Department for Environment Food & Rural Affairs

Rapid Pest Risk Analysis (PRA) for:

Agrilus horni

June 2021

Summary and conclusions of the rapid PRA

Agrilus horni (Coleoptera: Buprestidae) or aspen root girdler is a phytophagous jewel beetle. It is only found in North America (USA and Canada), where it injures species of young *Populus* suckers found in sparse stands; some of the susceptible *Populus* species are present in the UK. All potential pathways of entry have been assessed as unlikely or very unlikely, but, if it arrived in the PRA area, this beetle would be likely to establish. All potential impacts are assessed as small, albeit with low confidence. This is because there is a possibility that *Populus* species present in the UK that this beetle has not encountered might yet prove to be more susceptible, since *Agrilus* species can sometimes be very damaging to novel hosts. Test planting and nurseries of *Populus* trees are most at risk.

This rapid PRA shows:

Risk of entry

The risk of most potential pathways of entry were assessed as unlikely, with plants for planting and waste wood being very unlikely. *Populus* **plants for planting** are prohibited pending risk assessment. Even if a risk assessment were performed and imports allowed, they would still need to be checked for other pests, so damage caused by *A. horni* would likely be noticed. Furthermore, between 2016 and 2020 there were no imports of *Populus* plants for planting from USA or Canada. Therefore, this pathway was scored as very unlikely

with high confidence. Given that the available literature suggests that *A. horni* only exploits young *Populus* suckers, all **wood pathways** (fuelwood, sawn and rough wood) of entry are also unlikely, as young suckers have too small a diameter to be used for wood. However, confidence was rated low for fuelwood and sawn wood and medium for rough wood, as we cannot completely discard the possibility that *A. horni* might also exploit older *Populus* trees, since literature on this beetle is scarce. As most **wood waste** will be a result of wood manufacturing processes, mostly from larger trees, this pathway was also considered very unlikely, albeit with low confidence. *Populus* wood from young stems could be part of **woodchip** imports, and some *A. horni* may survive this pathway. There has been low-level trade of woodchips between the USA and Canada and the UK in the last six years. As such, this pathway was considered unlikely with medium confidence. Finally, **wood packaging material (WPM)** would only pose a risk if this beetle could exploit older *Populus* trees, but, even in that case, if the WPM is ISPM 15 compliant, the likelihood should be low. It was rated as very unlikely with high confidence.

Risk of establishment

Outdoor establishment in the UK is assessed as likely with medium confidence because this species seems to perform well in a variety of different climates. It is very unlikely to establish in protected cultivation because the hosts are not grown there.

Economic, environmental and social impact

All impacts have been rated as small, with low confidence. This is because, even if impacts in its native range are small, *Agrilus* beetles that are introduced to a new area can, in some cases, prove to be a lot more damaging to new, naïve hosts. In the UK, there are several *Populus* species that could serve as new potential hosts for *A. horni* and might prove to suffer heavier infestations, so mortality rates could be higher than estimated. *Populus* nurseries, young plantations and test plantings are the most likely to be affected by this pest, as this is the only issue that has been reported in the beetle's native range.

Endangered area

Experimental test plantings and nurseries of *Populus* trees are most at risk, as well as sites where clonal growth is common or where young *Populus* trees might be planted (e.g., as windbreaks).

Risk management options

Continued exclusion is the preferred management option. If *A. horni* can only use young *Populus* suckers – as the literature suggests – the only possible pathways of entry would be plants for planting and woodchips. *Populus* plants for planting are currently prohibited and would need to be checked for other pests in order to be imported, so damage caused by *A. horni* would likely also be noticed. There has been low-level trade in woodchip from the USA and Canada in the last six years. Specifying that *Populus* plants and woodchip come from

a pest free area – the main risk management option for other *Agrilus* species of concern – might not be easily viable, since this pest might be under-recorded in its native range.

If *A. horni* did enter the PRA area, measures for detection and containment could be put into place, like felling and removal of infested and nearby suckers or surveillance for symptoms and *Agrilus* adults, especially in test plantings or other areas with a high proportion of young suckers. Containment measures, such as preventing the movement of wood or live trees from infested areas, might prevent human-assisted spread.

Key uncertainties and topics that would benefit from further investigation

The **key issue is to determine whether this pest is**, as the available literature suggests, **only able to infest young *Populus* suckers** or whether it can also attack older trees in some cases. It would also be beneficial:

- To determine the current distribution of this buprestid in its native range.
- To determine its current population levels in its native range.
- To know whether this beetle is still causing mortality of young *Populus* stands in North America and to what extent.

Finally, there is also great uncertainty regarding whether *A. horni* might prove to be more damaging to the *Populus* species present in the UK that it has not encountered yet.

Images of the pest

A)

B)

C)

A) *Agrilus horni* (aspen root girdler) larval galleries © Mike Ostry, USDA Forest Service, Bugwood.org
B) *Agrilus anxius* © John A. Davidson, Univ. Md, College Pk, Bugwood.org

C) Spiral bark swelling due to aspen root girdler © Mike Ostry, USDA Forest Service, bugwood.org

Is there a need for a detailed PRA or for a more detailed analysis of particular sections of the PRA? If yes, select the PRA area (UK or EPPO) and the PRA scheme (UK or EPPO) to be used.

No	✓				
Yes		PRA area: UK or EPPO		PRA scheme: UK or EPPO	

Given the information assembled within the time scale required, is statutory action considered appropriate / justified?

Yes Statutory action	✓	No Statutory action	

The PRA concludes that statutory action against this pest is appropriate, and that continued exclusion of the pest would be the preferred management option.

Stage 1: Initiation

1. What is the name of the pest?

Agrilus horni Kerremans, 1900 (Coleoptera: Buprestidae), a phytophagous jewel beetle also known as the aspen root girdler. It has one known synonym, *Agrilus blanchardi* (Bellamy, 2020; ITIS, 2021). It is similar to other *Agrilus* species from the *Agrilus anxius* species group (*A. anxius*, *A. pensus*, *A. granulatus* and *A. quadriguttatus*), particularly *A. anxius* (Nord *et al.*, 1965; Paiero *et al.*, 2012).

Kerremans (1914) and Théry (1904) incorrectly used the name *A. horni* for other species of *Agrilus* (*A. acastus* and *A. horniellus*, respectively). The host plant of both these species is unknown. As such, these usages of the name – which have not been used in recent literature other than to state that they are synonyms – should not be confused with *A. horni* as currently accepted and used in this PRA.

2. What initiated this rapid PRA?

Agrilus horni was selected for PRA in a Norwegian commodity risk assessment of deciduous woodchip from eastern North America and was ranked the 5th out of ten assessed insects in terms of risk (Sundheim *et al.*, 2013). Several *Populus* (i.e., poplar and aspen) species can host this pest, including some that are present in the UK (Nord *et al.*, 1965). The need for a rapid PRA was identified during Plant Health Risk Group when discussing its addition to the Plant Health Risk Register in November 2019 to better establish the level of risk to the UK.

3. What is the PRA area?

The PRA area is the United Kingdom of Great Britain and Northern Ireland.

Stage 2: Risk Assessment

4. What is the pest's status in the plant health legislation, and in the lists of EPPO[1]?

The legislation for Great Britain is The Plant Health (Phytosanitary Conditions) (Amendment) (EU Exit) Regulations 2020[2]. The legislation which applies to Northern Ireland is the EU legislation: 2019/2072 and 2016/2031[3]. *Agrilus horni* does not appear in either set of legislation. This pest is not on either the EPPO A1 or A2 list, nor is it on the EPPO Alert List.

5. What is the pest's current geographical distribution?

Agrilus horni is native to North America and has not been reported outside its native range. In Canada, it is present from Ontario to Manitoba, and in the US, it has been recorded from Massachusetts to South Dakota and in the east to Arizona (**Table 1**) (Bright, 1987; Nord *et al.*, 1965). It should be noted that most of the available records for this pest are from over 40 years ago. There are currently 11 occurrences on GBIF (Global Biodiversity Information Facility), only one of which dates from after the year 2000 (GBIF, 2021). This indicates that, although fairly widespread, this beetle is relatively rare and/or understudied.

Table 1: Distribution of *Agrilus horni*	
North America:	It is native to North America, being present in the USA and Canada. Canada (Bright, 1987; Nord *et al.*, 1965): Manitoba and Ontario† and Quebec. USA (Nord *et al.*, 1965; Bohne *et al.*, 2019; GBIF, 2021): Arizona†, Iowa†, Massachusetts, Michigan, Minnesota, New York†, Pennsylvania†, Rhode Island South Dakota† and Wisconsin. †Identifications from preserved specimens in National Collections.
Central America:	No records.
South America:	No records.
Europe:	No records.
Africa:	No records.
Asia:	No records.
Oceania:	No records.

[1] https://www.eppo.int/ACTIVITIES/quarantine_activities

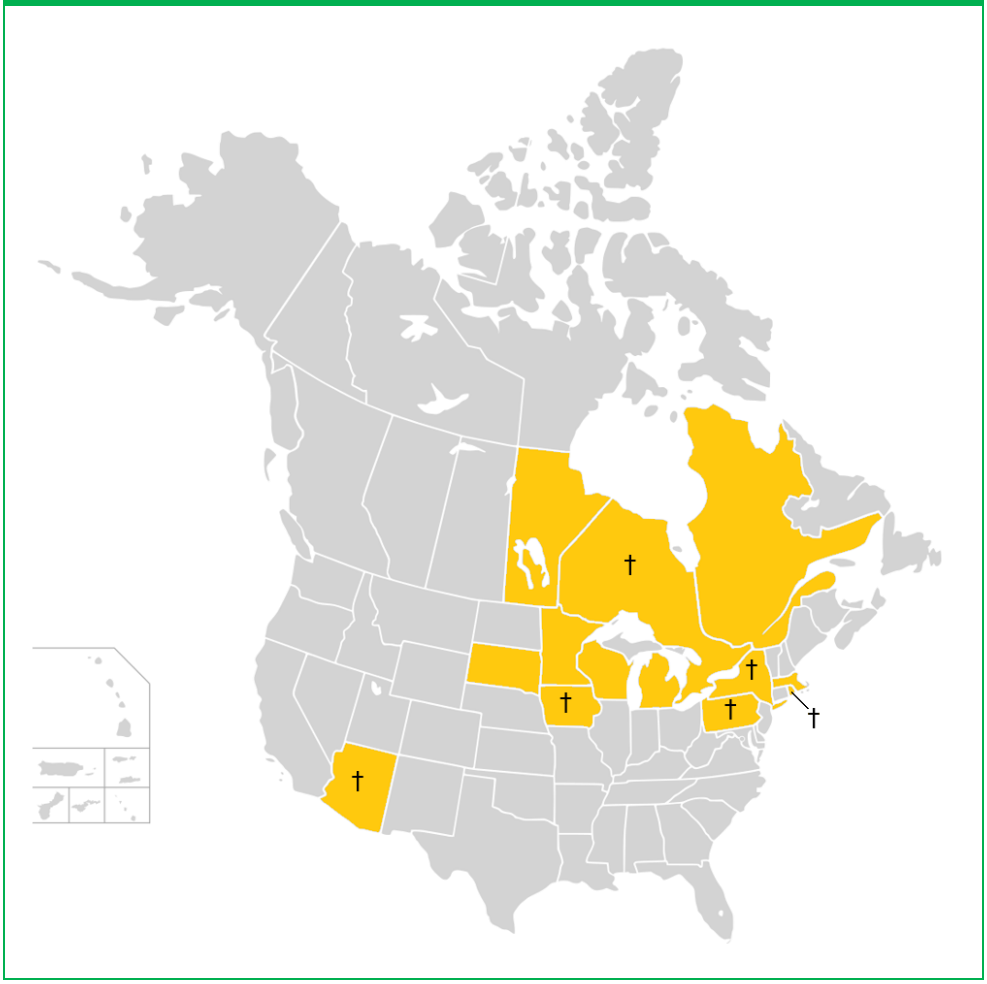
[2] https://www.legislation.gov.uk/uksi/2020/1527/contents/made

[3] The latest consolidated versions can be accessed via a search on https://eur-lex.europa.eu/

Status in Arizona: Nord *et al*. (1965) state that *A. horni* "has also been identified in the U.S. National Museum Collections from northern Arizona". Later published papers (Bright, 1987; Solomon, 1995) state that this beetle is present in Arizona, either with no reference to the source of the information or with reference to Nord *et al*. (1965) and Carlson & Knight (1969) – which is not accessible. The status of this pest in Arizona is therefore unclear.

Figure 1: Recorded distribution of *Agrilus horni* in North America

Map based on information compiled from Nord *et al.* (1965), Bright (1987), Bohne *et al.* (2019) and GBIF (2021). †Identifications from preserved specimens in National Collections.



6. Is the pest established or transient, or suspected to be established/transient in the UK/PRA Area?

There are no records of this species in the UK, and it has not been intercepted.

7. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK/PRA area?

Agrilus horni has only been reported to utilise young *Populus* suckers. Known hosts include:

- North American trembling aspen (*Populus tremuloides*) – reported as main host (Solomon, 1995; Baker, 1972).
- Big-tooth aspen (*P. grandidentata*) – can be "severely damaged" (Bright, 1987).
- Balsam poplar (*P. balsamifera*) (Nord *et al.*, 1965; Bright, 1987).
- Aspen hybrids – although there is no indication of which particular species (Nord *et al.*, 1965; Benson & Einspahr, 1967). Nord *et al.* (1965) state that they suffer "heavy infestations".
- Eurasian white poplar (*P. alba*) and European quaking aspen (*P. tremula*) (Nord *et al.*, 1965; Benson & Einspahr, 1967) – Nord *et al.* (1965) note that they suffer "heavy infestations".

Of note, Jendek & Polakova (2014), who carried out a critical review of the literature on *Agrilus* host plants, consider *P. tremuloides*, *P. grandidentata*, *P. alba* and *P. tremula* to be the only hosts for which there are reliable larval host records (i.e., they exclude *P. balsamifera*).

Populus species are widespread in the PRA area, both in forests and as amenity trees. They are pioneer species, and many are planted as windbreaks, in screens or plantations. Most do sucker (i.e., shoots will grow from the base of the tree and give rise to a new clonal tree), but some do not. Species present include *P. balsamifera*, *P. alba* and *P. tremula*, as well as other *Populus* species – which could be new potential hosts – such as *P. nigra* or *P. tristis* (BSBI, 2021) (**Table 2**). White poplar (*P. alba*) is a naturalised tree, widely distributed across Britain and that can be used as a coastal windbreaker (Jobling, 1990) but that is rarely found in plantations. In the UK, the Eastern balsam poplar (*P. balsamifera*) has been planted in parks, gardens and amenity woodlands, but it has grown less well than other poplars (Jobling, 1990). The native European aspen (*P. tremula*), although distributed all throughout Britain, is most common in north and west Scotland (Jobling, 1990; Cosgrove *et al.*, 2005). It mainly occurs in isolated stands of a few trees (Cosgrove *et al.*, 2005) and is common in oak and birch, and sometimes pine, woodlands (Jobling, 1990). In large areas of Scotland, aspen is considered a key species for current and future planting and, where viable, encouraging natural regeneration. Aspen forms important associations as part of a range of iconic and species-rich native woodland habitats. Historic aspen populations were particularly severely impacted by felling and over browsing. Current and future prospects for the species are hampered by good seed production from existing, remnant, aspen stands not being a regular occurrence (Patrick Robertson, Scottish Forestry, pers comm. 2021). The native black poplar (*P. nigra*), once a common tree in southern Britain, is now considered to be the rarest native timber tree in the UK (Milne-Redhead, 1990), with a

heavily male-skewed population of 7,000 surviving trees estimated in 2002 (Cooper *et al.*, 2002). It presents many fastigiate cultivars and is usually grown as an amenity tree in parks (Cottrell, 2004). Other non-native *Populus* species and hybrids, such as the Western balsam poplar (*P. tristis*) or the grey poplar (*P.* × *canescens*), are also present in the UK (BSBI, 2021) (**Table 2**). Some, like *P.* × *canadensis* and *P.* × 'Balsam Spire' are grown in plantations (BRC, 2021). Finally, other *Populus* species are also available. For example, the RHS currently has 5 suppliers for the Chinese necklace poplar (*P. lasiocarpa*).

Table 2: Known and notable potential hosts of *Agrilus horni* present in the PRA area. Information on UK distribution and native status retrieved from BSBI (2021).

Taxon name	Vernacular	Known host?	UK native?	Sucker?
Populus alba L.	White poplar	yes	non-native	yes
P. balsamifera L.	Eastern balsam poplar	yes	non-native	yes
P. tremula L.	European quaking aspen	yes	native	yes
P. nigra L.	Black poplar	no	native	yes
P. tristis Fish. (= *P. trichocarpa*)	Western balsam poplar	no	non-native	yes
P. × *canescens* (Aiton) Sm. (*P. alba* × *tremula*)	Grey poplar	no	non-native	yes
P. × *jackii* Sarg. (*P. balsamifera* × *deltoides*)	Balm of Gilead	no	non-native	yes
P. × canadensis Moench (*P. deltoides* × *nigra*)	Canadian poplar	no	non-native	yes
P. × 'Balsam Spire' (*P. balsamifera* × *tristis*)	Hybrid balsam poplar	no	non-native	no
P. × *generosa* *(P. deltoides x trichocarpa)*	Generous poplar	no	non-native	no

8. Summary of pest biology and/or lifecycle

Life cycle

Agrilus horni adults present a green coppery colour and are 6.5-11 mm long (Baker, 1972). They have been reported to emerge between late May and June (Nord *et al.*, 1965) and will feed on leaves for three weeks before oviposition (Solomon, 1995). Unlike most *Agrilus* species, which oviposit in bark cracks and crevices, females will lay their eggs on the smooth bark surface of young suckers (Nord *et al.*, 1965). Eggs are deposited over several weeks during summer, singly or in small groups, usually about 2.5 cm above the ground (Nord *et al.*, 1965). High egg mortality has been suggested by Nord *et al.* (1965), as dissection of many infested suckers showed only one early instar larval gallery. Eggs will hatch after two weeks (Solomon, 1995), and the larvae, unlike those from other *Agrilus* species, will bore into the cortex of the stem and then straight down into a large root (Nord *et al.*, 1965), where they tunnel in a near straight line for 20-50 cm, until the root becomes too small (Nord *et al.*, 1965; Bright, 1987). They next penetrate to the cambium-xylem interface and move back towards the main stem, creating a compact spiral (Nord *et al.*, 1965). Once they reach the stem, they tunnel spirally upward around it for 5-35 cm (Nord *et al.*, 1965) and then bore to the centre of the stem to construct its cylindrical pupal chamber. Afterwards, they will bore exit tunnels to the outer layers of the bark and return to the pupal chamber (Nord *et al.*, 1965). The larvae reach maturity before mid-September and overwinter in the pupal chamber (Nord *et al.*, 1965), after which adults will emerge. The life cycle of *A. horni* likely lasts two years (Nord *et al.*, 1965).

Damage

Young trees in sparse *Populus* sucker stands appear most susceptible to *A. horni* (Solomon, 1995) and can die from only a few larval attacks (Ostry *et al.*, 1989). However, according to Nord *et al.* (1965), suckers in dense stands can sometimes also be infested. Weakened, dying and dead sprouts are signs of infestation (Solomon, 1995). Girdled suckers that die before normal leaf abscission can be easily recognised over winter, as their dead, brown leaves will remain attached (Nord *et al.*, 1965; Solomon, 1995). Spiral swelling around the lower stems is characteristic of *A. horni* infestations (Solomon, 1995), and the D-shape emergence holes will heal to form oval bark scars (Solomon, 1995). Nord *et al.* (1965) noted that this beetle can successfully infest and kill both weakened and vigorous *Populus* suckers (Nord *et al.*, 1965). Although not a concern in dense stands in its native range, *A. horni* can be harmful to sparsely stocked stands – maybe due to higher sunlight exposure, as *Agrilus* are sun-loving beetles – (Nord *et al.*, 1965) and it might thus pose a threat to test plantings and commercial plantations (Nord *et al.*, 1965; Bright, 1987).

9. What pathways provide opportunities for the pest to enter and transfer to a suitable host and what is the likelihood of entering the UK/PRA area?

Agrilus horni is usually found on young *Populus* suckers. This beetle has only been reported to infest healthy trees with a small stem diameter and there may only be one mature larva per sucker (Nord *et al.*, 1965). Nord *et al.* (1965) report that the maximum diameter of infested suckers was 1 inch (2.5 cm), but it is not clear whether this was the maximum diameter present in the test stand or whether there were bigger suckers that were not infested. They also state that, in another study, "the borer was found only in the roots and stems of apparently healthy aspen suckers most of which were less than 3/4 inch [1.9 cm] in diameter". Trees with a small diameter are generally not used for wood products, which lowers the probability of this pest being introduced to the PRA area. However, as this beetle has been little studied (most of the information on it comes from just one scientific paper, i.e., Nord *et al.*, 1965), we cannot rule out the possibility that it might also be able to infest (although less frequently and successfully) older – and potentially more resistant – *Populus* trees without causing severe damage and thus going unnoticed.

Although this beetle has been reported in several different states in the USA and Canada, there are few current records, which might simply be a reflection of the fact that this is a North American native beetle, hard to distinguish – as it is very similar to the better-known *A. anxius* – and that does not pose a problem in most cases. However, this could as well be an indication of low population levels. This would also make it less likely to enter and establish in the UK. With *A. planipennis* (emerald ash borer), it has recently been suggested that the introduction of wide-spread plantings of non-Asian ash trees in China (i.e., *A. planipennis*' native range) triggered an outbreak several decades later (Dang *et al.*, preprint). This, in turn, caused this pest's population to increase in its native range, leading to its introduction to North America (Dang *et al.*, preprint). If the population of susceptible poplar species – such as *P. tremula*, which can be attacked even in dense stands (Nord *et al.*, 1965) – increased in the USA or Canada, this could potentially lead to an *A. horni* outbreak, thus enhancing the risk of an accidental introduction outside its native range via trade.

Pathways that have been assessed in relation to the entry of *A. horni* include plants for planting, *Populus* wood, woodchips, waste wood and wood packaging material. Cut branches have not been considered, as this plant genus is not used for ornamental purposes.

Plants for planting

According to APHA-PHSI, no *Populus* plants for planting have been imported from the US or Canada since December 2015 (when detailed recording began), and all *Populus* imports of live plants for planting from the USA and Canada are currently prohibited pending risk assessment, so this is very unlikely to be a pathway of entry. Even if a risk assessment were performed and imports of dormant plants allowed, *Populus* plants from the USA and Canada would still need to be checked for other pests, namely *Melampsora medusae f. sp.*

tremuloidis and *Sphaerulina musiva*, as well as *Anoplophora glabripennis* for plants from the USA. This means that damage caused by *A. horni* – like spiral bark swelling or exit holes – would likely also be noticed in these assessments, particularly since *S. musiva* and *A. glabripennis* cause stem damage.

The likelihood of this pest being introduced on plants for planting was considered **very unlikely** with **high confidence**.

Plants for planting	Very unlikely	✓	Unlikely		Moderately likely		Likely		Very likely	
Confidence	High Confidence	✓	Medium Confidence		Low Confidence				

Populus fuelwood

Young suckers have too small a diameter to be used for wood, but we cannot completely discard the possibility that *A. horni* might also exploit – albeit less frequently – older *Populus* trees. This pest likely has a 2-year life cycle and would probably be able to complete it on cut wood – as it has been suggested for *A. planipennis* (EPPO, 2013). The pupal cell is present in the centre of the stem which might protect it against wood processing, desiccation and bark removal. Any wood imported to the UK must be bark-free or have been kiln-dried to below 20% moisture content. However, *A. horni* pupae and pre-pupae would probably survive the debarking process and according to EUPHRESCO, kiln-drying is not effective at eliminating all insect pests (Schröder, 2010).

Populus trees are usually not the preferred choice for firewood, as the wood is considered lower quality. It can be burnt green but will produce heavy smoke. Because it burns fast (due to its low density), it can be used for campfires, which could facilitate transfer of the pest to a suitable host.

According to EUROSTAT, there has been some trade of fuelwood from the USA and Canada to the UK in the past six years, although it is not specified whether *Populus* has been used for these exports. Since *Populus* wood is considered lower quality for firewood, it probably constitutes only a small fraction, if any. Taking this into account, together with the fact that *A. horni* has only been reported to infest young suckers and that that there are not many current records of this beetle, the risk of entry on this pathway is probably low.

The likelihood of this pest being introduced on *Populus* firewood was considered **unlikely** with **low confidence**.

Wood	Very unlikely		Unlikely	✓	Moderately likely		Likely		Very likely	
Confidence	High Confidence		Medium Confidence		Low Confidence	✓				

Sawn or sliced wood (with a thickness > 6 mm)

Sawn wood imported to the UK also needs to comply with the measures stated in the above pathway. According to EUROSTAT, there is a considerably high level of trade of “poplar, sawn or chipped lengthwise, sliced or peeled, of a thickness of > 6 mm” from the USA and Canada to the UK. This pathway would only pose a (moderate) risk if *A. horni* is able to exploit older *Populus* trees. Even in that case, sawing practices are likely to kill some individuals. As such, this pathway presents very high levels of uncertainty.

The likelihood of this pest being introduced on *Populus* sawn wood was considered **unlikely** with **low confidence**.

Wood	Very unlikely	☐	Unlikely	☑	Moderately likely	☐	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑			

Rough wood (whether or not stripped of bark)

Rough wood imported to the UK also needs to comply with the measures for wood imports stated above. According to EUROSTAT, there has been little trade of rough poplar wood (which could potentially, e.g., be used for walking sticks) from the USA and Canada to the UK. This pathway would also only pose a reasonable threat if *A. horni* is able to exploit older *Populus* trees.

The likelihood of this pest being introduced on *Populus* rough wood was considered **unlikely** with **medium confidence**.

Note that all three wood pathways have been rated as unlikely, as population levels of *A. horni* seem to be low and there are only records of this insect infesting young trees with a small stem diameter that would not be used for this purpose. However, confidence levels are low or medium, as there is little information on this pest so it could be that occurrences on older trees have thus far gone unnoticed.

Wood	Very unlikely	☐	Unlikely	☑	Moderately likely	☐	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			

Waste wood

There is some trade of wood waste between the US, Canada and the UK – although only a proportion of this will come from *Populus* wood. Most wood waste will be a result of wood manufacturing processes, i.e., much time may have passed since harvest and the wood will have undergone some form of processing, therefore most individuals would not be expected

to survive. However, ‘sawmill rejects’ and ‘bark’ are also included in the definition of wood waste. For this material, less time may have passed since harvest and the dimensions of the wood could be large. Waste from manufacturing is likely to have come from larger, more mature *Populus* trees. As most waste will come from wood from more mature trees, similarly to the wood pathway, this pathway would not pose a threat if *A. horni* is only able to exploit young *Populus* suckers. There is a very high degree of uncertainty associated with this pathway, therefore confidence is very low.

The likelihood of this pest being introduced on waste wood was considered **unlikely** with **low confidence.**

Waste wood	Very unlikely	☑	Unlikely	☐	Moderately likely	☐	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑			

Woodchips

Populus wood from young stems with a small diameter could be part of woodchips imported into the PRA area. In the case of *A. planipennis*, a small proportion have been reported to survive the wood chipping process (McCullough *et al.*, 2007). According to EUROSTAT, there has been a low level of trade in the last six years between the USA and Canada and the UK of non-coniferous, non-eucalyptus wood. Under current regulation, *Populus* woodchips need to conform to one of the following:

- Have been produced from debarked round wood – Debarking should remove the bark and cambial region, and thus also the *A. horni* adults and larvae present, but not the pupae or prepupae.
- Have been kiln-dried to below 20% moisture content – According to EUPHRESCO, kiln-drying is not effective at eliminating some wood-inhabiting insects (Schröder, 2010).
- Have undergone a heat treatment to achieve a minimum temperature of 56°C for a minimum of 30 minutes – The heat treatment alone might not be able to ensure 100% mortality, based on studies performed with *A. planipennis* (Sobek *et al.*, 2011; EPPO, 2013).

This pathway could pose a risk – particularly if *A. horni* population levels were to increase in its native range –, as some individuals might survive the chipping process. If the chips are shipped soon after production, stored outdoors or used for mulch, the probability of transfer would be increased (EPPO, 2013).

The likelihood of this pest being introduced on woodchips was considered **unlikely** with **medium confidence.**

Woodchips	Very unlikely	☐	Unlikely	☑	Moderately likely	☐	Likely	☐	Very likely	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				

Wood packaging material

According to EUROSTAT, there have been high levels of trade of wood packaging material (WPM) as a commodity from the USA and Canada to the UK – a portion of which will come from *Populus*. Solid wood packaging used to import goods into the UK must be compliant with the ISPM15, meaning that it must be made of debarked wood and heat treated or fumigated according to Annex 1 of the ISPM15. These measures are thought to be adequate for *A. planipennis* (EPPO, 2013) and therefore most likely also for *A. horni*.

This pathway would only pose a risk if this beetle could exploit *Populus* large enough to construct WPM from. Even in this case, if the WPM is ISPM 15 compliant the likelihood of entry should be very low.

The likelihood of this pest being introduced on wood packaging material was considered **very unlikely** with **high confidence**.

WPM	Very unlikely	☑	Unlikely	☐	Moderately likely	☐	Likely	☐	Very likely	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				

10. If the pest needs a vector, is it present in the UK/PRA area?

Agrilus horni is a free-living organism and no vector is required.

11. How likely is the pest to establish outdoors or under protection in the UK/PRA area?

The climate classification of Köppen-Geiger (Kottek *et al.*, 2006) indicates that the climate of most of this beetle's native range, which is mainly north-east USA and Canada, moderately differs to that of the UK. However, Nord *et al.* (1965) report that there is an *A. horni* record from a Museum Collection in Arizona, which presents a very different climate from that of north-east USA and Canada. Assuming this record is not a misidentification, this suggests that this pest might be able to perform well in a variety of different climates. It should also be noted that this beetle has been little studied, so its range might be wider than reported.

For the establishment of other *Agrilus* species, it has been suggested that host presence might be more important than climate, and this could also be the case for *A. horni*. One of these species is *A. anxius* (bronze birch borer), a pest thought to be closely related to *A. horni* (Nord *et al.*, 1965). It presents a wider reported distribution in North America across different climatic conditions, with host availability (birch, in this case) likely being the most relevant indicator of environmental suitability (Schrader *et al.*, 2020). However, some climatic requirements might still need to be met. For example, *A. anxius* needs temperatures above 21 °C (with an optimum of 30 °C) for oviposition (Schrader *et al.*, 2020). The prepupae of *A. planipennis* (emerald ash borer) – which also presents a wider reported distribution in North America – can survive temperatures down to -30 °C (Crosthwaite *et al.*, 2011). As it spends a large part of its life cycle inside the trunk and it may take longer to develop under unfavourable conditions, it has been suggested that its distribution is also probably mostly dependent on host presence (EPPO, 2013). In fact, this pest has successfully established in warmer zones in North America than in its native range in China (Dang *et al.*, preprint).

Populus trees are widespread in the PRA area – although only a fragment of these will be young suckers. Most do sucker, but some do not, and many are planted as windbreaks, in screens or plantations. Assuming host distribution is more important than climate for this pest's establishment and that it can likely perform well in a variety of different climates, *A. horni* would probably be able to survive in the UK climate.

Populus trees are normally not grown under protected cultivation in the PRA area, and therefore *A. horni* is very unlikely to establish there. However, bonsais or first year seedlings could be started in structures like polytunnels.

Establishment outdoors was considered **likely** with **medium confidence**. Establishment under protection was considered **unlikely** with **high confidence**.

Outdoors	Very unlikely	☐	Unlikely	☐	Moderately likely	☐	Likely	☑	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			
Under Protection	Very unlikely	☑	Unlikely	☐	Moderately likely	☐	Likely	☐	Very likely ☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐			

12. How quickly could the pest spread in the UK/PRA area?

No information has been published on the spread capabilities of *A. horni*. For *Agrilus* species, it is thought that they will only fly far if host trees are not immediately available (Chamorro *et al.*, 2015). While *Populus* trees are widely distributed in the PRA area, only a fraction of these will be young suckers, which might potentially promote the pest's spread.

According to the US Federal Register (2003), *A. anxius* individuals can spread 16-32 km/year, but they may not fly far if hosts are available (Schrader *et al.*, 2020). In fact, the median of the maximum distance/year for *A. anxius* for average European conditions (assuming no shortage of suitable hosts) has recently been estimated to be 1.3 km (with a 95% uncertainty range of 42 m to 7.5 km) (EFSA, 2019a). *Agrilus planipennis* is only thought to naturally spread a few km per year, depending on environmental conditions, such as wind or host abundance (Siegert *et al.*, 2015). Similar to *A. anxius*, the maximum distance expected to be covered in one year by *A. planipennis* for average European conditions has been estimated to be 1.6 km (EFSA, 2019b).

Agrilus horni could be transported longer distances through human-assisted spread with nursery plants – although these would likely first be inspected and trees with noticeable damage discarded –, woodchips or other potential pathways. Movement of *A. planipennis* in North America has been associated with pathways such as nursery plants, logs and firewood (Mercader *et al.*, 2016).

Natural spread was considered **slow** with **medium confidence**. Human-assisted spread was considered **moderate** with **low confidence**.

Natural Spread	Very slowly	☐	Slowly	☑	Moderate pace	☐	Quickly	☐	Very quickly ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			
With trade	Very slowly	☐	Slowly	☐	Moderate pace	☑	Quickly	☐	Very quickly ☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑			

13. What is the pest's economic, environmental and social impact within its existing distribution?

The impacts of *A. horni* within its current distribution are considered small. This beetle is poorly studied, as literature on this pest is scarce and most of the information comes from a single scientific paper from over 50 years ago (Nord *et al.*, 1965), indicating that *A. horni* has not been of high concern recently. In North America, it has been reported that big-tooth aspen (*P. grandidentata*) (Bright, 1987), aspen hybrids, Eurasian white poplar (*P. alba*) and European quaking aspen (*P. tremula*) (Nord *et al.*, 1965) can suffer "heavy infestations" – with *P. tremula* suckers having been attacked even in dense stands (Nord *et al.,* 1965). There are only a few records of this pest from recent years, which suggests that its population is likely to be low.

In North America, *Populus* trees are used for the manufacture of various products, such as pulp and paper (Balatinecz & Kretschmann, 2001). *Agrilus horni* seems to only cause "serious damage" to suckers in sparsely stocked stands, such as test plantings and commercial plantations, where young, healthy trees can die from only a few larval attacks

(Nord *et al.*, 1965; Bright, 1987). Nord *et al.* (1965) observed 4% mortality in a 4-year planting of *P. tremuloides* due to *A. horni* but informed that “more serious damage has occurred” in other areas – without giving any more details.

Impacts in this buprestid’s current distribution were considered **small** with **high confidence**.

Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				

14. What is the pest’s potential to cause economic, environmental and social impacts in the UK/PRA area?

The only two UK native *Populus* species are *P. tremula* and *P. nigra*, both of which are widely distributed in North America (i.e., this pest’s native range). Interestingly, while *P. tremula* has been recorded to suffer “rather heavy” *A. horni* infestations (Nord *et al.*, 1965) – although with no quantitative data to support this claim –, even in dense stands (Nord *et al.*, 1965), no attacks have been reported for *P. nigra*. Other poplar species present in the PRA area, such as hybrid aspen stands, *P. balsamifera* (North American native) or *P. alba* (Eurasian native), have also been recorded to suffer “heavy infestations” in low density stands in North America (Nord *et al.*, 1965; Benson & Einspahr, 1967).

Agrilus species are usually not a great concern in their native range, likely due to co-evolution with their endemic plant hosts and presence of natural enemies (Peterson & Cipollini, 2020). However, in some cases – with the most notorious example being emerald ash borer (Herms & McCullough, 2014) – *Agrilus* beetles that are introduced to a new area can prove to be a lot more damaging to new, naïve hosts. In the UK, there are several *Populus* species that could serve as new potential hosts for *A. horni* and might prove to suffer heavier infestations – maybe even if trees are older or present in more highly dense stands. If this were the case, mortality rates could be higher than estimated.

It should be noted that some of the hybrids present in the UK, like *P.* × *'Balsam Spire'* and *P.* × *generosa*, do not sucker, so they are not likely to be infested. Finally, none of this beetle's known parasitoids (namely *Mastrus smithii*, *Xylophrurus fasciatus*, *X. agrili*, *Baryscapus nordi* and *Metastenus* sp.) (Nord *et al.*, 1965) are present in the PRA area, although other *Mastrus* species have been detected in the UK (GBIF, 2021; *NBN Atlas*, 2021). It is possible that some native generalist parasitoids may be capable of using *A. horni* as a host.

Economic impacts

Populus nurseries, young plantations and test plantings are the most likely to be affected by this pest, as it usually attacks young suckers in sparsely stocked stands. This is the only issue that has been reported in the beetle's native range and is therefore the main concern.

Environmental impacts

Young suckers of the UK native *P. tremula* have been recorded to suffer "heavy" *A. horni* infestations (Nord *et al.*, 1965). In the UK, this species mainly occurs in isolated clonal stands of a few trees in oak, birch or pine woodlands (Jobling, 1990; Cosgrove *et al.*, 2005). If able to reach these areas, this pest may cause severe damage, as these trees are sparsely distributed and highly susceptible. In Scotland in particular, where aspen is key for future regeneration and planting, this pest could have an impact on natural regeneration and the sector's capacity to grow on, and establish young trees. The UK native *P. nigra* currently has a small surviving population and, if susceptible to this beetle, this might pose an important threat. Young *Populus* trees used as windbreaks (like *P. alba*, *P.* × *canescens* or *P. nigra*) might also be affected.

Social impacts

Populus trees grown in parks, natural gardens or as screens or windbreaks around orchards (such as *P. balsamifera*, highly susceptible, and *P. nigra*) might suffer, particularly if they are present in low densities.

All potential impacts in the PRA area were considered **small** with **low confidence**.

Economic Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑				
Environ - mental Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑				
Social Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑				

15. What is the pest's potential as a vector of plant pathogens?

Agrilus horni is not known to vector any plant pathogens.

16. What is the area endangered by the pest?

Test plantings and nurseries of *Populus* trees are most at risk, as this type of material has already been attacked in the pest's native range. Sites where clonal growth is common or where young *Populus* trees might be planted (e.g., as windbreaks and in areas of regeneration) are also particularly at risk.

Stage 3: Pest Risk Management

17. What are the risk management options for the UK/PRA area?

The available literature suggests that *A. horni* only attacks young *Populus* suckers. In this case, the only viable pathways of entry would be plants for planting and woodchips. However, there has been no trade of plants for planting in the last five years between North America and the UK and trade levels of woodchips are low. Even if dormant plants for planting were imported after being risk assessed, they would need to be checked for other pests, so damage caused by *A. horni* would likely also be noticed. For *A. planipennis*, there is no evidence of survival in chips processed with a 2.5-cm screen (McCullough *et al.*, 2007); however, this is not currently an import requirement. It is assumed that chips of this size would probably be safe also for *A. anxius* (EPPO, 2011), and thus also probably *A. horni*. For other *Agrilus* species, like *A. planipennis*, *A. bilineatus* and *A. fleischeri* (*Populus* is also a host of *A. fleischeri*), proposed regulations include a statement that plants for planting or woodchips come from a pest free area. This option may not be as viable for *Agrilus horni*, as this pest might be under-recorded in its native range.

If *A. horni* did enter the PRA area, eradication would be difficult to achieve, as i) this beetle lives inside the bark of the tree for most of its life cycle – although it does cause visible damage, i.e., spiral bark swelling and exit holes. However, low infestations may still be difficult to detect; ii) *Agrilus* species are hard to distinguish. However, none of the *Agrilus* species currently established in the UK utilise *Populus*, which should make this beetle stand out; and iii) *Populus* trees are widespread – although only a portion will be young suckers. Measures for detection and containment could be put into place, like felling and removal of infested and nearby suckers or surveillance for symptoms and *Agrilus* adults from May to September, especially in test plantings or other areas with a high proportion of young aspen suckers. Containment measures, such as preventing the movement of wood or live trees from infested areas might prevent human-assisted spread of this beetle. Risk management options developed for *A. planipennis* and *A. anxius* are also relevant for this species.

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