

NURSERY PAPERS

OCTOBER
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Polyphagous Shot Hole Borer

Euwallacea fornicatus

DESCRIPTION

Scientific name:	<i>Euwallacea fornicatus</i> (Eichhoff, 1868) / <i>Fusarium</i> sp.
Synonyms:	<i>Xyleborus fornicatus</i> Eichhoff, 1868, <i>Xyleborus perbrevis</i> Schedl, 1951, <i>Xyleborus schultzei</i> Schedl, 1951, <i>Xyleborus tapatapaensis</i> Schedl, 1951
Order:	Coleoptera
Family:	Curculionidae/ Hypocreales
Status:	Environmental pest

SUMMARY

Polyphagous shot hole borer (PSHB) is a complex organism that carries the fungal disease *Fusarium euwallaceae*. Native to Asia, in August 2021 it was detected in Western Australia (WA). PSHB is classified as an environmental pest because of the high risk it poses to acacia trees which are a prominent feature of environmental significance in the Australian landscape. Apart from a risk to the environment PSHB also poses a risk to urban landscape trees. Assessments from the United States indicate that the economic risk to amenity tree plantings in the urban environment will be high if PSHB is not contained and eradicated from its current quarantine zone in WA. This nursery paper provides information on the insect morphology, life cycle, host range, symptoms of damage, current quarantine zones and information to support monitoring and reporting of PSHB.



Adult female PSHB (DPIRD, 2022)

BACKGROUND

PSHB is known to affect more than 400 tree host species in horticulture production, native and amenity settings.

Comprised of the beetle itself PSHB and its fungal symbiont carries and introduces the fungal organism to reproductive tree hosts as food for their young. Fungal symbionts carried by the beetle can vary, and are often multiple, however the fungal species detected in Australia is described as *Fusarium* AF-18.

The first detection in Australia of PSHB was made in East Fremantle, WA in August 2021 in amenity box maple trees (*Acer negundo*).



Comparison of larvae sizes, NSW DPI

Host plants

PSHB has a known host range of more than 400 plant species in 75 families, usually attacking cut, stressed, or dying trees, small stems and branches. Attacks on healthy plants also occur. WA Department of Primary Industries and Regional Development (WA DPIRD) is currently determining the local reproductive host range as PSHB may behave differently in WA. The box elder maple tree (*Acer negundo*) has been identified as the main host and amplifier tree for PSHB in WA although it is expected that the host species list will expand as PSHB is extremely polyphagous. Other key hosts for surveillance include maple (*Acer*), oak (*Quercus*), plane (*Platanus*), coral (*Erythrina*), avocado (*Persea*), locust (*Robinia*), fig (*Ficus*) and poplars (*Populus*) trees.

Reproductive hosts

PSHB has a symbiotic relationship with the fungus *Fusarium euwallaceae*, which is a food source for the beetle and its larvae. Reproductive hosts are those plants in which the beetle and the fungi it feeds on can complete their life cycle. Reproductive host trees facilitate the establishment and spread of PSHB. The health of these trees is negatively impacted by PSHB infestation and associated establishment of the *Fusarium euwallaceae* fungus which disrupts water and nutrient movement within the vascular system, causing the disease Fusarium dieback.

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Additional genera that have been identified as reproductive hosts and key hosts for surveillance in Australia are:

- acacia (*Acacia*)
- castor oil (*Ricinus*).

Non-reproductive hosts

Non-reproductive hosts are attacked by the beetle, but PSHB are not reported as able to establish galleries and complete their lifecycle on these species. These hosts are not expected to die from PSHB infestation.

Symptoms

PSHB is a wood boring beetle that introduces *Fusarium* fungi to trees as it tunnels through stressed and healthy stems and branches of

trees. The fungus spreads through these tunnels causing damage to the vascular tissue of the tree interrupting the flow of water and nutrients causing dieback. Females usually colonise the base of secondary branches, resulting in localised branch dieback

Symptoms to look for in affected trees are:

1. Beetle entry holes about 2mm in diameter or the size of the tip of a ballpoint pen
2. Discolouration or staining of wood cause by the *Fusarium* fungus
3. Gumming which is thick resin or sap exuded by the tree as a defence. This sometimes pushes the beetle out or smothers it.



Beetle entry holes (DPIRD, 2022)

4. Sugar exudates or “volcanoes” – a crystalline foam exuded from entry/exit holes (common on avocado trees)
5. Frass produced by beetles tunnelling, can be an indicator of high pest population
6. Dieback of tree branches and tree death.

TABLE 1. Reproductive host trees for polyphagous shot hole borer (as at August 2022)

Scientific name	Common name
<i>Acer negundo</i>	Box elder maple
<i>Bauhinia</i> spp.	Orchid tree
<i>Citrus x latifolia</i>	Tahitian lime
<i>Corymbia ficifolia</i> *	Red flowering gum
<i>Delonix regia</i>	Poinciana
<i>Eriobotrya japonica</i>	Loquat
<i>Erythrina caffra</i>	African coral tree
<i>Erythrina x sykesii</i>	Coral tree
<i>Ficus carica</i>	Common fig
<i>Ficus elastica</i>	Rubber tree
<i>Ficus macrophylla</i> *	Moreton Bay fig
<i>Ficus rubiginosa</i> *	Port Jackson fig
<i>Gleditsia triacanthos</i>	Honey locust
<i>Mangifera indica</i>	Mango
<i>Persea americana</i>	Avocado
<i>Platanus x acerifolia</i>	London plane tree
<i>Populus nigra</i>	Black poplar
<i>Quercus suber</i>	Cork oak
<i>Ricinocarpus tuberculatus x cyanescens</i> **	Wedding bush
<i>Robinia pseudoacacia</i>	Robinia, Mop top robinia
<i>Salix babylonica</i>	Weeping willow
<i>Sapindus saponaria</i> subsp. <i>drummondii</i>	Western soap berry
<i>Schefflera actinophylla</i> *	Australian umbrella tree
<i>Ulmus</i> sp.	Elm
<i>Wisteria</i> sp.	Wisteria
<i>Zelkova serrata</i>	Zelkova, Japanese elm

* Australian native, ** Western Australian native.
Source: WA DPIRD, 2022

Highly susceptible reproductive host

TABLE 2. Non-reproductive host trees for polyphagous shot hole borer (as at August 2022)

Scientific name	Common name
<i>Aleurites moluccanus</i>	Candlenut
<i>Brachychiton populneus</i> *	Kurrajong, Bottle tree
<i>Cassia fistula</i>	Golden shower tree
<i>Citrus limon</i>	Lemon
<i>Citrus x meyeri</i>	Meyer / Eureka lemon
<i>Dovyalis caffra</i>	Kei apple
<i>Dracaena</i> sp.	Dracaena
<i>Erythrina indica</i>	Coral tree
<i>Fatsia japonica</i>	Japanese aralia
<i>Ficus benjamiana</i>	Weeping fig
<i>Fraxinus</i> sp.	Ash tree
<i>Hibiscus</i> sp.	Hibiscus
<i>Jacaranda mimosifolia</i>	Jacaranda
<i>Morus alba</i>	White mulberry
<i>Morus nigra</i>	Black mulberry
<i>Platanus occidentalis</i>	American sycamore
<i>Prunus cerasifera</i>	Cherry plum
<i>Pyrus calleryana</i>	Callery pear
<i>Schotia brachypetala</i>	Drunken parrot tree
<i>Styphnolobium japonica</i>	Weeping saphora / sappora
<i>Syzygium smithii</i> *	Lilly pilly
<i>Talipariti tiliaceum</i> (syn. <i>Hibiscus tiliaceus</i>)*	Sea hibiscus, Cottonwood
<i>Templetonia retusa</i> **	Cockie's tongue

* Australian native, ** Western Australian native.
Source: WA DPIRD, 2022



Tree branch dieback (Joseph O'Brien, 2018)

Insect Phenology

The adult female beetles are 2mm long and tunnel into the tree's stems and branches, as small as 20mm in diameter to large trees causing damage and dieback. Adults and larvae are spread with the movement of infested trees, firewood, and green waste material. After mating, female borers disperse during the day to look for suitable host trees and may fly up to 400 metres. Although generally they will fly to hosts within a 30-35m range. Adults of PSHB develop in 22 days at 24°C.

Impact

PSHB is confirmed as present throughout Asia and has recently been detected in the USA and Israel causing damage to the avocado industry and it has caused significant economic impact in urban tree environments in South Africa

PSHB was assessed as a high environmental risk to Australian acacia species (PHA, 2021). In The National Priority List of Exotic Environmental Pests, Weeds and Diseases, PSHB was determined to be a significant environmental risk (DAWE, 2021). The PSHB/Fusarium wilt complex is thus primarily recognised as an environmental pest threat to Australia.

Comprising 8.2% of Australia's total forested area, acacia is the second-most dominant natural forest taxa in Australia. They are a keystone environmental species, across a range of marginal habitats, as resources for native animals, stabilising soils and playing an integral role in nutrient cycling through nitrogen fixation. If their population is affected by PSHB it will also impact negatively on Aboriginal communities as the plants are used medicinally, as food sources and in making tools and musical instruments.

Damage to amenity trees and urban environments from PSHB presents a risk to public safety through falling limbs, death of trees, increased fire danger, risk of flooding from blocked waterways, loss of shade and associated benefits of green spaces. Surveys performed on incursions of the beetle in South Africa and the US have indicated that the major economic impact in Australia due to PSHB infestation will relate to urban tree management and removal.

Monitoring

Growers should be on the lookout for multiple beetle entry holes, discolouration and staining of wood, gumming or gummosis, sugar volcanoes, presence of frass and wilting and dying branches indicating tree dieback. Tree dieback often starts in the upper canopy of affected trees.

Monitor susceptible trees particularly Box Elder Maples (*Acer negundo*) by checking for dieback in the canopy, borer holes around larger stems and branch collars and in any fallen limbs. Regular monitoring should be performed regularly for PSHB in any of the quarantine areas of WA listed in the map on the next page.

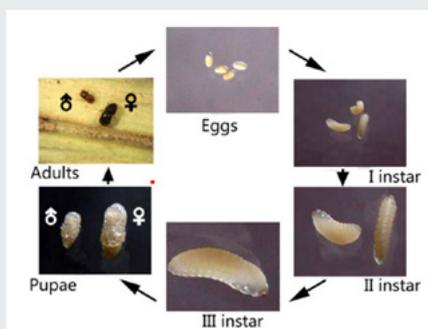
Identification

The life cycle of PSHB varies with host plant and temperature but takes about one month to reach adulthood.

Eggs – Females bore a tunnel in branches and stems of reproductive host trees creating a parental gallery. Egg laying commences as soon as the tunnel entrance has been completed. The eggs are off-white, partly translucent and about 0.3 mm long, hatching in four to six days. Eggs can be laid singly or in groups, freshly laid eggs are pale in colour darkening as they age.

Larvae – Occurring in three instars (stages) mature larva are about 3.5 mm long and 1.1 mm wide. Larvae are white, legless, C-shaped, with a reddish orange head, feeding entirely on the fungus taking 16-18 days to pupate

Pupae – Pupae are white, the same size as the adults and pupate in the tunnels. Pupation takes 7 to 9 days and occurs in the parenting chamber. After emergence from the pupal stage, young females remain in the galleries for several days while they are fertilised by males. Optimum temperatures for development are 28°C and 30°C with development time of



PSHB lifecycle (University of Florida, 2018)

pupae significantly slower at 18°C at 15 days compared to 6 days at 28°C.

Adults – Adults are small, robust, weevil-like beetles with a hard, rounded appearance. Males are rare, wingless, and brown, 1.5mm to 1.7mm long, and have large, sharp mandibles that are suspected to be used for fighting with other males or predators. Females are 1.8mm to 2.5mm long, and black or near black. Mated females disperse during the day, usually infesting trees within 35 metres, but can travel up to 400 metres to find a new host.

Prevention

Currently the Western Australian government Department of Primary Industries and Regional Development (DPIRD) is responding to the confirmed detections of the exotic beetle PSHB in the Perth metropolitan area. Response activities include:

- Conducting surveillance to determine the distribution of PSHB
- Containing the pest to prevent further spread to non-infested regions within Western WA
- Providing advice and information to residents, industry, and other stakeholders
- Ensuring that all response activities are conducted safely, consistently.

Training for identification of PSHB is available through DPIRD: <https://regtraining.dpird.wa.gov.au/externaluser/login/index.php>

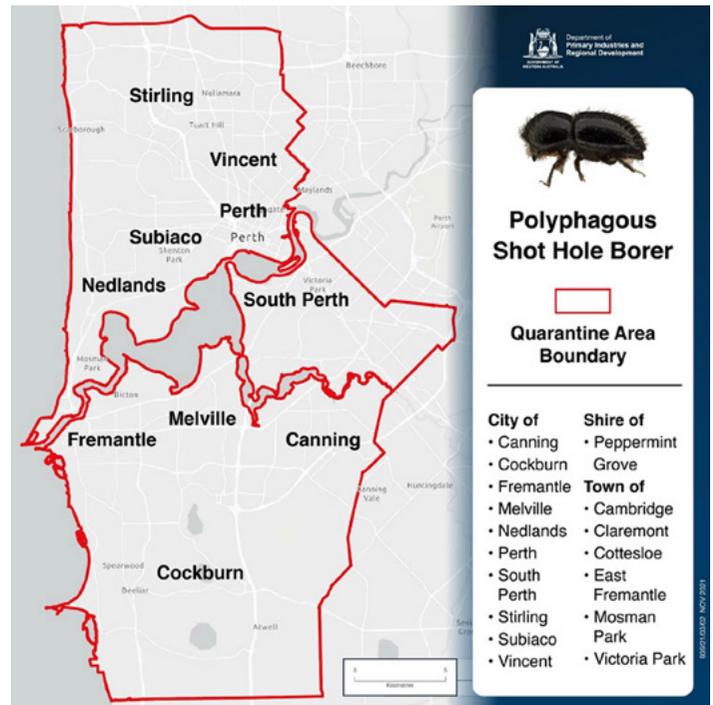


Within the Quarantine Area (WA)

PSHB spreads with the movement of infested trees, firewood, and green waste material. To minimise dispersal of the PSHB in WA, directives are in place that wood must be chipped to pieces that are less than 2.5cm in diameter before leaving the quarantine area. Living plants with woody stems greater than 2cm must not leave the quarantine area, and machinery used to handle green waste must be cleaned of wood material prior to leaving the quarantine area.

It is anticipated that an extensive response plan for PSHB will be developed to eradicate PSHB using the following methods:

- removing infested reproductive host trees
- managing infested non-reproductive trees
- tracing and surveillance
- compliance
- community engagement



ANYTHING UNUSUAL should be reported to the **Exotic Plant Pest Hotline** on **1800 675 888** or through the **MyPestGuide Reporter App**. Early detection significantly improves the chances of eradication.

ADDITIONAL INFORMATION

Additional information as well as fact sheets can be found at either of the links below:

Pest Identification Images - <https://pestid.com.au/>

Training for identification of PSHB is available through DPIRD: <https://regtraining.dpird.wa.gov.au/externaluser/login/index.php>

Report suspect PSHB infestation - DPIRD Pest and Disease Information Service +61 (0)8 9368 3080 or email padis@dpird.wa.gov.au

ATTRIBUTION

The 'National biosecurity and sustainable plant production program' (NY20001) project is funded by Hort Innovation using nursery research and development levy and funds from the Australian Government.

REFERENCES

CABI invasive species compendium, (2022), *Euwallacea fornicatus* (polyphagous shot-hole borer), <https://www.cabi.org/isc/datasheet/18360453#totaxonomicTree> Viewed 29/08/2022

Commonwealth of Australia, 2022, National pest and disease outbreaks - Polyphagous shot-hole borer. <https://www.outbreak.gov.au/current-responses-to-outbreaks/polyphagous-shot-hole-borer> Viewed 30/08/2022.

Department of Primary Industries and Regional Development (DPIRD), 2022. Biosecurity Alert: Polyphagous Shot hole borer. Viewed 30/08/2022

Department of Primary Industries NSW (NSW DPI), Unknown, Polyphagous shot hole borer, <https://www.dpi.nsw.gov.au/biosecurity/plant/insect-pests-and-plant-diseases/polyphagous-shot-hole-borer> Viewed 30/08/2022

Pest ID Tool, 2022, unknown, Polyphagous shot hole borer; Shot-hole borer; Ambrosia borer; Ambrosia beetle

Euwallacea fornicatus. <https://www.pestid.com.au/pest-insect/tea-shot-hole-borer-shot-hole-borer-polyphagous-shot-hole-borer-ambrosia-borer> Viewed 02/09/2022

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