Cooperative Agricultural Pest Survey (CAPS) pest datasheets provide pest-specific information to support planning and completion of early detection surveys.

Trichoferus campestris

Scientific Name

Trichoferus campestris (Faldermann, 1835)

Synonym:
Hesperophanes campestris (Faldermann, 1835)

Common Names

Velvet longhorned beetle, VLB, Chinese longhorned beetle

Type of Pest

Beetle, woodborer

Taxonomic Position

Class: Insecta, **Order:** Coleoptera, **Family:** Cerambycidae

Figure 1. Adult *T. campestris* on a cherry tree (Photo courtesy of Baode Wang, USDA-APHIS-PPQ).

Reason for Inclusion in Manual

CAPS Exotic Wood Borer/Bark Beetle Commodity Survey list – 2010-present

Pest Description

Eggs: Eggs are 1.5 mm ($^{1}/_{16}$ in) long and 0.5 mm (0.02 in) wide, white, and oval-shaped (Rodman et al., 2019).

Larvae: Mature larvae are 15-30 mm ($^{9}/_{16}$ -1$^{1}/_{4}$ in) long and white with six short legs. The abdominal end does not have projections. The front part of the head is dark, and each side of the head has three simple eyes arranged in a vertical row. The labrum is much narrower than the clypeus, and the mandibles have spoon-shaped ends that meet in the middle (Grebennikov et al., 2010) (Fig. 2).

Pupae: Pupae are 18 mm ($^{3}/_{4}$ in) long and whitish beige with dark spines along the back that are most noticeable near the abdominal end (Fig. 2; Grebennikov et al., 2010).

Adults: Adults are 16 mm ($^{3}/_{4}$ in) long, parallel-sided, not shiny, and uniformly brownish black (Grebennikov et al., 2010) to orange-brown, with legs and antennae that are lighter colored than the rest of the body (Spears and Ramirez, 2014). Antennae are shorter than the body: slightly so in males and significantly so in females. The entire body is covered densely with short, uniform hairs and sparsely with long, erect hairs. The dorsal side of the thorax has fine lines (Fig. 1, 2; Grebennikov et al., 2010).

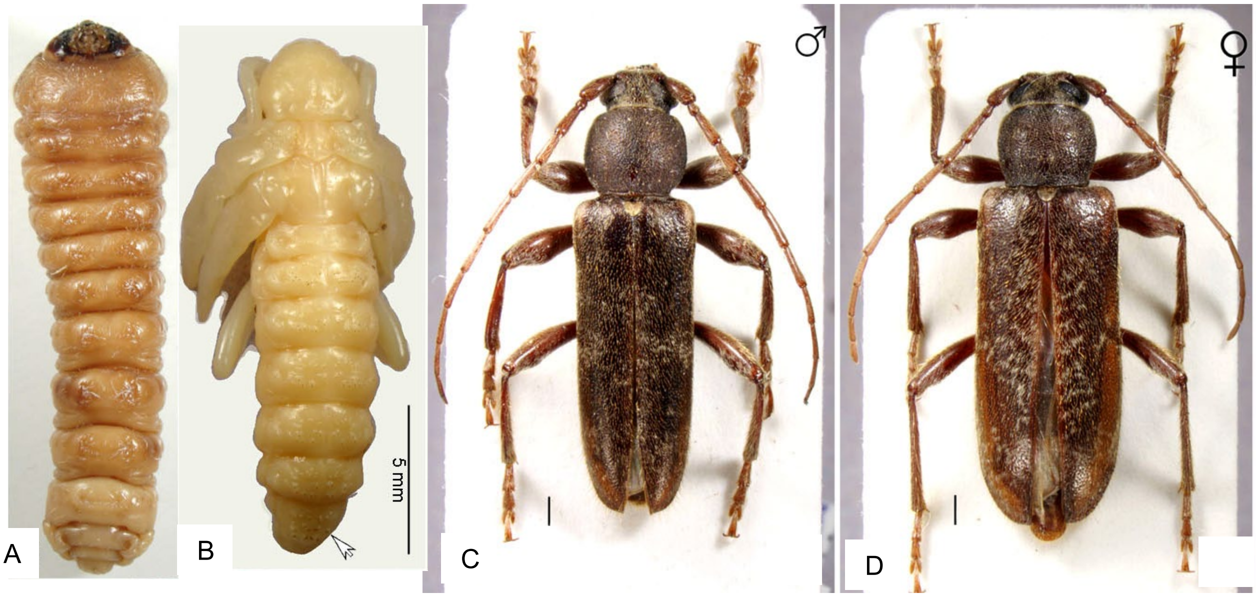

Figure 2. A. Larva, B. pupa, C. adult male, and D. adult female of *T. campestris*. Scale bar in A-B = 5 mm (1/4 in), C-D = 1 mm (1/25 in). (Photos courtesy of Vasily Grebennikov, Canadian Food Inspection Agency).

Biology and Ecology

Trichoferus campestris lives in forests and orchards, as well as in wood piles, wood packaging material, rustic furniture, and other wooden structures (Iwata and Yamada, 1990). *T. campestris* adults are active at night and each female lays approximately 50 eggs in her lifetime (Xinming and Miao, 1998) on tree trunks or branches or on the bark of dry logs (Iwata and Yamada, 1990; Rodman et al., 2019). In China, adults have been observed to fly for short distances and survive for 15-20 days (Xinming and Miao, 1998).

Peak flight and mating occur from June to early August in Utah (Rodman et al., 2019) and from late June to mid-August in New York (Francese, 2019). In one study in Utah, sentinel traps caught the first adults on June 14^{th} (Ray et al., 2019). In Canada (Grebennikov et al., 2010) and in its native range in Russia (Švácha and Danilevsky, 1987), adults emerge from July to August, although we found no studies that looked at factors influencing the phenology of the beetle.

Eggs hatch after 10 days, and larvae burrow shallowly beneath the bark to form tunnels between the phloem and xylem (Xinming and Miao, 1998). As larvae mature, they may burrow deeper into the tree. In most cases, early instar larvae need bark to survive (Dockray and Nadel, 2016; Iwata and Yamada, 1990), but once they enter deeper into the wood, the bark is no longer necessary. This explains how *T. campestris* can develop and emerge from debarked wood packaging materials (Wu et al., 2017) and finished wooden products (MDA, 2016). Larvae pupate within the tree in late winter, either shallowly beneath the bark or within a pupal chamber. They remain inside the tree throughout the winter and emerge as adults in early summer (Fig. 3). They can take as long as two years to complete development (Rodman et al., 2019).

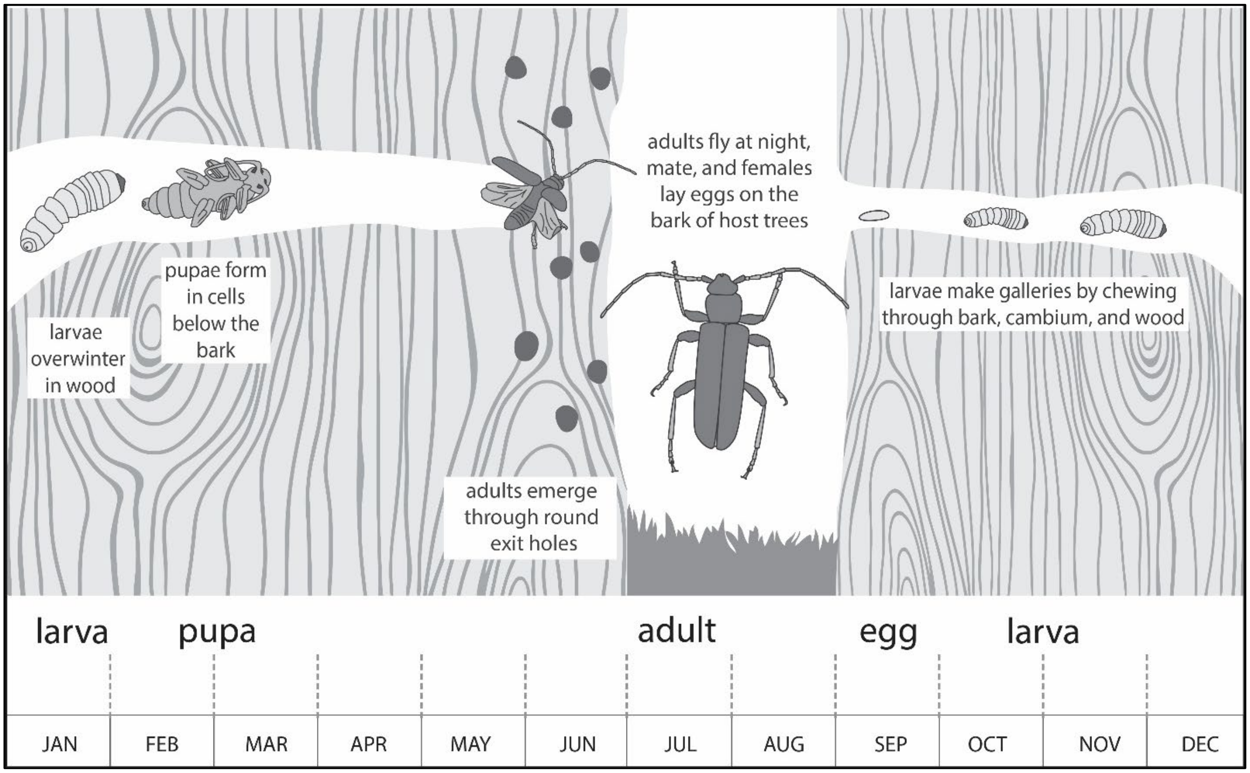

Figure 3. Life history of *T. campestris* in Utah. Larvae remain in host trees for one to two years to complete their development (Image courtesy of Cami Cannon and Lori Spears, Utah State University).

Damage

Trichoferus campestris larvae damage trees by tunneling within the wood. Emergence holes and larval tunnels can affect wood marketability (Fig. 4; Spears and Ramirez, 2014). Damage to trees may also lead to thinning or yellowing of the tree canopy, sucker growth, and weakening of branches (Rodman et al., 2019), though *T. campestris* does not cause rapid tree death (Spears and Ramirez, 2014). Larvae can also damage rustic log furniture (Fig. 5; MDA, 2016) and could possibly damage untreated structural wood (Kostin, 1973).

Pest Importance

Trichoferus campestris mostly infests stressed or unhealthy trees (Zhang et al., 2017). In Utah, it infests live peach and cherry trees, many of which are old and may be stressed or are located near piles of dead wood. It is also found in stressed environments such as golf courses and riparian areas (Watson et al., 2019). We found no studies that directly investigated the impact of *T. campestris* infestation, though one study in Canada found that *T.*

Figure 4. *T. campestris* exit holes (Photo courtesy of Clint E. Burfitt, Utah Department of Agriculture and Insect Program).

campestris was a secondary agent, which infested a tree that was already dying from *Armillaria* root rot infection (Bullas-Appleton et al., 2014).

Trichoferus campestris is a pest of stored timber within its native range in Japan (Iwata and Yamada, 1990). Canada and Taiwan list it as a harmful organism (APHIS, 2019) and it is an A2 pest for the European Union because it is present in several European countries (EPPO, 2019).

Figure 5. Rustic log furniture with *T. campestris* larval tunneling damage beneath bark (Photo courtesy of Minnesota Department of Agriculture 2016).

Known Hosts

Trichoferus campestris infests dry wood logs from almost any host, as long as bark is present during the first few months of larval development (Iwata and Yamada, 1990). It also infests wood products and living trees, including cultivated and wild fruit trees, ornamentals, and conifers, from many different host species (Rodman et al., 2019). It is unknown whether *T. campestris* can infest healthy trees in nature and in nurseries or only trees that are weak, stressed, or dying (Spears and Ramirez, 2014).

Preferred living hosts
Malus spp. (apple)*, *Morus* spp. (mulberry)*, *Prunus avium* (sweet cherry)*, and *Prunus persica* (peach)* (Jiangsu Mulberry Pests Survey Group, 1997; Ray et al., 2019; Zhang et al., 2017).

Other living hosts
Acer platanoides (Norway maple)*, *Astragalus membranaceus* (membranous milk-vetch), *Betula utilis* (Himalayan birch), *Cunninghamia lanceolata* (Chinese fir)*, *Fraxinus velutina* (velvet ash)*, *Juglans* spp. (walnut)*, *Larix sibirica* (Siberian larch), *Malus pumila* (paradise apple)*, *Paeonia lactiflora* (Chinese peony)*, *Picea obovata* (Siberian spruce), *Picea crassifolia* (Qinghai spruce), *Pinus sibirica* (Siberian pine), *Pinus* spp. (pine)*, *Populus* spp. (aspen, cottonwood, poplar)*, *Prunus armeniaca* (apricot)*, *Prunus pseudocerasus* (Chinese sour cherry), *Quercus* spp. (oak)*, *Quercus variabilis* (Chinese cork oak), *Salix* spp. (willow)*, *Sorbus aucuparia* (European mountain ash, rowan)*, *Styphnolobium japonicum* (Japanese pagoda tree)*, *Syzygium aromaticum* (clove), *Ulmus pumila* (Siberian elm)*, *Ulmus* spp. (elm)*, and *Ziziphus jujuba* (jujube)* (Bullas-Appleton et al., 2014; Cao et al., 2012; Cao et al., 2014; Dong and Guo, 2018; Gui et al., 2016; Guo and Yin, 2005; Jiang and Zhang, 1996; Kadyrov et al., 2016; Lei et al., 2017; Li et al., 2009; Lin, 2014; Makhnovskii, 1966; Rehemaidula, 2013; Shen and Tang, 1987; Zhang et al., 2017; Zou et al., 2018).

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* Host with U.S. distribution.

Dry wood hosts
Alnus spp. (alder)*, *Betula* spp. (birch)*, *Chamaecyparis obtusa* (hinoki false cypress), *Diospyros* spp. (persimmon, ebony)*, *Fagus crenata* (Japanese beech), *Glycyrrhiza uralensis* (Chinese licorice), *Juglans mandshurica* (Manchurian walnut), *Juglans regia* (walnut)*, *Morus australis* (Korean mulberry), *Pinus densiflora* (Japanese red pine), *Quercus* spp. (oak)*, *Robinia pseudoacacia* (black locust)*, *Rubus idaeus* (raspberry)*, *Zelkova serrata* (Japanese zelkova)*, and *Vitis vinifera* (grape)* (Bai and Zhang, 1999; Hegyessy and Kutasi, 2010; Iwata and Yamada, 1990; Sama et al., 2005; Wang et al., 1988).

Wood products of uncertain origin
Dunnage, solid wood packaging material, and home goods such as trays and rustic log furniture (Allen and Humble, 2002; Haack, 2006; Hodgetts et al., 2016; MDA, 2016; Wu et al., 2017).

Pathogens or Associated Organisms Vectored
This species is not known to be associated with pathogens or other organisms.

Known Distribution
Trichoferus campestris is native to Asia and both the Asian and European regions of Russia (Grebennikov et al., 2010). It has been introduced to several eastern European and North American countries (Fig. 6).

Its native distribution range includes:
Asia: Armenia, China, Russia (Asian), Kazakhstan, Kyrgyzstan, Japan, Mongolia, North Korea, South Korea, Tajikistan, Turkmenistan, and Uzbekistan; and **Europe:** Russia (European) (Anisimov et al., 2018; Danilevsky, 2003; EPPO, 2019; Iwata and Yamada, 1990; Kadyrov et al., 2016; Karpiński et al., 2018; Lee and Lee, 2018; Makhnovskii, 1966; Mohammed et al., 2018; Okamoto, 1927; Yagdyev, 1987; Zhang et al., 2017).

This species has been introduced and is most likely established in the following countries:
Asia: Iran; **Europe:** Czech Republic, Hungary, Moldova, Poland, Romania, Slovakia, and Ukraine; and **North America**: Canada and the United States (Bullas-Appleton et al., 2014; Chyubchik, 2010; Dascălu et al., 2013; Grebennikov et al., 2010; Hegyessy and Kutasi, 2010; Kruszelnicki, 2010; Majzlan, 2014; Majzlan and Vidlička, 2016; Ray et al., 2019; Sabol, 2009; Sama et al., 2005; Zamoroka and Panin, 2011).

This species has been eradicated from:
Europe: Germany (EPPO, 2019).

Status of infestation in the United States (June 2019)
Since 1998, *T. campestris* has been intercepted many times at U.S. ports of entry and in regulatory incidents and domestic detections throughout the country (Watson et al., 2019). In most of these incidents, adult beetles emerged from wood furniture, packaging

materials, or log piles or were trapped during surveys for exotic wood borers or bark beetles (Pfister and Valdez, 2017). *T. campestris* is established in Utah and Illinois (MDA, 2019) but has been found in at least 14 states (Rodman et al., 2019).

In collaboration with state government, academic, and industry partners, the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Services (APHIS) Plant Protection and Quarantine (PPQ) identified the sex pheromone for *T. campestris* and developed a highly attractive species-specific lure (Ray et al., 2019). As of 2019, this *T. campestris* lure is approved for CAPS surveys. Use of the lure in surveys during the summer of 2019 will help in detection of the pest to understand its full distribution within the United States.

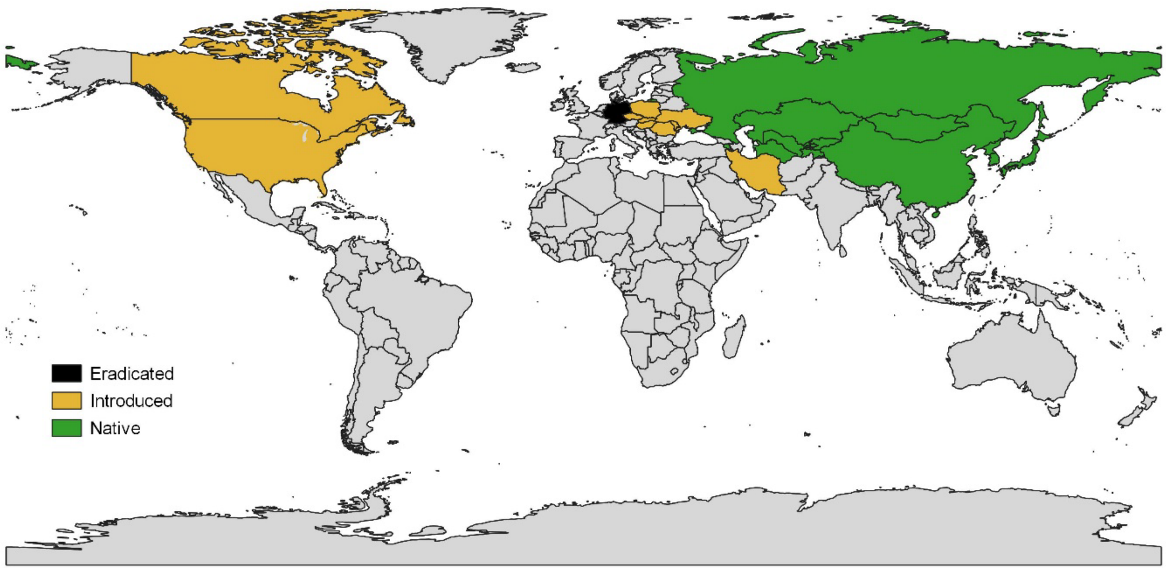

Figure 6. Global distribution map of *T. campestris* (Map represents data presented in the Known Distribution section of this document, USDA-APHIS-PPQ).

Pathway

Larvae of *Trichoferus campestris* spread into new areas within infested wood packing material (Watson et al., 2019), logs, or other wood material, such as furniture (Pfister and Valdez, 2017). Its entry into Montreal, Canada, in the mid-2000s was probably via solid wood packaging material from China (Grebennikov et al., 2010). It has been intercepted 44 times at 13 U.S. ports in commodities that originated in at least six countries (Pfister and Valdez, 2017). Most of these interceptions were in wood packaging material associated with stone or metal products from China.

The United States regulates the importation of wood packaging materials from all countries (7 CFR § 319.40, 2019)† and calls for most wood packaging materials to be either heat-treated or fumigated with methyl bromide before entry into the United States (CBP, 2018). Such materials must be accompanied by phytosanitary certificates. *T. campestris* is one of the most commonly intercepted pests in wood packaging materials

† The Code of Federal Regulations (CFR), published by the Office of the Federal Register and the Government Publishing Office, lists all current rules and regulations currently in federal administrative law.

because of non-compliance with required treatments (Wu et al., 2017). Genetic analysis showed that *T. campestris* individuals don't move between populations within the U.S. and that each U.S. population probably originated from an introduction from overseas (Wu et al., submitted).

Potential Distribution within the United States

Based on temperature and precipitation in its native range, *Trichoferus campestris* may potentially establish throughout the northern and central states of the contiguous United States (Krishnakutty et al., submitted). Laboratory trials indicate that late instar larvae may require a chill period to pupate (Dockray and Nadel, 2016), limiting its potential distribution. Urban areas, especially those with busy ports or warehouses, may be at greater risk since the pathway for introduction is most likely through wood packaging materials or infested wood products (Krishnakutty et al., submitted). Domestic quarantine programs for emerald ash borer (7 CFR §301.53), gypsy moth (7 CFR §301.45), and Asian longhorned beetle (7 CFR §301.51) regulate the movement of most *T. campestris* host material.

Survey

Approved Methods for Pest Surveillance*:

The approved method for surveillance is a trap and lure combination. The preferred trap is a black cross vane panel trap treated with a fluoropolymer resin. The preferred lure is the *Trichoferus campestris* lure, which is effective for 28 days (4 weeks).

For negative data reporting in 2019, you may use an ethanol lure or a *Trichoferus campestris* lure with a black cross vane panel trap coated with a fluoropolymer resin. Beginning in 2020, the *Trichoferus campestris* lure will be the only lure approved for negative data reporting.

IPHIS Survey Supply Ordering System:

Trap Product: "Cross Vane Panel Trap, Black."
Lure Product: "*Trichoferus campestris* Lure"

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

Literature-Based Methods:

Survey Site Selection:

Hang traps near sites of previous *T. campestris* detections (if known), riparian habitats, and wood cull piles in commercial fruit production areas (Rodman et al., 2019). Areas with stressed trees, such as in industrial or urban settings, may also be suitable. Inspect nearby trees for emergence holes and symptoms of tree injury (Rodman et al., 2019). U.S. detections have occurred at orchards, golf courses, riparian areas, industrial sites (Watson et al., 2019), forested areas (Ray et al., 2019), pallet manufacturers, and warehouses of imported wood, stone, metal, and tile products (Pfister and Valdez, 2017).

Trap placement:
Suspend traps at a height of 1.5 m (4.9 ft) and position them at least 10 m (32.8 ft) apart (Ray et al., 2019).

Time of year to survey:
The best time of year to place traps is when adults are active, typically from June to August. In Utah, adults emerge from mid-June to early August (Rodman et al., 2019) and, in New York, adults emerge from late June to mid-August (Francese, 2019). In Canada (Grebennikov et al., 2010), Russia (Švácha and Danilevsky, 1987), and central Asia (Kadyrov et al., 2016), adults are active from July to August.

Key Diagnostics/Identification

Approved Methods for Pest Surveillance*:

Morphological:
For field-level screening, use:
Royals, H. R., and T. M. Gilligan. 2019. Screening Aid: Velvet Longhorn Beetle *Trichoferus campestris* (Faldermann). Identification Technology Program (ITP), Colorado State University, USDA-APHIS-PPQ-S&T, Fort Collins, CO. 5 pp.

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

Literature-Based Methods:
Grebennikov et al. (2010) provide detailed taxonomic descriptions and high resolution images of *T. campestris* adults, larvae, and pupae.

Wu et al. (2017) identified *T. campestris* from both DNA barcoding and morphological features of adults reared from larvae and pupae intercepted in solid wood packaging materials imported into the United States. The two methods provided the same results, indicating that DNA barcoding is a viable technique for identification of *T. campestris*. Hodgetts et al. (2016) used DNA barcoding to identify a damaged *T. campestris* adult that emerged from a wooden silverware tray in the United Kingdom. The beetle had been crushed, so morphological identification was impossible, but DNA barcoding identified the species with 100 percent confidence.

Easily Confused Species

Larvae of *T. campestris* can be confused with those of *Hylotrupes bajulus,* the old house borer, which is found in structural timbers throughout the United States east of the Rocky Mountains (Jacobs, 2007). The head capsule of *Hylotrupes bajulus*, however, is much lighter than that of *T. campestris* (Grebennikov et al., 2010). All life stages of *T. campestris* are easily confused with those of other species of *Trichoferus* and *Hesperophanes*. *Hesperophanes pubescens*, which is a native species (Royals and Gilligan, 2019), is the only other species from either genus that is present in the United States, and *H. pubescens* is very similar to *T. campestris* (Fig. 7). Royals and Gilligan

(2019) provide a tool to differentiate the two morphologically, but since identification is difficult, all similar longhorned beetles should be sent to a trained coleopterist for identification.

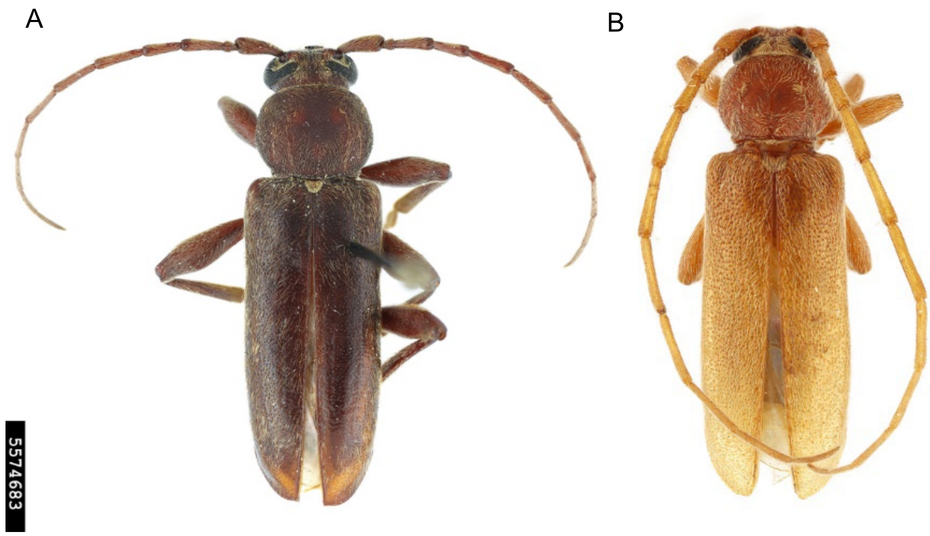

Figure 7. A. *Trichoferus campestris* and B. *Hesperophanes pubescens* (Photos courtesy of Hanna Royals, Screening Aids, USDA APHIS PPQ, Bugwood.org).

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Versions

February 2013: Datasheet completed (Version 1)
August 2016: Datasheet completed (Version 2)
August 2019: Datasheet revised (Version 3)

1. Transferred datasheet to new template.
2. Rewrote **Biology and Ecology** section.
3. Rewrote **Pest Description** section.
4. Rewrote **Damage** section.
5. Rewrote **Pest Importance** section.
6. Revised **Known hosts** section to add references. Removed hosts for which there were no primary references.

7. Rewrote **Pathway** section.
8. Rewrote **Survey – Literature-based methods** section for new methods.
9. Added **Key Diagnostics/Identification** section which was absent in old datasheet.
10. Added **Easily Confused Species** section which was absent in old datasheet.

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