SECOND BROODS OF *PISSODES STROBI* (COLEOPTERA: CURCULIONIDAE) IN PREVIOUSLY ATTACKED LEADERS OF INTERIOR SPRUCE

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Abstract

Oviposition and successful brood production by spruce weevil, *Pissodes strobi*, were observed below the previous year's attacked, dead leader in as many as 19.5 percent of current attacked trees in a 15-year-old plantation of interior spruce. This occurrence may have significant impacts upon weevil survey and control programmes and, ultimately, the regime under which the stand will be managed.

During the establishment of a trial investigating the feasibility of silvicultural control of spruce weevil, *Pissodes strobi Peck* (Coleoptera: Curculionidae), unusual oviposition behaviour and brood development of this weevil was observed in leaders which had been attacked in the previous year. These observations were made in a 15-year-old plantation of interior spruce (*Picea glauca x engelmannii*), located approximately 50 km east of Prince George, British Columbia. Clearcut harvesting of the area took place in 1969. The plantation was established in the spring of 1971, using 2+1 bareroot interior spruce stock, following a broadcast burn in the fall of 1970.

The spruce weevil attacks and kills the terminal shoot of young spruce trees ranging in height from 1 - 15 m, and occasionally to over 25 m. Lateral branches are then forced to compete for apical dominance. This commonly results in multiple or crooked stems which can represent losses to merchantable tree volume and value. The overtopping of attacked trees by healthy coniferous trees and competing deciduous trees may result in mortality from competition (Stevenson 1967; Wood and McMullen 1983).

Table I. Occurrence of re-infestation of previously infested spruce leaders by *Pissodes strobi*, expressed in relation to current attacks, in a 15-year-old interior spruce plantation, 50 km east of Prince George, B.C.

Attack year	Previously uninfested leaders		Reinfested leaders	
	n[1]	Av. emerging adults per leader (range)	n[1]	Av. emerging adults per leader (range)
1984	50	3.98 (0-14)	1	3.00 (-)
1985	71	5.72 (0-24)	5	4.00 (0-8)
1986	59	3.12 (0-19)	16	6.25 (0-31)
TOTAL	180	5.26 (0-24)	22	5.82 (0-31)

1 'n' will not be consistent with the attacks represented in Table I since some trees were too tall to determine adult emergence and some leaders were heavily damaged by birds feeding upon maturing brood.

Adult spruce weevils emerge from their overwintering locations in the duff soon after the snow disappears and the site is warmed to above 6°C (Sullivan 1959). The weevils crawl up potential host trees, to begin feeding, immediately after their emergence from hibernation. Stevenson (1967) observed that feeding on stems that had been attacked the previous year occurred only in the uppermost living tissues. Overhulser and Gara (1975) reported that weevils were found initially only on brood trees. However, with the first day of temperatures conducive to adult flight, weevils were also observed on trees attacked two years earlier and on those trees being attacked for the first time. They also noted that flight occurred from the previous year's dead leader on brood trees towards leaders which promised suitable feeding and oviposition sites. Spruce trees have not generally been considered as available for reattack by the spruce weevil for at least two years after their terminals have been killed. This is the time necessary for the tree to produce a new leader with characteristics attractive to the weevil (Alfaro 1982). Commonly, the longest, thickest leaders presenting a vertical silhouette have been found to be the most likely to be attacked (VanderSar and Borden 1977; Kline and Mitchell 1979; Wood and McMullen 1983). It has been documented by several authors (Silver 1968; VanderSar and Borden 1977; Alfaro 1982; Alfaro and Borden 1985) that spruce trees, once initially attacked, appeared to be pre-disposed to further attacks on the resultant multiple terminals. The favoured feeding, mating and oviposition site has been determined to be the tip of the previous year's leader(s) below the terminal bud (Gara *et al.* 1971; Overhulser and Gara 1975; VanderSar and Borden 1977; Wood and McMullen 1983).

The author observed, in 1984, 1985 and 1986, abnormal infestation behaviour of spruce weevils. In addition to the occurrence of spring feeding below the previous year's dead leader, oviposition sites were evident in several of the trees examined (1984 - 2 trees; 1985 - 7 trees; 1986 - 16 trees) (Table I). Current year's feeding and oviposition locations were identified by fresh resin flow from the area of activity below the dead leader. The oviposition punctures were distinguished from feeding punctures, which are normal on such leaders, by the presence of a fecal cap over those in which oviposition occurred (Stevenson 1967; Silver 1968). Further confirmation of oviposition was by the presence of adult exit holes below the oviposition punctures in question (Fig. 1). Hulme *et al.* (1986) determined that the lethal temperature for *P. strobi* in sitka spruce, *Picea sitchensis* (Bong.) Carr., to be near −16°C. Earlier observations (unpublished data) had demonstrated that spruce weevil brood would not overwinter successfully in leaders in the geographic area of the study plots. The emerging adults thus could not be progeny of the previous year's attack. Dissection of similarly attacked leaders collected from outside of the study plots revealed an area between the successive year's attacks in which no larval activity was evident. Average brood production from re-infested leaders was slightly more than that from normally infested leaders; 5.82 adults per leader (range 0–31) vs. 5.26 adults produced per normally attacked leader (range 0–24) (Table II). Total brood production per re-infested leader was almost 250% of that of a singly infested leader; 12.6 adults emerging per leader (range 0–39) vs. 5.26 adults emerging per singly infested leader (range 0–24) (Table III).

Table II. Adult *Pissodes strobi* emergence from previously uninfested and reinfested spruce leaders in a 15-year-old interior spruce plantation, 50 km east of Prince George, B.C.

Attack year	Total number of trees examined	Total number of current attacks	Number of attacks on previously unattacked leaders	Number of attacks below previously attacked leaders	Percent reattack
1984	5383	87	85	2	2.3
1985	5383	92	85	7	7.6
1986	5383	82	66	16	19.5

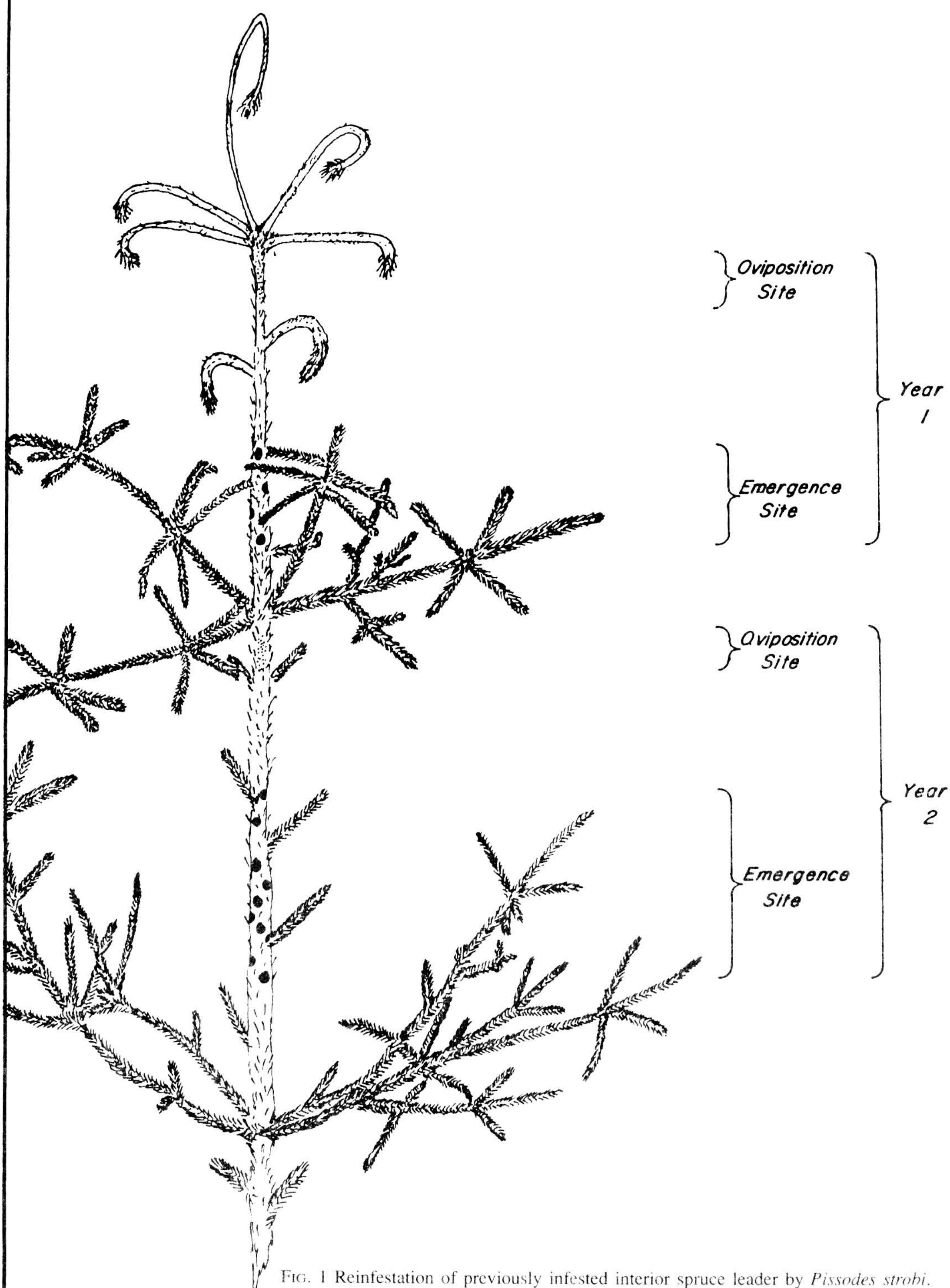

FIG. 1 Reinfestation of previously infested interior spruce leader by *Pissodes strobi*.

Table III. Average emergence from single infestations and multiple infestations of spruce leaders by *Pissodes strobi* in a 15-year-old interior spruce plantation, 50 km east of Prince George, B.C.

Single infestations		Re-infested leaders			
n^1	Av. emerging adults (range)	n^1	Av. emerging adults		
(range)			Initial infestation	Re-infestation	Total
180	5.26 (0-24)	20	6.4 (0-24)	6.2 (0-31)	12.6 (0-39)

'n' will not be consistent with the attacks represented in Table I since some trees were too tall to determine adult emergence and some leaders were heavily damaged by birds feeding upon maturing brood. 'n' will not be consistent with the attacks represented in Table II since it was necessary to determine adult emergence from both the initial infestation and re-infestation.

The occurrence of successful re-infestation by the spruce weevil is of significance in both survey and control activities. Based on the information from these observations, up to 20 percent of the previous year's infested leaders may be re-infested. Since the identification of currently infested spruce trees is by the drooping or dead current leader, depending upon the time in the year of examination, nearly 20 percent of current attacks may well be overlooked by conventional detection methods. This could result in the non-recognition and non-treatment of sufficient numbers of potential adults to perpetuate a reduced but active weevil population in a young spruce stand. Therefore, a major decision must be made prior to the start of any survey or control programme: either all previous year's infested trees must be inspected carefully for re-infestation, and subsequently treated; or, the exclusion of any re-infested leaders from control treatment must be accepted in conjunction with the potential consequences of the decision. This decision must be made by the forest manager with full realization and acceptance of both the immediate and possible long term effects upon stand development.

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