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FOREST Pest LEAFLET

Pacific Forestry Centre

Spruce weevil in British Columbia

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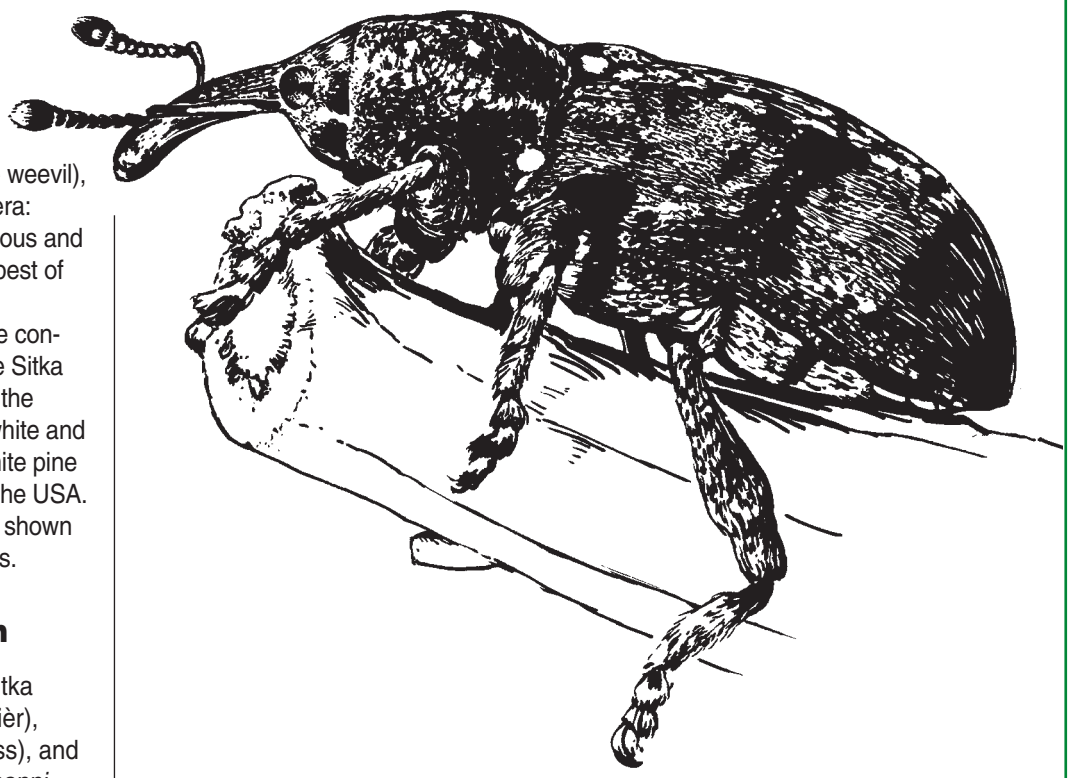

Introduction

The spruce weevil (=white pine weevil), *Pissodes strobi* Peck (Coleoptera: Curculionidae), is the most serious and economically important native pest of spruce regeneration in British Columbia. The weevil was once considered to be three species: the Sitka spruce weevil on Sitka spruce; the Engelmann spruce weevil on white and Engelmann spruce; and the white pine weevil in eastern Canada and the USA. However, genetic studies have shown that these are the same species.

Hosts and distribution

The weevil primarily attacks Sitka (*Picea sitchensis* (Bong.) Carrièr), white (*P. glauca* (Moench) Voss), and Engelmann spruce (*P. engelmanni* Parry) in British Columbia, although black spruce (*P. mariana* (Mill.) B.S.P.), Norway spruce (*P. abies* (L.) Karst.), Colorado spruce (*P. pungens* Engelm.), red spruce (*P. rubens* Sarg.), Serbian spruce, (*P. omorika* (Pancic) Purk.), lodgepole pine (*Pinus contorta* Dougl. var. *latifolia* Engelm.) eastern white pine (*P. strubus* L.), jack pine (*P. banksiana* Lamb.), red pine (*P. resinosa* Ait.) Austrian pine (*P. nigra* Arnold), Mugho pine (*P. mugo* Turra) and Scots pine (*P. sylvestris* L.) are also attacked. No records of attack exist for western white pine (*P. monticola* Dougl.) and ponderosa pine (*P. ponderosa* P. Laws.).

In British Columbia, this insect is commonly found on spruce south of 56˚ north latitude, except for the Queen Charlotte Islands where the insect has not been found (6) (Fig. 1). Isolated weevil collections have been made near Cassiar in the northeast and near Kotcho Lake in the northwest corner of the province. Damage attributable to this weevil is less serious on the extreme west coast of Vancouver Island, particularly north of Brooks Peninsula, as well as near the tip of Vancouver Island north of Quatsino Sound.

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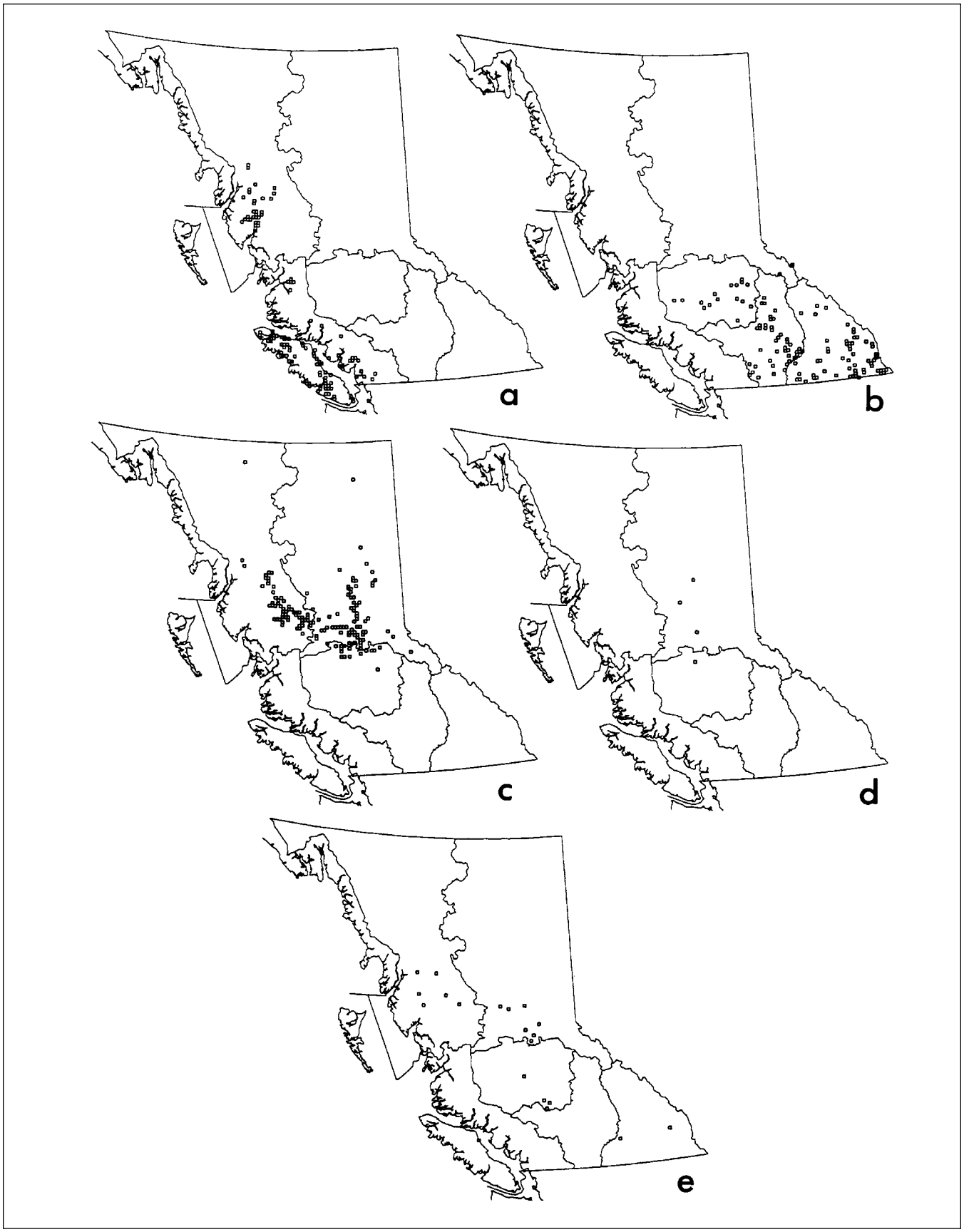

Fig.1. Locations of *P. strobi* collections in British Columbia (6): a – on Sitka spruce; b – on Engelmann spruce; c – on white spruce; d – on black spruce; e – on lodgepole pine.

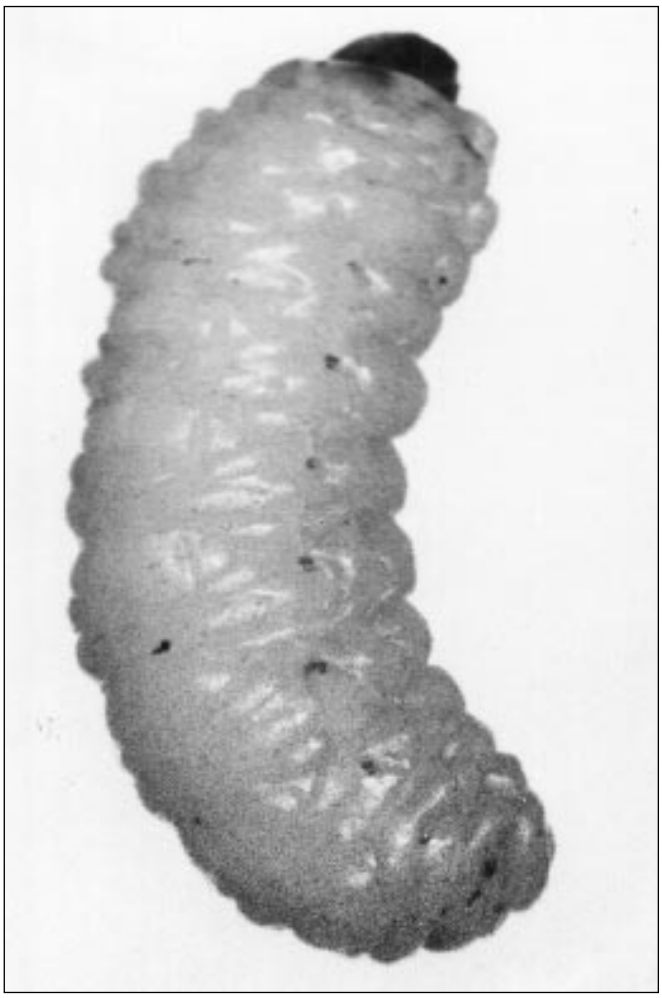

Fig. 2. Larva

Fig. 3. Pupa

Description

Egg: The egg is pearly white, oblong, equally rounded at both ends and about one-half the size of a pinhead.

Larva: The larva is yellowish white, cylindrical, elongated and legless, with a light brown head; about 6 mm long when full-grown (Fig. 2).

Pupa: The pupa, about the same size as the adult, is shiny white at first, darkening while maturing, with well developed wings and legs; the developing head bears a prominent snout (Fig. 3).

Adult: The adult, 5 to 6 mm in length, is a typical weevil with a long, curved snout and a cylindrical, posteriorly-tapered body, usually reddish brown with patches of lighter brown or grey scales, and ridged, roughened wing covers (Fig. 4).

Life history and habits

The spruce weevil has one generation a year. The eggs are laid from late April to June in punctures made by the female in the bark below the apical buds of the terminal (year-old) shoot (Fig. 5). The larvae burrow downward beneath the bark, feeding on the phloem, which eventually kills the terminal (Figs. 6-7). In many cases, the larvae mine past the year-old leader into the 2-year-old and occasionally the 3-year-old shoots, causing even more dieback. By mid-summer, they construct oval pupal cells in the wood and pith, and pupation occurs within a "cocoon" of wood fibers (Fig. 8). Depending on local climate, a portion of the larvae may remain to overwinter in the attacked leader. Most adults emerge from the leaders in late August and September (Fig. 9); the newly emerged adults feed on terminals and branches and overwinter primarily in the duff. The following April or May, the adults fly or crawl to young spruce terminals and resume feeding. They mate and lay eggs soon afterward. Occasionally, and especially in the interior, adults will re-attack below the previously attacked leader. Adults may live for up to four years.

Damage and Detection

The weevil attacks the terminal growth on spruce trees regeneration, prefering the most vigorous trees from 1.5 to 9 m in height, with longest leaders. The insect kills the previous year's growth, resulting in loss also of the current year's growth. Laterals then become

dominant and repeated attacks result in multiple or crooked stems, general bushiness, and loss of height (1). Normally, trees are attacked only if a new leader has formed; however, re-attack below a dead leader occurs occasionally. More than 50% of the trees in a stand have been attacked in one year.

In the spring, small punctures near the top of the previous year's leaders, usually accompanied by copious resin flow, indicate new attacks. The current growth on infested leaders becomes deformed by midsummer, wilts, and forms the characteristic "shepherd's crooks", changing colour through yellow, red and brown. Leaders showing evidence of insect mining, "chip cocoons", and emergence holes made by new adults are most noticeable in the fall as some infested leaders break off during the winter.

Attacks in past years are indicated by discolored or deformed leaders, dead stubs protruding at intervals along the main stem, crooked or forked stems with multiple leaders, and bushy or stunted trees. Figures 6-9 illustrate the damage caused by the weevil.

Outbreaks of the spruce weevil in single-species, open-grown Sitka spruce plantations begin when stands are about five years old. First a few trees are attacked, then the population grows rapidly until 30-50% of the trees are attacked per year (Fig. 10). The rapid increase in this initial stage is due to the large proportion of trees available for attack; in addition, many attacks result in multiple leaders, and this further increases the number of oviposition sites and food supply. After this period of invasion, the percentage of trees attacked each year stabilizes. During this stage of the outbreak, the rate of attack will vary from year to year due to the effects of weather, natural enemies, larval crowding, and other factors. This stable phase may last 10 to 20 years, and is caused by equilibrium between the weevil population and its food supply – the number of attackable leaders.

Fig. 4. Adult, top view

In good sites, where vigorous growth ensures a rapid development of new leaders, weevil populations and attack rates are higher during this phase than on slow-growing plantations.

Gradually, this equilibrium gives way to a population decline and the rate of attack drops to about 5% per year by the time the plantation reaches 30 to 40 years of age. This level of attack is considered endemic for the spruce weevil in coastal British Columbia. There are probably many reasons why outbreaks decline. By this age, the plantation has passed its stage of most rapid height growth and inter-tree competition increases. This brings about a gradual reduction in leader size and food supply. It is also possible that, with the onset of canopy closure, there may be changes in the stand microclimate which decrease weevil survival.

Volume losses from a spruce weevil outbreak depend on the severity and the duration of the infestation; a severe outbreak that persists for 30 or 40 years may reduce stand volume by as much as 30-40%.

Management

The spruce weevil is a native insect in British Columbia and is normally present in most spruce ecosystems; therefore, the goal of spruce weevil management should be to reduce

Fig. 5. Sitka spruce leader with egg punctures

Fig. 6. Dead leader about eight months after attack

damage rather than to eliminate the weevil. For this, the recommended approach is to apply an Integrated Pest Management system (IPM) in which several methods are combined (4). Individually each of these methods brings only partial control; the combined system, however, will result in satisfactory control.

IPM tactics differ depending on whether the objective is the management of existing plantations or the development and management of new plantations so as to minimize susceptibility to weevils and to reduce damage.

Existing plantations should be closely monitored to determine current attack rates (3) and past weevil history. Future course of the infestation should be determined based on stand hazard and tree vigour. Vigorous plantations on high hazard zones will be heavily attacked. High hazard stands are those on warmer sites where the higher temperatures facilitate the development of weevil larvae. McMullen (8) identified as high hazard those spruce plantations located on habitats where heat accumulation exceeds 888 (Sitka spruce) or 785 growing degrees (white spruce), above a 7.2°C threshold.

Spacing and thinning should be delayed to maintain high stand density, as this reduces infestations and improves tree form. Heavily crooked and forked trees should be taken out of preference but leaving large openings should be avoided. Non-host species should be favoured during spacing and thinning operations. Since weevil populations are negatively affected by shade (7,9), naturally regenerated deciduous trees should be conserved until spruce trees reach a height where susceptibility diminishes. Non-host conifers could be interplanted in young plantations to provide shade and to dilute the weevil habitat. In incipient infestations, leaders could be clipped to remove weevils and enhance stem form, however clipping alone is not sufficient to control infestations.

In new plantations, sites should be hazard-rated prior to harvesting to guide the selection of a management tactic, as described in McMullen (8) or Heppner and Wood (5).

Fig. 7. Broken-over leader. One lateral branch has become the new leader.

Fig. 8. Pupal chambers in a dead leader

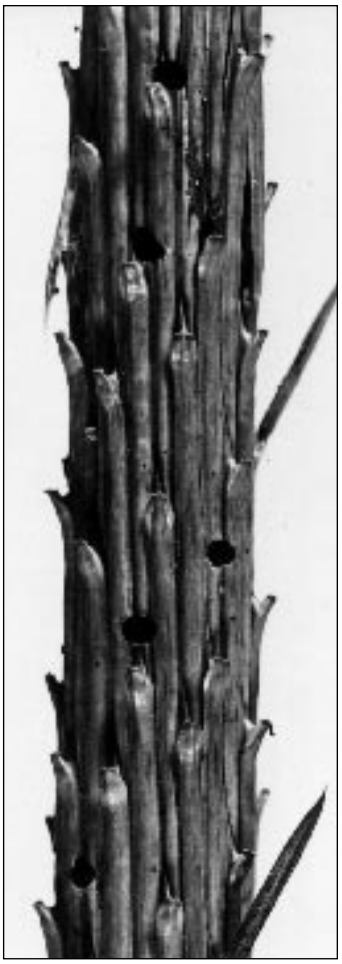

Fig. 9. Adult emergence holes in a dead leader

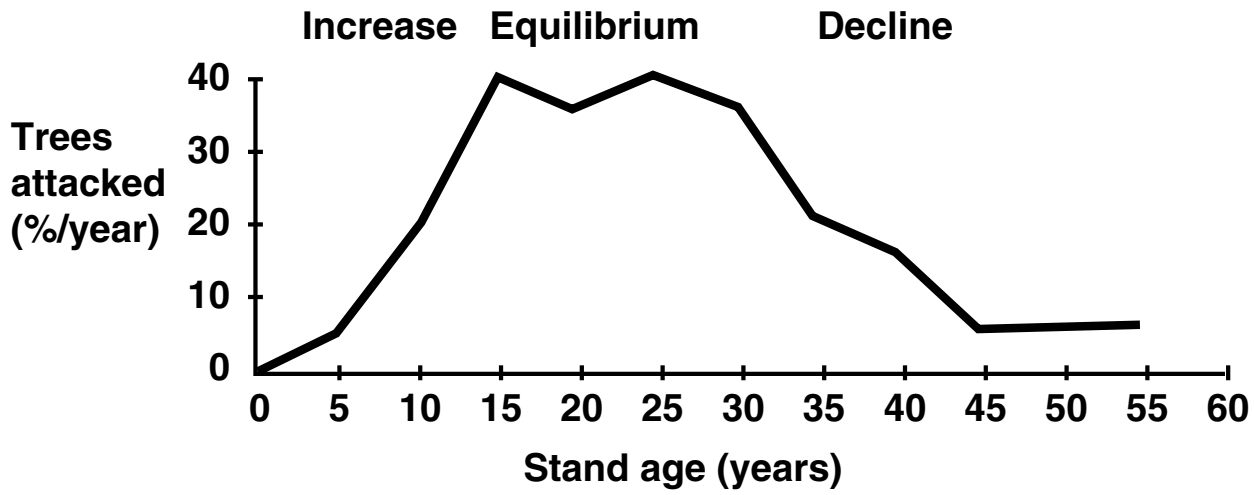

Fig. 10. Schematic representation of the typical course of a white pine weevil outbreak on open-grown Sitka spruce in a locality with high weevil hazard. The population passes through a stage of rapid increase, a phase of insect-host equilibrium, and a phase of decline (2).

In low hazard areas, weevil damage can be controlled by planting at high density, using mixtures of spruce and other conifers. In medium to high hazard zones, shading by deciduous species should be encouraged until trees grow beyond susceptible height. Weevil attack is rare in stands taller than 20 m unless sources of weevils exist in the vicinity. As in existing plantations, spacing and thinning regimes should be delayed and modified to favour a non-susceptible conifer component and deciduous shade. Alternate silviculture systems, such as conventional and group selection and shelterwood systems, should be implemented whenever feasible. The use of resistant stock is being investigated as a possible addition to a weevil IPM system (4). Resistant genotypes have been found and are currently being evaluated.

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