Prepared by CABI and EPPO for the EU under Contract 90/399003

Data Sheets on Quarantine Pests

# *Dendroctonus ponderosae*

## IDENTITY

**Name**: *Dendroctonus ponderosae* Hopkins
**Synonyms**: *Dendroctonus monticolae* Hopkins
**Taxonomic position**: Insecta: Coleoptera: Scolytidae
**Common names**: Mountain pine beetle, Black Hills beetle (English)
Dendroctone du pin ponderosa (French)
**Bayer computer code**: DENCPO
**EPPO A1 list**: No. 265
**EU Annex designation**: II/A1

## HOSTS

*D. ponderosae* mainly attacks *Pinus contorta* and *P. ponderosa* but also *P. albicaulis*, *P. lambertiana*, *P. monticola*. It has been recorded on *P. aristata*, *P. balfouriana*, *P. coulteri*, *P. edulis*, *P. flexilis*, *P. monophylla* and other *Pinus* spp. During an outbreak, it has been recorded from *Picea engelmannii*.

## GEOGRAPHICAL DISTRIBUTION

**EPPO region**: Absent.
**North America**: Canada (Alberta, British Columbia, Northwest Territories, Saskatchewan), Mexico, USA (Arizona, California, Colorado, Idaho, Montana, Oregon, South Dakota, Utah, Washington, Wyoming).
**EU**: Absent.

## BIOLOGY

The adults and larvae of *Dendroctonus* spp. are phloeophagous or bark-feeding. *D. ponderosae* mostly overwinters as 2nd or 3rd-instar larvae but also as 4th-instar larvae and adults. Adults emerge from overwintering sites between February and June. Activity is resumed when subcortical temperatures become sufficiently high, about 7-10°C. The insects fly individually or in small groups, during the warmth of the day in spring or near nightfall in summer (at temperatures between 20 and 45°C), and infest further trees. In *D. ponderosae*, flight activity falls in a single concentrated period (e.g. mid-July to end of August). Terpenes in the oleoresin are the primary source of attraction, guiding pioneer beetles in the selection of a new host. Pheromones are responsible for the secondary attraction of other members of the same species and are the means by which individuals communicate after colonization. Like other bark beetles, *D. ponderosae* is associated with a bluestain fungus, *Ceratocystis montia*.

*D. ponderosae* is monogamous. The female initiates the boring of a new gallery by constructing a radial entrance tunnel through the bark into the wood. After pairing has occurred, the female is generally responsible for boring egg galleries, the formation of egg

niches, and care of eggs and larvae. The male keeps the nuptial chamber and entrance tunnel clean and expels the frass from the entrance hole. Oviposition commences about 7 days after attack and the eggs are deposited individually or in small clusters in niches, or in rows in long grooves. In *D. ponderosae*, the egg niches are narrow and shallow, and distributed in a characteristic pattern with alternating groups of one (mostly) to five. The incubation period is 7-14 days.

The number of larval instars is four. The length of the larval period under optimum conditions is, as in other scolytids, about 30 to 90 days. The end of the larval mine is usually slightly enlarged and cleared of frass to form a pupal chamber. The pupal stage, as in other scolytids, requires between 3 and 30 days, but averages 6-9 days under ideal conditions. It may be extended if pupation begins in late autumn, but is rarely an overwintering stage except in areas where the winters are very mild.

Adult *Dendroctonus* may emerge from the host tree immediately or may require a period of maturation feeding before emerging. They usually emerge through separate exit holes. After completing one gallery system it is not uncommon for the parent beetles to re-emerge and construct a second, third or fourth system of tunnels to produce an equal number of broods. A few old adults may survive the winter and participate in the production of the spring brood. However, a majority of the adults die in their tunnels after producing one brood. *D. ponderosae*, as a univoltine species, usually has its life cycle closely correlated with the seasons (Wood, 1982). However, in California, two and a partial third generation may develop, while one generation may take two years in the coldest parts of its range. For further information on the biology of *D. ponderosae*, see Blackman (1931), Craighead (1931), Beal (1939), McCambridge & Trostle (1972), Waters *et al*. (1985).

## DETECTION AND IDENTIFICATION

### Symptoms

For *D. ponderosae* on *Pinus contorta*, attack on green trees usually results in wilting; the needles change to a yellowish-green in the spring and finally to a bright-orange by July. Pitch tubes on newly infested trees range in colour from dark reddish-orange to cream; they consist of resin and particles of bark expelled from the egg gallery by the beetles. Orange to cream-coloured particles of bark and wood in crevices and at the base indicate that the tree has been infested and killed by beetles.

The galleries formed by the adults and larvae are diagnostic. Within the gallery system, the entrance tunnel, mother or egg galleries and larval galleries can usually be distinguished. The entrance tunnel is usually short, more or less perpendicular to the tree axis and found at the base of simple galleries (in *Dendroctonus* spp., which are monogamous). This tunnel serves for the evacuation of frass and other debris which accumulates. The entrance hole is closed by tightly packed frass in *Dendroctonus*.

The mother or egg galleries are the same diameter along their length and sometimes possess perforations (aeration or ventilation holes) to the exterior. These galleries are constantly cleared of boring frass in most species. In *D. ponderosae*, the galleries (average length 32.6 or 47.5 cm depending on locality, up to 79.0 cm) ascend diagonally from the entrance hole for 3-5 cm before turning straight upwards. The diameter of the individual egg galleries is slightly greater than the width of a beetle. The ventilation holes are usually placed at irregular intervals and may be absent, especially in trees with relatively thin bark.

The larval galleries commence more or less parallel to or divergent from the egg gallery, penetrating the bark or wood to varying depths and progressively widening away from it. These galleries are usually full of debris. The gallery terminates in a small chamber, where pupation occurs and the adult emerges through a hole from this chamber.

In most *Dendroctonus* spp., the galleries are individual and radiate from the parental mine, or the larvae may feed in congress for part or all of their development. The mines usually extend for 1-4 cm along a straight or winding route without increasing in diameter, and then abruptly expand into an oval to irregular feeding chamber approximately 0.5-1.0 cm wide by 1 or 2 cm long.

## Morphology

### Eggs

Smooth, oval, white, translucent. Eggs are laid separately but packed in niches and covered with frass.

### Larva

In general, *Dendroctonus* larvae are white, legless, with lightly sclerotized head; head usually as broad as long with evenly curved sides, protracted or slightly retracted. Body at most only slightly curved; abdominal segments each with two or three tergal folds; pleuron not longitudinally divided. Larvae do not change appreciably in form as they grow. Identification requires the assistance of a specialist. For generic keys to the larvae of *Dendroctonus* and other bark beetles, see Thomas (1957, 1965), Peterson (1951). Bentz *et al.* (1996) provides characters for differentiating *D. ponderosae* larvae from those of *Ips pini*, with which it frequently cohabits.

### Pupa

The pupae of scolytids are less well known than the larva: exarate; usually whitish; sometimes with paired abdominal urogomphi; elytra rugose or smooth; head and thoracic tubercles sometimes prominent. See in particular Thomas (1965).

### Adult

In general, *Dendroctonus* adults are relatively large bark beetles, 3-8 mm in length; *D. ponderosae* is 4-7.5 mm long, cylindrical, black. Antennae geniculate, funicle five-segmented, with abrupt three-segmented club; subcircular. Head visible from above, not prolonged into distinct rostrum, narrower than pronotum, with mouthparts directed downwards. Eyes flat, usually elongate, entire. Pronotum scarcely declivous in anterior half, usually without crenulations except sometimes anterolaterally. Scutellum small and rounded or depressed. Elytra entire, concealing pygidium, with basal margin usually procurved and with crenulations. Elytra terminate in a rounded or blunt slope (the declivity) which may be fringed by a row of spines or tubercles. Tibiae unguiculate. Tarsal segment 1 not longer than 2 or 3, pseudotetramerous with third tarsal segment bilobed. For generic and specific keys to *Dendroctonus* and other genera, see Wood (1982), Duncan (1987) and Lanier *et al.* (1988).

## MEANS OF MOVEMENT AND DISPERSAL

Some bark beetles are strong fliers with the ability to migrate long distances. The most common mode of introduction into new areas is unseasoned sawn wood and wooden crates with bark on them. If wood is barked, there is no possibility of introducing bark beetles. Dunnage is also a high-hazard category of material, on which most of the scolytids intercepted in the USA are found. It is particularly difficult to monitor properly.

## PEST SIGNIFICANCE

### Economic impact

Like other scolytids, *Dendroctonus* spp. periodically cause loss of wood (cut wood or standing trees) over extensive areas. Their galleries do not affect the structural properties of the wood significantly, but may render it useless for veneer or furniture making. In general,

compared with other genera such as *Ips*, they tend to be more aggressive and more host-specific. They mostly breed in coniferous hosts larger than 15 cm in diameter.

*D. ponderosae* is often considered the most serious enemy of mature hard and soft pines, particularly *Pinus contorta* in western North America, with losses ranging from 60% of the 30-cm DBH class to about 90% of the trees of 45 cm DBH and larger. In British Columbia, Canada, the beetle has greatest potential in hotter drier areas with mild winters, and infestations usually develop into outbreaks in stands older than 80 years with many trees over 25 cm in diameter. Any acceptable host is then attacked. The severe killing caused is an increasing problem in second-growth stands of *P. ponderosa* in Oregon and Washington, USA, especially on poor sites where outbreaks result in natural thinning from above and cause understocking. Longer epidemics and more severe damage have occurred in *Pinus contorta* in Utah, Idaho, Wyoming and Colorado, USA. The average annual loss attributed to *D. ponderosae* since 1895 may approach 1.5 billion board feet (Wood, 1982).

Trees selected for attack by populations of this beetle are usually overmature or weakened standing trees, larger than 15 cm DBH. Windfalls or cull logs may occasionally provide favourable breeding places (Evenden et al., 1943), particularly when the bole is inclined. During outbreaks the more vigorous, rapidly growing trees may be preferred (Beal, 1939), and coniferous host species not belonging to the genus Pinus may be attacked. The area of a particular tree attacked by this species may be restricted or forced upward from the base of the bole by such competing species as D. adjunctus, or downward from upper parts of the bole by *D. brevicomis*. In a given area, the local population may exhibit a strong preference for one host species, even though other acceptable host species may be intermixed. During an outbreak, any acceptable host, or sometimes any conifer, may be attacked, but following the outbreak the attacks are usually again confined to the host species originally favoured.

## Control

Broadly, the same control methods are available for all bark beetles. A tree that has been attacked usually cannot be saved, so preventive rather than curative control is best. Since scolytid populations are probably always present in a forest, breeding on unthrifty, injured, broken, wind-thrown or felled material, damage can be reduced or avoided by maintaining the health and vigour of the stand; especially by thinning stagnated young stands or removal of overmature trees in older stands.

Losses caused by bark beetles usually involve individual trees or irregularly distributed groups of trees. Insect surveys are made to locate and appraise infestations in their early stages. If endemic conditions prevail, natural control factors (climate, weather, predators, parasites, disease) will hold the population at a steady level at which damage is within normal limits (losses less than annual tree growth). If epidemic conditions exist, damage exceeds normal limits (losses exceed annual growth). Such surveys determine the need for direct control. The available methods have been reviewed in EPPO/CABI (1992). Treatment with insecticides is used, if at all, for logs rather than for trees. Several risk classification systems have been developed to assist management of *D.ponderosae*, but Bentz *et al*. (1993) recently reevaluated them and found that none performed satisfactorily.

## Phytosanitary risk

*D. ponderosae* is an A1 quarantine pest for EPPO, within the category "non-European Scolytidae" (EPPO/CABI, 1992). It is mainly a primary pest, and attacks *P. contorta* and *P. ponderosa*, two pines which are widely planted in the EPPO region. In addition, it occasionally attacks a number of other *Pinus* spp. in North America. Though attacks on native European pines have not apparently been documented, there is a clear possibility that *D. ponderosae* might attack these, which would increase the risk for the EPPO region yet further. The climatic conditions of the area of distribution of *D. ponderosae* in North

America are broadly similar to those of western Europe. This species seems to present the highest risk of all the North American *Dendroctonus* spp.

*D. micans* and other indigenous bark beetles (*Ips* spp.) already occur on conifers throughout most of the EPPO region, so the risk arising from introduced species is uncertain. However, those areas of the EPPO region which lack indigenous bark beetles and and protect themselves from species already present elsewhere in Europe have evident reason to protect themselves also from North American bark beetles.

## PHYTOSANITARY MEASURES

EPPO recommends that all countries should prohibit import of plants of *Pinus* from countries where *D. ponderosae* occurs, and optionally also bark of *Pinus* (OEPP/EPPO, 1990). If bark is imported, it should be heat-treated or fermented. Wood of *Pinus* from such countries should be debarked, or kiln-dried, or treated (see below). An EPPO phytosanitary procedure for fermentation has been published (OEPP/EPPO, 1994a) and procedures for the other treatments are in preparation.

Infested conifer logs can be treated with chemicals on an individual basis, and fumigation of stacks with methyl bromide can provide excellent control where specialist facilities exist and temperature conditions are correct for effective treatment (White, 1971). EPPO recommends a phytosanitary procedure specifically for this fumigation (OEPP/EPPO, 1994b).

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