

Notes on the biology and behaviour of eucalypt-defoliating sawflies (Hymenoptera: Pergidae) in Tasmania

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Abstract

Four species of eucalypt-defoliating sawflies occur in Tasmania. Their life cycles are similar, with adults emerging in summer, and larval development occurring over winter and spring, followed by a long prepupal/pupal stage in the soil. There are marked behavioural differences between species, particularly in egg-laying behaviour. Thirteen species of eucalypts are recorded as hosts for the four sawfly species.

Introduction

Sawflies are widespread pests of eucalypts, particularly in woodland forests in many areas of Australia (Carne 1965). Despite their common name, these insects are not flies, but wasps (Hymenoptera). The term sawfly is derived from the serrated, saw-like egg laying apparatus (ovipositor) which the female wasp uses to lay eggs within the leaves of the host plant. The larval stages of sawflies are sometimes called spitfires because, when disturbed, they regurgitate a fluid smelling strongly of eucalyptus oil. These insects are best known by their large masses of larvae which are often seen on the trunk and branches of trees during the day, particularly in the later stages of larval development. The larvae feed on eucalypt leaves over several months and are responsible for all defoliation caused by sawflies.

In Tasmania, there are four species of sawflies, all in the family Pergidae, which defoliate eucalypts. These are the large green sawfly, *Perga affinis insularis*; the pale brown sawfly, *Pseudoperga lewisii*; the eucalypt-

defoliating sawfly, *Pergagraptia bella*; and the cattlepoisoning sawfly, *Lophyrotoma interrupta*, a species recorded as being eaten by cattle in Queensland when large masses of larvae are on the ground (McKenzie *et al.* 1985). Two other species with eucalypt hosts in Tasmania are the leafblister sawflies, *Phylacteophaga froggatti* and *Phylacteophaga eucalypti tasmanica*, but these species form blotch mines on the leaf surface rather than defoliating the host. Information on the appearance and life history of the four eucalypt-defoliating species in Tasmania has been provided by Elliott and Bashford (1978) and Elliott and de Little (1984). This paper describes some further aspects of their biology, life cycle and host plants.

Methods

The information in this paper is based on field observations of the four species over many years in Tasmanian forests, mainly dry woodland eucalypt forests in the south-east and north-east. Egg counts and larval measurements were made in the laboratory using a Wild M5 stereo microscope with an optical graticule. Incubation times were determined both by examining tagged leaves in the field from the time of egg laying, and by removing leaves containing egg batches to the laboratory for study. Parasitoids were reared in the laboratory from pupal cocoons excavated from around trees which had previously had large masses of larvae on their trunks and branches.

Nomenclature follows Naumann (1993) for insects and Chippendale (1988) for plants.

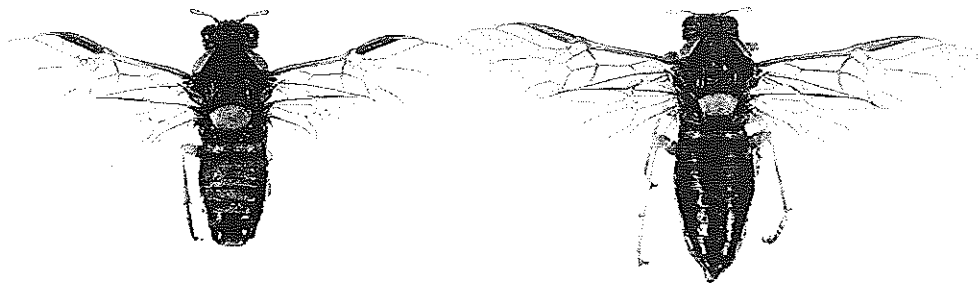


Photo 1. Perga affinis insularis (x1.5). (male, left; female, right)

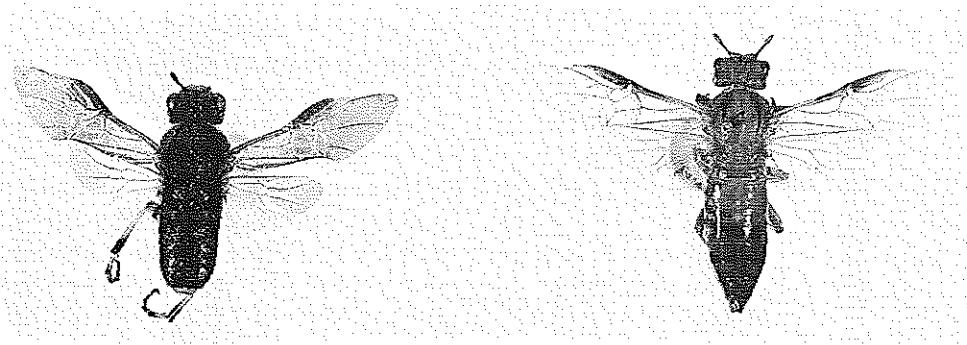


Photo 2. Pseudoperga lewisii (x1.8). (male, left; female, right)

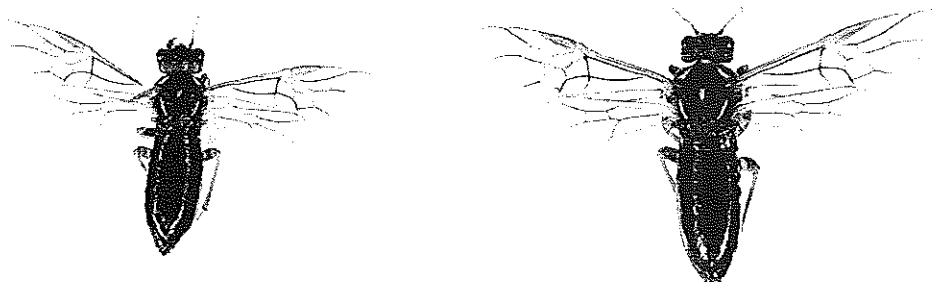


Photo 3. Pergagraptia bella (x2.2). (male, left; female, right)



Photo 4. Lophyrotoma interrupta (x2.2). (male, left; female, right)

Results and discussion

Adults of the four sawfly species which defoliate eucalypts in Tasmania are shown in Photos 1–4.

Egg laying (oviposition)

All four species lay their eggs within the leaf, forming an egg 'pod' recognised by the discoloured leaf tissue in the region of the pod. Egg batches of the different species can be recognised by variations in the size, shape, and position of the batch. *Perga affinis insularis* lays its eggs adjacent and perpendicular to the midrib of the leaf in a single row (Photo 5). The eggs are 4 mm long, spindle-shaped and bluish-green. The eggs of *Pseudoperga lewisii* are oval, white, 2.5 mm long and are laid in one or two layers in a manner similar to that described for *Perga* (Photo 6). They are laid on younger and narrower leaves than those favoured by *Perga* and the leaf becomes more swollen and discoloured in the vicinity of the batch. After inserting eggs within the leaf, *P. lewisii* stands guard over the egg batch and subsequent young larvae for several weeks, gripping the sides of the leaf with its legs (Photo 7). The yellow, tapering eggs of *Pergagraptia bella* are 2.5–3 mm long and are laid in a single layer usually starting from the petiole end of the leaf. When laying eggs, *P. bella* holds the edges of the leaf with its legs and produces characteristic scrape marks on the leaf surface. The eggs of *Lophyrotoma interrupta* are a similar size to those of *Perga* and are laid on the outer edge of mature leaves (Photos 8, 9).

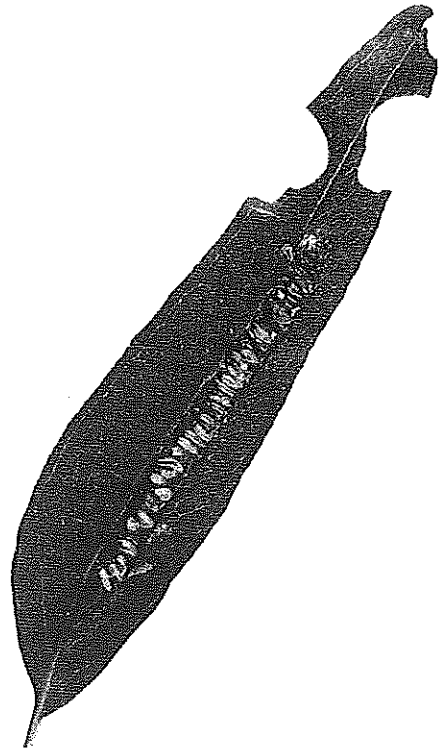


Photo 5. Egg batch of *Perga affinis insularis*, with leaf surface removed to show a single layer of eggs.

On the leaf samples examined, the mean number of eggs per batch ranged from 31 for *Pergagraptia bella* to 84 for *Pseudoperga lewisii* and incubation times ranged from 21 days (*Pseudoperga lewisii*) to 57 days (*Pergagraptia bella*) (Table 1). Young larvae of *Perga affinis*, *Pseudoperga lewisii* and *Pergagraptia bella* emerged from the egg pods via small circular holes, but *Lophyrotoma interrupta* larvae emerged at the outer edge of the pod, forming a longitudinal slit along the leaf margin.

Table 1. Number of eggs per batch and incubation times

| Species | No. eggs/batch (mean \pm s.e.) | n | Incubation time (days)* |
|--------------------------------|-------------------------------------|----|----------------------------|
| <i>Perga affinis insularis</i> | 56 \pm 4 | 23 | 31 |
| <i>Pseudoperga lewisii</i> | 84 \pm 1 | 21 | 21 |
| <i>Pergagraptia bella</i> | 31 \pm 3 | 27 | 57 |
| <i>Lophyrotoma interrupta</i> | 36 \pm 5 | 9 | 30 |

* based on 1–3 batches per species

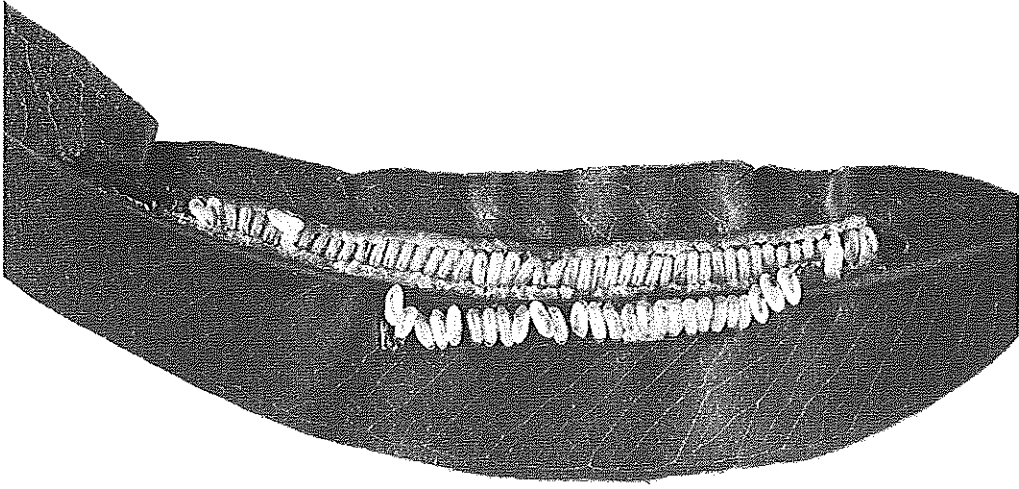


Photo 6. An egg batch of Pseudoperga lewisii, with the leaf surface folded back to show two layers of eggs.

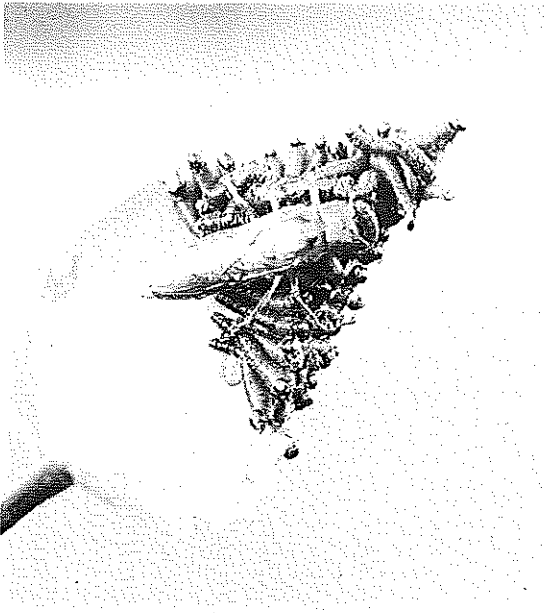


Photo 7. Pseudoperga lewisii standing guard over a batch of young larvae.

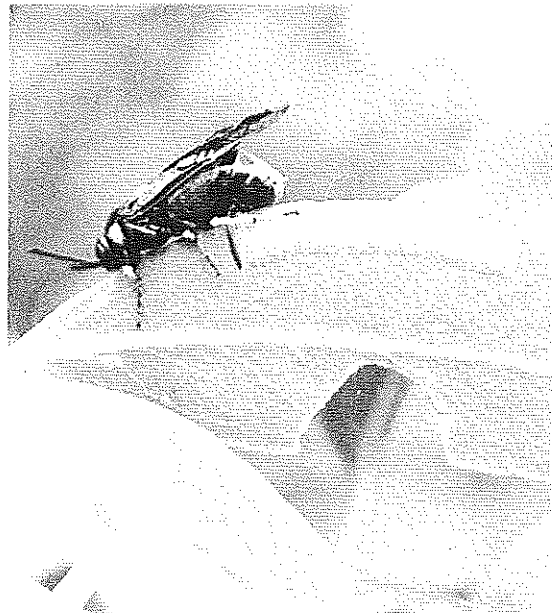


Photo 8. Lophyrotoma interrupta laying eggs along the leaf margin.

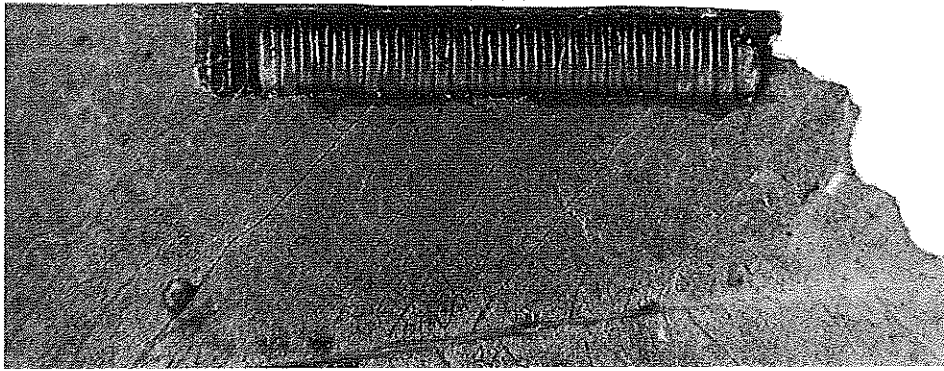


Photo 9. Egg batch of *Lophyrotoma*, with the leaf surface removed.

Table 2. Field observations of sawfly life stages.

| Species | Eggs | Larvae | Pupae | Adult |
|--------------------------------|----------------|----------------|-----------------|----------------|
| <i>Perga affinis insularis</i> | March–April | March–November | September–March | February–March |
| <i>Pseudoperga lewisii</i> | March–April | April–November | October–March | February–March |
| <i>Pergagrapta bella</i> | March–May | May–November | November–June | March |
| <i>Lophyrotoma interrupta</i> | February–April | March–October | September–March | February–March |

Life cycles

The four species of sawflies have similar life cycles. The adults and eggs are present in summer and autumn. The larval period extends from late summer/autumn to spring, with the prepupal/pupal stage occurring over spring, summer and autumn, extending into winter in the case of *Pergagrapta bella* (Table 2). A one-year life cycle was normal for all four species studied, but it sometimes extended for two or more years for a small proportion of *Perga affinis insularis* populations and it may also occur in the other species but this has not been confirmed. Carne (1962) reported a similar phenomenon for *Perga affinis affinis*, a subspecies closely related to *P. affinis insularis*, in south-eastern mainland Australia. He noted that these longer life cycles were caused by delayed pupation following extended diapause of the prepupa.

After eggs hatch, the young larvae of *Perga*, *Pseudoperga* and *Pergagrapta* form into a rosette pattern on the leaf surface, with their heads facing outwards and begin to feed. Larvae of *Lophyrotoma* often move to the tip of the leaf and feed beside each other, gradually moving down the leaf blade (Photo 10). As the larvae of all four species develop, their feeding changes from simply skeletonising the leaf surface (Photo 11) to consuming all leaf tissue. During the day, the larvae of *Perga*, *Pergagrapta* and *Pseudoperga* aggregate in large masses on the trunk and branches of their host trees (Photo 12) and at night they break into smaller groups and individuals to feed. *Lophyrotoma* larvae (Photo 13) feed during the day and do not form large masses even at the later stages of their development.

When fully fed, sawfly larvae leave the tree usually by crawling down the trunk in a mass (Photo 14) or, in the case of *Lophyrotoma*, often

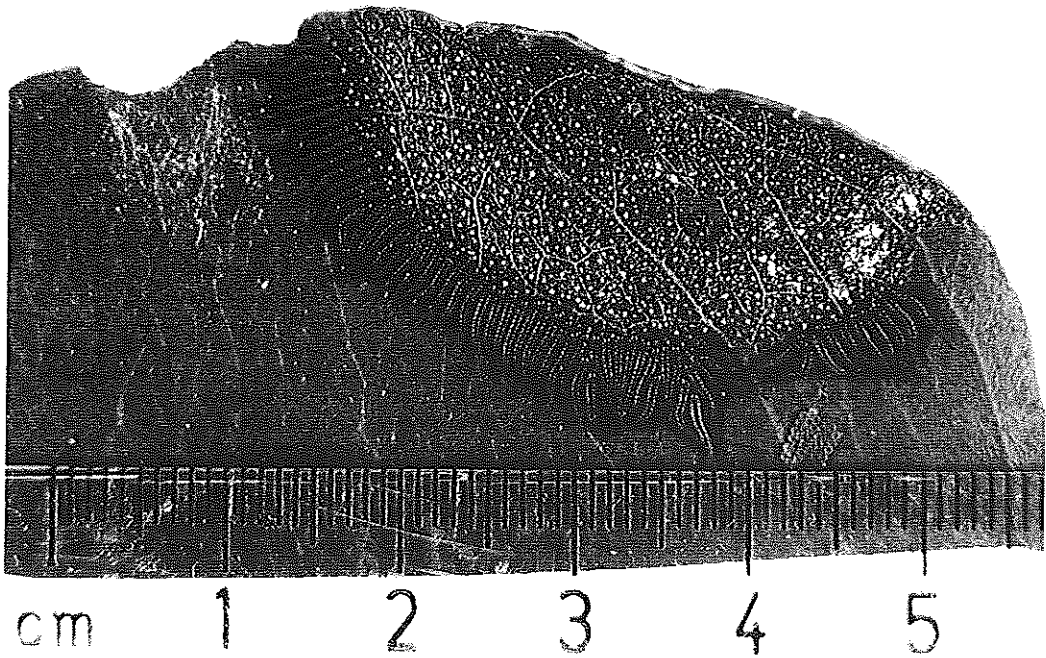


Photo 10. Mass feeding by newly hatched larvae of *Lophyrotoma interrupta*.



Photo 11. Young larvae of *Lophyrotoma interrupta* and skeletonised leaf. Note the empty egg pod at the top edge of the leaf, near the petiole.

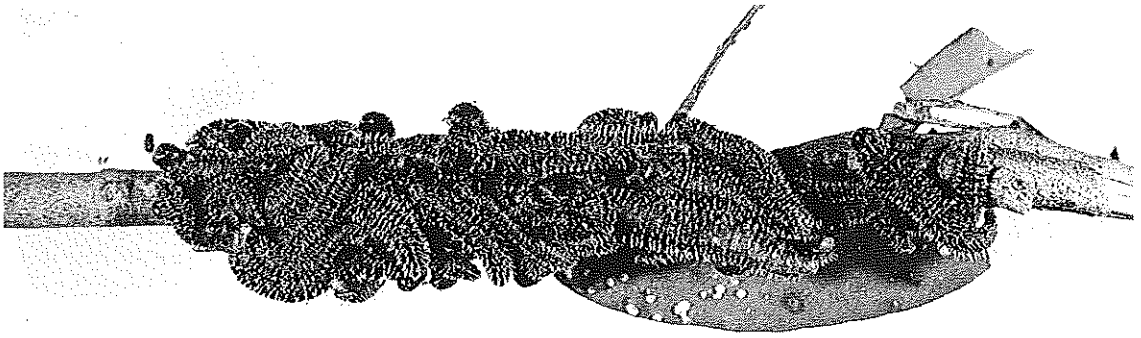


Photo 12. Typical daytime aggregation of *Perga affinis insularis* larvae.

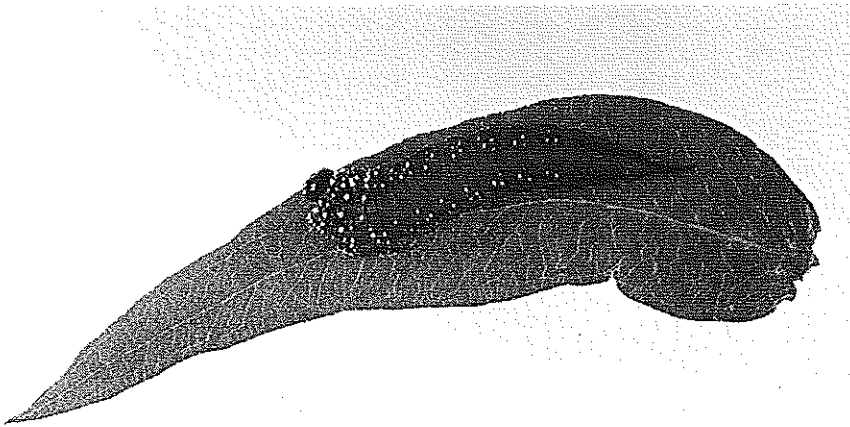


Photo 13. Mature larva of *Lophyrotoma interrupta*.

dropping from the foliage. They enter the soil and form cocoons containing the prepupae. They remain in this stage over most of the summer before changing to the pupal stage in late summer/autumn of the year of emergence. In *Perga*, *Pseudoperga* and *Pergagraptia*, many individuals enter the soil together, often forming large rafts of tough, brown cocoons containing the prepupae, whereas *Lophyrotoma* cocoons are softer and

are usually found singly or with just a small number in a group. Large groups of mature larvae of *Perga*, *Pseudoperga* and *Pergagraptia* are more successful in achieving soil entry than small groups or individuals as they are less prone to desiccation and the mass squirming action of the large group is more likely to break the soil crust. Soil entry is achieved with the least mortality in soft soils (Carne 1969).

Host plants

Thirteen eucalypt hosts, of which six are Tasmanian natives, have been recorded for



Photo 14. A large group of mature *Perga affinis insularis* larvae leaving their host tree.

these four sawfly species in Tasmania, with *Perga* having the widest host range (11 species). The only species attacked by all four eucalypt defoliating sawflies is *Eucalyptus viminalis* (Table 3). These sawflies are not known to feed on any other plant genera.

Defoliation of individual trees by the four sawfly species is often very severe and sometimes total, but rarely extends over large areas. Trees usually recover from even total defoliation, but death can occasionally occur when defoliation is repeated in successive years and drought conditions prevail. Damage is most commonly observed on roadside plantings and small woodlots (Elliott and De Little 1984), edges of plantations (Hand *et al.* 1995) and in sunny, open areas of native forest woodlands. These species also occasionally occur as very localised populations in more productive commercial forests, but their pest status in these forests is low.

Mortality factors

Three species of insect parasitoids were reared from two of the sawfly species studied. *Hypopheltes* sp. (Hymenoptera: Ichneumonidae) and *Froggattimyia* sp. (Diptera: Tachinidae) emerged from cocoons of *Perga affinis insularis*, and *Pergaphaga* sp. (Hymenoptera: Ichneumonidae) was reared from *Pergagraptella bella*. All three parasitoids attack the larval stage of their host sawfly. Carne (1969) recorded both *Hypopheltes* sp. and *Froggattimyia* sp. as parasitoids of the related sawfly, *Perga affinis affinis*.

Other significant mortality factors which affected populations of the four species studied were starvation of larvae as they moved between host trees, desiccation of larvae in tree crowns from high temperatures and exposure on defoliated branches, and desiccation of larvae during soil entry. Predation of *Perga affinis affinis* larvae by birds was recorded by Carne (1969) and has been observed in populations of *P. affinis insularis* in Tasmania by the authors but appears to be a relatively minor mortality factor.

Table 3. Host eucalypts for defoliating sawflies in Tasmania

| <i>Perga affinis insularis</i> | <i>Pseudoperga lewisii</i> | <i>Pergagraptella bella</i> | <i>Lophyrotoma interrupta</i> |
|--------------------------------|----------------------------|-----------------------------|-------------------------------|
| <i>E. amygdalina</i> * | <i>E. nitens</i> | <i>E. amygdalina</i> * | <i>E. camaldulensis</i> |
| <i>E. ficifolia</i> | <i>E. viminalis</i> * | <i>E. pauciflora</i> * | <i>E. grandis</i> |
| <i>E. globulus</i> * | | <i>E. viminalis</i> * | <i>E. nicholii</i> |
| <i>E. grandis</i> | | | <i>E. obliqua</i> * |
| <i>E. landsdowneana</i> | | | <i>E. ovata</i> * |
| <i>E. leucoxydon</i> | | | <i>E. viminalis</i> * |
| <i>E. nicholii</i> | | | |
| <i>E. nitens</i> | | | |
| <i>E. obliqua</i> * | | | |
| <i>E. ovata</i> * | | | |
| <i>E. viminalis</i> * | | | |

* Eucalypt species native to Tasmania

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