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Invasive Shot-Hole Borer and Fusarium Dieback Field Guide

Identifying Polyphagous and Kuroshio Shot-Hole Borer in California

Background

A. Beetle-Fungal Complex

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Adult female burrowing into wood (A1); colonies of the beetles symbiotic fungi recovered in the lab (A2). The invasive shot-hole borers (ISHB), *Euwallacea* spp., are invasive beetles that vector the plant disease fusarium dieback (FD). "ISHB" refers collectively to the polyphagous and Kuroshio shot-hole borers. Over 260 plant species have been attacked by ISHB and FD. The disease disrupts the flow of water and nutrients in susceptible hosts, which can kill individual branches or, in severe cases, the entire tree. It is caused by the fungi that the beetle uses as a food source: PSHB (*Fusarum euwallaceae, Graphium euwallaceae,* and *Paracremonium pembeum*), KSHB (*Fusarium kursohium,* and *Graphium kuroshium*).

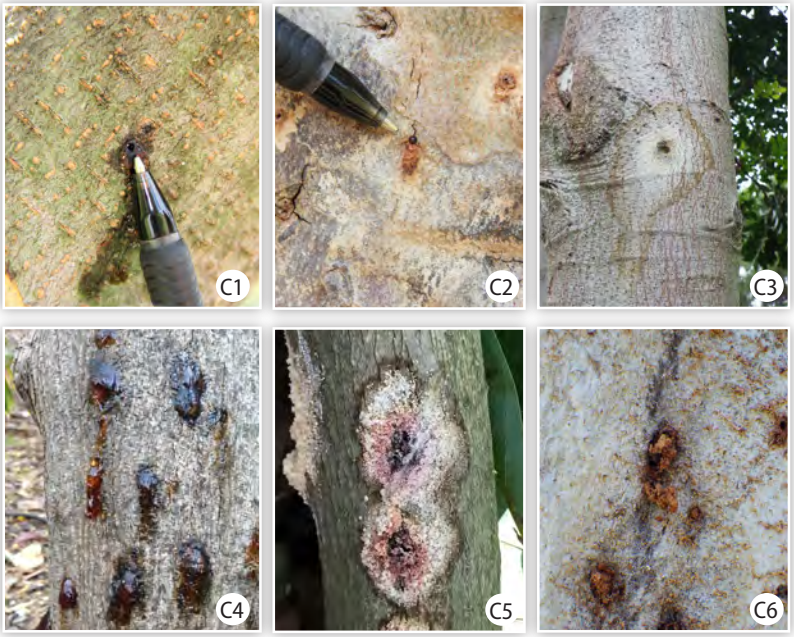

A1


A2

B. Beetle Biology and Identification

ISHB bore tunnels (galleries) into host trees where they lay their eggs and grow the fungi. The two beetle species are physically identical. At 1.8 to 2.5 mm long, ISHB adult beetles are smaller than a sesame seed. The adult females (B1) are larger than the adult males (B2) and are also darker (B3). Most of the beetle's life cycle, from larva to adult (B4), is spent in the galleries. Mature siblings mate with each other so females are already pregnant when they leave to start their own galleries.

C. Signs and Symptoms



Entry holes are round and about 0.85 mm wide, the size of a ball-point pen tip (C1). The abdomen of the female beetle may be seen sticking out of the hole (C2). Tree symptoms are unique to each host species. Around the entry hole, look for dark, wet staining that sometimes dries to white or yellow (C3), thick gumming (C4), powdery white exudate (C5), or frass (C6), which resembles sawdust.

Symptoms of infection by FD pathogens include brown to black discoloration on wood beneath the bark. Scrape away bark around the entry or exit hole to reveal dark staining surrounding the gallery (C7, C8). Cross-sections of cut branches show the extent of infection (C9). Branch dieback is the result of advanced infection by ISHB's associated fungi. It may begin on a few branches (C10) and can eventually kill entire trees (C11).

D. Look-Alike Pests

Other pests may cause damage similar to that of ISHB-FD. Clues that may indicate a pest other than ISHB include

- staining, gumming, or exudate but no entry hole
- entry holes with an irregular shape (not round)
- entry holes larger or smaller than a ball-point pen tip
- the tree is not a known host of ISHB-FD (e.g., pine or most eucalyptus species)

Visit the University of California Statewide Integrated Pest Management Program website, ipm.ucanr.edu, to learn more about these pests.

Fruit tree shot-hole borer (*Scolytus rugulosus*) (D5)

Hosts: Fruit trees in *Prunus* genus, English laurel. Look for entry holes (2 mm) oozing sap or frass; the holes are larger than those of ISHB, with slightly rougher edges (D6.). Exit holes are sap free.

Look-Alike Pests That May Have an Entry Hole

Foamy bark canker caused by *Geosmithia* sp. #41

Spread by the western oak bark beetle (*Pseudopityophthorus pubipennis*). Hosts: Coast live oak; stressed or dying trees. Look for beetles (D1) 1.7 to 2.3 mm long; reddish frass (D2), reddish sap, wet discoloration, and/or foamy liquid (D3) (a sign of infection) from an entry hole (1 mm) that is smaller than that of ISHB; dead tissue around entry hole beneath bark (D4).

Western sycamore borer, *Synanthedon resplendens*

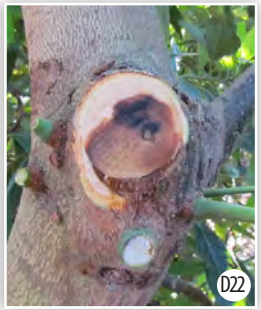
Hosts: Sycamore, oak, and ceanothus. Look for larvae 25 to 38 mm long (D7); roughened bark (D8); reddish sawdust-like frass and/or pupal cases (D9) in bark crevices or on ground; bleeding.

Lesser ambrosia beetle, *Xyleborinus saxeseni*

Hosts: Stressed and dying trees. Look for beetles 2 to 2.4 mm long (D10); entry holes (1 mm) smaller than those of ISHB (D11); reddish frass and/or sap; wet discoloration and/or dead tissue around entry hole and beneath bark (D12).

Oak ambrosia beetles, *Monarthrum dentiger, M. scutellare* (d)

Hosts: Oak species, tanoak, California buckeye. Look for slightly larger beetles (D13) (*M. scutellare*, 3.5 to 4.1 mm long; *M. dentiger*, 1.9 to 2.4 mm long) and entry holes (1 to 1.5 mm diameter) with bleeding, frothing, bubbling, or white boring dust (D14) that is tan when oxidized. Often attack stressed trees.



Look-Alike Pests That Lack an Entry Hole

Avocado trunk canker caused by *Phytophthora mengei* (D15, D16). Avocado branch canker and dieback caused by *Botryosphaeria* spp. and *Phomopsis* sp. Bacterial canker caused by *Xanthomonas campestris* (D17, D18). Black streak disease caused by *Botryosphaeria* spp. (D19–D22).

E. Reproductive Hosts

Reproductive host species support beetle reproduction and the growth and development of the symbiotic fungi. Each species is affected differently. Trees may be more susceptible if they are already under stress due to other pests, diseases, or environmental conditions or are in close proximity to an existing infestation. This list of species is not meant to be used as a do-not-plant list. However, as known hosts of ISHB-FD, species on this list should be closely monitored for potential infestation. Visit the Invasive Shot-Hole Borers website, www.pshb.org, for updates.

Acacia spp.
Acer buergerianum
Acer macrophyllum
Acer negundo
Acer palmatum
Acer paxii
Aesculus californica
Ailanthus altissima
Albizia julibrissin
Alectryon excelsus
Alnus rhombifolia
Archontophoenix cunninghamiana
Baccharis salicifolia
Bauhinia variegata
Brachychiton populneus
Camellia semiserrata
Castanospermum australe
Cercidium (= Parkinsonia) floridum
Cercidium (= Parkinsonia) sonorae
Cocculus laurifolius
Cupaniopsis anacardioides
Erythrina coralloides
Erythrina falcata
Eucalyptus ficifolia
Fagus crenata
Ficus altissima
Ficus carica
Gleditsia triacanthos
Harpullia pendula
Howea forsteriana
Ilex cornuta
Koelreuteria bipinnata
Liquidambar styraciflua
Magnolia grandiflora
Parkinsonia aculeata
Persea americana
Platanus mexicana
Platanus racemosa
Platanus x acerifolia
Populus fremontii
Populus nigra
Populus trichocarpa
Prosopis articulata
Quercus agrifolia
Quercus chrysolepis
Quercus engelmannii
Quercus lobata
Quercus robur
Quercus suber
Ricinus communis
Salix babylonica
Salix gooddingii
Salix laevigata
Salix lasiolepis
Tamarix ramosissima
Wisteria floribunda
Xylosma avilae

Native Host Species

1. Big Leaf Maple

Acer macrophylum

Native reproductive host

Signs/Symptoms: Staining

Native Host Species

2. Box Elder

Acer negundo

Native reproductive host

Signs/Symptoms: Staining, bleeding, frass

Native Host Species

3. California Sycamore

Platanus racemosa

Native reproductive host

Signs/Symptoms: Staining

Native Host Species

4. Red Willow

Salix laevigata

Native reproductive host

Signs/Symptoms: Staining, frass

Native Host Species

5. Godding's Black Willow

Salix gooddingii

Signs/Symptoms: Staining

Native Host Species

6. Fremont Cottonwood

Populus fremontii

Native reproductive host

Signs/Symptoms: Staining

Native Host Species

7. White Alder

Alnus rhombifolia

Native reproductive host

Signs/Symptoms: Staining

Native Host Species

8. Coast Live Oak

Quercus agrifolia

Native reproductive host

Signs/Symptoms: Staining

Native Host Species

9. Engelmann Oak

Quercus engelmannii

Native reproductive host

Signs/Symptoms: Staining

Native Host Species

10. Valley Oak

Quercus lobata

Native reproductive host

Signs/Symptoms: Staining

Native Host Species

11. Mesquite

Prosopis articulata

Native reproductive host

Signs/Symptoms: Staining

Agricultural Host Species

12. Avocado

Persea americana

Reproductive host

Signs/Symptoms: Sugary exudate, staining

Non-Native Host Species

13. Castor Bean

Ricinus communis

Invasive reproductive host

Signs/Symptoms: Staining

Non-Native Host Species

14. Tree of Heaven

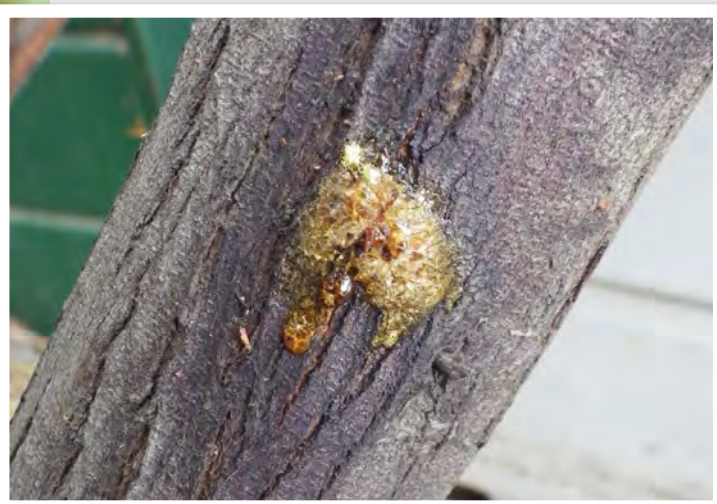
Ailanthus altissima

Invasive reproductive host

Signs/Symptoms: Staining

Non-Native Host Species

15. Acacia



***Acacia* spp.**

Reproductive host

Signs/Symptoms: Gumming, staining

Non-Native Host Species

16. Silk Tree/Mimosa

Albizia julibrissin

Reproductive host

Signs/Symptoms: Staining, gumming

Non-Native Host Species

17. Coral Tree

Erythrina coralloides

Reproductive host

Signs/Symptoms: Staining

Non-Native Host Species

18. Palo Verde

Parkinsonia aculeata

Reproductive host

Signs/Symptoms: Staining, frass

Non-Native Host Species

19. Moreton Bay Chestnut

Castanospermum australe

Reproductive host

Signs/Symptoms: Staining, gumming

Non-Native Host Species

20. Chinese Flame/Goldenrain

Koelreuteria bipinnata, K. paniculata

FD-susceptible hosts

Signs/Symptoms: Gumming, staining

Non-Native Host Species

21. Japanese Maple

Acer palmatum

Reproductive host

Signs/Symptoms: Staining

Non-Native Host Species

22. Trident Maple

Acer buergerianum

Reproductive host

Signs/Symptoms: Staining

Non-Native Host Species

23. English Oak

Quercus robur

Reproductive host

Signs/Symptoms: Staining

Non-Native Host Species

24. Cork Oak

Quercus suber

Reproductive host

Signs/Symptoms: Staining

Non-Native Host Species

25. Weeping Willow

Salix babylonica

Reproductive host

Signs/Symptoms: Staining, gumming, frass

Non-Native Host Species

26. Shiny Xylosma

Xylosma avilae

Reproductive host

Signs/Symptoms: Staining

Non-Native Host Species

27. American Sweetgum

Liquidambar styraciflua

Reproductive host

Signs/Symptoms: Staining

Non-Native Host Species

28. Kruuajong

Brachychiton populneus

Reproductive host

Signs/Symptoms: Gumming

Non-Native Host Species

29. London Plane

Platanus x acerifolia

Reproductive host

Signs/Symptoms: Staining

Non-Native Host Species

30. Kentia Palm

Howea forsteriana

Reproductive host

Signs/Symptoms: Gumming, frass

Non-Native Host Species

31. Camellia

Camellia semiserrata

Reproductive host

Signs/Symptoms: Staining

References

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For Further Information

For additional photos and the full host list, as well as the most recent list of reproductive hosts, information, research, and news, see the University of California Agriculture and Natural Resources Invasive Shot Hole Borers website, www.pshb.org.

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