# A Devastating Threat to California Trees

## Polyphagous and Kuroshio Shot Hole Borers + Fusarium Dieback

Willows in a San Diego creek devastated by KSHB.

PSHB galleries in castor bean wood.

Two exotic, invasive beetles are causing increasingly extensive damage to Southern California's urban trees, native and riparian forests, and avocado groves. Thousands of severely affected trees have died or been removed in both natural and landscaped areas.

## The Beetles

**Polyphagous Shot Hole Borer (PSHB) and Kuroshio Shot Hole Borer (KSHB)**

These two closely related, physically identical beetles are also referred to simply as Invasive Shot Hole Borers. How they arrived in California is uncertain, but scientists believe they most likely originated in Southeast Asia. PSHB was first discovered in Los Angeles County in 2012 and can now be found in Orange, Ventura, Riverside, and San Bernardino Counties. KSHB was discovered in San Diego County in 2012 and has also been detected in Orange County.

## The Disease

**Fusarium Dieback**

Both beetles carry a type of Fusarium fungus that is pathogenic (disease-causing) to susceptible trees.

## Damage

The beetles tunnel into trees to lay their eggs and introduce the fungus that causes Fusarium Dieback. The disease and the tunneling activity disrupt the flow of water and nutrients that the tree needs to survive and also weaken the tree's trunk and branches. After repeated attacks, the beetle/disease complex can cause branch dieback and tree mortality.

## Trees at Risk

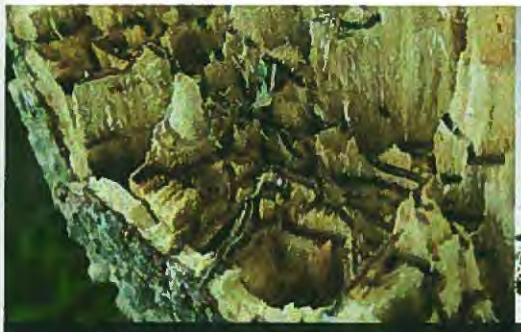
The beetles attack landscape, agricultural, riparian, and native trees. Common trees like sycamore, cottonwood, willow, avocado, white alder, and box elder appear to be especially susceptible. See the list of reproductive host trees (trees that support beetle reproduction and are susceptible to the disease) at www.pshb.org.

## Impact

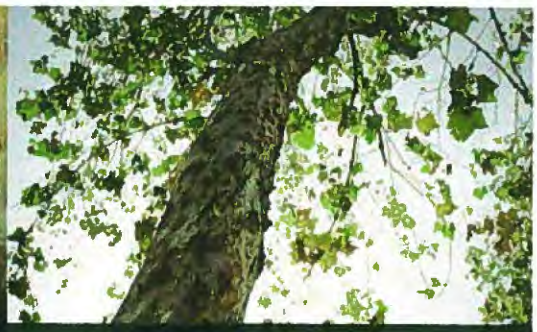
PSHB and KSHB are attacking dozens of tree species found throughout Southern California, many of which are native to the region and common on private properties; municipal, county, state, and federal public lands; and tribal lands.

Tree decline and death can result in:

- Public safety hazards due to falling limbs, increased fire danger, and increased flood risk due to blockages of water ways
- Decreased property value
- Increased air and noise pollution
- Habitat loss for endangered birds and other wildlife
- Loss of ecosystem services, including cooling, water filtration, and carbon sequestration



PSHB galleries in a box elder branch.



PSHB attacks on Mexican sycamore.

**Authors:** Monica Dimson[1]; John Kabashima, Ph.D[1]; Akif Eskalen, Ph.D [2]; Janis Gonzales[1] ([1]UC Cooperative Extension, [2]UC Riverside) All images provided by these authors.

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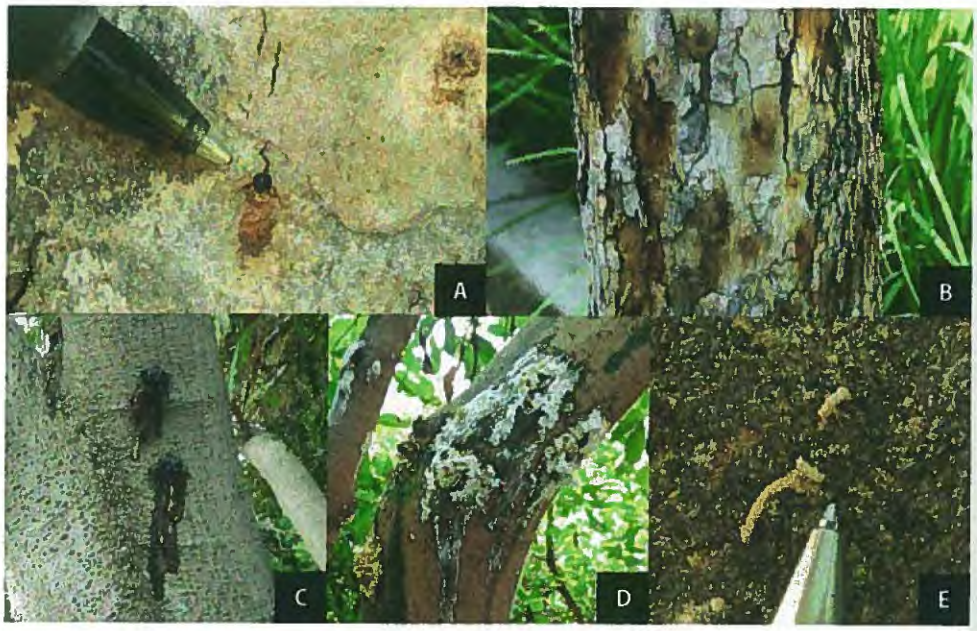


## What to Look For

Look for these signs of attack:

1. Entry-holes to the beetle galleries. Perfectly round and less than 1 mm wide (use the tip of a ball-point pen for scale) (A, on California sycamore).
2. Tree symptoms. Dark, wet staining (B, on sycamore); thick gumming (C, on silk tree); white, powdery exudate (D, on avocado); and/or frass (resembles fine sawdust) (E, on black mission fig). Symptoms are unique to each tree species. See more photos and descriptions of beetle attacks at www.pshb.org.
3. Dieback. Dead branches with wilting leaves may be a sign of severe infection by the Fusarium Dieback disease.

## What's Being Done?

Researchers are actively looking for solutions to control this new beetle/disease complex. Experiments by UC Riverside are investigating pesticide efficacy, detection methods, and natural predators or parasites (biocontrol). While there is no known method that offers complete control at this time, multiple surveys are being conducted to monitor the infestation. UC has also collaborated with various agencies and stakeholders to increase awareness and outreach and to identify research funding needs.

## How You Can Help

Be a part of local, state, and federal efforts to contain this damaging pest. Non-native insects and diseases that can kill large numbers of trees are often transported long distances by firewood or branches that have been trimmed from infested trees. Once they arrive in a new location, they can infest and kill other trees. Below are a few ways that you can help to contain this pest:

### Don't Move Firewood

Please use locally sourced firewood to help slow the spread of non-native pests like the invasive shot hole borers.

- Buy firewood where you will burn it
- Purchase and use wood from local sources for both home heating and outdoor recreation
- Leave wood at home when visiting a park or taking a camping, hunting, or RV trip
- Buy only what you need and always burn responsibly

### Take Care of Green Waste

The beetles can survive in cut wood for weeks or even months. Dispose of infested wood properly to avoid spreading the beetle to other areas (see www.pshb.org for more details):

- Chip infested wood whenever possible
- Chips and logs should either be: composted, solarized, kiln-dried, used as landfill Alternative Daily Cover, or burned at a biogeneration facility
- Wrap or cover infested wood during transport
- Disinfect tools and equipment after trimming infested trees

## Stay Informed

Subscribe to our email list to receive announcements on the latest PSHB/KSHB news and information.

www.pshb.org

www.eskalenlab.ucr.edu

**Authors**

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[1]UC Cooperative Extension, [2]UC Riverside

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PSHB-infested sycamore in a research trial.

Box elder logs full of PSHB tunnels and beetles.

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# Polyphagous Shot Hole Borer + Fusarium Dieback
# Identifying Symptoms and Look-Alike Pests

## BACKGROUND

Photo credit: (A) Gevork Arakelian/LA County Dept of Agriculture

Polyphagous Shot Hole Borer (PSHB), *Euwallacea* sp., is an invasive beetle that attacks dozens of common native and landscape trees. The tiny beetle tunnels into host trees and spreads Fusarium Dieback (FD), a disease known to infect over 110 tree species. FD is caused by *Fusarium euwallaceae*, a fungus that disrupts the transport of water and nutrients in the tree, leading to branch dieback and overall decline.

A closely related beetle called the Kuroshio Shot Hole Borer (KSHB) has been detected in San Diego County. KSHB looks identical to PSHB and also carries disease-causing fungi, but the species are genetically distinct.

## HOSTS

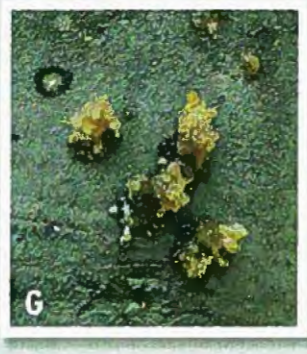
PSHB can reproduce and grow *Fusarium* in at least 38 known species, called reproductive hosts. Relative susceptibility among these species is dynamic and varied. Some of the more susceptible reproductive hosts appear to be box elder, avocado, coral, palo verde, silk tree, white alder, castor bean, and several species of sycamore, cottonwood, and willow.

See the full list of known reproductive hosts at eskalenlab.ucr.edu.

## EXTERNAL SIGNS + SYMPTOMS

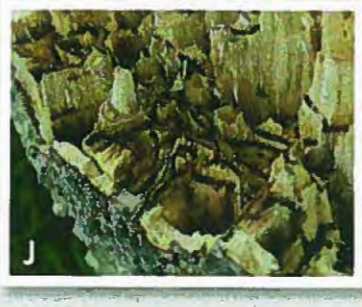
Attack symptoms, a host tree's visible response to stress, vary by host species. Look for the beetle's entry-holes (B), which are ~0.85 mm in diameter, accompanied by staining (C, D), sugary exudate (E), gumming (F, G), and/or frass (H). The symptoms may be noticeable before the beetles—at 1.8-2.5 mm long, females are smaller than a sesame seed. The abdomen of the female beetle can sometimes be seen sticking out of the hole.

Species below: C. California sycamore, D. Fremont cottonwood, E. Avocado, F. Mimosa/Silk tree, G. Titoki, H. Box elder



## INTERNAL DAMAGE

*Fusarium* causes dark discoloration of wood beneath the bark (I) and in the beetle's galleries (J). Advanced infections lead to branch dieback (K) and tree mortality.



**AUTHORS:** Monica Dimson (UC Cooperative Extension) ; John Kabashima, Ph.D (UC Cooperative Extension); Akif Eskalen, Ph.D (UC Riverside). Images provided by Monica Dimson and Akif Eskalen unless cited otherwise.

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## PSHB/FD LOOK-ALIKES

**Western oak bark beetle + Foamy bark canker disease**

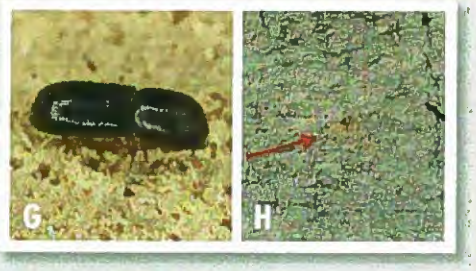
| | |
|---|---|
| HOST TREES: | Stressed coast live oak, tanoak, CA buckeye |
| BEETLE SIZE: | 1.7-2.3 mm long |
| ENTRY-HOLE: | Smaller than PSHB |
| SYMPTOMS: | Reddish frass/sap; disease causes wet discoloration and/or foamy liquid from entry-hole |

**Fruittree bark beetle, *Scolytus rugulosus***

| | |
|---|---|
| HOST TREES: | Fruit and nut trees (e.g. stone fruits, apples, almonds), English laurel |
| BEETLE SIZE: | 2-2.5 mm long |
| ENTRY-HOLE: | Larger than PSHB |
| SYMPTOMS: | Entry-hole oozes sap or frass; exit-holes are sap-free |

**Oak ambrosia beetles, common species: *Monarthrum scutellare***

| | |
|---|---|
| HOST TREES: | Stressed or dying oaks, tanbark oaks, CA buckeye |
| BEETLE SIZE: | 3.5-4.1 mm long |
| ENTRY-HOLE: | Larger than PSHB |
| SYMPTOMS: | Bleeding, frothing, white boring dust from entry-hole |




**Secondary ambrosia beetle, *Xyleborus saxeseni***

| | |
|---|---|
| HOST TREES: | Dying or stressed trees |
| BEETLE SIZE: | 2-2.4 mm long |
| ENTRY-HOLE: | Smaller than PSHB |
| SYMPTOMS: | Reddish frass and/or sap; wet staining and/or dead tissue around entry-hole |

**Bacterial canker, *Xanthomonas campestris***

| | |
|---|---|
| HOST TREES: | Avocado |
| BEETLE SIZE: | N/A (Bacteria) |
| ENTRY-HOLE: | Cavity; no hole |
| SYMPTOMS: | White, sugary exudate and bleeding from cavity in the bark |

Photo credit:
(A) (C) (E) Jack K. Clark/UC IPM <ipm.ucanr.edu>. (F) Pavel Svihra/UC Regents. (G) Christoph Benisch <kerbtier.de>.

## PSHB RESOURCES

Stay up to date on the latest PSHB research and news:
www.pshb.org - Polyphagous Shot Hole Borer, UC Cooperative Extension central website
www.eskalenlab.ucr.edu - Eskalen Lab, UC Riverside
www.cisr.ucr.edu - UC Riverside Center for Invasive Species Research

## HOW TO REPORT A SUSPECT TREE

Please report suspected infestations to the Eskalen Lab at UC Riverside (eskalenlab@gmail.com).

Download the reporting form at eskalenlab.ucr.edu and submit the following information:

- Your contact information
- Suspect tree species
- Description of location (and/or GPS coordinates)
- Description of symptoms
- Photos of suspect tree and close-up photos of symptoms (see below)
- If dieback is observed, include a picture of the entire tree.

Take photos of suspect trees from several distances. Include photos of:

1. the trunk or symptomatic branches
2. the symptoms (close-up)
3. the entry/exit hole, if visible, with a ballpoint pen for scale (remove gumming or exudate if necessary)

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