Screening Aid

Pine Sawyer Beetles

Monochamus sutor (Linnaeus) and *M. alternatus* Hope

Joseph Benzel

1) Identification Technology Program (ITP) / Colorado State University, USDA-APHIS-PPQ-Science & Technology (S&T), 2301 Research Boulevard, Suite 108, Fort Collins, Colorado 80526 U.S.A. (Email: itp@USDA.gov)

Version 3
6 July 2015

This CAPS (Cooperative Agricultural Pest Survey) screening aid produced for and distributed by:
USDA-APHIS-PPQ National Identification Services (NIS)
This and other identification resources are available at: http://caps.ceris.purdue.edu/taxonomic_services

The pine sawyer beetles (*Monochamus* spp.) are a widespread genus of longhorn beetles with several members of economic importance. Within this group are two species that are considered potentially invasive pests: the small white-marmorated longhorned beetle (*Monochamus sutor*) (Fig. 1) and the Japanese pine sawyer (*Monochamus alternatus*) (Fig. 2). *Monochamus alternatus* feeds primarily on pines (*Pinus*) but will attack a variety of conifers and some deciduous trees. *Monochamus sutor* attacks a variety of conifer species including fir (*Abies*), larch (*Larix*), and spruce (*Picea*). Both species are known to carry the pine wood nematode (*Bursaphelenchus xylophilus*) and other phytoparasitic nematodes that are capable of killing trees and spreading bacterial diseases. The beetle itself feeds on the phloem as a larvae and in the crown as an adult (Figs. 3-4) but is unlikely to directly kill its host.

Fig. 1: *Monochamus sutor* on tree (photo by Stanislaw Kinelski, Bugwood.org).

Monochamus belongs to the family Cerambycidae, which are known as the longhorned beetles. Members of this family are recognized by their highly elongate antennae, in males sometimes reaching twice the length of body. *Monochamus* belongs to the subfamily Lamiinae which is distinguished by its hypognathus head, acute palpi, and obliquely sulcate anterior tibia.

The genus *Monochamus* contains over 100 species and is found worldwide. Eight species and six additional subspecies occur in the U.S. *Monochamus* adults are identified by large acute lateral tubercles on the pronotum, coursely rougose elytral bases, and elongate front legs in the male. Neither *M. alternatus* nor *M. sutor* have been detected in the United States.

This aid is designed to assist in the sorting and screening of *M. alternatus* and *M. sutor* suspect adults collected in Lindgren funnel traps and by visual surveys in the continental United States. It covers basic Sorting of traps, First Level, and Second Level screening, all based on morphological characters. Basic knowledge of Coleoptera morphology is necessary to screen for *M. alternatus* and *M. sutor* suspects.

Fig. 2: *Monochamus alternatus* on tree (photo by William M. Ciesla, Forest Health Management International, Bugwood.org).

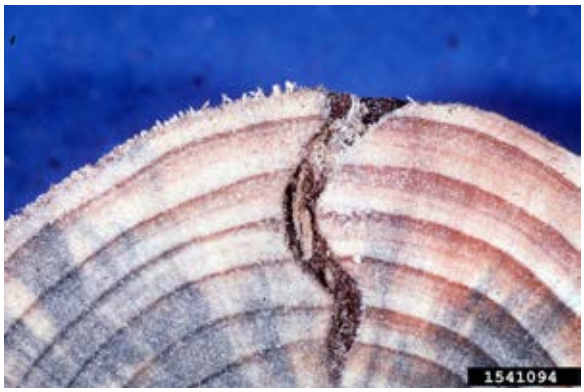
Insects collected during *Monochamus* surveys should be sorted initially for the presence of beetles of the appropriate size, color, and shape.

1. Beetles are between 15 mm (0.6 inches) and 28 mm (1.1 inches) in length.

2. Beetles have highly elongate antennae, over twice body length (Fig. 5).

3. Beetles are black, or mottled brown with white patches (Figs. 11 & 14).

Beetles meeting these requirements should be forwarded to Level 1 Screening (Page 3).



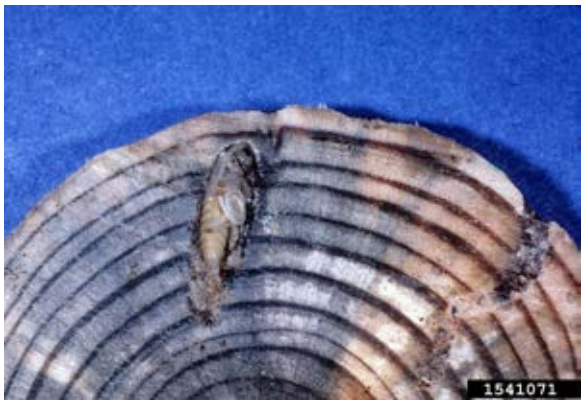


Fig. 3-4: *Monochamus* sp. galleries infected with bluestain fungi and containing larvae (top) and pupae (bottom). Despite their large size, *Monochamus* do little direct damage the host tree. They burrow in the phloem and heartwood where they feed on wood and symbiotic fungi. Most trees that are killed die as the result of infection by parasites vectored by the beetle. These include bluestain fungus, the pine wood nematode, and a variety of pathogenic bacteria (photos by Lacy L. Hyche, Auburn University, Bugwood.org).

Fig. 5: male *Monochamus* sp.

Fig. 6: female *Monochamus* sp.

Fig. 5-6: Lateral views of male (top) and female (bottom) *Monochamus* sp. *Monochamus* is a sexually dimorphic genus with males having antennae and forelegs significantly longer than those of females. Conversely, the overall body size of females is usually greater than that of males, although some overlap does occur.

Suspect adults should be pinned and properly labeled. Level 1 Screening is based on characteristics of the head, tarsal claws, general dorsal surface, and antennae. It is designed to separate *Monochamus* from related genera.

Fig. 7: Head of *Monochamus* sp. In the Lamiinae the head is vertically oriented with the mouthparts directed ventrally, and the genal margin is directed posteriorly.

Head

The heads of the subfamily Lamiinae are vertical with the genial margin directed posteriorly rather than ventrally (Fig 7).

Tarsal Claws

The tarsal claws of *Monochamus* are divergent (Fig. 8) rather than being divaricate or bifid.

Antennae

The antennal scape of *Monochamus* has a distinct carinate ring called a “circatrix” at the apex (Fig. 9).

General Dorsal Features

The prothorax of *Monochamus* bears a pair of large prominent lateral tubercles (Fig. 10). The elytral bases are coarsely rougose and the elytra themselves are uniformly covered with pubescence (Fig. 10). The related genus *Anoplophora* (which includes the Asian longhorned beetle - ALB) is always black in color and has pubecence only in distinct patches.

Specimens meeting these requirements should be forwarded to Level Two Screening.

Fig. 10: Dorsal view of *Monochamus marmorator*. Note the pair of large horns on the pronotum (circled), the coarsely rougose elytral bases, and the uniformly pubescent elytra. Many species have elaborately patterned pubescence.

Fig. 8: Tarsal claws of *Monochamus* sp.

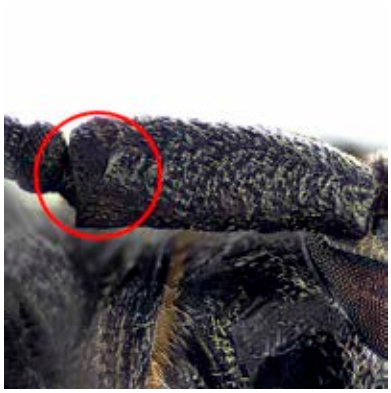


Fig. 9: Antennal base of *Monochamus* sp. The scape has a distinct cicatrix at its apex (circled).

Level 2 screening is designed to separate *M. alternatus* and *M. sutor* suspects from native *Monochamus*. Screening is based on characters of the elytra and scutellum as well as general notes on size. *Monochamus* spp. are sexually dimorphic (Figs. 5-6), with the male having antennae twice as long as the body and females having antennae 1.5 times as long as the body.

Monochamus sutor

Monochamus sutor (Fig. 11) bears a close resemblence to the native *M. scutellatus* (Fig. 12). Both beetles are black in color which distinguishes them from other native *Monochamus* (Fig. 13). The apices of their elytra are rounded and unarmed by spines at the suture (Fig. 20). The two species can be distinguished by the larger amounts of pubescence on the elytra of *M. sutor.* Usually this pubescence is yellow in color and occurs in dense patches. In *M. scutellatus* the pubescence is more evenly distributed and is snow white in color. Both species have a densley pubescent scutellum where the difference in color of the pubescence can be easily observed (Figs. 25-26).

Monochamus alternatus

The elytral apex of *M. alternatus* (Fig. 21) is more narrowly rounded than that of *M. sutor* (Fig. 20). *Monochamus alternatus* is reddish brown to black in color with two broken stripes of orange pubescence on the pronotum (Fig. 27). Two native species, *M. carolinensis* (Fig. 15) and *M. titillator* (Fig. 16) bear a close resemblence to *M. alternatus* (Fig. 14). The three can be distinguished by the unarmed and somewhat flattened elytral apicies of *M. alternatus* compared to the broad tooth seen in *M. carolinensis* and the narrow conical tooth of *M. titillator* (Figs. 21-23). Other non-target species (Figs. 17-19) lack the tooth entirely (e.g., Fig. 24).

Fig. 11: *Monochamus sutor* (target)

Fig. 12: *Monochamus scutellatus*

Fig. 13: *Monochamus obtusus*

Fig. 14: *Monochamus alternatus* (target) (Photo by Steven Valley, Oregon Department of Agriculture, Bugwood.org).

Fig. 15: *Monochamus carolinensis.*

Fig. 16: *Monochamus titillator.*

Fig. 17: *Monochamus mutator.*

Fig. 18: *Monochamus clamator.*

Fig. 19: *Monochamus notatus.*

Fig. 20: *Monochamus sutor* (target).

Fig. 21: *Monochamus alternatus* (target). (Photo by Steven Valley, Oregon Department of Agriculture, Bugwood.org).

Fig. 22: *Monochamus carolinensis.*

Fig. 23: *Monochamus titillator*.

Fig. 24: *Monochamus clamator*

Figs. 20-24: Elytral apicies of various *Monochamus* spp. The apex of *M. sutor* is broadly rounded while that of most other *Monochamus* are more acute and often armed with spines as seen with *M. carolinensis* and *M. titillator*. The apex of *M. alternatus* is narrowed but unarmed.

Fig. 25: *Monochamus sutor* (target).

Fig. 26: *Monochamus scutellatus.*

Figs. 25-26 (left): Scutellums of *M. sutor* and *M. scutellatus*. Note the difference in the color of the pubescence.

Suspect *M. sutor* (black cerambycids with vertical heads, a circatrix on the antennae, broadly rounded elytral apicies, and small spots of yellow pubescence) and *M. alternatus* (red-brown cerambycids with vertical heads, a circatrix on the antennae, narrowed but unarmed elytral apicies, and two stripes of orange pubescence on the pronotum) should be sent forward for identification. Specimens must be labeled and carefully packed to avoid damage during shipping.

Fig. 27 (below) Pronotum of *Monochamus alternatus*. Note the two stripes of orange pubecence. (Photo by Steven Valley, Oregon Department of Agriculture, Bugwood.org).

Key and References

Key to Sort and Screen *M. sutor* and *M. alternatus* Suspects in the United States

1. Beetles approxmately 15-28 mm long; antennae significanly longer than body and with distinct circatrix on scape (Fig. 9); coloration black or red-brown with uniformly pubescent elytra, mouthparts directed ventrally (Fig. 7); tarsal claws divergent (Fig. 8) 2

1'. Beetles larger or smaller than 15-28 mm long; antennae not significantly longer than body or without distict circatrix; color not black or red brown or without uniformly distributed pubescence on the elytra; mouthparts directed forward; or tarsal claws divaricate or bifid. ..... Not suspect

2. Elytral apices rounded (Fig. 20); body usually black 3

2'. Elytral apices flattened or armed with tooth (Fig. 21); body usually reddish brown..... 4

3. Body with large amount of pubescence; patches of pubescence yellow in color (Fig. 25) ..... ***M. sutor* suspect**

3'. Body with less pubescence, patches of pubescence white in color (Fig. 26)..... Not suspect

4. Pronotum with two stripes of orange pubescence (Fig. 27); elytral apices not armed with tooth (Fig. 21). ..... ***M. alternatus* suspect**

4. Pronotum without stripes of orange pubescence; elytral apex armed with tooth (of various forms) (Figs. 22-23) ..... Not suspect

Citation

Benzel, J. S. 2015. Screening aid: Pine sawyer beetles, *Monochamus sutor* (Linnaeus) and *M. alternatus* Hope. Identification Technology Program (ITP), USDA-APHIS-PPQ-S&T, Fort Collins, CO. 7 pp.

References for more information on *Monochamus sutor, M. alternatus*, and non-targets

CERIS. 2011**.** *Exotic Wood Borer/Bark Beetle Survey Reference: Monochamus sutor.* https://caps.ceris.purdue.edu/node/506.

CERIS. 2013**.** *Exotic Wood Borer/Bark Beetle Survey Reference: Monochamus alternatus.* https://caps.ceris.purdue.edu/node/506.

Lingafelter, S. W. 2007. *Illustrated key to the longhorned woodboring beetles of the eastern United States.* The Coleopterists Society. North Potomac. Maryland. pp. 7-15.

Lingafelter, S. W. and Hoebeke, E. R. 2002. *Revision of the genus Anoplophora (Coleoptera: Cerambycidae).* The Entomological Society of Washington. Washington D.C. pp. 30-32.

Linsley, E. G. and Chemsak, J. A. 1984. *The Cerambycidae of North America, Part VII, No. 1: Taxonomy and Classification of the Subfamily Lamiinae, Tribes Parmennini Through Acanthoderini. Entomology: Volume 102.* University of California Press. Berkeley, California pp. 49-78

Turnbow, R. H. and Thomas, M. C. 2002**.** Family 120. Cerambycidae, pp 568-601. In, Arnett R. H., *American Beetles: Volume II.* CRC Press. Boca Raton, Florida.

Acknowledgments

Funding for this project was provided to J. S. Benzel through section 10201 of the FY2014 Farm Bill. I would like thank Terrence Walters (USDA-APHIS-PPQ-S&T ITP) and USDA-APHIS-PPQ National Identification Services for support of this work and access to imaging equipment. Boris Kondratieff, Donald Bright, and Todd Gilligan (Colorado State University) provided advice on species identification, image editing, and screening aid formatting.