



California Society for Ecological Restoration Quarterly Newsletter *Fall Volume 26, Issue 3*

## Managing California's Shot Hole Borer Infestation

by *Chris Kallstrand*<sup>1</sup>

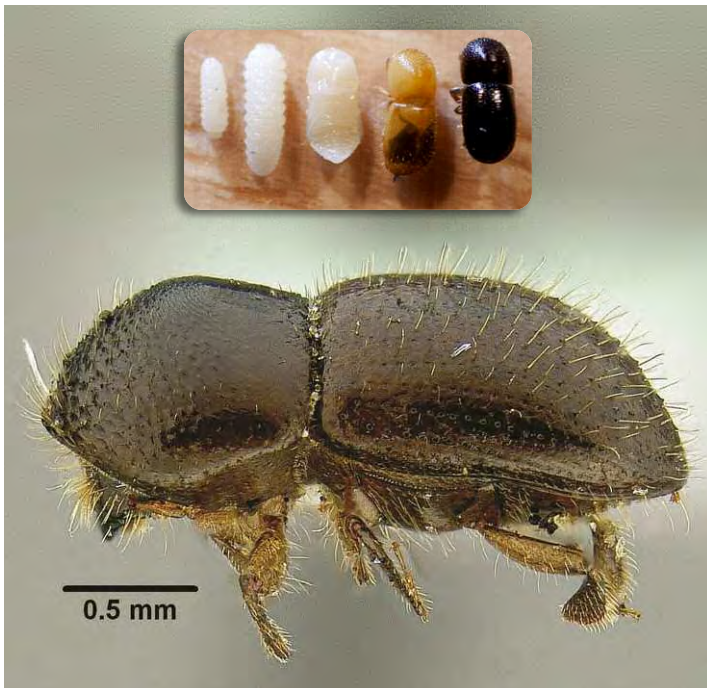
The polyphagous shot hole borer (PSHB), an exotic forest pest from Southwest Asia, is causing millions of dollars of damage and devastating native woodlands in California.

Proving to be one of the most dangerous of both native and non-native tree pests in California, PSHB has the ability to attack and kill hundreds of tree species, including native coast live oak, western sycamore, and red willow.

Unlike most bark beetles, PSHB does not feed on the tree itself, but on a fungus, which it introduces and transports from tree to tree.

*continued next page*

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Adult beetles come in a range of shades between black (females) and brown (males) and are very small, ranging from 0.05 to 0.1 inches in length. *Photo: Stacy Hishinuma, UC Davis, Department of Entomology.*

Inset Life stages of a female PSHB (*Euwallacea* sp.) from left to right: Young larva, older larva, pupa, immature adult, mature adult. *Photo: plantheroes.org.*

*This issue was compiled by Region 1 Director, Ralph Vigil.*

*Ecesis* is published quarterly by the California Society for Ecological Restoration, a nonprofit corporation, as a service to its members. Newsletter contributions of all types are welcome and may be submitted to any of the regional directors (see page 3).

5... **The Arroyo, Arundo, and an Increasing Presence of Beetles**  
9... **Fusarium Dieback and its Shot Hole Borer Vectors Threaten Native Vegetation in California**

**Plus...** SERCAL Contacts (p. 3) and Membership News (p. 11)

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**Shot-hole Borer Infestation** *continued*

The fungus spreads throughout the tree, damaging the tree layer that carries water and minerals up the tree from the roots—effectively starving the tree. The resulting damage varies from tree to tree but can include:

- Discolored wood
- Leaf discoloration and wilting
- Weakened structural integrity
- Dieback of limbs from the tree’s tips and roots inward
- Increased susceptibility to other pests and disease
- Tree death

PSHB infestation has contributed to the decline of native woodlands, reduced canopy cover near river and stream banks, and reduced habitat for several threatened and endangered species. Additionally, the devastation has resulted in millions of dollars of damage to native restoration efforts and agricultural production.

**Shot hole bore beetles cultivate a symbiotic fungus upon which both adult beetles and larvae feed. The fungus is transported from tree to tree by females which have special organs in their mouth parts for this purpose.**

Gold spotted oak borer (GSOB) and Kuroshio shot hole borer (KSHB) are also presenting serious threats to California native trees, including black oak, canyon live oak, and coast live oak

**Managing the Threat**

The University of California, Riverside, is researching treatment methods, but they are not yet available for public use. Currently, management programs for these pests are focused on 1) limiting their spread into new areas, and 2) protecting healthy trees where possible.

Measures to limit the spread of infected/infested trees include minimizing firewood transportation (“Buy Where You Burn”) and disposing infested material by chipping, grinding, and tarping (using heat generated by the sun to kill beetle larvae)(USDA 2013).

The protection of healthy trees includes:

- Practicing appropriate cultural practices (irrigation, mulching, pruning, and fertilization at optimal levels)
- Using plants and soil that are known to be free of pests and pathogens
- Cleaning/sterilizing tools that come into contact with infected plant material

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Ryan Gilmore inspecting Lindgren funnel trap for the presence of PSHB.  
Photo courtesy Chris Kallstrand.

## Shot-hole Borer Infestation *continued*

Dudek arborists certified by the International Society of Arborists are providing ongoing pest inspection monitoring throughout Orange County and portions of Los Angeles County. Monitoring efforts include identifying pests through rapid woodland assessment monitoring, ongoing pest trapping, and visual woodland and urban forest assessments. Once pests are found, Dudek arborists record the location and extent of the outbreak, establish an action threshold, and provide management options and treatment recommendations.

For more information on Dudek's effort to treat the infestation, contact Chris Kallstrand at [ckallstrand@dudek.com](mailto:ckallstrand@dudek.com) or Ryan Gilmore at [rgilmore@dudek.com](mailto:rgilmore@dudek.com).



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An area of high activity, the alders continue to die back with the increase of the beetle population.

# The Arroyo, *Arundo*, and an Increasing Presence of Beetles

by Anisha Malik<sup>1</sup>

Throughout the span of a restoration project there are various obstacles that may arise. As restoration ecologists, our adaptive approach to these routine challenges is based on experience and knowledge of the subject habitats.

However, when an unknown stress is brought upon a site, the original restoration plan must be flexible to allow for more adaptive management and collaboration among other scientific communities examined. With the shot hole borer rise within Orange County and, on a larger scale, Southern California, these species are presenting new complications that affect not only the health of the system but also budget constraints associated with the restoration plan. The original restoration design is clear and based on existing conditions within a system; however, with the introduction of shot hole borer species, functional lift may be

slowed and vegetation may be threatened, either of which would require immediate attention. One example of this is a restoration site within Orange County, in Arroyo Trabuco Creek.

**Previous monitoring reports and photos were sorted through for any indication of the beetle's introduction onsite — good record-keeping and photograph documentation showed evidence of symptoms in the lower downstream reaches.**

## Site Background

Prior to restoration activities (enhancement and re-establishment) commencing onsite, Arroyo Trabuco Creek was dominated by *Arundo donax*. *Arundo* was present from the invert to the widest parts of the floodplain and acted as a wall for wildlife movement and sediment transport.

The existing native habitat within the Arroyo consists of sycamore–alder riparian forest and willow forest within the low-flow channel, and sycamore and coast live oak woodland on the floodplain and banks. The intent of the *Arundo* removal was to re-establish the historic function of the Arroyo and remove the

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# The Arroyo, Arundo and an Increasing Presence of Beetles *continued*

exotic species from the upstream reach. *Arundo* removal has been completed for a few years, with the final removal of *Arundo* this summer. The changes within the Arroyo have been well noted. Degraded trees, in particular arroyo willow (*Salix lasiolepis*), are showing increased signs of new growth and overall health improvements. Volunteer species are also present within the floodplain where *Arundo* had been present. The invert has begun to meander and again interact with the floodplain.



Improvements on site with the removal of *Arundo* is clear with decreased competitive species and increased sunlight reaching more areas. The photos show the change between one month.

Wildlife movement throughout the corridor has also increased, and is tracked through volunteer support and wildlife cameras. The riparian habitat and emerging understory continues to improve as future phases of the restoration project are implemented.

## Initial Appearance

Entering the second phase of the project (rhizome removal, recontouring, and planting), a new issue arose of shot hole borer beetles onsite. The beetle's existence became evident during the month of August, with multiple white alders (*Alnus rhombifolia*) showing signs of staining along the trunks. With the rise of the infestation becoming a concern countywide, previous monitoring reports and photos were sorted through for any indication of the beetle's introduction onsite — good record-keeping and photograph documentation showed evidence of symptoms in the lower downstream reaches.

Generally, the beetles are more active in the late spring with their flight patterns; however, the drought and warmer, humid weather has allowed high activity to continue through late summer into fall. Research indicates the male and female beetles leave their host trees in search of new trees during this time, which coincides with the spread of beetles monitored onsite. Symptoms along the large spans of alders were not noted until July of this year, once *Arundo* was removed.

## Identifying the Severity of the Problem

To categorize the severity of the infestation, ethyl alcohol bait traps were placed onsite to monitor the population, initially in areas showing symptoms but exhibiting no entry or exit holes. To minimize the unforeseen expenses, traps were created using plastic bottles and string. Ethyl alcohol was used to mimic the ethanol released by trees in response to abiotic stressors, in this case stressors included drought, competition with *Arundo*, and/or higher temperatures. Different lures were tested with different strengths of ethyl alcohol, with the trap containing Purell (75% ethyl alcohol) having the most success — catching 25 beetles in one area. As of now, categorization of host trees is underway within a two-acre area.

*continued next page*

# The Arroyo, Arundo and an Increasing Presence of Beetles *continued*

The area with the highest beetle activity is located at the northern end of the project boundary. The alders are almost dead, with hundreds of entry/exit holes observed up and down the tree trunks. With further monitoring, traps were placed at the base of the high activity area and placed every 40 feet leading up to the area originally tested, totaling an estimated 40 traps. Different beetles were found present and species identification is underway.

## Research, Collaborate and Adapt

Since majority of the site appears to be in the early stages, containment and further prevention is a possibility. The continued use of bait traps is ideal for capturing, studying and ultimately decreasing the beetle population. Though few biological controls can be explored, some treatments may not be an option due to the proximity of open water within the Arroyo. Best management practices have been implemented with the occurrence of the beetles onsite. These include cleaning of vehicles and tools before leaving the site and hauling away cut wood to dump sites rather than green waste services. Though few trees have been trimmed or removed during the restoration process, any showing symptoms of the beetles and corresponding fungi will be cut and solarized onsite before ultimate removal.

At this stage, maintaining the health of other desired host species is the most important. With continued restoration of the site, in addition to long-term maintenance and monitoring, the habitat will continue to increase. Because the beetles require trees large enough in diameter to support their galleries, new plantings may not be affected at their younger stages, allowing for the restoration to continue and the beetle population to decrease over time.

The beetle infestation is generally new to Orange County and information must be shared as data is collected and distribution known. Collaborating with different scientific communities is key in approaching restoration with troubled sites. As more research is completed on shot hole borers and other ambrosia beetles, there are many different groups that can provide guidance for the restoration site, as the site also offers an opportunity for studying these specimens. Our proactive collaboration has included coordination with the University of



Top Samples of the trees were sent to the University of California, Riverside to identify the species of shot hole borers present at the site.

Bottom Bait traps are placed at the beginning of each week and collected on Fridays in various areas on site.

California Riverside and University of California Agriculture and Natural Resources, which conduct research on a specific species of shot hole borers and polyphagous shot hole borers. Stressors and challenges will always be part of ecosystem restoration; however, we can reduce the threat of such issues through collaboration and proper documentation so that watersheds benefit—not just single sites.



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Figure 2 Beetle gallery and their fungus on Box Elder (*Acer negundo*). Figure 3 Dead willow trees in Tijuana River Valley.

# Fusarium Dieback and its Shot Hole Borer Vectors Threaten Native Vegetation in California

by Shannon Lynch<sup>1</sup> and Akif Eskalen<sup>2</sup>

The polyphagous shot hole borer (PSHB), *Euwallacea* sp. nov *fornicatus* (Figure 1) is an invasive beetle that vectors a disease called *Fusarium* dieback (FD). The disease stops the flow of water and nutrients in over 45 susceptible tree species, which can lead to the death of individual branches or, in severe cases, the entire tree (Figure 3). It is caused by the fungi that the beetle farm in their gallery as a food source: *Fusarium euwallaceae*, *Graphium euwallaceae*, and *Paracremonium pembeum*. PSHB attacks a wide variety of host species. The beetles bore tunnels (galleries) in which to lay their eggs and grow the fungi (Figure 2). A closely related *Euwallacea* species, the Kuroshio shot hole borer (KSHB), has been detected throughout Orange and San Diego Counties. Morphologically identical to PSHB, it also spreads a fungal disease caused by other species of *Fusarium* and *Graphium*.

In 2003, a single PSHB beetle was caught in a CDFA trap in Long Beach. The beetle went unnoticed until 2012 when it was found damaging backyard avocado and urban forest trees in the Los Angeles basin. A rapid monitoring response uncovered the broad

host range of the pest-disease complex, but its ability to establish in native vegetation was only gradually recognized.

This wide suitable host range makes native riparian, oak woodland, and mixed evergreen communities highly susceptible to invasion and mortality by FD-SHB (Eskalen et al., 2013). By October 2015, FD-KSHB infested over 280,000 native trees in the Tijuana River Valley in San Diego County, including arroyo willow (*Salix lasiolepis*) (Figs. 4-5), Goodding's black willow (*S. gooddingii*), and mule fat (*Baccharis salicifolia*) (Boland 2016). We continue to confirm SHB attacking native vegetation in many new areas throughout San Diego, Los Angeles, Orange, and Riverside Counties (Eskalen and Lynch *pers. obs.*).

These particular plant communities are critical breeding habitat for endangered species such as the least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Epidomax traillii extimus*), and arroyo toad (*Anaxyrus californicus*). As FD-SHB kills willows, cottonwood, and mule fat,

*continued next page*



Figure 1 Female Polyphagous shot hole borer (*Euwallacea* sp.).

University of California, <sup>1</sup>Riverside and <sup>2</sup>Santa Cruz.



Figure 4 PSHB/FD Symptoms on Arroyo Willow. Figure 5 Recently infested Arroyo Willows in Santa Ana River near the city of Riverside.

## Fusarium Dieback *continued*

it can make riparian habitats more susceptible to invasion by giant cane (*Arundo donax*) and saltcedar (*Tamarix* spp).

At these early stages of the epidemic, preventative and containment measures can fortunately be effective, providing adequate, rapid assessment of key landscape factors. At present, knowing which management approaches are more effective is limited by the lack of data on how the pest-disease complex spreads across a complex landscape. Monitoring efforts have recently focused on avocado groves (due to immediate investment in research and development by the agricultural industry), but have now expanded to include the broader landscape to allow for regional planning and land management that will reduce or manage this threat within southern California.

For updates and more information, please visit our lab at [www.eskalenlab.ucr.edu](http://www.eskalenlab.ucr.edu).



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## Hello Members!

Where does the time go? It's already Fall and plans are falling into place for SERCAL 2017 at UC Davis Conference Center next May 10-11. We're talking about sessions on tidal wetlands, climate change, plant propagation (including more on *Phytophthora*), technical innovations, citizen science, long-term monitoring, stream and riparian restoration, and more! Plus, during the conference, mini fieldtrips and special panels for students and emerging issues, and after the conference, some awesome SERCAL fieldtrips. Watch [sercal.org](http://sercal.org) and your mailbox later this Fall for more information and the Call for Abstracts.

The SERCAL Board will be meeting soon to discuss updating our Bylaws and perhaps tweaking our Board structure just a bit to increase the efficiency of how our volunteer board moves the organization forward. For that reason, we decided this past summer to postpone elections until the first of the year.

Thanks so much for all your good energy, enthusiasm, and support this past year! If you would like to become more involved in the forward movement of SERCAL (e.g., ideas for regional events or fieldtrips, student outreach opportunities, etc.), please contact Harry or your regional board rep, or me at [julie.sercal@gmail.com](mailto:julie.sercal@gmail.com).

All the best,

Julie St John, your Admin Director



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