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
Ambrosia beetle

CNESTUS MUTILATUS (COLEOPTERA: SCOLYTINAE)
camphor shot borer, sweetgum ambrosia beetle

EPPO Lists: Not listed. 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
Cnestus mutilatus (Blandford 1894). Synonyms: *Xylosandrus mutilatus* (Blandford 1894); *Xyleborus mutilatus* Blandford 1894; *Xyleborus sampsoni* Eggers 1930; *Xyleborus banjoewangi* Schedl 1939; *Xyleborus taitonus* Eggers 1939.

Associated fungi
In Japan, *Ambrosiella* sp. (as an obligatory symbiont), *Paecilomyces* sp. and *Candida* sp. were found associated (Kajimura and Hijii, 1992), but were not fully described. *Ambrosiella beaveri* was described as the main symbiont in the USA (Six *et al.*, 2009), and other fungi were also found: *Geosmithia lavendula*, *G. obscura* (in two beetles) and *Candida homilentoma*. *G. lavendula* was previously reported as a laboratory air contaminant and an elm bark beetle associate in the USA, and in association with bark beetles in the Mediterranean area; *G. obscura* had been reported only from *Scolytus* in Europe (Six *et al.*, 2009). None of these fungi have been reported as being pathogenic.

Morphology and biology
Adults are relatively large for an ambrosia beetle, with females measuring 3.5-4 mm. In Nagoya (Central Honshu, Japan), *C. mutilatus* was found to be univoltine (Kajimura and Hijii, 1992), but Oliver *et al.* (2012) state that there may be more generations in Southern USA. Development from egg to callow adults takes 4-5 weeks. *C. mutilatus* is an inbreeder with a sibling-mating system (Kajimura and Hijii, 1992). In addition, female ambrosia beetles are able to lay eggs and produce brood even if they have not copulated and are not fertilized (parthenogenesis).

C. mutilatus appears to prefer host material that recently died (Kajimura and Hijii 1992, 1994; Schiefer and Bright, 2004 citing articles relating to Asia; Stone *et al.*, 2007). In Asian literature, it has sometimes been mentioned as a pest in crops (see *Known impact*), suggesting attacks on live plants. In Mississippi, attacks on live stressed plants were observed on *Acer saccharum*, *Ostrya virginiana* and *Cornus florida*, as well as one case of attack on healthy potted *Quercus shumardii* (ca. 3 m tall) in a nursery in Alabama (Stone *et al.*, 2007, citing others).

C. mutilatus attacks branches and stems. For example, attacks on stems were observed on a stressed *Liquidambar styraciflua* (Stone *et al.*, 2007). Despite its relatively 'large' size, *C. mutilatus* has been observed to prefer material of a small diameter (Schiefer and Bright, 2004), such as branches and the upper part of tree trunks (Stone *et al.*, 2007; Werle, 2016). Kajimura and Hijii (1992) established colonies by felling trees 1-5 cm in diameter. Stone *et al.* (2007) observed few successful attacks when the stem diameter at the point of attack was 3 cm or greater. In China, authors (Tang, 2000) stated that attacks occurred on parts of the branch having a diameter of 1.2 to 2.5 cm. In Louisiana, *C. mutilatus* was found associated with dead twigs (Ferro and Nguyen, 2016). *C. mutilatus* tunnels galleries into the xylem (Kajimura and Hijii, 1992).

Spread biology
No details were found. Oliver *et al.* (2012) mention that *C. mutilatus* has been 'reported to be a strong flyer' (details are not given). The spread in the USA appears to have been rapid since the first known specimens were collected in 1999 in Mississippi, and presumably were due in part to natural spread.

Nature of the damage
The major damage is due to tunnelling by the females, which may weaken the structural integrity of the host (Oliver *et al.*, 2012).

Detection and identification

- *Symptoms*. Plants may show leaf wilting, sawdust on branches or at the base of trees, circular entry holes (2 mm), sap oozing near sites of attacks, branch dieback, and eventually tree death (Oliver *et al.*, 2012).
- *Trapping*. *C. mutilatus* is attracted to ethanol, and trap logs baited with ethanol were effective in capturing these beetles (Coyle *et al.*, 2015). Conophothrin, which enhances captures of some other species if added to ethanol, decreased captures of *C. mutilatus* (Miller *et al.*, 2015).
- *Identification*. Adult morphology is described in Schiefer and Bright (2004). *C. mutilatus* is easily distinguished from other Xyleborini (details provided in Gomez *et al*., 2018).

Distribution (see Table1)
C. mutilatus is native to Asia (Olatinwo *et al.*, 2014 citing others) and has been introduced into the USA. In the USA, it was first reported from Mississippi in 2002, but specimens collected in 1999 in the same State were later found (Haack, 2006). It has then spread throughout the South-East, and possibly further North, according to some recent records considered uncertain in Table 1. In any case, *C. mutilatus* appears to be in the process of a rapid range expansion across South-East USA; in South Carolina, few individuals were first collected in 2010 and increased capture rates were observed from 2011 to 2013, with hundreds of individuals (Coyle *et al.*, 2015). *C. mutilatus* has not been reported in the EPPO region.

Host plants (see Table 2)
C. mutilatus is polyphagous and has been recorded from 20 host families worldwide, including in new species and families during studies in Mississippi, USA (Hamamelidaceae, Magnoliaceae, Pinaceae, Rosaceae, Ulmaceae and Vitaceae). It appears to have low host specificity (Stone *et al.*, 2007). Its host range includes temperate deciduous genera, such as *Acer*, *Castanea*, *Juglans*, *Prunus* or *Quercus*. The known host species are used mostly for ornamental purposes in the EPPO region.

Known impacts and control in current distribution
China appears to provide the only record of major impact worldwide repeated in recent US sources, as a major pest of young *Castanea mollissima* in Zhejiang, attacking trunks and branches (e.g. Six *et al.*, 2009, Beaver *et al.*, 2014, Stone *et al.* 2005, all citing Tang, J. Zhejiang Forestry College, 17 (2000) 417-420). The Chinese literature could not be fully exploited here for language reasons, but the following records found in Internet searches (abstracts in Chinese) also point to *C. mutilatus* being a pest in China: serious pest of chestnut in Qianshan county (Anhui province) (Zhang, 2009), considered presenting a high risk to eucalyptus in Guangxi (alongside others such as *Anoplophora glabripennis*; Huang *et al.*, 2013), covered in a study on attractants to monitor main pests of forest trees in Zhejiang (Mou *et al.*, 2007), among the bark beetles of Guizhou fruit trees (Luo *et al.*, 1986).

In Japan, Kajimura and Hijii (1992) reported attacks on dead material, and no recent reference to attacks on live plants was found. It has been reported as an 'injurious insect' as camphor shoot-borer (details were not available - Shiraki, 1952 cited in Schiefer and Bright, 2004).

In the Korean Republic, *C. mutilatus* was the most abundant species in a study on the wood-boring and bark beetle community in monoculture plantations of white pines (*Pinus koraiensis*). It is a native species that has not caused outbreaks. However, the authors concluded that it should be considered a potential pest and, in the context of climate change, a threat to Korean white pine forest health (Choi *et al.*, 2017).

Referring to Asia, Ebeling (1959 cited in Schiefer and Bright, 2004) listed *C. mutilatus* as a minor pest of avocado.

In the USA, concerns are expressed in the literature that *C. mutilatus* has not expressed its full potential for damage and that its importance could increase in the future: it has been introduced only recently, but it has spread considerably since its introduction, it has a broad host range of native and ornamental plants, and is closely related to other *Xylosandrus* species, such as *X. compactus*, *X. crassiusculus*, *X. germanus* or *X. saxeni*, which have emerged as pests of nurseries or ornamental trees plantations (e.g. Schiefer and Bright, 2004; Reding *et al.*, 2017; Klingeman *et al.*, 2017). In Tennessee, the potential impact of *C. mutilatus* was still unknown, but its affinity for small diameter stems increases concerns that it could become a significant economic and aesthetic pest of trees in nurseries and the landscape. Even if plants survive, their value will be reduced. Attacks on trees in containers used in research experiments were observed, and *C. mutilatus* also attacked *Liquidambar styraciflua* in a nursery (stressed plants, under-watered and in a substrate with insufficient air) (Oliver *et al.*, 2012). Considering its abundance in areas where it is well established, *C. mutilatus* was considered likely to have an impact on forest ecosystems in Eastern USA (Schiefer and Bright, 2004; Olatinwo *et al.*, 2014).

In Louisiana, unusual damage was observed, thought to be the first record of a Scolytinae attacking non-plant material, where large numbers of borings by females of *C. mutilatus* were observed on several plastic gasoline storage containers (containing gasoline with a 10% ethanol component, to which females were presumably attracted) (Carlton and Bayless, 2011).

Control: Little is known about insecticide management of the pest. Destroying infested plants and injured and unsalable nursery stock will reduce emergence at the nurseries and also lessen human-assisted spread; trees that are adapted to the site should be used, and good cultural practices should promote plant vigour and reduce stress (Oliver *et al.*, 2012). Reding *et al.* (2017) found that *C. mutilatus* and other ambrosia beetle species were attracted to ethanol-injected trap trees, and suggested that such trees might be used to attract ambrosia beetles, for example in the context of monitoring or push-pull strategies (i.e. strategies using repellents to push a pest away from vulnerable plants and attractants to pull it into traps or trap-plants – Cook *et al.*, 2007; Ranger *et al.*, 2016).

POTENTIAL RISKS FOR THE EPPO REGION

Pathways

Entry

C. mutilatus had not been intercepted in the USA prior to its introduction (Haack *et al.*, 2006). Life stages are associated with the xylem. *C. mutilatus* has a preference for small diameter material (twigs to branches or stems of a few cm diameter - see *Pest overview*), which may limit its association with wood commodities to those that include whole trees or harvesting residues (which may contain small-diameter material). It is not known if such material would be traded internationally, and whether such wood could be used for commodities such as firewood (as round wood), wood chips, hogwood, processing wood residues or wood packaging material. In addition, processing 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 may not be able to sustain development of the pest. Bark on its own is an unlikely pathway.

C. mutilatus has sometimes been observed on nursery trees. Plants for planting may be a pathway, although they are subject to a degree of control during production, during which attacked plants may be detected and discarded. Cut branches are a less likely pathway, as they are normally used indoors, and the pest is unlikely to be able to transfer to a suitable host. It is also not known if there is a trade of any species to which *C. mutilatus* may be associated.

Finally, *C. mutilatus* is an inbreeder and the females are parthenogenetic, both of which is favourable for successful entry and establishment.

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

- *plants for planting (except seeds) of hosts*
- *wood (round or sawn, with or without bark, incl. 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*
- *cut branches of hosts?*

Pathways may also cover the known coniferous hosts.

Spread (following introduction, i.e. within EPPO region)
No data is available on the natural spread of *C. mutilatus*. *C. mutilatus* is known to have spread considerably in the USA in the past twenty years, but it is not known if this was due to natural spread or human-assisted pathways. In the EPPO region, it may spread naturally and through human-assisted pathways. Human-assisted pathway may help in creating multiple foci in the EPPO region, if introduced, from which local spread could occur.

Establishment
Based on the climate classification of Köppen Geiger (see Annex 6 of the study), *C. mutilatus* currently occurs mostly in one climate type that is also present in the EPPO region: Cfa[1], which is dominant in the largest part of its USA distribution. In the EPPO region, this climate type is present in areas such as the Black Sea, Northern Italy and part of the Balkans. In addition, *C. mutilatus* is possibly also present in the climate types Cfb and Dfb[1] (these climates occur in regions where the pest is recorded, but they cover only a small part of these areas, and it is not known if the pest occurs in these areas). In the EPPO region, this extends the area potentially suitable from a climatic point of view to Western and Central Europe and around the Black Sea (Cfb), and northwards and eastwards into the south of Scandinavia and Russia (as well as in Far-East Russia) (Dfb).
The host list does not include major native species from the EPPO region, but many temperate genera which are present in the wild, and used in forests, as crops or as ornamentals in the EPPO region (see *Host plants* above and in Table 2). *C. mutilatus* appears to have low host specificity and was found attacking new species and families in the USA. Thus, it would probably find some hosts that are appropriate for growing its symbiont fungi in the EPPO region.
Given the suitable ecological conditions, at least in some parts of the EPPO region, *C. mutilatus* has the potential to establish.

Potential impact (including consideration of host plants)
The potential impact would depend on the plant species attacked, on how far north it is able to establish and on the number of generations in warmer locations. Because small-diameter material is preferred, the main concern, as for the USA, possibly relates to small plants, such as in nurseries or landscape. If *C. mutilatus* reached in the EPPO region similar abundance as in the USA, this may raise concerns for forest ecosystems, as in the USA. In particular, it may hamper forest regeneration by attacking small plants, although there is no evidence of this to date.

Table 1. Distribution

	Reference	**Comments**
EPPO region		
Absent		
Asia		
China: -Anhui, Sichuan, Yunnan, Zhejiang -*Uncertain records*: Guizou, Guangxi	-Dole and Cognato, 2010	

[1] **Cfa**: warm temperate climate, fully humid, hot summer; **Cfb**: warm temperate climate, fully humid, warm summer; **Dfb**: snow climate, fully humid, warm summer.

	Reference	**Comments**
	- Huang *et al.*, 2013; Luo *et al.*, 1986	- obtained from Google translation from Chinese, not verified
India (Andaman Isl., Assam)	Dole and Cognato, 2010	
Indonesia	Dole and Cognato, 2010	
Japan	Dole and Cognato, 2010	
Korea	Dole and Cognato, 2010	
Malaysia	Dole and Cognato, 2010	
Myanmar	Dole and Cognato, 2010	
Sri Lanka	Dole and Cognato, 2010	
Taiwan	Dole and Cognato, 2010	
Thailand	Dole and Cognato, 2010	
North America		
United States		Introduced
- Florida, Mississippi	- Schiefer and Bright, 2004	- Mississippi: first found 1999
- Texas	- Cognato *et al.*, 2006	- first found 2005
- Alabama, Arkansas, Georgia, Louisiana, North Carolina	- Ghandi *et al.*, 2009	
- Tennessee	- Oliver *et al.*, 2012	- first found in 2008
- South Carolina	- Chong *et al.*, 2012	
- Kentucky	- Leavengood, 2013	
- Pennsylvania	- Gomez *et al.*, 2018	
- *Uncertain records*: Delaware, Illinois, Indiana, Maryland, Missouri, New Jersey, Ohio, Virginia, West Virginia	- Atkinson *et al.*, 2018	- considered uncertain, because based on unpublished records
Oceania		
New Guinea	Dole and Cognato, 2010	

Table 2. Hosts.
*Some records in Oliver *et al.* (2012) and Reding *et al.* (2007) refer to plants attacked after injection with ethanol

Family	**Genus/Species**	**Reference**
Altingiaceae	*Liquidambar styraciflua*	Oliver *et al.*, 2012
Arecaceae	*Calamus* spp.	Oliver *et al.*, 2012
Betulaceae	*Carpinus laxiflora*	Oliver *et al.*, 2012
Betulaceae	*Ostrya virginiana*	Oliver *et al.*, 2012
Cornaceae	*Cornus* spp.	Oliver *et al.*, 2012
Cornaceae	*Cornus florida*	Oliver *et al.*, 2012
Fabaceae	*Albizia* spp.	Oliver *et al.*, 2012
Fabaceae	*Cercis canadensis*	Werle, 2016
Fabaceae	*Ormosia hosiei*	Oliver *et al.*, 2012
Fagaceae	*Castanea* spp.	Oliver *et al.*, 2012
Fagaceae	*Castanea mollissima*	Oliver *et al.*, 2012
Fagaceae	*Fagus crenata*	Oliver *et al.*, 2012
Fagaceae	*Fagus grandifolia*	Oliver *et al.*, 2012
Fagaceae	*Quercus alba**	Oliver *et al.*, 2012
Fagaceae	*Quercus shumardii*	Oliver *et al.*, 2012
Juglandaceae	*Carya* spp.	Oliver *et al.*, 2012
Juglandaceae	*Juglans nigra**	Oliver *et al.*, 2012
Juglandaceae	*Platycarya strobilacea*	Oliver *et al.*, 2012
Lauraceae	*Benzoin* spp.	Oliver *et al.*, 2012
Lauraceae	*Cinnamomum camphora*	Oliver *et al.*, 2012
Lauraceae	*Lindera erythrocarpa*	Oliver *et al.*, 2012
Lauraceae	*Lindera (Parabenzoin) praecox*	Oliver *et al.*, 2012
Lauraceae	*Lindera triloba*	Oliver *et al.*, 2012
Lauraceae	*Persea thunbergii*	Oliver *et al.*, 2012

Family	Genus/Species	Reference
Magnoliaceae	*Liriodendron tulipifera**	Oliver *et al.*, 2012
Magnoliaceae	*Magnolia virginiana**	Oliver *et al.*, 2012
Meliaceae	*Melia azedarach*	Oliver *et al.*, 2012
Meliaceae	*Swietenia macrophylla*	Oliver *et al.*, 2012
Oleaceae	*Osmanthus fragrans*	Oliver *et al.*, 2012
Pinaceae	*Pinus taeda*	Oliver *et al.*, 2012
Proteaceae	*Grevillea robusta*	Oliver *et al.*, 2012
Rosaceae	*Prunus americana*	Oliver *et al.*, 2012
Rosaceae	*Prunus serotina*	Oliver *et al.*, 2012
Rosaceae	*Pyrus calleryana**	Reding *et al.*, 2007
Sapindaceae	*Acer* spp.	Oliver *et al.*, 2012
Sapindaceae	*Acer rubrum*	Oliver *et al.*, 2012
Sapindaceae	*Acer palmatum*	Oliver *et al.*, 2012
Sapindaceae	*Acer saccharum*	Oliver *et al.*, 2012
Sapindaceae	*Acer sieboldianum*	Oliver *et al.*, 2012
Sapindaceae	*Koelreuteria paniculata**	Oliver *et al.*, 2012
Taxodiaceae	*Cryptomeria japonica*	Oliver *et al.*, 2012
Theaceae	*Camellia* spp.	Oliver *et al.*, 2012
Ulmaceae	*Ulmus alata*	Oliver *et al.*, 2012
Vitaceae	*Vitis rotundifolia*	Oliver *et al.*, 2012

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