This text is an integral part of the *EPPO Study on bark and ambrosia beetles associated with imported non-coniferous wood* and should be read in conjunction with the study

Pest information sheet
Bark beetles

SCOLYTUS SCHEVYREWI (COLEOPTERA: SCOLYTINAE)
banded elm bark beetle

EPPO Lists: Scolytus schevyrewi was added to the EPPO Alert List in 2005 and deleted in 2008 (the EPPO Panel on Quarantine Pests for Forestry considered that it was not more damaging than existing European *Scolytus*). The assessment of potential risks in this information sheet is not based on a full PRA for the EPPO region, but on an assessment of the limited information for that species used to prepare the information sheet.

PEST OVERVIEW

Taxonomy
Scolytus schevyrewi Semenov, 1902. Synonyms: *Eccoptogaster emarginatus* Wichmann, 1915; *Eccoptogaster transcaspicus* Eggers, 1922; *Scolytus frankei* Wichmann, 1915; *Scolytus seulensis* Murayamas, 1930.

Beaver *et al.* (2016) note that *S. transcaspicus* (Eggers, 1922) (present in Iran, Kazakhstan, Russia (Daghestan, Astrakhan), Turkmenistan) has been treated as a synonym of *S. schevyrewi*, but is considered a distinct species by Petrov (2013). It is not known if some distribution or host records in this datasheet relate to *S. transcaspicus.*

Associated fungi
When *S. schevyrewi* was found in the USA in 2009, there was a concern that it could be a vector of Dutch elm disease (caused by *Ophiostoma novo-ulmi*, the aggressive strain of *Ophiostoma ulmi*), and that it may be a more efficient vector than the introduced European species *S. multistriatus*. *S. schevyrewi* was confirmed as a vector of *O. novo-ulmi* (Jacobi *et al.*, 2013), with low transmission rates, and the authors suggested that *S. schevyrewi* may be no better or even less effective as a vector than *S. multistriatus*. Zhu (2017) isolated fungi associated with *S. schevyrewi* in apricot orchards in Xinjiang (*Yamadazyma mexicana*, *Candida xinjiangensis*, *Wickerhamomyces ciferrii*, *Cladosporium macrocarpum*, *Meyerozyma guilliermondii* and *Paecilomyces* sp.) as well as a number of bacteria; potential plant pathogens among the fungi and bacteria found were: *Y. mexicana*, *C. macrocarpum*, and *Pantoea agglomerans*.

Morphology and biology (from Lee *et al.* 2009; Negrón *et al.*, 2005; Veuilleux, 2012; CABI CPC, all citing others)
Adults are 3-4 mm long, and are reddish black in colour with a black head. In China (location not specified), some authors reported 2-3 overlapping generations per year, with a life cycle of 40-45 days in the field; a study in Tajikistan found 3-4 generations per year; in the USA, there are 2-3 generations per year (Davis, 2011; Seybold *et al.*, 2016, citing Lee *et al.*, 2011). In the Kashi area of Xinjiang (North-West China), there were 3-4 generations per year, with a life cycle of 40-50 days (Zhu *et al.*, 2017). In experimental conditions in the USA (i.e. in favourable conditions), completion of the life cycle took fewer than 30 days (Negrón *et al.*, 2005, citing others). In Canada (Manitoba and Saskatchewan), *S. schevyrewi* has 2 generations, and possibly a third one (although it is unlikely that adults of the third generation would lay eggs or that eggs would successfully develop) (Veuilleux, 2012).

In China, *S. schevyrewi* was reported to overwinter as mature larvae, pupae or adults under the bark, while in Canada, it overwintered as mature larvae and, to a lesser extent, as pupae. Winter survival in Canada was low (Veuilleux, 2012).

Maturation feeding was reported to occur on the bark at the intersections of tender twigs. In Tajikistan, studies on *S. schevyrewi* and several other *Scolytus* indicated that they could reproduce without maturation feeding. The females then attack host trees by constructing individual entrance holes through the bark. It is believed that females release a pheromone to attract the males. Mating occurs on the bark surface, and each female constructs a single egg gallery in the inner bark, which contains ca. 60 eggs on average. The newly hatched larvae feed in the inner bark and construct individual galleries. When feeding is completed, the mature larvae construct pupal chambers in the outer bark and pupate (CABI CPC, citing others; Veuilleux, 2012). Veuilleux (2012) notes that the related species (and vectors of Dutch elm disease) *S. multistriatus* and *Hylurgopinus rufipes* can reach the xylem when feeding, and this is also likely for *S. schevyrewi.* On *P. armeniaca*, entry holes are located mostly on the main branches, but also on the trunk and other types of branches (lateral, bearing) (Zhu, 2017).

S. schevyrewi has been collected from broken elm branches, fallen elm trees, stacks of elm firewood, and drought-stressed elm trees, as well as from elms dying from Dutch elm disease (Maryland Extension, 2008, citing others). In Asia, *S. schevyrewi* usually attacks weakened or stressed trees, although during outbreaks it can also attack healthy *Ulmus*. *S. schevyrewi* is able to kill stressed *U. pumila* as a result of its feeding and breeding activities (Veuilleux, 2012, citing others). Although it is mentioned that occasional outbreaks can occur that result in widespread tree mortality (CABI CPC, citing others), this seems to mostly relate to stressed trees. On apricot, live trees are attacked (Zhu, 2017) (whether they are stressed is not indicated); the same publication appears to point to mortality of trees in Xinjiang (but this is not entirely clear in the abstract available).

Trees older than 4 years with trunks or branches greater than 5 cm in diameter are most likely to be attacked, especially in open areas or urban settings. Young trees or healthy trees are generally more resistant to attack (CABI CPC, citing others). Veuilleux (2012) noted that galleries can be constructed in the trunk and in branches with a diameter of ≥ 3 cm. Logs that are too small or too large seem to be unsuitable for brood galleries (Veuilleux, 2012). In experiments in the USA and Canada (reported in Veuilleux, 2012), the median diameter of colonized logs was 18 cm, and the smallest ones 8 cm diameter; Lee *et al.* (2011) studied infestation in ca. 10-24 cm diameter logs of *U. pumila* and found *S. schevyrewi* in all of them.

In the USA, *S. schevyrewi* was shown to have competitive advantages over the introduced European *S. multistriatus* (Lee and Seybold, 2010; Lee *et al.*, 2010, 2011), and it has now become much more abundant than *S. multistriatus* in some areas where both occur. There is some evidence that *S. schevyrewi* possibly has, since its introduction, already displaced *S. multistriatus* in Colorado and Wyoming (Lee *et al.* 2009), as well as California and Minnesota (Seybold *et al.*, 2016 citing others).

Spread biology
Adults are weak fliers and prefer to attack adjacent, freshly cut logs, stumps or host trees that are weakened by diseases, other insects, rodents, drought, extreme temperatures, etc. (CABI CPC, 2017).

Nature of the damage
S. schevyrewi tunnels galleries in the bark of its hosts. High larval densities lead to complete girdling and eventually tree death.

Detection and identification
- *Symptoms* include wilting of the foliage, boring dust on the trunks of heavily attacked trees, and occasionally sap flow on the bark surface near entrance holes. The consumption of inner bark leads to easy peeling and sloughing. Life stages and galleries can be seen when removing the bark. Adults can also be found in the outer bark of infested trees. Exit holes can be observed (CABI CPC, 2017).
- *Trapping.* Adults are attracted to funnel traps baited with either commercial Ips lures (ipsenol and ipsdienol) or *Scolytus multistriatus* lures [alpha-multistriatin plus 4-methyl-3-heptanol (threo isomer) and alpha-Cubenene) (CABI CPC, 2017). *U. pumila* trap logs were found to be a sensitive monitoring tool for detecting the presence of *S. schevyrewi* (Lee *et al.*, 2009).
- *Identification.* LaBonte (2010) gives a key for distinguishing *Scolytus schevyrewi* from other species of *Scolytus* in North and Central America (including the European species *S. multistriatus*). A molecular technique (RAPD-PCR) for separating *S. schevyrewi* and *S. multistriatus* is provided in Johnson *et al.* (2008).

Distribution (see Table 1)
S. schevyrewi is native to Asia, where it occurs in China, Mongolia, Korea, Russia and several Central Asian countries. It has therefore a limited distribution in the EPPO region. *S. schevyrewi* has been introduced to Canada, Mexico and the USA. It has been reported in four provinces in Canada, and throughout the USA, except in the South-East.

Host plants (see Table 2)
Ulmus spp. are the major hosts of *S. schevyrewi*, which has attacked Asian, but also European and American species. In North America, *S. schevyrewi* has been found only on *Ulmus* spp. (Negrón *et al.*, 2005; Veuilleux, 2012; Campos-Bolaños *et al.*, 2015). In the USA, it attacked a new North American host, *U. americana* (Negrón *et al.*, 2005).
S. schevyrewi has been reported in older literature on hosts belonging to several other families (see Table 2). Recent publications from Xinjiang (China) support that several *Prunus* spp. are hosts (Zhu, 2017 - field; Zhong *et al*., 2018 – laboratory and field): *P. armeniaca* (apricot), *P. dulcis* (almond) and *P. ferganensis* (*P. persica* subsp. *ferganensis*). *P. armeniaca* was the most suitable host for development and reproduction (Zhong *et al*., 2018).
Records on some other hosts arise from older publications, and no recent evidence was found (in particular regarding *Malus*, *Pyrus* and *Salix*). Lee *et al.* (2011) considered that only *Ulmus* spp. are hosts, and note it is unclear from previous references on other hosts whether *S. schevyrewi* was colonizing or had developed in the hosts, or were simply collected on the host surface. Experiments conducted in the USA and Canada on the colonization of various previously reported hosts (on logs in the laboratory in the USA, Lee *et al.*, 2011; on trap logs outdoors, Veuilleux, 2012) found *S. schevyrewi* only on *Ulmus*, and not on *Caragana arborescens*, *Elaeagnus angustifolia*, *Prunus fontanesiana* and *Salix alba*. It was also not found in logs of *U. parvifolia* (Lee *et al.*, 2011) (which is not a reported host). *Salix babylonica* and *Elaeagnus angustifolia* were not attacked in recent investigations of hosts in Xinjiang (laboratory and field; Zhong *et al*., 2018).

Known impacts and control in current distribution
In the Karamay region of the Xinjiang Province, China, *S. schevyrewi* is a major pest of elm trees and has caused an average of 3-5% tree mortality of urban elms and 20-25% mortality of rural elms (CABI CPC citing Li *et al.*, 1987). Other authors consider that records of damage in China related to drought-stressed elms (Negrón *et al.* 2005, Lee *et al.*, 2009 citing others). Fan *et al*. (2015) refer to severe damage to elm forests in Yanchi County (Ningxia Province), with large scale destruction and death of trees. In Xinjiang (China), *S. schevyrewi* is an important pest of *Prunus*, especially apricot, and research is ongoing to develop management strategies (Zhu, 2017; Zhong *et al*., 2018). In the USA, *S. schevyrewi* has damaged drought-stressed elms in the arid Rocky Mountain and Intermountain regions where *U. pumila* is a primary shade tree. In 2004, 333 infested *U. pumila* trees were removed from Newcastle, Wyoming (Seybold *et al.*, 2016 citing Lee *et al.*, 2007). No mentions of attacks on other hosts were found in the literature, which may support the hypothesis that non-*Ulmus* hosts are accidental. However, part of the early literature on this pest was not readily available to EPPO (including publications from China).

Regarding initial concerns in North America in relation to Dutch elm disease, *S. schevyrewi* has not led to an increase of the disease. Jacobi *et al.* (2013) noted that the incidence of Dutch elm disease (DED) in Colorado has been decreasing, in parallel with *S. schevyrewi* displacing *S. multistriatus*. It is noted that in colder climates, DED transmission is done by *H. rufipes* (Jacobi *et al.*, 2007). The interactions between *S. schevyrewi* and *H. rufipes* have not been fully studied, but in experiments in Canada (Veuilleux, 2012), *S. schevyrewi* showed a preference for *U. pumila*, while *H. rufipes* preferred *U. americana*, implying that they might not compete with each other.

Control: In Asia, control involves the maintenance of tree vigour, coupled with cultural practices such as the sanitation-felling of wilting and dying trees, and topical insecticide treatment of infested trunks to prevent adult emergence (CABI CPC citing others). Removal of infested trees and destruction of bark (e.g. by chipping) have been used in the USA, and insecticide treatments may be applied to ornamental trees (Davis, 2011, CABI CPC).

Regarding the control of Dutch elm disease (DED), as *S. schevyrewi* has been shown to be a new vector, Jacobi *et al.* (2013) mentions that current management programmes involving removal of declining elms, rapid removal of DED-infected elms prior to beetle emergence, and planting of DED-resistant elms should continue to be effective management tactics.

POTENTIAL RISKS FOR THE EPPO REGION

Pathways

Entry

The life stages of this insect are present in the bark. Wood commodities of *Ulmus* with associated bark may all be pathways. Processes applied to produce wood commodities would destroy some individuals. The likelihood of entry on wood chips, hogwood and processing wood residues would be lower than on round wood, as individuals would have to survive processing and transport, and transfer to a suitable host is less likely. The wood would also degrade and not be able to sustain development of the pest. From a biological point of view, bark on its own may carry the pest, but it is not known if the bark of hosts is used and traded. No data specific to trade of *Ulmus* round wood was found.

Plants for planting of hosts may also be a pathway. Such plants are normally subject to controls during production, and attacked plants may be detected and discarded. Cut branches are a less likely pathway, as they are used indoors, and the pest is unlikely to be able to transfer to a suitable host; it is not known if cut branches of the hosts are used and traded.

Summary of pathways (uncertain pathways are marked with '?'):

- *wood (round or sawn, with bark, including firewood) of hosts*
- *non-coniferous wood chips, hogwood, processing wood residues (except sawdust and shavings)*
- *wood packaging material if not treated according to ISPM 15*
- *bark of hosts?*
- *plants for planting (except seeds) of hosts*
- *cut branches of hosts?*

According to current knowledge on hosts, pathways cover at least Ulmus spp. and the Prunus known hosts.

Spread (following introduction, i.e. within EPPO region)

Adults are reported to be weak flyers, but spread appears to have been rapid in the USA. Over long distances, human-assisted pathways could ensure spread.

Establishment

Establishment of *S. schevyrewi* in the EPPO region where it does not occur is considered possible. *S. schevyrewi* is present in North America in areas with a similar climate than the EPPO region. It is native to part of the EPPO region but has not spread to the Western part of the region. Elms are widely used as ornamentals, and also in shelterbelt and windbreak plantings, and veneer quality lumber. There are some native *Ulmus* species in the EPPO region. *Prunus* spp. are widespread in th wild or in cultivation (including for fruit and as ornamentals). In particular the known hosts *P. armeniaca* and *P. dulcis*, as well as *P. persica* (*P. ferganiana* is a subsp. of *P. persica*) are widely grown commercially in the southern part of the EPPO region, and are present elsewhere as ornamentals.

Potential impact (including consideration of host plants)

Ulmus species are valuable forest and ornamental trees in the EPPO region. *S. schevyrewi* can cause mortality of elms, some European elms species are reported as hosts and the pest attacked new elm species when it was introduced into the USA. *S. schevyrewi* presents a higher risk for stressed elm trees, but it is likely that there are drought-stressed elm trees in cities in parts of the region, as there are in North America The role that *S. schevyrewi* would have in the EPPO region with regards to the transmission of Dutch elm disease is not clear, and would depend on the elm species attacked and its interactions with existing vector species (mainly *S. scolytus*, but also *S. multistriatus* and *S. pygmaeus*). However, even as secondary pest, *S. schevyrewi* is still potentially capable of causing significant damage and mortality to elms (as reported from China). *Prunus* are economically, environmentally and socially important in the EPPO region, and damage to *Prunus*, in particular the known hosts commercially grown for fruit, would increase impact. Finally, if the host range includes other species for which there are old reports, this would also add to the potential impact.

Table 1. Distribution

	Reference	**Comments**
EPPO region		
- Kazakhstan, Kyrgyzstan, Russia (Eastern Siberia, Far-East), Tajikistan, Uzbekistan - Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan, East Siberia *(*Pribaikalje, Zabaikalje), Far East (Primorje) - also Kazakhstan, East Siberia (Irkutsk region), West Siberia (Altai) - West Siberia (Krasnoairsk Territory) *Unconfirmed record*: SE European Russia	- EPPO Global Database - Stark, 1952 - Lafer *et al.*, 1996 - Akulov and Mandelshtam, 2012 - Burdaev, 2003	- First record in 2008, South of the territory - in Samara. considered uncertain because it is referring to an unpublished finding (collector, date and place missing)
Asia		
China: Hebei, Heilongjiang, Henan, Ningxia, Qinghai, Shaanxi, Xinjiang	EPPO Global Database	
Korea Dem. Rep.	EPPO Global Database	
Korea Rep.	EPPO Global Database	
Mongolia	EPPO Global Database	
Turkmenistan	EPPO Global Database	
North America		
Canada - Alberta, Manitoba, Ontario, Saskatchewan - British Columbia	- EPPO Global Database - Humble *et al.*, 2010	- First in Alberta in 2006 (Veuilleux, 2012, citing others) - First report in 2010
Mexico	Campos-Bolaños *et al.*, 2015	
USA: Arizona, California, Colorado, Connecticut, Delaware, Idaho, Illinois, Indiana, Kansas, Maryland, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Jersey, New Mexico, North Dakota,	EPPO Global Database	First trapped in 2003 (Colorado, Utah), but present for several years (specimens in collections collected 1994, 1998, and 2000 in Colorado, New Mexico, and

	Reference	Comments
Ohio, Oklahoma, Oregon, Pennsylvania, South Dakota, Texas, Utah, Virginia, Washington, Wyoming		Oklahoma, respectively – Negrón, 2005). First trapped in California in 2002 (Seybold *et al.*, 2016).

Table 2. Hosts
All host records are from Negrón *et al.* (2005, citing others), except * Lafer *et al.*, 1996, **Zhu, 2017 and [#]Zhong *et al*. 2018 (the latter mentions laboratory and field experiments, but only the English abstract was used, which does not indicate if some species are experimental hosts only).

Family	Genus/Species
Ulmaceae	*Ulmus americana*
Ulmaceae	*Ulmus davidiana* var. *japonica* (*U. japonica*, *U. propinqua*)
Ulmaceae	*Ulmus laevis*
Ulmaceae	*Ulmus macrocarpa*
Ulmaceae	*Ulmus minor* (*U. carpinifolia*)
Ulmaceae	*Ulmus procera*
Ulmaceae	*Ulmus pumila*
Ulmaceae	*Ulmus thomasii*
Ulmaceae	*Ulmus* sp.
Fabaceae	*Caragana arborescens**
Fabaceae	*Caragana korshinskii*
Fabaceae	*Caragana* spp.
Elaeagnaceae	*Elaeagnus*
Elaeagnaceae	*Elaeagnus angustifolia*
Rosaceae	*Malus pumila*
Rosaceae	*Prunus dulcis* (*P. amygdalus*)
Rosaceae	*Prunus armeniaca#***
Rosaceae	*Prunus armeniaca* var. *ansu* (*P. ansu*)
Rosaceae	*Prunus dulcis#* (as *Amygdalus communis*)
Rosaceae	*Prunus ferganensis#* (*P. persica* subsp. *ferganensis*) (as *Amygdalus ferganensis*)
Rosaceae	*Prunus glandulosa*

Family	Genus/Species
Rosaceae	*Prunus padus* (*P. germanica*)
Rosaceae	*Prunus persica*
Rosaceae	*Prunus pseudocerasus*
Rosaceae	*Prunus salicina*
Rosaceae	*Prunus yedoensis*
Rosaceae	*Pyrus* x *bretschneideri*
Rosaceae	*Pyrus* sp.
Salicaceae	*Salix babylonica*
Salicaceae	*Salix* spp.

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