Tomicus piniperda **System:** Terrestrial

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Coleoptera	Scolytidae

Common name PSB (English), pine shoot beetle (English), common pine shoot beetle (English), larger pine shoot beetle (English)

Synonym

Similar species *Tomicus destruens, Tomicus yunnanensis*

Summary The international movement of non-native forest insects is a threat to forest sustainability worldwide. Tomicus species (Coleoptera, Scolytidae) are important pests of pine forest in Eurasia, Europe and the Mediterranean, with the common pine shoot beetle (Tomicus piniperda) reported to be the second most destructive shoot-feeding species in Europe. Unlike deciduous trees, which can easily replace their foliage soon after defoliation, conifers are not able to replace their foliage as readily. As such, Tomicus piniperda can permanently destroy the shoots and severely hinder the development of new foliage.

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Species Description
Adult common pine shoot beetles (*Tomicus piniperda*) are 3 to 5mm long, or about the size of a matchhead. They are brown or black and cylindrical. The legless larvae are about 5mm long with a white body and brown head (Plant Protection and Quarantine 1993). The following information may be used in the recognision of this pest (from: Humphreys and Allen Undated). Larvae, pupae and adults can be found at different times in galleries under the bark of dead or stressed trees in spring (usually before native North American beetles emerge). Adults create 2mm holes when exiting tree stems and 2 to 3mm entrance holes when attacking new shoots. First and second year shoots droop and become yellow and red in early summer. Dead shoots from current or previous years may be visable on the ground. Shoots damages by the pine shoot beetle will have 2 to 10cm tunnels and may have circular entrance holes near the broken end. Microscopic features of the pine shoot beetle include: clubbed antennae with a 6-segmented funicle; tootth-like projections on front edge of elytra; on the elytra rows of pits alternate with rows of setae on raised bases; and second row on the declivity has no setae on raised bases. Individuals somewhat resemble individuals of *Dendroctonus* (southern pine beetle and black turpentine beetle) in general appearance, but the funicle of the antenna is composed of six antennomeres (Thomas and Dixon 2004). *T. piniperda* can be distinguished from other members of the genus by the smooth second elytral interval on the declivity (Thomas and Dixon 2004).
Please see PaDIL (Pests and Diseases Image Library) Species Content Page Beetles: Pine shoot beetle *Tomicus piniperda* (Linnaeus) (Coleoptera: Curculionidae: Scolytinae: Hylesinini: Tomicina) for high quality diagnostic and overview images.
Note: *Tomicus yunnanensis* Kirkendall & Faccoli, (described in Kirkendall *et al*. 2008) a highly aggressive species of pine shoot beetle, present in the forests of southwest China and decimating *Pinus yunnanensis* for almost three decades was confused with *T. pinniperda* until recent molecular studies showed the SW China populations to be quite divergent from *T. piniperda* of northeast China and Europe. The authors recommend \"improved communication between taxonomists and forest entomologists, as avoidable taxonomic confusion such as that of *T. yunnanensis* and *T. destruens* with *T. piniperda* hinders the combatting of outbreaks of forest insects\". (Kirkendall *et al*. 2008)

Notes
Common pine shoot beetles (*Tomicus piniperda*) and other species of scolytids use host volatiles such as a-pinene and ethanol to locate suitable breeding material (Schroeder and Lindelöw 1989, in Morgan, de Groot and Smith 2004). Tree vigour may alter the quantity or quality of volatiles released by the trees, which in turn may alter the trees' attractiveness to *T. piniperda* (Schroeder 1987, in Morgan, de Groot and Smith 2004).

It is likely that the differences in the probability of stem attack between species were due to differences in the relative vigour of the trees. For example, Långström and collegues (1999, in Morgan, de Groot and Smith 2004) reported that *T. piniperda* attacks on fire-damaged Scots pine trees in Sweden were avoided by all trees carrying at least 40-50% of their foliage. Another study, conducted in southwestern Finland, found that stem attacks by *T. piniperda* were often avoided on Scots pine trees that retained 10% of their needles after defoliation by *Diprion pini* (L.) (Annila *et al*. 1999, in Morgan, de Groot and Smith 2004). This suggests that *T. piniperda* is a secondary bark beetle species, able to successfully colonise only pine trees that are severely weakened by other predisposing factors.

Lifecycle Stages
Common pine shoot beetles (*Tomicus piniperda*) complete only one life cycle per year in North America. They spend the winter months inside the thick bark at the base of living pine trees. The beetles become active and leave their over-wintering sites in March and April to mate and lay eggs in dead trees, dying trees, and recently cut stumps. Adults can fly several miles during this period in search of a suitable host. Females lay eggs in gallery systems they bore between the inner bark and outer sapwood of the tree. Egg galleries are 10 to 25cm long. From April to June, larvae feed under the bark of the tree in separate feeding galleries 4 to 9cm long. Mature larvae stop feeding, pupate, and emerge as adults. From July through October, adults tunnel out and fly to new pine shoots to feed. The beetles bore into the centre of the shoot during maturation feeding, hollowing 2.5 to 10cm of wood. Affected shoots droop, turn yellow, and fall off during the summer and fall. Feeding adults attack living pine trees of all sizes. This is the most destructive stage of the life cycle. When shoot feeding is severe, tree height and diameter growth are reduced (Plant Protection and Quarantine 1993).

Unlike most scolytid bark beetles that feed exclusively on the inner bark of their hosts, the pine shoot beetle has two feeding stages. Adults emerge from over-wintering sites in early spring to seek new breeding material in the form of stumps, fresh logs, and broken limbs (Schroeder 1987).

Mated females construct egg galleries within the phloem and deposit eggs along the sides of the galleries. After eclosion, larvae consume the phloem and remain beneath the bark until they pupate and subsequently emerge as adults. Newly emerged adults fly to nearby trees where they mine the centres of new shoots for several months, they build energy reserves, and the eggs mature in the females. Maturation feeding has been well documented in Scots pine stands in Canada (Ryall and Smith 2000, in Eager *et al*. 2004) and in Scots pine Christmas tree plantations in Indiana (Kauffman *et al*. 1998, Haack *et al*. 2001, in Eager *et al*. 2004) and Michigan (Haack *et al*. 2000 2001, in Eager *et al*. 2004). A single adult may mine several different shoots during late summer and fall. Intensive maturation feeding may cause shoot mortality and result in growth reduction or some loss of form. Additionally, seed production may be reduced when cone-bearing shoots are attacked. In colder parts of its range, decreasing daylength and freezing temperatures induce pine shoot beetle adults to seek over-wintering sites in the outer bark at the base of trees near the soil line (Langstrom 1983, Petrice *et al*. 2002, in Eager *et al*. 2004).

Habitat Description
Common pine shoot beetles (*Tomicus piniperda*) frequently infest unbarked pine timber in the forests, railway stations, timber yards and other timber storage areas and spread into surrounding pine forests if no preventive measures are taken (Juutinen 1978, Långström and Hellqvist 1990 1991, in Martikainen *et al*. 2005). Logging waste and stumps in thinned stands and clearcuts are also favoured by *Tomicus* spp. (Långström 1979, Annila and Heikkila 1991, in Martikainen *et al*. 2005). Natural disturbances, such as forest fires, windstorms and defoliating insects, can also create favourable conditions for the breeding of pine shoot beetles which may lead to shoot damage in the surrounding pine forests (Nilsson 1974a; Ehnström *et al*., 1995, Långström *et al*. 1997 2001, Annila and Heikkila 1999, Cedervind *et al*. 2003, in Martikainen *et al*. 2005). The pine shoot beetle (*T. piniperda*) seems to prefer sites that have numerous dead and dying pine trees that can be exploited for reproduction (Morgan, de Groot and Smith 2004). These low-vigour sites support large populations of the beetles, which subsequently attack the living shoots of trees, leading to additional stress on the trees and an increased potential for growth reductions (Morgan, de Groot and Smith 2004). In Eurasia, the primary native host for *T. piniperda* is Scots pine (*Pinus sylvestris* L.) but *T. piniperda* is capable of colonising, developing, and shoot-feeding in many North American pine species (Siegert and McCullough 2003).

Reproduction
The common pine shoot beetle (*Tomicus piniperda*) flies in early spring, a flight which is strongly influenced by the maximum daily temperature (with a flight threshold estimated at 12 degrees C in Europe and northeastern US and 13 degrees C in the Chinese Kunming region) (Bakke 1968, Haack *et al*. 1998, Hui 1991, in Gallego *et al*. 2004). Reproduction in bark beetles and other insects living in bark or wood is usually limited to dead or weakened trees (Schroeder 1988). Vigorously growing host material is not considered to be suitable for brood production (Schroeder 1987). Male and female bark beetles do not seem to have an aggregation pheromone unlike many scolytids but instead rely on host volatiles to attract both sexes (Loyttyniemi *et al*. 1980, in Eager *et al*. 2004; Haack 2006). In particular, *T. piniperda* respond to the monoterpene hydrocarbons released from pine oleoresin (e.g. Kangas *et al*. 1965, in Kohnle 2004). This is synergised by ethanol emanating from plant tissue under anaerobic fermentation, and indicates to the beetle a potential breeding habitat (Moeck 1970, Klimetzek *et al*. 1986, Vite´ *et al*. 1986, Kelsey and Joseph 2003, in Kohnle 2004). Terpinolene (a monoterpene hydrocarbon present in specific high proportions in the odour bouquet of Scots pine) appears to be of particular importance and is particularly attractive to the pine shoot beetle (Byers *et al*. 1985, Volz 1988, in Kohnle 2004).

Nutrition
The two major groups of Scolytidae are the bark and ambrosia beetles (Haack and Slansky 1987, in Haack 2006). Adult bark beetles tunnel and breed at the bark–wood interface, and their larvae feed primarily on inner bark (phloem) (Haack 2006). By contrast, adult ambrosia beetles tunnel in wood and inoculate the gallery walls with fungi (the “ambrosia”) that serve as food for their larvae (Haack 2006). *Tomicus piniperda* feeds on both the shoots and the inner bark (phloem) of pine trees (Morgan, de Groot and Smith 2004). Scots pine, *Pinus sylvestris* L., is the principal host of the beetle in its native range; however, the beetle will breed and shoot feed in most species of North American pines (Schroeder 1987, Sadof *et al*. 1994, Lawrence and Haack 1995, in Morgan, de Groot and Smith 2004).

General Impacts

The common pine shoot beetle (*Tomicus piniperda*) is considered the most serious scolytid pine pest in Europe (Thomas and Dixon 2004). In Europe, losses of 20–45% in annual growth increment and volume have been reported (Långström 1980, Långström and Hellqvist 1991, in Poland *et al*. 2003). The beetle breeds and lays eggs under the bark of dying or recently killed pine trees (Morgan, de Groot and Smith 2004). Soon after development, the progeny adults emerge and feed by mining the shoots of healthy or weakened pines, causing the shoots to break and fall to the ground. Shoot feeding results in a loss of foliage and has been demonstrated to significantly reduce tree growth (Långström and Hellqvist 1990 1991, Czokajlo *et al*. 1997, in Morgan, de Groot and Smith 2004). In addition to impairing photosynthetic ability and stunting growth, intensive shoot feeding reduces tree vigour and may predispose the trees to stem attacks (Ye 1991, Annila *et al*. 1999, Långström *et al*. 2002, in Morgan, de Groot and Smith 2004).
T. piniperda almost exclusively depends on Scots pine (*Pinus sylvestris*) as a host: emerging adults feed on vital shoots for maturation, causing considerable loss of increment (Borowski 2001, in Kohnle 2004), and mature adults reproduce in slash or logs of Scots pine. In Europe, it occasionally attacks spruce (*Abies* spp.) and larch (*Larix* spp.) (Thomas and Dixon 2004). The beetles rarely breed on other conifers (Ratzeburg 1837, Escherich 1923, in Kohnle 2004). In North America *T. piniperda* readily colonises at least two native pine species and these hosts can support the production of a large number of offspring beetles.
Scolytids usually attack stressed or recently fallen host material, but some can attack and kill apparently healthy hosts (Haack 2006). In its native Europe and Asia the pine shoot beetle infests the stems of stressed pine trees (Speight 1980, in Jacobs *et al*. 2004). The pine shoot beetle is normally considered a secondary coloniser of the stems of trees, but is a primary pest on the terminal shoots where it undergoes maturation, especially in the growing tips. These shoots become hollow, die and can be recognised by the brown foliage and resin holes near the shoot bases (Speight 1980, in Jacobs *et al*. 2004). The species is considered a pine-damaging bark beetle species in the Mediterranean area and especially in Tunisia (Jamaa *et al*. 2007).
Bark and ambrosia beetles are usually vectors of fungi and other microorganisms that grow in the woody host tissues (Kuhnholz *et al*. 2001, Kirisits 2004, in Haack 2006). La°ngstro¨m *et al*. (1993), and Solheim *et al*. (1993) studied a variety of factors related to possible interactions between pine shoot beetle attacks and tree mortality. Among other conclusions reached was that the pine shoot beetle did introduce fungi into host trees, and that one of these, *Leptographium wingfieldii*, a highly phytopathogenic fungus, can kill healthy trees (Hausner *et al*. 2005). The simultaneous presence of *Leptographium wingfieldii* and *Ophiostoma minus* (phytopathogenic fungi) in the galleries of *T. piniperda* and on the insects themselves has already been reported from various regions of Europe: France (Lieutier *et al*. 1989, Piou *et al*. 1989), Sweden (Solheim and La°ngstro¨m 1991), and UK (Gibbs and Inman 1991), demonstrating the large distribution and the generality of this association (Jamaa *et al*. 2007). However the very low frequency of association of these fungi with *T. piniperda*, together with the high between-plot variations of *O. minus*, make the significance of these fungi in the establishment of the beetle on its host trees questionable, similar to the conclusions for Europe (Lieutier *et al*. 1995, Lieutier 2002, in Ben Jamaa *et al*. 2007).

Management Info

Preventative measures: Because of growing awareness of the threat posed by untreated wood packing material, new worldwide standards for wood treatment were recently proposed. In 2002, United Nation FAO's (Food and Agriculture Organization) Interim Commission on Phytosanitary Measures imposed a global standard for treating wood packaging International Standard for Phytosanitary Measures No. 15 to stop the spread of invasives, that are now being adopted by individual countries (e.g., USDA APHIS 2004b). Anticipating severe losses from the pine shoot beetle (*Tomicus piniperda*), a US federal quarantine was initiated in 1992 (USDA APHIS 1992, in Haack 2006), and a similar Canadian quarantine began in 1993. The quarantines regulated movement of *Pinus* logs, Christmas trees, nursery stock, and bark from infested to un-infested areas (Haack and Poland 2001, in Haack 2006). Both quarantines were still in effect as of 2005, even though *T. piniperda* related damage has been low in North America (Morgan *et al.* 2004, in Haack 2006).
Please follow this link for detailed management information for the common pine shoot beetle compiled by the ISSG.

Pathway
Insects are often transported on commodities such as nursery stock, cut flowers, fresh food, seed, wood packing material, logs, and lumber (Wood 1977, Siitonen 2000, Haack 2001, Dobbs and Brodel 2004, USDA APHIS 2004a, in Haack 2006).Wood packing material, like crating and pallets, often harbors bark- and wood-boring insects, especially when (1) manufactured from recently cut trees, (2) not treated with heat or chemicals, or (3) bark is retained (USDA APHIS 2000, in Haack 2006). The order Coleoptera (beetles) is the most commonly intercepted order of insects found in association with wood packing material. For example, Coleoptera constituted 84% of the intercepted insects associated with wood in both Chile and New Zealand and 92% in the US (Beeche-Cisternas 2000, Bain 1977, Haack 2001, in Haack 2006).

Principal source:

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PaDIL is available from : http://www.padil.gov.au/aboutOverview.aspx, this page is available from: http://www.padil.gov.au/viewPestDiagnosticImages.aspx?id=457 [Accessed 28 February 2008]

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