



## Summertime California Ground Squirrel Management

Summer is upon us so what does that mean for California ground squirrel management? As a practitioner of IPM, you are likely aware that effective ground squirrel management requires an integrated approach, including knowledge of pest biology. Ground squirrel behavior, which impacts the effectiveness of different management tools, is significantly affected by the season. Now that we are in summer, the soil is dry and the California ground squirrel (Figure 1) diet has likely switched from green vegetation to seeds. During this season, fumigation, which requires moist soil, will be much less effective, but trapping and toxic baits may still be effective.

Regardless of what type of management option you use, you must first consider whether there are endangered or threatened species present on the property that may use ground squirrel burrows (such as burrowing owls, tiger salamanders, etc.). To check if there are endangered species on your property and to learn about proper uses of pest management products when these species are present, you can consult the PRESCRIBE tool

(see Resources section). Trapping may still be an option if there are endangered species present, as long as you use and properly set specific trap designs, ensuring that they are inaccessible to endangered species. After determining whether endangered or threatened species need to be considered, you need to think through the pros and cons of each method, as explained below.

### Toxic Baits

There are two categories of toxic baits available for California ground squirrel control: first generation anticoagulant rodenticides (FGARs, which require multiple feedings) and zinc phosphide (an acute toxin that may only require a single feeding). Many toxic baits are restricted use pesticides. Anyone applying a restricted material must hold a pesticide applicator's license and will need a restricted use material permit. A notice of intent must be given to your county agricultural commissioner's department at least 24 hours before the application of a restricted use material. Applicators then have up to four days after the planned date (the date on the notice of intent) to begin the application; otherwise, a new notice of intent must be filed. A written recommendation from a Pest Control Advisor may also be required. If you have any questions about what permits or paperwork are required for



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Figure 1. A California ground squirrel.

using a particular rodenticide, check with your local Agricultural Commissioner's office.

In general, when applying any type of rodenticide, always read the label carefully. The label will specify how to apply the bait correctly, the timing of subsequent applications (if applicable), the target species for which the toxic bait can be used, and the locations permitted for use. You must always have a copy of the label with you on site when you apply rodenticides.

FGARs can be used as spot treatments, broadcast applications (though not for resident use), or in bait stations. There is an antidote (Vitamin K1) available for the active ingredients in FGARs, but, since it is not 100% effective and requires a prescription from a veterinarian, these products should not be applied if you have any concerns that nontarget animals will be able to access the bait. There is a primary

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risk of nontarget exposure from the use of FGARs, however it is generally necessary for it to be consumed over multiple days, on multiple occasions to achieve a toxic dose.

Zinc phosphide does not have an antidote available and can only be used as a spot treatment or a broadcast application (NO bait stations). It is not permitted for use in or around buildings, and the label is species-specific for many locations, so always double check the label before applying it. You must be a licensed pesticide applicator to use this toxic bait to manage California ground squirrels. It poses a higher primary toxicity risk (due to direct consumption) but a lower secondary toxicity risk (due to consumption of a poisoned animal) to nontarget animals than the FGARs.

When using toxic baits, you should check for and properly dispose of squirrel carcasses daily. Always wear gloves when handling carcasses.

## Trapping

If you are interested in using traps, there are many options available (Figure 2). In general, trapping can be more time intensive and may not be as effective as toxic baits at knocking down a population. But it still can be an effective method for controlling smaller ground squirrel populations. If you are contracting out for trapping services, you need a trapping license from the California Department of

Fish and Wildlife. If you work for a county or if a California ground squirrel, or another nongame mammal is causing damage on your property, you are exempt from this licensing requirement. Both live traps and lethal traps are available for ground squirrels. Keep in mind, though, that even if you use a live trap you will need to euthanize the ground squirrels in a manner following American Veterinary Medical Association (AMVA) guidelines. If you are worried about catching non-target animals, then live traps may be the better option.

For multi-catch live traps, which allow you to catch multiple ground squirrels at once, it is very important to pre-bait. That means you should place bait within the trap for a few days without setting the trap and allow the ground squirrels to feed on the bait freely. Pre-baiting will get the older and potentially trap-shy ground squirrels more comfortable with the trap and will increase your odds of catching them once the traps are set. When doing any sort of trapping, you are ideally looking to catch the adults, not just the younger, typically less wary, individuals. If you are able to catch a mature individual, its alarm calls will act as a form of bait in and of itself and will attract other ground squirrels into the trap.

To avoid contacting squirrel urine or feces, wear gloves when handling any type of trap, even if the trap is empty.



Figure 2. A Conibear trap placed directly in the burrow opening so the squirrel must pass through the Conibear jaws.

You are required by the California Department of Fish and Wildlife to check the traps at least once daily.

Traps must be set more than 150 yards from any structure used as a permanent or temporary residence, unless such traps are set by a person controlling such property or by a person who has and is carrying written consent of the landowner to place the trap or traps.

California ground squirrels, once trapped, must be immediately killed or released in the site where trapped. Unless released, trapped animals shall be euthanized following AMVA guidelines or by shooting where local ordinances, landowners, and safety permit.

For more detailed information on ground squirrel control and other control methods not mentioned here, check out ANR's online resources *Pest Notes: Ground Squirrel* and the Ground Squirrel BMPs website.

Best of luck!

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## Resources for Ground Squirrel Management

PRESCRIBE tool, the Pesticide Regulation's Endangered Species Custom Realtime Internet Bulletin Engine:  
[cdpr.ca.gov/docs/endspec/prescint.htm](http://cdpr.ca.gov/docs/endspec/prescint.htm)

County Agricultural Commissioners contact information:  
[cdfa.ca.gov/exec/county/countymap/](http://cdfa.ca.gov/exec/county/countymap/)

American Veterinary Medical Association (AMVA) guidelines:  
[avma.org/sites/default/files/2020-01/2020-Euthanasia-Final-1-17-20.pdf](http://avma.org/sites/default/files/2020-01/2020-Euthanasia-Final-1-17-20.pdf)

UC IPM Pest Notes: Ground Squirrel:  
[ipm.ucanr.edu/PMG/PESTNOTES/pn7438.html](http://ipm.ucanr.edu/PMG/PESTNOTES/pn7438.html)

Ground Squirrel BMPs website:  
[groundsquirrelbmp.com/management-cgs.html](http://groundsquirrelbmp.com/management-cgs.html)

# Invasive Shothole Borers—an Ongoing Threat to California’s Trees

Two identical looking species of wood-boring beetles, collectively known as invasive shothole borers (ISHB), have killed thousands of trees in Southern California and pose an ongoing threat to California’s urban and wildland forests. These beetles, which are not native to the United States, were first identified in Los Angeles County in 2012 and have since spread to six other counties: Orange, Riverside, San Bernardino, San Diego, Santa Barbara, and Ventura.

## Beetles, Fungus, and Impact

The polyphagous shothole borer (*Euwallacea fornicatus*) (Figure 1) and the Kuroshio shothole borer (*Euwallacea kuroshio*) are small ambrosia beetles that have a symbiotic relationship with several species of fungi, including *Fusarium* species. Female beetles carry spores of these fungi in specialized pocket-like structures called mycangia at the back of their heads. The beetles inoculate trees with the fungal spores when they bore into the cambium layer of trunks and branches and create tunnel systems, called galleries, (Figure 2) where they lay their eggs. The adult beetles and their larvae feed on the fungi growing in the galleries rather than the wood of the tree.

As the fungus grows, it colonizes the tree’s vascular system, blocking transport of water and nutrients. This causes a disease called *Fusarium* dieback that can kill branches or entire trees. The beetles and their symbiotic fungi have a wide range of suitable hosts, including more than 65 species of trees found in California. The most highly susceptible trees include many of the species commonly used for landscaping, such as sycamores, oaks, cottonwoods, and box elder trees. ISHB beetles attack healthy trees as well as stressed or diseased trees in a variety of urban,



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Figure 1. Polyphagous shothole borer in its gallery.



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Figure 2. Galleries in box elder created by invasive shothole borers.

suburban, and riparian settings. Visit [www.ishb.org](http://www.ishb.org) to find the full list of reproductive hosts in California.

Female beetles can fly short distances, allowing the pest-disease complex to spread into new areas near already infested trees. Beetles can also be transported in infested firewood and green waste, leading to spread over much greater distances. While beetles have only been identified in Southern California and the Central Coast to date, further spread throughout much of California is possible.

ISHB-infested trees can quickly become public safety hazards. Trees with heavily infested branches can be especially hazardous, since the combined damage of the fungal disease and the beetle’s tunneling activity weakens the wood, causing limbs to break and fall. In addition, severely infested trees will become constant sources of beetles that can disperse and infest neighboring trees. Such “amplifier” trees generally need to be removed completely, while more lightly infested trees can be managed or treated without requiring removal. Therefore, early detection and rapid response is the key to controlling ISHB. Substantial recovery in lightly to moderately infested trees has

been observed in some areas where amplifier trees have been removed.

## Identifying an ISHB Infestation

Correct identification is the first step to successful ISHB management. The following are typical signs and symptoms of ISHB infestation:

- **Beetle entry holes:** When the beetles tunnel into trees they make small, perfectly round holes, each about the size of the tip of a medium ballpoint pen (0.8 mm) (Figure 3).
- **Additional signs and symptoms:** Entry holes are usually accompanied by one or more of the following signs and symptoms, which vary by the tree species: staining, gumming, white powdery exudate, or frass (boring dust).
- **Dieback:** Dead or wilting branches can be a sign of a severe infestation. If you see dieback on trees, check for entry holes on the trunk or the branch collars.

In addition to visual inspections, traps using quercivorol, a plant-based lure

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that attracts the beetles over short distances, can help determine the presence and abundance of beetles in an area. Trapping is especially useful for large or inaccessible areas where regular visual inspections of all the trees are not practical. In those cases, trapping can help determine if ISHB is present in the area and can help focus survey efforts on infested trees. Because the lure has relatively low attractiveness, trapping is not an effective control method for ISHB and is only used for detection purposes.

## What Can You Do?

1. Keep trees healthy. Proper irrigation and maintenance will keep trees strong and help protect them from ISHB and other pests.
2. Prune out infested branches. Removing branches that have clusters of 50 or more ISHB holes would help control this pest. For trees that undergo heavy pruning every year, like avocado trees, removal of all infested branches is recommended. Tools should be disinfected after pruning by spraying them with a solution of 5% disinfecting bleach or 70% ethanol to avoid spreading the fungal disease to other trees.
3. Remove severely infested trees. Unfortunately, severely infested trees (with more than 150 entry holes and ISHB-related dieback) are not likely to survive. These trees should be removed as soon as possible, and the stump should be ground to one inch or less. (Figure 4)
4. Manage downed wood. Green waste generated by branch and tree removals should be properly disposed.

Chipping/grinding to one inch or less kills 99.9% of the beetles. If that is not possible, chipping to three inches or less still will kill 98% of the beetles in the wood. In already infested areas, chipped wood can be used onsite as mulch. However, if working on a newly infested area or if the wood chips will be moved to another area, chipping should be combined with solarization or composting to kill 100% of the beetles. If chipping is not an option, logs can also be solarized or kiln dried to exterminate the beetles.

Solarization involves covering the material with clear plastic tarp and letting the heat from the sun kill the remaining beetles. Chips and beetles should be fully contained by wrapping plastic both underneath and over the material. Chips should remain covered for at least six weeks during the summer months or for at least six months between September and June. The depth of the pile should be no more than 30 inches deep, to ensure even heating.

Composting, when done correctly, should also kill the remaining beetles in the chips. It is recommended to send infested chips to a professional composting facility that has earned the U.S. Composting Council's Seal of Testing Assurance.

5. Prevent the spread. Avoid spreading this pest by not moving firewood or mulch that hasn't been properly solarized or composted. If you must move infested greenwaste (for example, to bring it to a composting facility) make sure the load is tightly covered while in transit.
6. Consider chemical control. Trees that are reproductive hosts for ISHB



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Figure 3. Invasive shothole borer entry hole in sycamore (first layer of the bark was removed to clearly expose the hole).



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Figure 4. California sycamore heavily infested with invasive shothole borers.

and that show signs of active infestations can be treated with a combination of insecticide and fungicide. The decision to treat a particular tree depends, among other things, on the tree's condition, value, and hazard level. Trees that aren't already infested should be monitored but not treated. There are various chemical options that can be used against ISHB-FD.

Trunk sprays of a contact insecticide, such as bifenthrin, combined with *Bacillus subtilis* or tebuconazole (which are fungicides) have been demonstrated to offer some degree of control.

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Systemic soil injections or drenching with the insecticide imidacloprid has also provided control, as has trunk injection with emamectin benzoate (insecticide) combined with tebuconazole or propiconazole (fungicides).

These pesticides should only be applied by a licenced professional following the instructions on their labels to avoid harming non-target organisms.

Biocontrol options are currently under research. They include the use of natural enemies (such as parasitic wasps

from the beetles' point of origin), entomopathogenic fungi (which are fungi that attack insects), endophytes (which are microorganisms that live in the tree that may provide protection) and nematodes. But these biological management options might take time before they are tested and available.

Until then, prevention, early detection, and rapid response are our best weapons to keep trees healthy and alive.

For more information on invasive shothole borers and their management, visit [www.ishb.org](http://www.ishb.org).

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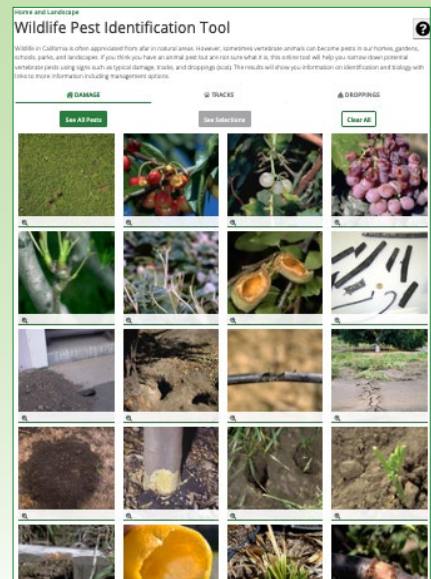
## Ask the Expert!

**Q:** We spotted some burrows in the landscape. How can we find out what kind of animal made them?

**A:** Vertebrate animals can become pests in our homes, gardens, schools, parks, and landscapes and when they are, management efforts may be required. But identifying what has burrowed under the porch, eaten the fruit off garden plants or trees, or caused holes in a lawn can be difficult if you don't see the culprit in action.

If you think you or your customer has an animal pest but are not sure what it is, the new UC IPM Wildlife Pest Identification Tool will help you narrow down potential vertebrate pests using signs such as typical damage, tracks, and droppings (scat).

Check it out today!  
[ipm.ucanr.edu/wildlife-pest-identification](http://ipm.ucanr.edu/wildlife-pest-identification)

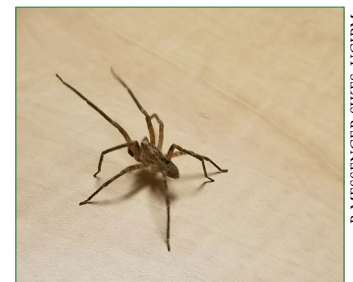


## Pest Insight Webinar, August 17, 2021

Pest Insight is a series of workshops that aims to provide applied, scientific, and decision-based pest control information to pest control licensees. It is presented by UC IPM Advisor Dr. Siavash Taravati. Continuing Education hours for both DPR and SPCB licenses are available.

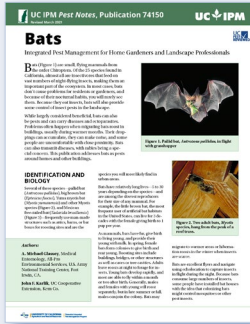
The next webinar is on August 17, 2021 from 9–11:15 am. Carlos Anguiano, Pest Control Working Supervisor at Los Angeles County will present “Troubleshooting common bed bug management.” Blaine Hébert, an arachnologist and private pest control consultant will present an introduction to spiders and their management.

To register, go to [ucanr.edu/sites/pestinsight/workshops/](http://ucanr.edu/sites/pestinsight/workshops/)



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# New and Revised *Pest Notes*



## Bats

Bats can be a problem if they roost in a building. This recently updated *Pest Notes*, authored by UC Cooperative Extension advisor John Karlik and US Army entomologist Mike Glassey, offers suggestions on exclusion.



## Giant Whitefly

Learn about the giant whitefly, a serious pest on ornamentals like hibiscus and begonia in the revised *Pest Notes*. UC Riverside entomologists Rick Redak and Eric Schoeller and John Kabashima, UCCE Orange County updated the publication.

Online at [ipm.ucanr.edu/PMG/PESTNOTES/pn74150.html](http://ipm.ucanr.edu/PMG/PESTNOTES/pn74150.html)

Online at [ipm.ucanr.edu/PMG/PESTNOTES/pn7400.html](http://ipm.ucanr.edu/PMG/PESTNOTES/pn7400.html)



## Poison Oak

Find information on poison oak and how to deal with rash caused by poison oak contact in this publication authored by UC Cooperative Extension Advisor Scott Oneto and emeritus UC Davis weed specialist Joe DiTomaso.



## Wild Turkeys

Wild turkeys are emerging pests in many neighborhoods. Greg Giusti, emeritus advisor Lake and Mendocino counties details their biology and behavior, their impacts, and managing wild turkey problems in the new publication, *Pest Notes: Wild Turkeys*.

Online at [ipm.ucanr.edu/PMG/PESTNOTES/pn7431.html](http://ipm.ucanr.edu/PMG/PESTNOTES/pn7431.html)

Online at [ipm.ucanr.edu/PMG/PESTNOTES/pn74176.html](http://ipm.ucanr.edu/PMG/PESTNOTES/pn74176.html)

Visit UC IPM's *Pest Notes* web page for these and many more titles [ipm.ucanr.edu/PMG/PESTNOTES](http://ipm.ucanr.edu/PMG/PESTNOTES).

**WHAT IS IPM?** Integrated Pest Management (IPM) programs focus on long-term prevention of pests or their damage through a combination of techniques including resistant plant varieties, biological control, physical or mechanical control, and modification of gardening and home maintenance practices to reduce conditions favorable for pests. Pesticides are part of IPM programs but are used only when needed. Products are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.

All pesticide products mentioned have been reviewed by the UC Office of Pesticide Information and Coordination and are current at the time of publication. Always read and carefully follow all precautions and safety instructions provided on the pesticide container label, as well as any other regulations regarding the use of pesticides. Not following label directions, even if they conflict with information provided herein, is a violation of state and federal law. No endorsements of named products are intended, nor is criticism implied of products not mentioned.

### University of California Statewide Integrated Pest Management Program



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