



Invasive Shothole Borers

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Shothole borers
website:

ishb.org


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Invasive Shothole Borers

Pest Overview ▾ Diagnosis ▾ Management ▾ News & Events ▾ Resources ▾ Contacts ▾




Small Beetle, Big Problem

Invasive shothole borers (ISHB) are two closely related species of small, non-native, beetles that bore into trees. ISHB introduce fungi that cause a tree disease called *Fusarium* dieback (FD). The ISHB-FD pest-disease complex is responsible for the death of thousands of trees in Southern California and poses an imminent threat to the integrity of our urban and natural forests.

Invasive shothole borers attack a wide variety of tree species including avocados, common landscape selections, and California native species in urban and wildland environments.

For more information about invasive shothole borers and *Fusarium* dieback, view the video below and explore this website.



Online Training

[ISHB eXtension Training!](#)
The course is served by the eXtension national online learning platform.

ISHB Detection & Management Assessment

Before reporting infestations, take the [ISHB Detection Assessment](#) to see if your tree is suffering from ISHB damage.

Shothole borers Outline of this talk

1. ISHB biology
2. ISHB effects (*Kurt will tell us more!* 😊)
3. ISHB management options
4. ISHB planning and management considerations
5. Discussion

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My goal is for you to:

1. ~ understand the biology of this pest and its effects
2. ~ begin learning to recognize ISHB
3. ~ understand management options
4. ~ have a good overview of the educational resources

Shothole borers My goals and your follow-up 😊

What you will need to do:

- a. **Spend some time with the ISHB.ORG website**
- b. Decide on the management options you can accept
- c. Figure out the funding, including funding for REPLANTING
- d. Set up a monitoring and/or trapping plan
- e. Monitor → Manage/Remove → Monitor → **Replant!**

ISHB **lessons-learned** from John K. (boring since 2013)

1. Monitoring is key (visual and trapping)
2. So: have a tree inventory before the borers arrive!
And learn to recognize ISHB infestations
3. Amplifier trees: identify and remove
4. Low-to-medium severity: insecticide + fungicide
imidacloprid (soil, inject.), bifenthrin (bark); dinotefuran
+ fungicide: tebuconazole, or *Bacillus subtilis*
5. IF monitored, then OK to only treat infested trees
6. Borers LOVE *Botryosphaeria*: so, remove Bot
canker-infested branches, and check for Bot!

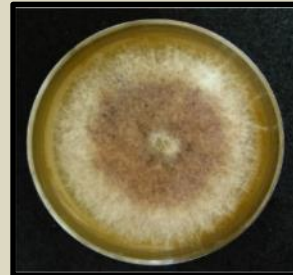
Invasive Shot-Hole Borers / Fusarium Dieback



Polyphagous Shot Hole Borer
(PSHB)



Photos | Akif Eskalen - UCR

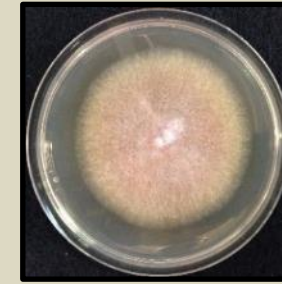


*Fusarium
euwallaceae*

Kuroshio Shot Hole Borer
(KSHB)



Photos | Akif Eskalen - UCR



Fusarium sp.

Morphologically indistinguishable (look the same)

- DNA analysis
- ID the associated fungus

How did they get here?

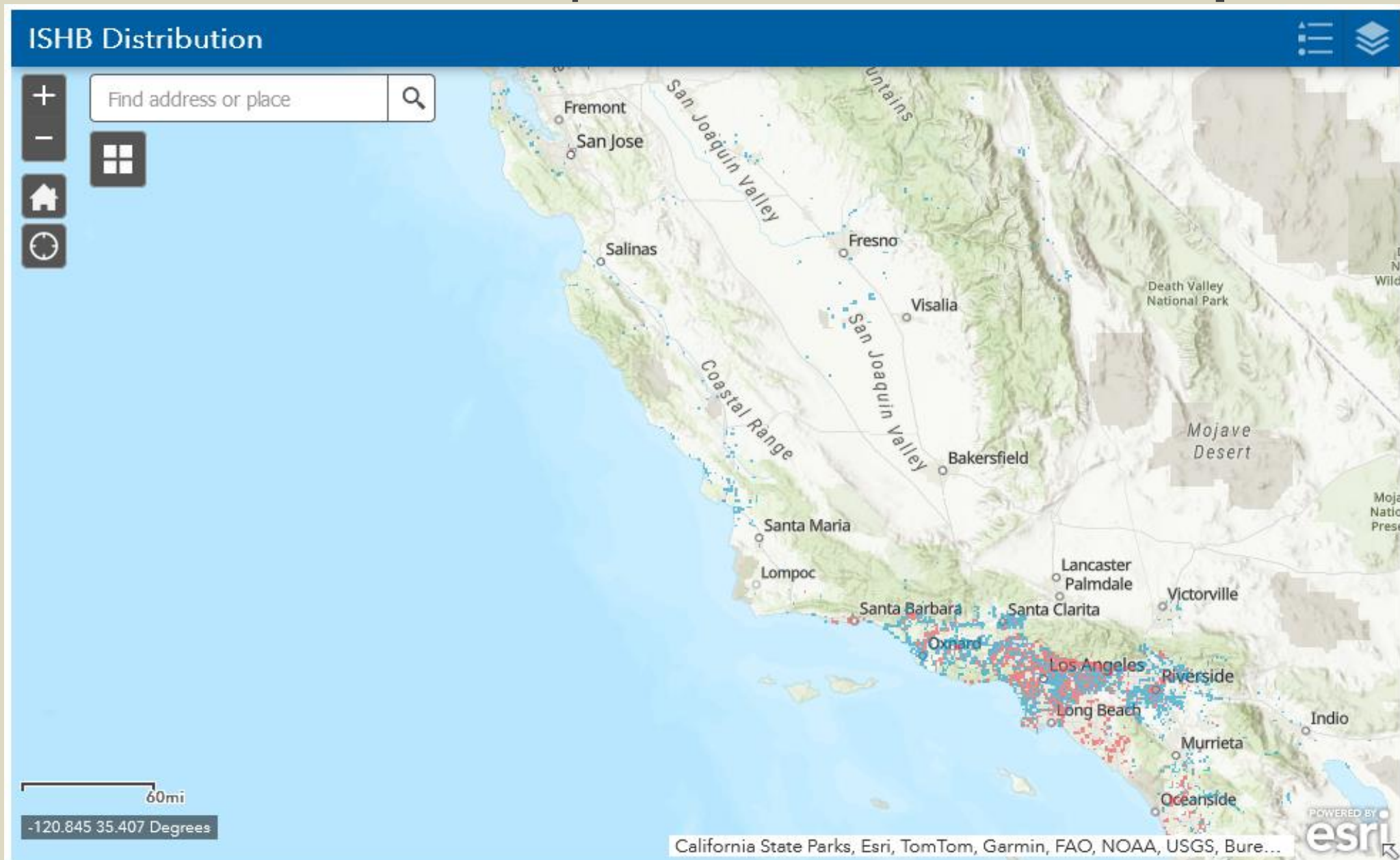


Pallets



Packing crates

Shothole borers: <https://ucanr.edu/sites/pshb/>



Invasive Shot-Hole Borer / Fusarium Dieback



ISHB effects on tree trunk and branches



24"
60cm



Infestation in
main trunk



7"
18cm

Infestation in
branches

Life cycle of Shot Hole Borers / Fusarium Dieback



Beetles inoculate the fungus onto gallery wall.



Females make galleries in the wood and lay eggs.



Female beetle attacks healthy host tree

Life cycle of Shot Hole Borers / Fusarium Dieback



Developing larvae feed on the fungus in the gallery; mate with siblings.



Females leave the gallery, staying on the same host tree to make their own gallery.



Fungus continues to colonize the wood beyond the gallery wall.



Life cycle of Shot Hole Borers / Fusarium Dieback



Fungus causes branch dieback and tree mortality.



Female beetle attacks healthy host tree



When the host tree dies, adults leave the host to find a new host.

Amplifier tree concept



When some preferred host trees are infested, beetles will **STAY** on their “birth tree” until it declines



- a. Some trees get badly infested and “produce” a lot of beetles
- b. Amplifiers will not recover; and “their” beetles will pressure neighboring trees
- c. **Remove amplifier trees!**
- d. Use traps to assess effect
- e. Then **replant!**



Which tree species are susceptible?

247 species of trees attacked,

BUT:

“only” 78 species of trees
can support ISHB reproduction

AND

“only” about 17 tree
species are killed

See: UC IPM Pest Note

https://ipm.ucanr.edu/legacy_assets/pdf/pestnotes/pninvashotholeborer.pdf

Table 1. Current list of confirmed ISHB-FD reproductive hosts.

Hosts killed by ISHB-FD

Latin Name	Common Name
<i>Acer buergerianum</i>	Trident maple
<i>Acer macrophyllum</i>	Big leaf maple*
<i>Acer negundo</i>	Box elder*
<i>Acer palmatum</i>	Japanese maple
<i>Liquidambar styraciflua</i>	American sweet gum
<i>Parkinsonia aculeata</i>	Palo verde
<i>Platanus racemosa</i>	California sycamore*
<i>Platanus x acerifolia</i>	London plane
<i>Populus fremontii</i>	Fremont cottonwood*
<i>Populus nigra</i>	Black poplar*
<i>Populus trichocarpa</i>	Black cottonwood*
<i>Quercus lobata</i>	Valley oak*
<i>Quercus robur</i>	English oak
<i>Ricinus communis</i>	Castorbean
<i>Salix gooddingii</i>	Black willow*
<i>Salix laevigata</i>	Red willow*
<i>Salix lasiolepis</i>	Arroyo willow*

Hosts NOT killed by ISHB-FD

Latin Name	Common Name
<i>Acacia melanoxylon</i>	Australian blackwood
<i>Acacia mearnsii</i>	Black wattle†
<i>Acacia spp.</i>	Acacia
<i>Acer paxii</i>	Evergreen maple
<i>Acer saccharinum</i>	Silver leaf maple
<i>Aesculus californica</i>	California buckeye*
<i>Ailanthus altissima</i>	Tree of heaven
<i>Albizia julibrissin</i>	Mimosa
<i>Alectryon excelsus</i>	Titoki
<i>Alnus rhombifolia</i>	White alder*
<i>Archontophoenix cunninghamiana</i>	King palm

Hosts NOT killed by ISHB-FD

Latin Name	Common Name
<i>Cocculus laurifolius</i>	Laurel leaf snailseed tree
<i>Combretum kraussii</i>	Forest bushwillow†
<i>Corymbia ficifolia</i>	Red flowering gum
<i>Cupaniopsis anacardioides</i>	Carrotwood
<i>Dombeya cacuminum</i>	Strawberry tree
<i>Erythrina caffra</i>	Coast coral tree
<i>Erythrina coralloides</i>	Coral tree
<i>Erythrina falcata</i>	Brazilian coral tree
<i>Fagus crenata</i>	Japanese beech
<i>Ficus altissima</i>	Council tree
<i>Ficus carica</i>	Black mission fig
<i>Gleditsia triacanthos</i>	Honey locust
<i>Harpullia pendula</i>	Tulip wood
<i>Howea forsteriana</i>	Kentia palm
<i>Ilex cornuta</i>	Chinese holly
<i>Jacaranda mimosifolia</i>	Jacaranda
<i>Koelreuteria bipinnata</i>	Chinese flame tree
<i>Magnolia grandiflora</i>	Southern magnolia
<i>Magnolia virginiana</i>	Sweet bay
<i>Persea americana</i>	Avocado
<i>Platanus mexicana</i>	Mexican sycamore
<i>Podalyria calyptрата</i>	Keurtije†
<i>Populus tremuloides</i>	Quaking aspen
<i>Prosopis articulata</i>	Mesquite*
<i>Psoralea pinnata</i>	Fountain bush†
<i>Pterocarya stenoptera</i>	Chinese wingnut
<i>Ptychosperma elegans</i>	Solitaire palm
<i>Quercus agrifolia</i>	Coast live oak*
<i>Quercus chrysolepis</i>	Canyon live oak*
<i>Quercus engelmannii</i>	Engelmann oak*
<i>Quercus macrocarpa</i>	Bur oak

Which tree species should you focus on?

~ the 17 species that get killed

~ especially:

Box Elder

Sycamore

Willows

Castorbean

In city parks &
street trees:

London Plane Tree

English oak

~ these species will be hit FIRST, and
they will be hit HARDEST

~ once these preferred hosts are near
death, the beetles will move on to less
desirable hosts

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What are we looking for? Holes! < 1 mm, perfectly round



Number of holes indicate SEVERITY

- **Low Infestation Level: < 50**
- **Moderate Infestation Level: ≥ 50 and < 150**
- **Heavy Infestation Level: ≥ 150**
- **Severe Infestation Level: ≥ 150 + ISHB-related dieback**

→ Severe infestation = no recovery

→ Are the holes still “active?” Paint over, and see if the beetle re-opens the hole

1: Low (<50)



2: Moderate (50-150)



3: Heavy (>150) Without Dieback



4: Severe (>150) With Dieback



Branch Collar



Control Options

Cultural / Sanitation

- Tree removal
- Pruning infested branches
- Pruning wound protection
- Chipping, Solarization/ fumigation
- Restrict firewood movement

Chemical

- Beetle and/or Fungal Symbionts
- Trunk sprays
- Systemic-Soil injection/drench, trunk injection

Attract & Kill Traps and deterrents

- Lure-Pesticides and deterrents

Biocontrol

- Natural Enemies
- Use of Entomopathogen Fungi
- Use of Endophytic bacteria and/or fungi

Management matrix

ISHB Infestation Level & Management Options for High Value Trees

Host Type	Hazard Level	No Infestation	Low Infestation	Moderate Infestation	Heavy Infestation	Severe Infestation
Reproductive Host	Low	Monitor	Treat and/or remove infested branches*	Treat and/or remove infested branches*	Treat and/or remove infested branches*	Remove tree & stump
Reproductive Host	High	Monitor	Treat and/or remove infested/hazard branches*	Treat and/or remove infested branches*	Remove infested branches*, or remove tree & stump	Remove tree & stump
Non-Reproductive Host	Low	Monitor	Monitor	Notify your local UCCE office; consult with ISHB-FD experts to determine if species is a new reproductive host		
Non-Reproductive Host	High	Monitor	Monitor	Notify your local UCCE office; consult with ISHB-FD experts to determine if species is a new reproductive host		

Wood management

1. Grind out the stump, if at all possible
 - ~ beetles will continue to emerge from stump!
2. Chipping: to 1" (>99% kill), or to 3" (98% kill)
 - ~ for total kill, either compost or solarize chips
3. Wood: solarize on-site, or kiln-dry
 - ~ solarization may take excessively long;
 - ~ DO NOT MOVE un-covered wood!

Resources

1. ISHB website

~ handouts, webinars, videos

~ you should spend 1-2 hours here! 😊

2. eXtension on-line course (that's "E-extension" 😊)

~ requires registration (but is free!)

3. County Ag. Commissioner's Office

4. California Dept. of Food and Agriculture

5. UC Cooperative Extension, and UC Davis

Thank you!

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