Mountain Pine Beetle

Yukon Forest Health — Forest insect and disease

13

Yukon
Energy, Mines and Resources
Forest Management Branch

Introduction

The mountain pine beetle, (*Dendroctonus ponderosae*) is a native North American bark beetle. It is distributed almost throughout the range of lodgepole pine (*Pinus contorta*) in B.C. and has recently crossed into Alberta. All species of *Pinus* are susceptible to attack. Its range has not yet expanded as far north as Yukon. At endemic levels, the beetle attacks stressed and weakened trees, preferring large diameter hosts. When the beetle population builds to epidemic proportions, such as those currently being observed in B.C., non-stressed and smaller diameter trees are also aggressively attacked. The beetle is susceptible to extended cold periods of -40°C, which cause high levels of brood mortality, especially if they occur in early or late winter. The inhospitable climate of northern B.C. and Yukon has thus far limited the northern spread of the beetle. Recent successive mild winters and warm, dry summers combined with abundant host availability have enabled populations to reach unprecedented levels and to substantially expand their range both north and east. However, it is estimated that the cold winter of 2008/2009 killed over 90% of overwintering beetle populations in Alberta.

On the west side of the Rocky Mountains light attacks have recently been seen within the Rocky Mountain Trench, just beyond the north end of Williston Lake. The prevalence of pine between here and the Liard River drainage make this the most likely connecting pathway to Yukon. However the mosaic of age classes that have resulted from logging southwest of Fort Nelson will likely significantly impede this advancement. On the east side of the Rockies, beetles are now well established around Fort St. John. However, from here it is a long way against prevailing winds and discontinuous pine to reach Yukon. A regular program of pheromone trapping in southeast Yukon will ensure that the beetle will be detected if and when it arrives.

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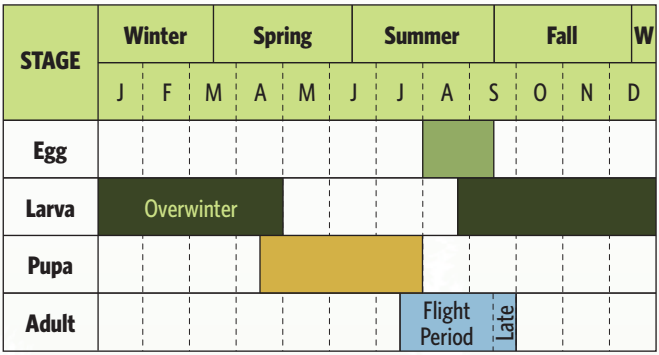
Life Cycle



The life cycle of the mountain pine beetle typically takes one to two years depending on site position, temperature and elevation. In lowland areas of B.C. the vast majority of the population cycles in one year. At the northern fringes and on the slopes and east of the Rocky Mountains where conditions are considerably harsher, one and one-half and two-year cycling is common.

1. Adults typically emerge in mid-July and fly to new host trees. Attacking females bore into the phloem and cambium region of the host tree and release an aggregation pheromone that attracts beetles of both sexes to the same tree. This leads to the mass-attack of the host tree, and enables the beetles to overcome the host's defences and successfully colonize the tree. Unlike other beetles that concentrate attacks just on the lower bole, mountain pine beetle attacks can extend upward well into the crown.

   When the beetles sense that attacks have reached optimum density in any given tree, they release a second, anti-aggregation pheromone to repel further attacks.

2. Adult beetles carry in special receptacles the spores of one or more species of Ceratocystis fungus. The beetle employs the fungus to help weaken the tree and overcome its defences. Once inside the tree the spores germinate and the fungus colonizes the phloem and eventually the xylem of the tree, plugging the tissues with mycelium and preventing the transport of nutrients and water within the tree. The fungus causes the characteristic blue staining in the sapwood of infested trees.

3. The female, once inside the cambial region of the tree, constructs an egg gallery. Egg galleries extend vertically up the bole of the tree for approximately 30 cm, etching both the bark and the sapwood. Normally between 60 and 80 eggs are laid within small niches on alternating sides of the gallery. The female packs the gallery with frass behind her as she moves upward.

4. Eggs are pearly white, about 1 mm in size. After 10–14 days the eggs hatch and the larvae feed on the phloem, fungal spores and micro-organisms. Larvae are white legless grubs with red-brown heads, about 5 mm long when mature. Larvae typically overwinter in second or third instar. With the onset of cold weather larvae replace the water in their cells with ethylene glycol (anti-freeze) which enables them to survive temperatures down to -27°C under the bark.

5. Larvae pass through four instars and pupate the following spring. Pupae are white at first, changing to light brown, about 5 mm long, with the external characteristics of the adult beetle visible.

6. The pupae metamorphose into young (teneral) adults in early summer. Teneral adults are light creamy-tan in color. They finally emerge as mature adults by boring through the bark to continue the life cycle as per step 1. Adults have hard, stout bodies and are cylindrical ranging from 3.5 to 7.5 mm in size. They have black heads and thorax, and black or brownish bodies.

Definitions:

Phloem: *the tissue in trees that transports nutrients found just below the bark.*

Cambium: *the actively dividing layer of cells which produces the continuing tissues in a tree, therefore increasing the girth of the tree.*

Bole: *the main stem of a tree.*

Instar: *the stages in the growth of a larva before it pupates.*

Frass: *a mixture of fecal matter and chewed plant debris.*

Host Species Attacked and Damage

Tree species attacked: All species of pine are susceptible and occasionally spruce will be attacked though these are not a preferred host.

The blue stain fungi begin to grow in the phloem soon after the beetles start construction of their galleries and then invade the xylem. Occlusion of the xylem prevents the transport of water to the crown and reduces the flow of defensive allochemicals around the tree. In this way, the fungi contribute to the death of the tree by inhibiting water flow and reducing the tree's ability to defend itself against beetle attack. The reduced water flow also appears to aid the survival of developing beetles by maintaining higher than usual moisture conditions in the attacked tree during the following summer.

A distinguishing feature of mountain pine beetle damage is the gallery pattern. Adults construct vertical egg galleries, usually with a crook at the bottom end that gives them a "J" shape. Galleries are packed with frass. Larval galleries extend perpendicular to the egg galleries. As they extend outward the larval galleries intersect with galleries from adjacent attacks and, given sufficient attack density, the living cambium is girdled and the tree dies.

In the first few months following attack, boring dust will be apparent in the bark crevices and around the base of infested trees. Following that period the boring dust becomes less obvious. Pitch tubes are normally present at the site of attack. If the tree is particularly vigorous or if attacks are light, the pitch will often wash the beetle out of the tree. In these cases because the beetle has not had a chance to produce much boring dust the colour of the pitch is clear to white and often contains a dead beetle. If the attack has been successful (at least initially) the pitch will contain boring dust and be brown in colour. Woodpeckers characteristically de-bark trees in search of larvae. Woodpecker damage is often a sign of beetle infestation.

If attack is successful, crowns of infested trees will turn to dull green, yellow and then red in late May/June of the year following attack. Red needles will normally be retained for a full two years before they are shed, so it is imperative that aerial surveyors be able to distinguish the bright red of year-old attacks from the brick red of two-year-old attacks.

Similar damage

Damage by secondary bark beetles such as the engraver beetle, *Ips spp*, may be mistakenly attributed to mountain pine beetle. However, adult engraver beetles differ from mountain pine beetle because they have 3–6 small spines on each side of a posterior declivity. Any confusion can be resolved by removing the bark and checking the gallery pattern. *Ips* larval galleries radiate star-like from a single point called a nuptial gallery. Single and small groups of trees are occasionally attacked by the lodgepole pine beetle, *Dendroctonus murrayanae*, but these trees are invariably under stress from drought, flooding or some other disturbance.

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