EPPO Datasheet: *Monochamus titillator*

Last updated: 2022-09-19

IDENTITY

Preferred name: *Monochamus titillator*
Authority: (Fabricius)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Cerambycidae
Common names: southern pine sawyer
view more common names online...
EPPO Categorization: A1 list
view more categorizations online...
EPPO Code: MONCTI

more photos...

Notes on taxonomy and nomenclature

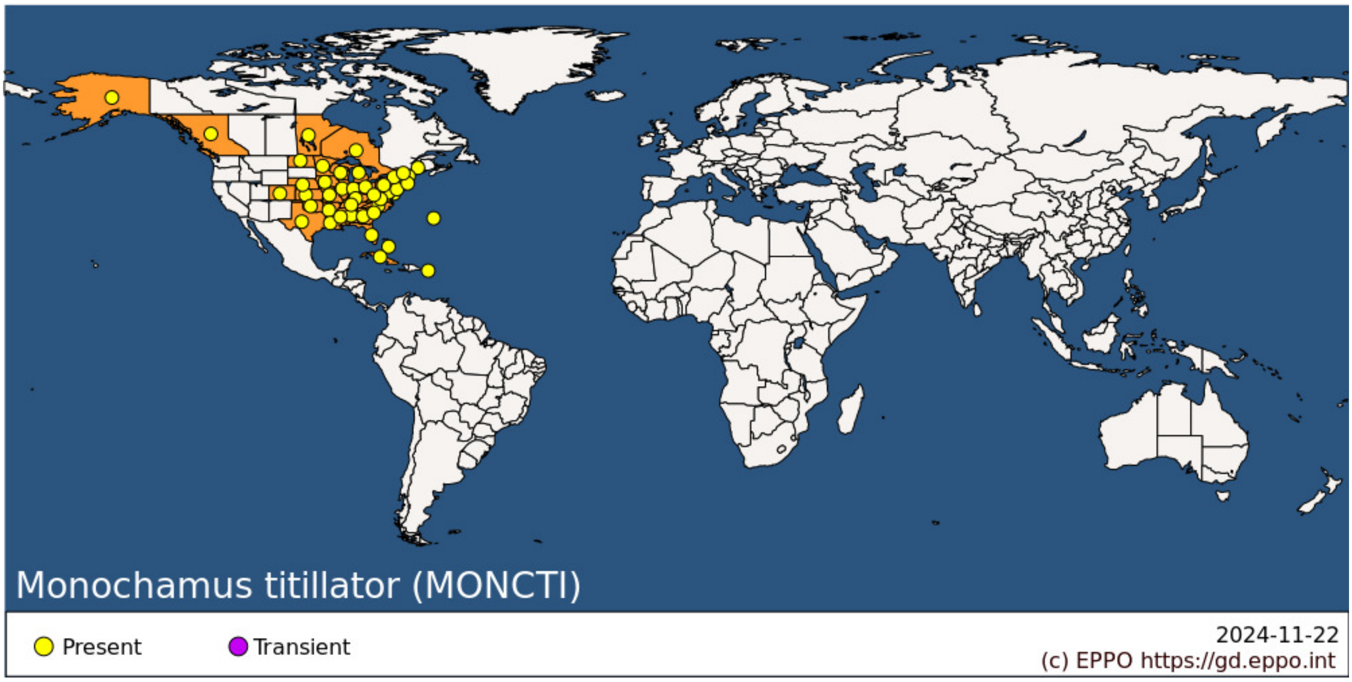
Miller *et al.* (2013) described *M. titillator* and *M. carolinensis* (Oliver) as a species complex, however in this datasheet, *M. titillator* is considered as a separate species. In the Titan cerambycid database, *M. titillator obesus* is not considered to be a valid name (IRD, 2021).

HOSTS

Host list: *Abies balsamea*, *Abies*, *Picea*, *Pinus rigida*, *Pinus*

GEOGRAPHICAL DISTRIBUTION

M. titillator is found in 31 states in the USA and Ontario, Canada (Akbulut & Stamps, 2012) as well as in the Caribbean and Colombia (Blackwelder, 1946, Duffy, 1960, Monné & Nearns, 2020). In North Carolina and throughout most of the South-Eastern United States, *M. titillator* and *M. carolinensis* are common. In most areas, the population is maintained in felled and dead standing trees, in windthrown timber, and in large slash (the term used in the USA to describe waste left from forestry operations) (Alya & Hain, 1985).



North America: Canada (British Columbia, Manitoba, Ontario), United States of America (Alabama, Alaska, Arkansas, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin)
Central America and Caribbean: Bahamas, Bermuda, Cuba, Puerto Rico

BIOLOGY

M. titillator breeds in recently-cut, windthrown, fire-killed, insect-killed and dying pines (Baker, 1972)

The eggs are laid in felled or injured trees, healthy trees are seldom attacked. Alya and Hain (1985) studied the life history of *Monochamus carolinensis* and *M. titillator* in pine logs in the Piedmont of North Carolina in the summers of 1982-83. The species had very similar life cycles. The adult female gnaws a funnel-shaped pit approximately 8 mm long and 3 mm wide and sometimes just a transverse slit, in thin barked logs the slit can be just 2 mm long in the bark which extends into the soft sappy inner bark (Alya & Hain, 1985). The female, while digging the egg pit, is generally accompanied by the male who clasps the posterior end of her body with his forelegs and frequently mates with her while she is digging. The eggs are laid in groups of up to nine in the bottom of these pits. Between three and nine eggs were found in 325 egg niches examined (Alya & Hain, 1985). Oviposition occurs between March and October. Incubation lasts around 5-9 days. The larvae penetrate into the outer sapwood when they are three to four weeks old and then emerge to feed on the inner bark. Wooden fibres and frass are packed between the bark and the wood. When mature, the larvae extend the pit through the sap wood into the heart wood. In the heartwood, the larvae will start to tunnel parallel to the grain of wood for 5 to 7.5 cm and then turn to tunnel to a point 6 mm from the surface forming a U-shaped gallery. Normally the larvae pupate at the bottom of the U-shaped gallery, but rarely they can pupate underneath the bark (Duffy, 1960, Webb, 1909).

Larval behaviour is similar to other *Monochamus* spp. from the Eastern United States. The larvae are commonly known as ‘sawyers’ because of the loud noise they make while feeding. Freshly cut, felled or dying trees or trees that recently died, are preferred. Young larvae feed on the inner bark, cambium and outer sapwood, forming shallow excavation s called surface galleries and filling them with coarse fibrous borings and frass. As they grow older, they bore deep into the heartwood, and then turn around and bore back towards the surface, thereby forming a characteristic U-shaped tunnel. A pupal cell is formed at the outer end of the tunnel, from which the adult emerges by chewing a hole through the remaining wood and bark. Full-grown larvae are often more than 50 mm long (Baker, 1972).

In the Piedmont area of the southern states of the USA, the emergence of *M. titillator* adults reaches a peak in April and May. However adult activity continues until late autumn and probably to some extent throughout the winter. There are at least two generations a year in the south of the USA with overlapping generations (Baker, 1972, Webb, 1909). In a test of trapping techniques, Boone *et al.* (2019) found that peak catches of *M. titillator* in Arkansas occurred in mid-late July.

M. titillator has one to one and a half generations per year in the Piedmont area of North Carolina. In 1983, there was a peak of activity in mid-June and then a second peak in September which may have represented a second generation. Newly emerged adults feed almost exclusively on the tender bark of small shoots and branches for about three weeks, later the insects began to feed on the thicker bark of the logs and larger branches. Females go through a period of maturation feeding of about three weeks before they oviposit. The incubation period is about a week. *Monochamus* were not observed feeding in healthy trees. Pine logs remain attractive to ovipositing female *M. titillator* for up to 42 days. In one study, mortality from early instar to emerged adults averaged about 85% (Alya & Hain, 1985).

In southern Mississippi, the egg-laying period lasts from of the beginning of March to the middle of October. The larvae hatch in about five days. The larval period is thought likely to take several months, but the pupal period is two to three weeks. It appears that normally there is one complete generation and one partial generation a year (Webb, 1909).

Competitive effects have been noted between *M. titillator* and the mountain pine beetle, *Dendroctonus frontalis* in the inner bark tissue (Billings & Cameron, 1984). *Monochamus* spp. may play a role in naturally regulating *D. frontalis* populations (Coulson *et al.*, 1976). *M. titillator* are attracted to trees that have been attacked by *D. frontalis,* primarily arriving between 1 and 10 days after a successful *D. frontalis* attack (Hennier, 1983). Billings and Cameron (1984) showed that behavioural chemicals produced by co-habiting bark beetle species attract *M. titillator* to trees that have been attacked by *D. frontalis.* This behaviour brings male and female *M. titillator* close together at a suitable site for mating and oviposition. The object of competition is the limited area of inner-bark which is necessary for the development of both species (Coulson *et al.*, 1976). Miller (1986) studied the impact of excluding *Monochamus* spp. from freshly cut bolts (sections of logs) of *Pinus taeda* on other insects. The presence of *Monochamus* spp. significantly reduced the number of emerging *Ips calligraphus* (Coleoptera: Curculionidae), *Platysoma cylindricum* (Coleoptera: Histeridae) and *Medetera bistriata* (Diptera: Dolichopodidae). This demonstrates that reducing *Monochamus* sp. populations could lead to increased populations of other damaging species.

Dauer larvae of pine wood nematode, *Bursaphelenchus xylophilus* have been found in association with *M. titillator* on *Pinus thunbergia*, *Pinus sylvestris* and *Pinus glauca* in Virginia. Carling (1984) found that *M. titillator* was the primary insect associated with *B. xylophilus* in Virginia and thought that it was likely to be the primary vector. Luzzi *et al.* (1984) found that all 53 *M. titillator* that emerged from samples of fire-damaged *Pinus elliotti* in Florida were carrying *B. xylophilus* and that hosts trees can infected with the nematodes during maturation feeding.

DETECTION AND IDENTIFICATION

Symptoms

The following signs and symptoms may be seen in wood infested with *Monochamus* spp. (Wilson, 1975):

1. Slits chewed by adult female for egg laying in the bark, although only a minority of these may have eggs in them
2. Scoring in the xylem and phloem caused by larval feeding
3. Frass – the waste expelled by feeding larvae from trees
4. Oval shaped holes made by larvae as they bore deeper into sap wood
5. Circular exit holes created by adults

Morphology

Webb (1909) provided an extensive description of the juvenile stages of *M. titillator*, extracts are provided below.

Eggs

Eggs are elongate-oval, approximately 4 mm long by 1.5 mm in diameter at the middle. They are opaque white. Under a high-power microscope the pretty sculpturing can be seen on the outer surface of the chorion.

Larvae

Fully grown larvae are up to 60 mm long and 9 mm wide at the broadest point (Baker, 1972, Webb, 1909). The head of the larvae is longer than broad and is capable of being deeply retracted into the thorax. The pro-thorax, upon the anterior part of the upper or dorsal surface is smooth and shining, but the posterior part has an opaque leathery appearance. This opaque surface is dotted with small shining spots more or less longitudinally elongate in shape. The mesothorax is smooth on the dorsal surface, but on the ventral surface there is a double transverse row of fine fleshy granules (Webb, 1909). . *Monochamus* spp. larvae can also be identified using DNA barcoding, but it has not been validated for all species (EFSA, 2018).

Pupae

The pupae share some of the appearance of the larvae and the adults. The number of segments is the same as the larvae, but the first abdominal segment is not visible on the underside of the body (Webb, 1909).

Adults

Male antennae are often two to three times as long as the body, there is a strong spine on each side of the thorax and the elytral sutures are prolonged into sharp spines. Females have much shorter antennae than the males, but they are still longer than the body (Webb, 1909). *M. titillator* is almost identical to *M. carolinensis* (Akbulut & Stamps, 2012), but can be separated from *M. carolinensis* by examination of the male genitalia. Adults of *M. carolinensis* and *M. titillator* are characterized by an elongate, rather slender body, moderate to long legs, with variegated pubescence throughout the elytra (Pershing & Linit, 1985). *M. titillator* is usually larger, it ranges from 17.5-30 mm, whereas *M. carolinensis* ranges from 13-22.5 mm. The elytral apices form an acute angle with the suture in *M. carolinensis* and a right angle with the suture in *M. titillator* (Dillon & Dillon, 1941). In male *M. titillator,* the median lobe of the genitalia is bluntly rounded, whereas it is pointed in *M. carolinensis* (Pershing & Linit, 1985).

Detection and inspection methods

There is little specific information on detection and inspection for *M. titillator,* but *Monochamus* spp. are attracted to weakened, dying or dead host trees. Therefore, such trees, which often have partly or completely discoloured needles, should be the focus of surveillance for *Monochamus* spp. Close inspection may allow the detection of oviposition slits in the bark of dead or dying trees, oval-shaped larval entrance holes in the sapwood under the dead bark, or round adult exit holes in the sapwood. For *M. carolinensis* and *M. titillator,* females apparently prefer to lay their eggs in partial shade. The phloem in this area soon turns brown which can make it easy to find eggs (Alya & Hain, 1985). *Monochamus* spp. larvae can be extracted from the bark or sapwood, and adults can be found walking or resting on cut or dead wood during the summer (EFSA, 2018). The most efficient detection method is trapping (see below). Blatt *et al.* (2019) caught *M. marmorator, M. notatus* and *M. scutellatus* in traps in plantations of healthy Christmas trees (*Abies balsamea*) showing that there are exceptions to the general association between *Monochamus* spp. and weakened or dead trees.

Trapping

Billings and Cameron (1984) found that *M. titillator* showed no response to a southern pine beetle trap (*Dendroctonus frontalis* Zimmermann) containing frontalin, trans-verbenol and pine turpentine, but traps baited with an *Ips* attractant paste containing ipsenol, ipsdienol and cis-verbenol were attractive. Billings (1985) found that *M. titillator* did not respond to frontalin plus pine turpentine, but turpentine had a synergistic effect when added to a paste of ipsenol, ipsdienol and cis-verbenol, increasing catches by sevenfold when compared to turpentine or the *Ips* pheromone mixture alone.

The application of Teflon or Fluon to cross-vane, panel or multiple funnel traps can significantly increase capture and retention of *Monochamus* sp. adults (Allison *et al.*, 2016, Allison & Redak, 2017, Álvarez *et al.*, 2015, Boone *et al.*, 2019, Graham *et al.*, 2010).

In a large study at 16 sites across North America, Miller *et al.* (2013) demonstrated that multiple-funnel traps baited with a blend of ipsenol, ipsdienol, ethanol and ?-pinene were attractive to the *M. titillator / M. carolinensis* complex, *M. scutellatus, M. clamator, M. obtusus* and *M. maculosus.* This mixture of four compounds, was more effective than unbaited traps or traps with a mixture of ipsenol and ipsdienol or traps with a mixture of ethanol and ?-pinene. Ethanol is produced by stressed conifer trees and ?-pinene is a constituent of the oleoresin of most pine species. Ipsenol and ipsdienol occur naturally in pine forests (Miller *et al.* 2013).

Ryall *et al.* (2015) provided evidence that monochamol is attractive to *M. scutellatus*, *M. notatus* and *M. carolinensis* which supported evidence from previous studies (e.g Fierke *et al.* (2012); Allison *et al.* (2012)). The studies also demonstrated a synergism between monochamol and host volatiles. Allison *et al.* (2012) showed that monochamol is attractive to *M. titillator* as well as to traps baited with (2R*,3R*)-2,3-hexanediol plus -pinene (but not to traps baited with (2R*,3R*)-2,3-hexanediol alone). There is evidence showing that monochamol is attractive to 12 *Monochamus* species and so it has excellent potential for surveys of beetles of the genus (Ryall *et al.*, 2015).

Miller *et al.* (2016) tested the efficacy of different combinations of ?-pinene, monochamol and ipsenol for catching *Monochamus* spp. in two Canadian provinces and eight states in the USA. The study provided evidence of the beneficial effect of including both monochamol an ipsenol in lures. Monochamol did not increase catches of other Cerambycidae, bark beetles, other weevils or bark beetle predators.

Boone *et al.* (2019) tested the efficacy of teflon-coated cross-vane traps with four lures monochamol: 2 mg/day; ipsenol: 2.5 mg/day, 2-methyl-3-buten-1-ol: 10 mg/day; and ?-pinene: 500 mg/day. Large numbers of *M. carolinensis* , *M. maculosus*, *M. notatus*, *M. scutellatus*, *M. clamator*, and *M. titillator* were trapped in North America, while large numbers of *M. alternatus* were trapped in China. This result demonstrated that such traps could be used for the detection of non-native *Monochamus* spp. in Europe.

PATHWAYS FOR MOVEMENT

There is no specific information on the pathways for *M. titillator* and so the following information is generic to the genus. *Monochamus* spp. are able to naturally disperse by flight. A number of dispersal studies have been carried out with *Monochamus spp.* For example, *Monochamus alternatus* adult were shown to be able to disperse 3.3 km from infested logs to diseased trees (Kobayashi *et al.*, 1984). In a mark-recapture experiment in Spain, *Monochamus galloprovincialis* (Olivier) flew a maximum of 22.1 km with around 2% of beetles flying further than 3 km (Mas *et al.*, 2013).

Pinewood nematode, which is vectored by *Monochamus* spp. has been found to be able to spread at a mean rate of 5.3 km per year in Portugal (de la Fuente *et al.*, 2018), 6 km / year in Japan (Togashi & Shigesada, 2006) and an estimated 7.5 km / year in China (Robinet *et al.*, 2009). However, long distance man assisted spread of pine wood nematode can occur over much larger distances with a mean annual dispersal of 111-339 km estimated in China (Robinet *et al.*, 2009). *Monochamus* spp. can be spread in coniferous wood and coniferous wood packaging material, dunnage, particle wood and waste conifer wood, hitchhiking and in finished wood products (EFSA, 2018, Ostojá-Starzewski, 2014). Between 1998 and 2018 there were 124 interception records of *Monochamus* sp. on wood packaging material in the EU (EFSA, 2018). Between 1984 and 2008, there were 42 interceptions of *Monochamus* spp. on wood packaging material in the USA which were identified to species level: *M. alternatus* (17), *M. carolinensis* (2), *M. clamator* (1), *M. galloprovincialis* (5), *M. sartor* (5), *M. scutellatus* (2), *M. sutor* (9) and *M. teserula* (1) (Eyre & Haack, 2017). Plants for planting are considered to be an unlikely pathway for the spread of *Monochamus* spp. because they tend to attack weakened or dead trees (EFSA 2018). However, the trapping of *Monochamus* spp. in plantations of healthy Christmas trees (*Abies balsamea*) suggests there would be some risk in importing host trees from North America into the EPPO region (Blatt *et al.*, 2019).

PEST SIGNIFICANCE

Economic impact

There is little specific information about the impacts of *M. titillator*, although, at an outbreak site in Mississippi, approximately 25% of the wood in each log infested by *M. titillator* was damaged (Webb, 1909).

Monochamus are not considered to be plant pests in their own right because they do not tend to attack healthy trees however, they can damage timber and can facilitate the introduction and spread of pine wood nematode in Europe (EFSA, 2018). *Monochamus* spp. rarely, if ever, attack vigorously growing trees (Gibson, 2010). However, the impact from *Monochamus* spp. in the USA is high, largely due to the export restrictions of forestry products associated with pine wood nematode, *Bursaphelenchus xylophilus* (Miller *et al.*, 2013). In the USA, *Monochamus* spp. larvae, are also responsible for extensive damage to fire damaged, dying, recently killed, and felled conifers of various species—but especially pines, spruce, true firs, and Douglas-fir. The larvae damage infested trees and logs through series of extensive mines that introduce decay-causing fungi (Baker, 1972, Gibson, 2010). Wood chips harvested from wood infested by *Monochamus* species can be too small for use at pulp mills (Wilson, 1962).

Control

Prompt salvage and utilization of windthrow and dead and dying trees, debarking recently dead trees, and water storage of logs will prevent attacks by *M. titillator* (Baker, 1972, Duffy, 1960, Webb, 1909).

This paragraph relates to other *Monochamus* spp. but the control methods are likely to be applicable to the genus. Wilson (1962) studied attacks by wood boring insects on stacks of felled balsam fir, *Abies balsamea* in Minnesota. *M. scutellatus* was the most frequently observed cerambycid beetle, accounting for c. 90-95% of all beetles observed. *M. notatus* and *M. marmorator* were also occasionally observed. Piles of wood placed in full shade suffered less damage and wood in standard piles with less wood exposed to beetle damage suffered less damage than wood stacked in open perpendicular layers (‘pens’). The average volume of wood lost from standard piles of wood over two years in the sun ranged from 0.47% of interior logs to 2.64% for exterior logs and for piles in the shade from 0.37% for interior logs to 0.59 % for interior logs. Damage to felled wood can be reduced by: i) transporting wood as soon as possible after felling; ii) placing wood in the shade of other trees; ii) covering wood in a layer of 45 cm of slash; iv) stacking wood in standard piles to reduce the area exposed to beetle attacks; v) removing bark from felled wood; vi) immersing logs in water; vii) applying insecticides to exposed wood (Wilson, 1962, Wilson, 1975). *Monochamus* damage can be prevented by not exposing wood during the July-September egg laying period and minimized by processing any infested wood as soon as possible (Gibson, 2010).

M. titillator are parasitized by the wasp *Bracon webbi* (Vierk) (Duffy, 1960, Webb, 1909). Larvae are frequently attacked in the pupal cells by a tachinid (Craighead, 1923, Duffy, 1960) and the adults of this and most species of *Monochamus* are frequently covered with clusters of mites (Duffy, 1960).

Phytosanitary risk

High populations of *M. titillator* are frequently associated with tree stress due to drought conditions, windstorms, physiological stress, bark beetle epidemics, defoliator depredations, logging etc. Under these conditions wood damage will occur if timber is not salvaged promptly (Alya & Hain, 1985). The introduction of non-native *Monochamus* spp. into Europe could introduce pine wood nematode to new locations and hosts and enhance the rate of spread of the pest. Pinewood nematode causes severe damage to forests in East Asia and in Europe and the impacts are likely to increase (EFSA, 2018). *M. titillator* is known to be a vector of pinewood nematode (Akbulut & Stamps, 2012).

PHYTOSANITARY MEASURES

The EU has emergency measures to prevent the spread of pinewood nematode within the union (EU, 2012). These measures include demarcating areas, destruction of contaminated material, heat treatment of wood and wood products, hygiene protocols for forestry vehicles and transport conditions for plants, wood and bark (EFSA, 2018). Measures to reduce the risk of wood becoming infested during transit include: not transporting wood through infested areas; not transporting wood during the flight season or covering the wood during transit. Debarking of harvested wood can also reduce risks from *Monochamus* spp. (EFSA, 2018).

Recommended phytosanitary measures to reduce the risk of the introduction and spread of non-European *Monochamus spp.* and pinewood nematode are set out in the EPPO commodity standard for Coniferae, PM 8/2 (3). For example, there are recommendations by host species to reduce the risk of introducing pinewood nematode or its *Monochamus* sp. vectors on wood, such as pest free areas, treatment of wood and conditions for the transport of the wood (EPPO, 2018).

The treatment of wood according to ISPM 15 will reduce the risk of the introduction of xylophagous pests such as *Monochamus* spp. and pine wood nematode being introduced to previously uninfested areas in wood packaging material, although treatments are not always applied effectively (Haack *et al.*, 2014).

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