FRESH NOTES
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The Bonnie and Clyde of the Beetle World

The polyphagous shothole borer (PSHB) and its deadly fungus are terrorizing our trees

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Background

Dynamite comes in small packages, and in this case a tiny 2mm beetle and its deadly fungus are the causes of great havoc in the urban forests of Sandton, Johannesburg. This power couple has researchers in quite a frenzy after seeing the damage it caused in in trees in the US and Israel, and is threatening a wider variety of trees in South Africa than seems possible.

The polyphagous shothole borer was first discovered in South Africa by Dr Trudy Paap, a postdoctoral fellow at FABI, the Forestry and Agricultural Biotechnology Institute at the University of Pretoria. The catch-me-if-you-can series of events first started back in 2017, when Paap (as a participant in the International Plant Sentinel Network or IPSN) was doing a routine survey for plant diseases in Pietermaritzburg.

Noticing a first set of clues, small lesions resembling shotgun marks on the stems and branches of plane trees in the KwaZulu-Natal Botanical Gardens, she decided to investigate further. Looking closely, hint after hint appeared. The lesions surrounded entrance holes of small beetles and the sapwood was clearly discoloured by a fungus, so evidence was sent to FABI (the Forestry and Agricultural Biotechnology Institute, at the University of Pretoria) for examination.

DNA tests of the sampled material confirmed a worrying suspicion: the tiny beetle and its fungi were the exact same genotypes as a malicious beetle-fungus complex which have devastated trees in California and Israel. The discovery of this minute beetle and fungus in South Africa is of huge concern to our foresters and growers, as these organisms are known as vicious tree killers.
It seems that it can be quite important to sweat the small stuff after all.

The polyphagous shothole borer, or *Euwallacea fornicatus*, together with its fungal symbiont *Fusarium euwallaceae*, is a beetle native to Southeast Asia. There, possibly due to a developed resistance in the trees or natural enemies controlling the beetles, not much damage has been caused by the team. However, in California and Israel, this Bonnie and Clyde of the beetle world have been disastrous for the past 15 years, causing severe damage to especially avocado trees.

The beetle sets to work first. It bores into the sapwood and introduces the lethal fungus into the tree, which can then spread through the sapwood and cause the disease or possibly the death of the tree.

So what is the risk in South Africa? Quite serious, it seems. The lists of infested trees from California, more than 200 tree species in two Los Angeles botanical gardens, includes important crop trees like peach, avocado, pecan, macadamia nut, grapevine and orange, all commercial crop trees that are also planted in South Africa.

Not only crop trees are in danger, as some of the susceptible trees are native South African species that have been planted in the United States, such as the cabbage tree, common Calpurnia and the honey flower, or *kruidjie-roer-my-nie*. Multiple exotic tree species planted as ornamentals here, can also be infested. Never, in South Africa's plague and pest history, has a single insect crossed the boundaries and attacked all of our tree sectors types: agricultural, commercial, natural forests, and urban trees.

This means that all of these tree species are in danger of polyphagous shothole borer infestation and Fusarium dieback, the insect-vectored disease caused by the beetle's deadly fungus. One small step for beetle, one giant leap for tree destruction.

P.O.A.

Because of the extent of the problem, and the beetle's unusual ways of moving from one sector to another, the industry's routine plans of action might not suffice this time. Therefore, the government is looking to find alternatives to best handle the problem. The Department of Agriculture, Fisheries and Forestry (DAFF) has called together a committee consisting of government officials, representatives of forestry and agriculture sectors, academics, arborists and nurserymen. The group is responsible for monitoring the spreading of the beetle and handling research efforts as to best contain the situation.

So PSHB is in my tree, what now?

Currently, the only known way to destroy the insect and its fungus, is by applying aggressive heat. As the saying goes, it's not the size of the dog in the fight, it's the size of the fight in the dog. Therefore, all must be done to curb the six-legged problem, and the public can help.

If you are a gardener, farmer, forester or grower and spot infested or suspicious looking material, do help by:

- Taking photos of the symptoms
- Attaching GPS coordinates or an address
- Labelling the host tree species
- Adding your contact details, and
- Sending all of the above to diagnostic.clinic@fabi.up.ac.za
- Samples can also be submitted to Department of Conservation Ecology and Entomology, Stellenbosch University (fr@sun.ac.za or pia@sun.ac.za).

Affected plant material should:

- Be burnt on site, or
- Cut into smaller pieces, sealed in refuse bangs and placed in direct sunlight to get rid of the insect.
- Not be moved around, as to avoid spreading the insect (i.e. don't store infested wood for later use).

Read More

- The Polyphagous Shothole Borer (PSHB) and its fungus in South Africa. *FABI information pamphlets on the PSHB*. https://www.fabinet.up.ac.za/index.php/pshb

- The spread of shothole borer beetles in South Africa is proving tough to control. *The Conversation*. https://theconversation.com/the-spread-of-shothole-borer-beetles-in-south-africa-is-proving-tough-to-control-102996

- A tiny beetle and its deadly fungus is threatening South Africa's trees. *The Conversation*. http://theconversation.com/a-tiny-beetle-and-its-deadly-fungus-is-threatening-south-africas-trees-92050

Academic Articles

- **Paap T, de Beer ZW, Migliorini D, Nel W, Wingfield MJ.** 2018. *The polyphagous shot hole borer (PSHB) and its fungal symbiont Fusarium euwallaceae: a new invasion in South Africa*. Australasian Plant Pathology 47(2):231-237. 10.1007/s13313-018-0545-0

- **Gomez DF, Skelton J, Steininger MS, Stouthamer R, Rugman-Jones P, Sittichaya W, Rabaglia RJ, Hulcr J.** 2018. *Species delineation within the Euwallacea fornicatus (Coleoptera: Curculionidae) complex revealed by morphometric and phylogenetic analyses*. Insect Systematics and Diversity 2(6):1-11.10.1093/isd/ixy018

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- Fig 4: S. Bush, FABI
- All other photos: Z.W. de Beer, FABI

Fig 1. *External symptoms on London plane trees infested with PSHB.*

Fig 2. *Circular breeding galleries of PSHB in thinner branches of Chinese maple.*

Fig 3. *Fungal stain around beetle tunnels on English Oak.*

Fig 4. *A mature Polyphagous Shothole Borer female.*

Fig 5. *Gallery of PSHB on pecan tree. Greyish mould in the tunnels is the Fusarium fungus on which the beetles feed. Several older (black) and younger (brown) females live together with a single (small brown) male in the gallery. Larvae are of the beetle are white.*

Fig 6. *English oaks dying in Meades street, George, as a result of PSHB infestation.*

Fig 7. *Reproductive galleries of PSHB stained by the Fusarium fungus in the wood of Chinese maple trees.*