

# Host Range of the Invasive Polyphagous Shot Hole Borer

Yigen Chen<sup>1</sup>, Tom W. Coleman<sup>2</sup>, Andrew D. Graves<sup>3</sup>,  
James R. Meeker<sup>4</sup>, and Steven J. Seybold<sup>5</sup>

<sup>1</sup>University of California, Davis, CA;

<sup>2</sup>USDA FS FHP, San Bernardino, CA;

<sup>3</sup>USDA FS FHP, Albuquerque, NM;

<sup>4</sup>USDA FS FHP, Pineville, LA;

<sup>5</sup>USDA FS PSW, Davis, CA





# Outline

- ◆ Biology and damage

- ◆ No-choice tests



Gel caps



Buckets

- ◆ Dual-choice tests



Standing logs



Hanging logs

# Polyphagous Shot Hole Borer

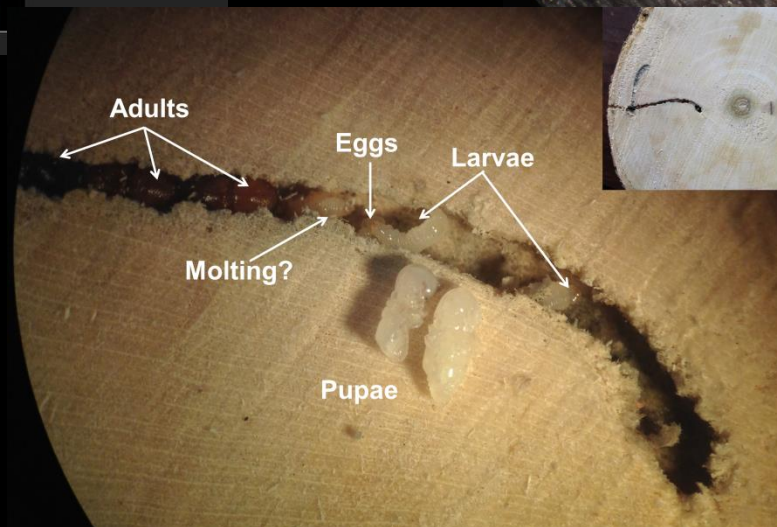
*Euwallacea* sp. (Coleoptera: Scolytidae)

- ◆ First found in Los Angeles Co. in 2003. It's likely introduced from southeastern Asia.

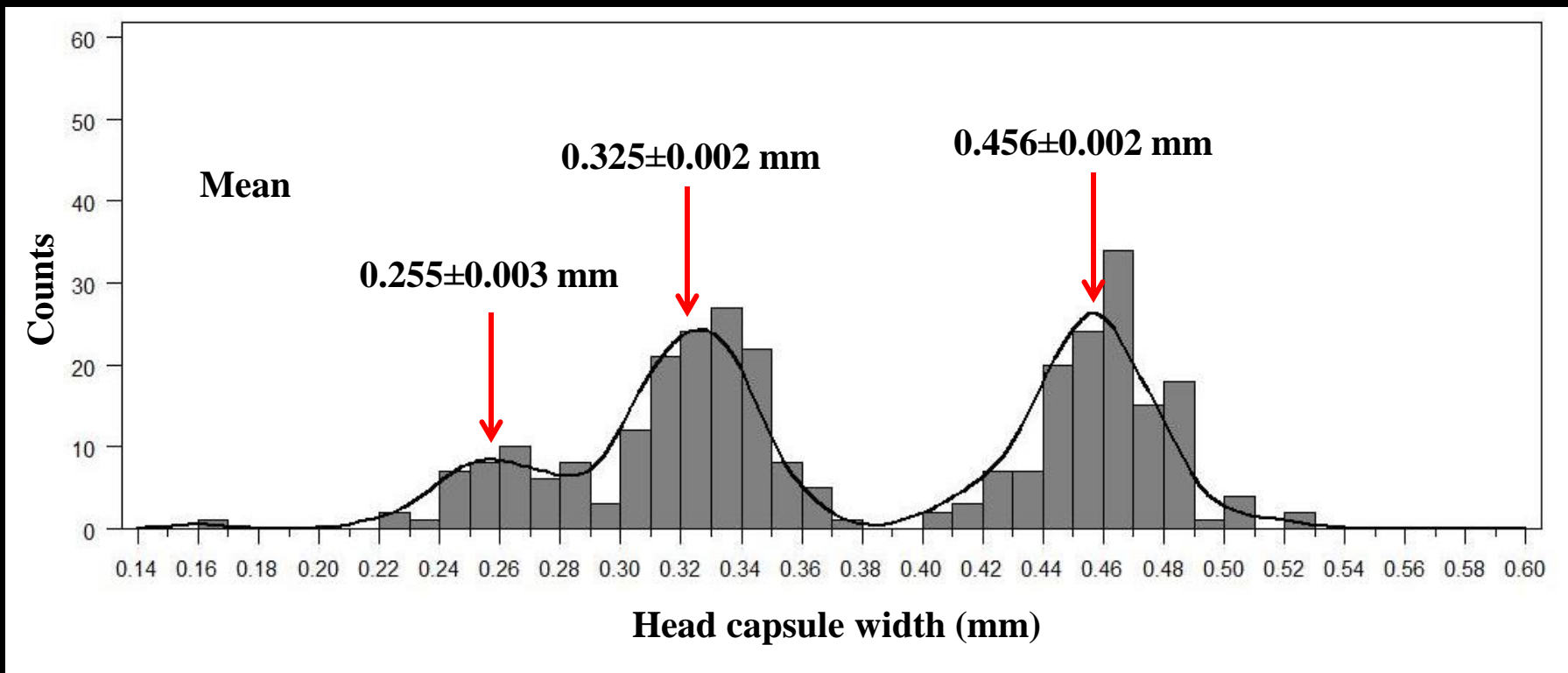
**Fusarium dieback, *Fusarium euwallaceae***

- ◆ PSHB females inoculate *Fusarium*, and both adults and larvae feed on *Fusarium*

# Polyphagous Shot Hole Borer (*Euwallacea* sp.)



# PSHB Larval Instars



**$N = 303$**



# Distribution



counties:

Angeles

ge

rside

Bernardino

Diego

3)



# PSHB Damage



# Infestation and Mortality

~800 trees surveyed across four sites

(Arcadia Wilderness Park, Glendora, Pasadena Glen, Whittier Narrows Park)

Species	% Infested	% Severely Injured	% Dead with PSHB
Box elder ( <i>N</i> =84)	89%	83%	30%
Red willow ( <i>N</i> =103)	83%	49%	17%
Castor bean ( <i>N</i> =25)	68%	71%	16%
Willow spp. ( <i>N</i> =27)	88%	0%	7%
California sycamore ( <i>N</i> =149)	77%	25%	5%
Fremont's cottonwood ( <i>N</i> =52)	60%	61%	4%
White alder ( <i>N</i> =54)	74%	18%	2%
Ash spp. ( <i>N</i> =33)	32%	8%	0%
Coast live oak ( <i>N</i> =92)	23%	0%	0%
Southern California black walnut ( <i>N</i> =14)	23%	0%	0%



# Host Range

Over 200 species of known host plants in the LA area.

1. Box elder (*Acer negundo*)
2. Big leaf maple (*Acer macrophyllum*)
3. Evergreen maple (*Acer paxii*)
4. Trident maple (*Acer buergerianum*)
- 5 Japanese maple (*Acer palmatum*)
6. Castor bean (*Ricinus communis*)
7. California sycamore (*Platanus racemosa*)
8. Red willow (*Salix laevigata*)
9. Avocado (*Persea americana*)
10. Mimosa (*Albizia julibrissin*)
11. English Oak (*Quercus robur*)
12. Coast live oak (*Quercus agrifolia*)
13. London plane (*Platanus x acerifolia*)
14. Cottonwood (*Populus fremontii*)
15. White Alder (*Alnus rhombifolia*)
16. Titoki (*Alectryon excelsus*)
17. Engelmann Oak (*Quercus engelmannii*)
18. Cork oak (*Quercus suber*)
19. Valley oak (*Quercus lobata*)
20. Coral tree (*Erythrina corallodendron*)
21. Blue palo verde (*Cercidium floridum*)
22. Palo verde (*Parkinsonia aculeata*)
23. Moreton Bay Chestnut (*Castanospermum australe*)
24. Brea (*Cercidium sonora*)
25. Mesquite (*Prosopis articulata*)
26. Weeping willow (*Salix babylonica*)
27. Chinese holly (*Ilex cornuta*)
28. Camelia (*Camellia semiserrata*)
29. Acacia (*Acacia* spp.)
30. Liquidambar (*Liquidambar styraciflua*)
31. Red flowering gum (*Eucalyptus ficifolia*)

# No-choice Tests

## (Gel caps)

### Materials & Methods

- ◆ Logs 1-foot long & 2-4 inch in diameter
  - ◆ Individual PSHB female in a gel cap
  - ◆ 5-6 PSHB females/log
  - ◆ 4-6 logs/tree species
- 
- ◆ Check daily for 10 days
  - ◆ Cut logs in ca. 45 days and check gallery status



**Reproductive host plants: the ability of PSHB to establish a gallery and produce offspring.**





# No-choice tests

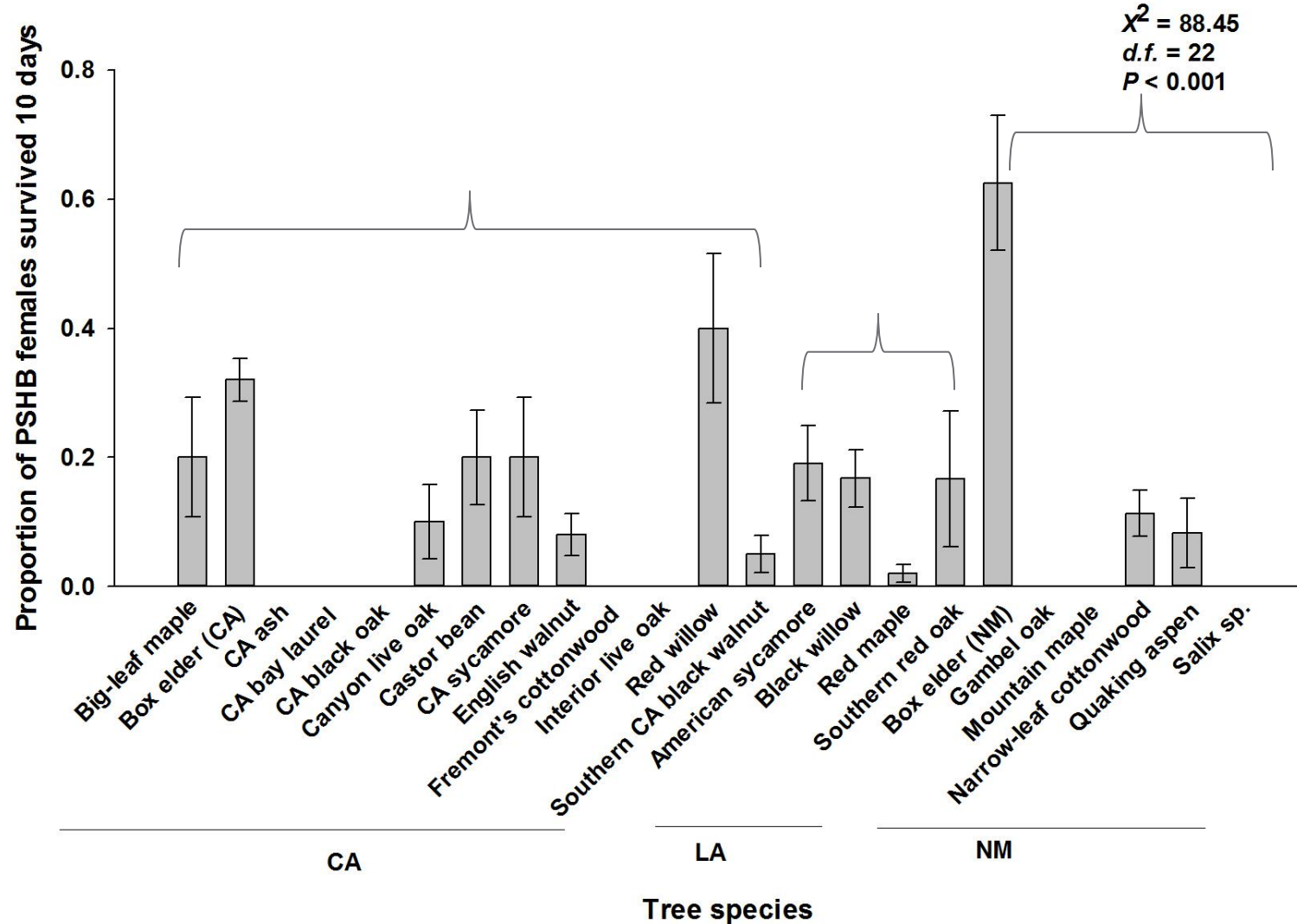
## (Gel caps)

California (15)	Louisiana (4)	New Mexico (6)
Big leaf maple, <i>Acer macrophyllum</i>	American sycamore, <i>Platanus occidentalis</i>	Box elder, <i>Acer negundo</i>
Box elder, <i>Acer negundo californicum</i>	Black willow, <i>Salix nigra</i>	Gambel oak, <i>Quercus gambelii</i>
California bay laurel, <i>Umbellularia californica</i>	Red maple, <i>Acer rubrum</i>	Mountain maple, <i>Acer glabrum</i>
California ash, <i>Fraxinus dipetala</i>	Southern red oak, <i>Quercus falcata</i>	Narrow leaf cottonwood, <i>Populus angustifolia</i>
California black oak, <i>Quercus kelloggii</i>		Quaking aspen, <i>Populus tremuloides</i>
California sycamore, <i>Platanus racemosa</i>		Unidentified willow, <i>Salix</i> sp.
Canyon live oak, <i>Quercus chrysolepis</i>		
Castor bean, <i>Ricinus communis</i>		
Coast live oak, <i>Quercus agrifolia</i>		
English walnut, <i>Juglans regia</i>		
Fremont's cottonwood, <i>Populus fremontii</i>	Tree species tested	
Interior live oak, <i>Quercus wislizeni</i>		
Red willow, <i>Salix laevigata</i>		
Southern California black walnut, <i>Juglans californica</i>		
White alder, <i>Alnus rhombifolia</i>		

# No-choice Tests

## (Gel caps)

## Results





# No-choice Tests

## Results

(Gel caps)

### CA (9)

Box elder

California ash\*

California bay laurel\*

California sycamore

Castor bean

English walnut\*

Fremont cottonwood

Interior live oak\*

Red willow

### LA (3)

Black willow\*

Red maple\*

Southern red oak\*

### NM (4)

Box elder\*

Quaking aspen\*

Narrow-leaf cottonwood\*

*Salix* sp. \*



Based on the ability of PSHB to establish a gallery

\* = Newly found host plants

# No-choice Tests

## (Buckets)

### Materials & Methods

- ◆ Logs 1-foot long & 2-4 inch in diameter
- ◆ 3-4 logs of the same tree species/bucket
- ◆ 40-60 PSHB females/bucket
- ◆ Logs split 2 mo later and check gallery
- ◆ Presence of PSHB males, larvae, and pupae



Buckets





# No-choice Tests

## (Buckets)

### Results

#### CA (6)

Box elder

California ash\*

California bay laurel\*

California sycamore

Fremont cottonwood

Interior live oak\*

#### LA (3)

Black willow\*

Red maple\*

Southern red oak\*

#### NM (3)

Quaking aspen\*

Narrow-leaf cottonwood\*

*Salix* sp. \*

**Based on the presence of PSHB males, larvae, and pupae**

**\* = Newly found host plants**

# Dual-choice Tests

## (Standing logs)

### Materials & Methods

- ◆ Logs 1-foot long & 2-4 inch in diameter
- ◆ 1 log from each tree species/cage
- ◆ 20 PSHB females/cage
- ◆ Check entrance holes/females on logs 48 h later
- ◆ 4-7 replications/test



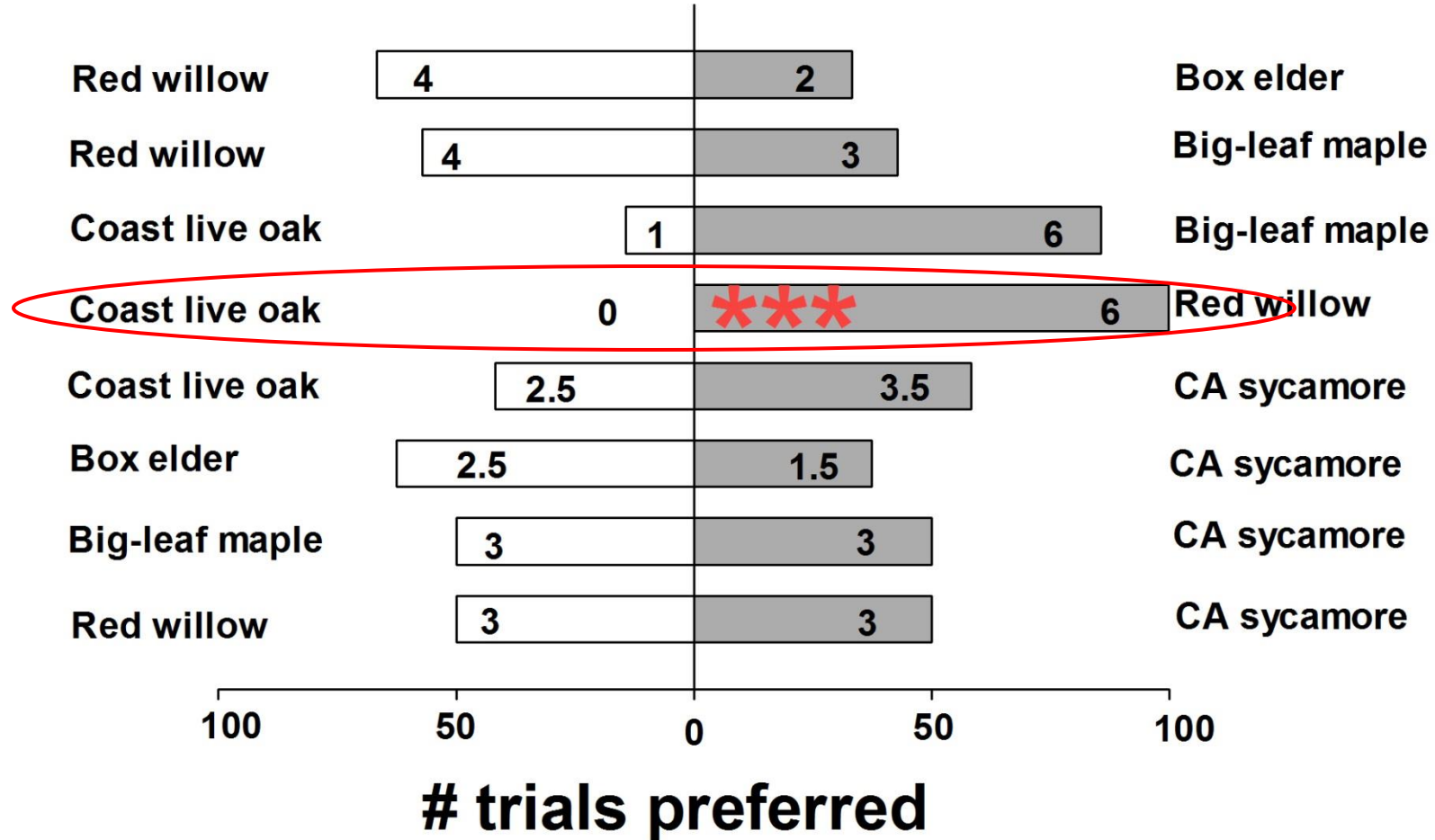
### Tests

1. California sycamore vs. Red willow
2. Coast live oak vs. Red willow
3. Coast live oak vs. California sycamore
4. Coast live oak vs. Big leaf maple
5. Red willow vs. Big leaf maple
6. Box elder (California) vs. Red willow
7. Big leaf maple vs. California sycamore
8. Box elder (California) vs. California sycamore



# Dual-choice Tests

(Standing logs)



#s on bars denote the # of trials in which the species was preferred; \*\*\* $P < 0.001$ .

# Dual-choice Tests

## (Hanging logs)

### Materials & Methods

- ◆ Logs 1-foot long & 2-4 inch in diameter
- ◆ One log from each tree species/cage
- ◆ 20 PSHB females/cage
- ◆ Check entrance holes/females on logs
- ◆ 3-6 replications/test



Hanging logs

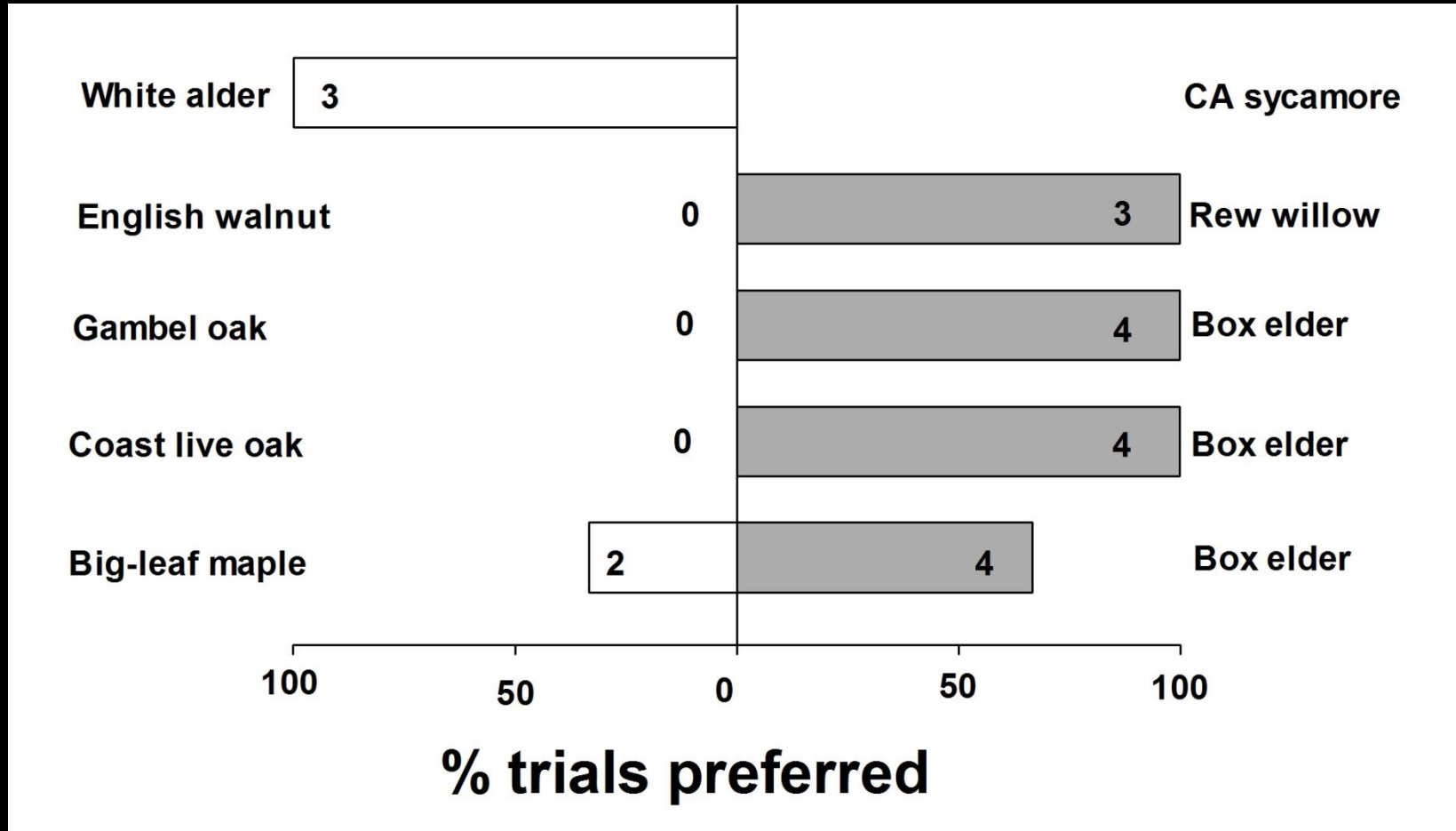
### Tests

1. Coast live oak vs. Box elder (CA)
2. Gambel oak vs. Box elder (CA)
3. Red willow vs. English walnut
4. California sycamore vs. White alder
5. Box elder (CA) vs. Big-leaf maple



# Dual-choice Tests

## (Hanging logs)



#s on bars denote the # of trials in which the species was preferred.

# Summary & Future Research

1. PSHB is spreading rapidly in CA. It could be a considerable threat to hardwood trees due to its broad host range;
2. Results so far indicated that many host trees are susceptible. Many more tests will need to be conducted;
3. Its complete host range is still unknown. We are testing tree species from various states. Many species from Louisiana and New Mexico are susceptible; and
4. Its broad host range is due to that they feed on fungi and do not need to interact tree chemistry.



# Acknowledgements

## Funding

USDA FS, STDP

## Technical Assistance

Adrian Poloni (UC Davis)

Paul Dallara (UC Davis)

Kellenberger (UC Davis)

