Hylobius abietis

Scientific Name
Hylobius abietis (Linnaeus, 1758)

<u>Synonyms:</u>
Hylobitelus abietis (Linnaeus, 1758)
Curculio abietis Linnaeus, 1758
Curculio pini Marsham, 1802
(reviewed in CABI, 2015)

Figure 1. Adult *Hylobius abietis*. (Gyorgy Csoka, www.bugwood.org)

Common Name(s)
Large pine weevil, large brown pine weevil, fir-tree weevil

Type of Pest
Weevil, borer

Taxonomic Position
Class: Insecta, **Order:** Coleoptera, **Family:** Curculionidae

Reason for Inclusion in Manual
CAPS Target: AHP Prioritized Pest List – 2006 through 2009

Pest Description
<u>Eggs:</u> The egg is less than 1 mm (~$^{1}/_{32}$ in) long, less than 0.5 mm (<$^{1}/_{32}$ in) wide, pearly-white and oval (Salisbury & Leather, 1998).

<u>Larvae:</u> (Fig. 2) "Fully grown larvae may be 9.5-16 mm [$^{3}/_{8}$ to $^{5}/_{8}$ in] in length (Day et al., 2004), cream-colored, soft, curved and legless. They have a large brown head with flattened mandibles (Bakke and Lekander, 1965). Larvae are typical of the genus *Hylobius*.


Figure 2. Larva and pupa of *H. abietis* (Gyorgy Csoka, www.bugwood.org)

<u>Pupae:</u> (Fig. 2) The pupa is 8 to 10 mm [$^{5}/_{16}$ to ~$^{3}/_{8}$ in] long, appendages are free and unpigmented (Bakke and Lekander, 1965).

<u>Adults:</u> (Fig. 1) "9-16 mm [~$^{3}/_{8}$ to $^{5}/_{8}$ in] long, elytra [the wing cases] are purple-brown in new adults, turning reddish brown to dark brown. Elytra have patches of long narrow yellow scales (ensiform) arranged in small groups in short irregular lines; surface is finely punctured. Pronotum has irregular patches of yellow ensiform scales, surface is punctured and wrinkled with a raised central line; shape is broader than long, strongly convex and constricted at the front. Head has 2 small patches of yellow scales, is

extended to form a long cylindrical snout with mandibles at the tip. Antennae are elbowed and attached to the snout near the end. Legs have sharp claws with a strong tooth on the inner edge of each femur" (PaDIL, 2005).

Biology and Ecology

The biology of *H. abietis* is most recently reviewed by Leather et al. (1999) and Day et al. (2004).

Hylobius abietis can live for 3 to 4 years or more (Guslits, 1968). In Europe, the time from egg hatch to first reproduction is generally 2 years (reviewed in CABI 2015). However, development depends largely on host quality, temperature, and time of oviposition. Populations vary in size depending largely on the availability, age, and condition of host trees (Guslits, 1968).

Adult activity is strongly influenced by temperature, light and humidity. Adults are most active at early dawn and dusk when air temperatures are between 17 to 21°C (63 to 70°F) and relative humidity is high (85 to 95%). Activity decreases with air temperatures above 25°C (77°F). Females are more sensitive to humidity than males and avoid humidity extremes. Adult weevils emerge at the end of summer or in spring when temperatures rise above 8 to 9°C (46 to 48°F).

Flight occurs at temperatures above 18 to 19°C (64 to 66°F) and wind velocity of 3 to 4 m s^{-1} (7 to 9 mph) (Day et al. 2004). Adults disperse in search of new hosts to feed until maturation in tree crowns (Bylund et al., 2004; Day et al,. 2004; Guslits, 1968; Wainhouse et al., 2004). Weevil flight muscles degenerate 2 to 3 weeks following dispersal. Adults tend to move toward light at the beginning of their dispersive period and away from light at the end of the dispersive period (Day et al., 2004). In Europe, adult weevils migrate by flight for about two weeks during late May and early June (Solbreck and Gyldberg, 1979; Solbreck, 1980). Weevils have been reported to migrate anywhere from tens of meters to hundreds of kilometers (Rose et al., 2005) at wind speeds up to 3 m/s (Day et al., 2004). This depends mainly on host availability and wind-assisted flight (Day et al., 2004). Adults of *H. abietis* are capable of flight up to 30 to 50 m above the forest canopy (Day et al., 2004).

Adults mate multiple times. Oviposition by weevils depends largely on temperature but generally occurs throughout the entire adult life span of about 1 to 3 years (Lekander et al., 1985). In spring, oviposition begins about 2 weeks after emergence. Reproduction is terminated in late summer, presumably triggered by shortened day length and cooler temperatures (Day et al., 2004; Guslits, 1968; Lekander et al., 1985; Wainhouse et al., 2001). According to Guslits (1968), sexual maturity is achieved at the expense of fat body (energy) reserves, and oviposition ceases when energy reserves are exhausted. Fecundity depends on weevil age, size and host quality (Day et al., 2004; Guslits, 1968; Wainhouse et al., 2001,). Weevils oviposit during the summer months in the first year following clear-cutting. Oviposition peaks in June at a temperature of 22°C (72°F) (Day et al., 2004; Lekander et al., 1985,). Adults overwinter in pupal chambers, in litter, or below the soil surface when temperatures fall below 8°C (46°F) (Day et al., 2004;

Leather et al., 1999). Adults completing development before fall may emerge and maturation feed before overwintering in litter (Day et al., 2004). The sex ratio for *H. abietis* is 1:1 but may vary depending on the season (Leather et al., 1999).

Eggs are deposited in any woody tissue in contact with soil, including roots, felled stems, or stumps (Wainhouse et al., 2001). Slits are made in the bark of the trunk below ground (often the root collar or root) and eggs are deposited singly or in small, irregular groups. Eggs may also be deposited in the soil a short distance away from host roots. Under experimental conditions, deposition depth varies by soil type and ranges from 25 to 150 cm (10 to 60 in), with the majority close to the soil surface (within 10 cm (4 in)) in moist sand (Day et al., 2004; Pye and Claesson, 1981). Under field conditions, eggs were deposited in peat 20 to 30 cm (8 to 12 in) beneath host roots (Day et al., 2004). One female produces between 22 to 71 eggs (Day et al., 2004; Wainhouse et al., 2001).

Larval development is highly variable (1 to 5 years) depending on several factors including host quality (Day et al., 2004). There are 5 instars. If oviposition occurs in soil, newly hatched larvae will move toward host roots to begin feeding. If oviposition occurs at or above the soil surface, larvae will bore long irregularly-shaped tunnels in the cambial region and move toward the roots (Day et al., 2004). This insect overwinters in the third or fourth larval instar or adult stages (Day et al., 2004).

Overwintering larvae can generally survive temperatures of -12 to -19°C [-2 to 10°F] (Day et al., 2004). Larvae have an average super cooling point of -12.6°C [9°F] (Leather et al., 1999). First instar larvae experience facultative pre-pupal diapause when temperatures fall below a threshold of 21°C [70°F] and overwinter in a quiescent state. Late instar larvae overwinter in diapause. Under experimental conditions, diapause was terminated 6 months following oviposition for larvae developing at 12°C [10°F]; however, requirements for diapause are not well known for this insect (Day et al., 2004).

Pupation occurs within 1 to 2 years of egg deposition depending on host quality and microclimate. Larvae pupate within oval pupal chambers that are excavated inside the bark (Day et al., 2004).

Damage

Young trees may exhibit signs of decline resulting from feeding damage by *Hylobius abietis* and/or infection by associated fungi (Day et al., 2004; Leather et al., 1999). External symptoms include feeding damage, dieback of affected branches, and death. Adults feed at the base and roots of transplanted seedlings and in the crown of mature trees (Schlyter, 2004). Feeding on the main stem or lateral shoots can cause a characteristic “shepherd’s crook,” which can be confused with damage caused by *Tomicus piniperda* (pine shoot beetle). Heavy infestations can result in stem girdling and subsequent death (reviewed in Leather et al., 1999; reviewed in Ciesla, 2001; reviewed in CABI, 2015). If bark near the root collar is peeled back, long, irregularly-shaped tunnels extending through the cambium toward the roots may be evident. Periodic fresh air “ducts” are also built between the excavated tunnel and bark surface (Day et al., 2004). The depth to which larvae tunnel depends on bark thickness and climate. In species with thin bark, pupal chambers may be constructed in wood and sealed with excavated wood chips (Day et al., 2004).

Pest Importance

Hylobius abietis can be an economically important pest of young conifer plantations in Europe and Asia, causing more than $1 million in damage annually (reviewed in Leather et al., 1999). In the United Kingdom, estimated annual control costs to the public and private forest industry totaled the equivalent of nearly $6.5 million USD in 1999, excluding replanting costs (reviewed in CABI, 2015). *Hylobius abietis* is especially problematic to newly-planted hosts near 2 to 3 year-old stumps or trees with downed or damaged branches (reviewed in Leather et al., 1999, reviewed in CABI, 2015). Damaged tissue may release chemicals that attract emerging adults from infested trees to new hosts. Chemical control is routinely used to protect transplanted seedlings and is thought to significantly impact the environment and pose a health risk to forest workers (reviewed in Leather et al., 1999).

Seedling mortality caused by *H. abietis* and associated pathogens is lower in undisturbed natural areas than in forest plantations (Leather et al., 1999). In areas where *H. abietis* is established, control measures are recommended to prevent significant loss of newly planted seedlings (reviewed in Leather et al., 1999, reviewed in Ciesla, 2001). Without control measures, plantations less than 2 years old have suffered 30 to 100% seedling mortality (reviewed in Ciesla, 2001, reviewed in CABI, 2015).

The extent of damage caused by this pest and associated pathogens is highly variable and not well understood (reviewed in Leather et al. 1999, reviewed in CABI, 2015). Damage depends on numerous factors, including new host availability, age and health of transplanted seedlings, silvicultural practices (e.g., clear cutting), damage from other insect pests, and wind or lightning damage (Leather et al. 1999, reviewed in Ciesla 2001, reviewed in CABI, 2015). The amount of seedling mortality that can be attributed to associated fungi is not fully known, but mortality may increase when trees are subjected to fungal infection and damage from insect feeding (reviewed in Leather et al., 1999). Adults emerging from infected trees may transmit these fungi while feeding on new hosts. Feeding wounds create an opportunity for fungal infection, particularly by *Heterobasidion annosum* and *Leptographium procerum* (Kadlec et al., 1992; Viiri, 2004). See 'Pathogens or Associated Organisms Vectored' section.

Known Hosts

Hylobius abietis is polyphagous, though its preferred host genera are *Pinus* and *Picea* (Lindelöw and Björkman, 2001; Toivonen and Viiri, 2006). Lof et al. (2004; 2005) found *Hylobius abietis* strongly prefers Norway spruce (*Picea abies*) to deciduous tree species such as beech, oak, ash, cherry, lime, and maple. However, adults will feed on silver birch (*Betula pendula*) even when coniferous hosts are available (Toivonen and Viiri, 2006). Borg-Karlson et al. (2006) list Scots pine (*Pinus sylvestris*) as the preferred host. When there is food of similar quality above and below ground, adult *H. abietis* prefer to feed underground (Wallertz et al., 2006).

Major hosts
Picea spp. (spruce), *Picea abies* (Norway spruce), *Picea stichensis* (Sitka spruce), *Pinus* spp. (pine), *Pinus contorta* (lodgepole pine), *Pinus pinaster* (maritime pine), *Pinus strobus* (eastern white pine), *Pinus sylvestris* (Scots pine)

(Borg-Karlson et al., 2006; Bratt et al., 2001; reviewed in CABI, 2015; Ciesla, 2001; Dillon et al., 2006; Hannerz et al., 2002; Heijari et al., 2005; Leather et al., 1994; Lindelöw and Björkman, 2001; Lof et al., 2004, 2005; Manlove et al., 1997; Moore et al., 2004; Orlander and Nordlander, 2003; Petersson and Orlander, 2003; Rose et al., 2005, 2006; Zas et al., 2005, 2006; Zumr and Starý, 1992)

Minor hosts
Acer platanoides (Norway maple), *Acer pseudoplatanus* (sycamore maple),[1] *Alnus glutinosa* (European alder), *Betula* spp. (birch), *Betula pendula* (common silver birch),[1] *Calluna vulgaris* (heather), *Fagus sylvatica* (common beech), *Fraxinus excelsior* (European ash),[1] *Larix* spp. (larch), *Larix decidua* (European larch), *Populus tremula x tremuloides* (hybrid aspen), *Prunus avium* (sweet cherry), *Prunus padus* (bird cherry), *Pseudotsuga menziesii* (Douglas-fir), *Quercus robur* (common oak), *Salix* spp. (willow), *Tilia cordata* (lime), *Vaccinium myrtillis* (bilberry)

(reviewed in CABI, 2015; Ciesla, 2001; Lof et al., 2004, 2005; Manlove et al., 1997; Toivonen and Viiri, 2006; Wallertz, 2006)

[1]Mortality of adults feeding on these species is greater than 70% (Manlove et al., 1997).

Pathogens or Associated Organisms Vectored
Hylobius abietis is associated with a number of potentially pathogenic fungi including *Graphium canum*, *Heterobasidion annosum*, *Leptographium alethinum*, *L. procerum*, *L. wingfieldii*, and *Ophiostoma piliferum* (Viiri, 2004). See 'Pest Importance.'

Heterobasidion annosum is a fungal pathogen of conifers, particularly pines and firs (Viiri, 2004). Kadlec et al. (1992) found live spores of *H. annosum* on the body surface and in the excrement of *Hylobius abietis*. Larvae have also been found in *Pinus sylvestris* roots infected with *H. annosum* (Viiri, 2004).

Leptographium procerum, a fungus associated with bark beetles and weevils, causes root decline in *Pinus strobus* and other conifers (Jacobs and Wingfield, 2001). Its pathogenicity has been debated (Jacobs and Wingfield, 2001). Spores of *L. procerum* are carried on the pronotum of male and female *H. abietis* (Viiri, 2004). Leather et al. (1999) suggest *L. procerum* is transmitted by adults during feeding, leading to increased seedling mortality.

Leptographium alethinum has been isolated from galleries of *H. abietis* in the UK (Viiri, 2004). In France, *Leptographium wingfieldii*, *Graphium canum*, and *Ophiostoma piliferum* have been isolated from newly emerged weevils (Viiri, 2004).

Known Distribution

Asia: Armenia, Azerbaijan, China, Georgia (Republic), Japan, Kazakhstan, Tajikistan, and Turkey; **Europe:** Austria, Belarus, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Moldova, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, and the United Kingdom; **Oceania:** New Zealand[1] (reviewed in CABI, 2015; Ciesla, 2001; Dillon et al., 2006; Lof et al., 2004; Nordlander et al., 2005; Pitkanen et al., 2005; Schwenke, 1974; Wallertz et al., 2006; Zumr and Starý, 1992).

[1]Formerly present (reviewed in CAB, 2005).

Pathway

This species has been intercepted 15 times at U.S. ports of entry (AQAS, 2015). Many of the interceptions occurred on wood packaging material for miscellaneous items, including machinery, ironware, marble, and stones. This species has also been found loose on the ship deck. Three interceptions occurred through the mail. Interceptions identified to the genus level only, have occurred over 200 times at U.S. ports of entry on similar material. Ciesla (2001) states that “since breeding takes place in stumps and root systems of recently cut conifers, there is less possibility of transporting the immature life stages via international trade than with wood borers or bark beetles. However, there is a possibility that adult weevils could hitchhike on conifer logs or other wood products.” This seems to agree with the interception records, as all but two of the interceptions were adults.

Potential Distribution within the United States

In a recent host map developed by USDA-APHIS-PPQ-CPHST (Fig. 3), parts of the United States with the highest concentration of pine include: the southeastern, northeastern, western, and upper great lakes regions of the United States. These areas are the most suitable areas of establishment for *Hylobius abietis* based on host. Overwintering larvae can generally survive temperatures of -12 to -19°C [-2 to 10°F] (Day et al., 2004); this corresponds to a U.S. Hardiness Zone of 6a.

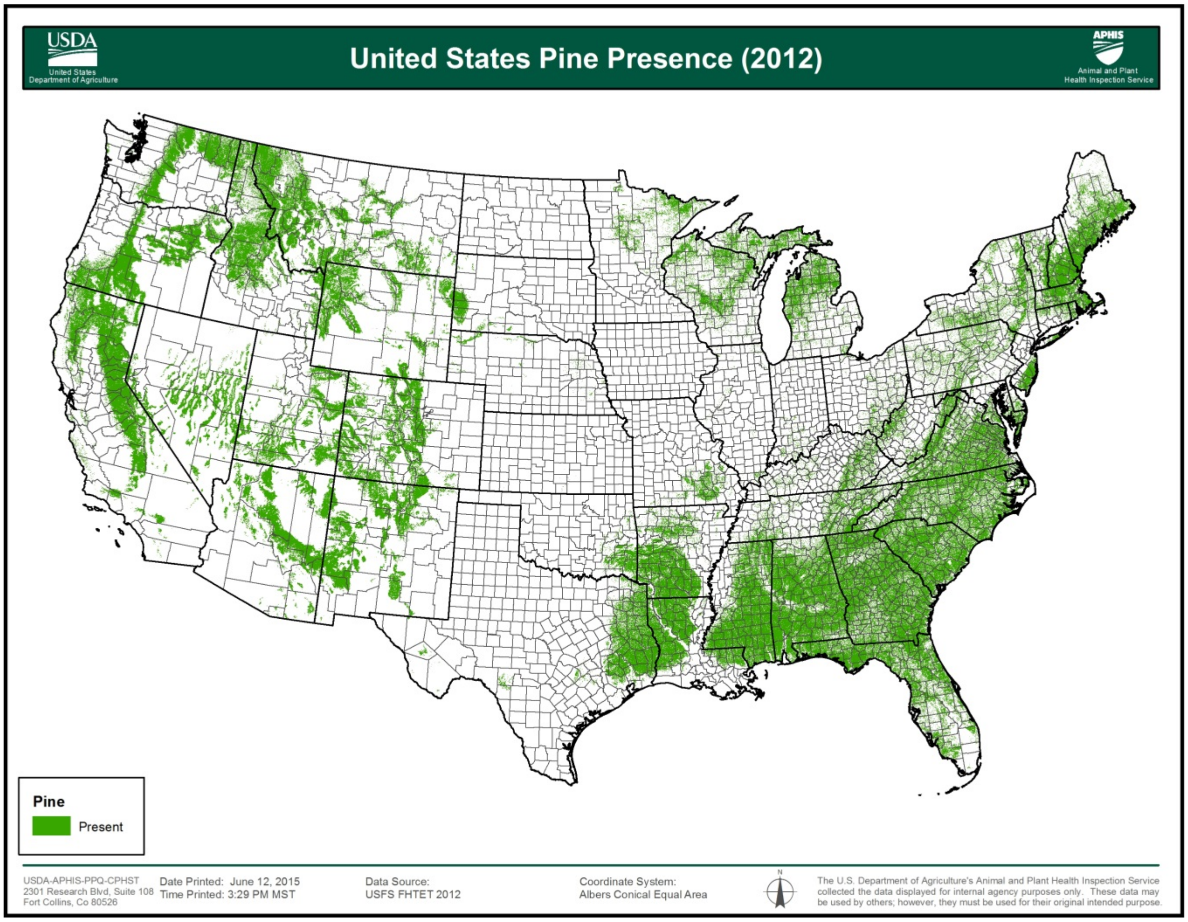

Figure 3. Tree species presence map for Pine (*Pinus* spp.) modeled in 2012 at a 240 meter resolution (USDA Forest Service, Forest Health Technology Enterprise Team). Map courtesy of USDA-APHIS-PPQ-CPHST.

Survey

Approved Methods for Pest Surveillance *:

The Approved Method is a trap and lure combination. The trap is a multi-funnel trap. There are two lure options: 1) Ethanol and 2) Alpha Pinene UHR Lure; or 1) Ethanol and 2) Alpha Pinene UHR Lure, and 3) Monochamol Lure. The Ethanol Lure and Alpha Pinene UHR Lures are both effective for 56 days (8 weeks). The Monochamol Lure is effective for 28 days (4 weeks).

The second combination is the approved method for the CAPS targets *Monochamus alternatus* (Japanese pine sawyer*)* and *Monochamus urussovii* (Black fir sawyer). If you are surveying for *Monochamus alternatus* and *Monochamus urussovii* using the three lure combination, you may also report negative data for *Hylobius abietis*. If you are only surveying for *Hylobius abietis*, you may use just the Ethanol and Alpha Pinene UHR Lure combination.

The addition of monochamol does not increase trap catches for *Hylobius abietis* and it is not expected to decrease trap catches (Miller et al., 2016). Monochamol is the name given to 2- (undecyloxy)-ethanol, the male-produced pheromone of *Monochamus galloprovincialis,* a congener of *M. alternatus* (Teale et al., 2011). Using the three lure combination for all three targets allows for data reporting for *Hylobius abietis* from surveys for *Monochamus alternatus* and *Monochamus urussovii*.

Any of the following Trap Product Names in the IPHIS Survey Supply Ordering System may be used for this target:

1) Multi-funnel Trap, 12 Funnel, Wet
2) Multi-funnel Trap, 8 Funnel, Wet

The Lure Product Names in the IPHIS Survey Supply Ordering System are:

1) Alpha Pinene UHR Lure,
2) Ethanol Lure,
3) Monochamol Lure

Note: There are two alpha pinene products available in the IPHIS Ordering Database: 1) Alpha Pinene Lure and 2) Alpha Pinene UHR Lure. The Alpha Pinene Lure is an un-gelled lure in a bottle dispenser that is used by the PPQ Program for *Tomicus piniperda* (pine shoot beetle). This lure should only be used for the program survey.

The Alpha Pinene UHR Lure is a polysleeve, ultra-high release dispenser used for other Exotic Wood Borer/ Bark Beetle (EWB/BB) targets. This lure should be used with the Ethanol Lure for the following three EWB/BB targets: *Hylobius abietis, Monochamus alternatus, Monochamus urussovii*, and *Tomicus destruens*.

The release rate of this lure is highly temperature-dependent. However, CAPS has listed a conservative length of effectiveness that will be effective for even the warmest climates in the CAPS community.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at https://caps.ceris.purdue.edu/approved-methods.

Key Diagnostics/Identification

Approved Methods for Pest Surveillance*:

Morphological: Confirmation of *H. abietis* is by morphological identification. It is difficult to identify *H. abietis* to the genus level (Brodel, personal communication, 2014). *Hylobius abietis* closely resembles species in the genera *Hylobius*, *Pissodes* and *Eudociminus*. Identification will likely require assistance from taxonomists specializing in *Hylobius* (Brodel, personal communication, 2014).

The following characteristics (Chamorro, personal communication, 2014) can be used to differentiate between the genera and species. Millers (1963) can also be consulted to distinguish between North American species. Final identification should be performed by a taxonomic expert.

Pissodes: smaller; narrow space between procoxae; has apical comb of stout setae along longitudinal axis of tibae (see Anderson, 2002); lack postocular lobes (anterolateral margin of pronotum not produced anterad).

Hylobius: larger; lacks space between procoxae; apical comb located on ventral margin mostly; each elytral puncture has an elongate seta; anterolateral margin of pronotum (near eye) produced anterad (=postocular lobes) with vibrissae (stout row of setae). *Eudociminus* has similar characters: second funicular antennomere longer than first (see Anderson, 2002).

H. abietis: black; larger, more robust; scales bright yellow and stouter; row of stout setae at apex of tibia longer-angled; scutellum has white scale-like setae when observed under high magnification the tips are bifurcate; vibrissae longer; characters of the genitalia.

H. radicis: brownish-red; narrower body (proportion); scales dull yellow, at a distance most specimens appear to have a white or yellow scutellum.

H. pales: brownish-red; narrower body; stout and greater number of scales on scutellum; at a distance most specimens appear to have a white or yellow scutellum.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at https://caps.ceris.purdue.edu/approved-methods.

Easily Confused Species

Hylobius abietis could be confused with species in the genera *Hylobius*, *Pissodes* and *Eudociminus*. *Hylobius abietis* could be confused with *H. congener* and *H. pales*, which “fill a similar niche” (Drooz 1985, Leather et al. 1999, Petersson and Orlander 2003, Rose et al. 2005). Both *H. congener* and *H. pales* exist in the United States (Dixon and Foltz 1990, Nordlander et al. 2003b). *H. abietis* also closely resembles all *Pissodes* species, particularly *P. castaneus* and *P. pini* (reviewed in CABI, 2015).

Eudociminus mannerheimii is the only species in the genus *Eudociminus* (Figs. 4 and 5). The body length of *E. mannerheimii* varies from about 10 mm to 17 mm, similar in length to species of *Hylobius*, especially *H. abietis* (Brodel, personal communication, 2014).

Datasheet for *Eudociminus mannerheimii:*
http://entnemdept.ufl.edu/creatures/trees/beetles/cypress_weevil.htm

The species *H. aliradicis* is distributed throughout the southeastern United States and the Bahamas (O’Brien and Wibmer, 1982). Refer to Warner (1966) for additional taxonomic and biological information about U.S. species of *Hylobius*.

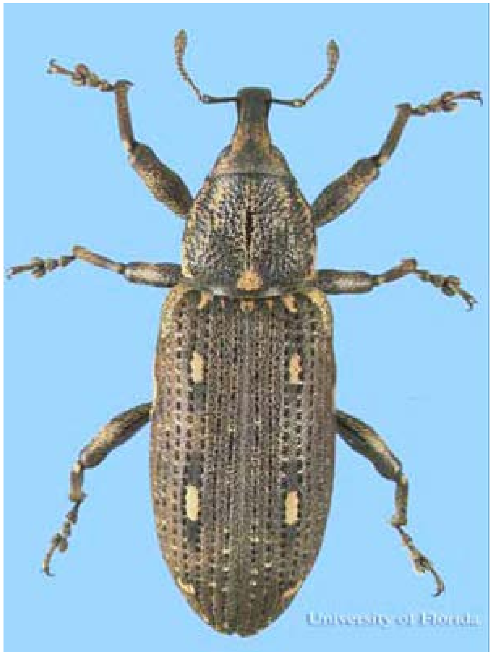

Figure 4. Adult *Eudociminus mannerheimii* (Boheman) (cypress weevil), dorsal view (Lyle Buss, University of Florida).

Figure 5. Adult *Eudociminus mannerheimii* (Boheman) (cypress weevil), lateral view (Lyle Buss, University of Florida).

For information on the Korean *Hylobius* species, *H. sibiricus* Egorov, *H. gebleri* Boheman, *H. haroldi* Faust, *H. montanus* Kono, and *H. pinastri* (Gyllenhal), refer to Hong, Egorov, and Korotyaev (2000). These and other species of *Hylobius* from the Palearctic region might potentially enter the United States with cargo shipped from there (Brodel, personal communication, 2014).

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Revisions

August 2016
1) Added a second lure option in the **Approved Methods for Pest Surveillance** section.

July 2015
1) Updated AQAS interception records in **Pathway** section.
2) Added updated Pine host map.
3) Conducted literature review of all sections for new information since last datasheet update.

July 2014
1) Added the **Pathways** section.
2) Revised the **Key Diagnostics/Identification** section.
3) Revised the **Easily Confused Species** section.
4) Revised the overall format of the document to match standalone datasheets.

Reviewers

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