** in the Nelson Region was generally light with patches of moderate and severe, similar to 1988. **Larch budmoth** populations remained endemic in the West Kootenay, and were present in low numbers east of Oliver in the Kamloops Region.

Numbers of **black army cutworm** larvae declined significantly in and near previously infested areas in the interior and were detected in only one 1989 planting. Parasitism and entomopathogens were probable causes of the decline. Seedling mortality following infection by **Rhizina root disease** increased in areas where infections occurred in 1988; mainly in the wetter parts of the Nelson, Prince George, and Prince Rupert regions. Feeding damage to recently planted seedlings by high numbers of **voles** increased near Squamish in the Vancouver Region, but declined in the western part of the Prince Rupert Region. In the same part of the Prince Rupert Region, and east of Boston Bar in the Vancouver Region, feeding by **porcupines** continued to kill significant numbers of young and semimature conifers, particularly lodgepole pine. Mortality and dieback of roadside conifers, particularly regeneration in low lying areas, attributed to **site, drought, and road-salt** are widespread along highways, particularly in the Cariboo Region and the East Kootenay.

Defoliation of deciduous trees and shrubs by **forest tent caterpillar** was more severe and widespread in parts of the Cariboo, Nelson, and Prince George regions, some for the fifth consecutive year. **Western tent caterpillar** populations remained at near endemic levels in the north Okanagan Valley and at Terrace. Defoliation of trembling aspen by increased **large aspen tortrix** populations was widespread along the Alaska Highway in northeastern British Columbia, and in the southwestern part of the Yukon Territory. The upper crowns of exotic poplars near Chilliwack were lightly defoliated by reduced numbers of **satin moth** larvae. **Birch leafminer** discolored birch stands in parts of the Nelson Region, some for the fifteenth consecutive year, and increased in watersheds north of the Fraser Valley, and on ornamental birch at Terrace. Broadleaf and vine maples and other deciduous shrubs were more severely defoliated by **western winter moth** over more widespread areas in the Vancouver Region than in the previous two years. **Winter moth** populations increased in birch and apple in the Lower Mainland, but remained at low levels on southern

Vancouver Island. An introduced pest of apple and crab apple trees, **apple ermine moth**, first found near Duncan in 1981 was collected along the east coast of Vancouver Island to Comox, throughout the mainland part of the Vancouver Region, the Sunshine Coast, and in western and northern parts of the Kamloops Region.

## PINE PESTS

**Mountain pine beetle**  
**Dendroctonus ponderosae**

The generally high numbers of mountain pine beetle broods in and adjacent to previously infested mature lodgepole pine stands, mostly in interior British Columbia, are expected to result in tree mortality similar to the volume and area killed in 1988 in more than 8000 infestations in six forest regions.

Based on the ratio of progeny to parent beetles ('R' values greater than 4.1), populations are forecast to increase at 32 of 50 locations sampled in May-June, decline slightly at six, and remain static at the remainder. Average regional 'R' values ranged from 4.9 to 10.2. This is a slight decline from 1988 when increases were forecast at 75% of the locations.

In the Cariboo Region, the value in the major outbreak area at Chilko Lake was 10.2, indicating increasing populations.

In the Kamloops Region mountain pine beetle outbreaks are most widespread and are forecast to increase in the Okanagan TSA, where values averaged 7.8, (range 4.0-12.9) at eight locations, similar to 1988. The highest (8.0-12.9), were at four sites in the Carmi and Ellis Lake areas east of Penticton.

'R' values increased at 14 of 27 locations in the Nelson Region and averaged 6.4, the highest at Perry Creek (14.3) and Redstreak (13.8) in the East Kootenay, and in the Boundary TSA in the West Kootenay (12.1). Static populations are forecast at Findlay, Bloom, and Skookumchuck creeks areas in the East Kootenay and at Ferroux and Sand creeks in the West Kootenay. Declining populations are expected at Gold Creek south of Cranbrook, where overwintering mortality in thin-barked trees was 75%.

Increased populations are forecast at three of six sites northwest of Fort St. James in the Prince George Region, where the overall 'R' value averaged 5.6, up from 4.2 in 1988. The highest values ( 10.1, 6.7, and 4.7) were in the Takla Landing area and in TFL 42.

In the eastern part of the Prince Rupert Region, population increases (avg. 6.1, up from 5.3 in 1988), are forecast in the Trout Creek (10.8), Maxim and Decker lakes areas (11.3, 8.6), but remain static in the Telkwa Forest Service Road access area (4.0). Average values in the western part of the Region declined (range 1.7-3.9) at four locations near Coyote Creek, Sideslip Lake, Kitwanga, and New Aiyansh. Host depletion and harvesting have contributed to the decline, with fewer recently killed lodgepole pine visible near Cranberry Junction, Cedarvale, and Kitwanga.

Tree mortality in small long-term infestations near Birkenhead Lake, east of Pemberton in the Vancouver Region, where current attack averaged 3% in 1988, are expected to decline further in 1989.

Mountain pine beetle was the primary cause of mortality of increased numbers of recently killed mature ponderosa pine in pockets from Midway to Conkle Lake and in the Kettle River Valley in the Nelson Region. Western pine

beetle, Dendroctonus brevicomis, and turpentine beetle, D. valens, often associated with mountain pine beetle also contributed to the pine mortality. Increased attacks by ambrosia beetles, Trypodendron spp., were widespread in mountain pine beetle infested stands in the western part of the Nelson Region, northwest of Fort St. James, and at Franklyn Arm in the Chilcotin. There was less evidence this year of pine engraver beetle, Ips pini, which had been common in mountain pine beetle infestations in the interior regions for three years.

**A pine needle sheathminer**  
**Zelleria haimbachi**

There was no evidence of feeding by the sheathminer in previously infested stands in the Kamloops and Nelson regions, and populations declined near Pemberton. However increased populations defoliated immature pine for the first time in recent years east of Boston Bar.

About 15% of the new shoots on about 60% of the immature lodgepole pine were mined and discolored for about 5 km along the Anderson River access road east of Boston Bar. In the nearby Mowhokam River Valley an average of 20% of the shoots on 80% of single and scattered pockets of lodgepole pine were discolored for about 10 km along the access road. The defoliation is not expected to have much impact on tree growth or form. Only 6% of the new shoots were infested on about 70% of the pine regeneration at Twin One Creek on the east side of Lillooet Lake, south of Pemberton. This was the fourth consecutive year of larval mining and foliage discoloration, with little damage apparent.

**Pine needle diseases**  
**Elytroderma deformans**  
**Lophodermella concolor**

Infection of year-old needles of lodgepole and ponderosa pines by native needle diseases was common for the third consecutive year in parts of the Cariboo, Kamloops, Nelson, and Prince Rupert regions.

Infection of year-old and older lodgepole pine needles by Lophodermella needle disease in most parts of the East Kootenay was more severe and widespread than in 1988. Generally light discoloration was widespread, with patches of moderate and severe over 1-2 ha, in the Elk, White, and Bull river drainages, and in the St. Mary River Valley east of Kimberley. At Bloom and Ward creeks south of Cranbrook, infection decreased generally to 30-40% of the needles infected and discolored, with occasional 10-30 ha patches of 90% infection.

Patches of severely infected lodgepole pine were widespread near Boya Lake in the northern part of the Prince Rupert Region, but infections were less severe in the southern Yukon Territory, and along the Alaska Highway, and in parts of the Kamloops Region.

Infection of ponderosa pine by Elytroderma needle disease in the Cariboo and Kamloops regions was widespread throughout the host range. Needle discoloration and brooming of up to 60% of the trees was common in the Clinton and Heffley Creek areas, but less severe in the southern Okanagan.

**European pine shoot moth**  
**Rhyacionia buoliana**

Surveys of ornamental pines indicate that the shoot moth is established in localized urban areas including the Okanagan Valley, the Lower Mainland, and Victoria. The areas have remained static since quarantine regulations lapsed in 1981, and there has been no evidence of shoot moth populations in native pines. Results of surveys to determine parasitoids are pending.

Distorted shoots, similar to damage caused by the shoot moth, were more common on ponderosa pines than in 1988 in the Lytton area, and were caused by increased populations of a gouty pitch midge, Cecidomyia pininopsis. New tips and deformed leaders on about 5% of immature lodgepole pine were also infested by the midge for about 3 km along the Mowhokam River access road near Boston Bar.

**DOUGLAS-FIR PESTS**

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**Western spruce budworm**  
**Choristoneura occidentalis**

Surveys of infested buds in Douglas-fir stands in the southern interior in 1989 indicated a decline in the area and intensity of defoliation by the budworm from the 360 000 ha affected in 1988 mostly in the Kamloops Region. This decline was also forecast based on 1988 egg mass assessments.

An average of 19% of the buds in 50 Douglas-fir stands in four regions were infested by early-instar larvae in late May-early June, down from 25% in 1988, and 33% in 1987. Twenty buds on each of five trees at each location were examined.

The declines were mostly in the Thompson River drainage in the Kamloops and Lillooet TSAs, where an average of 6% of the buds were infested at 19 of 20 sites. This indicates light defoliation throughout the area except at Sabiston Creek, north of Kamloops Lake, where 19%, (12% in 1988), of the buds were infested. Elsewhere in the Kamloops Region, where most of the defoliation is forecast to occur, severe defoliation is expected at 16% (28% in 1988), of the areas, moderate at 13% (44% in 1988), and light at the remainder. Sites where severe defoliation is forecast are mostly west of Okanagan Lake at Equis Creek, Darke Lake, along Peachland Main access road, and in the Glenrosa area. Moderate defoliation is forecast farther south in patches near Apex, Yellow, and Twin lakes.

In the Cariboo Region, where Douglas-fir was defoliated in 1988 over 8000 ha and where 40% of the buds were infested in late May, severe defoliation is predicted at Jacques Lake between Horsefly and Mahood lakes. Moderate or light defoliation is forecast at Viewland Mountain (20%), Klinne Lake (2%), and Keno Lake (1%), but none at Pendleton Lake.

Defoliation is forecast to increase in the Boundary TSA in the western part of the Nelson Region between Anarchist Mountain and Rock Creek, where the average number of infested buds increased 23% to 39% at nine sites, including Bridesville, and Johnstone, McKinney and Nicholson creeks.

East of Pemberton in the Soo TSA in the Vancouver Region, defoliation which covered 3640 ha in 1988 is expected to be mostly light with moderate patches in the Devine, Haylmore and Blackwater creeks areas where 18%, 12%, and 24% of the buds were infested.

Budworm-infested Douglas-fir west of Peachland were sprayed with Bacillus thuringiensis over 150 ha in three separate blocks, in a cooperative research project with Forestry Canada and the B.C. Forest Service. Results will be reported later.

More detailed information on the extent and intensity of defoliation by the budworm will be reported later after aerial surveys, along with levels of parasitism, and forecasts of population trends based on pheromone-baited traps, numbers of egg masses, and overwintering larval assessments.

**Douglas-fir tussock moth**  
**Orgyia pseudotsugata**

Tussock moth larvae were reported for the second consecutive year on ornamental conifers in urban Kamloops, and for the first time since 1985 in Douglas-fir stands in the Kamloops Region. However, an infestation is not expected this year. Only 39 larvae were collected in a standard FIDS sample at a permanent sample location at Jamieson Creek north of Kamloops, 12 at Cherry Creek, two at Indian Garden, and a single larva near Winfield in the Okanagan Valley.

Pheromone-baited sticky traps continue to be placed in 17 Douglas-fir stands with the greatest historical frequency of outbreaks in the Kamloops Region.

**Douglas-fir beetle**  
**Dendroctonus pseudotsugae**

The number of mature Douglas-fir killed by Douglas-fir beetle increased in the Fraser River drainage in the Cariboo, Vancouver and Prince George regions, and in the Rocky Mountain Trench in the Nelson Region. The increase, as predicted, followed two years of increased numbers of beetle-killed Douglas-fir, many predisposed by drought and root disease.

In the Cariboo Region, the most recently killed trees were in groups of 16-30 at Chimney Creek, and in a municipal park at Williams Lake. On the west side of the Fraser River north of Quesnel, numerous pockets of 'red-topped' Douglas-fir totaled about 100 ha, a tenfold increase from 1988. Increased numbers of beetle-killed trees in the Vancouver Region included five patches containing 10-30 overmature (100-cm dbh) Douglas-fir on the west side of Twin One Creek at the top end of Lillooet Lake. Current attack is only present in blowdown and trap trees in TFL 42 northwest of Fort St. James. Groups of 20-30 standing beetle-killed Douglas-fir were scattered throughout the Rocky Mountain Trench in the Nelson Region, with occasionally larger groups of 150-200 from south of Radium to the International border, including Wickman Creek. In the Thompson River drainage in the Kamloops Region, pockets of up to 25 overmature beetle-killed Douglas-fir were scattered from Cache Creek to Pavilion, in the Deadman River Valley, and between Barriere and Clearwater.

**Western false hemlock looper**  
**Nepytia freemani**

Larval populations in Douglas-fir stands in parts of the Kamloops Region increased significantly, but there was no evidence of defoliation. Up to 20 larvae were collected in standard FIDS samples at permanent sample sites near Spences Bridge, and Savona to Falkland including Cherry Creek and Pritchard. Periodic infestations in parts of the Kamloops Region since 1963 have occurred along with increases in Douglas-fir tussock moth populations, currently on the increase in the Kamloops area.

**TRUE FIR PESTS**

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**Budworms**  
**Choristoneura spp.**

Populations of eastern and 2-year cycle budworms in alpine fir and spruce forests (in boreal and interior sub-alpine zones) in parts of four forest regions are continuing; however, defoliation intensities and areas will vary.

Eastern spruce budworm, Choristoneura fumiferana, which infested 130 separate stands totaling 36 000 ha in the Fort Nelson area in 1988, defoliated alpine fir and spruce more severely and over more areas in 1989, some for the fifth consecutive year. Patches of mostly light defoliation extend along both sides of the Liard River from Coal River east to Smith River and Liard Hot Springs. Defoliation is mostly moderate at Kledo Creek, in the Muskwa and Prophet river drainages south of Fort Nelson, and mostly moderate with areas of severe defoliation over several thousand hectares in the Fort Nelson River Valley north to the Beaver River Valley and into the Yukon and Northwest Territories.

Alpine fir and white spruce stands east of Prince George were infested, but with minimal defoliation, by immature larvae of 2-year cycle budworm, C. biennis, which had infested and discolored new shoots over 17 500 ha in 1988. Defoliation by mature larvae is forecast for 1990 to be mostly light and moderate with isolated areas of severe, based on the number of buds infested by immature larvae in late May-early June. At Everett Creek 80% were infested; 78% at Tumuch Creek; 29% and 18% at Slim Lake and km 68 Bowron Coal Road, 3% at km 76, and 6% and 2% in the Stoney Lake area.

Budworm larvae were collected from understory alpine fir and spruce by forest industry employees in the Ospika River drainage north of Mackenzie. This is significantly farther north of previously recorded 2-year cycle budworm populations and considerably south of eastern budworm populations; species identification is being determined.

In the northeastern part of the Cariboo Region, immature 2-year cycle budworm larvae infested 18-85% (avg. 55%), of the alpine fir and white spruce buds at seven locations. Mostly severe defoliation by mature larvae is forecast for 1990 in the Big Valley Creek area including Lussons Creek, and moderate defoliation in the Swift River Valley.

There is little evidence of 2-year cycle budworm this year in alpine fir-spruce stands in the North Thompson and Adams river drainages in the Kamloops Region, where 159 areas were lightly defoliated in 1988. At Keefer Lake east of Cherry Creek, 10% and 50% of the buds at two sites were infested, indicating continuing populations and potentially light and severe defoliation in 1990.

Severe defoliation and some top stripping of fir-spruce stands by mature 2-year "off-year" cycle budworm larvae is expected as forecast, at Plant and Barnes creeks in the West Kootenay, where an average of 55% and 28% of the buds were infested at five sites in each of the two areas, respectively. In the East Kootenay, mostly light, and patches of moderate defoliation of new tips by mature 'off-year' larvae is forecast at Baker, Redding, and Dewar creeks and in the upper St. Mary River drainage east of Kimberley, and at Bugaboo Creek in the Invermere TSA, where an average of 14% (range 5-31%) of the buds were infested by immature larvae in 1988.

A study to develop more reliable and accurate forecasting of budworm populations by correlating larval and adult numbers, continued in higher-elevation fir-spruce stands in three regions.

**Balsam woolly adelgid**  
**Adelges piceae**

Continuing surveys on Vancouver Island found active adelgid populations on true fir for the first time in the China Creek drainage south of Port Alberni and near Qualicum. Both areas are within the quarantine regulation zone. Additional surveys of grand fir in the Nelson Region along the International border have not found any occurrence of the adelgid, which is common in northern Idaho in pockets of grand fir. Predator recovery surveys continue for the third consecutive year; results will be reported later.

**Balsam shoot boring sawfly**  
**Pleroneura brunneicornis**

Sawfly populations increased significantly, for the second consecutive year, and killed high numbers of new shoots of true firs higher elevation forests near Sechelt, Powell River, and Chilliwack in the mainland part of the Vancouver Region, and near Creston in the Nelson Region.

Near Grant Lake, southwest of Powell River, 60% of the buds on 80% of the amabilis fir over about 50 ha were killed. At Chipmunk Creek near Chilliwack, 5-40% (avg. 20%) of the lateral shoots on 70% of 20-year-old, higher-elevation amabilis fir were killed. Increased sawfly populations along the Arrow Creek access road near Creston destroyed most terminals on understory grand fir, and defoliated 40-50% of the lateral shoots on the understory and 10% of the overstory. Only 1% of the shoots on the understory were infested in 1988.

Mining by the sawfly causes shoot deformity, and usually kills the shoots. Infested shoots turn a reddish brown, resembling frost damage, and the dead parts of the shoots eventually fall off. There is one generation a year with the adult sawflies emerging in the spring from overwintering pupae or cocoons. Eggs laid near the tip of the shoot hatch into creamy-white grubs which burrow into the shoot axes and feed until mid-summer, then drop to the ground to

spin cocoons.

The sawfly has not previously been considered a noteworthy pest of true firs in British Columbia. In 1988 it was recorded in the south coast part of the Vancouver Region for the first time, on amabilis fir near Holberg, and near Creston for the first time in more than 15 years.

**Fir engraver**  
**Scolytus ventralis**

Mortality of semimature and mature grand fir by fir engraver beetles increased significantly in the Pend-d'Oreille area of the West Kootenay. Single trees and up to 30% of the grand fir over areas up to 5 ha were killed, the largest number near Seven Mile Dam. The significant population build-up was attributed to the availability of hosts predisposed by drought-stress during the previous two years.

**SPRUCE PESTS**

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**Spruce beetle**  
**Dendroctonus rufipennis**

Host depletion, salvage and sanitation have contributed to the decline in spruce beetle populations and mortality of mature white and Engelmann spruce in the interior regions, for the seventh consecutive year. Populations remain generally at endemic levels. However, pockets of recent windthrown mature spruce, particularly in the East Kootenay, in the McGregor and Table river drainages in the Prince George Region, in Mt. Robson Provincial Park and in Sitka spruce near Bella Coola, have the potential for population build-up.

Scattered blowdown is common at the heads of most drainages in the East Kootenay, but contain very few new attacks. However, 2-year-cycle populations in larger patches of blowdown are increasing at Redding Creek east of Kimberley, and in the Bull and White river drainages on the east side of the Rocky Mountain Trench. Late instar larvae were numerous and healthy, and should emerge in 1990.

Aerial and ground surveys north and east of Prince George in cooperation with Industry, B.C. Forest Service, Provincial Parks, and Forestry Canada, recorded widespread recent blowdown but only very low beetle populations in the McGregor and Table river valleys, and about 20 recently windthrown mature spruce along the trail to Berg Lake in Mt. Robson Provincial Park.

East of Bella Coola, 25 mature standing Sitka spruce adjacent to recent windfall in a 5 ha pocket near Odegaard Falls in the upper Nusatsum River Valley, were recently attacked by spruce beetle. The broods pose a threat to adjacent standing susceptible spruce in 1991. Beetle populations in spruce predisposed by mud slides associated with road construction along the Haines Road in the northern part of the Prince Rupert Region, have been effectively reduced to endemic levels by control programs including salvage, and strip debarking of felled trees.

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**HEMLOCK PESTS**


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**Western blackheaded budworm and Hemlock sawfly**  
**Acleris gloverana** and **Neodiprion tsugae**

Defoliation of western hemlock near Holberg on northern Vancouver Island by the budworm is forecast to continue. Stands over 4830 ha were defoliated for the first time in 1988 from William Lake east to Nahwitti lake, south to Glerup Creek and in Cape Scott Provincial Park. Standard FIDS sampling indicates active populations in the same areas this year. Defoliation will be assessed by aerial surveys later in August, and egg sampling later in the year to forecast population trends for 1990. There is no evidence of increasing populations elsewhere on western Vancouver Island, where the last budworm outbreak during 1970-73 covered 164 000 ha from Holberg south to Jordan River. An experimental interagency control program near Holberg applied Bacillus thuringiensis, over an estimated 120 ha in mid-July; assessment is in progress

Defoliation of western hemlock on the Queen Charlotte Islands is expected to continue in 1989, but mostly by hemlock sawfly, and mostly in the Massett Inlet area where healthy cocoons were numerous in 1988. Blackheaded budworm populations on the Islands declined significantly in 1988, following three years of infestation.

Blackheaded budworm larvae in alpine fir-spruce stands in the eastern part of the Prince Rupert Region are more numerous and widespread than in 1988, and defoliation of the new foliage is expected to increase in most previously defoliated stands.

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**LARCH PESTS**


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**Larch casebearer**  
**Coleophora laricella**

Populations of larch casebearer in the host range in the Nelson Region and adjacent areas of the Kamloops Region continued to cause only light or no defoliation, as predicted.

At 19 long-term study sites from Anarchist Mountain to east of Cranbrook defoliation was moderate at only one site near Castlegar Pulp Mill; light mostly on understory at six sites; trace at seven, and nil at the remainder.

There were no parasites released in 1988-1989, following periodic releases totaling more than 15 000 specimens of Chrysocharis laricinellae or Agathis pumila, in a biological control program initiated in 1966 against the casebearer.

**Larch sawfly**  
**Pristiphora erichsonii**

Populations are expected to continue in native and exotic larch stands at widespread locations in British Columbia and the Yukon Territory in 1989.

Current damage to tips of western larch at Millar Creek near Grand Forks in the Nelson Region was minimal, and only very few larva were evident by late June where moderate to severe defoliation occurred over 100 ha in 1988. A high incidence of parasitism in the East Kootenay in 1988 by a chalcid, Dibrachys soltans, severely reduced populations and resulted in little or no defoliation this year in the Elk River Valley, where patches totaling 400 ha were defoliated in 1988.

Defoliation is forecast to occur for the third consecutive year on exotic larch at Terrace and on tamarack in Prince George for the second year, but decline in exotic larch plantations at the U.B.C. Research Forest near Haney, after three consecutive years of defoliation.

Numbers of sawfly larvae in the southwestern part of the Yukon Territory increased considerably and moderate defoliation of tamarack is expected for the third consecutive year north of Watson Lake, from Frances Lake to Simpson Lake, and in the Finlayson Lake area.

**Larch needle blight**  
**Hypodermella laricis**

New infections and discoloration of western larch by larch needle blight in the western and southeastern parts of the host range in the Nelson and Kamloops regions was generally light with pockets of moderate and severe at widespread locations, similar to 1988.

In the West Kootenay, severe discoloration, mostly of the mid-crown, was common on most larch from Eholt to Grand Forks. Moderate to severe discoloration was common from Christina Lake to the Paulson bridge, over 40 ha at Sand Creek, and in pockets up to 10 ha from Westbridge to Beaverdell. Light and moderate discoloration was common in lower and upper crowns and light throughout lower elevation stands at Sand Creek. At Johnstone Creek west of Bridesville, 5-10% of the foliage was infected on 80% of the western larch. New infections in the East Kootenay increased overall to generally light with moderate and severe patches up to 5 ha in most western larch stands in the western and southern parts of the Rocky Mountain Trench, including Gold, Teepee and Bloom creeks, Moyie Lake, the St. Mary River drainage and at Ellenvale Creek. Infections in the upper Kootenay and Palliser river valleys and at Fenwick Creek declined slightly, but scattered trees at Premier Lake east of Skookumchuck were severely infected and discolored.

Most western larch in the north Okanagan Valley, from Deep Creek to Sicamous and east of Cherryville in the Kamloops Region, were lightly and moderately discolored, similar to areas and intensity of infections in 1988.

**Larch budmoth**  
**Zeiraphera improbana**

Budmoth populations remain endemic in previously infested western larch stands in the West Kootenay near Rossland, Castlegar, and west of Bridesville at Johnstone Creek Provincial Park. Increased numbers of larvae, tentatively identified as budmoth, very lightly defoliated mixed-age larch over about 10 ha along the McKinney road, east of Oliver in the Kamloops Region, the first record of defoliation in the area in several years.

**MULTIPLE HOST PESTS****Black army cutworm**  
**Actebia fennica**

Cutworm populations declined significantly in previously infested areas in interior British Columbia this Spring. Larvae were found at only one 1989 planting in a recently slash-burned site, in the eastern part of the Prince Rupert Region, at six previously infested sites in the Nelson Region, and one north of Prince George. None were found at twelve sites in two regions. Populations were expected to continue in parts of four forest regions, based on male adult catches in traps in 1988. Larval and pupal mortality from natural parasites and an entomopathogen reduced populations by up to 42% in mass-reared collections from 11 sites in three regions in 1988.

In the Nelson Region, cutworm larvae were very few, (none to less than 5/1000 cm<sup>2</sup> at six sites), in the Beaverfoot, Chatter, Quartz, and Ice creek areas in the Golden TSA, down from 15/1000 cm<sup>2</sup> in nearby areas in 1988. Small patches of fireweed were stripped at Chatter Creek, but there was no damage to recently planted seedlings. There was no evidence of larvae at three sites near Redrock Harbour east of Mica Dam in the West Kootenay, where on average less than three adult males were trapped in 1988. In 1988, in the first recorded outbreak in that area, 45% of the spruce seedlings at two sites were stripped, and ground cover was defoliated. In 1989, 10% of the seedlings previously stripped, and 16% of the Douglas-fir seedlings at Esplanade Bay, were dead.

In the Prince Rupert Region, where cutworms were numerous in 1988, larvae were present at only two of ten sites, including sites where up to nine male adults were trapped in late 1988. At Corral Creek in the eastern part of the Region about 10% of the 2-year old planted white spruce in a 1986 burned site, were lightly (20%) defoliated by reduced numbers of larvae. Seedlings and ground cover in a 1989 plantation in the Kispiox River drainage were lightly defoliated. In the Bell-Irving River drainage, fireweed was very lightly defoliated at one site where adults were trapped in 1988; conifer seedlings were not defoliated.

Only singular cutworm larvae were widespread at Weedon Lake north of Prince George, where ground cover was defoliated in 1988. Larvae were not found elsewhere in the Prince George Region, including near McBride where seedlings and ground cover were defoliated over 30 ha last year.

A contract for a system to forecast population fluctuations and the subsequent degree of defoliation, based on numbers of male adults in pheromone non-sticky traps, is in its third and final year of development.

Pheromone-baited sticky traps will be set out in recently burned sites to detect and monitor adult male populations. Data on the moth catches and larval parasitism from the few larvae collected this year will be reported later.

**Rhizina root disease**  
**Rhizina undulata**

Seedling mortality linked to infection by Rhizina root disease was found in the wetter parts of the Prince Rupert, Nelson, and Prince George regions in 1988. Re-examinations of affected sites this spring found an increase in seedling mortality at two sites in the West Kootenay, at one north of Prince George, and at one site north of Kispiox in the Prince Rupert Region.

At Downie Creek, north of Revelstoke in the Nelson Region, 34% of the Douglas-fir seedlings, and 19% of the spruce seedlings at nearby Cariboo Creek, were dead up from 15% and 6% respectively; as expected current year fruiting was not yet present.

An estimated 40% of the white spruce in a 1986-burned site (CP 304) in the Corral Creek drainage north of Kispiox in the Prince Rupert Region were dead in May. In early June, new fruiting was present on three seedlings at Corral Creek and in recently burned sites in the Kispiox and Morice TSAs in mid-July.

At Peculiar Lake, south of Weedon Lake north of Prince George, where 1% of the seedlings were infected and killed by the disease in 1988, an additional 1% were dead in early 1989.

**Animal damage**

Feeding damage to recently planted conifer seedlings by high numbers of meadow voles, Microtus sp., increased significantly near Squamish in the Vancouver Region, but were not present in the western part of the Prince Rupert Region where seedling mortality was prevalent in 1987-88. Rabbit populations and feeding damage to roadside willow were common throughout the Yukon Territory. Porcupines continued to kill young and semimature conifers, particularly lodgepole pine, in the western part of the Prince Rupert Region, and was recorded for the first time in recent years in the Vancouver Region, east of Boston Bar.

**Voles**

In the Crawford Creek drainage east of Squamish, about 80% of the western hemlock seedlings in a new plantation were killed by significantly increased populations of meadow voles; regeneration hemlock about 0.5 m high were not affected. Nearby at Ring Creek, 2-3 year old feeding damage killed 2% of the seedlings, and 50% of the 0.3- to 1.0-m hemlock, cedar, and Douglas-fir saplings had clipped lateral and terminal leaders. About half of the saplings had basal scars, and multiple tops from old feeding were common. New vole damage was not apparent in plantations in the Bell-Irving and Kitimat areas where feeding damage occurred in 1988.

**Porcupines**

Porcupines chewing patches of stem and branch bark continue to kill young and semimature conifers, particularly lodgepole pine. Tree mortality has occurred annually for many years in the western part of the Prince Rupert Region, and is a significant factor in spaced stands. East of Boston Bar in the Mowhokam River Valley, about 5% of the 10-year-old lodgepole pine at 13 Mile

were killed as were 3% of the 10-15-year-old pine at 9 Mile at nearby Uztlius Creek; basal scarring was present on about 4% of the trees at each of the locations. This was the first incidence of tree mortality from porcupine in this part of the Vancouver Region in recent years.

### Rabbits

De-barking and girdling of willow stems by rabbits or hares were more common throughout the Yukon Territory than in 1988. Damage to mainly small roadside willow was most common from Carmacks to Mayo and Dawson City.

### Climatic injury

Discoloration of foliage on most conifers, particularly hemlock and cedar, was widespread across the province in early 1989. Colder than normal temperatures were accompanied by strong winds in late January and early February.

In the Cariboo Region, up to 100% of the foliage of most age classes of hemlock, cedar, and Douglas-fir were discolored in areas of 60 to 1600 ha from Likely to Horsefly, and occurred in open exposed stands from Mahood to Quesnel lakes. However, by mid-June the new flush was in progress

In the Bella Coola Valley in the mid-coast section of the Vancouver Region, moderate and severe discoloration of 30-100% of the hemlock and cedar foliage occurred over 1500 ha; full recovery is expected. In late January temperatures, accompanied by high winds, changed from 0 to -19°C in 24 hours.

Discoloration of most conifer species, including lodgepole and ponderosa pines, Douglas-fir and cedar, was widespread in the Kamloops Region, most severe in the Highland Valley between Ashcroft and Logan Lake. Damage was common at Kanaka Bar, Lytton, Lillooet to Gold Bridge, Fountain Valley, and near Knutsford, Sorrento and Anglemont. Discoloration of cedar was extensive in the Interior Cedar-Hemlock Zone, particularly in Wells Gray Park and in the Vavenby area.

Western hemlock, mostly on exposed sites in the Bush River Valley, and in Glacier National Park in the Nelson Region were generally very lightly discolored. Elsewhere in the region, buds of western larch and spruce in the Wigwam, Couldry, and Kishinena creek valleys were affected by the cold temperatures and winds which also caused premature loss of desiccated needles, and resulted in very thin crowns in numerous areas totaling 2 500 ha. In these areas terminal buds on spruce above 1350 m, and lateral buds on 90% of the spruce above 1450 m were killed. Stands of whitebark pine near the tree-line on western slopes in the Flathead and upper Elk river valleys, and at Corbin Creek, were severely discolored in patches of 20-50 ha.

An average of 30% of the foliage (range 0-80%) of the western hemlock along Hwy 16 east of Prince George from Sugar Bowl Creek to McBride, was discolored in patches totaling about 5000 ha. Up to 80% (avg. 30%) of the foliage was discolored on up to 70% of the hemlock and cedar in numerous areas, totaling 500 ha to 5000 ha at Tumuch Creek and the Bowron River Valley respectively. Mortality of about 20% of the new spruce buds is common on most trees in stands east of Prince George, including the Torpy River drainage.

Loss of 1988 foliage on exposed hemlock was common along the Skeena River Valley in the Prince Rupert Region, but anew flush was in progress in mid-June. Up to half the lodgepole pine seedlings in some exposed plantations along the Fulton Lake access road in the eastern part of the region lost up to 20% of the 1988 needles.

In the Yukon Territory, at Conglomerate Mtn. south of Carmacks, 75% of the foliage of lodgepole pine over 750 ha were discolored by the cold winds and temperatures.

### Roadside conifer mortality

Tree mortality, crown and branch dieback, and foliage discoloration of mostly regeneration conifers along paved highways and access roads were widespread in the Cariboo Region, and in the East and parts of the West Kootenay, but less common elsewhere in the interior. The most probable cause was a combination of site, moisture stress and salt injury.

The most conspicuous damage in the Cariboo Region was Douglas-fir, lodgepole pine, and spruce along Hwy 97 from 100 Mile House to Lac la Hache, from 150 Mile House to Williams Lake, and from Hawkes Creek to McLeese Lake. Roadside conifers were severely discolored along Hwy 24 east of Hwy 97 to Lone Butte, from 100 Mile House east to Horse Lake, near Alexis Creek along Hwy 20, and from Heckman Pass west to Stuie in Tweedsmuir Provincial Park.

In the East Kootenay, tree mortality and foliar discoloration, mostly of Douglas-fir and some lodgepole pine were common. Groups of 30 dead and discolored trees occurred in low lying areas along Hwy 3 from Moyie Lake to Cranbrook, Elko, and Kimberley to Ta Ta Creek, and near Columbia Lake and Windermere.

Roadside cedar, pines, Douglas-fir, and spruce were discolored at widespread locations in the West Kootenay, most commonly along Hwy 3 near Nancy Greene Lake, from Paulson Bridge west to Christina Lake and Grand Forks, and less commonly along Hwy 33 from Rock Creek to Beaverdell and along the Christian Valley Road.

Except for light discoloration to widely scattered lodgepole pine and Douglas-fir, there was little roadside damage south and east of Prince George.

### DECIDUOUS AND ORNAMENTAL TREE PESTS

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#### **Tent caterpillars** Malacosoma spp.

Defoliation of deciduous trees and shrubs by forest tent caterpillar, Malacosoma disstria, was more severe and widespread in parts of three forest regions than in 1988. Western tent caterpillar, M. californicum pluviale, colonies were common but mostly light in the north Okanagan, at Kitimat, and in and west of Terrace.

### Forest tent caterpillar

The most widespread infestations were as predicted, mainly in trembling aspen and to a lesser extent cottonwood and other deciduous trees and shrubs, over an estimated 90 000 ha north and west of Prince George in the Salmon River Valley, including the Ness, Nukko and Chief lakes areas. This was the fourth consecutive year of defoliation in the area and was more than double the area defoliated in 1988. More than half the area was severely defoliated, but by mid-July refoliation was in progress. In the Peace River area, defoliation was variable and patchy over an estimated 3000 ha, from Pouce Coupe to Ft. St. John.

Populations increased from Bridge Lake to Green Lake in the eastern part of the Cariboo Region, where severe defoliation was more widespread than in 1988, when pockets totaling 460 ha were defoliated.

In the East Kootenay, the area and intensity of defoliation increased significantly from Hosmer and Yahk to the Blaeberry River Valley east of Golden, where 24 pockets of aspen and other hosts totaling 1500 ha were defoliated in 1988. Most of the larger new infestations were from Fort Steele to Wasa in the Kootenay River Valley, and near Golden. Smaller 2-15 ha patches occurred from Canal Flats to Brisco and Parsons.

In the Bella Coola Valley, alder, birch, and other deciduous trees and shrubs were severely defoliated for the third consecutive year, mostly near Hagensborg. The number of forest tent caterpillar larvae in exotic poplar stands near Chilliwack, declined along with the previously high numbers of satin moth, Leucoma salicis, in the same stands. The decline was probably due to the high incidence (90%) of a nuclear polyhedrosis virus in the larval population in 1988.

### Western tent caterpillar

Increased western tent caterpillar populations in the north Okanagan lightly defoliated a variety of deciduous hosts from Vernon to Falkland and near Armstrong and Enderby, but damage was light, similar to that of the two previous years in the central Okanagan.

Generally light defoliation of mostly black cottonwood was common throughout Terrace, with patches of moderate and severe defoliation at Kitimat and for 3 km east of the Exchamsiks River west of Terrace in the Skeena River Valley. This is the first tent caterpillar infestation in the area for many years.

An estimated 15% of the larvae in predominantly forest tent caterpillar infestations in the East Kootenay were western tent caterpillar, present for the first time in the area since 1979.

### Satin moth Leucoma salicis

Populations which severely defoliated exotic poplar over about 200 ha southeast of Chilliwack in the Vancouver Region in 1988, declined significantly and only lightly defoliated the upper crowns in 1989. The decline was due to the presence of a nuclear polyhedrosis virus in 90% of the larvae last year.

**Large aspen tortrix**  
**Choristoneura conflictana**

Tortrix populations in southwestern Yukon Territory increased nearly threefold and severely defoliated trembling aspen over about 3000 ha in widespread areas west of Takhini towards Kusawa Landing, north to the southwest end of Lake Laberge, and around Whitehorse. This was the second consecutive year of defoliation in the area. Defoliation of aspen was also widespread along the Alaska Highway in northeastern B.C. where patches of mostly light defoliation were widely scattered between km 110-220, with moderate to severe patches from km 175-220, and between km 555-570 on Steamboat Mountain.

**Birch leaf miners**  
**Lyonetia sp. and Fenusa pusila**

Discoloration of birch by leafminers continued in the northern and western parts of the Nelson Region, in places for the fifteenth successive year. Increases also occurred in the Vancouver Region, and on ornamental birch in Terrace.

Birch in mixed stands in the Golden and Donald areas of the Nelson Region, were severely discolored. Defoliation in the West Kootenay again increased with mostly light and occasionally severe discoloration of single birch and pockets up to 0.5 ha. Discolored birch were common for about 10 km along Hwy 31A near Kaslo and for 15 km along the Whatshan Lake road, west of Lower Arrow Lake.

For the first time in recent years, increased leafminer populations in the Lower Mainland discolored half the foliage on all the regeneration birch over about 20 ha in a clearcut in the Coquitlam watershed. A small patch of ornamental birch at the south end of Alouette Lake was lightly defoliated.

Ornamental birch in Terrace were lightly and moderately discolored by increased leafminer populations, which are not known on native birch in the area.

**Western winter moth**  
**Erannis vancouverensis**

Defoliation of broadleaf and vine maples and other deciduous hosts by western winter moth was more severe and widespread in the Vancouver Region in 1989, the third consecutive year of defoliation. Populations declined in the Kamloops Region, where numerous scattered patches of defoliated maple and birch occurred in 1988.

In the Vancouver Region, maples, birch, and to a lesser extent alder and willow were defoliated in widely scattered patches of up to 500 ha from Chilliwack to Boston Bar. The largest and most severely defoliated stands were in Sasquatch Provincial Park at Harrison Lake; additional areas of severe defoliation over 5-5000 ha were from Sardis to Boston Bar, and along the Coquihalla Highway. Despite two consecutive years of severe defoliation, refoiliation was expected by late summer. Infestations usually last 2 or 3 years, usually declining due to parasitism or infection by entomopathogens, the incidence of which will be reported later.

Populations in the Shuswap Lake area, and the Turtle, Clearwater, and North Thompson river valleys declined after three successive years of defoliation, as predicted due to natural factors.

**Winter moth**  
**Operophtera brumata**

A significant increase in winter moth populations in the Lower Mainland severely defoliated birch stands in the area of Hwy. 99 and the New Westminster Highway, moderately to severely defoliated fruit and oak trees from Ladner to Tsawwassen, and was suspected broadleaf maple at Newton and Surrey. This is the first report of visible defoliation of trees by the winter moth on the mainland, although adult males were caught previously in pheromone-baited sticky traps in the Richmond area, and there has been feeding on blueberry.

On southern Vancouver Island, where defoliation of deciduous trees, mainly Garry oak, has occurred for more than 15 years, populations remained at very low levels for the fifth consecutive year. The reduced levels were attributed to periodic releases of introduced parasites in the Victoria area since 1979. Discoloration and premature loss of foliage on widely scattered individual Garry oaks in the area has increased during the past three years, caused by an oak leaf phylloxeran, Phylloxera nr. coccinae or a jumping gall wasp, Neuroterus saltatorius.

Small numbers of a closely related native defoliator, Bruce spanworm, Operophtera bruceata, were collected on the Lower Mainland on broadleaf and vine maples in North Vancouver and near Hope, but defoliation was minimal.

**Apple ermine moth**  
**Yponomeuta malinella**

An introduced pest of apple trees, the apple ermine moth was first detected in B.C. in 1981 in a nursery on Vancouver Island. Since then larvae have been detected throughout southern Vancouver Island, Vancouver, the Fraser Valley, and near Pemberton. Surveys in 1989 by Forestry Canada, FIDS, detected larvae and defoliation of crabapple and old orchard trees on Saltspring Island, north of Duncan, near Courtenay and Comox, on the Sechelt Peninsula, at Lund, in the Fraser Canyon to Boston Bar, from Lytton to Hat Creek, and from Kamloops to Little Fort.

Defoliation was most severe at Pemberton and at Agassiz, where single crabapple trees were totally stripped. The high numbers of pupae at most sites indicate that populations will be present in 1990.

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