



Polyphagous Shot Hole Borer

Appendix 5

Introduction:

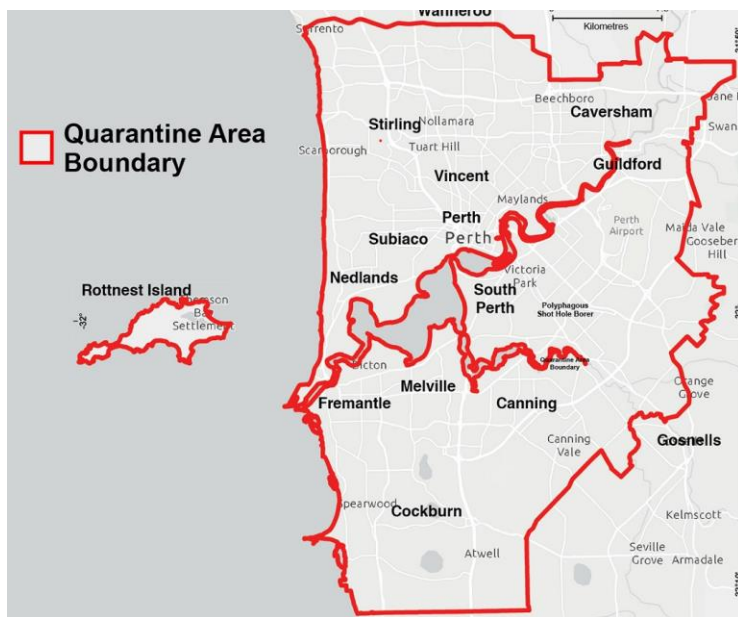
Polyphagous Shot-Hole Borer (PSHB), *Euwallacea fornicates* is a small ambrosia beetle measuring less than 2mm in length originating from South-East Asia. There are over 40 species identified within the *Euwallacea* genus, and potentially several subspecies of *fornicates* throughout the world. Ambrosia beetles in the *Euwallacea* genus have symbiotic relationships with *Fusarium*, a fungus which the beetle uses as a food source for the adults and its larvae, causing *Fusarium* dieback (FD) which can result in tree death.

PSHB was first detected in Western Australia in August 2021 in the Town of East Fremantle by a member of the public and reported to Department of Primary Industries and Regional Development (DPIRD). [2]

Response:

Since the first sightings, DPIRD has issued a Quarantine Area Notice (QAN) and set up an ongoing surveillance program to determine and monitor the spread of PSHB. The Quarantine Area (QA) covers 25 Local Government Areas (LGA'S).

The QAN restricts the movement of wood and plant materials from properties as the materials could host PSHB and possibly spread the pest. Movement is allowed within the QA to specific locations (collection points) and can only be moved outside of the QA if it has been chipped to less than 2.5cm.



Map 1: PSHB Quarantine Area Boundary Current as of May 2024

Identification of PSHB (*Euwallacea fornicates*):

Adult females -
Size: < 2mm in length
Colour: Brown to black
Features: Wings

Adult males-
Size: ~ 1.6mm in length
Colour: Brown to black
Features: No wings

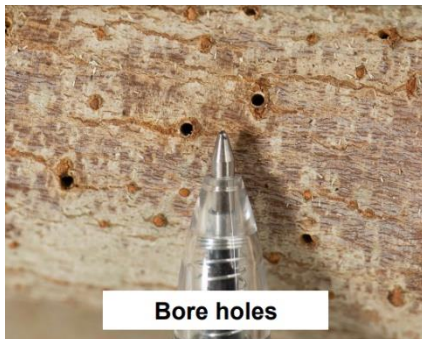
Larvae -
Size: 3.5mm long and 1.1mm wide
Colour: White with reddish head
Features: C-shape, legless



Figure 1: Adult female *Euwallacea fornicates*

Signs & Symptoms:

The most obvious and easily visible symptom of PSHB is *Fusarium* dieback, which will typically start at the top of the canopy and result in loss of leaves. While dieback is a symptom associated with many pests and diseases, it's important to look closer. Below is a list of signs and symptoms associated with PSHB.



1. Bore holes or beetle entry holes are used as an entrance by PSHB and are approximately the size of the tip of a ball point pen.

2. Galleries (or tunnels) are created by the beetle to house eggs and larvae. These tunnels are infected with a *Fusarium* fungus, which is used as a food source.





3. Frass is the waste product produced as the beetle creates tunnels. Frass is not always present but can indicate a high level of infestation.

4. Gumming (gummosis) is an injury response in some trees, where it produces sap to protect a wound. In the case of PSHB multiple small entry points may become more visible.



5. Sugar volcanos (similar to gumming), is an injury response in some trees; most commonly found *Acer sp.* Excretion of sugars can cause further issues such a sooty mould

6. Lesions or staining may appear on the bark around borer entry holes as a result of sap or the infecting fungus



Host Trees:

DPIRD have compiled a list of trees susceptible to the beetle. This list has been divided into two groups, reproductive hosts, and non-reproductive hosts, each being split into exotic, Australian native, and Western Australian (WA) native species.

Reproductive Host Trees:

Host trees, in which both the beetles and the fungus establish, are where the beetle successfully reproduces. Some reproductive hosts can be killed by PSHB.

Preferred hosts are host trees that have been recorded as reproductive on at least three properties and are typically associated with moderate to heavy infestation levels.

Preferred Host Trees in Western Australia:

- *Acer negundo* - Box elder maple (highly susceptible reproductive hosts that die within two years of PSHB attack. They amplify the PSHB population and increase the risk to surrounding areas).
- *Coprosma repens* - Mirror bush
- *Delonix regia* - Poinciana
- *Erythrina x sykesii* - Coral tree
- *Ficus macrophylla* - Moreton Bay fig
- *Ficus rubiginosa* - Port Jackson fig
- *Morus alba* - White mulberry
- *Morus nigra* - Black mulberry
- *Platanus x acerifolia* - London plane tree
- *Robinia pseudoacacia* - Robinia, mop top robinia, black locust

Reproductive Host Trees:

*Australia Native ** Western Australian Native

Scientific Name	Common Name
<i>Acalypha wilkesiana</i>	Copperleaf
<i>Acer buergerianum</i>	Trident maple
<i>Albizia lebeck</i> **	Broome raintree, lebeck tree
<i>Archontophoenix cunninghamiana</i> *	Bangalow palm, King palm, Illawara palm
<i>Banksia littoralis</i> **	Swamp banksia
<i>Banksia prionotes</i> **	Acorn banksia
<i>Bauhinia variegata</i>	Orchid tree
<i>Bauhinia variegata var. candida</i>	Orchid tree
<i>Bossiaea linophylla</i> **-	Leaved Bossiaea
<i>Brachychiton acerifolius</i> *	Illawarra flame tree
<i>Brugmansia arborea</i>	Angel's trumpet
<i>Brugmansia suaveolens</i> t	Angel's trumpe

<i>Buxus sempervirens</i>	Caucasian boxwood
<i>Callistemon viminalis</i> ** (syn. <i>Melaleuca viminalis</i>)	Creek bottlebrush
<i>Castanospermum australe</i> *	Moreton Bay chestnut
<i>Casuarina cunninghamiana</i> *	River sheoak
<i>Casuarina obesa</i> **	Swamp sheoak
<i>Ceratonia siliqua</i>	Carob tree
<i>Citrus x aurantium</i>	Bitter orange, Seville orange
<i>Citrus x latifolia</i>	
<i>Coprosma repens</i>	Mirror bush
<i>Corymbia calophylla</i> **	Marri
<i>Corymbia ficifolia</i> **	Red flowering gum
<i>Delonix regia Poinciana</i>	Cape wedding flower
<i>Dombeya tiliacea</i> (syn. <i>Dombeya natalensis</i>)	
<i>Dovyalis caffra</i>	Kei apple
<i>Dracaena reflexa</i> var. <i>angustifolia</i>	Song of India
<i>Duranta erecta</i>	Golden dewdrops
<i>Erythrina caffra</i>	African coral tree
<i>Erythrina x sykesii</i>	Coral tree
<i>Eucalyptus cladocalyx</i> *	Sugar gum
<i>Eucalyptus globulus</i> *	Southern blue gum
<i>Eucalyptus robusta</i> *	Swamp mahogany
<i>Eucalyptus rudis</i> **	Flooded gum
<i>Ficus benjamina</i> *	Weeping fig
<i>Ficus carica</i>	Common fig
<i>Ficus elastica</i>	Rubber tree
<i>Ficus macrophylla</i> *	Moreton Bay fig
<i>Ficus microcarpa</i> *	Green Island fig
<i>Ficus rubiginosa</i> *	Port Jackson fig
<i>Ficus sycomorus</i>	Mulberry fig
<i>Fraxinus angustifolia</i>	Narrow-leaf ash
<i>Gleditsia triacanthos</i>	Honey locust
<i>Grevillea robusta</i> *	Silky oak
<i>Ligustrum japonicum</i>	Japanese privet
<i>Liquidambar styraciflua</i>	Sweet gum, liquidambar
<i>Harpephyllum caffrum</i>	Kaffir plum
<i>Heptapleurum actinophyllum</i> (syn. <i>Schefflera actinophylla</i>)*	Australian umbrella tree

<i>Heptapleurum arboricola</i> (syn. <i>Schefflera arboricola</i>)	Dwarf umbrella tree
<i>Hibiscus mutabilis</i>	Confederate rose
<i>Hibiscus rosa-sinensis</i>	Chinese hibiscus
<i>Koelreuteria paniculate</i>	Golden rain tree
<i>Macadamia integrifolia</i> *	Macadamia nut
<i>Magnolia grandiflora</i>	Southern magnolia
<i>Mangifera indica</i>	Mango
<i>Melaleuca quinquenervia</i> *	Paper bark
<i>Melaleuca raphiophylla</i> **	Swamp paperbark
<i>Morus alba</i>	White mulberry
<i>Morus alba</i> 'Pendula'	Weeping mulberry
<i>Morus nigra</i>	Black mulberry
<i>Persea americana</i>	Avocado
<i>Platanus x acerifolia</i>	London plane tree
<i>Platanus occidentalis</i>	American sycamore
<i>Populus deltoides</i>	Eastern cottonwood
<i>Populus nigra</i>	Black poplar
<i>Populus simonii</i>	Simon's poplar
<i>Prunus cerasifera</i>	Cherry plum
<i>Pyrus calleryana</i>	Callery pear
<i>Quercus chrysolepis</i>	Canyon live oak
<i>Quercus petraea</i>	Durmast oak
<i>Quercus robur</i>	English oak
<i>Quercus suber</i>	Cork oak
<i>Rhaphiolepis loquata</i> (syn. <i>Eriobotrya japonica</i>)	Loquat
<i>Ricinocarpos pinifolius</i> *	Wedding bush
<i>Ricinocarpos tuberculatus x cyanescens</i> **	Ricinocarpos bridal star, wedding bush.
<i>Ricinus communis</i>	Castor oil
<i>Robinia pseudoacacia</i>	Robinia, mop top robinia, black locust
<i>Salix babylonica</i>	Weeping willow
<i>Salix matsudana</i>	Corkscrew willow
<i>Salix humboldtiana</i>	Humboldt's willow
<i>Sapindus saponaria</i> subsp. <i>drummondii</i>	Western soap berry
<i>Spyridium globulosum</i> **	Basket bush
<i>Syzygium smithii</i> *	Lilly pillly
<i>Talipariti tiliaceum</i> (syn. <i>Hibiscus tiliaceus</i>)*	Sea hibiscus, cottonwood
<i>Triadica sebifera</i> (syn. <i>Sapium sebiferum</i>)	Chinese tallow
<i>Ulmus glabra</i>	Wych elm, Scots elm
<i>Ulmus</i> sp. 1 cf. <i>glabra</i> or <i>minor</i>	Elm (Wych/Scots or Field)

<i>Wisteria sinensis</i>	Chinese wisteria
<i>Wisteria sp. 1</i>	Wisteria
<i>Zelkova serrata</i>	Zelkova, Japanese elm

Non-Reproductive Host Trees:

Host trees that are attacked but the beetles do not establish breeding galleries. The fungus may or may not cause disease. Trees are generally not expected to die.

Scientific Name	Common Name
<i>Acacia longifolia</i> *	Golden wattle
<i>Acacia retinodes</i> *	Silver wattle
<i>Acacia saligna</i> **	Orange wattle, golden wattle
<i>Acer palmatum</i>	Japanese maple
<i>Agonis flexuosa</i> **	Willow myrtle
<i>Albizia julibrissin</i>	Persian silk tree
<i>Aleurites moluccanus</i>	Candlenut
<i>Annona reticulata</i>	Bullocks heart
<i>Banksia grandis</i> **	Bull banksia
<i>Banksia integrifolia</i> *	Coast banksia
<i>Banksia menziesii</i> **	Menzie's banksia
<i>Bougainvillea sp.</i>	Bougainvillea
<i>Brachychiton populneus</i> *	Kurrajong, bottle tree
<i>Calodendrum capense</i>	Cape-chestnut
<i>Camellia japonica</i>	Common camellia
<i>Camellia oleifera</i>	Tea-oil camellia
<i>Carya illinoensis</i>	Pecan
<i>Cassia fistula</i>	Golden shower tree
<i>Casuarina equisetifolia</i> *	Coastal sheoak
<i>Cedrela sp.</i>	Cedrela
<i>Celtis sinensis</i>	Chinese hackberry
<i>Cestrum nocturnum</i>	Queen of the night, night jessamine
<i>Citharexylum spinosum</i>	Spiny fiddlewood
<i>Citrus x limon</i>	Lemon
<i>Citrus x meyeri</i>	Meyer / Eureka lemon
<i>Citrus paradisi</i>	Grapefruit
<i>Cordyline stricta</i> *	Narrow-leaf palm-lily
<i>Dombeya acutangula</i>	Bois bete
<i>Dracaena sp.</i>	Dracaena
<i>Elaeocarpus sp.</i>	Elaeocarpus

<i>Erythrina crista-galli</i>	Cockspur coral tree
<i>Erythrina lysistemon</i>	Common coral tree
<i>Erythrina variegata</i>	Indian coral tree
<i>Eucalyptus camaldulensis</i> **	Red river gum
<i>Eucalyptus gomphocephala</i> **	Tuart
<i>Euphorbia tirucalli</i>	African milkbush, naked lady, firesticks
<i>Fatsia japonica</i>	Japanese aralia
<i>Ficus benghalensis</i>	Indian banyan
<i>Ficus racemosa</i> *	Cluster fig
<i>Fraxinus angustifolia</i> subsp. <i>oxycarpa</i>	Claret ash
<i>Fraxinus griffithii</i>	Himalayan ash tree, evergreen ash
<i>Fraxinus</i> sp.	Ash tree
<i>Grevillea banksii</i> *	Red silky oak
<i>Grevillea rosmarinifolia</i> *	Rosemary grevillea
<i>Grewia occidentalis</i>	Crossberry
<i>Hakea multilineata</i> **	Grass-leaf hakea
<i>Hakea prostrata</i>	Harsh hakea
<i>Hakea Harpullia pendula</i> *	Moreton Bay tulipwood
<i>Hibiscus martianus</i>	Heartleaf rose-mallow
<i>Howea forsteriana</i> *	Kentia palm
<i>Inga edulis</i>	Ice-cream-bean
<i>Jacaranda mimosifolia</i>	Jacaranda
<i>Kigelia africana</i>	Sausage tree
<i>Lagunaria patersonia</i> *	Norfolk Island hibiscus
<i>Lambertia orbifolia</i> **	Roundleaf honeysuckle
<i>Lantana camara</i>	Lantana
<i>Ligustrum ovalifolium</i>	Privet
<i>Ligustrum sinense</i>	Chinese privet
<i>Ligustrum vulgare</i>	Common privet
<i>Magnolia figo</i>	Banana shrub
<i>Malus</i> sp. 1 'Crab apple'	Crab apple
<i>Morus rubra</i>	Red mulberry
<i>Olea europaea</i>	European olive
<i>Oncoba spinosa</i>	Snuff-box tree
<i>Pararchidendron pruinosum</i> *	Snow wood
<i>Paulownia tomentosa</i>	Empress tree
<i>Platanus orientalis</i>	Oriental plane
<i>Plumeria rubra</i>	Common frangipani

<i>Prunus armeniaca</i>	Apricot
<i>Rosa</i> sp. 'Restless'	<i>Rosa</i> sp. 'Restless'
<i>Salix alba</i>	White willow
<i>Schotia brachypetala</i>	Drunken parrot tree
<i>Stenocarpus sinuatus</i> *	Firewheel tree
<i>Sterculia quadrifida</i> **	Orange-fruit kurrajong
<i>Strelitzia nicolai</i>	Bird of paradise tree, wild banana
<i>Styphnolobium japonicum</i>	Weeping saphora / sappora
<i>Syzygium cumini</i>	Java plum
<i>Tecoma capensis</i>	Cape honeysuckle
<i>Tecoma stans</i>	Yellow trumpet tree
<i>Templetonia retusa</i> **	Cockie's tongue
<i>Tetrapanax papyrifer</i>	Chinese rice-paper plant
<i>Tipuana tipu</i>	Tipa
<i>Toona ciliata</i>	Australian red cedar, toon tree
<i>Ulmus pumila</i>	Siberian elm

Treatment:

At present the most effective form of treatment is removal of the tree (severe infestations) or reduction pruning of the infected branches (minor infestations). Infected limbs are then chipped to a size of < 2.5cm, and stumps are ground. This treatment method is estimated to be 99.99% effective in eliminating the beetle.

Trials are being conducted by DPIRD in the form of log traps and leading researchers are investigating chemical treatment options, but this is proving very difficult due to the beetle and fungus interrupting the natural vascular system of the tree or plant, meaning the chemical would not be effectively uptaken.

Management at Lake Claremont:

- Town staff have attended training sessions on how to identify and report suspected cases of infested trees to DPIRD.
- Volunteers can also be eyes on the ground when undertaking weeding activities.
- DPIRD have consulted with Traditional Owners and advised them of works undertaken.
- During the first six months of 2023 a total of thirty-two trees have been removed including Moreton Bay Figs, Banksias, Flooded Gums, Tasmanian Blue Gums, London Planes, Weeping Willows and assorted other Eucalypts.
- A further 77 trees were flagged for removal in early 2024 including a mixture of native and non-native species in the lake bed, bushland, Mulder Park and Stirling Road Park

- In addition to complete tree removal, in cases where the infestation is caught early, reduction pruning can be undertaken.
- The Town and FOLC will collaborate with DPIRD on the most suitable replacement species that will be less vulnerable to attack.
- Residents can apply for Adopt a Tree Program to aid in replacement of canopy loss by purchasing established tree stock for lake surrounds.
- Capital projects and budgets to be allocated for shade sails, picnic shelters and larger tree stock.
- Town tree contractors do a monthly sweep of the park and collect any fallen branches on one day and chip them at the mulch pile to minimise wood movement.
- Chipping of branches to the required size of less than 2.5mm in diameter
- The Town's communications team continues to post information and My Pest Guide Reporting App on social media and have brochures and measurement cards at the front administration desk so residents can be best informed about how to manage PSHB in their private gardens
- DPIRD continue to use Lake Claremont as a significant study site and have brought in international scientists to share knowledge on any potential alternative treatment methods

Reporting:

Any suspected cases can be reported to DPIRD via the below methods, along with a photo including a ballpoint pen or ruler in photos of bore holes. This assists them in assessing the size of the bore holes.

DPIRD Pest and Disease Information Service

- [**\(08\) 9368 3080**](tel:0893683080)
- [**padis@dpiird.wa.gov.au**](mailto:padis@dpiird.wa.gov.au)
- [**MyPestGuide® Reporter app**](#)
- [**mypestguide.agric.wa.gov.au**](http://mypestguide.agric.wa.gov.au)