



## Citrus Longhorned Beetle

*Anoplophora chinensis* Forster (Coleoptera: Cerambycidae)

### INTRODUCTION:

The Citrus Longhorned Beetle (CLHB) is an exotic invasive pest from Asia accidentally introduced into the U.S. on maple tree bonsai plants shipped from Korea to a nursery in Tukwila, Washington, in 2001. Considered a serious pest of citrus in China, the USDA Forest Service rates this polyphagous feeder as a very high risk to successfully establish in the U.S. CLHB attacks healthy specimens of over 100 species of fruit trees and woody ornamental plants, giving it a larger host range than its close relative, the Asian Longhorned Beetle (ALB). CLHB could potentially cause even greater damage at higher cost than the hundreds of millions of dollars spent on ALB damages and suppression efforts since its introduction in 1996.

Fortunately, CLHB offers a case study in the effectiveness of a rapidly implemented control program. Promptly reported to authorities by a nursery owner, Washington State entomologists reacted quickly to the threat based on lessons learned with ALB. Within a week, surveys revealed a second introduction site at another nursery on bonsai in a separate shipment from Korea. An aggressive eradication program was implemented, and no new infestations have since been reported. However, with the dramatic increase in bonsai imports to the U.S. (< 600 in 1993; 54,749 in 1998), the risk of accidental reintroductions of this pest is high in spite of regulatory restrictions.



CLHB adult. Art Wagner, USDA APHIS PPQ, Bugwood.org

### DISTRIBUTION/SPREAD:

CLHB are native to Asia and occur primarily in China, Korea and Japan, although a few specimens have been reported from Macau, Malaysia, Myanmar, Vietnam, Taiwan, Indonesia, and the Philippines. CLHB have become a serious threat in Europe, with an expanding infestation in Northern Italy, interceptions in the UK and France, and recent infestations in the Netherlands (2007) and Germany (2008). In the U.S., a single adult was detected in 1999 at a nursery in Georgia on crepe myrtle bonsai shipped from China. There are no records of established infestations prior to the 2001 report from Tukwila, Washington, which has since been eradicated. There are occasional interceptions at various ports of entry, including Hawaii, Georgia, Wisconsin, and Washington State, but infested plant materials have been destroyed, preventing establishment of the pest. CLHB are therefore considered to be not established in North America.

CLHB spread naturally through flight up to a distance of several hundred yards, and artificially through human activities. CLHB primarily enter European countries in small nursery stock, then spread to infest mature landscape trees. CLHB have entered the U.S. as adults or as larvae hidden within the stems of bonsai plants, but there is concern that they could emerge and infest landscape plants. It is also thought that larvae and pupae can enter undetected in raw lumber or wooden shipping pallets like its relative, ALB, and could then be moved throughout the U.S. hidden in live nursery stock or raw wood products. The USDA Forest Service predicts that CLHB can survive anywhere in this country except Alaska.

### HOST PLANTS:

CLHB are known to attack a wide range of trees and shrubs in more than 26 different families and 40 genera, including over 100 species of fruit trees, conifers and woody ornamental plants. CLHB are capable of surviving in large and small diameter trees and bonsai plants. Unlike most borers native to the U.S., which primarily attack dead or stressed trees, CLHB attack and kill apparently healthy trees. Based on plants attacked in its native range, potential hosts for CLHB in the U.S. include:

Tree hosts: alders (*Alnus*), amur maple (*Maackia amurensis*), ash (*Fraxinus*), Australian pine (*Casuarina equisetifolia*), beech (*Fagus*), beefwood-tree (*Casuarina*), birch (*Betula*), hickory/pecan (*Carya*), chestnut (*Castanea*), elm (*Ulmus*), locust (*Robinia*), mahogany (*Meliaceae*), maples (*Acer*), mulberry (*Morus*), oaks (*Quercus*), pagoda tree (*Sophora*), poplars/aspens (*Populus*), snowbell tree (*Styrax*), sycamore/plane tree (*Platanus*), walnut (*Juglans*), and willow (*Salix*).



Antennae have 11 black and bluish/white bands; elytra are shiny black with irregular white spots. Pest and Diseases Image Library, Bugwood.org



Adult CLHB feeding damage on bonsai maple. Art Wagner, Washington State Department of Agriculture, Bugwood.org



Mature larva: robust, creamy white with amber colored head and black mouth mouthparts. Plant Protection Service Archive, Plant Protection Service, Bugwood.org

Other ornamental hosts: Aralia/ivy (*Araliaceae*), Chinaberry or Indian lilac (*Meliaceae*), crape myrtle (*Lagerstroemia*), Ficus tree (*Ficus*), firethorn (*Pyracantha*), holly (*Ilex*), Japanese cedar (*Cryptomeria japonica*), jujube (*Ziziphus jujube*), knotweed (*Polygonaceae*), laurel (*Lauraceae*), mallow (*Hibiscus*), paper mulberry (*Broussonetia papyrifera*), Photinia (*Rosaceae*), pigeon pea (*Cajanus cajan*), wild olive (*Elaeagnus*), Bradford pear (*Pyrus calleryana*), roses (*Rosaceae*), silk tree (*Albizia julibrissin*), spicebush (*Lindera*), spurge (*Euphorbia*), sumac (*Rhus*), tea (*Camellia sinensis*), verbena (*Verbena*), and yew (*Taxus*).

Fruit hosts: apple (*Malus*), apricot/cherry/peach/plum (*Prunus*), blackberry/raspberry (*Rubus*), Chinese pear leaved crabapple (*Malus spectabilis*), fig (*Ficus*), guava (*Psidium guajava*), lime/lemon/oranges/tanger (*Citrus*) kumquat (*Fortunella*), litchi (*Litchi sinensis*), loquat (*Eriobotrya japonica*), olive (*Oleaceae*), pear (*Pyrus*), and trifoliate orange (*Poncirus trifoliata*).

### BIOLOGY and DAMAGE:

CLHB belong to the Cerambycidae family of longhorned beetles (adults) and round-headed borers (larvae), and typically produce one generation per year. Some individuals may require two years to complete development in the northern part of their range, so larvae may be present throughout the year. CLHB overwinter in the pupal or pre-adult stage inside a host plant. In China, adults emerge from April to August (peaking May-July) and begin feeding on the bark, leaves and petioles of host trees, usually causing little damage beyond leaf wilt. Most adult CLHB activity, including feeding and mating, occurs during the day.

After mating, adult females often remain on the tree from which they emerge to lay eggs, but may fly to a new host. CLHB typically infest the lower 20 inches (0.5 m) and exposed roots of living trees. Unlike ALB, female CLHB do not chew oviposition notches. Female CLHB appear to locate natural cracks in the bark, insert their ovipositors there, then deposit eggs individually beneath the bark, hidden from view. CLHB females have been reported to lay 15-200 eggs each.

Eggs hatch after one to three weeks into grub-like larvae that initially feed on the green, sappy portion of the inner bark. The larvae develop into very large grubs, about 2" long (5 cm) and nearly 1/2" wide (1.3 cm). Late instar larvae have stronger mouthparts that enable them to burrow deep into woody tissue, where they bore numerous irregular tunnels that interfere with the translocation of water and nutrients within the tree. Larval feeding accounts for most of the damage caused by CLHB and can quickly girdle a tree, leading to rapid tree decline, wind breakage of weakened trunks, and death. Boring wounds also increase host susceptibility to various plant disease pathogens.

Pupation and pre-adult development take place inside the tree. The pupal stage lasts four to six weeks and at the final molt a pre-adult is formed. The pre-adult is inactive and takes about one to two weeks to mature. Adults eventually emerge from host plants in the spring, leaving a distinct round or slightly oval-shaped exit hole on the bark surface.



Exit hole damage. Plant Protection Service Archive, Plant Protection Service, Bugwood.org



Damage in trunk of bonsai maple. Art Wagner, Washington State Department of Agriculture, Bugwood.org

### IDENTIFICATION:

- Adults are large, stout beetles about 1-1½” long (~25-40 mm); females are larger than males.
- Adults are shiny black with 10 to 12 irregular white spots on their back.
- The ventral surface is pubescent (hairy): In Chinese populations, the pubescence is white; in Japanese populations formerly designated as *A. malasiaca*, the pubescence is blue.
- The elytra (wing covers) of females are rounded distally; male elytra are tapered distally.
- Female antennae are 1.2 times the body length; male antennae are ~2 times the body length.
- Antennae are bluish/white at the base, and have 11 black and bluish/white banded segments.
- Eggs are ~0.22” long (5.5 mm), 0.07” wide (1.8 mm), smooth, and elongate, tapered at both ends.
- Eggs are initially creamy white but gradually turn yellowish/brown prior to hatching.
- Larvae are creamy white, legless, roundheaded grubs with amber colored heads and black mouthparts, and yellow patterns on the prothorax.
- Larvae are ~0.2” (5 mm) at hatching but reach ~2.0” long (up to 60 mm) and 0.4” wide (10 mm) by pupation.
- Pupae are 1-1½” long (~25-40 mm).

### WHAT TO LOOK FOR:

- Exit holes after adult emergence that are round or slightly oval shaped, and range from about ¼-½” in diameter (~ 6-13 mm).
- Adult feeding damage includes chewed leaves and petioles, leaf wilt, and narrow, vertical rectangular sections of scraped bark about 0.8 x 1.0” (~2 x 2.5 cm) on stems or branches.
- Oviposition sites are difficult to detect, but may appear as slits in the bark of living trees close to the ground, around the root collar, or on exposed roots.
- Large amounts of sawdust-like frass ejected by feeding larvae from small holes in the tree trunk, accumulated at the base of the tree.
- Larval tunnels in the wood underneath loose or thin bark.
- Rapid tree decline in heavy infestations (leaf wilt, branch dieback); younger trees decline more rapidly than older trees with larger trunk diameters.
- Heavily mined trunks and dead branches may break, especially during strong winds.

### MONITORING:

CLHB is a regulated pest and ports of entry and imported host plants are regularly inspected for this beetle. Identification of suspect CLHB is critical: Any unknown specimen of large black beetles with white spots should be collected and sent to your state department of agriculture, state university entomology department, or USDA-APHIS for action.

## MANAGEMENT:

CLHB is considered a pest of regulatory significance due to the potential for significant property and commercial losses, as well as loss of markets due to quarantines that could occur should CLHB become established in the U.S. An Integrated Pest Management (IPM) approach including surveys, quarantines, removal/treatment of infested plants, and regulation of the movement of host plant species is required for successful control of CLHB. Eradication measures typically include removal and destruction of infested trees.

### Regulatory

The USDA Forest Service performed a CLHB risk summary in 2001 immediately following detection of CLHB at nurseries in Tukwila and Olympia, WA. CLHB was determined to warrant a very high risk rating, so the Washington State Department of Agriculture (WSDA) imposed a quarantine of properties within a ¼ mile radius of the point of introduction. The quarantine prohibited moving the beetle or any potentially infested plant material out of the quarantine area, including: untreated hardwood grown in the regulated area, firewood from hardwood species, deadwood, stumps, tree trunks and similar portions of hardwood species, and tree prunings.

The rapid response by state authorities was possible because of preparations already made to deal with potential ALB detections. Quarantine plans allowed for the unprecedented measure of cutting down and chipping potential host trees, whether infested or not, within ½ mile from the nursery. Host trees within the next ⅛ mile were treated with a systemic pesticide injection into the main trunk. Tree surveys within the quarantined area to look for evidence of egg laying, twig and leaf damage, and the adult beetle itself were continued for five more years, and eradication was declared in 2007.

In August 2002, new federal regulations were introduced requiring that imported bonsai trees be quarantined in the country of origin in a fully enclosed greenhouse or screened house for two years prior to shipment to the U.S., a measure the European Union (EU) already had in place. To date, no new infestations have been detected in the U.S.

### Mechanical/Physical Control

Infested plant material can be cut down, chipped or otherwise destroyed to eliminate immature stages in the wood.

### Biological Control

CLHB have no natural enemies in the U.S., but some organisms from their native range are being investigated as potential biological control agents. CLHB larvae are most susceptible to natural enemies during the first two months of development when they are in the early larval instar stage. In China, it has been reported that weaver ants, *Oecophylla smaragdina* Fabricius, can control CLHB well enough to prevent the need for chemical control. Studies in Japan have demonstrated high mortality in adult CLHB when exposed to the pathogenic fungi *Beauveria brongniartii* (Sacc.). The Japanese have also tested an entomopathogenic nematode, *Steinernema feltiae*, applied in bark compost. A gregarious larval ectoparasite, *Ontsira anoplophorae* (Hymenoptera: Braconidae), also has potential as a biological control agent for several species of *Anoplophora*.

### Chemical Control

Systemic insecticides may be injected into the base of large trees, but it is not practical to inject dwarfed or bonsai plant materials. Tree injection with imidacloprid is a component of the ALB eradication program and was used in the eradication program for CLHB in Washington State. Both adults and larvae are exposed to insecticides when treated by tree injection.

## LOOK-ALIKE INSECTS and DAMAGE:

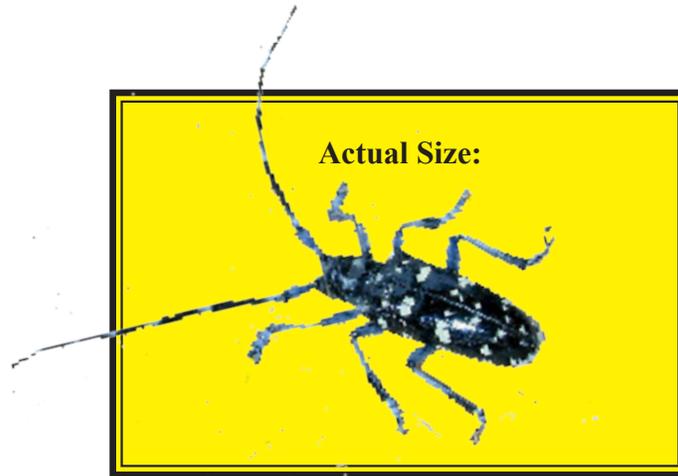
CLHB may be confused with its close relative, ALB (*A. glabripennis*). They may be differentiated by:

- CLHB has numerous white tubercles at the base of the elytra; the base of the elytra in ALB is smooth.
- CLHB (morph from Japan) has two bluish-white hair spots on either side of the pronotum, which are missing in ALB and CLHB (morph from China).
- CLHB (morph from Japan) has a white hair patch on the scutellum, which is missing in ALB and CLHB (morph from China).
- CLHB girdle trees at the base, quickly leading to death; ALB causes top-down damage resulting in slower tree death.

CLHB superficially resembles the indigenous borers Banded Alder Borer and White Spotted Sawyer. For a good comparison, see: <http://agr.wa.gov/PlantsInsects/InsectPests/CLHB/Photos.htm>

***Anoplophora* is a large genus of Asian beetles, with many species similar in appearance.**

**Positive identification is best left to an entomologist with expertise in the family Cerambycidae.**



### How to Report a Possible Sighting/Infestation

#### **In Maryland:**

**University of Maryland Cooperative Extension Exotic Pest Threats Website:**

<http://extension.umd.edu/ipm/pest-threats>

**Maryland Department of Agriculture:** call 410-841-5920 to report suspect pests; visit [http://www.mdinvasivesp.org/invasive\\_species\\_md.html](http://www.mdinvasivesp.org/invasive_species_md.html) for information.

#### **Nationally:**

**USDA-Animal and Plant Health Inspection Service (APHIS)**

[http://www.aphis.usda.gov/services/report\\_pest\\_disease/report\\_pest\\_disease.shtml](http://www.aphis.usda.gov/services/report_pest_disease/report_pest_disease.shtml)

#### **Where to Get More Information:**

UMD Extension Exotic Pest Threats Website: <http://extension.umd.edu/ipm/pest-threats>

North American Plant Protection Organization Alert:

<http://www.pestalert.org/viewArchPestAlert.cfm?rid=72&keyword=citrus%20longhorned%20beetle>

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