

# Tree injury and mortality associated with the polyphagous shot hole borer in southern California



Tom W. Coleman<sup>1</sup> and Steven J. Seybold<sup>2</sup>

<sup>1</sup>USDA Forest Service, Forest Health Protection, San Bernardino, CA

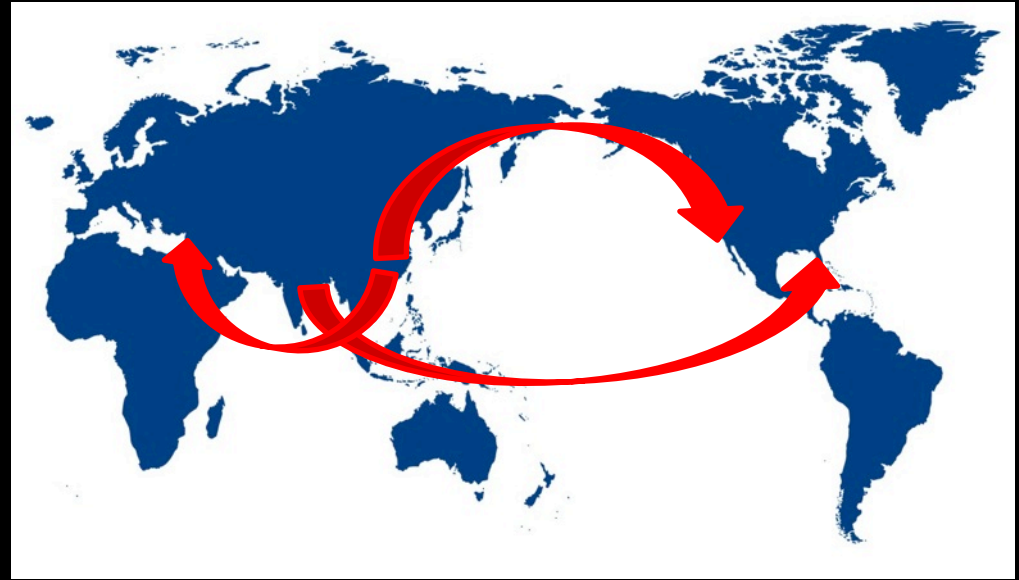
<sup>2</sup>USDA Forest Service Pacific Southwest Research Station, Davis, CA

# Polyphagous shot hole borer (PSHB), *Euwallacea* sp.



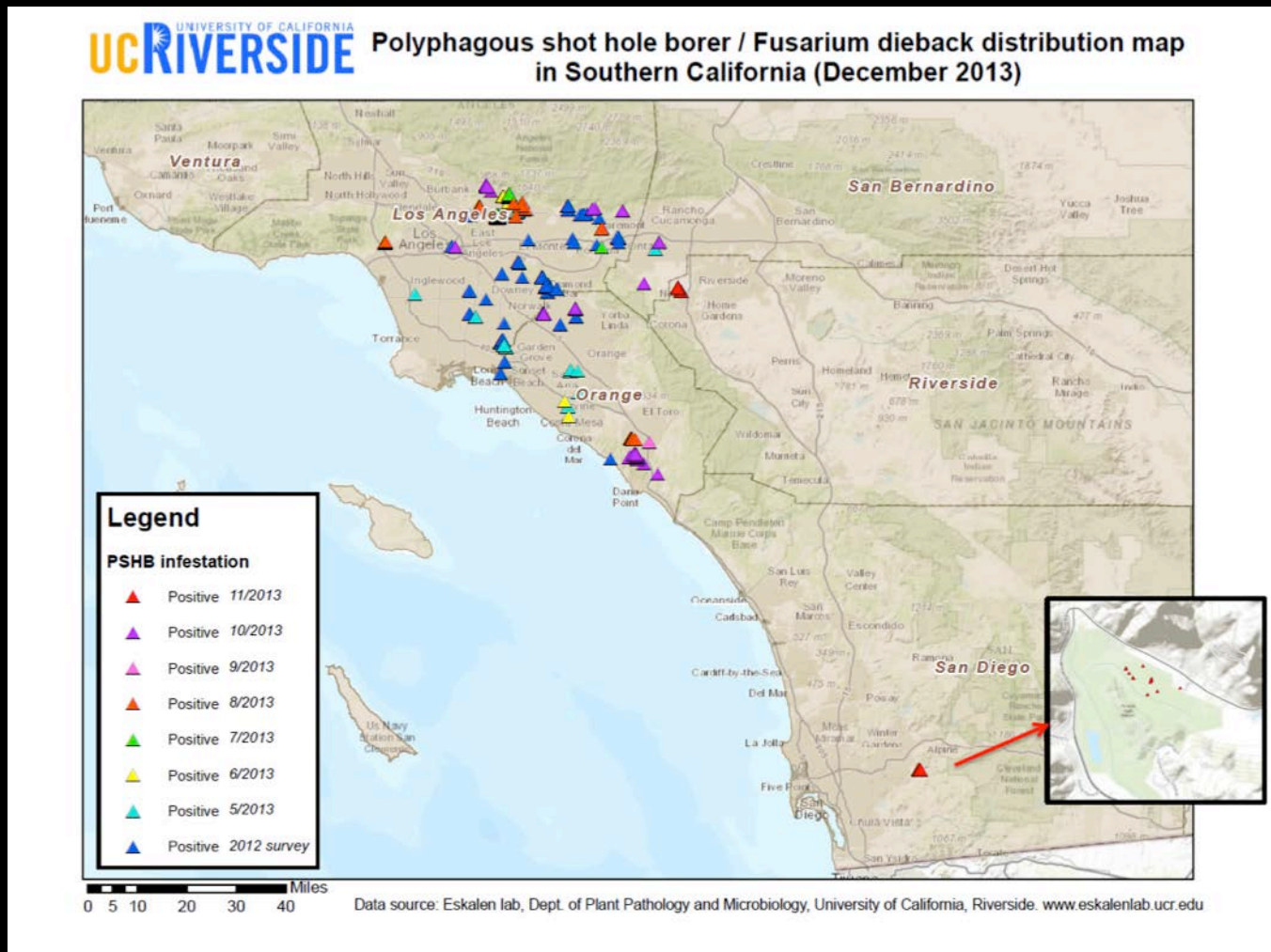
- First detected in California in 2003
  - Whittier Narrows Recreation Area (LA Co.). This insect/disease complex was not linked to tree injury and mortality until 2012 in LA Co.
- PSHB in California was believed initially to be the tea shot hole borer, *Euwallacea fornicatus*, which had been introduced into Florida
- Recent molecular analyses suggest that the CA species of *Euwallacea* may be a new species (R. Stouthamer Laboratory, UCR)
  - The same species attacks hardwood trees and shrubs in Israel

# Polyphagous shot hole borer (PSHB) and Fusarium dieback (*Fusarium euwallacea*)



- Polyphagous shot hole borer, *Euwallacea* sp.
  - Similar to tea shot hole borer in FL
- Fusarium dieback, *Fusarium euwallacea*
  - Same insect-disease complex found in Israel

# Current distribution of PSHB in CA

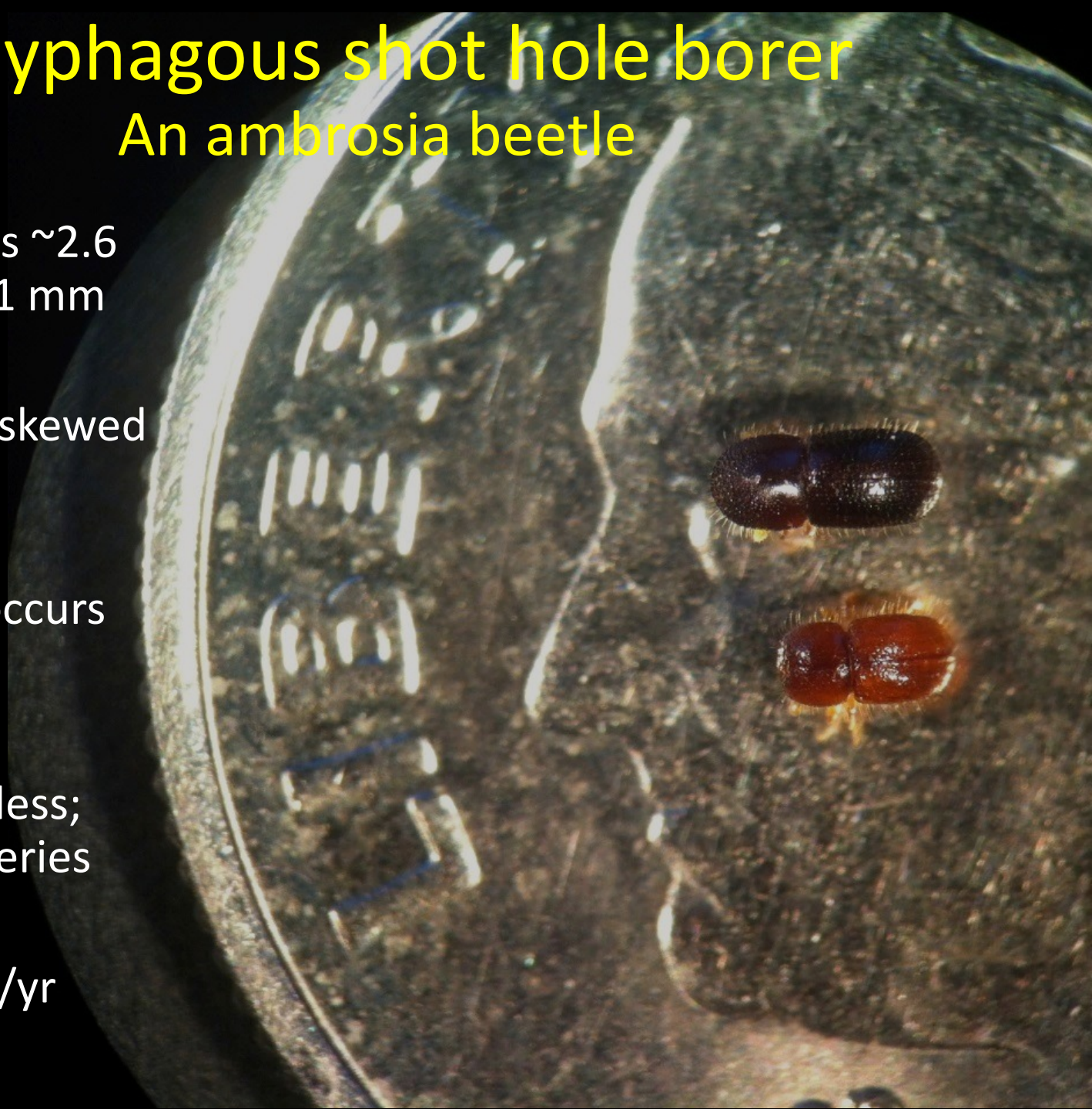


- El Cajon (San Diego Co.): Recent detection of PSHB

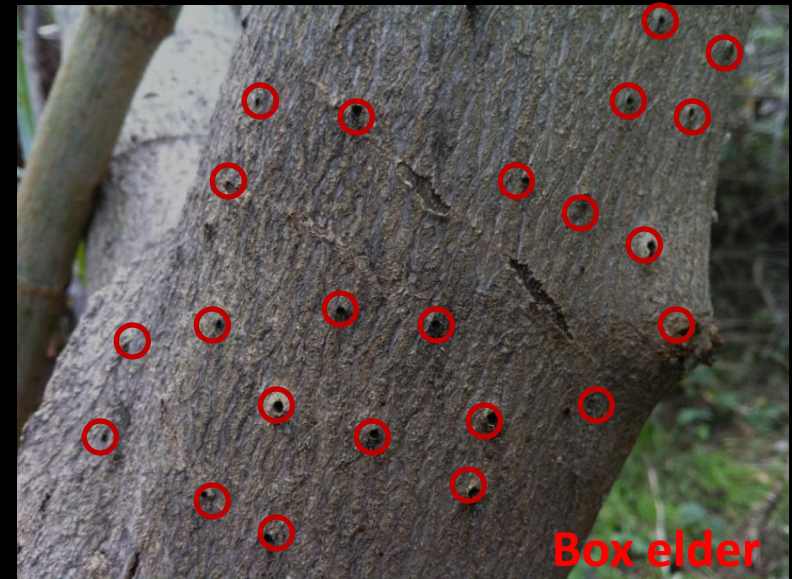
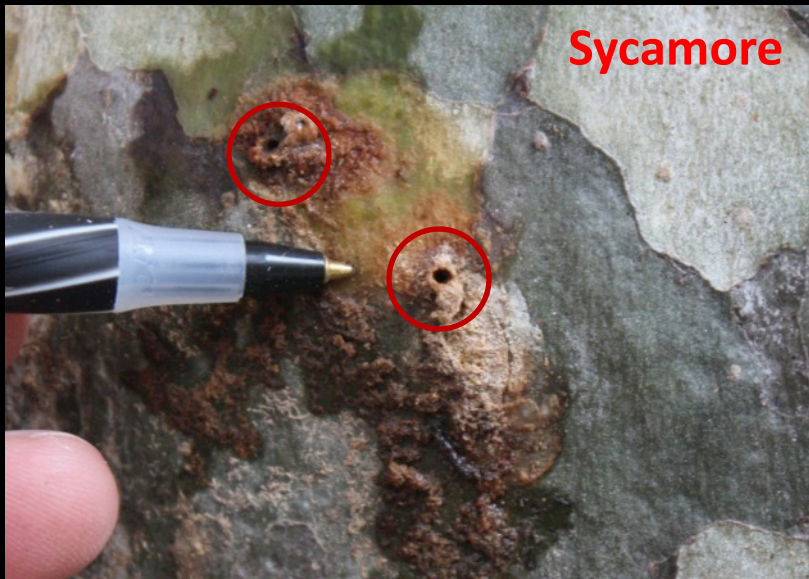
# Polyphagous shot hole borer

## An ambrosia beetle

- Length: Females ~2.6 mm; Males ~ 1.1 mm
- Sex ratio highly skewed toward females
- Sibling mating occurs in galleries
- Males are flightless; rarely leave galleries
- Two to four gen/yr



# PSHB entrance/emergence holes



- Attacks found from the root collar to smaller branches



# PSHB injury symptoms

- Dark-colored bark staining, gumming, and sugaring
- Attacks frequently observed on the main stem and larger branches



# PSHB injury symptoms



- White- and tan-colored boring dust
- Can appear as string-like projections from the tree
- Boring dust observed frequently at the base



# PSHB injury symptoms



- Crown dieback and thinning
- Epicormic and basal sprouting



# PSHB injury symptoms



- Branching dark-stained galleries
- Galleries can penetrate to a depth of 8 cm into the xylem



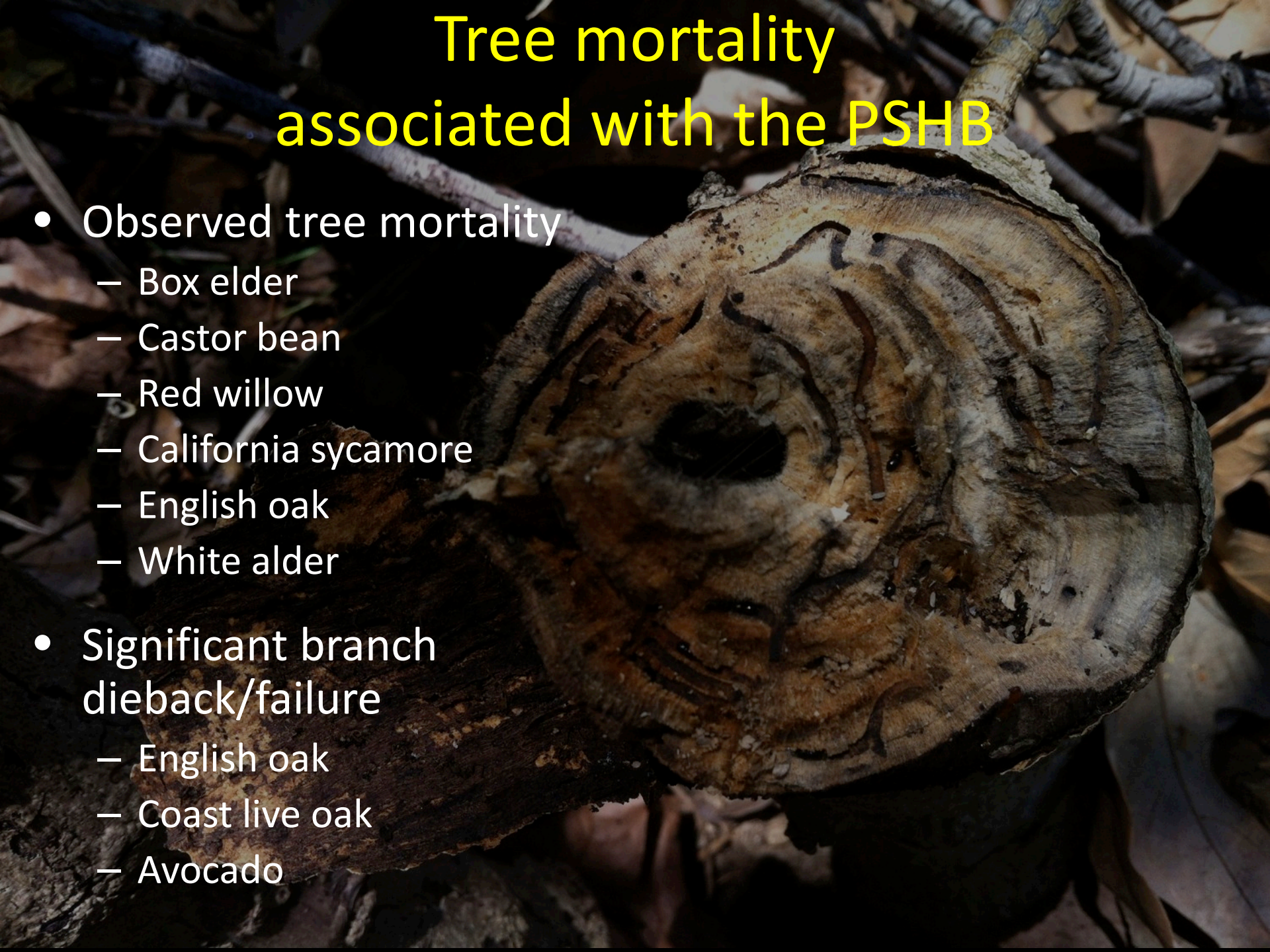
# Tree mortality associated with the PSHB

- Observed tree mortality

- Box elder
- Castor bean
- Red willow
- California sycamore
- English oak
- White alder

- Significant branch dieback/failure

- English oak
- Coast live oak
- Avocado



# Fungi associated with PSHB



- An new species of *Fusarium* and *Graphium* associated with *Euwallacea* sp.
  - Eskalen (UCR) is conducting virulence tests with each fungus
- The same *Fusarium euwallacea* is found in CA and Israel

# PSHB hosts-primarily ornamental species

1. Box elder, *Acer negundo*
2. Castorbean, *Ricinus communis*
3. Avocado, *Persea americana*
4. English oak, *Quercus robur*
5. Coast live oak, *Quercus agrifolia*
6. California Sycamore, *Platanus racemosa*
7. Big leaf maple, *Acer macrophyllum*
8. Mimosa, *Albizia julibrissin*
9. Coral tree, *Erythrina corallodendron*
10. Titoki, *Alectryon excelsus*
11. Blue palo verde, *Parkinsonia florida*
12. Tortuosa, *Salix matsudana*
13. Weeping willow, *Salix babylonica*
14. Red willow, *Salix laevigata*
15. Trident maple, *Acer buergerianum*
16. Japanese maple, *Acer palmatum*
17. Evergreen maple, *Acer paxii*
18. Chinese holly, *Ilex cornuta*
19. Brea, *Cercidium sonora*
20. Black bean, *Castanospermum australe*
21. Camellia, *Camellia semiserrata*
22. Cork oak, *Quercus suber*
23. Valley oak, *Quercus lobata*
24. Engelmann oak, *Quercus engelmannii*
25. White alder, *Alnus rhombifolia*



- Host susceptibility varies
- Will attack numerous hardwood species, but can't develop in these trees

# Why are we concerned about PSHB in CA?

- PSHB attacks avocados
- California produces 90% of the nation's avocado crop
- ~21,000 ha of avocados planted from San Luis Obispo to San Diego
- Crop valued at \$382,000,000/yr
- And, avocados taste good



# Native hardwood stands in southern California



# PSHB also attacks and kills our native riparian trees



Red willow



White alder



California sycamore

# Summary

- PSHB is already impacting the native hardwood stands of southern California and the urban areas
  - Loss of hardwood stands can impact wildlife and threatened and endangered species
  - Willow flycatcher, bell vireo, Arroyo toad, yellow-legged frogs, western yellow-billed cuckoo, gray vireo, 3 bat species, and 6 snake species
- Its impact may be more prevalent in lower elevation hardwood stands on California sycamore, castorbean, and willow spp.
  - All size classes appear to be susceptible

# PSHB information



United States Department of Agriculture  
Forest Service  
Pacific Southwest Region  
State and Private Forestry  
RS-PR-032  
November 4, 2013

## New Pest Complex in California: The Polyphagous Shot Hole Borer, *Euwallacea* sp., and Fusarium Dieback, *Fusarium euwallaceae*

The polyphagous shot hole borer, *Euwallacea* sp., and *Fusarium euwallaceae*, a fungus it carries, are an exotic pest complex causing dieback and mortality to numerous native and ornamental hardwood trees and shrubs in southern California. The ambrosia beetle carries several symbiotic fungi, including *Fusarium euwallaceae* which was newly identified as a species associated with recent tree dieback symptoms. Injury occurs when the ambrosia beetle bores into a tree to create tunnels (galleries) for its eggs and larvae and, in the process, inoculates the tunnels with its symbiotic fungi that subsequently clog the surrounding water conducting tissue, or xylem. These pests in combination have killed several hardwood species in urban areas and on National Forest lands. This ambrosia beetle attacks over 20 species as hosts, including bigleaf maple, *Acer macrophyllum*, California box elder, *Acer negundo* var. *californicum*, California sycamore, *Platanus racemosa*, coast live oak, *Quercus agrifolia*, castorbean, *Ricinus communis*, red willow, *Salix laevigata*, valley oak, *Q. lobata*, and white alder, *Alnus rhombifolia*, all of which are found on public land. The large number of hosts increases the likelihood that this pest complex could spread to other areas.

### Identification

Adults are oval in shape and brown to black in color. Adult females are approximately 2.62 ( $\pm 0.02$ ) (mean  $\pm$  s.e.) mm long and 1.07 ( $\pm 0.02$ ) mm wide (Fig. 1) while adult males are smaller (approximately 1.80 ( $\pm 0.02$ ) mm long and 0.81 ( $\pm 0.02$ ) mm wide). Males are rarely observed because they are unable to fly, they typically do not leave the galleries, and very few are produced compared to females. Immature stages (eggs, larvae, and pupae) are white in color and restricted to the galleries in the xylem.

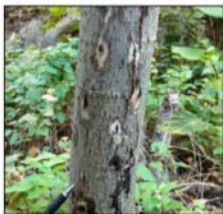


Figure 2. The pest complex can cause bark staining and discoloration around the entry holes on red willow (pictured above) and other species.



Figure 3. Amber-colored staining is commonly associated with polyphagous shot hole borer attacks on California sycamore.



Figure 4. Polyphagous shot hole borer attacks can cause gumming along the stem and branches of several ornamental tree species.



Figure 1. The adult female of the polyphagous shot hole borer is about 2.6 mm long (A). The relative size of the adult female and male can be seen on a dime (B).

## UC New invasive beetle/disease complex on California avocado and landscape trees: Polyphagous Shot Hole Borer (*Euwallacea* sp.) and Fusarium dieback (*Fusarium euwallaceae*)

Akif Eskalen (PhD), Department of Plant Pathology and Microbiology, University of California, Riverside [www.eskalenlab.ucr.edu](http://www.eskalenlab.ucr.edu)

**Status:** Recently a new beetle/fungal complex was detected on avocado and other host plants in Los Angeles, Orange and San Bernardino Counties. The two fungal species are *Fusarium euwallaceae* and *Graphium* sp., which form a symbiotic relationship with a recently discovered beetle that is commonly known as the polyphagous shot hole borer (PSHB, *Euwallacea* sp.) (Fig. A). Together, they cause the disease Fusarium dieback (FD). When the beetle burrows into the tree, it inoculates the host plant with the fungus (Fig. D), which is carried in its mouthparts in a structure called mycangia. The fungus attacks the vascular tissue of the tree, blocking the transport of water and nutrients from the roots to the rest of the tree, and eventually causing branch dieback. The beetle larvae live in galleries within the tree and feed on the fungus. FD has been observed on more than 110 different plant species in California, including many species common in urban landscapes and on such agriculturally important species as avocado, olive and persimmon.

**Symptoms:** Each host species shows different symptoms depending on the response to infection. Sycamore, box elder, maple, red willow, and castor bean are good trees to search for signs and symptoms of the beetle, as it tends to prefer to infest these hosts first. Depending on the tree species attacked, PSHB injury can be identified either by staining, gumming, or a white-sugar exudate on the outer bark in association with a single beetle entry hole.

**The beetle:** An exotic ambrosia beetle (*Euwallacea* sp.) is very small and hard to see. At the advanced stage of infestation, there are often many entry/exit holes on the tree (Fig. E-F). Females are black and about 1.8 – 2.5 mm (0.07-0.1 inch) long (Fig. A-B (right)); males are brown colored and about 1.5 mm (0.05 inch) long (Fig. B (left)). The entry/exit hole is about 0.85 mm (0.033 inch).

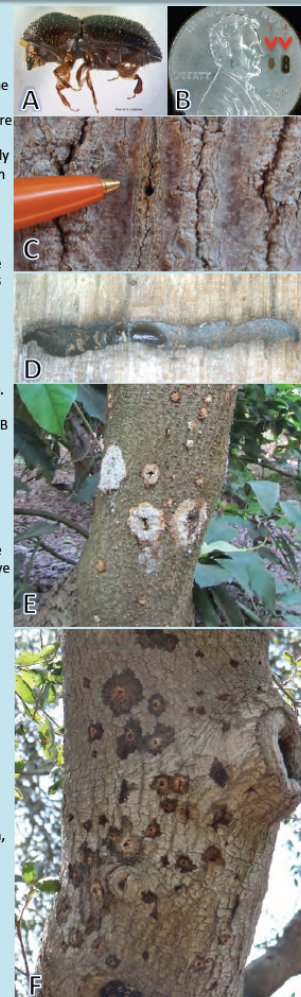
**Known Hosts:** The following is a selective list from over 110 hosts: Box elder (*Acer negundo*), castor bean (*Ricinus communis*), avocado (*Persea americana*), coast live oak (*Quercus agrifolia*), English oak (*Q. robur*), valley oak (*Q. lobata*), California sycamore (*Platanus racemosa*), big leaf maple (*Acer macrophyllum*), Japanese maple (*A. palmatum*), red willow (*Salix laevigata*), goldenrain (*Koeleruteria paniculata*), olive (*Olea europaea*), persimmon (*Diospyros* sp.), silk tree (*Albizia julibrissin*), American sweet gum (*Liquidambar styraciflua*), coral tree (*Erythrina corallodendron*), weeping willow (*Salix babylonica*), blue palo verde (*Parkinsonia florida*), palo verde (*Parkinsonia floridum*), tortuosa (*Salix matsudana*), white alder (*Alnus rhombifolia*).

### What to do:

- Look for a single entry/exit hole surrounded by wet discoloration of the outer bark
- Scrape off the bark layer around the infected area to look for brown discolored necrosis caused by the fungus.
- Follow the gallery to look for the beetle (may or may not be present).
- Avoid movement of infested firewood and chipping material out of infested area.
- Look for other hosts (Castor bean, sycamore, maple, coast live oak, goldenrain, liquidambar) showing symptoms of the beetle/disease.
- Sterilize tools to prevent to spread of the disease with either 25% household bleach, Lysol® cleaning solution, or 70% ethyl alcohol.

### Who to contact if you find the problem:

If you suspect that you have found this beetle or seen symptoms of the Fusarium dieback on your tree please contact either your local farm advisor, pest control advisor, county Ag Commissioner office or Dr. Akif Eskalen by either phone 951-827-3499 or email at [akif.eskalen@ucr.edu](mailto:akif.eskalen@ucr.edu). For more information visit [www.eskalenlab.ucr.edu](http://www.eskalenlab.ucr.edu).



[www.cisr.ucr.edu](http://www.cisr.ucr.edu)