Monochamus urussovii

Coleoptera: Cerambycideae
Black fir sawyer

Host(s)	CAPS-Approved Survey Method
Major hosts *Abies* spp. (fir), *Abies alba* (silver fir), *Abies holophylla* (Manchurian fir), *Abies nephrolepis* (Khingan fir), *Abies sibirica* (Siberian fir), *Larix* spp. (larch), *Larix gmelini* (Dahurian larch), *Larix sibirica* (Siberian larch), *Picea* spp. (spruce), *Picea abies* (Norway spruce), *Picea jezoensis* (Yeddo spruce), *Picea koraiensis* (Korean spruce), *Picea obovata* (Siberian spruce), *Pinus* spp. (pine), *Pinus koraiensis* (Chinese pinenut), *Pinus sibirica* (Siberian pine), *Pinus sylvestris* (Scots pine) (Cherepanov, 1990; USDA-FS, 1991; Cesari et al., 2004). In Japan, this species is recorded on *Abies* (fir), *Betula* (birch), and other deciduous trees (reviewed in Bílý and Mehl, 1989). Van Driesche et al. (2012) state that this species attacks all plants in the family Pinaceae. USDA-FS (1991) states that adults may also feed on some hardwoods, including: *Acer* (maple), *Betula* (birch), *Populus* (aspen), *Quercus* (oak), and *Salix* (willow). Yanovskij and Baranchikov (1998) state that this species has been recorded completing development on aspen (*Populus tremula*) and birch (*Betula pubescens*).	Monochamol, ethanol, and ultra-high release alpha-pinene in a cross-vane black panel trap.

Synonyms:
Cerambyx urussovii Fischer, 1806
Monochamus urussovii Fischer, 1806
Monochammus quadrimaculatus Motschulsky, 1845
Monochamus rosenmuelleri Cederjelm, 1798

There is some confusion regarding the status of *M. urussovii* Fischer; it is considered a senior synonym of *M rosenmulleri* Cederhjem by taxonomists (R. Brown, personal communication).

Figure 1. *Monochamus urussovii* (Fischer, 1806) male (Photo: U. Schmidt, 2006, http://www.flickr.com/photos/coleoptera-us/4058074945/).

Reason for Inclusion in Manual

CAPS Target: AHP Prioritized Pest List – 2014

Pest Description

Eggs: "White, elongate, slightly curved, narrowly rounded at poles. Chorion matte, with fine, dense, reticulate (almost punctate) sculpture. Length 4.2 – 4.8 mm [approx. $^{3}/_{16}$ in], width 1.2 – 1.4 mm [approx. $^{1}/_{16}$ in]" (Cherepanov, 1990).

Larvae: "Head parallel-sided, moderately flat…Antennae short, projecting from antennal socket by one or two segments…Mandibles black, on outer side basally with pair of deep longitudinal notches, each bearing one-four bristles, apically truncate, with elongate ventral denticle…Pronotum insignificantly sloping toward head, in anterior fourth whitish, along posterior margin of whitish fringe with dense, somewhat rusty, setiform hairs forming comparatively uniform transverse band…Abdomen elongate, laterally with dense rusty hairs…Body white. Body length of last instar larvae 55 – 60 mm [approx. 2 $^{3}/_{16}$ to 2 $^{3}/_{8}$ in], width of head 4.5 – 6.0 mm [approx. $^{3}/_{16}$ to $^{1}/_{4}$ in]" (Cherepanov, 1990).

Pupae: "Distinguished from the pupa of the closely related species *Monochamus sutor* (L.) by much larger spinules at tip of abdomen. Body large…Abdomen elongate, almost parallel-sided, gradually tapering from segment VII (female) or form base (male) toward tip, dorsally with median longitudinal groove…Body length 24 – 35 mm [approx. $^{15}/_{16}$ to 1 $^{3}/_{8}$ in], width of abdomen 7 – 12 mm [approx. $^{1}/_{4}$ to $^{1}/_{2}$ in]" (Cherepanov, 1990).

Adults: "Adult beetles are 18 to 37 mm [approx. $^{11}/_{16}$ to 1 $^{1}/_{2}$ in] long, with antennae that are 2 to 2.5 times the body length in males but only slightly longer than the body in females. The pronotum is as long as it is wide. The head and pronotum have sparse white or yellowish pubescence. Legs, elytra and antennae are all black with a very slight brass tinge, but female elytra also have spots of whitish-gray hairs" (Kimoto and Duthie-Holt, 2006).

In depth descriptions of all life stages can be found in Cherepanov (1990).

Biology and Ecology

Adult flight begins by the end of May to early June and continues until the end of September. The max amount of beetles is seen around July. Beetles are not yet sexually mature when they emerge and must feed before they can successfully mate (Cherepanov, 1990). Adults fly to the tree canopy and feed on the bark of young, thin, growing shoots as well as the phloem of host material, including fir, spruce, cedar, and other coniferous woody species (Cherepanov, 1990; USDA-FS, 1991). Adults live for about 2 months, feeding on and off several times (Cherepanov, 1990). Based on other *Monochamus* spp., *M. urussovii* is probably able to fly up to several kilometers (reviewed in USDA-FS, 1991).

About 1 week after emergence from the pupal cells, *M. urussovii* will mate. Before laying their eggs, females will chew an oviposition site in the bark of the host tree (coniferous species); females will then oviposit under the bark, usually one per cavity. Females lay 9 to 20 eggs during their lifetime (Cherepanov, 1990).

Eggs develop for 2.5 to 4 weeks before hatching. Larvae begin hatching by the end of June to July and continue until the end of September. Mass hatching of eggs occurs from July to August. After hatching, the larvae gradually bore into the bark. Initially, the larvae will live in or under the bark. The gallery is sinuous and sometimes squarish and is weakly impressed in the wood. The gallery width is 2 – 2.5 cm (approx. $^{13}/_{16}$ to 1 in) (Cherepanov, 1990). The second instar larvae will hibernate and then bore into the wood, leaving an oval entry hole (15 x 6 to 17 x 7mm; approx. $^{5}/_{8}$ x $^{1}/_{4}$ in) longitudinal to the stem (Cherepanov, 1990; Ciesla, 2011). Fibrous frass can be seen extruding from the ventilation hole. The gallery is at first transverse, and then becomes longitudinal in the upper layer of wood (Cherepanov, 1990). Galleries are filled with frass (Van Driesche et al., 2012). Tunnels are up to 12 cm long and 1 cm wide (approx. 4 $^{3}/_{4}$ x $^{3}/_{8}$ in) (Tsankov, 1975).

After larval development is complete, the larva makes a pupal cell, plugging it with coarse, fibrous frass. The pupal cell is usually 2 – 5 mm (approx. $^{1}/_{16}$ to $^{3}/_{16}$ in) from the bark surface. Larvae can undergo a second hibernation before pupation occurs. Pupae occur from late May to July, with the max amount occurring from the end of June to early July. Adults remain in the pupal chamber for 7 – 8 days and then chew an exit hole (6 – 12 mm, approx. $^{1}/_{4}$ to $^{1}/_{2}$ in diameter) through the bark (Cherepanov, 1990).

Bílý and Mehl (1989) state that the larval habitat for this species is in the base of recently dead or sick trees. The biology is similar to *Monochamus sutor*. *Monochamus urussovii* adults emerge later than *M. sutor* adults, from the middle of June to the end of August (Bílý and Mehl, 1989). The lifecycle in Fennoscandia takes one to two years (reviewed in Bílý and Mehl, 1989). USDA-FS (1991) states the life cycle in Siberia takes 2 years.

Countries of Origin

This is a transpalearctic species that occurs in coniferous forests from Finland to the Pacific Ocean (Baranchikov, 1997).

Current Distribution

Asia: China, Japan, Kazakhstan, Korea, Mongolia, and Russia; **Europe:** Belarus, Czech Republic, Estonia, Finland, Latvia, Lithuania, Norway, Poland, Sweden, and Ukraine (Bílý and Mehl, 1989; Cherepanov, 1990; Cesari et al., 2004; Sama, 2004; Van Driesche et al., 2012)

Distribution in United States

This species has not been found in the United States.

Pathway

This species has not been intercepted at U.S. ports of entry; however, the genus has been intercepted at least 700 times. Most interceptions have occurred on wood material (crating, dunnage, pallets, wood packing material) and have originated from countries where this species is known to occur (AQAS, 2012; queried March 9, 2012).

Bílý and Mehl (1989) state that this species can occasionally be found in Denmark and Great Britain with imported timber. Tsankov (1975) reports that this species has been found in timber imported into Bulgaria from Komi Republic. It was found along with larvae of *M. sutor*, *M. galloprovincialis*, and *Rhagium inquisitor* causing severe damage to the timber. USDA-FS (1991) also states that this species could move through international trade through infested wood material, especially larvae found in the wood. Many trees cut down in Siberia for timber are not immediately removed from the forests. This could allow time for the host material to become infested with potentially harmful pests, including *M. urussovii* (USDA-FS, 1991).

If introduced into the United States, the beetle could further spread through human mediated movement of logs, firewood, and lumber (non-kiln dried) (USDA-FS, 1991).

Pathogens Vectored

Monochamus urussovii is known to vector certain pathogenic fungi. Because adults feed on living trees, the species could become an important vector of native or introduced pathogens if introduced into the United States (USDA-FS, 1991).

Maturation feeding can infect branches with the blue-stain fungus *Leptographium sibiricum* (Jacobs et al., 2000; Van Driesche et al., 2012). Ciesla (2011) states that this species is introduced while females oviposit. This species is also a vector of the pinewood nematode, *Bursaphelenchus xylophilus* (the causal agent of pine wilt disease) (Rutherford and Webster, 1987). This pathogen serves as a serious threat to native pines in Japan where it causes annual losses of up to 1% of the country's pine forests (Mamiya, 1984; in Rutherford and Webster, 1987). *Monochamus* spp. introduce the pathogen to healthy trees when maturation feeding and to weakened trees when ovipositing (USDA-FS, 1991). It was recently found to vector *Bursaphelenchus mucronatus*, a nematode with similar morphology and life history to *B. xylophilus* (Togashi et al., 2008).

USDA-FS (1991) states that this species is associated with a *Ceratocystis* spp. in Russia, but the relationship between the fungi and beetles is unclear. The *Ceratocystis* sp. is known to be pathogenic to *Abies* (fir) species (Baranchikov, 1991).

At high population densities, maturation feeding by the adult can weaken trees, increasing their susceptibility to other pests, like bark beetles (USDA-FS, 1991).

Damage

Maturation feeding by adults removes bark strips from the host plant (Kimoto and Duthie-Holt, 2006).

Oviposition occurs on physiologically weak and freshly felled trees (Cherepanov, 1990). Trees weakened by fire, defoliation, and other disturbances are susceptible to attack. Adults also prefer wind thrown trees and logs (USDA-FS, 1991).

Females excavate oviposition niches in the host plant (Kimoto and Duthie-Holt, 2006). Oviposition pits are usually found on the lower part or sides of felled trees. The upper part of trees is rarely infested. This species infests the entire circumference of stems of standing, rooted trees. This species prefers stems 16 – 40 cm (approx. 6 $^{5}/_{16}$ to 15 $^{3}/_{4}$ in) or more in diameter. This species can be found in coniferous forests of different species composition (Cherepanov, 1990).

Figure 6. *Monochamus urussovii* male near exit hole. Note, small larva near exit hole (Stanislaw Kinelski, Bugwood.org).

Figure 7. *Monochamus urussovii* adult (Vitaly Gumenuk, Bugwood.org).

Broad, sinuous galleries can be found beneath the bark and are filled with frass and fine chips. Frass is also expelled through the ventilation holes found along the gallery. Galleries are initially transverse, becoming longitudinal, showing almost a 90° turn (reviewed in Kimoto and Duthie-Holt, 2006).

Although reproduction usually occurs on weakened or dying trees, outbreaks can occur on live, healthy trees. As infested host trees dies, the tree needles change colors from green to yellow to red (reviewed in Kimoto and Duthie-Holt, 2006; Van Driesche et al., 2012). This species can infest nearly all species of Pinaceae; however *Abies* (firs) are the most heavily damaged (Baranchikov, 1997).

Pest Importance

Although this species is considered rare in many parts of northern Europe, like Sweden, it is considered an important pest in Siberia, causing damage to spruce and fir forests (reviewed in Evans et al., 2004). This species infests coniferous plantations and can be found at 1,500 feet above sea level. It causes maximum damage to fir, especially in deciduous, cedar, and spruce plantations (Cherepanov, 1990). Van Driesche et al. (2012) state that fir trees are especially vulnerable to damage by *M. urussovii*. This species is found to a lesser extent in pine forests, where it is replaced by *Monochamus galloprovincialis*. Mass breeding of this species can occur in forests damaged by cone-eating insects, including *Dendrolimus sibiricus* and *Boarmia bistortata* (Cherepanov, 1990). Repeated defoliations by *Dendrolimus* spp. can lead to severe attacks by secondary insects including *M. urussovii* (USDA-FS, 1991).

Figure 8. Damage caused by *Monochamus urussovii* (Stanislaw Kinelski, Bugwood.org).

Apparently healthy trees can be attacked and killed when populations are high (Ciesla, 2011). "By attacking healthy fir stands dense beetle populations can maintain outbreak levels indefinitely, causing the death of fir forests over enormous areas" (Baranchikov, 1997). It has been suggested that outbreaks of *M. urussovii*, along with other insects, can dramatically increase the fire danger in host forests, specifically *Abies sibirica* (Furyaev et al., 1983).

Ciesla (2011) states that this species "is one of the most destructive pests of fir forests in northern Asia". Feeding kills the distal portions of stems and reduces foliage area of host trees (Ciesla, 2011). Maturation feeding can also lead to branches being infected with pathogens which can cause branch dieback; this weakens the tree and reduces resin flow. Once the host tree has been damaged, it becomes more suitable for beetle reproduction and larval feeding (Van Driesche et al., 2012). Shoots damaged by this beetle will usually wither. Wood damaged by larvae can lead to losses of commercial quality. Damage can make the wood unsuitable for industrial and technical requirements (Cherepanov, 1990). USDA-FS (1991) states that "larval feeding can significantly degrade the value of salvageable timber or logs in storage…[this species] could drastically reduce the potential for salvaging timber damaged or killed by native pests or wildfires".

In the Altai, this species can partially damage the shoots of birch when maturation feeding, but damage is usually kept at a minimum. Beetles can feed constantly for 24 hours a day during the warm periods of the year (July and first half of August); feeding slows down to only during the day during August and September (Cherepanov, 1990).

This species, in association with *Monochamus sutor*, killed 2 million m^3 of timber in the Tomsk Oblast of western Siberia in the late 1950s. This led to the collapse of the forest industry in the region and also delayed the construction of a railroad. Another outbreak from 1971 to 1976 led to 300,000 ha of damaged fir forests in the Krasnoyark Kray in central Siberia (Ciesla, 2011).

Survey

1.1 Survey Site Selection

Identify known or prospective hosts of *M. urussovii* and follow the general instructions on **General Site Considerations for Trap Placement** in the manual section **Planning a Survey.**

1.2 Trap and Lure

The CAPS-approved survey method for *M. urussovii* is a three lure combination: 1) monochamol, 2) ethanol, and 3) ultra-high release alpha-pinene in a cross-vane black panel trap. (Ryall et al., 2014).

Alpha-pinene is a host volatile released by pine trees. It is a generic attractant for many pine-attacking wood-borers and bark beetles. Ethanol is released by microorganisms in decaying woody tissue and is used by insects to locate stressed trees (Byers, 1992). Monochamol is the name given to 2-(undecyloxy)-ethanol, the male-produced pheromone of *Monochamus galloprovincialis*, a congener of *M. urussovii* (Teale et al., 2011).

The release rates of these lure are 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. The ethanol and ultra-high release alpha-pinene lures are both effective for eight weeks; the monochamol lure is effective for four weeks.

IPHIS Survey Supply Ordering System Product Names:

1) Alpha Pinene UHR Lure
2) Ethanol Lure
3) Monochamol Lure
4) Cross Vane Panel Trap, Black

There are two alpha pinene products available in the IPHIS Survey Supply Ordering System: 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 EWB/BB targets. This lure should be used with the Ethanol Lure for the following two EWB/BB targets: *Monochamus alternatus, M. urussovii*, and *Tomicus destruens*.

1.3 Trap Placement

Follow the general instructions on **Trap Placement** and **Trap Setup** for multi-funnel traps in the manual section **Conducting a Survey**.

1.4 Time of year to survey

In Japan, *M. alternatus* requires one or two years to complete its life cycle. In central Japan, adults emerge between May and late July (CABI, 2007; Togashi and Magira, 1981). In sub-tropical China, the insect can complete two to three generations per year (CABI, 2007). In bivoltine populations, overwintering adults emerge between April and May and the first-generation adults emerge between July and August; in trivoltine populations, the three generations emerge from March through November (CABI, 2007).

In a study targeting *M. urussovii* in Poland, traps were placed from June 4 to July 30 (Ryall et al., 2014).

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

Literature-Based Methods:

Trapping: Sweeney et al. (2003) found that spruce blend was significantly attractive to *M. urussovii*. This species has been caught in both multi-funnel traps and cross vane traps. Attractive baits include spruce blend lures, spruce blend lures + ethanol lure, α-pinene lure + ethanol lure, α-pinene lure, ethanol lure, and unbaited traps, in that order (Sweeney et al., 2004).

Not recommended: This species has been found using pitfall traps, but Martikainen and Kouki (2003) suggest that this trapping method is not very effective.

Identification

CAPS-Approved Method*:

Morphological. Identification can be performed by a Domestic Identifier using Cherepanov (1990).

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

Mistaken Identities

A key to four *Monochamus* spp. found in Scandinavia can be found in Bílý and Mehl (1989) and includes *M. galloprovincialis, M. sartor, M. sutor*, and *M. urussovii*.

Cherepanov (1990) states that the immature stages of this species are similar to *Monochamus sutor*.

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Updated for 2015
Added survey method.