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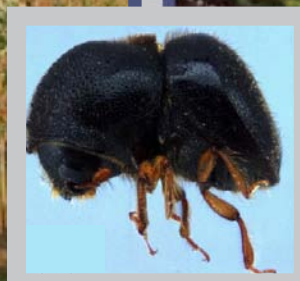

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Camphor Shot Borer
A New Nursery and Landscape Pest in Tennessee

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Introduction

The camphor shot borer, (*Cnestus mutilatus* [Blandford]), (CSB) (Fig. 1) is a beetle pest native to Asia.

Fig. 1. Female (left) and male (right) camphor shot borer (CSB).

The beetle was first detected in the United States in Oktibbeha County, Mississippi in 1999. It is now known to occur in Alabama, Florida, Georgia, Louisiana, North Carolina, Ohio, Tennessee, Texas and West Virginia. In Tennessee, the CSB was first detected on April 25, 2008 near a lumber facility in Wayne County. As of 2012, CSB has been trapped in 18 Tennessee counties (Fig. 2) and probably occurs in other Tennessee counties. The CSB most likely entered the U.S. in some type of wood packing material. In the U.S., nursery stock and firewood are other likely means of transport.

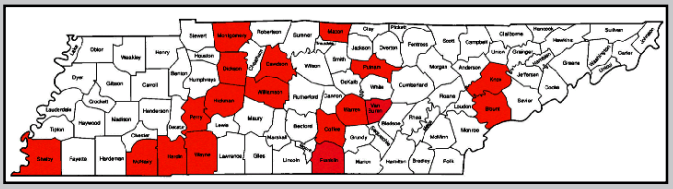

Fig. 2. Tennessee counties with known infestations of CSB in 2012.

CSB Biology

The CSB belongs to a group of wood-boring beetles called the ambrosia beetles. All ambrosia beetles carry fungi (ambrosia), which they subsequently introduce into the tunnels (galleries) when boring into the tree (Fig. 3). The ambrosia fungi grow in the galleries and serve as food for adult beetles and developing young (i.e., larvae).

Fig. 3. Cross-section of a CSB gallery showing eggs and white-colored ambrosia fungus.

Male CSB do not fly, so all new tunnels in the trunk are initiated by females (Fig. 4). On the tree trunk surface, the gallery entrance appears as a small round hole (Fig. 4).

Fig. 4. *Left photo:* Adult female CSB boring into a tree branch. *Right photo:* Gallery entrance hole recently excavated in the branch. The rear of the female CSB is visible inside the gallery entrance.

Temperature influences CSB developmental rate from egg to adult, which may take as little as 5 to 6 weeks in warm weather. Male CSB are believed to stay in the gallery, where they likely mate with siblings before eventually dying. Females may remain in the gallery to over-winter or may emerge and begin attacking new plants.

When to Expect CSB Activity

In Mississippi, CSB flight begins in March, and is high from April to June (peaking in April), has a second smaller peak in August, and ends in September. In Tennessee during 2010 to 2012, CSB attacked containerized trees used in research experiments during April and May and were captured on traps throughout the summer. A Tennessee producer during 2012 had CSB attacks on dogwood trees during March. The CSB flight patterns and tree attack timing in Tennessee to date suggests mid-March to June as the period with the highest risk to trees and greatest possible need for preventative treatments. CSB is reported to have one generation per year in Japan, but there may be more than one in the southern U.S.

The CSB as a Plant Pest

The likelihood of CSB becoming an important pest of nursery and landscape plants is still undetermined, but CSB has many host plants that include common nursery plants (Table 1). Sweetgum appears to be a preferred host. CSB attacks have been associated with plant stressors like herbicide injury, poorly drained soil, trunk and branch damage, and inadequately managed container production. During 2012, containerized dogwood trees under CSB attack at a Tennessee nursery were both under-watered and growing in a container substrate with little to no air space. CSB attacks have been artificially induced on black walnut, goldenraintree, red maple, sweetbay magnolia, tulip poplar, and white oak by injecting tree trunks with ethanol. Ethanol is naturally produced by stressed trees and is used by ambrosia beetles like CSB to locate trees suitable for attack. Plants infested with CSB may display symptoms similar to other ambrosia beetles (*e.g.*, granulate ambrosia beetle), including leaf wilting, branch dieback, and tree death. Even if trees survive CSB attacks, their value as nursery plants will be reduced by the large entrance holes on the trunks and branches.

Recognizing CSB Tree Attacks

Relative to other species, the CSB is a large ambrosia beetle, and therefore produces a large entrance hole (Figs. 4, 11, and 12). A 5/64-inch (2 mm) drill bit will fit into the entrance of a CSB gallery and is a quick way to check the hole-size in the field (Fig. 5). The next largest drill bit size (*i.e.*, 3/32-inch [2.4 mm]) does not fit into CSB galleries.

Fig. 5. A 5/64 inch (2 mm) drill bit can be inserted into a CSB gallery.

Sawdust from CSB boring activity may sometimes be observed on the branch or at the base of the tree (Fig. 6).

Fig. 6. *Left Photo:* Sawdust from CSB boring activity. *Right Photo:* Sawdust at base from boring activity of multiple ambrosia beetles.

Some ambrosia beetles that attack nursery plants will produce toothpick-like strands of sawdust and excrement from the gallery entrance (Fig. 7). CSB galleries may also have these toothpick strands but because the diameter of the gallery entrance is larger, the strands usually break off before they become obvious.

Fig. 7. Toothpick-like strands of mixed sawdust and excrement extending from non-CSB ambrosia beetle galleries.

Tree trunks may have sap stains (*i.e.*, bleeding) near the site of attack (Fig. 8).

Fig. 8. Sap accumulation at the entrance of a CSB gallery and stains on the trunk resulting from sap draining below the gallery.

Inside the gallery, the wood may develop dark stains from the ambrosia fungi (Fig. 9). Unlike other ambrosia beetles, which generally bore straight into the tree trunk, the CSB gallery typically consists of a short horizontal entrance that branches into long vertical tunnels (up to 1.5 inch [3.8 cm] long) (Fig. 9). It is not uncommon for CSB adults to tunnel up and down the pith of small trees, which could weaken the structural integrity of the tree.

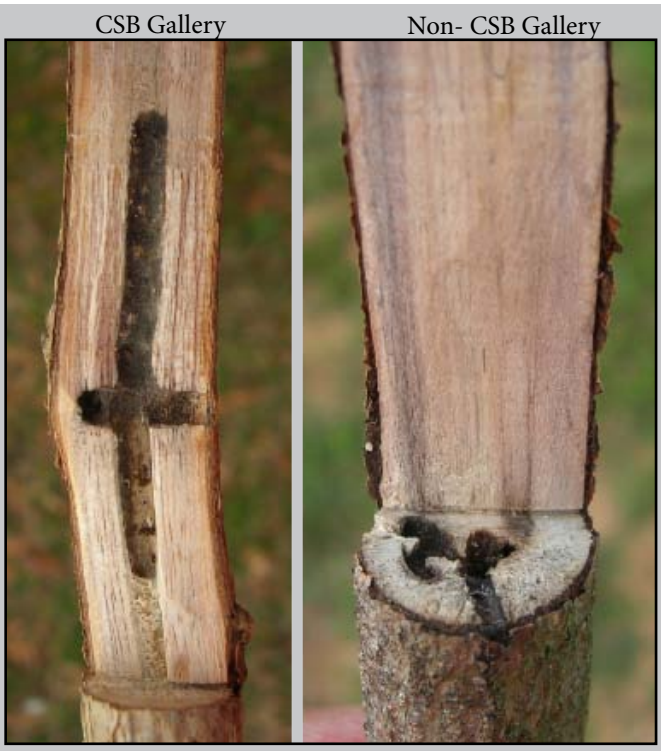

Fig. 9. *Left photo*: Tree branch cut open to reveal internal structure of a CSB gallery. Note the tunnels that go up and down the inside of the branch and the black staining inside the galleries. *Right photo*: Tree branch cut open to show the gallery of a non-CSB ambrosia beetle species.

CBS adults have been reported to block the gallery entrance with their body, possibly to protect developing larvae from natural enemies (Fig. 10).

Fig. 10. CSB abdomen tip blocking the entrance to the gallery.

Although CSB are large ambrosia beetles, the beetles preferentially attack smaller branches (0.8 inches or less) at about chest level height, which is where scouting should be focused. The affinity of CSB for smaller-diameter stems increases concerns that CSB could become a significant economic and aesthetic pest of both nursery-grown plants and landscape trees.

Identifying CSB Adults

To determine if beetles attacking trees are CSB, a knife can be used to cut the beetle from the gallery. Cutting off the branch near the gallery entrance may facilitate CSB extraction. The adult female CSB is a large beetle relative to other common ambrosia beetles (Fig. 11-12). Unlike other ambrosia beetles, female CSB have an abdomen that is shorter in length than the thorax, appearing 'squashed' (Fig. 13).

Fig. 11. *Top to bottom:* CSB (largest beetle), yellow-banded timber beetle (*Monarthrum fasciatum Say)*, granulate ambrosia beetle (*Xylosandrus crassiusculus Motschulsky*), black stem borer (*Xylosandrus germanus Blandford*), and the fruit tree pinhole borer (*Xyleborinus saxesenii Ratzeburg*).

Fig. 12. Gallery entrance holes on a dogwood tree. The larger bottom hole is a CSB gallery and the upper hole is another ambrosia beetle species. Note the size difference and also the CSB abdomen tip blocking the gallery entrance.

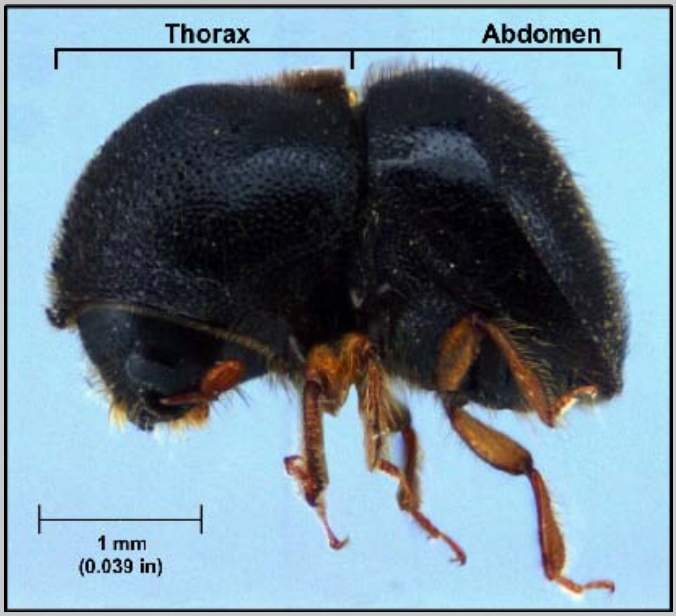

Fig. 13. CSB have a shorter abdomen than the thorax, which is unusual for most beetles.

The compressed abdomen can be seen without a hand lens if you have good eyesight. If you need additional assistance with CSB identity, you can take the specimen to your local county extension office. Another CSB character that can be viewed with a microscope is the presence of a small gap between the basal segments of the front pair of legs (Fig. 14). The gap character is not exclusive to CSB, but it could distinguish it from species that lack a gap

In general, if the ambrosia beetle is large relatively to other ambrosia beetles (Fig. 11), has a compressed abdomen, black color, and the gap is present between the base of the front legs, the beetle is most likely CSB.

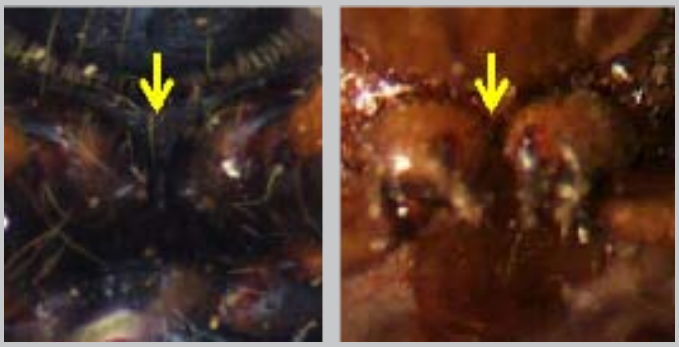

Fig. 14. *Left photo*: CSB adult with a gap between basal leg segments of the first pair of legs. *Right photo:* Non-CSB ambrosia beetle with no gap between basal leg segments of first pair of legs.

Managing CSB

We currently know very little regarding management of CSB with insecticides. Insecticides will not likely be effective once CSB have entered a tree. Insecticides containing permethrin as an active ingredient have been the most effective for controlling other problem ambrosia beetles, but permethrin has not been tested against CSB. If insecticides are used, they should be thoroughly applied to the upper trunk and branches where CSB prefer to attack. March to June is the period when CSB attacks are most likely. Sprays applied during March to June would also coincide with the primary flight periods of other pest ambrosia beetles like the granulate and black stem borer (Fig. 11), so treatments at this time may protect against multiple ambrosia beetles. Destroying infested plants and injured and unsalable nursery stock will also reduce future CSB emergence at the nurseries and also lessen human-assisted spread of CSB through the movement of plant materials. However, CSB is reported to be a strong flier, and it will probably be difficult to prevent re-infestation of nursery plants when CSB originate from areas outside the nursery. The best prevention for CSB is likely to be growing trees that are adapted to a given site location and following good cultural practices that promote plant vigor and reduce stress.

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Photo Credits

Tennessee State University: Nadeer Youssef (Figs. 4-9, 10, and 12) and Joshua Basham (Figs. 1, 3, 11, and 14)
University of Tennessee: Mark Halcomb (Image of nursery rows on cover page) and Garry Menendez (University of Tennessee Department of Plant Sciences; Landscape image on cover page)

Table 1. Reported Host Plants of the Camphor Shot Borer.[a]

SPECIES[b]	COMMON NAME	FAMILY
Acer spp.	Maple	Aceraceae
Acer rubrum L.	Red maple	Aceraceae
Acer palmatum Thunb.	Japanese maple	Aceraceae
Acer saccharum Marshall	Sugar maple	Aceraceae
Acer sieboldianum Miq.	Siebold's maple	Aceraceae
Albizia spp.	Mimosa	Fabaceae
Benzoin spp.	Spicebush	Lauraceae
Calamus spp.	Rattan palm	Arecaceae
Camellia spp.	Camellias	Theaceae
Carpinus laxiflora (Siebold & Zucc.) Blume	Hornbeam or ironwood	Betulaceae
Carya spp.	Hickory	Juglandaceae
Castanea spp.	Chestnut	Fagaceae
Castanea mollissima Blume	Chinese chestnut	Fagaceae
Cinnamomum camphora (L.) J. Presl.	Camphor tree	Lauraceae
Cornus spp.	Dogwood	Cornaceae
Cornus florida L.	Flowering dogwood	Cornaceae
Cryptomeria japonica (L.f.) D. Don.	Japanese cedar	Taxodiaceae
Fagus crenata Blume	Japanese beech	Fagaceae
Fagus grandifolia Ehrhart	Beech	Fagaceae
Grevillea robusta A. Cunn. ex R. Br.	Australian silver-oak	Proteaceae
Juglans nigra L.	Black walnut	Juglandaceae
Koelreuteria paniculata Laxmann	Golden rain tree	Sapindaceae
Lindera erythrocarpa Makino	Unnamed spicebush	Lauraceae
Lindera praecox (Siebold & Zucc.) Blume	Unnamed spicebush	Lauraceae
Lindera triloba (Siebold & Zucc.) Blume	Unnamed spicebush	Lauraceae
Liquidambar styraciflua L.	Sweetgum	Hamamelidaceae
Liriodendron tulipifera L.	Tulip poplar or tulip tree	Magnoliaceae
Magnolia virginiana L.	Sweet bay magnolia	Magnoliaceae
Melia azedarach L.	Chinaberry or umbrella tree	Meliaceae
Ormosia hosiei Hemsley & E.H. Wilson	Unnamed tree	Fabaceae
Osmanthus fragrans (Thunb.) Lour	Fragrant olive	Oleaceae
Ostrya virginiana (Miller) K. Koch.	Hop hornbeam	Betulaceae
Parabenzoin praecox (Siebold & Zucc.) Nakai	Unnamed shrub / small tree	Lauraceae
Persea [Machilus] thunbergii (Siebold & Zucc.) Kosterm	Unnamed tree	Lauraceae
Pinus taeda L.	Loblolly pine	Pinaceae
Platycarya strobilacea Siebold & Zucc.	Unnamed tree	Juglandaceae
Prunus americana Marshall	Wild plum	Rosaceae
Prunus serotina Ehrhart	Black cherry	Rosaceae
Quercus alba L.	White oak	Fagaceae
Quercus shumardii Buckley	Shumard or swamp red oak	Fagaceae
Swietenia macrophylla King	Big-leaf mahogany	Meliaceae
Ulmus alata Michaux	Winged elm	Ulmaceae
Vitis rotundifolia Michaux	Muscadine grape	Vitaceae

[a] The camphor shot borer has a broad host range, which undoubtedly includes more plant species than listed in this table. Citations for known plant hosts comes from the Global Invasive Species Database 2010, Rabaglia 2003, Schiefer and Bright 2004, Stone and Nebeker 2007, Stone et al. 2007, and Oliver et al. unpublished data of plants that were attacked by CSB following experimental injection of their trunks with ethanol.

[b] Some listed plants may not occur in the U.S., but plants in the same genus or family might still be susceptible to the CSB.

For additional information, contact your local county Extension office at:

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