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FOREST Pest LEAFLET

Pacific Forestry Centre

Douglas–fir beetle in British Columbia

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Introduction

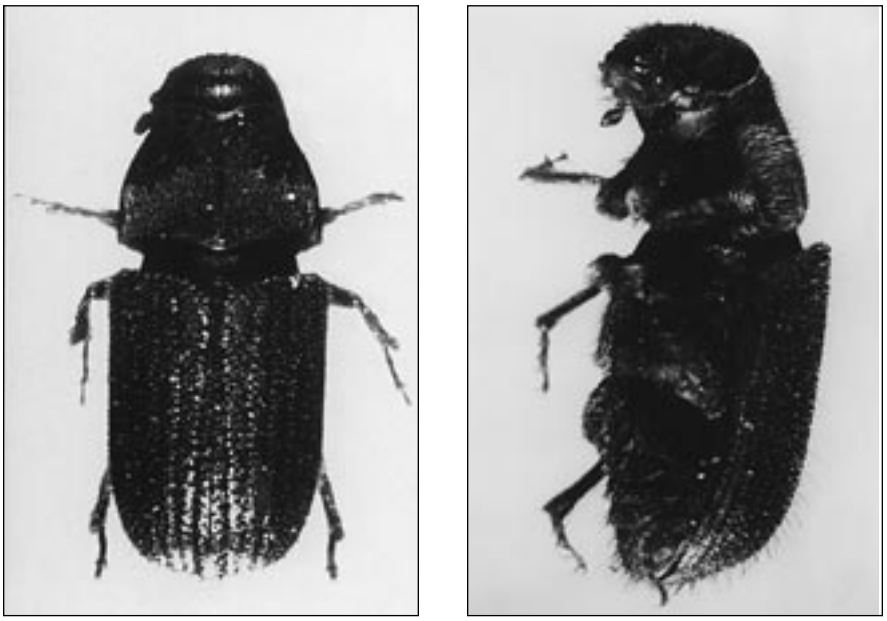
The Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopk.) is an important native pest throughout the range of its principal host, Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco). Western larch (*Larix occidentalis* Nutt.) is also occasionally attacked. Damage caused by this beetle has been most extensive in the interior of British Columbia. Tree volume losses from 1956 to 1994 were estimated at about 2 403 000 m^3; ninety percent of this mortality occurred in the interior of the province.

Description and life cycle

The egg is elliptical, pearly white, and 1 to 1.2 mm long. The larva is a white, legless grub with a pale brown head, about 6 mm long when mature. The pupa is white to light tan, about 6 mm long, with adult features (legs, wings, etc.) visible. The adult is a stout, brown to blackish-brown beetle with reddish elytra, 4 to 7 mm long.

The duration of the life cycle is approximately one year and two broods may be produced each year.

The Douglas-fir beetle overwinters primarily as young adults or as mature or nearly mature larvae. The adults typically fly and attack susceptible trees in the spring, shortly after daytime temperatures exceed 18°C. The major flight period usually occurs in May and June. Larvae that have overwintered complete their development and emerge in July and August. The parent beetles occasionally emerge the same summer for a second flight or “summer flight”, and then attack fresh material and establish a second brood.



Adult Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins: top view (left); side view (right)

The female chews through the outer bark into the inner bark, constructs the egg gallery and deposits egg masses of 10 to 36 in small niches in groups which alternate along the sides of the gallery. A male follows the female into the gallery; although he does no excavating, he helps initially in pushing boring dust out the entrance and later in packing the boring dust in the part of the gallery closest to the entrance.

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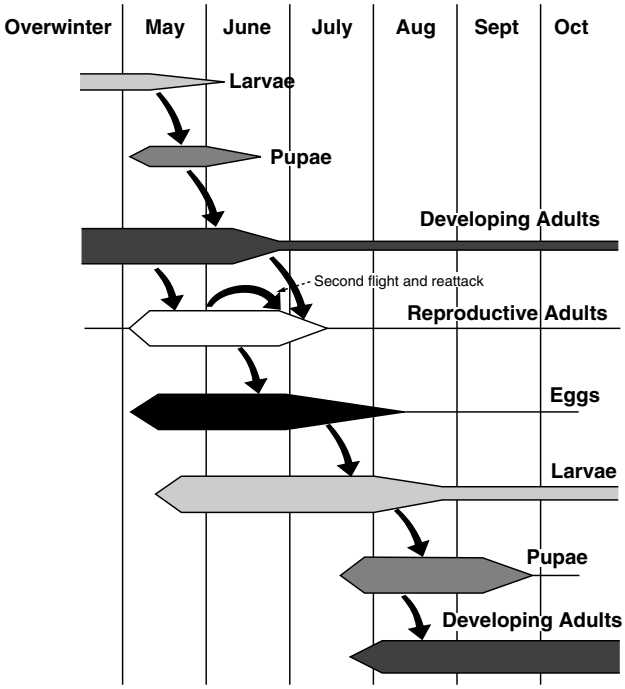


The life cycle of the Douglas-fir beetle

Several Douglas-fir beetle galleries

Eggs hatch in about 2 weeks and the young larvae bore away from the egg gallery. The larvae feed in the inner bark for 2 to 3 months (until winter intervenes), enter the pupal stage, and a few weeks later become young adults. At emergence, the young adults bore a circular hole to the bark surface. Although young adults may be present as early as late July, none emerge until the following spring.

Damage

Gallery system

The gallery system is in the inner bark next to the sapwood. The egg galleries made by the parent adults are parallel to the grain of the wood, usually with a slight hook or curve at the beginning. They are usually 20 to 25 cm long but may be 75 cm long and 5 to 6 mm wide. The larval galleries diverge from the egg groups in fan-shaped groups which alternate from side to side of the egg gallery. Most of the egg gallery and all of the larval gallery are packed with boring dust. The larval mines frequently disappear from the inner surface of the bark since the larvae, when nearing maturity, often bore into the inner bark. The pupal cells are constructed at the end of the larval mines.

Brood survival in standing trees is usually higher and more concentrated in the middle portion of the infested stem. In downed trees, egg galleries tend to be uniformly successful but more dense on the shaded underside.

Trees are usually not infested above a top diameter of 15 to 20 cm. Other bark beetles often occur in the top of the stem, especially *Scolytus tsugae* (Swain) and *Pseudohylesinus nebulosus* (Le Conte).

Effect on the tree

The work of adults and larvae eventually girdles the tree and, along with an associated fungus, results in the tree's death. Foliage discoloration, from green to pale yellow-green to red, occurs a few months to a year after attack, depending on seasonal weather, locality, date and intensity of infestation, and elevation. The red foliage remains on the tree for an average of two years. Occasionally the needles may drop without discoloration. Often conks of the pouch fungus, *Cryptoporus volvatus* (Peck) Shear, form on the outer bark the year following attack.

Host susceptibility and attack pattern

The Douglas-fir beetle prefers hosts such as felled trees, slash, stumps, windfall, overmature and decadent trees, trees damaged by abiotic factors, and trees stressed by defoliation and root disease. Host material over 20 cm is preferred; the beetle occasionally attacks trees of smaller diameter, but brood production is low.

Where susceptible trees are abundant, the beetle can quickly become epidemic and kill adjacent apparently healthy green timber. Consequently, groups of killed trees may surround trees such as windfall, a lightning-struck tree, or fire-damaged trees.

In endemic situations, the damage caused by the insect occurs in small scattered groups in the stand.

The Larva of the Douglas-fir beetle is white with a brown head, and is about 6 mm long when mature.

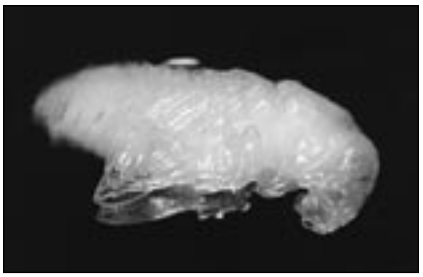
The size of these groups and intensity of attack is a reflection of both the amount of suitable host material and the population level in the stand. Frequently, trees around a killed group may have been attacked but were able to survive. In urban areas, trees weakened by a sudden change in environmental conditions due to development or construction may become suitable hosts for the insect.

Association with root disease

There appears to be a strong relation between Douglas-fir beetle and the root rots *Armillaria ostoyae* (Romagn.) Herink, *Phellinus weirii* (Murr.) Gilbertson, and *Phaeolus schweinitzii* (Fr.) Pat. During studies of Douglas-fir beetle outbreaks in northern Idaho *Leptographium wageneri* (Kendr.) Wingf. var. *pseudotsugae* Harrington & Cobb was found for the first time in Douglas-fir. The relationship between root disease and bark beetles is more pronounced with endemic beetle populations. Root rots reduce water uptake and vigor in infected trees. Lower vigor predisposes the tree to attack by bark beetles. The severity or amount of the root disease is related to the success of beetle attack. Successful beetle attacks are more likely in trees with 70 to 90 percent of their roots affected by disease. Root rot also contributes to blowdown which helps to initiate and perpetuate beetle outbreaks.

Defoliation

There is some evidence that defoliation by western spruce budworm,



The pupa of the Douglas-fir beetle is white to light tan and about 6 mm long.

Choristoneura occidentalis (Freeman), and the Douglas-fir tussock moth, *Orgyia pseudotsugae* (McDunnough), predisposes larger trees to bark beetle attack. Defoliation weakens the trees and its ability to resist beetle attacks, possibly due to the fact that heavy defoliation reduces the trees ability to produce monoterpenes. Trees that have been more than 90% defoliated by tussock moth are very susceptible to attack and provide host material for the build-up of beetle populations.

Detection

The first obvious evidence of attack in a stand is the presence of trees with discolored foliage. However, this discoloration may not occur until a year following attack when the beetles are ready to leave (in some cases, may have already left) to attack new host material. This discoloration may be observed from the air or from high vantage points. Confirmation that the damage is due to Douglas-fir beetles may be obtained by removing bark and observing the typical gallery systems.

Detection of infested trees in the early stages of attack is difficult. The earliest evidence of attack is the reddish brown boring dust on the bark at the entrance holes of the gallery. There are no pitch tubes such as those associated with certain other *Dendroctonus* species, although clear resin (pitch) exuding from entrance holes at the upper limit of the infestation on the stem has been noted. Early detection thus requires examination of individual boles, which is best done in late June or July while the boring dust is still easily seen.

Control of Douglas-fir beetle

The following recommendations are grouped primarily into two categories: preventive measures and remedial measures. Although the concepts are the same, the timing of these operations changes somewhat when trees are already infested. A third category describes methods of brood destruction.

Preventive measures

(a) Log and slash disposal

1. All infested logs should be removed and utilized before beetles emerge. Those felled during May, June and July should be removed before April of the following year.
2. All culls and slash over 20 cm in diameter should be kept to a minimum and, if infested, they should be treated by burning or peeling bark to prevent emergence of the brood within the time specified above for removal of the logs.
3. Tops should be kept small (under 20 cm in diameter).
4. Stumps should be cut as low as possible and, if infested, should be treated burning or removing bark to destroy the bark beetles in them.
5. Roads and right-of-way should be constructed if possible after August immediately before their use. If logs, slash, etc., resulting from road construction, can be utilized or treated as in steps 1 to 4 above, cutting roads and right-of-way in early spring would remove some of the beetle population. Stands adjacent to new roads should be carefully examined in late summer of the year of road construction and infested trees should be removed. Trees with root damage should be re-examined for attack the summer of the next year, and if they are infested they should be removed.
6. Procedures 1 to 4 should receive special attention during the last year of logging in an area.

(b) General logging practices

1. Priority should be given to overmature or decadent stands, particularly those in which the Douglas-fir beetle is active.
2. The residual stand should be carefully watched for evidence of infestation, and infested trees should be removed promptly.
3. Trees felled during May and June should

absorb much of the beetle population. If this felling procedure is followed, it must be accompanied by strict sanitation measures as described in (a) 1 to 4.

4. Care must be taken to ensure minimal mechanical damage to the residual stand. This includes root damage such as that caused by road cuts.

Remedial measures

If, in spite of all precautions, infestations develop in standing timber, remedial action may be necessary for control.

1. The procedures described above under "Preventive measures" should be continued and, if possible, intensified.
2. Currently infested trees should be removed before the following April. Single tree removal with helicopters and small block harvesting have proved successful in controlling the beetle in the past. Identification of these trees requires examination of individual boles for the presence of the reddish brown boring dust. Removal of red-topped trees from which the beetles have emerged does not reduce the beetle population. In some years, discoloration of foliage may occur in the year of attack before beetles emerge.
3. Trap trees may be used to attract beetle populations to highly susceptible and readily extractible material. Fall the trap trees shortly before beetle flight, preferably in early April, and dispose of them by late March of the following year, before beetle emergence. The area at risk should be gridded with groups of trap trees at intervals of about 0.4 to 0.8 km. The groups of trap trees should be placed where they can be easily removed. Beetles will be attracted to these trap trees and may attack some adjacent green trees as well; all of the resulting infested material should be removed or treated by April of the following year.
4. The effectiveness of trap trees may be increased with the use of pheromones. When pheromones (such as frontalin or seudenol) are used on live or recently felled trees, flying beetles are attracted to them; in some studies up to 5 or 6 times as many beetles have attacked baited trees compared with non-baited trees. Stand density and tree diameter also influence attacks in baited stands.
5. The anti-aggregative pheromone MCH (methylcyclohexenone) has been used to disrupt or prevent beetle attacks. Attacks and progeny have been reduced by over 90% by the application of this pheromone. The use of the pheromone could be most useful in areas of blowdown.

Brood destruction

The following methods may be used for brood destruction in slash and other material not removed from the woods.

1. Piling and Burning. The fire should be intense and all bark should be thoroughly burned. Broadcast burning does not produce a fire hot enough to overcome the insulating qualities of Douglas-fir bark.
2. Peeling. Peeling the bark exposes the broods to weather and predators. Since many beetles can overwinter in the forest duff, peeling should be done in July or August, before the young adults develop. The procedure increases the fire hazard, but when peeling is used in conjunction with burning, a less intense burn is required.
3. Lethal trap trees using MSMA (monosodium methanearsonate) can significantly reduce the number of progeny in trap trees.

Selected references

Dubreuil, L.H.; Tunic, S.; Doling, O.J. 1982. Bark beetle history and root disease on the hungry horse district Flathead National Forest. USDA For. Serv. North. Reg. Rep. 82-18.

Furniss, Malcolm M.; Determine, G.A.; Kiln, L.H. McGregor, M.D.; Trestle, G.A.; Pettifogger, L.H.; Rudinsky, G.A. 1974. Effectiveness of the Douglas-fir beetle anti-aggregative pheromone methylcyclohexenone at three concentrations and spacings around felled host trees. Can. Entomol. 106: 4, 381-392.

Furniss, Malcolm M.; McGregor, M.D.;Foiles, M.W.; Partridge, A.D. 1979. Chronology and characteristics of a Douglas-fir beetle outbreak in northern Idaho. USDA For. Serv., Gen. Tech. Rep. INT-59.

Furniss, Malcolm M.; Orr, P.W. 1978. Douglas-fir Beetle. USDA For. Serv. For. Ins. and Dis. Leafl. 5.

Hadley, Keith J.; Veblen, T.T. 1993. Stand response to western spruce budworm and Douglas-fir bark beetle outbreaks, Colorado Front Range. Can. J. For. Res. 23: 479-491.

James, R.L.; Goheen, D.J. 1981. Conifer mortality associated with root disease and insects in Colorado. Plant Dis. 65:6, 506-507

Manville, J.F.; McMullen, L.H.; Reimer, K. J. 1988. Impact and role of monosodium methanearsonate on attack and progeny production by the douglas-fir beetle (Coleoptera: scolytidae) in lethal trap trees. J. Econ. Entomol. 81(6): 1691-1697.

Partridge, A.D.; Miller, D.L. 1972. Bark beetles and root rots related in Idaho conifers. Plant Disease Reptr. 56(6): 498-500.

Ringold, G.B.; Gravelle, P.J.; Miller, D.; Furniss, M.M.Miller, M.D. 1975. Characteristics of Douglas-fir beetle infestaton in northern Idaho resulting from treatment with Douglure. USDA For. Serv. Res. Note 189. 10 p.

Wright, K.H.; Lauterbach, P.G. 1958. A 10-year study of mortality in a Douglas-fir sawtimber stand in Coos and Douglas Co's. Oregon. USDA For. Ser. Res. Paper 27.

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