Preventative tactics aim to create landscapes with a mosaic of stands of different age classes and species to exclude large monocultures of over-mature pine. In areas where significant MPB populations and damage exist, high value trees (e.g., on private land) may be protected by application of commercial formulations of the anti-aggregative chemical, verbenone. Verbenone is applied in release containers, which are attached to trees, and as it evaporates the odour produced is repellent to beetles as they fly and search for new hosts.

Control tactics are employed to reduce beetle numbers to levels that do not cause economically important damage or to reduce rate of population expansion in order to implement longer term solutions. Control is most effective when applied during the incipient populations of MPB when infestations exist as relatively small, discrete clumps of infested trees. When MPB populations reach the outbreak stage, little can be done for effective control. Detection of incipient populations must be accomplished in a timely fashion to maximize response times for application of control tactics. Detection requires extensive and thorough annual aerial surveys to detect clumps of red-topped trees. Aerial detection must be followed by ground-truthing to verify MPB presence and assess the extent of new 'green-attacked' trees. In cases where a beetle flight period will occur from the time of detection of incipient populations until control is implemented, commercial formulations of MPB pheromones may be applied in and around the infestation to concentrate MPB populations in small geographic areas in preparation for application of control.

Removal of currently infested trees or stands reduces beetle populations and retards rate of population and damage expansion. Infested trees may be salvaged, and the processing kills beetles under the bark. Transport of infested wood poses some risk for spread of MPB. It is preferable that wood be processed at mills located within infested regions and that transport be prohibited during the MPB flight period. In cases where it is not economical to salvage infested trees due to unavailability of roads or low numbers of trees, infested trees may be cut, bucked, piled around the stump and burned. During harvesting it is important to also destroy beetles in stumps using mechanical means or burning. Mountain pine beetle broods in trees may also be killed by application of MSMA (monosodium methanearsenate), an herbicide with insecticidal properties. The MSMA is applied in axe frill around the base of the infested tree while the tree still has enough life left in it to translocate the material up the bole, usually within 4 weeks of attack. Generally, it is cheaper to treat trees with MSMA than other single tree treatments, such as felling and burning, provided the treatment can be done within the 4 week window of opportunity. Although the MPB has many natural enemies including insect predators, parasitoids, and woodpeckers, these do not have sufficient impact on incipient and outbreak populations to exert effective control.

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Mountain Pine Beetle


adult beetle


adult and larval galleries

pitch tubes

Canada

Distribution and Hosts

In the prairie provinces, the mountain pine beetle (MPB) is currently confined to the foothills of western Alberta, north to southern Wilmore Wilderness area, and in the Cypress Hills of southeastern Alberta and southwestern Saskatchewan. The main host is lodgepole pine, but whitebark pine and limber pine have also been attacked in Alberta. It is highly likely that jack pine is also a suitable host.

Symptoms and Damage

Trees undergoing attack by the MPB are first detectable only from the ground, and identification of symptoms requires close examination of trees. Accumulations of pitch or sawdust are conspicuous around entrance holes bored into the bark of trees by adult beetles from mid-July to early September. Sawdust is quickly blown or washed away, but abundant pitch tubes may remain for more than a year after attack. Pitch tubes may be much less evident on trees under severe drought stress prior to attack. During the fall and winter after attack, woodpeckers feed on bark- and wood-boring insects on infested trees. Trunks of trees foraged on by woodpeckers are easily visible as much bark is stripped off and bark fragments accumulate in piles on the ground at the base of trees. Removal of bark from infested trees reveals adult egg galleries, larval feeding galleries, and one or more life stages (eggs, larvae, pupae, adults), depending on the time since attack. Egg galleries are 10–41 cm (average, 28 cm) long, oriented vertically on the stem, and have a short curved or diagonal section at the bottom. Grayish blue staining of sapwood, caused by colonization of ray parenchyma cells by blue stain fungi transmitted by adult beetles, provides a conspicuous symptom shortly after successful attack. Various fungal fruiting structures (such as synnemata and perithecia) and mycelia of blue stain fungi and other fungi are often evident in beetle galleries and pupal chambers.

Aerial detection of successfully attacked trees is possible as early as late spring (more typically mid-summer) in the year following attack. The needles of infested trees first turn a faint yellow and then a reddish brown by late summer, which allows easy detection; however, by the time trees prominently display these symptoms, they are often vacated by the MPB, which has moved on to attack other trees. Nonetheless, aerial surveys are useful to detect stands where MPB activity is probable. Detection of small groups of red-topped trees should be followed with ground inspection to verify cause. If MPB is confirmed, ground surveys may be implemented to look for newly attacked trees in the vicinity.

The MPB is the most serious enemy of mature pines in western Canada. Outbreaks of this insect occurred in Banff National Park, Alberta, from 1940 to 1944, and in southwestern Alberta from 1976 to 1986. Since about 1997, MPB populations and damage have steadily increased in Banff National Park (BNP), aided by a series of warm winters, which increases MPB survival, and extensive availability of susceptible mature pine forests. Several thousand trees were infested in BNP in 2002. The MPB spread eastward into the Canmore area in 2001, and several hundred trees were infested in 2002. Since 1999, MPB infestations in the southern Wilmore Wilderness area have steadily grown and several patches of infested trees exist in the western part of Jasper National Park. There is concern that if eastward spread of MPB from Wilmore continues there may be risk of spread into boreal jack pine forests.

Over 1 million m^3 of lodgepole pine were killed in Alberta during the last outbreak. The monetary loss may be far greater than indicated by the volume loss because the MPB tends to attack the largest and most valuable trees first. In addition to direct volume loss, outbreaks of MPB upset harvesting plans, reduce aesthetic value in recreational areas, and increase fire hazard. Blue stain and extensive checking of sapwood from salvaged trees killed by MPBs lowers the commercial value of trees used for lumber and pulp; however, there is a small emerging market for blue-stained ('denim') wood for use as panelling.

Causal Agent

The MPB and associated blue stain fungi (Ascomycetes) act together to kill trees. Adults transport spores of the blue stain fungi to new trees within a specialized sac (mycangium) in the mouth area. These fungi are believed to stop water transport in the stem and thus kill infected trees. Adult beetles are black, stout-bodied, cylindrical, and 4.0–7.5 mm long. Larvae are creamy-white, legless grubs with light brown heads, and they are 6–7 mm long when fully grown. Adults emerge and attack green trees in mid-summer. They construct vertical egg galleries in the phloem and lay eggs along the sides of the galleries. Larvae feed away from the egg galleries until early fall, overwinter, and continue feeding in the spring. Pupation occurs in late spring to early summer, and new beetles feed under the bark for a few days before emerging to attack new trees.

Prevention and Control

Prevention of MPB outbreaks requires a long-term and comprehensive forest management plan to reduce tree and stand susceptibility to MPB. There are inherent characteristics of stands that affect their susceptibility to attack and damage by the MPB. Stand characteristics that are usually associated with the development of MPB outbreaks in natural lodgepole pine stands include average tree diameter (dbh) over 20 cm, a large proportion of trees over 25 cm dbh, trees more than 80 years of age, and stand densities between 750 and 1500 trees per hectare. Tools exist to rate stand susceptibility and risk of MPB infestation, and these may be employed to aid decisions for reduction of stand and landscape susceptibility. Susceptibility may be reduced by harvesting highly susceptible stands, thinning stands to increase tree vigor and decrease habitat suitability, and by stand conversion through selective logging of pine in mixed stands or by planting harvested blocks with non-host species.