Department for Environment Food & Rural Affairs

Rapid Pest Risk Analysis (PRA) for:

Aproceros leucopoda

October 2016

Summary and conclusions of the rapid PRA

Provide: (i) a very brief introduction to the pest and the reason for undertaking the PRA, (ii) an overall summary and conclusions of the PRA and (iii) short text to summarise each section.

This rapid PRA shows that *Aproceros leucopoda* is a highly invasive Asian sawfly that is a pest of elm and is spreading rapidly across Europe with little prospect of continued exclusion from the UK.

Risk of entry

Aproceros leucopoda completes its lifecycle on the leaves, with the exception of the overwintering pupae which may be found in soil or leaf litter, and hence may be associated with dormant trees. The UK imports elms from the range of the pest, and, although 75% of consignments are inspected the pest may be difficult to detect on dormant trees if they enter with growing media or leaf litter. Entry on plants for planting was rated as moderately likely, with medium confidence. The pest has spread rapidly along roads and railways in Europe, and since females reproduce parthenogenetically (asexually) only a single female is required for a new population to establish. Entry by hitchhiking is rated as likely, with low confidence. Entry on cut branches for decorative purposes is very unlikely, with high confidence, as damage is conspicuous and entry by natural spread is very unlikely, with

medium confidence, as there is no evidence the pest can fly the necessary distances to cross the English Channel.

Risk of establishment

Establishment outdoors is rated as very likely with high confidence. Hosts are widespread, and the pest is established in regions with similar climates to the UK.

Economic, environmental and social impact

When mass occurrences of *A. leucopoda* occur, impacts are incurred due to severe to complete defoliation of elms. Such defoliation has been observed in consecutive years in some European countries, and rarely in Japan, leading to branch dieback and a reduction in the aesthetic value of the trees. No death of trees due to *A. leucopoda* infestation has been reported. Impacts in the current range are rated as medium with medium confidence.

Potential impacts in the UK will be strongly influenced by how often mass occurrences of the pest occur, the factors that lead to high population numbers are unknown. Since pest damage is not apparent on dormant elms, which is how the majority of trees are sold, marketability is not reduced – though widespread defoliation may lead to a reduction in the demand for elm trees. Potential economic impacts are rated as small with medium confidence.

Aproceros leucopoda could cause potential environmental impacts by a) weakening trees that are already affected by Dutch elm disease and b) impacting on species that rely on elm foliage as their primary food source, by defoliating elms. Two species of conservation importance that could be impacted by *A. leucopoda* is the white letter hairstreak butterfly, *Satyrium w-album,* and the white-spotted pinion moth, *Cosmia diffinis*. More research would be required to fully assess impacts on biodiversity. No impacts on other species have been reported in Europe, however the introduction of *A. leucopoda* is still relatively recent with impacts only recently emerging in some countries. Environmental impacts have been rated as medium with low confidence.

Social impacts could be incurred in regions where there is still a significant elm population, such as the National Elm Collection in Brighton and Hove. Social impacts will be related to the defoliation of trees which reduces their aesthetic value, and have been rated as medium, with low confidence, as it is not known how often severe defoliation of trees due to *A. leucopoda* feeding may occur in the UK.

Endangered area

The whole of the UK is endangered by the pest.

Risk management options

Given the pest's rapid spread across Europe and its ability to be introduced via hitchhiking on vehicles, there are few effective measures that could be used to prevent introduction. In

the event of an outbreak, the quick dispersal of females which can reproduce parthenogenetically makes eradication or containment very unlikely. There are also few options for cultural control. Sprays of insecticides can kill larvae, but reinvasion quickly occurs from untreated areas.

Key uncertainties and topics that would benefit from further investigation

- The factors that lead to mass occurrences/outbreaks of *A. leucopoda*, and how often such mass occurrences leading to severe defoliation may occur in the UK.
- Potential impacts on species strongly associated with *Ulmus*, including the white letter hairstreak, *S. w-album*. Defoliation of elms by *A. leucopoda* will mean elm leaves are not available to other species which feed on them. Assessing potential impacts on these species would require a more detailed analysis.
- The rate at which *A. leucopoda* may hitchhike in association with vehicles or other modes of transport.
- If all species of *Ulmus* are equally susceptible to infestation.
- Potential control options to help prevent defoliation of high value trees.

Images of the pest

	
An adult *Aproceros leucopoda*. Image credit: Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org	Damage to an elm leaf and *A. leucopoda* larva. Image credit: Gyorgy Csoka, Hungary Forest Research Institute, 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 EU) and the PRA scheme (UK or EPPO) to be used.

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

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

Aproceros leucopoda is currently absent from the PRA area, though given its rapid spread across Europe in the past decade it is clearly a highly invasive species. There are no practical options that would ensure continued exclusion from the UK, especially in the light of the likelihood of the pest to enter via hitchhiking and quickly establish and spread. Because of this, statutory action against findings in the wider environment would not be technically justified. Statutory action will be taken against interceptions on traded material and if the pest is detected in the wider environment, this decision will be reviewed.

Yes Statutory action	✓	No Statutory action	

Stage 1: Initiation

1. What is the name of the pest?

Aproceros leucopoda (Hymenoptera: Argidae) Takeuchi

Common name: zigzag elm sawfly

2. What initiated this rapid PRA?

This PRA was initiated because the pest has become increasingly widespread in Europe, and to see if phytosanitary measures were technically justified.

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 EC Plant Health Directive (Council Directive 2000/29/EC[1]) and in the lists of EPPO[2]?

The pest is not listed in the EC Plant Health Directive and is not recommended for regulation as a quarantine pest by EPPO. The pest appeared on the EPPO Alert List in 2011 and was deleted in 2015, after being on the Alert List for 3 years with no international action requested by EPPO countries (EPPO, 2015).

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

Aproceros leucopoda is native to East Asia, being found on themain Japanese islands of Hokkaido and Honshu and has also been collected from the province of Gansu in China (Blank *et al.*, 2010). Publications from 2011 identified *A. leucopoda* as a new pest of elms in the Hebei Province, near Beijing in China (Jiangfeng, 2011, Zheng-Hao & He, 2011). It is likely to be more widespread in East Asia than currently reported.

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0029:20100113:EN:PDF

[2] https://www.eppo.int/QUARANTINE/quarantine.htm

EPPO (2015) lists *A. leucopoda* as present in the Far East of Russia though Blank *et al.* (2010) states this record requires confirmation. A later paper details the presence of *A. leucopoda* in the Middle Volga region of Russia (Ленгесова & Мищенко, 2013). Other publications (in Russian), state it is present in the Rostov Region, Stavropol region and Krasnodar Territory (regions between the Ukrainian and Georgian borders) and Moscow (Гниненко *et al.*, 2013).

Aproceros leucopoda was first recorded in Europe in 2003 in Poland and Hungary (Blank *et al.*, 2010), since then it has spread to an additional 14 European countries. This, coupled with it becoming more widespread in China and Russia as well, suggests it is very likely the distribution of the pest will continue to expand.

Table : Distribution of *Aproceros leucopoda* taken from (EPPO, 2015), unless otherwise cited.	
North America:	No records
Central America:	No records
South America:	No records
Europe:	Austria, Belgium, Bulgaria (Doychev, 2015), Croatia (Matošević & Pajač Živković, 2013), Czech Republic, Germany, Hungary, Italy, Latvia (Notification to the European Commission, 2015), Netherlands, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Ukraine
Africa:	No records
Asia:	China, Japan
Oceania:	No records

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

Aproceros leucopoda has not been recorded in the UK, nor has it 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?

Aproceros leucopoda has been recorded on a number of *Ulmus* (elm) species, having been recorded on both European and Asian native *Ulmus* species (Blank *et al.*, 2010).

Recorded *Ulmus* spp. hosts are *U. davidiana* var. *japonica* (Japanese elm), *U. glabra* (wych elm), *U. lacinata* (cut-leaf elm), *U. laevis* (European white elm), *U. minor* (field elm, containing many subspecies and varieties including English elm and smooth-leaved elm) and *U. pumila* (Siberian elm) (Blank *et al.*, 2010, Blank *et al.*, 2014, EPPO, 2015).

In addition, several hybrid elms, bred for their resistance to Dutch Elm Disease, have been recorded as hosts including 'New Horizon', 'Regal' and 'Rebona' (Blank *et al.*, 2014). Whether the whole genus of *Ulmus* can be infested was an uncertainty highlighted by the 2013 German Express PRA (Schrader & Schröder, 2013), and this remains uncertain. Blank *et al.,* 2014 noted only light damage to some cultivars, though it is not clear if this suggests resistance of those cultivars or other factors, given *A. leucopoda* is still a relatively recent invasion in Europe.

The importance of *Ulmus* spp to the UK has previously been summarised in the PRA for *Candidatus* Phytoplasma ulmi (Webber, 2014). *Ulmus minor* and *U. glabra* are widespread in the UK, and, although populations of both species were drastically reduced by Dutch elm disease (DED) and few mature trees remain, elm is still an environmentally important species in the UK. The National Elm Collection is in Brighton and Hove, an area with a low prevalence of DED. It currently has around 17000 elms and actively seeks to extend the range of elms in the collection (Brighton & Hove City Council, 2016). In Scotland, the north-west Highlands is a stronghold for *U. glabra*.

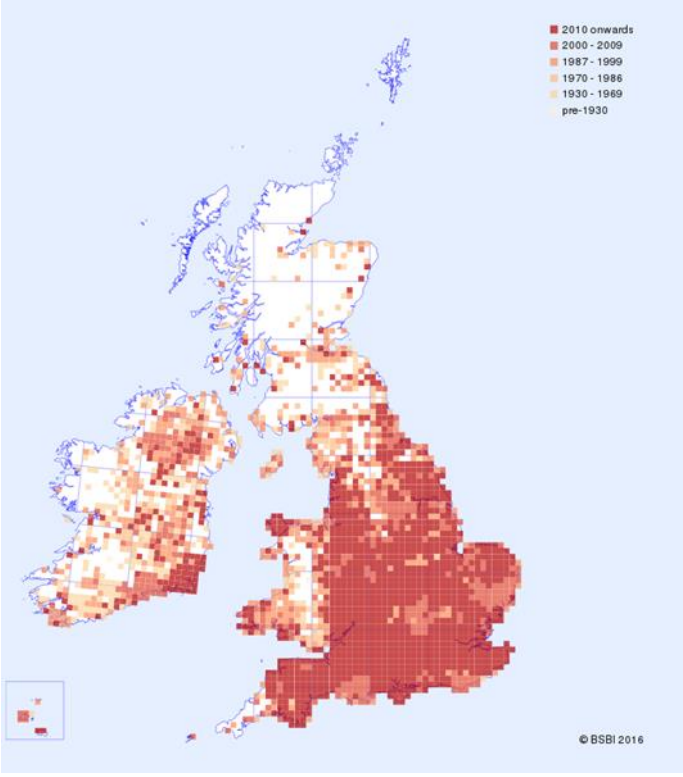

Figure 1: Distribution of *Ulmus minor*, one species of elm found in the UK, in the British Isles. Image copyright BSBI, 2016.

8. 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?

Aproceros leucopoda is parthenogenetic, meaning females are able to produce offspring without any males, in fact males have never been recorded (Blank *et al.*, 2010). Thus only a single *A. leucopoda* needs to enter for there to be a risk of a population establishing. *Aproceros leucopoda* is a multivoltine species, with four or five generations reported per year. The eggs are laid at leaf edges and after hatching the larvae feed on the leaves, in a characteristic zigzag pattern. There are six larval stages (instars), with the final instar larvae either making a loose, net-like cocoon on the underside of a leaf, or a sturdier, solid walled cocoon, which is found in the leaf-litter or the soil under the tree, and in which the sawfly overwinters (Schrader & Schröder, 2013, EPPO 2015).The pathway by which *A. leucopoda* first entered Europe is unknown.

Plants for Planting

The majority of *A. leucopoda* life stages are associated with the leaves, and thus trees moved in leaf present a higher risk than trees moved in dormancy. Trees that are heavily infested would most likely be rejected for sale. Only a very light infestation may go unnoticed, but this seems unlikely since the feeding damage by larvae is highly distinctive. Bonsai in particular are unlikely to be infested, as there would be a very low level of tolerance for damage of these high value trees.

The majority of trees are moved when they are dormant and often bare-rooted, though data from the statutory pre-arrival notification scheme for *Ulmus* spp. indicates limited imports of trees in spring/summer months when they would be in leaf. The egg stage of the pest is relatively cryptic, and if trees were then moved on quickly these may not be detected before the larvae hatch. Where trees are imported dormant, the over-wintering pupae may be found with associated growing media or still attached to leaf litter transported incidentally with the tree. Cocoons are relatively small, only a few millimetres across, and could easily be missed if trees were inspected on arrival. Females could then emerge in spring and locate a suitable host, establishing a population.

No imports of *Ulmus* from 3rd countries occurred into the UK in the past 12 months (APHA, unpublished data). There is a statutory pre-arrival notification scheme for the import of *Ulmus* into the United Kingdom from the EU. In the 12 month period between April 2015 and April 2016, 122 consignments (17204 trees total) were notified under this scheme and nearly all consignments originated from countries where *A. leucopoda* is known to occur (APHA, unpublished data).

As of September 2016, the PHSI are inspecting 75% of all consignments imported under the pre-arrival notification scheme.

Since the majority of trees are moved when dormant it is the pupal stage of *A. leucopoda* that is most likely to be transported undetected within growing medium or leaf litter. Entry

on plants for planting is rated as **moderately likely but with medium confidence**, as there are no reported instances of *A. leucopoda* being associated with plants intended for planting moving in trade.

Cut Branches

All of the life-stages of *A. leucopoda* could be present on infested branches of *Ulmus* spp. which may be imported as part of bouquets or for other ornamental purpose. However, *Ulmus* is rarely used for such purposes, and where it may be there would be a low tolerance for damage caused by pests, reducing the chances of *A. leucopoda* being associated with cut branches. To transfer to a suitable host, cut branches would need to be disposed of outdoors, as composting is common in the UK this is likely. It would also need to stay fresh enough to allow the larvae to reach the pupation stage. **Entry on cut branches is rated as very unlikely with high confidence**, due to the very limited trade in this commodity and the very low likelihood of survival on a perishable commodity.

Hitchhiking

It is intrinsically difficult to judge the likelihood of a pest hitchhiking (e.g. utilising transport conveyances to be moved to new locations) because there is often a lack of data on the rate at which this occurs. The 2013 German Express-PRA notes the spread along traffic lines of *A. leucopoda* and how it being a "blind passenger" could be an important pathway of spread over long distances (Schrader & Schröder, 2013). Blank *et al.* 2014 noted that the arrival of the pest in the Netherlands and Belgium was likely to be by human mediated jump-dispersal, as no infestations could be found between these and those nearest in Germany. They also noted they had not observed *A. leucopoda* being associated with traded plant material, thus hitchhiking may explain the arrival of this pest in the Low Countries. Introduction into Italy was also theorised to be related to road traffic, with the greatest infestations being found along a motorway and severe defoliation noted at motorway carparks often used by those travelling from Central Europe to Italy (Zandigiacomo *et al.*, 2011).

There is significant long distance movement of vehicles between those countries where *A. leucopoda* occurs and the United Kingdom each day. In addition, the pest continues to spread rapidly in Europe, increasing the risk of the pest becoming associated with conveyances. *Ulmus* species are so widespread that an individual is likely to be able to locate a host species upon arrival in the UK (see figure 1 in section 7). For this reason, **entry via hitchhiking is rated as likely, with low confidence.** Confidence is low because formal evidence of hitchhiking has not been published, and this rating has been based on the observations of spread in Europe rather than scientific data.

Natural Spread

Although females are thought to be “strong fliers” (EPPO, 2015), there is no evidence they would be capable of completing the distance necessary to fly across the English Channel. The pest is not yet recorded in France with the Straits of Dover (between Dover and Calais) being the narrowest part of the Channel at just over 30 km wide. However, given the rapid spread in Europe and the presence of the pest in Belgium, it is very likely to enter France in the coming years. Blank *et al.* 2014 commented that the British Isles and Scandinavia may be adequately protected by the sea from self-dispersal event. **Entry by natural spread is rated as very unlikely with medium confidence**; confidence is not rated higher as there are no published data on the natural dispersal capacity of *A. leucopoda.*

Plants for planting	Very unlikely	☐	Unlikely	☐	Moderately likely	☑	Likely	☐	Very likely	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				
Cut branches	Very unlikely	☑	Unlikely	☐	Moderately likely	☐	Likely	☐	Very likely	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				
Hitchhiking	Very unlikely	☐	Unlikely	☐	Moderately likely	☐	Likely	☑	Very likely	☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑				
Natural spread	Very unlikely	☑	Unlikely	☐	Moderately likely	☐	Likely	☐	Very likely	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				

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

Aproceros leucopoda is a free living organism that does not require a vector.

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

Aproceros leucopoda is becoming increasingly widespread in Europe, and is found in countries with a similar climate to the UK including the Netherlands, Belgium and the

northern Japanese island of Hokkaido. Although mature elm numbers have been greatly reduced by DED, *U. minor* is still found widely in hedgerows and DED resistant elms have been planted as ornamentals or amenity trees, so host availability is unlikely to limit establishment. Based on current distribution and availability of hosts, **establishment outdoors is rated as very likely with high confidence.**

Ulmus spp. is not normally grown under protection and neither has *A. leucopoda* been recorded as a pest of protected cultivation. **Establishment under protection is rated as very 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	☐			

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

There are no data on the flight capacity of *A. leucopoda*, but females are thought to be strong fliers (EPPO, 2015), and the Germany express-PRA concluded that "rapid natural spread" was expected (Schrader & Schröder, 2013). Blank *et al.* 2014 estimated invasion speeds in Europe as between 45-90 km/yr based on distances "between closest neighbouring sites, where *A. leucopoda* was recorded only a few years later". Relatively little is known about the natural dispersal capacity of sawflies but other species are capable of similar distances (Blank *et al.*, 2014). However, not all spread may have been due to the flight of females alone, and hitchhiking along roads or railways may have contributed to the overall spread in Europe especially as only a single female is required to start a new population. **Natural spread is rated as very quickly, with medium confidence** due to the lack of specific data on the flight capacity of *A. leucopoda*.

As discussed in section 8, the majority of the life stages of *A. leucopoda* are associated with the leaves, with the exception of the over-wintering cocoons which drop to the ground and may be found amongst leaf litter or soil. Trees are usually moved when dormant, which does limit the association of most lifestages, however, not of the over-wintering cocoons which are potentially difficult to spot. For this reason **spread with trade is rated as moderate with medium confidence**, though the pest has not been observed moving in trade in Europe**.**

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	☐			

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

The larval feeding of *A. leucopoda* can lead to impacts in its current range. Larvae can be voracious feeders and cause near complete defoliation of trees in years when mass occurrences occur.

Though native to Hokkaido, severe defoliation caused by *A. leucopoda* (on *U. pumila*) was only observed between 1991-1993, when there was a mass occurrence of *A. leucopoda*. The defoliation led to trees going on to suffer dieback (Blank *et al.*, 2010). Apart from this report, there are no other reported impacts from the native range of the pest.

In Italy, the pest was first observed in 2009. At least four generations a year occur in the lowlands of north-eastern Italy (Zandigiacomo *et al.*, 2011). In 2009 a mass occurrence, leading to severe or complete defoliation, was observed in the Friuli Venezia Giulia region (north-eastern Italy, near the Slovenian border). The infested trees did produce new leaves in 2010, and similar damage was then recorded – along with some dying branches observed. No elms attacked by *A. leucopoda* were found to be killed (Zandigiacomo *et al.*, 2011). Leaf damage associated with *A. leucopoda* was noted in Slovenia for the first time in 2011 near the Italian border, and similar damage as seen in Italy may be possible in Slovenia (Seljak, 2012). In the Middle Volga region of Russia, defoliation of elms was also noted, and the pest showed a preference for feeding on *U. pumila* over *U. glabra* (Ленгесова & Мищенко, 2013). Damage where the pest is invasive in the Hebei Province, China, has been described as "severe" on *U. pumila* and investigations into potential control methods have been undertaken (Jiangfeng, 2011).

Blank *et al.* (2010) include observations of defoliation rates from sites in Romania and Hungary. At the studied sites in Romania, average defoliation of individual trees (all *U. glabra*) was between 74-98%. In Hungary the level of defoliation varied between sites. 100% defoliation was seen on individual trees of *U. minor* and *U. pumila*, but more leaves were produced by the tree in the same season. Amenity trees in Budapest suffered 70% defoliation, leading to a significant reduction in the aesthetic quality of the trees. Trees attacked in 2008 went on to produce new leaves in 2009 but dieback of some branches was observed.

First reports of the pest in Croatia in 2011 stated that damage was not severe and no defoliation occurred, though the authors noted that the possibility of complete defoliation of elm trees in Croatia in the future could not be excluded (Matošević, 2012). The pest was first reported in Bulgaria in 2015, but observed damage levels were considered insignificant, with only 1 – 2 % defoliation reported (Doychev, 2015). During investigations

into the life-cycle and distribution of the pest in the Netherlands, *A. leucopoda* was found to be locally common and largely found in urban areas, but no severe damage was seen, despite four or five generations being observed (Mol & Vonk, 2015). It is likely these low rates of damage are related to the recent arrival of the pest, and that severe defoliation may occur in the future.

Some publications make reference to the fact that *A. leucopoda* may further weaken trees that are already affected by other *Ulmus* diseases such as *Ophiostoma novo-ulmi* (DED) and *Ca.* Phytoplasma ulmi (elm yellows phytoplasma) (Blank *et al.*, 2010, Schrader & Schröder, 2013, Zandigiacomo *et al.*, 2011), though to date there are no specific reports related to the cumulative impacts of *A. leucopoda* defoliation and other elm pests and diseases. No environmental impacts, including impacts on other species associated with *Ulmus*, have been reported.

The majority of the damage caused by *A. leucopoda* is aesthetic, as defoliated trees are reported as producing new leaves in the same season or the next season. There have been occasional reports of dieback of branches but no tree mortality has been observed. **Impacts in the current range are rated as medium, with medium confidence.** Confidence is medium as *A. leucopoda* is a highly invasive species, and many areas have only been recently invaded, so it can be expected that impacts will continue to emerge over the coming years including unusually large populations which lead to severe defoliation.

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

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

The impacts of *A. leucopoda* will be strongly influenced by how often, and how widely, population explosions of the pest may occur which lead to severe or complete defoliation of trees. To date, there is no published evidence linking certain factors (e.g. local weather conditions) to mass occurrences of *A. leucopoda*. This is a considerable source of uncertainty in this section of the PRA.

Where nurseries are selling elm trees in leaf, economic impacts may be incurred as damage from the sawfly will reduce the marketability of the plants. Most trees are, however, sold when dormant and when the sawfly is not apparent. Demand for *Ulmus* spp. may also be reduced if the pest becomes widespread and causes regular defoliation. **Potential economic impacts in the UK are rated as small, with medium confidence,** as *A. leucopoda* will not reduce the marketability of dormant trees. Confidence is medium as it is uncertain how many years' mass occurrences of *A. leucopoda* may occur which could lead to knock on effects on elm sales.

Environmental impacts may be incurred by high population densities of *A. leucopoda* larvae, as this will reduce availability of *Ulmus* as a food resource for other species. An example of a species which could be impacted by the introduction of *A. leucopoda* is *Satyrium w-album,* the white-letter hairstreak butterfly. This elm specialist is a priority species in the UK Biodiversity Action Plan, due to the 99% decline in abundance seen over a 25 year period (JNCC, 2010a). Since both larvae of *S. w-album* and *A. leucopoda* feed on *Ulmus* leaves, infestation by *A. leucopoda* could impact on populations of *S. w-album*, but the differing lifecycles of the two pests may aid in reducing impacts. Firstly, in the Netherlands which has a similar climate to the UK, females of *A. leucopoda* were first seen at the end of April, which means the first generation larvae would be expected to occur at the start of May in the UK. In contrast, *S. w-album* caterpillars are active from mid-March, initially feeding on elm flowers before moving onto leaf buds and emerging leaves, with the first pupae being formed around mid-May and adults emerging in mid-June (Ellis & Wainwright, 2016). This means it is likely that at least some *S. w-album* will complete their lifecycle before severe defoliation of elms by *A. leucopoda* can occur. Eggs are the overwintering stage of *S. w-album*, and these are on the twigs (Ellis & Wainwright, 2016), so should not be affected by the activity of *A. leucopoda*. Further research would be required to have greater confidence on potential indirect environmental impacts of *S. w-album*.

Another species on the UK Biodiversity Action Plan, which relies on elm, is *Cosmia diffinis*, the white-spotted pinion, a moth whose distribution is now thought to be restricted to Cambridgeshire, Bedfordshire and Essex (Wigglesworth *et al.*, 2016). This species has suffered a 77% decline over 24 years in the UK and is also declining in other European countries (JNCC, 2010b). The larvae of this species would be expected to be active at a similar time to the larvae of *A. leucopoda*, being found between mid-April and mid-June (Wigglesworth *et al.*, 2016), and are thus more likely to be impacted by any defoliation of *Ulmus* caused by *A. leucopoda* feeding.

There are a significant number of other native invertebrates which rely on elm as their primary food source, the BRC lists over 200 invertebrate species that are associated with *Ulmus* (BRC, 2016), though not all of these will rely on *Ulmus* foliage as their primary food source. It is not within the scope of a rapid pest risk analysis to assess potential impacts on all species associated with elm. It is important to note that no impacts on biodiversity have been recorded in the current range of the pest, though it is unclear if impacts on biodiversity have been explicitly monitored. This should also be considered in the light of *A. leucopoda* still being a relatively recent introduction to Europe with impacts in some regions still emerging.

Environmental impacts could also be caused due to cumulative damage that could occur if trees tolerant, but infected, by Dutch elm disease are further weakened by the infestation of *A. leucopoda*. However impacts of this kind in Europe, where many DED resistant and tolerant varieties have been planted, have yet to be reported.

Potential environmental impacts are rated as medium, with low confidence.

Though there is no evidence of death of *Ulmus* due to *A. leucopoda* infestation, with dieback of branches only recorded occasionally, *A. leucopoda* could still cause social impacts due to significant defoliation leading to a reduction in the aesthetic value of the trees. Though DED dramatically reduced elm populations in the UK, there are still areas with a high number of *Ulmus* such as the National Elm Collection in Brighton and Hove, as well as areas where resistant *Ulmus* trees have been planted as amenity trees. Some iconic single trees remain which, for unknown reasons, did not succumb to DED. These trees can also be locally important. Projects which aim to replace elm in the environment that was lost to DED may also be impacted by this pest.

Areas where *Ulmus* is locally prevalent, especially urban areas have potential to incur large social impacts due to reduction in the aesthetic value of the trees when significant defoliation occurs. Taking into account the fact that elm is not evenly distributed across the country; overall social impacts have been rated as **medium with low confidence**. The major contributing factor to the low confidence score is that it is not known how often severe defoliation events may occur in the United Kingdom.

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	☑				

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

Aproceros leucopoda is not recorded as a vector of plant pathogens.

15. What is the area endangered by the pest?

The whole of the UK is endangered by the pest.

Stage 3: Pest Risk Management

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

Exclusion

Prospects for continued exclusion of *A. leucopoda* are very low, as it is practically impossible to reduce the likelihood of the pest arriving by hitchhiking. For this reason protection via regulatory options such as a protected zone is not recommended.

There are some measures that could be placed on plants for planting to reduce the likelihood of the pest being associated with this commodity. By only allowing the transportation of trees when dormant, bare rooted and free from soil and leaf litter, no life stages of the pest will be associated with the plants. Importing plants only from pest free areas could also be considered, though given the rate of spread of the pest in Europe this would be likely to severely limit import options in the future.

Eradication and Containment

If an outbreak is detected in the wider environment, it is very unlikely to be eradicated or contained. This is because females are active fliers and able to disperse quickly, and reproduce asexually.

If, during inspection of elms, overwintering pupae or other life stages were found on recently imported plants destruction of these plants may be justified if the pest was not already present in the wider environment.

Cultural Control

There is relatively little information on potential control options for *A. leucopoda*. Insecticidal sprays have been trialled in Hungary and China with some success, though the Germany Express-PRA pointed out that even after larvae have been, killed treated trees may be re-colonised by females arriving from outside of the treated area, and spraying of trees is technically difficult to achieve (Schrader & Schröder, 2013). Spraying trees will also have negative impacts on non-target invertebrates. Additional research into potential control options, such as tree injections or biological control, for *A. leucopoda* would be beneficial, especially where there may be a desire to protect high value trees.

17. References

Blank SM, Hara H, Mikulás J, Csoka G, Ciornei C, Constantineanu R, Constantineanu I, Roller L, Altenhofer E & Huflejt T (2010): Aproceros leucopoda (Hymenoptera:

Argidae): an East Asian pest of elms (Ulmus spp.) invading Europe. *European Journal of Entomology* **107**, 357.

Blank SM, Köhler T, Pfannenstill T, Neuenfeldt N, Zimmer B, Jansen E, Taeger A & Liston AD (2014): Zig-zagging across Central Europe: recent range extension, dispersal speed and larval hosts of Aproceros leucopoda (Hymenoptera, Argidae) in Germany. *Journal of Hymenoptera Research* **41**, 57.

BRC (2016) Database of Insects and their Food Plants: Ulmus. Biological Records Centre, UK. Available at: http://www.brc.ac.uk/dbif/hostsresults.aspx?hostid=6113 (accessed 08/09/2016.

Brighton & Hove City Council (2016) National Elm Collection. Brighton & Hove City Council. Available at: http://www.brighton-hove.gov.uk/content/leisure-and-libraries/parks-and-green-spaces/national-elm-collection (accessed 02/09/2016.

Doychev D (2015): First record of the invasive elm sawfly Aproceros leucopoda Takeuchi (Hymenoptera: Argidae) in Bulgaria. *Silva* **16**, 1.

Ellis S & Wainwright D (2016) White-letter Hairstreak. Butterfly Conservation, UK. Available at: https://butterfly-conservation.org/files/white-letter-hairstreak-psf.pdf (accessed 08/09/2016.

EPPO (2015) Aproceros leucopoda. EPPO, Paris, France. Available at: https://www.eppo.int/QUARANTINE/Alert_List/.../Aproceros_leucopoda.docx (accessed 31/08/2016.

Jiangfeng C (2011): Bionomics and control of Aproceros leucopoda. *Forest Pest and Disease* **6**, 004.

JNCC (2010a) UK Priority Species data collation *Satyrium w-album*. JNCC, UK. Available at: http://jncc.defra.gov.uk/_speciespages/2586.pdf (accessed 08/09/2016.

JNCC (2010b) UK Priority Species Page - *Cosmia diffinis*. JNCC, UK. Available at: http://jncc.defra.gov.uk/_speciespages/241.pdf (accessed 26/09/2016.

Matošević D (2012): First record of elm sawfly (Aproceros leucopoda), new invasive species in Croatia. *Šumarski list* **136**, 57-61.

Matošević D & Pajač Živković I (2013): Alien phytophagous insect and mite species on woody plants in Croatia. *Šumarski list* **137**, 191-203.

Mol AW & Vonk DH (2015): De iepenzigzagbladwesp Aproceros leucopoda (Hymenoptera, Argidae), een invasieve exoot in Nederland. *entomologische berichten* **75**, 50-63.

Schrader G & Schröder T (2013) Express-PRA for *Aproceros leucopoda*. Julias Kühn-Institut, Germany, p. 9.

Seljak G (2012): Six new alien phytophagous insect species recorded in Slovenia in 2011. *Acta entomologica slovenica* **20**, 31-44.

Webber J (2014) Rapid Pest Risk Analysis for Elm Yellows. Forest Research, UK, p. 15.

Wigglesworth T, Parsons M & Porter J (2016) White-spotted Pinion *Cosmia diffinis*. Butterfly Conservation, UK. Available at: http://butterfly-conservation.org/files/white-spotted_pinion-psf.pdf (accessed 28/09/2016.

Zandigiacomo P, Cargnus E & Villani A (2011): First record of the invasive sawfly Aproceros leucopoda infesting elms in Italy. *Bulletin of Insectology* **64**, 145-149.

Zheng-Hao YG-YZ & He W (2011): Identification and bionomics of the sawfly Aproceros leucopoda *Chinese Journal of Applied Entomology* **3**, 033.

Гниненко Ю, Гниненко М & Раков А (2013): Новые обнаружения ильмового пилильщика-зигзаг в России. *Защита и карантин растений*.

Ленгесова Н & Мищенко А (2013): Биология, экология и молекулярно-генетическое исследование ильмового пилильщика Aproceros leucopoda (Takeuchi, 1939)(Hymenoptera: Argidae)–вредителя вяза в Среднем Поволжье Biology, ecology and molecular characterization of Aproceros leucopoda (Takeuchi, 1939)(Hymenoptera: Argidae). *Кавказский энтомологический бюллетень* **9**, 163-167.

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This publication is available at https://secure.fera.defra.gov.uk/phiw/riskRegister/plant-health/pest-risk-analysis-consultations.cfm

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