



Small beetle,

BIG PROBLEM

by Dominic Castledine



It may be tiny, but the polyphagous shot-hole borer (*Euwallacea fornicatus*) is having a big impact on Perth's urban tree canopy. First detected in a suburban backyard in East Fremantle, this wood-boring beetle has since infested more than 3700 trees.





Originally from south-east Asia, polyphagous shot-hole borer (PSHB) is an invasive beetle about two millimetres in length that bores into the trunks and branches of certain trees. It has a symbiotic relationship with a fusarium fungus, which causes dieback in susceptible trees.

Female beetles carry the fungus from tree to tree in specialised pouches called oral mycangia, which are positioned on the sides of their mouth. The beetle farms the fungus as a food source.

As the beetle burrows into host plants, it constructs galleries, or tunnels, while

simultaneously inoculating the host tissue with the fungus. This disrupts the vascular system of the plant and stops the flow of water and nutrients, leading to dieback, and eventually, death in susceptible plants.

SIGNS AND SYMPTOMS

The hallmark signs of PSHB include tiny 'shot holes' the size of a ballpoint pen tip in trunks and branches, as well as intricate networks of tunnels or galleries that are stained black by the fusarium fungus.

Some trees such as the London planetree (*Platanus x hispanica*) may display staining from the fungus, while other trees including figs will try to push the beetles out by producing sap, also known as gumming.

Another symptom that may be seen in avocado trees is the presence of crystallised mounds known as sugar volcanoes, which are caused by the tree's response to the fungus and disruption to its vascular system.

Symptoms can vary greatly from tree to tree, depending on the level of infestation, host status and plant species.

UNPRECEDENTED BIOSECURITY RESPONSE

East Fremantle resident Joanne Taggart, first noticed symptoms of the invasive beetle on her box elder maple tree (*Acer negundo*) in August 2021. The tree was displaying signs of dieback and

dropping limbs that had unusual markings inside the branches.

Within hours of submitting photos via the MyPestGuide Reporter app, biosecurity staff and entomologists from the Department of Primary Industries and Regional Development (DPIRD) rushed out to inspect what would soon be the first case of PSHB in Australia.

An unprecedented biosecurity response is now underway in Western Australia to eradicate the pest.

DPIRD is leading the \$44 million response and has inspected more than two million trees during the past three years. More than 3700 of these trees have been confirmed as positive for PSHB, cut down and chipped, to stem the spread of the beetle.

While this is the first time that PSHB has been detected in Australia, the beetle has spread from south-east Asia to several other countries, including Israel, South Africa and the United States of America.

LEARNINGS FROM OVERSEAS

PSHB is considered both an agricultural and environmental pest and has caused substantial economic damage in other countries.

Dr Trudy Paap, a leading researcher from South Africa, is a research fellow at the University of Pretoria's Forestry Agriculture and Biodiversity Institute and has been

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Main Scientists are concerned that native swamp paperbark (*Melaleuca raphiophylla*) may be susceptible to polyphagous shot-hole borer damage.

Photo – Colin Ingram/DBCA

Inset left The invasive polyphagous shot-hole borer (*Euwallacea fornicatus*) in castor oil plant (*Ricinus communis*).

Photo – Akif Eskalen

Inset right The polyphagous shot-hole borer.

Above left DPIRD officers inspect infected areas.

Above centre Quarantine restrictions are in place across Perth.

Above right Arborists work to remove infected trees.

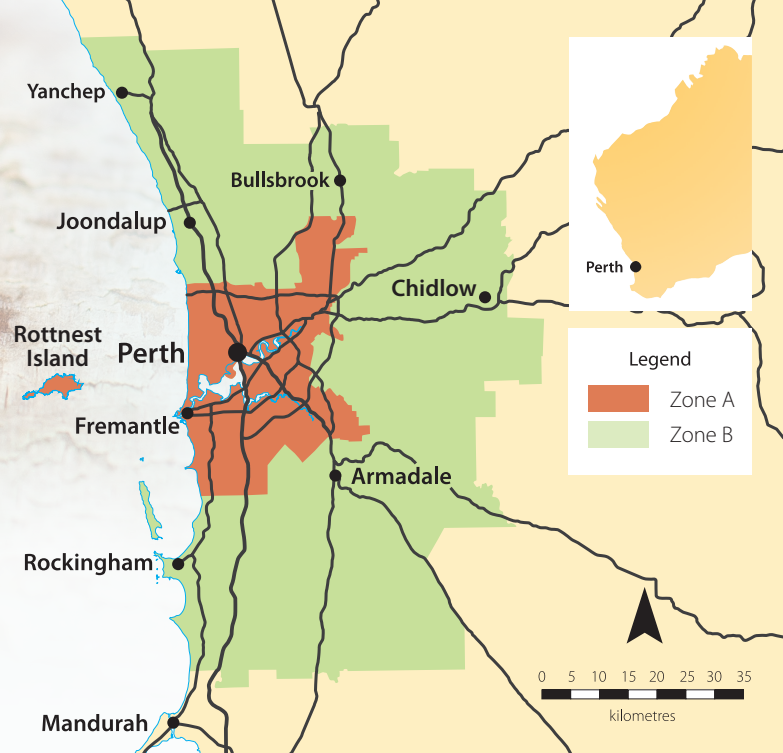
Photos – DPIRD



Perth PSHB quarantine zones

Zone A covers an area with high numbers of infested trees and where intensive control activities such as tree removal are underway. This zone has more restrictions on the movement of high-risk materials.

Zone B covers an area with fewer or no infested trees and where heightened surveillance is underway to identify and control new infestations. This zone helps create a buffer between areas of high infestations and the rest of WA, further protecting WA's growing areas.



involved in PSHB research since the pest was first detected in South Africa in 2017.

“There has been up to 100 per cent mortality caused by PSHB to some tree species that are commonly used in landscape design and residential gardens,” Dr Paap said.

“Unfortunately, we haven’t found a chemical treatment that is safe and efficient against PSHB.

“Tree pruning and removal of heavily infested trees is currently the most effective way to protect surrounding vegetation.”

Chief Plant Biosecurity Officer at DPIRD Dr Vincent Lanoiselet said the department was engaged in trials to test the efficacy of certain chemicals on early infestations of PSHB in Perth.

“We are engaging with local scientists to research alternative solutions under Western Australian conditions,” Dr Lanoiselet said.

Dr Shannon Lynch, an Assistant Professor from the University of California, shared her unique knowledge about the invasive beetle with DBCA and DPIRD at a public lecture at Murdoch University. Scientists in Southern California have been dealing with the pest for more than a decade, causing devastation in river valleys, where it has killed hundreds of thousands of willow trees.

Among the lecture attendees were scientists, horticulturalists, arborists,

gardeners, program managers and natural area managers across local and state government, academia, community and the private sector.

QUARANTINE RESTRICTIONS

Quarantine restrictions are currently in place for the entire Perth metropolitan area to prevent the pest from spreading and to safeguard WA's native forests and agricultural industries.

Unseasoned wood cannot be moved outside of the Perth metropolitan area unless it is chipped to less than 2.5 centimetres. Likewise, living plants with stems greater than two centimetres in diameter cannot be moved outside the quarantine area and any machinery used to handle wood or plant material must be cleaned.

Fortunately, PSHB does not live, breed in or otherwise affect lawn clippings and grasses, so these can be disposed of as normal and with no restrictions.

HOST RANGE

The PSHB pest complex has a wide host range, affecting more than 500 plant species globally.

Polyphagous means ‘feeding on many types of food.’ In WA, the beetle has been found reproducing in 100 different plants and trees, with a clear preference for exotic species.



Listen to more about
polyphagous shot-hole
borers

Scan this QR code to listen to the episode or search for ‘Western Australia by Nature’ wherever you get your podcasts.



In reproductive hosts, PSHB can successfully establish the fungus, complete its lifecycle and reproduce within the plant. Reproductive host species are more susceptible to dieback and can be killed by the pest.

In WA, the top reproductive host trees for PSHB are all exotic species and include the box elder maple (*Acer negundo*), black locust or Robinia (*Robinia pseudoacacia*), coral trees (*Erythrina x sykesii*), poinciana (*Delonix regia*), Moreton Bay fig (*Ficus macrophylla*), Port Jackson fig (*Ficus rubiginosa*), London planetree (*Platanus x acerifolia*), white mulberry (*Morus alba*), mirror bush (*Coprosma repens*) and castor oil plant (*Ricinus communis*).

Above left Polyphagous shot-hole borer infects a tree.

Photo – DPIRD

Above Map showing the quarantine zones covering the entire Perth metropolitan area. Source date – September 2024

Symptoms to look for:

- 1 **Shot holes:** the round entrance holes of PSHB are approximately the size of a ballpoint pen tip (1mm).
- 2 **Galleries:** dark tunnels form where the beetle is cultivating the fungus. May be visible when pruning a tree or a branch has broken off.
- 3 **Dieback:** often the first visible symptom. The fusarium fungus cuts off water and nutrient supply causing branch dieback.
- 4 **Staining/lesions:** the fusarium fungus cultivated by the beetle can cause dark discolouration around the shot holes.
- 5 **Frass:** the wood pushed out during the beetles tunnelling. This is a sign of an active infestation.
- 6 **Gumming:** thick resin or sap may form as the trees' response to damage, attempting to push the beetles out of the tunnels.



Above Shot holes inside an infected eucalyptus tree at Lake Claremont.

Insets

1) Placing a ballpoint pen next to a bore hole assists DPIRD in assessing the size of the holes. 2) Tunnels bored into a tree branch. 3) The fusarium fungus cultivated by the beetle cuts off water supply, causing dieback. 4) Tree branch showing staining from fusarium fungus. 5) Frass created by *Euwallacea fornicatus*. 6) Infected trees try to push the beetles out by excreting sap.

Top right Workers examine galleries or tunnels in wood from an infected tree.

Above right Polyphagous shot-hole borer on tree bark.

Right Sticky traps are installed in areas of concern to attract and trap the insects.

Photos – DPIRD



Dr Vincent Lanoiselet said the box elder maple was an amplifier species in which PSHB can breed prolifically, allowing the build-up of large populations of beetles.

“All box elder maple trees in Perth should be regularly inspected for symptoms of PSHB as they amplify the PSHB population and increase the risk to surrounding trees,” Dr Lanoiselet said.

Non-reproductive hosts can be attacked by PSHB, but the fungus does not establish, which means the beetle is unable to create breeding galleries and cannot reproduce.

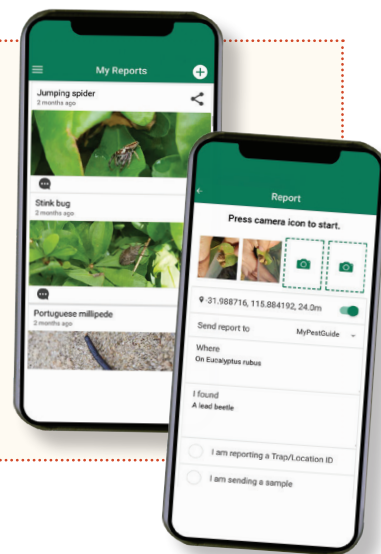
Some Western Australian native tree species have been attacked by PSHB, however they appear to be less susceptible to the beetle and its fungus, with many species listed as non-reproductive hosts.

Of concern, is the detection of the PSHB pest complex in the swamp paperbark (*Melaleuca raphiophylla*), a species that is endemic to the south-west



Protect your garden from PSHB

- Monitor plants for signs and symptoms of PSHB (see list on page 16).
- Photograph suspected PSHB signs using a ruler or pen for scale.
- Report signs using the **MyPestGuide™ Reporter** app or online at mypestguide.agric.wa.gov.au
- Check your local quarantine zone requirements before moving plants or wood.
- Do not take living plants or wood outside your quarantine zone.



“Up to three trees will be planted to replace every one lost on public lands.”

Above left Small cards with a ruler edge and a clear window are photographed and uploaded to the MyPestGuide Reporter website or app.

Photo – DPIRD

Left Removal of large infested Moreton Bay fig trees (*Ficus macrophylla*) at Kings Park.

Photo – C. Payne

of WA. The swamp paperbark grows along the banks of rivers and within wetlands, providing food and habitat for a range of native animals and reducing erosion along watercourses.

RESTORATION

Like many of Perth’s inner city historic parklands, Kings Park has not been spared from PSHB infestation. Plantings in the Parklands and Botanic Garden have been impacted, including infestations of iconic Moreton Bay and Port Jackson figs.

“The most significant area of infestation is centred on the Mount Eliza escarpment with 26 infested trees removed by DPIRD from the scarp this year,” Chelsea Payne, Curator, Arboriculture, Botanic Gardens and Parks Authority (BGPA) said.

“We had to act quickly to protect the Western Australian Botanic Garden at Kings Park, and the many rare and endangered flora in our collection.”

“The removal of these trees has resulted in a significant landscape change to the Mount Eliza escarpment. However, these works are only a chapter in the long history of changes on the scarp.”

Restoration of the scarp is underway with almost 18,000 plants from 16 species native to the area included as part of the first planting. These were chosen as species that were known to be endemic to the scarp, perform in tough conditions, with a number being known as species that thrive after disaster.

BGPA is working closely with Traditional Owners throughout the project to preserve and honour the cultural significance of the area, with consultation emphasising the importance of cultural sensitivity and environmental stewardship.

TREE REPLACEMENT PACKAGE

The State Government has announced a \$7.2 million investment to

improve Perth’s canopy cover and replace trees affected by PSHB.

The funding will allow more than 16,000 trees to be planted at iconic sites including Perth Zoo and Hyde Park. Local governments and residential landholders will also be eligible to apply for and receive funds.

Up to three trees will be planted to replace every one lost on public lands. The replacement trees will be selected with consideration to their resilience to PSHB and climate change.

The tree replacement program is scheduled to commence in 2025 and is being managed by the Department of Water and Environmental Regulation.

Dominic Castledine is a Public Information Manager with DPIRD’s polyphagous shot-hole borer response team. He can be contacted at dominic.castledine@dpiird.wa.gov.au

