

Notes on the incidence and host preference of *Dendroctonus punctatus* (Coleoptera: Scolytidae) in spruce forests near Prince George, BC

B. STAFFAN LINDGREN, KATHY J. LEWIS

COLLEGE OF SCIENCE AND MANAGEMENT,
UNIVERSITY OF NORTHERN BRITISH COLUMBIA, 3333 UNIVERSITY WAY,
PRINCE GEORGE, BC CANADA V2N 4Z9

and JEAN-CLAUDE GRÉGOIRE

FONDS NATIONAL BELGE DE LA RECHERCHE SCIENTIFIQUE &
LABORATOIRE DE BIOLOGIE ANIMALE ET CELLULAIRE, CP160/12, UNIVERSITÉ
LIBRE DE BRUXELLES, 50 AV. FD ROOSEVELT,
B-1050 BRUXELLES, BELGIUM

ABSTRACT

Dendroctonus punctatus (LeConte) was found to be common, but cryptic, in a survey of spruce stands near Prince George, BC. Characteristics of stands and attacked trees varied considerably, and attacked trees did not differ from healthy trees in the same stand in terms of age, height, or diameter. Attacked trees were normally isolated, but along the edges of two small gaps caused by the root disease-causing fungus, *Inonotus tomentosus* (Fr.:Fr.) S.Teng, we found three and four attacked trees, respectively. All other stands where we found attacks had a high incidence of tomentosus root disease, but we found only two attacked trees which were actually infected by the fungus. The majority of attacked trees displayed basal resinosis, which appeared to be caused by a stain-causing, unidentified pathogen.

Key words: boreal spruce beetle, root disease, *Inonotus tomentosus*, host selection

INTRODUCTION

The boreal spruce beetle, *Dendroctonus punctatus* (LeConte) is a relatively poorly known, transcontinentally distributed bark beetle closely related to the Eurasian *D. micans* (Kugelann) (Wood 1982, Kelley and Farrell 1998). Among native species, it is most similar in habit to the lodgepole pine beetle, *D. murrayanae* Hopkins and, to a lesser extent, the spruce beetle, *D. rufipennis* (Kirby). Single females of *D. punctatus*, probably fertilized in their natal brood chamber, attack standing live trees at very low attack densities. Normally, there is only one attack per tree. This is similar to the habits of *D. micans*. Furniss and Johnson (1989) described the galleries and larvae of *D. punctatus*, and Furniss (1995) provided extensive information on the biology of the species.

D. punctatus attacks most boreal species of spruce (*Picea* spp.). Attacks occur at ground level on individual, scattered trees, which range widely in size, but generally are stressed or injured (Furniss 1995). R. Duncan (Canadian Forest Service, Pacific Forestry Centre, Victoria, BC, pers. comm.) indicated that he had found most attacks on waterlogged trees in British Columbia.

During a casual survey of stands near Prince George, we observed an apparent association

between attacks by *D. punctatus* and the widespread root disease *Inonotus tomentosus* (Fr.:Fr.) S. Teng. This fungus is a primary mortality agent in sub-boreal and boreal spruce forests (Lewis 1997). Several important forest pest insect species are suspected to be associated with this disease, e.g., the Warren root collar weevil, *Hylobius warreni* Wood (Whitney 1961, 1962), and *D. rufipennis* (Lewis and Lindgren, pers. obs.).

We determined the incidence of *D. punctatus* attacks in stands of sub-boreal spruce near Prince George, and whether or not it is associated with *I. tomentosus*-infected trees.

MATERIALS AND METHODS

Seven spruce stands within a 250 km² area southwest of Prince George were surveyed by random walk-through surveys 29 June - 9 July 1997, and 7-8 July, 1998. Stands with low levels of undergrowth were selected for ease of survey. The bole of spruce trees were examined for evidence of attack, i.e., pitch tubes or brown frass. Particular attention was paid to the area near ground level. In 1997, the bark was carefully removed around the entrance hole, and all life stages collected for additional studies (Grégoire, unpublished data). Attacks were categorized as new if they had fresh, resin-soaked frass at the entrance (unsuccessful attacks) or contained eggs, larvae or pupae, and as old if they contained adults, or were empty but showed evidence of successful brood development, i.e., a large area of the phloem had been consumed. In 1998, the attacks were left undisturbed to facilitate further studies on tree characteristics (Lindgren, unpublished data)

Stand data from variable radius (prism) plots were collected at nine attacked trees in August, 1997, and at five trees in July 1998, and the major roots were examined for evidence of *I. tomentosus* or other root disease.

RESULTS AND DISCUSSION

Trees attacked by *D. punctatus* were found in every stand visited in 1997. A total of 25 trees were located at seven sites (Table 1). Of these, the majority contained live brood at different stages. In brood chambers with older larvae we frequently found the predatory rove beetle *Hapalaraea longula* (Mäklin) (Coleoptera: Staphylinidae). Only one old attack per tree was found on seven of the attacked trees, whereas there was an average of 2.0 new attacks per tree on 21 trees (some trees contained both old and new attacks). Of these, 11 trees had single attacks, whereas the remaining 10 trees had between 2 and 10 new attacks. In 1998, six trees were located in one of the stands surveyed in 1997 (West Lake Estate Road). Five of these trees had single attacks, one of which had failed. The sixth tree had three attacks.

Table 1

Summary data on *D. punctatus* in seven spruce stands near Prince George, 1997.

Site	# Trees	# Old Attacks	# New Attacks	# Attacks with Brood		
				Eggs	Larvae	Adults
Blackwater Road	9	5	12	10	2	0
Telegraph Trail	4	0	4	4	0	0
West Lake	3	0	5	4	1	0
West Lake Estate Road	2	1	5	4	1	0
Pelican For. Serv. Road, 15 km	2	0	4	3	0	0
Pelican For. Serv. Road, 45 km	1	1	4	4	1	1
University of Northern BC	4	1	15	8	5	1
Mean	3.5	1.1	7	5.3	1.4	0.3
Standard Error	2.44	1.64	4.2	2.43	1.59	0.45

Twelve of the 14 attacked trees at which stand data were collected were hybrid white x Engelmann spruce, *Picea glauca x engelmanni* (Parry) Engelmann, while the remaining two were black spruce, *Picea mariana* (Miller) Britton. Attacked trees varied considerably in size with a mean (± 1 SD) diameter at breast height (dbh) of 22.5 (± 4.0) cm for hybrid spruce (N=12), and 16.2 (± 3.89) cm (N=2) for black spruce. The dbh of attacked trees ranged from 75 - 140 % of the mean dbh for that species in the stand. The five hybrid spruce measured in 1998 had a mean (± 1 SD) height of 18.7 (± 2.65) m. Four of these trees were aged by counting the rings on increment cores. The age of these trees ranged from 80 to 140 years, with a mean (± 1 SD) of 102.5 (± 26.3) years. These data are similar to those of Furniss (1995), and did not differ from unattacked trees of similar diameters in the same stand (mean age = 103.0 \pm 26.8 years, N=5).

Stand structure varied considerably, with some stands having a closed canopy while others had an open structure. Spruce was the leading species in all cases, but since stands were selected on the basis of spruce dominance, we cannot determine to what extent stand structure influences the presence of *D. punctatus*.

Many of the attacked trees showed signs of decline, e.g., thinning and/or chlorotic foliage, short leaders, stress cone crops, etc., which is in agreement with Furniss (1995). No attacks were found in waterlogged areas. Attacks were found along the edges of tomentosus root disease pockets in two cases, where we found three and four attacked trees respectively. Tomentosus root disease was prevalent in all stands surveyed, although we did not quantify its incidence. Of nine attacked trees examined by KL, only two showed signs of infection by *I. tomentosus*. One declining, attacked hybrid white spruce had one root affected by a sap rot, possibly caused by *Armillaria sinapina* (Bérubé and Dessureault), and in another case three of four major roots had advanced brown rot. In another tree three of four roots were dead, without a visible cause of death. A small black spruce had no visible disease on the major roots. The majority of the attacked trees had resin streaming down the lower trunk. Generally the area of resin flow extended 50-100 cm up from the ground on one side of the trunk. When the bark was removed on these trees, a dark brown stain, similar to the stain caused by *Phytophthora* spp. was evident. Attacks were consistently located near the stained area, but not directly associated with it. Similarly, trees affected by other diseases sustained the attacks on the lower bole between healthy and diseased roots. All trees located in 1998 exhibited external resin flow. An attacked tree located during another study near Mackenzie, BC, 13 May, 1998, also had external resin flow and the associated stain. This tree yielded 29 adults. Also, two unsuccessful attacks were noted on a dead hybrid spruce infected by *Phellinus pini* (Thore:Fr.)Ames.

D. punctatus life stages found in 1997 agree with the life cycle interpretation by Furniss (1995). We found a high proportion of successful attacks, but it is possible that unsuccessful attacks are less evident, and therefore may be missed. Of the attacks located in 1998, only one (an old attack yielding 54 brood adults) was successful. Furniss (1995) found that only half of the attacks he investigated were successful.

Based on our findings, it appears that *D. punctatus* prefers to attack weakened trees, and that root diseases play a major role as predisposing agents. *Inonotus tomentosus* does not appear to directly predispose trees to attack by *D. punctatus*, but may do so indirectly by predisposing trees to invasion by the stain we observed. This would explain why we found several attacked trees in close proximity around the perimeter of two *I. tomentosus*-caused gaps.

We conclude that *D. punctatus* is widespread in sub-boreal spruce forests, and that it is most commonly associated with diseased trees. Attacks are probably often mis-diagnosed as single attacks by the spruce beetle, *Dendroctonus rufipennis*, by those unfamiliar with *D. punctatus*. Trees with basal resinosis, particularly along the edges of tomentosus root-disease gaps are most

likely to be attacked by this bark beetle.

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