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Pest Risk Analysis for

Agrilus fleischeri (Coleoptera: Buprestidae)

E. Jendek – EPPO Global Database (EPPO Code: AGRLFL) - Adult of *A. fleischeri* on *Populus*, Jilin province (China, 2017)

September 2019

EPPO
21 Boulevard Richard Lenoir
75011 Paris
www.eppo.int
hq@eppo.int

The risk assessment follows EPPO standard PM 5/5(1) *Decision-Support Scheme for an Express Pest Risk Analysis* (available at http://archives.eppo.int/EPPOStandards/pra.htm), as recommended by the Panel on Phytosanitary Measures. Pest risk management (detailed in ANNEX 1) was conducted according to the EPPO Decision-support scheme for quarantine pests PM 5/3(5). The risk assessment uses the terminology defined in ISPM 5 *Glossary of Phytosanitary Terms* (available at https://www.ippc.int/index.php).

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Based on this PRA *Agrilus fleischeri* was added to the EPPO A2 Lists of pests recommended for regulation as quarantine pests in 2019. Measures for *Populus* and *Salix* plants for planting, and wood are recommended.

Pest Risk Analysis for *Agrilus fleischeri* (Coleoptera: Buprestidae)

PRA area: EPPO region
Prepared by: Expert Working Group (EWG) on *Agrilus fleischeri* and *A. bilineatus*
Date: 3-7 December 2018. Further reviewed and amended by EPPO core members and Panel on Phytosanitary Measures (see below). Comments by the Panel on Quarantine Pest for Forestry have also been considered.

Composition of the Expert Working Group (EWG)

BARANCHIKOV Yuri (Mr)	V. N. Sukachev Institute of Forest, Siberian Branch, Russian Academy of Science, Krasnoyarsk, Russian Federation
BJÖRKLUND Niklas (Mr)	Swedish University of Agricultural Sciences, Uppsala, Sweden
BONIFÁCIO Luís Filipe (Mr)	Instituto Nacional de Investigação Agrária e Veterinária, Oeiras, Portugal
MATTHEWS-BERRY Sharon (Ms)	Department for Environment Food & Rural Affairs, York, United Kingdom
PETRICE Toby (Mr)	Northern Research Station, USDA Forest Service, Lansing, USA
SALLÉ Aurélien (Mr)	Laboratoire de Biologie des Ligneux et des Grandes Cultures, Université d'Orléans, Orleans, France
WANG Xiao-Yi (Mr)	Research Institute of Forest Ecology, Environment and Protection, Chinese Academy of Forestry, Beijing, China
EPPO	
PICARD Camille (Mr)	OEPP/EPPO, 21 boulevard Richard Lenoir, 75011 Paris, France
SUFFERT Muriel (Ms)	hq@eppo.int
Observer	
RAHIMOV Elnur (Mr)	Plant health and phytosanitary control department of Food Safety Agency of the Republic of Azerbaijan, Baku, Azerbaijan

In addition, the EPPO Secretariat would like to thank Mr Jendek (Faculty of Forestry and Wood Sciences, Czech University of Life Sciences) for all the information exchanged during the preparatory work of this PRA and Mr Haack (US Forest Service Northern Research Station) for the comments submitted.

All personal communications in this PRA were obtained in July-December 2018 from the following experts: Damus M (Canadian Food Inspection Agency), Jendek E (Faculty of Forestry and Wood Sciences, Czech University of Life Sciences), Tleppaeva A (Institute of Zoology of the Republic of Kazakhstan (Almaty)), Wang XY (EWG member – Chinese Academy of Forestry) and Zang K (Chinese Academy of Forestry).

The first draft of the PRA was prepared by the EPPO Secretariat.

For the determination of ratings of likelihoods and uncertainties, experts were asked to provide a rating and level of uncertainty individually during the meeting, based on the evidence provided in the PRA and on the discussions in the group. Each EWG member provided anonymously a rating and level of uncertainty, and proposals were then discussed together in order to reach a final decision.

Following the EWG, the PRA was further reviewed by the following core members: Avendaño Garcia N and Guitian Castrillon J M (with the help of Fernandez Gallego M M), Boberg J, Fried G, Hannunen S, MacLeod A and Van Der Gaag D J.

The Panel on Phytosanitary Measures considered the management options in 2019-03. EPPO Working Party on Phytosanitary Regulation and Council agreed that *Agrilus fleischeri* should be added to the A2 Lists of pests recommended for regulation as quarantine pests in 2019.

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Summary of the Pest Risk Analysis for *Agrilus fleischeri* (Coleoptera: Buprestidae)

PRA area: *EPPO region* (Albania, Algeria, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Guernsey, Hungary, Ireland, Israel, Italy, Jersey, Jordan, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Moldova, Montenegro, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tunisia, Turkey, Ukraine, United Kingdom, Uzbekistan)

Describe the endangered area:

The pest could establish where poplar and willow are grown (with an uncertainty on the poplar and willow species that will be attacked). The climatic conditions are considered suitable at least in the eastern part of Europe and central Europe, with uncertainties for the western part of Europe, the Mediterranean area, as well as for the warm (at least in summer) arid areas in North Africa, the Near East and Central Asia. However, it is expected that impact would be higher at least in areas where poplar coverage is important. This would correspond to an area from Northern France to Eastern Europe, with a particular risk for Russia.

Main conclusions

Overall assessment of risk:

Agrilus fleischeri is considered a separate species. However, no identification key or molecular methods (no sequences are recorded in GenBank) for identifying *A. fleischeri* are currently available. Distinguishing *A. fleischeri* from the European species *A. ater* is difficult.

A. fleischeri has caused damage in one stand in northeast China (Liaoning) on *P. nigra* var. *italica*, which is an exotic tree species for China but a native species for the EPPO region as well as on *P. tremula* var. *davidiana* in the same region. Limited information is available on this insect.

Entry was considered as moderately likely with a high uncertainty, the most likely pathways were import of host plants for planting, round wood with bark, wood chips, hogwood and processing residues bigger than 2.5 cm in two dimensions, and wood packaging material (if ISPM 15 is not applied). The pest has already been intercepted twice in Canada on non-compliant dunnage.

A. fleischeri is established in Kazakhstan, and in southern Far East and southern Siberia in Russia. Establishment of *A. fleischeri* is likely to occur in the rest of the EPPO region where host plants grow and may not be limited by climatic conditions. However, there are uncertainties for the western part of Europe, the Mediterranean area, as well as for the warm (at least in summer) arid areas in North Africa, the Near East and Central Asia. *Populus* and *Salix* are widespread in the region. It is assumed that *A. fleischeri* would be able to attack other species within the genera *Populus* and *Salix* in addition to those that are currently known as host plants.

The magnitude of spread was rated as moderate (1-10 km per year) with a moderate uncertainty, and there may be longer 'jumps' (e.g. with wood packaging material if ISPM 15 is not applied and plants for planting), that would lead to multiple outbreaks and increase the spread rate.

The impact in its native range is assessed as low with a moderate uncertainty. The damage reported in Liaoning concerns only a small part of where *P. nigra* var. *italica* is grown in Northern China. Limited or no data was found on its detailed situation and/or impact on other hosts, or in other areas where it occurs (i.e. other Chinese provinces, as well as Japan, Kazakhstan, Mongolia, Russia, Korea Rep, Korea Dem.). Potential impact in the EPPO region is assessed as low with a high uncertainty. Potential impact would mostly depend on the availability of host species that are susceptible and whether the pest can attack healthy trees.

Because of the recent damage recorded from the Liaoning province in northeast China, of the importance of poplar and willow in the EPPO region, and because of the high uncertainty on the potential impact, the EWG considered that phytosanitary measures may be considered to reduce the probability of entry.

Phytosanitary Measures to reduce the probability of entry: Risk management options have been identified and evaluated for host plants for planting, round wood and sawn wood of hosts, and wood chips, hogwood and processing wood residues). ISPM 15 is a sufficient measure for wood packaging material.

<table>
<tr><td colspan="4">If measures are applied, the EWG recommended that these should apply to host genera (Populus and Salix), and not only to known host species within these genera.</td></tr>
<tr><td>Phytosanitary risk for the <u>endangered area</u> (Individual ratings for likelihood of entry and establishment, and for magnitude of spread and impact are provided in the document)</td><td>High ☐</td><td>Moderate ☐</td><td>Low ☒</td></tr>
<tr><td>Level of uncertainty of assessment
(see Section 17 for the justification of the rating. Individual ratings of uncertainty of entry, establishment, spread and impact are provided in the document)

There is very limited information on the damage potential of this pest; however, a similar assessment would have been made on Agrilus planipennis prior to the finding in western Russia and North America where it causes very high impacts.</td><td>High ☒</td><td>Moderate ☐</td><td>Low ☐</td></tr>
<tr><td colspan="4">Other recommendations: The EWG made recommendations (detailed in section 18) relating to sentinel trees and surveys targeting Populus and Salix species in areas where A. fleischeri occurs; molecular tools and publication of a key based on morphology to assist the identification of the pest; as well as better evaluating under which conditions apparently healthy trees are colonized.</td></tr>
</table>

Stage 1. Initiation

Reason for performing the PRA: *Agrilus fleischeri* (Coleoptera: Buprestidae) is an Asian pest of poplars (*Populus* spp.), which has caused some tree mortality in poplar plantations in parts of China, in particular on *Populus nigra* var. *italica* (Lombardy poplar)[1]. Other closely related *Agrilus* species, such as *A. planipennis*, have shown that they have the capacity to become serious pests. These are the reasons why *A. fleischeri* was added to the EPPO Alert List in 2018 (https://www.eppo.int/QUARANTINE/Alert_List/insects/Agrilus_fleischeri.htm) based on a suggestion by the NPPO of the United Kingdom. In March 2018, the Panel on Phytosanitary Measures suggested *A. fleischeri* as one of the possible priorities for PRA in 2018, and the Working Party on Phytosanitary Measures selected it for PRA in June 2018.

PRA area: EPPO region in 2018 (map at https://www.eppo.int/ABOUT_EPPO/eppo_members).

[1] Some recent publications consider *P. nigra* var. *italica* as a cultivar (e.g. Isebrands & Richardson, 2014) and not a variety. However, because it is a widely used tree and still considered as a separate botanical variety by others, the approach was followed here to consider it as as a botanical variety in its own right.

Stage 2. Pest risk assessment

Very limited information was found on *Agrilus fleischeri*, including on its biology and ecology, despite including literature from China (in English or Chinese) where this pest is currently causing damage. Therefore, extrapolations were sometimes made in this PRA using the knowledge available on the following four *Agrilus* species belonging to the same subgenus, *Uragrilus*, and which are of comparable size:

- *A. anxius,* the bronze birch borer, and *A. bilineatus,* the two-lined chestnut borer, are North American species, on which many studies from the USA and Canada are available.
- *A. ater* is a common pest of *Populus* and *Salix* in Europe where it is native, occasionally killing urban trees. It is closely-related to *A. fleischeri* (see *Taxonomy*) and it is considered that the both species are morphologically and biologically very similar including sharing some host plants (Jendek, personal communication, 2018).
- *A. planipennis*, the emerald ash borer, is an Asian pest of ash (*Fraxinus*) which was introduced into the North American continent and later to the European part of Russia (Haack et al., 2015). The outbreaks in North America have triggered an enormous interest in this species resulting in numerous studies. It is now probably the most studied *Agrilus* species and, perhaps, generally of all Buprestidae (Jendek & Poláková, 2014).
- *A. suvorovi* is known in the EPPO region and causes significant damage to poplars in southern and South-Central Europe.

Both *A. anxius* and *A. planipennis* have been subject to EPPO PRAs (EPPO, 2011, 2013a) and are, respectively on EPPO A1 and A2 List of pests recommended for regulation. A PRA is being prepared in parallel on *A. bilineatus*, a North American pest of *Quercus* and *Castanea dentata*.

1. Taxonomy

Taxonomic classification. Domain: Eukaryota; Kingdom: Metazoa; Phylum: Arthropoda; Class: Insecta; Order: Coleoptera; Family: Buprestidae; Genus: *Agrilus*; Species: *fleischeri* (Obenberger, 1925).

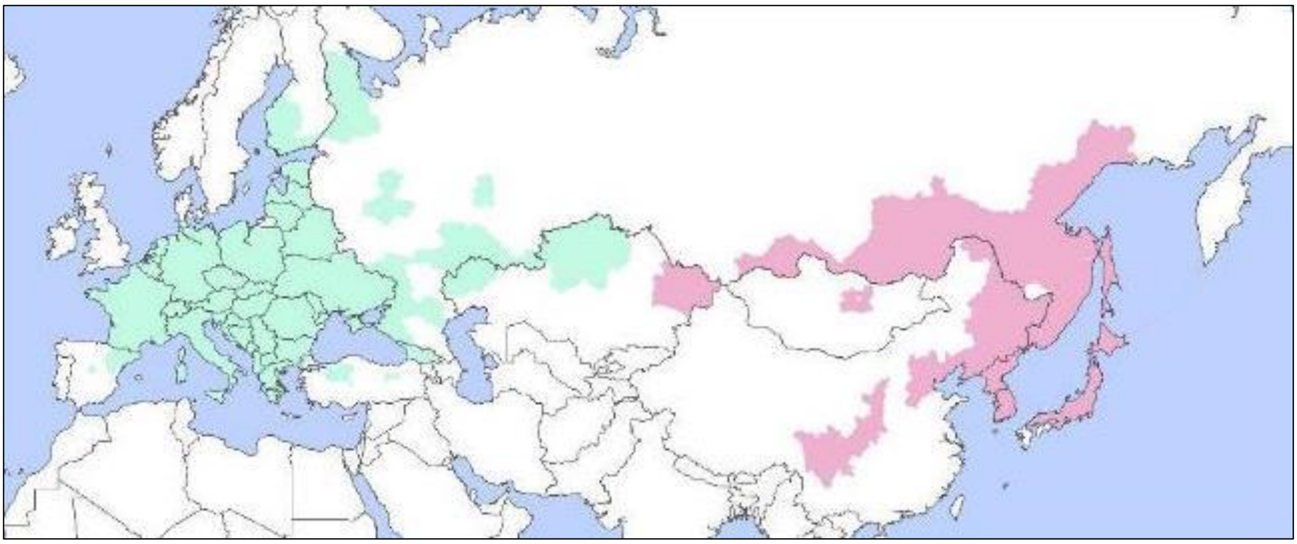
The taxonomy of *Agrilus fleischeri* is unsettled. The taxon is very similar, undoubtedly closely related to *A. ater* (Figure 1) and it has been sometimes considered by some authors as a subspecies of *A. ater* (Alexeev, 1989; Volkovitsh & Alexeev, 1988).

However, the current (valid) taxonomic concept is the species rank, which is supported by subtle differences between the two pests in terms of morphology (e.g. *A. ater* has aedeagus less expanded apically with flat parameres) (both aedeagus are shown in Figure 3). In terms of biology, it seems that *A. ater* prefers trunks with thick bark and its pupal chamber is usually situated in the bark (rarely in the outer xylem) (Schaefer, 1949) unlike *A. fleischeri*. *Agrilus ater* typically develops in stressed or dying trees, while *A. fleischeri* seems more aggressive and also attacks apparently healthy trees (Jendek, personal communication, 2018).

Both taxa follow to a large degree the distribution of pioneer arborescent *Populus* and *Salix* and show patterns of sympatric speciation by genetic polymorphism. Figure 2 displays known range of both species, *A. ater* and *A. fleischeri*, based on published data. The transition zone between both taxa is in Kazakhstan. So far, very few data exist from this region (Jendek, personal communication, 2018).

Figure 1. *Agrilus fleischeri* (left side) and *A. ater* (right)

Figure 2. Comparison of the distribution area of *Agrilus ater* (green) and *A. fleischeri* (red) (more information on *A. fleischeri* in Table 1). Map prepared by E. Jendek for this PRA (2018)



Synonyms. *Agrilus kurosawai* Obenberger, 1940; *Agrilus fleischeri kurosawai* Obenberger, 1940; *Agrilus tscherepanovi* Stepanov, 1954 (Jendek, 2005); *Agrilus kochi* Théry, 1942; *A. fleischeri nipponicola* Kurosawa, 1963 (Jendek & Grebennikov, 2011); *Agrilus fleischeri* var. *coreicus* Kurosawa[2], 1954 (Lee & Ahn, 2012).

English common names.
The name spotted poplar borer has been proposed (Wang, personal communication, 2018) but has not been used in the literature to date.

2. Pest overview
2.1 Morphology (Zang et al., 2017b)

- Eggs are oval or irregular in shape, changing colour from milky white to brown before hatching.
- Larvae are milky white to light yellow in color, with dark brown mouthparts and urogomphi.
- Pupae are exarate, initially milky white, with the eyes and the elytra milky white and then gradually changing to black.

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[2] The name *coreicus* Kurosawa, 1954 was proposed as a variety of *A. fleischeri* Obenberger, 1925. It was synonymized as unavailable synonym of the name *fleisheri* by Jendek, 2006.

- Adults are dark brown to black, glabrous, and beetles with six white elytral spots (the first and the second spot being usually linked on each elytra). The face of the male is green (or greenish blue (Lee & Ahn, 2012)), and that of the female is brown.

Photos of the life stages are given in ANNEX 2. Additional pictures can be viewed in the EPPO Global Database (https://gd.eppo.int/taxon/AGRLFL/photos).

Figure 3. Aedeagus of *Agrilus ater* (left) and *A. fleischeri* (right) (Jendek, personal communication, 2018)

Details on morphology can be summarized as follows

Stage	Colour/shape	Size
Eggs	milky white to brown, oval or irregular	0.9-1.3 mm long, 0.6-0.9 mm wide
Newly eclosed larvae	milky white to light yellow	2-4 mm long (Wang, personal communication, 2018)
Mature larvae		20-40 mm, 1.9-5.3 mm wide (Wang, personal communication, 2018)
Pupae	milky white	8.9 -13.3 mm long, 2.5-3.8 mm wide
Adults	dark brown to black, white elytral spots	7.8-12.3 mm long, 1.8-3.4 mm wide

2.2 Life cycle

The only detailed studies found on the life cycle of *A. fleischeri* is Zang et al. (2017b). These studies were conducted in the field during outbreaks in Liaoning (Nanmiao village, Saima Township, in Fengcheng city), in northeastern China, from April 2013 to September 2015 in plots containing *P. nigra* var. *italica* and *P. tremula* var. *davidiana* (cited as *P. davidiana*), as well as in the laboratory. No other studies are known from other areas where *A. fleischeri* occurs; the biology may be different in warmer climates, such as in southern China.

General:

- In the field, most individuals of *A. fleischeri* were found to be univoltine on *P. nigra* var. *italica* (one complete generation/year) and overwintered as mature larvae. On *P. tremula* var. *davidiana*, most individuals of *A. fleischeri* were semivoltine and overwintered the first year as 2nd or 3rd instar larvae, and the second year as mature larvae. So this experiment indicates that the insect larvae develop more slowly on *P. tremula* var. *davidiana* and a complete generation was completed in 2 years (Zang et al., 2017b). The life history on both host species is illustrated in
-
- Figure 4 and Figure 5.

Figure 4. Life history of *Agrilus fleischeri* on *Populus nigra* var. *italica* (Fengcheng, Liaoning Province, 2014–2015).

Date / Stage	Jan.-Apr.			May			Jun.			Jul.			Aug.			Sep.			Oct.-Dec.		
	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
Overwintering larva	▲	▲	▲	▲																	
Pupa				Θ	Θ	Θ	Θ														
Adult						+	+	+	+	+	+	+	+	+							
Egg							·	·	·	·	·	·	·	·	·						
Larva								Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ			
Overwintering larva															▲	▲	▲	▲	▲	▲	▲

Figure legends: E, M, and L denote the early, middle, and late period (ten days) of a month. ʘ, pupa. +, adult. ·, egg. △, larva. ▲, overwintering larva (Zang et al., 2017b).

Figure 5. Life history of Agrilus fleischeri on Populus tremula var. davidiana (synonym: Populus davidiana) (Fengcheng, Liaoning Province, 2014–2015).

Date / Stage	Jan.-Apr.			May			Jun.			Jul.			Aug.			Sep.			Oct.-next Apr.			May			Jun.			Jul.			Aug.			Sep.			Oct.-Dec.		
	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
Overwintering larva	▲	▲	▲	▲																																			
Pupa				Θ	Θ	Θ	Θ																																
Adult						+	+	+	+	+	+	+	+	+																									
Egg							·	·	·	·	·	·	·	·	·																								
Larva											Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ					
Overwintering larva																															▲	▲	▲	▲	▲	▲	▲	▲	▲

Figure legends: E, M, and L denote the early, middle, and late period (ten days) of a month. ʘ, pupa. +, adult. ·, egg. △, larva. ▲, overwintering larva (Zang et al., 2017b).

- No information was available on the number of accumulated degree-days needed for larval development.

<u>Adults and eggs:</u>

- Adults emerge through D-shaped exit holes (about 3 x 2 mm) (Zang et al., 2017b).
- In the field, after emergence females fed on poplar foliage for 2–11 days before mating, and for another 2–12 days before oviposition (Zang et al., 2017b).
- In experimental conditions (at an average equivalent to July in Fencheng of 23.4°C; 69% RH) on 1-meter-logs, females produced 218 eggs on average (range 0–614 eggs) throughout their lifespan, and laid on average 4 eggs per day (Zang et al., 2017b).
- The average longevity of adults in experimental conditions was about 34 days for both males and females (in the range of 2–82 days for males and 2–73 days for females) (Zang et al., 2017b).
- Eggs were laid either individually or in groups in bark cracks or crevices or beneath bark flakes (Zang et al., 2017b). Because the bark of *P. nigra* var. *italica* is coarse and has more bark crevices, it seems that the bark of this host is more suitable than the bark of *P. tremula* var. *davidiana*, which is smooth with few bark crevices (Zang et al., 2017a). As for *A. ater*, it is assumed that eggs will be laid on trunks and large branches if the bark is thick with crevices (Jendek, personal communication, 2018). However, presence on branches was never reported in China (Zang, personal communication, 2018).
- In experimental conditions (average 23.4°C, 67% RH), eggs hatched in 10–15 days (Zang et al., 2017b).

Larvae and pupae:

- In field experiments, neonate larvae bore into the bark until reaching the cambial region where they feed, often forming serpentine galleries under the bark, and with a few forming vertical galleries in *P. tremula* var. *davidiana* (Zang et al., 2017b).
- Early-instar larvae feed on the inner bark (phloem), cambium, and outer xylem (Figure 6).When larval densities are high; the galleries completely cover the phloem as well as the outer xylem, encircling the tree (Zang et al., 2017b).
- Late-instar larvae excavate a pupal chamber in the xylem, and then the forepart of its body folds backwards towards its abdominal segments, forming a J-shaped mature larva (Zang et al., 2017b). In *P. nigra* var. *italica*, mature J-larvae enter dormancy (possibly diapause) for overwintering and resume development to pupae the following spring in May (Zang et al., 2017b).
- Pupation takes place inside the tree and the lower-wall of the pupal chambers is located 4 to 14 mm beneath the surface of the outer xylem. In experimental conditions, development from pupa to adult (at an average of 17.5°C, 49% RH) took 25–29 days (Zang et al., 2017b).

Figure 6. Early-instar larvae of *A. fleischeri* feeding in the shallow outer-xylem, by Mr. Wang Xiao-Yi. More photographs available at https://gd.eppo.int/taxon/AGRLFL/photos.

2.3 Temperature requirements

There is little information about the temperature requirements of *A. fleischeri*. In Zang *et al.* (2017a & b), field studies were performed on two sites in Liaoning Province (see above). The annual average temperature for the growing season (May to September for 2013–2015, i.e. the study period) (Zang et al., 2017b), was approximately 21°C with a maximum of 35°C and minimum of 4 °C, while the average winter (December to March) temperature was about -3 °C. The annual rainfall was approximately 800–1200 mm.

2.4 Dispersal capacity of adults

Natural dispersal through adult flight has not been studied for *A. fleischeri*. Studies on the dispersal capacity are available for *A. planipennis* and *A. anxius* which are similar in size to adult *A. fleischeri*. *A. planipennis* is a strong flier. Adults typically fly in 8–12 meter bursts, but long distance flight of more than one kilometer is possible (Haack et al., 2002, citing Yu 1992, Minemitsu Kaneko, Japan Wildlife Research Center, Tokyo, Japan, personal communication). Flight distances of 0.3–19.3 km were reported, with a maximal dispersal of 1.37 km in an intensive quarantine zone (Taylor et al., 2010; Vannatta et al., 2012 citing Raupp, 2010 and Sargent *et al.*, 2010). *A. anxius* is capable of a natural spread of 16 to 32 km/year (Federal Register, 2003). By analogy with *A. planipennis*, when host plants are available, it can be assumed that the approximately 90 % of the individuals of *A. fleischeri* will disperse less than 100 m during one season (Mercader et al., 2009). At short distances (less than 200 m), in sites with more heterogeneous distribution of hosts, *A. planipennis* spread more towards areas with a higher abundance of ash than towards areas of low ash density (Siegert et al., 2010).

In conclusion, *Agrilus* beetles often have the capacity to fly considerable distances; however, they rarely do so and usually only fly short distances when suitable hosts are found in the immediate surroundings (Dunbar & Stephens, 1976).

2.5 Nature of the damage

Larvae develop mainly in the cambial region of infested trees, feeding on phloem (inner bark), cambium, and outer xylem. Feeding activity disrupts the transportation of water and nutrients in the tree. Larval galleries can completely cover all of this tissue when larval densities are high.
On *P. tremula* var. *davidiana*, which has smooth bark, a dark brown colouring of the infested part of the trunk is observed with longitudinal cracking (Zang et al., 2017a) which can affect wood quality (Wang, personal communication, 2018).

Figure 7. Dark brown colouring of an infested trunk of *Populus tremula* var. *davidiana* with longitudinal cracking, by Mr. Zang Kai. More photographs available at https://gd.eppo.int/taxon/AGRLFL/photos.

At low infestations, the trees still appear healthy (Jendek, personal communication, 2018) because *Populus* trees have diffuse porous xylem and, therefore, galleries have a lower impact on water conductivity compared to ring porous trees (Haack, personal communication, 2018). In addition to tree decline, Zang et al. (2017b) mention that, when high populations are present, larval galleries can girdle the trunk and kill the tree within 2 to 3 years.

In China, mortality caused by the pest was observed naturally in trees of *P. nigra* var. italica as well as in artificially girdled trees of *P. tremula* var. *Davidiana* (Wang, personal communication, 2018).

In addition, when population levels are high, adult feeding damages on leaves can be observed (Jendek, personal communication, 2018).

2.6 Trees attacked in a stand and location of the pest in the tree

The pest attacks the trunk of its hosts, and both apparently healthy and weakened trees of *P. nigra* var. *italica*. Stress factors can make the trees more susceptible to attack (Zang et al., 2017b).
A. fleischeri was described as a major wood-boring pest of both *P. nigra* var. *italica* and *P. tremula* var. *davidiana* in plantations in Fengcheng City, Liaoning Province, China in 2013 (Zang et al., 2017b).
The influence of poplar DBH (diameter at breast height), tree height and age on population densities and damage are known to be significant factors for *A. suvorovi* (which prefers to attack young trees (Monferrato, 1964; Rougon, 1998)) and *A. ater* (which prefers trees that are older than 5 years (Teunissen & Vendrig, 2017)). In a study in the Liaoning province, *A. fleischeri* is reported to colonize trees with an average DBH of

15.4 cm (13.1-18.2 cm, based on 12 trees) for *Populus nigra* var. *italica*, and an average DBH of 8 cm (6–10 cm) for artificially girdled *P. tremula* var. *davidiana*, (Zang et al., 2017a). Branches were not infested (Wang, personal communication, 2018). This was a study in a plantation and all trees were similar in size. Therefore, the ability to attack trees of other sizes needs to be further studied for *A. fleischeri*.

Exit holes produced by emerging adults were mainly concentrated 1–6 m above the surfaceline (mean DBH = 15.4 cm) on *P. nigra* var *italica* and at 1–3 m (mean DBH = 8.8 cm) for *P. tremula* var. *davidiana* (Zang et al., 2017a) which may suggest that the pest attacks smaller trees lower on the stem compared to larger trees. However, this could also be due to the difference in tree species.

2.7 Detection and identification

Signs and symptoms of infestation

- D-shaped exit hole (2 to 4 mm in length and 1.3 to 2.8 mm in width) (Zang et al., 2017b). (note. Exit holes of *Agrilus* can generally be observed before wilting for *Agrilus* infestations in diffuse-porous trees, but not on ring-porous trees, as shown for *A. planipennis* and *A. bilineatus*).
- Tortuous larval galleries filled with frass, which are typical for the genus *Agrilus*.
- Dark brown colouring of the trunk on some *Populus* species (e.g. for *P. tremula* var. *davidiana*, and young trees with thin bark) (Zang et al., 2017a). Cracking of the bark (Figure 7).
- Leaves turning yellow, top of the branches withering (Zang et al., 2017a).
- Dieback and dead trees.
- Signs of adult feeding on the margin of the leaves may be noticeable in large infestations (Jendek, personal communication, 2018).

None of the symptoms above are specific to *A. fleischeri*.

Additional considerations

All life stages (except adults) remain hidden (eggs in bark cracks; larvae, prepupae and pupae in the cambial region and xylem), making their detection more difficult. Trees infested by *A. fleischeri* can be apparently healthy or weakened (Jendek, personal communication, 2018) and present clear symptoms only if they are heavily attacked.

Symptoms expression is dependent on the host species. On *P. tremula* var. *davidiana*, which has a smooth bark, the initial symptoms are more apparent because of the dark brown discolouration and the clearer longitudinal cracking (Section 2.5 and Figure 7). On *P. nigra* var *italica*, which has a relatively rough bark, it is more difficult to distinguish the difference between affected and healthy trees in absence of exit holes (Zang et al., 2017a).

D-shaped exit holes produced by emerging adults may be few at first and they may be situated high in the canopy (i.e. not easily visible) on larger trees.

First emergence, and therefore the first appearance of D-shaped exit holes, can only be observed one to two years after the first infestation. Symptoms on infested trees as listed above are more easily observed in subsequent years after initial attack.

Because other *Agrilus* species are present in the EPPO region with similar body sizes and hosts, D-shaped exit holes on *Populus* and *Salix* are not characteristic of only *A. fleischeri*. Symptoms on trees are not characteristic either. D-shaped exit holes are produced by all taxa from the subfamily Agrilinae, in Europe particularly the genera *Agrilus*, *Coraebus* and *Meliboeus* (Jendek, personal communication, 2018).
Thus, first signs or symptoms following the introduction of *A. fleischeri* in the EPPO region may not be quickly identified.

Detection methods

No information was found on trapping of *A. fleischeri*. In China, field surveys are used to detect stressed trees, trees with dieback or dead trees (Wang, personal communication, 2018).

Different coloured sticky traps (green, purple, white and yellow sticky traps) have been used to capture *Agrilus* adults of other species. The green color is assumed to mimic green foliage, whereas purple is believed to have a similar reflectance as tree bark. Attraction to a specific trap color may depend on the species concerned and the sex, as well as where the trap is positioned in the tree (Petrice & Haack, 2015).

Males of several species of *Agrilus* (*A. angustulus*, *A. biguttatus*, *A. cyanescens*, *A. subcinctus*, *A. sulcicollis* and *A. planipennis*) are attracted to dead *Agrilus* adults when used as decoys and placed on host plants suggesting a common behavioral template for visual mate-finding among buprestids (Domingue et al., 2011; Lelito et al., 2011, 2007). 3D-printed decoys have also been used for *A. planipennis* (Domingue et al., 2015). Therefore, adding dead adults as decoys or silhouettes of an adult *Agrilus* may be used to improve attractiveness of traps.

As is true for *A. planipennis*, there is no reliable single method to detect low level populations of *A. fleischeri*. General monitoring methods such as trapping, visual examination for external symptoms on trees and tree sampling may be used, but they may not allow detection of low levels of infestations. The EPPO Standard PM 9/14 on *A. planipennis* (EPPO, 2013b), recommends the use of traps and biosurveys (with wasps that specialize in hunting buprestids) for situations of eradication and containment.

Girdled trees are found to be more attractive (Zang et al., 2017a), and may be used in specific situations (e.g. around the perimeter of an infested area to delimit this area) (Gninenko et al., 2012).

Identification
Morphological characters of *A. fleischeri* are given in several publications (Alexeev, 1989; Lee & Ahn, 2012; Stepanov, 1954). No identification key or molecular methods (no sequences are recorded in GenBank) for identifying *A. fleischeri* are currently available. Distinguishing *A. fleischeri* from *A. ater* is difficult and should be done by experts (Jendek, personal communication, 2018).

3. Is the pest a vector?

Yes	☐	**No**	✓

4. Is a vector needed for pest entry or spread?

Yes	☐	**No**	✓

5. Regulatory status of the pest
A. fleischeri is not listed as a quarantine pest by any of the EPPO countries (EPPO, 2018). It was added to the EPPO Alert List in 2018.

A. fleischeri was not found in the lists of regulated pests for other countries on www.ippc.int (neither under any of its previous names). However, *Agrilus* spp. (except *A. diaguita*, *A. sulcipennis* and *A. thoracicus*) are regulated pests for Chile (SAG, 2018). The information consulted is not exhaustive, and *A. fleischeri* may be regulated in more countries.

6. Pest distribution

A. fleischeri is native to Asia, including the eastern part of two EPPO countries, Russia and Kazakhstan (Jendek & Grebennikov, 2011). Details are given in Table 1 and visualized in Figure 8 and Figure 10.

Table 1. Distribution of *A. fleischeri* (details and uncertainties in the table)

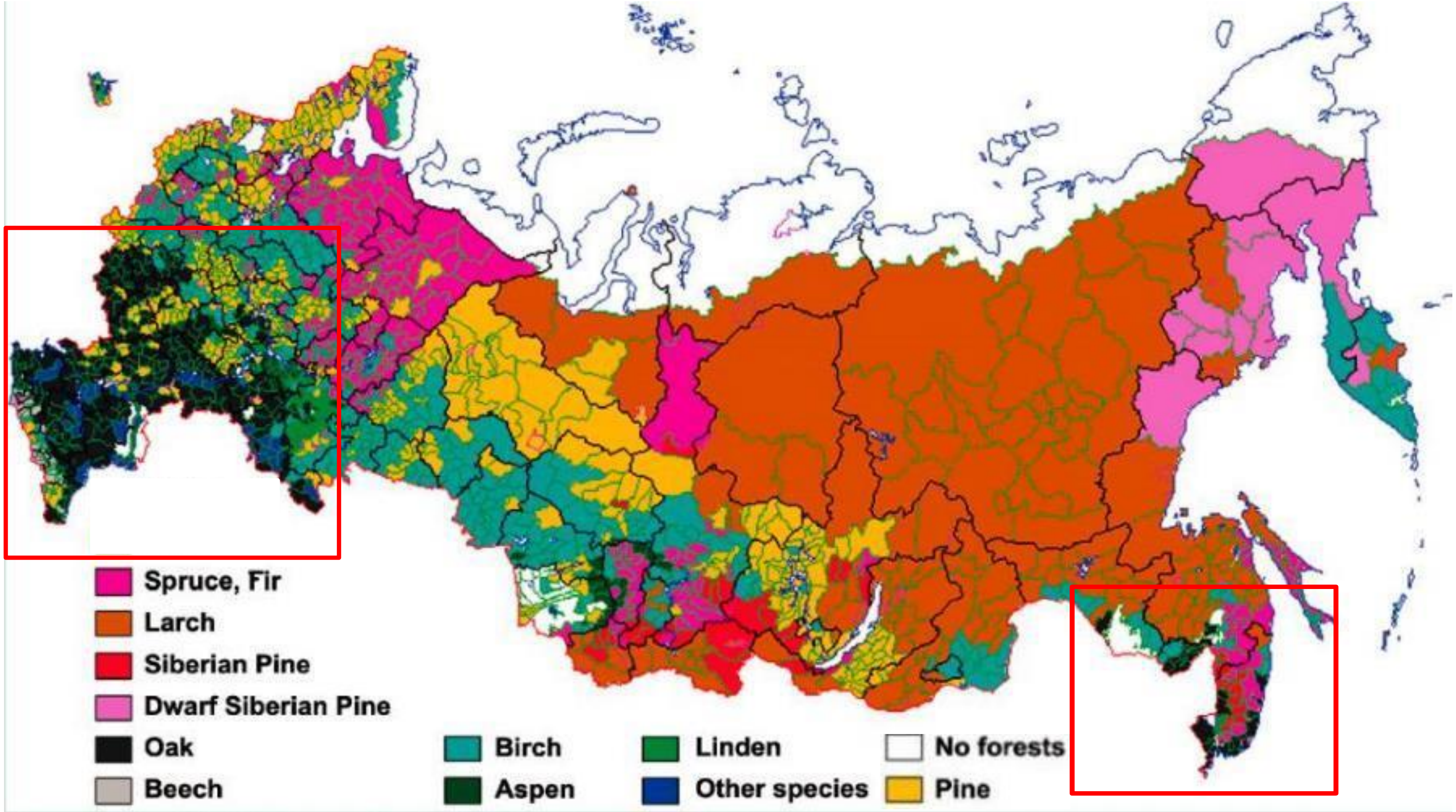
Region	Distribution	Additional details, references and uncertainties
EPPO region	**Kazakhstan**	First recorded in 2001. It is present in the Shyghys Qazaqstan oblysy (= East Kazakhstan) (Jendek & Grebennikov, 2011): S Altai montains and Ognevka (Jendek, personal communication, 2018). The pest was also found in the Dzhungar Alatau (Tleppaeva, personal communication, 2018).
	Russia	First reported from Berezovka, Transbaikalia, in 1925 (Jendek & Grebennikov, 2011). It is only reported in the south of Eastern Siberia and the south of the Far East (Jendek & Grebennikov, 2011; Vladivostok Dalnauka, 2009) which are located in the southeast of Russia.
Asia	**China**	First reported from Heilongjiang in 1939 (Jendek & Grebennikov, 2011). Present at least in the following regions: Beijing, Hebei, Heilongjiang, Liaoning, Shaanxi, Sichuan, Tianjin (Jendek & Grebennikov, 2011; Zang et al., 2017a, 2017b). The pest is also reported as present in Jilin region (two unpublished localities in Jendek collection) (Jendek, personal communication, 2018). Considered to be present in China wherever poplar is to be found (Jendek, personal communication, 2018).
	Japan	First records date from 1940 (Lee & Ahn, 2012). It is reported in Hokkaido, and Honshu (Akiyama & Ohmomo, 1997).
	Korea Dem. Rep.	First record in 1954 (Lee & Ahn, 2012)
	Korea Rep.	First reported in 2006 (Lee & Ahn, 2012)
	Mongolia	First reported in 2003. In Töv province (Jendek & Grebennikov, 2011; Lee & Ahn, 2012)

Figure 8. Distribution of *A. fleischeri* in Russia. Whole provinces are marked, no detailed distribution is given within provinces (prepared by the EPPO Secretariat, using © 2007–2018 d-maps.com)

in orange: provinces where the pest occurs; in blue: uncertain records (no record in the Russian literature, but probably present).

Remark: the Jewish province is surrounded by infested provinces in Russia and China, and aspen is reported as one of the major forest-forming-species in this province (Figure 9). Therefore, the pest is probably present in this province.

Figure 9. Distribution of the major forest forming species in Russia, including aspen (which includes *Populus* species) (VNIILM, 2003)



Red boxes: area where aspen is a major forest forming species

In Russia, forests where aspen (which includes *P. tremula*) is the major forest-forming species, are situated in the western part of Russia (European continent) and in the extreme south-eastern part of the country (Far East: Khabarovsk, Primorsky, Jewish) (Figure 4). Therefore, the presence of *A. fleischeri* in the Far East corresponds to the area where poplar is found in high density.

Figure 10. Distribution of *Agrilus fleischeri* in China. Whole provinces are marked, not detailed distribution is given within provinces (prepared by the EPPO Secretariat)

In red: provinces where outbreaks have occurred; in orange: other provinces where the pest has been recorded; in blue: records based on personal communication without reference in the literature

7. Host plants and their distribution in the PRA area

Host plants

A. fleischeri attacks poplar trees (*Populus* spp.) (see species in

Table 2). China is the leading country in terms of poplar forested areas (about 7.6 million ha) as well as the leading producer of poplar trees in agroforestry systems and outside natural forests (2.8 million ha in 2011) (FAO, 2012). Poplar are cultivated in all Chinese provinces, except Hainan (Dong & Wang, 1988; Fang, 2008). It should be noted that, in addition to *P. nigra* and *P. tremula,* China is home to a large number of other European native poplar species, including *P. alba*, which is widely grown in the EPPO region (Isebrands & Richardson, 2014), but no records were found of *A. fleischeri* attacks on this species. *A. fleischeri* has attacked *Populus nigra* var. *italica*, which is an exotic species in China, introduced from southern Europe and western Asia because of its fast-growing nature. *P. nigra* var. *italica* is used in China as a landscape tree, a street tree, for protective forest belts, as well as for making pulp and paper (Wang, personal communication, 2018). It is not known if *A. fleischeri* could also attack other *Populus* spp. currently not recorded as hosts.

Table 2. Hosts of *A. fleischeri.*

Host	Presence in PRA area (Yes/No/Not known)	References for host status	Confidence index* and/or life stage
Salicaceae			
Populus spp.	**Yes**	Alexeev, 1989; Jendek & Grebennikov, 2011	3/3
Populus nigra var. *italica*	**Yes.** Important plantation tree along roads, canals and in edges as windbreaks (Section 9.2).	Zang et al., 2017a, 2017b	Larvae, adults
Populus tremula	**Yes.** *P. tremula* is commonly growing in the EPPO region (ANNEX 7).	Jendek & Grebennikov, 2011. The report is assigned to *P. tremula* because it is the only host species known to be present in the area where the pest is reported (e.g. Berezovka, Transbaikalia)	Adults
Populus tremula var. *davidiana* (cited as *P. davidiana* by Zang et al, 2017a, 2017b and as *Populus sieboldi*[#] by Akiyama & Ohmomo, 1997)	**No.**	Zang et al., 2017a, 2017b; Akiyama & Ohmomo, 1997 (as *nipponicola*); Ohmomo & Fukutomi, 2013	Larvae, adults 3/3
Populus laurifolia	**Yes.** Ranges from eastern Kazakhstan and north-west China to Mongolia and Southern Siberia. It has also been cultivated occasionally in Europe (Bakulin, 2004; Isebrands & Richardson, 2014).	Stepanov, 1954 (as *tscherepanovi*);	3/3
Salix spp.	**Yes**	Alexeev, 1989; Carlson & Knight, 1969	3/3
Salix schwerinii (=*S. rjessoensis*, cited as *S. yezoensis*)	**Yes?** This species is native to Asia. It has been a parent in some hybridization work in Europe for biomass production (Isebrands & Richardson, 2014).	Reported as a host plant in Japan (Ohmomo & Fukutomi, 2013)	1/3, Adults

**The confidence index by Jendek & Polakova, 2014a, is ranging from 0–3, 3 being the highest level of confidence based on the presence of larval stage or on repeated captures of adults on leaves.*

[#] *Even though Jendek & Polakova, 2014a, is referring to* P. sieboldii, *the original publication by Akiyama & Ohmomo, 1997 is referring to* P. sieboldi. Populus sieboldi *Miq. is a synonym of* Populus tremula *var.* davidiana *(Dode) C.K.Schneid, whereas* Populus sieboldii *Miq. is a synonym of* Populus tremula *var.* sieboldii *(Miq.) H.Ohashi. Therefore, after a contact with Jendek E., it was decided to follow the original publication referring to* P. sieboldi *(synonym* Populus tremula *var.* davidiana*).*

Uncertain and erroneous host records

- Records of *A. fleischeri* on *Quercus* spp. (Alexeev, 1989) are considered erroneous (Jendek & Grebennikov, 2011; Jendek & Poláková, 2014).
- *A. fleischeri* was described as attacking willow species (*Salix* spp.) in Tianjin, Beijing, and Tangshan City, Hebei Province, China (Zang et al., 2017b, citing Wang, personal observation). However, this was confirmed later to be *A. dureli* and not *A. fleischeri* (Wang, personal communication, 2018).
- In addition to *P. nigra* var. *italica* which is also a host plant for *A. fleischeri*, the closely relative *A. ater* has the following published hosts: *P. alba*, *Populus alba* var. *pyramidalis*, *Populus balsamifera*, *Populus canadensis*, *Populus nigra*, *Populus tremula*, *Salix alba*, *Salix caprea* and *Salix cinerea* (Jendek & Poláková, 2014). It is very likely that *A. fleischeri* would be able to attack them as well (Jendek, personal communication, 2018).

For this PRA, all *Populus* spp. and *Salix* spp. are further considered as potential hosts.

8. Pathways for entry

A. fleischeri has already been shown to be transported with certain pathways. Canadian authorities have intercepted this beetle on two occasions on wood packaging material and wood dunnage from China (Table 6). Between 1984–2008, there were 49 distinct interceptions of *Agrilus* individuals at US ports-of-entry, of which 5 interceptions were in live plants, 30 in dunnage, 13 in crating and pallets, and 1 at large (i.e. not associated with wood or live plants) (Haack, unpublished data). In the EPPO region, 9 interceptions of Buprestidae (but not necessarily *Agrilus*) were reported between 2005–2017 in dunnage, pallets, wood packaging material and wood & bark. Three of these interceptions were from China (Table 3).

For wood products, *Agrilus* individuals would be most likely to complete development in items with some bark (e.g., logs and dunnage), given that *Agrilus* larvae feed in the cambial region and need bark to complete their development. However, it is possible for some individuals that have constructed pupal cells in the outer sapwood, that bark is not required.

Table 3. Interceptions of *Buprestidae* reported to EPPO and/or to the EU during the period 2005–2017 (source: Europhyt & EPPO reporting service). Legend: n.a. = not available.

Year	2009	2013	2014	2016	2017
Number of interceptions	1	2	1	1	4
Commodity (plant species)	Dunnage (n.a)	Wood pallets (n.a)	Wood packaging material (n.a)	Wood pallets (n.a)	A. Wood pallets (n.a) B. Wood & bark (*Eperua*) C. Wood & bark (*Juglans*) D. Wood & bark (*Ulmus*)
Origin	India	China	India	China	A. China B. Surinam C. USA D. USA

Remark: for all the wood pathways, by analogy with *A. planipennis,* it is considered that the pest is likely not to be associated with the heartwood, infesting only the bark and the outer sapwood.

In cut firewood stored outdoors, Petrice & Haack (2007) recorded successful adult emergence of *A. planipennis* one year after infested trees were cut, which was two years after they were initially infested.

Although it is possible that live *Agrilus* life stages could be transported in bark or wood chips (McCullough et al., 2007a; Økland et al., 2012), the risk of individuals completing their development would be greatest for those transported as J-larvae, prepupae, pupae, and pharate adults because they no longer need to feed before transforming to adults or emerging.

Specific issue for wood commodities: In China (including the area of high infestations in Liaoning), there is a ban on commercial logging in natural forests (Forest Trends, 2015). *Populus* trees are found both in natural forests (Forest Trends, 2015) and in plantations. This ban would therefore not restrict the trade of poplar wood from commercial plantations.

The *EPPO Study on wood commodities* ((EPPO, 2015b) or '*EPPO Study*' below) distinguishes many commodities (definitions in ANNEX 5). In this PRA, they were grouped into several pathways. This was done because the existence of a trade into the EPPO region is an important factor for assessing the risk, but there is no trade data for many of the commodities as described in the EPPO Study. The PRA relied on data from Eurostat, using existing CN customs codes, that can cover several EPPO wood commodities, hence the groupings proposed. Finally, the EPPO Study provides a preliminary assessment of pest risk for different types of pest groups depending on the initial material used to produce the commodity (e.g., different risks for wood chips produced from treated (heat treated or fumigated) or untreated wood). Such distinctions are not used here as there is no indication of specification at that level of the type of material entering the EPPO region.

It was noted that several railway freight routes have opened since 2011 between China and various European countries, through the Commonwealth of Independent States (CIS) (Shanghaiist.com, 2011; DB Schenker, 2017). They shorten transport time by about 15 days (GCR, 2017) compared to maritime transport (which may be over 40 days). Railway freight from China is planned to increase in volume, and in 2020 a high-speed freight train to Russia should further decrease transport times.

The following pathways for entry of *A. fleischeri* are discussed in this PRA. Pathways in bold are described and evaluated in section 8.1; other pathways were considered very unlikely for reasons stated in section 8.2.

- **Host plants for planting**
- **Round wood (with or without bark) and sawn wood of hosts**
- **Deciduous wood chips, hogwood, processing wood residues (except sawdust and shavings)**
- **Wood packaging material (including dunnage)**
- **Bark of hosts**
- **Cut branches**
- Natural spread
- Hitchhiking on other commodities or vehicles
- Furniture and other objects made of wood of host plants
- Wood sawdust and shavings, processed wood material, post-consumer scrap wood
- Seeds, fruits, bulbs and tubers, grain, pollen, stored plant products, soil and growing medium
- Movement of individuals, shipping of live insects, e.g. traded by collector

8.1 Pathways studied

All the pathways are considered for all *Populus* spp. and *Salix* spp., from areas where the pest is present to the EPPO region. Host plants for planting are presented in Table 4, wood commodities in Table 5 and Table 6. Bark of hosts and cut branches are discussed after these tables.

Examples of prohibition and inspection are given for some EPPO countries (in this express PRA the regulations of all EPPO countries were not analysed). Similarly, the current phytosanitary requirements in place in EPPO countries for the different pathways are not detailed in this PRA (although some were taken into account when looking at management options). EPPO countries would have to check whether their current requirements are appropriate to help to prevent the introduction of the pest.

Table 4. Host plants for planting

Pathway	Host plants for planting (except seeds, tissue culture, pollen)
Coverage	• Plants for planting in pots or similar (including bonsais), plants with bare roots, cuttings, scions. • Seeds, tissue culture, pollen are excluded because the pest is not associated with these pathways. Remark: Vegetative propagation of *Populus* for forest reproductive material is normally based on using cuttings (EPPO, 2008; Forestry Commission, 2007).
Pathway prohibited in the PRA area?	No (Note: in the EU, *Populus* plants for planting are prohibited from North America only. *Populus* and *Salix* have been listed on the provisional list of '*high risk plants*' in the EU. Therefore, in the EU, import of plants for planting of these genera will be prohibited from 14 December 2019, pending a risk assessment (EU, 2018))
Pathway subject to a plant health inspection at import?	Yes, partly, in some EPPO countries. - In the EU, *Salix* spp. and *Populus* spp. plants for planting having a stem diameter of 1 cm or more at their thickest point (Commission Implementing Decision (EU) 2015/893 on *Anoplophora glabripennis* and Commission Implementing Decision (EU) 2012/138 on *A. chinensis*), are subject to a specific plant health inspection for these pests at import. If produced in an infested country (such as China, Japan, Korea Dem. People's Republic, Korea Republic and Russia), the material should be grown under complete physical protection or in site surrounded by a buffer zone of 2km. However, this does not concern plants imported from Kazakhstan and Mongolia, for example. The buffer zone as well as a complete physical protection with a mesh size to exclude *Anoplophora chinensis* and *A. glabripennis* are not considered appropriate for *A. fleischeri*. - In the EU, any *Populus* spp. plants for planting is subject to a plant health inspection at import (with specific requirements related to the leaf rust *Melampsora medusae* which could indirectly allow the detection of infestation by *A. fleischeri*). This specific EU requirement does not concern *Salix* spp. even though *Salix* (>1cm) plants for planting should be accompanied by a phytosanitary certificate. After December 2019 in the context of application of EU regulation 2016/2031 (EU, 2016), all plants for planting (excluding seeds) will need to be accompanied by a phytosanitary certificate at import and an EU plant passport for movement within the EU. - In the EU, *Populus* spp. plants for planting for forestry purposes are regulated according to Council Directive 1999/105/EC (EU, 1999). Forest reproductive material coming from third countries should not be marketed within the EU unless it affords the same assurances as Community forest reproductive material. In particular, '*trees in stands must in general be free from attacks by damaging organisms*' and produced according to a specific certification scheme. However, neither *Salix* spp. plants for planting nor ornamental *Populus* spp. plants for planting are covered by this EU regulation.
Pest already intercepted?	No interception reported for the EU on plants for planting, not known for other countries. Five *Agrilus* interceptions have been reported on plants for planting in the USA.
Plants concerned	*Populus* and *Salix* species are the only known hosts. Records on *Populus* are more frequent than on *Salix*.
Most likely stages that may be associated	All life stages of *A. fleischeri* can be present in trees. However, no information is available on the minimum size or diameter of trees infested by *A. fleischeri* (Section 2.6).
Important factors for association with the pathway	*Populus* and *Salix* cuttings used for reforestation have generally a diameter below 2 cm. *A. fleischeri* seems to prefer stressed trees rather than healthy trees in China and nursery plants for planting are usually well maintained. Infestations are easier to detect if there are D-shaped exit holes from which adults emerged (this is only likely to occur in plants transported in non-cool conditions). In the context of import inspections, careful visual examination of the plants for presence of exit holes may enable an inspector to detect the presence of larvae. However, if only larvae are present, trees are lightly infested, and no adults have emerged, it will be very difficult to detect the presence of the pest. The presence of holes may be the result of attack by other insects, and they may not be conspicuous at low levels of infestation in a consignment.

Pathway	Host plants for planting (except seeds, tissue culture, pollen)
Survival during transport and storage	Eggs, larvae, pupae and callow adults can survive within the host plant during transport.
Trade	Between 2000 and 2012, 50000 nursery plants of *Salix* spp. (in 2005) and 11250 nursery plants of *Salix* spp. (in 2001) were imported from China. In addition, 3 plants of *Salix* spp. were imported from Japan in 2002. No other specific trade data of *Populus* or *Salix* plants for planting from infested countries to EPPO countries are given during this period (database used for Eschen et al., 2017 and concerns 14 EPPO countries). Remark: Bonsais of *Populus* spp. and *Salix* spp. imported from China, Korea Rep. and Japan can be bought on the internet for ornamental purposes (private use), escaping phytosanitary scrutiny and measures.
Transfer to a host	Eggs, larvae, pupae would continue their development once at destination. Emerging adults would already be on a suitable host.
Likelihood of entry and uncertainty	**Host plants for planting:** moderate with a high uncertainty (data on trade, size requirements for the larvae to develop, host range, pest distribution in Asia)

Table 5. Round wood (with or without bark) and sawn wood of hosts

Pathway	Round wood and sawn wood of hosts	Deciduous wood chips, hogwood, processing wood residues (except sawdust and shavings)
Coverage	This pathway intends to cover all types of round wood and sawn wood, including with or without bark. The understanding of sawn wood is as per definition in ISPM 5, i.e. wood sawn longitudinally, with or without its natural rounded surface with or without bark (FAO, 2018). Round wood includes logs, but also other types of material. Whole trees including branches, twigs, possibly stumps, may be harvested (e.g. as fuel wood). In addition, part of the commodity described in the EPPO Study as '*harvesting residues*' is a type of round wood (when in the form of tops of trees, branches, twigs etc.). - *composition*: Consignments of round wood (as logs) and sawnwood would generally be of one species. Harvesting residues (in the form of round wood) arise from the harvest of logs and may initially be from one tree species, but it is not known if they would be grouped with others tree species from other origins when traded (e.g. as fuel wood). Round wood intended for other purposes (e.g. fuel wood, production of chips) may contain a mixture of species. - *presence of bark*: round wood (as logs) and sawn wood may be traded with or without bark. Other types of round wood may also have bark attached. - *size*. Logs would normally be of a large size. For harvesting residues (in the form of round wood) and any material sold as fuel wood, the material may be of variable size (including branches, tops of trees, branches, twigs etc.). **Sawn wood of less than 6 mm of thickness is considered to pose a minimal risk because larvae and pupae will be damaged during the processing.** - *intended use*. Such commodities may be used for construction, furniture, long poles, energy purposes or processed (such as chips, pulp, fibreboard etc.).	*Note '(except sawdust and shavings)' is not repeated below to simplify but is intended throughout this pathway.* Where harvesting residues are in another form than round wood (e.g. residues from squaring), the EPPO study considers that they would either be left on-site or be transformed on-site, in which case they become another commodity (e.g. wood chips, hogwood). All these commodities may be used for different purposes, such as pulp, fibreboard production, energy purposes, mulch. - *composition:* depending on the intended use, wood chips are produced from one or a mixture of species. This is not known for the other commodities but would presumably be the same. - *presence of bark:* wood chips or hogwood may be produced from different types of initial material (e.g. wood with or without bark, post-consumer scrap wood etc.). Processing wood residues are residues from round and sawn wood, e.g. made from off-cuts, and may have bark attached. As a consequence, at least part of these commodities may include some bark. - *size:* wood chips are produced through a shredder using a round-hole sieve that defines the dimension of chips (e.g. <2.5 cm) on two sides (not the third). The European Standard on solid fuel (Alakangas, 2010; CEN, 2010) identifies four classes of wood chips according to size; in the class with the largest wood chips, 75% of wood chips should be comprised in the range 16–100 mm, and 6% can measure 200–350 mm. Hogwood or processing

Pathway	Round wood and sawn wood of hosts	Deciduous wood chips, hogwood, processing wood residues (except sawdust and shavings)
		wood residues have no size requirement. As a consequence, both wood chips and hogwood can be quite large. - *intended use*: use of the wood commodities as mulch presents the highest risk (as facilitating transfer of pests to nearby trees), but this is a minor use of such commodities. Plywood, particleboard production, pulp or biomass for energy would be the main uses of such *Populus* products (Castro & Fragnelli, 2006).
Pathway prohibited in the PRA area?	No	No
Pathway subject to a plant health inspection at import?	Yes, partly, in some EPPO countries. - In the EU, round wood and sawnwood of *Populus* and *Salix* imported from an *Anoplophora glabripennis*-infested country should be accompanied by an import certificate and inspected (Commission Implementing Decision (EU) 2015/893 on *Anoplophora glabripennis* and Commission Implementing Decision (EU) 2012/138 on *A. chinensis*). The wood should originate either from pest-free areas or have been heat treated (56°C, 30 minutes at his core). This concerns China, Japan, Korea Dem. People's Republic, Korea Republic and Russia. However, this does not concern all areas where *A. fleischeri* is known to occur (e.g. Kazakhstan, Mongolia, southern part of Eastern Siberia in Russia,). - In the EU, round wood and sawnwood of *Populus* should be either bark-free or have undergone a kiln-drying to below 20 % moisture content, expressed as a percentage of dry matter, achieved through an appropriate time/temperature schedule. This would decrease the risk of presence of *A. fleischeri*, but this is not considered enough as the pest may be present in the debarked wood, and because reaching 20% of moisture content when undergoing kiln-drying may be achieved using low temperatures compatible with the survival of *A. fleischeri* (EUPHRESCO, 2010). - In the EU, isolated bark of *Populus* spp. should be imported with an import certificate. In addition, specific requirements exist for *Populus* originating in the American continent. No requirement is given in the EU for wood or wood bark of *Salix* spp., apart from the ones defined for *A. glabripennis* and *A. chinensis* infested countries.	Yes, partly, in some EPPO countries. - In the EU, wood in the form of chips, particles, shavings, wood waste and scrap originating in third countries, where *Anoplophora glabripennis* is known to be present (e.g. China) shall be accompanied by an import certificate and inspected (Commission Implementing Decision (EU) 2015/893 on *Anoplophora glabripennis*). The wood should originate either from pest-free areas or have been heat treated (56°C, 30 minutes at its core) or should have been processed into pieces of no more than 2,5 cm thickness and width. The heat treatment and the cutting into 2.5x2.5 cm pieces is assumed to efficiently eliminate the pest (see below). However, this does not concern all areas where *A. fleischeri* is known to occur (e.g. Japan, Kazakhstan, Mongolia, southern part of Eastern Siberia in Russia,).
Pest already intercepted?	No interceptions have been reported for the EU on this pathway, it is not known whether there have been interceptions in others EPPO countries. However, interceptions of other Buprestidae have already been reported in the EU on this pathway (for other host plants). *Agrilus* larvae are sometimes intercepted in wood packaging material and dunnage.	No interceptions reported for the EU on this pathway, not known for other regions.
Plants concerned	*Populus* and *Salix* are the known hosts.	As for wood.

Pathway	Round wood and sawn wood of hosts	Deciduous wood chips, hogwood, processing wood residues (except sawdust and shavings)
Most likely stages that may be associated	The presence of eggs and feeding larvae on this pathway are restricted to wood with bark. Mature larvae and pupae may be associated with wood with or without bark. Adults would be associated with consignments of wood only if they are still in their pupal cells or emerge during transport or storage.	Given the size of larvae and pupae, both are likely to be associated with this pathway. Live mature larvae or pupae are likely to be killed during processing if wood pieces are smaller than 2.5 x 2.5 cm in two dimensions (see below).
Important factors for association with the pathway	The pest is only reported to cause outbreaks in part of its known distribution (Liaoning province). There may be many larvae or pupae in one trunk. Debarking will destroy or remove eggs and feeding larvae. The presence of bark on the wood would favour survival of larvae. Low levels of infestation may not be detected. The pest would probably be more easily detected in sawn wood as galleries may be seen after sawing (in relation to short galleries when the insect enters to molt and pupae), or in round wood without bark because larval galleries can be seen directly on the sapwood surface. As for *A. planipennis* and *A. bilineatus*, date of cutting may greatly affect the number of viable larvae present in the wood (Haack & Benjamin, 1980; Petrice & Haack, 2007). A lower proportion of the pest may survive in trees cut early during the summer when most larvae are early instars (Haack & Benjamin, 1980). The concentration is expected to be higher in wood for bio-energy use, as wood of poor quality is usually used for this purpose and no treatment is applied afterwards.	The pest is only reported to cause outbreaks in part of its known distribution (Liaoning province). As heavily infested trees cannot be used as round wood or sawn wood, they may be processed (e.g. into wood chips). For poplar and willow wood chips, there are existing requirements (e.g. in the EU) based on size, i.e. that chips should be below 2.5 x 2.5 cm in two dimensions, which would make it very unlikely that mature larvae, pupae and recently formed adults would survive the process. However, the third dimension can be of any size. The higher risk of introduction would arise from the presence of mature larvae or pupae (see other considerations below).
Survival during transport and storage	Larvae would survive during transport (transit), and during subsequent storage if they have enough bark and wood at their disposal, and that the bark and wood remains suitable for feeding/boring galleries. This is considered possible as there are reports of live larvae of other *Agrilus* species having survived on dying or dead trees in dunnage (although it may be more difficult on small diameter wood). Pupae would survive. If adults emerge during transport, their survival would be more limited. Indeed, adults of the related *A. anxius* have a similar life span (2–82 days) and were shown to have a limited survival time without food (4–7 days), and to require maturation feeding on leaves for oviposition (PRA for *A.* anxius; EPPO, 2011 citing others).	Chipping of infested wood greatly reduces survival of *Agrilus* species such as *A. bilineatus* (Dunbar & Stephens, 1974), *A. auroguttatus* (Jones et al., 2013) and *A. planipennis* (McCullough et al., 2007b). Chipping would cause high larval mortality because of the chipping process. This was demonstrated for *A. planipennis* prepupae using a horizontal grinder with a 2.5 cm x 2.5 cm screen: no evidence of survival was observed (McCullough et al., 2007a). Chipping below 2.5 cm x 2.5 cm is considered effective against *A. planipennis* [and therefore against *A. fleischeri* which has a similar size]. However, it cannot be excluded that surviving prepupae could have been found if a larger volume of wood chips would have been used in the experiment (Økland et al., 2012). Further, mortality of any insects that would survive chipping is presumed to be high since the chips are usually dry and because of all other treatments (Dunbar & Stephens, 1974). Poplar chips may be used to make Oriented Strand Boards (OSB). In that case, the risk of *A. fleischeri* being present in OSB is even lower because of the OSB production process.

Pathway	Round wood and sawn wood of hosts	Deciduous wood chips, hogwood, processing wood residues (except sawdust and shavings)
		In addition, young larvae would not be able to survive and complete their development since the amount of phloem would not be enough and of suitable quality. Mature larvae and pupae can survive in pieces of wood in which they have survived the chipping processing. Such commodities may be stored in big piles. The temperature in the core of the bulk for wood chips may become high (e.g. 60° C) due to composting effect, which will likely be detrimental to the pest. Temperatures in the periphery of the pile are expected to be much lower and seldom lethal. Thus, only part of the consignment/pile is likely to present conditions that would allow survival of larvae and pupae. If adults at the periphery of consignments emerge during transport, they would not find foliage to feed if the consignemnt is enclosed in a way which would prevent escapes in transits. They are less likely to survive, feed and reproduce (see assessment for "Round wood and sawn wood of hosts").
Trade	Detailed data is lacking on the trade of host species from countries where *A. fleischeri* occurs. However, *Populus nigra* and several other *Populus* spp. (not known as host species) and several *Salix* spp. are in the Working List of Commercial Timber Tree Species (Mark et al., 2014). It should be noted that some EPPO countries such as Italy and Belgium (Section 11) are major importers of poplar round wood and wood products from EPPO (non-infested) countries such as France and Hungary. This may present a risk in case of origin shift to an infested third country where *A. fleischeri* occurs in the future. <u>- Round wood</u> Trade data is available in Eurostat (i.e. into the EU) for '*Poplar and aspen* 'Populus spp.*' in the raw, whether or not stripped of bark or sapwood or roughly squared*' (EU CN code 44039700). Data was extracted for years 2012 to 2017. In 2017, there were major imports from Russia (180 000 t) mainly by Finland and Sweden (ANNEX 8, table 1). However, the species are not known. It should be noted that most of the tree production from the eastern Russia (e.g. Far East) are exported to the neighbouring area (China, Japan, Korea Dem. Rep., Korea Rep. and Vietnam) and not to the EPPO region (Milakovsky & Feditchskina, 2014). <u>- Sawn wood</u>	FAOStat (which includes data for most EPPO countries) groups coniferous and non-coniferous wood chips and was not useful here. Trade data is available in Eurostat (i.e. into the EU) for deciduous wood chips ('*Wood in chips or particles (excl. those of a kind used principally for dying or tanning purposes, and coniferous wood)*' (EU CN code 44012200), and for '*wood waste and scrap (whether or not agglomerated in logs, briquettes or similar forms (excl. sawdust and pellets)'* (EU CN 44013980). These data overlap several commodities as described in the EPPO Study; '*wood chips*' likely covers hogwood; '*wood waste and scrap (whether or not agglomerated in logs, briquettes or similar forms (excl. sawdust and pellets)*' would cover part of processing residues, possibly of harvesting residues, as well as other commodities that do not present a risk; it would cover both deciduous and coniferous wood. Data was extracted for 2013 to 2017 (ANNEX 8, Table 4 and 5). <u>- Wood chips</u> Major imports from Russia (260,000–343,000 t) in 2013–2017, mostly to Finland, but also to Estonia and Denmark, and more recently to Sweden. Minor and irregular imports to other countries: *China: 23 t to 5,457 t in 2013–2017 (highest value for 2016) *Korea Rep.: 3 to 123 t per year in 2013–2017 *Kazakhstan: 14 t in 2017 *Japan: 0.2 to 4 t per year in 2013–2017

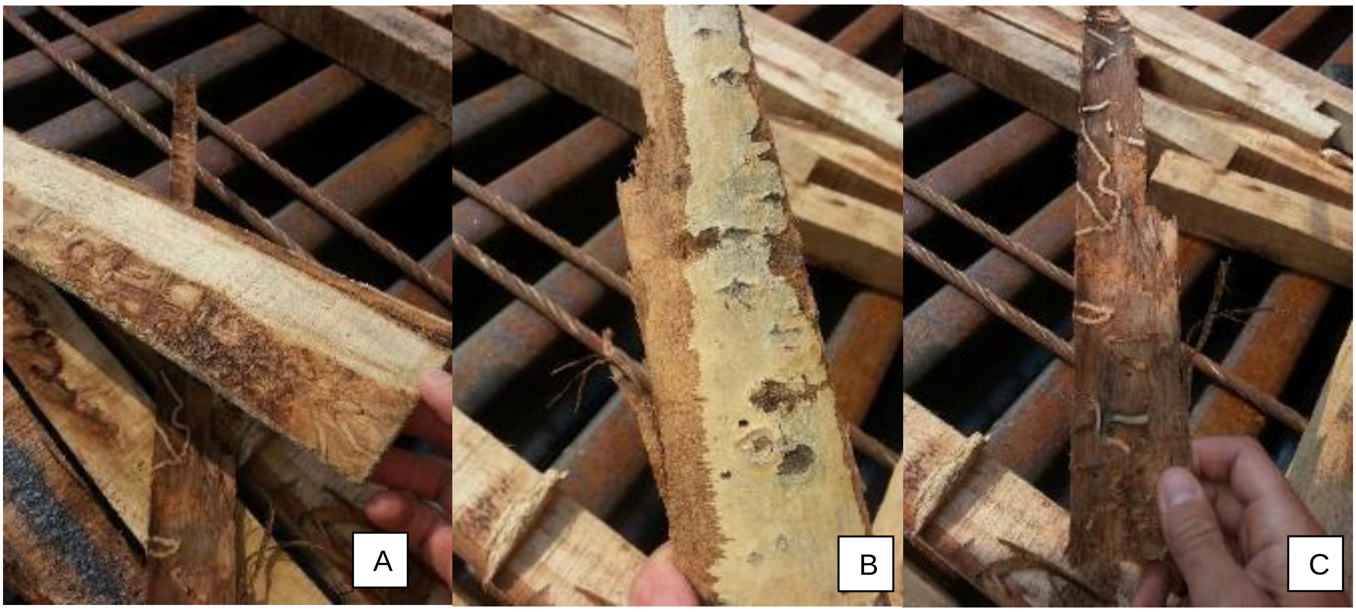
Pathway	Round wood and sawn wood of hosts	Deciduous wood chips, hogwood, processing wood residues (except sawdust and shavings)
	Trade data is available in Eurostat (i.e. into the EU) for '*poplar wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness exceeding 6 mm* (EU CN code 44079991). Data was extracted for years 2013 to 2017 (ANNEX 8, table 2). There were imports from Russia (302 – 565 t per year) and China (81 – 420 t per year) in 2013–2016.	- Wood waste and scrap Major imports from Russia in 2013–2017 (163,650 t to 222,202 t depending on years), in 2017 mostly to Belgium and Finland. Minor and irregular imports from other countries in 2013-2017: *China: 89–154 t per year * Japan and Korea Rep.: 0.3 t to 7 t per year
Transfer to a host	Wood is often stored outdoors. If mature larvae or pupae are present in the wood, adults could emerge later. Wood is often stored close to forest or trees, so transfer is considered possible. Emerging adults would need to find a suitable host tree species (i.e., live poplars or willows with foliage). The survival of young larvae would depend on their developmental stage and the availability of suitable quantity of wood in a suitable state. However, the conditions in drying wood are unlikely to allow their full development for more than 1 year (see introduction of Section 8). This also assumes that the wood is not used/processed before it becomes unsuitable to support the developments of the pest.	Transfer would be similar as for wood. In addition, transfer would be facilitated if the commodities are used outdoors (e.g. ground cover, mulch) or stored outdoors for enough time prior to processing, allowing emergence (e.g. chips for energy). However, products for ground cover (mulch) likely constitute to a small part of imports. Adults would need to find a suitable host tree species.
Likelihood of entry and uncertainty	**Round wood with bark.** Moderate (pathway highly favourable to entry of the pest from biological considerations. Limited trade from the infested area to the EU) with moderate uncertainty (volume of trade, lack of information on requirements for non-EU countries, end-use of wood, size of the logs that are traded, distribution of the pest, little knowledge on the biology of *A. fleischeri*) **Round wood without bark.** Very low with high uncertainty (real impact of the debarking process on the pupae, size of the logs that are traded, distribution of the pest, little knowledge on the biology of *A. fleischeri*) **Sawn wood of more than 6 mm with bark.** Low with moderate uncertainty (amount of bark, thickness of the sawn wood that are traded, proportion of sawn wood that was dried or not, distribution of the pest, little knowledge on the biology of *A. fleischeri*) **Sawn wood of more than 6 mm without bark.** Very low with moderate uncertainty (thickness of the sawn wood that are traded, proportion of sawn wood that was dried or not, distribution of the pest, little knowledge on the biology of *A. fleischeri*)	**Wood chips >2.5 x 2.5 cm in two dimensions, hogwood, processing wood residues.** Moderate with high uncertainty (distribution of the pest, proportion of poplar and willow within the consignment, proportion of wood imported from the infested area in Russia, types of processing wood residues that are traded) **Wood chips <2.5 x 2.5 cm in two dimensions.** Low with moderate uncertainty (impact of the process in real conditions on the survival of the pest, distribution of the pest, proportion of wood imported from the infested area in Russia)

Table 6. Wood packaging material

Pathway	**Wood packaging material**
Coverage	Pallets, dunnage etc. moving in trade
Pathway prohibited in the PRA area?	In international trade, WPM must be debarked and treated according to ISPM 15 (FAO, 2017a). However, unintentional noncompliance or fraud may occur (Haack et al., 2014).
Pathway subject to a plant health inspection at import?	In the EU, consignments are inspected randomly to check compliance with ISPM 15. In addition, Implementing decision 2013/92/EU (EU, 2013b) defines the supervision, plant health checks and measures to be taken on wood packaging material actually in use in the transport of specified commodities originating in China. It is expected that other EPPO countries also inspect randomly.
Pest already intercepted?	Yes: *A. fleischeri* has been intercepted in Canada associated with wood packaging material on two occasions: 1992: Adult insects on crates of a shipment intercepted in Vancouver that originated in Shaanxi province (China) and moved through the port of Tianjin Xingang. The packing material was deemed '*heavily*' damaged. However, it was not recorded whether damage was due to *A. fleischeri* or *Anoplophora glabripennis*, which was intercepted at the same time on the same material. 2015: One live adult and one pupa intercepted on non-compliant (i.e. with bark) wood dunnage (identified by inspectors as being poplar) on a ship in the port of Hamilton, Ontario. The shipment originated from China (Figure 11) (Damus, personal communication, 2018).
Plants concerned	*Populus* spp. wood is one of the main species used in China for wood packaging material (EU, 2013a). Poplar is a wood usually accepted for contact with all food types, including solid foods (e.g. it is also used for fruit and vegetable pallet boxes) (FEFPEB, 2018). Wood packaging material is built from wood of many tree species. It is comprised of wood-based products such as sawn wood, plywood, particle board, oriented strand board, veneer, wood wool, etc., which have been created using glue, heat, and pressure or a combination thereof used in supporting, protecting, or carrying a commodity (includes dunnage).
Most likely stages that may be associated	Larvae, pupae and newly formed adults may be present in pieces of wood used for wood packaging material if they consist of wood pieces larger than 2.5 x 2.5 cm in two dimensions. *A. fleischeri* has been intercepted in Canada associated with wood packaging material on two occasions, showing that at least pupae may be present in such material, and that development into adults has occurred in such material.
Important factors for association with the pathway	For mature larvae or pupae to still be alive in the wood packaging material, it would assume that: 1) Pieces of wood from infested trees have been used and the wood packaging material was made from recently harvested wood. The risk would be higher if wood packaging material is made from trees harvested at the time of the year when the mature larvae are entering the sapwood to overwinter, or later to pupate; 2) Treatments in ISPM 15 *Regulation of wood packaging material in international trade* (FAO, 2017a) were not applied or bark was not removed. ISPM 15 requires that all wood packaging material moved in international trade has to be debarked and heat treated (either 56°C for 30 min at its core if using a conventional chamber or dry kiln heat chamber; or 60 °C for 1 minute throughout the entire profile of the wood if using dielectric heating) or fumigated with methyl bromide (and stamped or branded with a mark of compliance). These treatments are internationally considered adequate to destroy insects (eggs, larvae, pupae) present in wood packaging material at the time of treatment. However, there are evidence that fraudulent marks are sometimes used (Eyre et al., 2018).
Survival during transport and storage	If ISPM 15 treatments were not applied, mature larvae and pupae would survive, allowing adults to emerge. If large amount of bark was not removed, this is the evidence that ISPM 15 Standard was not fully applied, and younger larvae may also survive.
Trade	No data was sought, but there are very large quantities of wood packaging material moving in trade (although only a small part would contain infested host wood material). Estimates based on the number of shipping containers moving goods from China to the EU suggest that approximately 4 million shipping containers containing solid wood packing material arrive in the EU annually from China (EPPO, 2015a).
Transfer to a host	If mature larvae or pupae are still present at destination, they may emerge, and adults may find hosts. Transfer would require certain circumstances, i.e. that

Pathway	Wood packaging material
	the wood packaging material is kept outdoors at destination, in an area where host plants are present and during a time period when host foliage is available. In places where used wood packaging material is collected in large quantities (e.g. for recycling), the probability of having several infested items increases. Because of the expected higher level of adults emerging, the probability of adults finding suitable hosts and mating also increases (EPPO, 2015a).
Likelihood of entry and uncertainty	**Proportion of Wood packaging material** - **on which ISPM 15 is appropriately applied.** Very low with low uncertainty - **which is not appropriately treated according to ISPM 15.** Moderate with high uncertainty (amount of bark, thickness of the wood that is used)

Figure 11. Symptoms of *A. fleischeri* on intercepted wood dunnage (2015, Ontario): galleries observed under the bark (A, C) and D-shaped exit holes on the surface of the bark (B). *Photographs by S. Cecchini, Canadian Food Inspection Agency.*



- *Bark of hosts.*
  This covers bark traded on its own, with the understanding that in bark consignments, pieces of cambium or wood may be attached to the bark (EPPO, 2015b). Eggs could be present on the bark before harvest, and larvae can be associated to thick bark. Mature larvae and pupae are in the outer-xylem and are unlikely to be associated with bark consignments. Some eggs or larvae would be destroyed during the removal of the bark and further processing. Early life stages would not complete their development in the absence of a sufficient quantity of wood, and because the material would degrade. Even if there was sufficient wood material, the further development to pupa would take about 1 year, during which the attached bark and wood would dessicate and probably become unsuitable for larvae. There is no information on the trade of bark of hosts into the EPPO region. In the EU, isolated bark of *Populus* spp. should be imported into the EU with an import certificate which will require phytosanitary inspections, but detection of the pest may be difficult in bark consignments. The intended use of bark may vary, from energy purposes to mulch. Mulching would present a higher risk. More recently, poplar barks are used as panels to cover interior or exterior house walls (**Erreur ! Source du renvoi introuvable.** and **Erreur ! Source du renvoi introuvable.**).

Figure 12. Example of two different grades of poplar bark panels

Premium Grade for outdoor use (1.6–2.5 cm thick) and Indoor Grade (0.6–1.4 cm thick)
Source: https://www.prlog.org/10537076-parton-bark-siding-increases-thickness-standard-of-poplar-bark-shingles.html

Figure 13. Poplar bark panels for outdoor use.

Source: https://barkhouse.com/whole-system-architectural-bark-wall-coverings-wood-wall-treatments/poplar-bark-shingles/

However, such bark panels may be dried at high temperatures (e.g. 65°C) that would reduce survival of the pest. If adults emerge, they would need to fly and find a suitable host.
Likelihood of entry: Low (low volumes)*; Uncertainty:* high (lack of experimental data confirming that the pest does not pupate in the bark).

- *Cut branches of hosts.* It is not known whether cut branches of any of the host tree species are used (e.g. for decoration), nor if they are traded as such at international level. *A. fleischeri* is not known to be associated with branches. Cut branches would be of a small diameter and it is not known either whether *A. fleischeri* could infest small diameter material. Life stages could survive and continue development, but emerging adults are unlikely to survive/find food in transport (leaves would probably be lacking or be unsuitably dry on such material). This may be a pathway (if the trade exists) for mature larvae and pupae if adults emerge at destination and find a host. However, such branches are often used indoors.
Likelihood of entry: Low*; Uncertainty:* High (association with branches or not, volume of trade, use of this material)

For all pathways and at the scale of the PRA area, the EWG considered that the current phytosanitary requirements in place are not enough to prevent the introduction of *A. fleischeri* into the EPPO region, even considering existing restrictions on movement of *Populus* spp. and *Salix* spp. plants for planting and wood (e.g. in the EU).

Overall rating of the likelihood of entry combining the assessments from the individual pathways considered:

Rating of the likelihood of entry	*Very low* ☐	*Low* ☐	*Moderate* ☒	*High* ☐	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* ☐	*High* ☒

8.2 Unlikely pathways: very low likelihood of entry

- *Natural spread from countries where* A. fleischeri *occurs to EPPO countries where it does not occur*.
A fleischeri is present in Kazakhstan and Mongolia, which are close to other Central Asian countries. However, there is no evidence of natural spread towards other countries, nor from Far East Russia and Eastern Siberia, where the pest has been present for many decades. Absence of spread may be due to

ecological barriers (absence of hosts, mountains, deserts). Natural spread is not excluded if it was introduced elsewhere in the EPPO region or in regions that border the EPPO region (section 11).
Uncertainty: low.

- *Hitchhiking on other commodities or in vehicles.*
Hitchhiking on vehicles was considered as a pathway for *A. planipennis* (PRA on *A. planipennis*, EPPO, 2013a) for spread of adults over relatively short distances (i.e. neighbouring countries). Adults of *A. fleischeri* may have a long life duration (range 2–82 days) but in the absence of foliage, their survival would probably be limited. Adults of the related *A. anxius* have a similar lifespan and were shown to have a limited survival time without food (4–7 days), and to need maturation feeding for oviposition (PRA for *A. anxius*; EPPO, 2011 citing others). Although hitchhiking cannot be excluded, it may be limited to countries that are relatively close to an infestation, i.e. possibly from the East of Kazakhstan to Khirghistan and from East Kazakhstan and East Siberia to Western Siberia. Hitchhiking may play a role in local spread if it is introduced somewhere else in the EPPO region (as for *A. anxius* and *A. planipennis* – EPPO, 2011, 2013b). The likelihood of entry through hitchhiking may increase in the future with trade using high-speed trains.
Uncertainty: moderate

- *Furniture and other objects made of wood of host plants.*
Some minor uses of objects made of wood of poplar and willow are reported such as poles, baskets, matches, furniture and cricket bats (FAO, 2012). For most of these objects, except rustic furnitures and decorations, any hole would be seen as a defect. Insects may have been killed during the manufacturing process. As the wood dries, the wood may become less suitable for larvae and, if pupae are present in the wood, it is not known if adults would be able to emerge from very dry wood. Some traded wood objects are known to allow the movement of insects: the longhorn beetles *Monochamus alternatus* (vectoring *Bursephalenchus xylophilus*) and *Trichoferus holosericeus* have been found in dining chairs, *Trichoferus campestris* in a wooden cutlery tray, and *Leptura quadrifasciata*, in a railway sleeper (Hodgetts et al., 2016; Ostojá-Starzewski, 2014). However, the size of some objects made of wood may not be sufficient to allow the presence or the complete development of the insect.
Remark on plywood: It is reported that China exports 5.3 million m^3 of plywood to the USA, Japan and the United Kingdom, measured in round wood equivalents (FAO, 2012). However, plywood is not considered to present a risk for entry.
Uncertainty: Moderate

- *Sawdust and shavings, processed wood material, post-consumer scrap wood* (see definitions in ANNEX 5). EPPO Study (EPPO, 2015b) assesses the risk as being low for all pests. Such wood material is processed to a level that would not allow survival of the pest. Any eggs, larvae or pupae present in the initial material would die or not be able to continue development.
Uncertainty: low.

- *Seeds, fruits, bulbs and tubers, grain, pollen, stored plant products, soil and growing medium*.
No life stages are associated with these.
Uncertainty: low.

- *Movement of individuals, shipping of live Buprestidae, e.g. traded by collectors.*
The insect will most likely be moved or shipped after they are dead, but not always[3]. This pathway is also difficult to regulate as such. *Uncertainty*: low.

9. Likelihood of establishment outdoors in the PRA area

9.1 Climatic suitability

In Liaoning (China), Zang *et al*. (2017a & b) have described the climatic conditions of the studied site (Section 2.3 and Fig. 1 in ANNEX 4). Liaoning has climates Dwa and Dwb according to the Köppen-Geiger Climate Classification. The pest is also already present in part of the EPPO region (Kazakhstan, southern Far East and south of Eastern Siberia in Russia) where other climate types occur (e.g. Dwc in Russia)

[3] Frequently Asked Questions' on a webpage for collectors: 'Do I need a permit to ship live insects…'
http://www.insectnet.com/faq.htm#usda

Agrilus fleischeri is currently present in areas that experience extremely cold winter temperatures, such as in Tuva (Eastern Siberia, Russia) where minimal average temperatures of -28°C (minimum value: -35°C) and Lioning where minimal average temperatures of -10°C (ANNEX 4) (minimum value: -32°C (Zang et al., 2017a) are observed in January. The lower temperature in the EPPO region and the duration of the cold winter period is not considered to be a limiting factor for the survival of larvae, which overwinter within the trees, as well as for completion of the life cycle.

Regarding comparisons of areas where *A. fleischeri* occurs and the EPPO region:

- The maps of degree-day accumulation for Europe/the Mediterranean area and Asia in ANNEX 4 (Fig. 2) shows similarities between a large part of the PRA area and areas where *A. fleischeri* occurs.
- In relation to plant hardiness, the distribution of *A. fleischeri* includes hardiness zones (at least) 3-10 (ANNEX 4, Fig. 3), which indicates that winter temperatures do not limit its distribution and also corresponds to a large part of the EPPO region.
- According to the classification of climates of Köppen-Geiger (maps in ANNEX 4, Fig 4), *A. fleischeri* is present in the climatic zone Dfb at least in Japan and possibly Far-East Russia and Kazakhstan. This climate type occurs in the EPPO region especially in eastern Europe (Estonia to Serbia and Russia), parts of Central Asia and the Far-East. *A. fleischeri* possibly also occurs in the climate type Dfc, which occurs in the EPPO region from Norway to the Far-East of Russia. Such climates probably also occur in other local areas in Western Europe. Most areas where the pest is present have a Dwa, Dwb or Dwc climate. However, apart from the Far East and Eastern Siberia of Russia where the pest is already present, Dwa is not represented in the EPPO region, Dwb is present very locally in the Western Siberia and Dwc very locally in Kyrgyzstan and Western Siberia (MacLeod & Korycinska, 2019). Moreover, Dw which means dry in winter, does not seem to be critical as during winter larvae are inside the tree.

Because of the lack of data on the threshold temperatures for development, and the air temperature and humidity levels suitable for adults, there is an uncertainty on climatic suitability of the EPPO region. The areas where it occurs have warm summers, and it is not known where the temperature accumulation (degree days) would be sufficient in the EPPO region (e.g. for temperate oceanic), or if the life cycle would take longer.

Moreover, the pest may adapt its life cycle (complete life cycle usually in one year, but sometimes in two years in relation to climatic conditions and host affinity) and is situated under bark or in sapwood in winter and is therefore protected somewhat from extreme cold.

The range of *A. planipennis* is partly overlapping the range of *A. fleischeri* in China (e.g. Liaoning) and in the southern Far East of Russia (Orlova-Bienkowskaja & Volkovitsh, 2018), which could indicate that climatic conditions in the eastern part of and central Europe, where *A. planipennis* has already established, would be suitable for the establishment of *A. fleischeri* as well.

Considering the above, climatic conditions are suitable at least in part of the EPPO region. There is more uncertainty for areas where climatic conditions differ notably from areas where the pest currently occurs, such as the western/temperate part of Europe, the Mediterranean area, as well as for the warm and (at least in summer) arid areas in North Africa, Near East and Central Asia.

9.2 Host plants

Poplar (*Populus* spp.) and willow (*Salix* spp.) are widely distributed and are important species in the PRA area (FAO, 2008). They occur in indigenous forests (pure and mixed) and are grown extensively in commercial plantations for wood production, fibre, pulp and biofuel. The wood is used for construction, furniture, flooring, plywood, packaging, matches and firewood (FAO, 2008). Poplars and willows are also planted for environmental purposes, especially phytoremediation of polluted soils and water, carbon exchange and storage, forest landscape restoration, rehabilitation of degraded lands and combating desertification. Information on the area planted with poplars and willow is provided for countries that are members of the International Poplar Commission (IPC) (ANNEX 6, Tables 1 to 3). Russia (24,757,600 ha in 2011), France (275,800 ha in 2007), Turkey (133,000 ha in 2011), Italy (143,600 ha in 2011) and Spain (113,100 ha in 2011) (ordered by surface area) are the countries of the IPC where the main areas of poplar are found in 2007 or 2011. In Sweden, the area of willow plantations for bioenergy has been increasing by 2005 (16,000 ha in 2005) (Dimitriou & Aronsson, 2005) but decreasing since then (7800 ha in 2017) (Karlsson, 2017); In Italy, within these poplar production areas, there are 4000 ha of short rotation poplar and willow plantations (FAO, 2008) (See distribution maps 1a-c in ANNEX 7 for *Populus*, *Populus nigra* and *Populus tremula*). The European black poplar (*P. nigra*) and the white poplar (*P. alba*) occur very commonly in natural forests and riverine woodlands (FAO, 2008).

Of the *Populus* species mentioned specifically as hosts for *A. fleischeri*, *P. nigra* and P. *tremula* are the most important species, owing to their extensive distribution and commercial deployment in the PRA area:

- *P. nigra* is native to Europe (but not Scandinavia), North Africa and western Asia (Isebrands & Richardson, 2014). *P. nigra* var. *italica* is certainly the most ancient poplar cultivar and the one with the widest distribution (Chenault et al., 2011). Although the name seems to indicate an Italian origin, its real origin is unknown. It was introduced in Italy in the 18th century. It spread from the Po Valley (from which the common name Lombardy poplar) to all over the world, including the rest of Europe (Cagelli & Lefevre, 1995; Turok et al., 1996). The Lombardy poplar (*P. nigra* var. *italica*) is mostly composed of males, and was planted mostly along roads and canals because it exhibits a columnar (fastigiate) growth habit, or is used in windbreak edges (because of its dense branching), or planted as isolated trees (Cagelli & Lefevre, 1995; Chenault et al., 2011). For example, it was introduced largely in France since the middle of the 18th century by Napoleon (first planting in 1745) and was first introduced in England in 1758. It is now also one of the two most widespread pyramidal poplars in Russia. It is currently unclear whether *P. nigra* var. *italica* is a single clone or if it comprises several genotypes that all exhibit the distinctive columnar habit (Chenault et al., 2011). In Europe, the majority of the planted poplar genotypes (or clones or cultivars) are *Populus* x *canadensis*, i.e. hybrids between *P. nigra* and *P. deltoides*, and *Populus* x *interamericana*. A quite low genetic variability is planted since in France 10 genotypes represent 70% of the cutting production (Paillassa, 2013).
- The common aspen, *P. tremula*, has the largest native range of any species in the genus (from 40° to 70°N latitude). It grows from the Atlantic Ocean in the UK, the Channel Islands and Ireland eastward to central Siberia, China and the central islands of Japan, as well as south to Algeria in North Africa (Isebrands & Richardson, 2014). In Russia, area of natural forests where *P. tremula* is the most prominent tree, represents 20,600,000 ha (Tsarev, 2005). On the territory of Asian Russia *P. tremula* covers a very large territory between 70° and 50°N latitude. *P. tremula* var. *davidiania* (cited as *P. davidiana* by Zang *et al.*, 2017a & 2017b) is not grown in the EPPO region except in the Far East of Russia.

For the other known host species:

- The laurel poplar, *P. laurifolia*, ranges from eastern Kazakhstan and north-west China to Mongolia and Siberia (EPPO, 2000; Isebrands & Richardson, 2014). It has also been cultivated occasionally in Europe (Isebrands & Richardson, 2014).

Information on the area planted with willow is provided for countries that are members of the International Poplar Commission (IPC) (ANNEX 6, Tables 1 to 3). Russia (6,568,000 ha in 2011) and France (66,600 ha in 2007), are the countries of the IPC where the main areas of willow are found in 2007 or 2011.
The known *Salix* host, *Salix schwerinii*, has been a parent in some hybridization work in Europe for biomass production (more information available in Section 7). *S. matsudana* is commonly used as an ornamental and garden plant. Within the *Salix* genus, more species may be hosts of the pest in the EPPO region such as *Salix alba* and *Salix caprea* which are very widespread in the region (no data available indicating that such species are hosts of the pest).

There are also other *Populus* spp. and *Salix* spp. in the PRA area, some of which are widespread and abundant, (e.g. *P. canescens*) and others which are rare and endangered (e.g. *P. berkarensis*) (IUCN, 2007).

9.3 Biological considerations

When introduced, an important factor for the establishment is that the development rate of the pest can be influenced by the host plant and climate conditions (section 9.1).

For the establishment of a population, there should be simultaneous entry of several individuals of both sexes (or a single mated female but this is even less likely because of the need for maturation feeding on foliage). Because adults only mate 2–11 days after emergence and have a limited lifespan (about 34 days), this may limit the chances of finding foliage for maturation feeding as well as finding a mate (if individuals are isolated), and of finding a host for feeding and oviposition. If mating occurred during transport, mated females may escape the consignment at destination, find a host and lay eggs. As eggs may be laid together and in relatively high numbers (average 218 eggs throughout the lifespan), it may result in the establishment of a population.

A. fleischeri shares the same host genera (*Populus* and *Salix*) with other existing native *Agrilus* spp. in the EPPO region, even the same host species (e.g. *A. ater* and *A. suvorovi* also attack *P. nigra*). There is no information indicating that establishment could be prevented by competition from existing *Agrilus* species in the PRA area, such as *Agrilus suvorovi* or *Agrilus ater*.

Rating of the likelihood of establishment outdoors	Very low ☐	Low ☐	Moderate ☐	High ☒	Very high ☐
Rating of uncertainty			Low ☐	Moderate ☒	High ☐

Uncertainty: suceptibility of other European species than *P. nigra* var. *italica*, climate suitability

10. Likelihood of establishment in protected conditions in the PRA area

A. fleischeri is a pest of woody plants, which are normally not grown under protected conditions in the PRA area. However, bonsais and ornamental plants may be grown in protected conditions, e.g. in nurseries or botanical gardens. Establishment would require that *A. fleischeri* be able to complete a life cycle on plants that are small in size. However, the pest would be easier to detect and eliminate in protected conditions.

Populus and *Salix* plants for planting are usually grown during a limited period in protected conditions and are often planted after in open air. Therefore, the risk of establishment is related to open field conditions rather than to protected conditions.

11. Spread in the PRA area

A. fleischeri may spread naturally and could be spread over larger distances via transportation in wood and wood products, including wood packaging material (if not treated according to ISPM 15 which is not mandatory within the EU and within countries such as Russia) or in plants for planting. Hitchhiking may play a role locally.

Large volumes of poplar wood products are traded within the EPPO region. In 2012 in the EPPO region, Italy, Belgium, Spain and Serbia were major importers of poplar wood products originating mainly from France and Hungary. Italy is the main importer of poplar round wood (335,000 m^3) followed by Belgium (224,000 m^3) (FAO, 2012). Similar figures had been reported in the 2008 report, though imports to Italy from France appear to have declined by ca. 120,000 m^3 (FAO, 2008) (ANNEX 8, Table 3). Italy also imports as well 193,000 m^3 (r) of sawn timber from Hungary (FAO, 2012). This shows that trade of wood, and potentially also wood products, may play a major role in the spread of the pest if it were introduced in the EPPO region.

In the EPPO region, Italy has been an important producer of *Populus* plants for planting and played a major role in the production of the known host *P. nigra* var. *italica* (section 9.2). Nowadays, the poplar nursery industry is very specialized. It is represented by a few hundred hectares in Italy, mainly located in Piedmont and Lombardy. About 4 million plants are produced each year in a few hundred of these specialized farms, where national quality standards are applied. In addition to these quality standards, *Populus* plants for planting, when produced in the EU, are subject to the EU Plant Passport dispositive, which implies inspection of the place of production. One- or two-year-old nursery material can be used. The main poplar clones grown in Lombardy belong to *Populus* × *canadensis* (hybrid of *P. deltoides* x *Populus nigra*) (Allegro, 2002; Allegro et al., 2006).

If the pest is first introduced in a *Populus* plant production area such as in Italy, and if the pest is not detected because of the other *Agrilus* species already feeding on *Populus* plants, this may lead to a quicker spread in the PRA area. However, quality and plant passport controls may help to detect the pest in such conditions.

Contrary to *Populus*, *Salix* plants do not need an EU plant passport to be circulated within the EU and could therefore favour the spread of the pest if introduced in the EU. However, this will change after December 2019 with application of EU regulation 2016/2031 which will impose an EU plant passport for all plants for planting (excluding seeds), thus including also *Salix* plants.

A. fleischeri is a good flyer. However, it can be assumed that the dispersal of *A. fleischeri* will be low (less than 1 km per year), if suitable hosts are available. Speed of spread will likely be affected by how easily it can locate suitable hosts, and whether it will be capable of infesting *Populus* spp. and *Salix* spp. that are currently not known as hosts and are widespread in the EPPO region (Section 2.4).

In conclusion, if *A. fleischeri* behaves like *A. planipennis*, speed of natural spread will depend on the situation (host plant availability and distribution in the landscape) and may be increased by hitchhiking. There may also be '*jumps*' with wood packaging material (when non-treated according to ISPM 15, e.g. when circulating within countries or within the EU), wood and plants for planting, that would lead to multiple outbreaks and decrease the time to spread to its maximum extent within the EPPO region.

Rating of the magnitude of spread		*Very low* ☐	*Low* ☐	*Moderate* ☒	*High* ☐	*Very high* ☐
Rating of uncertainty				*Low* ☐	*Moderate* ☒	*High* ☐

Uncertainty: host range, no direct data for this pest

12. Impact in the current area of distribution

Nature of the damage: See details in section 2.5.
Experts considered adults damage on the leaves to be negligeable. The main damage is caused by larvae, which construct feeding tunnels in the cambial region that possibly girdle and kill individual branches and entire trees, provoke lesions, and the desiccation of the underlying wood.

Impact in different countries
China
In China, *A. fleischeri* was first reported from Heilongjiang in 1939 (Jendek & Grebennikov, 2011) and more recently infesting *Populus tremula* var. *davidiana* in Fangshan District of Beijing in May 2008 by XF Mu and GZ Yan (Wang, personal communication). References to significant impact are much more recent (2013 and 2014, Zang et al., 2017a). The pest was found in '*previous investigations […] as the major wood-boring pest of […]* P. nigra *var.* italica *[…] in plantations located in Fengcheng City, Liaoning Province, China in 2013*' (Zang et al., 2017b). However, this information is mainly based on observations performed in one stand of the Liaoning province where the study was performed (Wang, personal communication, 2018). The pest was also found infesting the commonly used *P. tremula* var. *davidiana* (cited as *P. davidiana* by Zang *et al.*, 2017a & 2017b). This second species, *P. tremula* var. *davidiana,* is a native species in China, in contrast to *Populus nigra* var. *italica,* which is an exotic species introduced from southern Europe and western Asia because of its fast-growing nature. It has now been planted in many places (Zang et al., 2017a, 2017b) in the North of China, since the 1980s (Wang et al., 1984).

Over the past 30 years, China has afforested more than 54 million hectares of land and become the leading country for the greatest amount of afforestation in the world. In poplar plantations, the use of a single or very few clones with low genetic diversity has led to increasing insect pest problems (Ren et al., 2018).

As the larvae consumes the phloem and outer xylem tissues, the transport capacity of xylem vessels and phloem sieve tubes decreases. The galleries caused by larvae weaken the trees (see damages in section 2.5) and eventually cause the death of trees. Locally, they seriously affect the usage and aesthetic value of wood, causing losses to forestry production (Zang et al., 2017a).

The study by Zang et al (2017a) reports that *A. fleischeri* is causing a higher level of damage (tree mortality and decrease in wood quality and quantity) on *P. nigra* var. *italica* than on *P. tremula* var. *davidiana*: in comparison to *P. tremula* var. *davidiana*, apparently healthy *P. nigra* var *italica* are found to be more infested (12% of infestation after one year versus 0%), which is also the case for artificially stressed plants after girdling (90% vs. 65% of infestation after one year); and for the egg hatch rate (92% vs. 78%). This indicates that *P. nigra* var. *italica* is more susceptible to attack than *P. tremula* var. *davidiana* (Zang et al., 2017a). However, it could also be an effect of the preference for larger trees. Most individuals were found to be univoltine in *P. nigra* var. *italica*, and semivoltine in *P. tremula* var. *davidiana* which could indicate that *P. nigra* var. *italica* is more suitable for larval development (Zang et al., 2017a). It should be noted that 5.8% of the stand of *P. nigra* var. *italica* was infested by *Rusticoclytus (Xylotrechus) rusticus*, which may be a primary pest in China. Some trees were attacked by both species (Zang, 2016). Therefore, as 12% of infestation by *A. fleischeri* was observed on *P. nigra* var. *italica* after one year, in some cases *P. nigra* var. *italica* trees were only attacked by *A. fleischeri*. This indicates that *A. fleischeri* may be the main cause of the mortality observed in this stand.

Environmental and social impacts are not mentioned in the litterature.

Japan, Kazakhstan, Korea Rep., Korea Dem. Rep., Mongolia and Russia.
No information was found.

Existing control measures

Cultural practices
Sanitary felling of infested trees, dead trees and dying trees are performed in the infested area in China (Wang, personal communication, 2018).
Zang et al., 2017a, considers that planting Chinese native poplar species may in the long-term help reduce the level of damage in the areas where populations of *A. fleischeri* are very high.

Chemical treatments
The Dimethoate is considered as an effective insecticide treatment used against adults during the flight period of *Agrilus* species in China (Wang et al., 1995). Contact pesticides (e.g. used by painting trunks) could be used for controlling the adults when emerging out of the tree through its exit-holes (Zang et al., 2017a); however, this is not practical for a use in forestry.

Genetic transformation
China is currently the only country in the world that has commercialized genetically engineered tree species. Genetic transformation is performed for different goals, including resistance to wood-boring and defoliating insects (Ye et al., 2011). The Chinese government approved genetically transformed poplars for commercial use in 2005 (Isebrands & Richardson, 2014) and has already planted millions of Bt GM poplar trees (Cerier, 2016). However, it seems that GM poplar trees are currently more effective against defoliating than wood-boring insects (Hu et al., 2010).

Biological control
Biological control agents have been investigated in China but are not used currently: Egg parasitoids have been generally considered as effective natural enemies to protect host trees against wood-boring pests because they have the potential to neutralize the pest before feeding damage is done initiated on the host tree. Zang *et al.*, (2017b) identified six native enemies (parasitoids) of *A. fleischeri* in the study sites, with three of them (*Oobius* spp., *Polystenus rugosus*, *Paramblynotus* sp.) occurring in *P. nigra* var. *italica*, and four (*Oobius* spp., *Polystenus rugosus*, *Spathius* sp., and *Euderus fleischeri*) occurring in *P. tremula* var. *davidiana*. The entomogenous fungi *Beauveria bassiana* (Hypocreales: Clavicipitaceae) (Bals.-Criv.) Vuill. was also found to infect *A. fleischeri* larvae in *P. nigra* var. *italica* and *P. tremula* var. *davidiana*. More recently, two new species belonging to the *Oobius* genus, *Oobius saimaensis* and *Oobius fleischeri*, were described from eggs of *Agrilus fleischeri*. These may be used in the future as biological control agents (Yao et al., 2018).

Conclusion: Eventhough significant damages were locally observed in the current area of distribution, the magnitude of impact was rated as low considering all poplar populations in North China and the wider distribution of *A. fleischeri* in Asia.

Rating of the magnitude of impact in the current area of distribution	*Very low* ☐	*Low* ☒	*Moderate* ☐	*High* ☐	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* ☒	*High* ☐

uncertainty: lack of data for other areas in China

13. Potential impact in the PRA area
Will impacts be largely the same as in the current area of distribution? Yes /No, not like in north-east China

In view of the distribution of *A. fleischeri* in Asia (Figure 8 and Figure 10), significant damage has only been reported locally in China, in one stand of the Liaoning province, on *P. nigra* var. *italica*. Impact will probably be relatively similar in the EPPO region on the same host plant. This was the main argument used for the rating of the potential impact in the PRA area.

In addition, other considerations were taken into account for this rating and for the uncertainty:

- Importance of impacts on wood production and amenities would depend on whether *A. fleischeri* would attack the many other *Populus* and *Salix* species that are widely present in the EPPO region for forestry and amenity purposes (section 9.2). Significant damage may be foreseen on other poplar and willow species. Indeed, there are examples of *Agrilus* species encountering a non-coevolved host tree species, and that can infest and kill this apparently healthy tree species. In addition to the situation of *A. fleischeri* on the non-native *P. nigra* var. *italica* in China, this relationship has been shown for North American *A. anxius* on Eurasian Betula (Miller et al., 1991; Nielsen et al., 2011); for the Asian *A. planipennis* on European and North American *Fraxinus* (Haack et al., 2015); for the Mexican *Agrilus prionurus* on *Sapindus* in Texas (Billings et al., 2014); and even the Arizona species *Agrilus auroguttatus* on *Quercus* in California (Coleman & Seybold, 2011).

- High densities of *Populus* spp. in broadleaved forests are found in the eastern part of the EPPO region (Russia in particular). Locally, high densities are also observed (e.g. in Norway, Finland, Belgium and in the South of France (ANNEX 7). In the EPPO region, poplars are often planted with a little diversity and a dominance of elite genotypes (e.g. in France and probably also Italy, Spain and Belgium) and poplar production can be concentrated along main rivers like the Po in Italy or the Garonne in France (Sallé, personal communication, 2018). Therefore, the low genetic diversity in plantations in the EPPO region could locally affect the possible impacts in plantations, if one of these species is found to be highly susceptible to *A. fleischeri*. However, *Populus* x *canadensis* is one of the most frequent hybrids used in plantations in Europe. *Populus* x *canadensis* are grown in the Liaoning province and were not reported to be infested (Wang, personal communication, 2018). In Europe, a higher genetic diversity is found in the natural environment.

- It is shown that stressed trees are more attacked than healthy trees (Zang et al., 2017a).

  Therefore, impact by *A. fleischeri* may be lowered if all possible causes of stress of the plants are avoided. The following measures are already applied on *Populus* in the PRA area for *A. suvorovi* and *A. ater*, and may reduce the impact by *A. fleischeri*: following good planting practices (avoid delay in the planting, use appropriate hole depth, use appropriate compression of the soil around the stem), plant on appropriate sites (in terms of quality of soil – avoid sandy soils in relation to water stress, excess of clay that may cause asphyxia, and excess of acidity or alkalinity; or in terms of quantity of water available - especially during the spring months and at the beginning of the summer, but avoid stagnant groundwater), irrigate during drought periods to give vigour to plants and increase resistance to insect attacks, calibrate mechanical planters at the right depth in order not to damage the root system, avoide the use of herbicides or other chemicals that could damage young plants, good cultural maintenance of the plants (appropriate pruning of branches, avoid excess of nitrogenous fertilizers that may induce a miss-lignification), plant more resistant *Populus* varieties, etc. (Allegro, 2002; Monferrato, 1964; Rougon, 1998).

  Considering that, together with temperature, the frequency and duration of severe droughts is expected to increase in upcoming years because of climate change, the impacts of such pests may become more significant in the future (Sallé et al., 2014).

- Assuming similar effects of infestation as observed for *A. surovori* and *A. ater*, *A. fleischeri*-infested trees will be more prone to attacks by other insects or diseases. Timber depreciation is foreseen because of the gallery system and the consequent lesion (IEFC Net, 2018).

- If the pest is introduced, the only available measures are costly, and include sanitary felling of infested trees. As for *A. planipennis*, no practical treatment is available to control the pest in forest stands. Available treatments for other *Agrilus* species are costly and are only used for high value trees (e.g. urban trees, ornamentals). Systemic insecticides applied as soil injections or drenches (imidacloprid, dinetofuran), or as trunk injections (emamectin benzoate, azadirachtin, imidachloprid) may also be effective against *A. fleischeri* (EPPO, 2013b). However, poplar stands being generally located in alluvial areas, chemical spraying may lead to environmental issues.

- As for other wood borers, early detection and control is difficult given the hidden stages (eggs, larvae and pupae) of this pest. Infested trees would be detected more easily one or two years after egg-laying, as a result of adult emergence and the creation of D-shaped exit holes. In addition, woodpecker predation of mature larvae and prepupae may, at least during high density attacks, facilitate detection of infested trees before adult emergence.

- In the PRA area, damage by the related species *A. surovori* is mainly reported in Southern and South-Central Europe (e.g. Italy, Slovenia, Hungary, etc.). It is reported that heavily-infested trees frequently die. Damage caused by *A. ater* has also been observed in Fennoscandia (Csóka & Kovács, 1999; IEFC Net, 2018). Importance of the additional potential impact caused by *A. fleischeri* will depend on its optimal climatic conditions for development, on the susceptibility of local *Populus* and *Salix* host species, and of the overlap of these conditions with the optimal developmental conditions for *A. surovori* and *A. ater* in the EPPO region. In particular, if a new exotic species emerges before the native species, it could have an advantage over the natives, and possibly become the dominant species.

- Existing predators of native pests in the EPPO region may contribute to the control of *A. fleischeri*, such as *Cyanopterus* (*Ipobracon*) *nigrator* (Schaefer, 1949) on *A. ater*, *Oobius zahaikevitshi* (Gumovsky et al., 2013), *Spathius polonicus* (Braconidae), *Oodera formosa* (Pteromalidae), *Euderus albitarsis* (amphis) (Eulophidae) and *Tetrastichus agrilorum* (Eulophidae) (Rougon, 1998) on *A. suvorovi*. Similarly, this was the case for *A. planipennis* in Russia, for which outbreak collapse was caused in major extent by the local polyphagous parasitoid *Spathius polonicus* who have switched to this new abundant host (Baranchikov et al., 2018); as well as in the North America where predation by woodpeckers appears to be the most important source of mortality in *A. planipennis* populations, causing from 9 to 95% mortality rates (Cappaert et al., 2005).

- In the EPPO region, the species *Salix xanthicola* is considered as vulnerable according to the IUCN Red List classification (Rivers et al., 2017) and the species *Populus berkarensis* is considered endangered (IUCN, 2007). If these species are found to be particularly susceptible to *A. fleischeri*, introduction of the pest in the EPPO region may have an additional environmental impact.

All these additional considerations increase the rating of uncertainty for the impact in the PRA area.

Rating of the magnitude of potential impact	*Very low* ☐	*Low* ☒	*Moderate* ☐	*High* ☐	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* ☐	*High* ☒

Uncertainty: susceptibility of other European native host species, conditions for an outbreak, effect of natural enemies

14. Identification of the endangered area

The pest could establish where poplar and willow are grown (with an uncertainty on the poplar and willow species that will be attacked). The climatic conditions are considered suitable at least in the eastern part of Europe and central Europe, with uncertainties for the western part of Europe, the Mediterranean area, as well as for the warm (at least in summer) arid areas in North Africa, the Near East and Central Asia. However, it is expected that impact would be higher at least in areas where poplar coverage is important. This would correspond to an area from Northern France to Eastern Europe, with a particular risk for Russia (ANNEX 7).

15. Overall assessment of risk

Summary of ratings:

	likelihood	**Uncertainty**
Entry (overall)	**Moderate**	**High**
Host plants for planting with a diameter < 2 cms	Moderate	High
Round wood with bark	Moderate	Moderate
Round wood without bark	Very low	High
Sawn wood of more than 6 mm with bark	Low	Moderate
Sawn wood of more than 6 mm without bark	Very low	Moderate
Wood chips >2.5 x 2.5 cm in two dimensions, hogwood, processing wood residues	Moderate	High
Wood chips <2.5 x 2.5 cm in two dimensions	Low	Moderate

Wood packaging material (including dunnage) on which ISPM 15 is appropriately applied.	Very low	Low
Wood packaging material (including dunnage which is not appropriately treated according to ISPM 15.)	Low	High
Bark of host	Low	High
Cut branches	Low	High
Establishment outdoors	**High**	**Moderate**
Spread	**Moderate**	**Moderate**
Magnitude of impact in the current area of distribution	**Low**	**Moderate**
Magnitude of potential impact	**Low**	**High**

Agrilus fleischeri is considered a separate species. However, no identification key or molecular methods (no sequences are recorded in GenBank) for identifying *A. fleischeri* are currently available. Distinguishing *A. fleischeri* from the European species *A. ater* is difficult.

A. fleischeri has caused damage in one stand in northeast China (Liaoning) on *P. nigra* var. *italica*, which is an exotic tree species for China but a native species for the EPPO regionas well as on *P. tremula* var. *davidiana* in the same region. Limited information is available on this insect.

Entry was considered as moderately likely with a high uncertainty, the most likely pathways were import of host plants for planting, round wood with bark, wood chips, hogwood and processing residues bigger than 2.5 cm in two dimensions, and wood packaging material (if ISPM 15 is not applied). The pest has already been intercepted twice in Canada on non-compliant dunnage.

A. fleischeri is established in Kazakhstan, and in southern Far East and southern Siberia in Russia. Establishment of *A. fleischeri* is likely to occur in the rest of the EPPO region where host plants grow and may not be limited by climatic conditions. However, there are uncertainties for the western part of Europe, the Mediterranean area, as well as for the warm (at least in summer) arid areas in North Africa, the Near East and Central Asia. *Populus* and *Salix* are widespread in the region. It is assumed that *A. fleischeri* would be able to attack other species within the genera *Populus* and *Salix* in addition to those that are currently known as host plants.

The magnitude of spread was rated as moderate (1-10 km per year) with a moderate uncertainty, and there may be longer ‘jumps’ (e.g. with wood packaging material if ISPM 15 is not applied and plants for planting), that would lead to multiple outbreaks and increase the spread rate.

The impact in its native range is assessed as low with a moderate uncertainty. The damage reported in Liaoning concerns only a small part of where *P. nigra* var. *italica* is grown in Northern China. Limited or no data was found on its detailed situation and/or impact on other hosts, or in other areas where it occurs (i.e. other Chinese provinces, as well as Japan, Kazakhstan, Mongolia, Russia, Korea Rep, Korea Dem.). Potential impact in the EPPO region is assessed as low with a high uncertainty. Potential impact would mostly depend on the availability of host species that are susceptible and whether the pest can attack healthy trees.

Because of the recent damage recorded from the Liaoning province in northeast China, of the importance of poplar and willow in the EPPO region, and because of the high uncertainty on the potential impact, the EWG considered that phytosanitary measures may be considered to reduce the probability of entry.

Phytosanitary Measures to reduce the probability of entry: Risk management options have been identified and evaluated for host plants for planting, round wood and sawn wood of hosts, and wood chips, hogwood and processing wood material). ISPM 15 is a sufficient measure for wood packaging material.

If measures are applied, the EWG recommended that these should apply to host genera (*Populus* and *Salix*), and not only to known host species within these genera.

Stage 3. Pest risk management

16. Phytosanitary measures

16.1 Measures on individual pathways

Measures were studied (ANNEX 1) for host plants for planting, wood of hosts, and wood chips, hogwood and processing wood residues. ISPM 15 should be applied for wood packaging material. Measures for cut branches are suggested in the table below.

The EWG recommended that measures should apply to host genera (*Populus* and *Salix*), rather than to only the known host species, if it is considered that the host range of *A. fleischeri* is wider than where it occurs (section 7).

Possible pathways ***(in order of importance)***	**Measures identified (see Annex 1 for details)**
Plants for planting of *Populus* spp., *Salix* spp. (except seeds, tissue cultures and pollen)	PFA (see requirements below) and Plants packed in conditions preventing infestation during transport. Or Pest-free site of production under complete physical isolation (PM 5/8 *Guidelines on the phytosanitary measure* 'Plants grown under complete physical isolation') and Plants packed in conditions preventing infestation during transport (or moved outside the period where adults are present).
Round wood and sawn wood (> 6mm) of *Populus* spp., *Salix* spp.	PFA (see requirements below). Or Debarking followed by heat treatment (minimum temperature of 56 °C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including its core)) Or Irradiation (EPPO Standard PM 10/8(1) *Disinfestation of wood with ionizing radiation*) Or Fumigation with sulfuryl fluoride (only for debarked wood below 20 cm in cross-section) (ISPM 28 PT 22 or PT 23 (FAO, 2017b, 2017c)) Or Removal of bark and 2.5 cm of outer xylem
Wood chips, hogwood, processing wood residues obtained in whole or part from *Populus* spp., *Salix* spp.	PFA (see requirements below) and Storage and transport to prevent contamination by adults under control of the NPPO.
Wood packaging material obtained in whole or part from *Populus* spp., *Salix* spp.	ISPM 15.
Bark of *Populus* spp., *Salix* spp.	PFA (see requirements below).
Cut branches of *Populus* spp., *Salix* spp.	PFA (see requirements below).

Measures considered by the EWG but not retained:

Plants for planting of *Populus* spp., *Salix* spp. (except seeds, tissue cultures and pollen)

- Pre- or Post-entry quarantine (2 years);
- Visual inspection at the place of production;
- Visual inspection of the consignment;
- Plants with diameter below 2 cm;
- Plants packed;

Round wood and sawn wood (>6mm) of *Populus* spp. and *Salix* spp.:

- Visual inspection at the place of production;
- Harvesting in summer;

- Inspection;

Wood chips, hogwood, processing wood residues obtained in whole or part from *Populus* spp. and *Salix* spp.:

- For wood chips: chipped into pieces of less than 2.5 cm in two dimensions;
- Packed to avoid escape of the pest and processing or burning immediately after import;
- Visual inspection at the place of production;
- Specific packing;
- Harvesting in summer;

Bark of *Populus* spp. and *Salix* spp.:

- Treatment (heat treatment, irradiation, fumigation);
- Chipped into pieces of less than 2.5 cm in two dimensions;

Cut branches of *Populus* spp. and *Salix* spp.:

- Treatment (heat treatment, irradiation, fumigation).

Requirements for establishing a PFA:

PFA is not considered applicable in the native range of the pest.

Measures proposed to establish a PFA are similar to the requirements proposed for *A. planipennis* (EPPO, 2013):

- A minimum distance of 100 km between the PFA and the closest known area where the pest is known to be present.
- To establish and maintain the PFA, detailed surveys and monitoring (using trapping and other methods) should be conducted in the area in the three years prior to establishment of the PFA and continued every year. Specific surveys should also be carried out in the zone between the PFA and known infestation to demonstate pest freedom. The surveys should be targeted for the pest and should be based on appropriate combination of trapping, branch sampling and visual examination of host trees.
- Surveys should include high risk locations, such as places where potentially infested material may have been imported/introduced.
- There should be restrictions on the movement of host material (originating from areas where the pest is known to be present) into the PFA, and into the area surrounding the PFA, especially the area between the PFA and the closest area of known infestation.

16.2 Eradication and containment

This pest can fly long distances and early detection and control of an infestation are difficult. Therefore, it would be extremely difficult to eradicate (section 11. Spread). In North America, attempts to eradicate *A. planipennis* have not been successful. In particular, attempts to reduce *A. planipennis* populations by cutting large numbers of infested trees may reduce host resource available to the pest but may increase local natural spread.

Monitoring to determine pest distribution and densities, as well as inventories and surveys for host abundance and distribution, would be necessary before to elaborating strategies to slow the natural dispersal. The strategy should involve:

- activities to suppress populations by removing infested trees (before adult emergence), insecticide treatments, host utilisation or removal (harvesting for timber or firewood),
- regulatory measures such as restrictions on the movement of host material originating from areas where the pest is present.

Public education and outreach campaigns (support of residents and land owners) may help an earlier reporting of findings and a better implementation of measures.

This could be completed later by biological control when more knowledge would be available on this.

Remark: Emamectin benzoate, a systemic insecticide administered by trunk injection, has demonstrated three years of control against both *Agrilus* larvae and leaf-feeding *Agrilus* adults (Herms et al., 2014; Mccullough et al., 2011; Smitley et al., 2010). Using emamectin benzoate, it is reported that girdling *Fraxinus* trees 2–3 weeks after insecticide injection, created lethal trap trees that were attractive to *A. planipennis* adults (McCullough et al., 2016). However, no reported experience has been found for *A. fleischeri*. This active substance is authorized for other uses in Europe under the name emamectin (e.g. in the EU by injection of palm trees for *Rynchophorus ferrugineus* (ANSES, 2018)).

17. Uncertainty

Main sources of uncertainty within the risk assessment are linked to the limited information available on the biology of the pest (e.g. association with branches or not), the lack of information about its host range, the lack of information on the damage observed in its native range, the susceptibility of other European *Populus* and *Salix* species than *P. nigra* var. *italica*, the suitability of climatic conditions when it differs notably from areas where the pest currently occurs and the type of material being traded.

There is very limited information on the damage potential of this pest; however, a similar assessment would have been made on *Agrilus planipennis* prior to the finding in western Russia and North America where it causes very high impacts.

18. Remarks

- Planting sentinel trees (European/EPPO species, including the widely planted elite poplar/willow genotypes) in infested areas would be useful.
- Molecular tools for identification would be helpful. A published identification key based on morphology should be available.
- A survey targeting *A. fleischeri* on all *Populus* and *Salix* species present in infested countries would be useful to determine their susceptibility.
- Evaluating under which conditions apparently healthy trees are colonized would be also important.

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ANNEX 1. Consideration of pest risk management options

The table below summarizes the consideration of possible measures for the pathways '*plants for planting*',' *round wood and sawn wood*', and '*wood chips, hogwood, processing wood residues (except sawdust and shavings)*' (based on EPPO Standard PM 5/3). Measures for cut branches may be extrapolated from the ones described for round wood and sawn wood.
For measures, all *Populus* and *Salix* are considered as potential host plants.
When a measure is considered appropriate, it is noted "yes", or "yes, in combination" if it should be combined with other measures in a systems approach. "No" indicate that a measure is not considered appropriate. A short justification is included. Elements that are common to several pathways are in bold.

Option	**Host plants for planting**	**Round wood and sawn wood of hosts**	**Wood chips, hogwood, processing wood residues (except sawdust and shavings)**
Existing measures in EPPO countries	Partly, see section 8	No, see section 8.	No, see section 8
Options at the place of production			
Visual inspection at place of production	Yes, in combination* (for measures marked with *, see after the table). **Detection by visual inspection is unlikely to be completely effective and needs to be used within a systems approach. Infestation is difficult to detect without destructive sampling (signs and symptoms may be restricted to exit holes and galleries under the bark. Larvae may not produce signs externally visible).** Plants should be free from signs and symptoms of infestation.	Yes, in combination*. As for plants for planting, but detection by visual inspection in a forest would be more difficult due to the size and location (e.g. small exit holes relatively high in the trees) and number of trees.	Yes, in combination*. As for wood.
Testing at place of production	No. **Not possible without destroying the trees.**	No. As for plants for planting	No. As for wood
Treatment of crop	No. There is no evidence that insecticide treatments would provide enough protection for nursery stock. For *A. planipennis*, a range of systemic insecticides have been used to provide protection of mature trees (for example soil drench with imidacloprid, or stem injection with emamectin benzoate or azadirachtin). Such products are likely to provide protection for nursery material, but it still has to be proven. It is currently not considered as an option in nurseries in the USA and Canada (EPPO, 2013b).	Not relevant in forest.	Not relevant in forest.
Resistant cultivars	Not available	Not available	Not available
Growing the crop in glasshouses/ screenhouses	Yes, for bonsais. Yes (theoretically) for others. Plants for planting could be grown under protected conditions with sufficient measures to exclude the pest (following EPPO Standard PM5/8(1) Guidelines on the phytosanitary	Not relevant	Not relevant

Option	Host plants for planting	Round wood and sawn wood of hosts	Wood chips, hogwood, processing wood residues (except sawdust and shavings)
	measure 'Plants grown under complete physical isolation' - (EPPO, 2016)). However, this is not common practice for nurseries of forest or ornamental trees and would be realistic only for small scale production of high value material.		
Specified age of plant, growth stage or time of year of harvest	Size of plant: No. Limiting the commodity to small seedlings may prevent infestation, but it is not clear what the minimum diameter of such material should be. Growth stage/time of the year: No. **Larvae may be present in trunks or branches throughout the year**. In particular, dormant plants may contain overwintering larvae	Age/size of plant: No, trees need to be large enough before being cut for wood. Growth stage/time of the year: No. As for plants for planting.	Size of plant: No. As for wood Growth stage/Time of the year: No. As for wood
Produced in a certification scheme	Not relevant	Not relevant	Not relevant
Pest free production site	Yes, grown under complete physical isolation (see Growing the crop in glasshouses/screenhouses). It is not possible to establish a suitable buffer zone around a production site outdoor for a strong flyer.	Not relevant	Not relevant
Pest free place of production	Yes, grown under complete physical isolation. It is not possible to have a buffer zone for a strong flyer.	Not relevant	Not relevant
Pest free area	It is not considered possible to establish a PFA in the native range of the pest. Yes. Measures similar to the requirements proposed for *A. planipennis* (EPPO, 2013b): • A minimum distance of 100 km between the PFA and the closest known area where the pest is known to be present. • To establish and maintain the PFA, detailed surveys and monitoring (using trapping and other methods) should be conducted in the area in the three years prior to establishment of the PFA and continued every year. Specific surveys should also be carried out in the zone between the PFA and known infestation to demonstate pest freedom. The surveys should be targeted for the pest and should be based on appropriate combination of trapping, branch sampling and visual examination of host trees.	Same as plants for planting	Same as plants for planting. In addition, as recommended in the past for *A. planipennis*, the Panel on Phytosanitary Measures considered that storage and transport in the period after chipping should be done in conditions preventing entry of adults. This is because the chipping process releases strong concentrations of host volatiles, and adults may be attracted to consignments of wood chip soon after chipping.

Option	Host plants for planting	Round wood and sawn wood of hosts	Wood chips, hogwood, processing wood residues (except sawdust and shavings)
	• Surveys should include high risk locations, such as places where potentially infested material may have been imported. • There should be restrictions on the movement of host material (originating from areas where the pest is known to be present) into the PFA, and into the area surrounding the PFA, especially the area between the PFA and the closest area of known infestation.		
Options after harvest, at pre-clearance or during transport			
Visual inspection of consignment	Yes, in combination*. Visual inspection may detect some infested trees. However, the pest would be difficult to detect in large consignments. Plants are generally traded during the dormant season, when the larvae would be overwintering inside the tree. Destructive sampling could be used.	Yes, in combination*. Inspection will not guarantee detection. Visual inspection of wood consignments is generally difficult, but even more with consignments mixing several tree species (such as firewood). An infestation on wood without bark may be easier to detect. Low levels of infestation may not be detected.	No Inspection of consignments of wood chips and other such commodities is difficult. It is unlikely to detect *A. fleischeri* as consignments may contain several tree species, and signs of presence of the pest would not be easy to observe. In a study on *A. anxius*, when simulating the process from logging in North America to sampling the wood chips upon arrival in Europe, the probability of pest detection for current sampling protocols used by port inspectors was very low (<0.00005), while a 90% chance of detection may require sampling 27 million litres of wood chips per shipload (Økland et al., 2012). Remark: there is still a value in inspecting wood chip consignments at the point of entry in that it will contribute to a better understanding of the risks (e.g. categories of material that are traded, size of the chips, tree species).
Testing of commodity	No There is no information about the practical use of a scanner or sniffing dogs for this pest.	No There is no information about the practical use of a scanner or sniffing dogs for this pest.	Not relevant

Option	Host plants for planting	Round wood and sawn wood of hosts	Wood chips, hogwood, processing wood residues (except sawdust and shavings)
Treatment of the consignment	No.	Yes. *Heat treatment of debarked wood.* According to EPPO Standard PM 10/6(1) *Heat treatment of wood to control insects and wood-borne nematodes* (EPPO, 2009), Buprestidae are killed in round wood and sawn wood which have been debarked and heat-treated until the core temperature reaches at least 56 °C for at least 30 min. For wood with bark, the chamber temperature should be at least 70°C (section 8). Yes. *Irradiation*. According to EPPO Standard PM 10/8(1) Disinfestation of wood with ionizing radiation (EPPO, 2009), Buprestidae infesting wood are killed after an irradiation of 1kGy. Such treatments might be applied to quality logs but will be too expensive for low-value products such as firewood. Yes. *Fumigation with sulfuryl fluoride* could be applied. ISPM 28 PT 22 and PT 23 (FAO, 2017b, 2017c) only applies to debarked wood below 20 cm in cross-section. Note: methyl bromide has been phased-out and MBr fumigation is not considered here. Yes. *Processing*. Conversion of the wood into sawn timber of less than 6 mm.	No. The chipping down to a certain size (2.5cm x 2.5 cm) (Section 8) was suggested by the EWG as a standalone measure. However, in the past, when this measure was discussed for *A. planipennis* and *A. anxius*, the Panel on Phytosanitary Measures considered that further research should be performed to determine the safe size for wood chips and how such size can be consistently obtained in commercial production of chips. This measure, when combined with debarking, was not considered realistic due to the cost of debarking compared to the value of the chips. The Panel on Quarantine Pests for Forestry also commented that the chipping process was applied repetitively by McCullough et al. (2007) on the same material, which is not representative of a classical industrial process. In coherence with the measures recommended for *A. planipennis* and *A. anxius*, this measure was not proposed by the Panel on Phytosanitary Measures for *A. bilineatus*. Treatments (heat treatment, fumigation, irradiation) were suggested by the EWG (see Round wood and sawn wood). However, the Panel decided that the treatment of woodchips and bark should not be proposed as a measure before analysing specifically whether the measures detailed in PM 10/6(1) *Heat treatment of wood to control insects and wood-borne nematodes*, in PM 10/8(1) *Disinfestation of wood with ionizing radiation* as well as in ISPM 28 PT 22 or PT 23 on fumigation could be applicable for other wood commodities including woodchips and bark.
Pest only on certain parts of plant/plant product, which can be removed	No. **Life stages are on or in the trunk or branches.**	No. As for plants for planting. Debarking wood before movement has obviously some benefits. However, it would not remove older larvae and pupae that are in the wood.	No. As for wood.
Prevention of infestation by packing/handling method	Yes, associated with certain measures. Trees should be packed in conditions preventing infestation during transport and storage.	No. Not an appropriate option for imported material.	No. The EWG suggested that a specific packing should be required if wood chips were imported to be directly burned/transformed. However, the Panel on Phytosanitary Measures suggested that

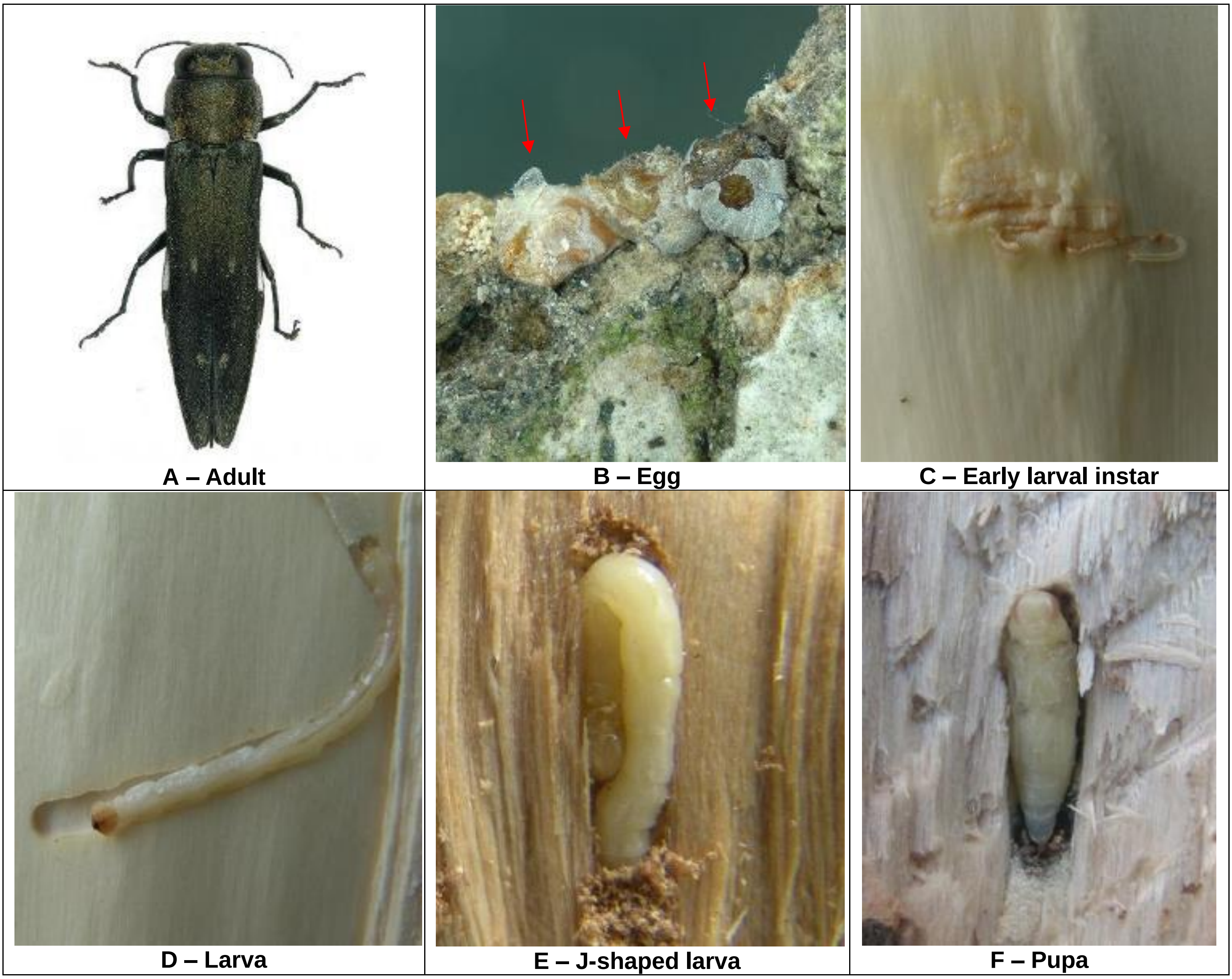
Option	Host plants for planting	Round wood and sawn wood of hosts	Wood chips, hogwood, processing wood residues (except sawdust and shavings)
			this measure should only be accepted by derogation, in a bilateral agreement between the exporting and the importing country.
Options that can be implemented after entry of consignments			
Pre or Post-entry quarantine	No, except in the framework of a bilateral agreement. The EWG suggested that plants may be kept in pre or post-entry quarantine for a sufficient time to detect the symptoms of larval activity or adult emergence (2 years to provide that the pest is detected if there were only eggs on the plants). This measure is likely to be applicable only for small scale imports of high value plants, but it may pose practical difficulties for large trees. The Panel on Phytosanitary Measures considered that this measure should only be proposed in the framework of a bilateral agreement.	Not relevant for wood	Not relevant for wood
Limited distribution of consignments in time and/or space or limited use	No. Plants for planting are destined to be planted, and if adults emerged, they could fly and may find hosts in the vicinity. Limiting the distribution to areas where the pest is not likely to establish is not feasible (and this area cannot be precisely defined).	No. **Not possible/practical to restrict import to periods of the year outside of the emergence and flight period of *A. fleischeri* (these are also not clearly known), and to process the material before the next such period (with appropriate conditions in storage).**	No. As for wood.
Only surveillance and eradication in the importing country	No **Detection is difficult, and the pest may be detected only years after establishment. Moreover, signs and symptoms are already caused on the same host plants by other *Agrilus* in the EPPO region, such as *A. ater* and *A. suvorovi*. Adults may be confused with adults of other *Agrilus* spp. Surveillance and eradication are difficult.**	As for plants for planting.	As for plants for planting.

*The EWG considered whether the measures identified above as 'Yes in combination' (listed below) could be combined to achieve a suitable level of protection. This was not possible for all these commodities. Therefore, the measures noted as 'Yes in combination' in the above table are not relevant.

Host plants for planting	Round wood and sawn wood	Wood chips, hogwood etc.
Visual inspection at the place of production	Visual inspection at the place of production	Visual inspection at the place of production
Visual inspection of the consignment	Harvesting in summer	Specific packing
Plants with diameter below 2 cm	Inspection	Harvesting in summer
Plants packed		

ANNEX 2. Different life stages of **A. fleischeri**

Figure 1. Different life stages of *Agrilus fleischeri*. Photograph A by Dr. Cao Liang-Ming, B to D by Mr. Zang Kai. More photographs available at https://gd.eppo.int/taxon/AGRLFL/photos.



ANNEX 3. Larval galleries of Agrilus fleischeri

Figure 1. Larval galleries by *Agrilus fleischeri*. Photograph A by Dr. Wang. More photographs available at https://gd.eppo.int/taxon/AGRLFL/photos.

ANNEX 4. Climate in Fengcheng and basic comparison of climate between the area where the pest is present and the EPPO region

Fig 1a. Climate chart for Fengcheng, Liaoning province, China
(from Climate-Data.org, location 2278, data collected from 1982 to 2012)

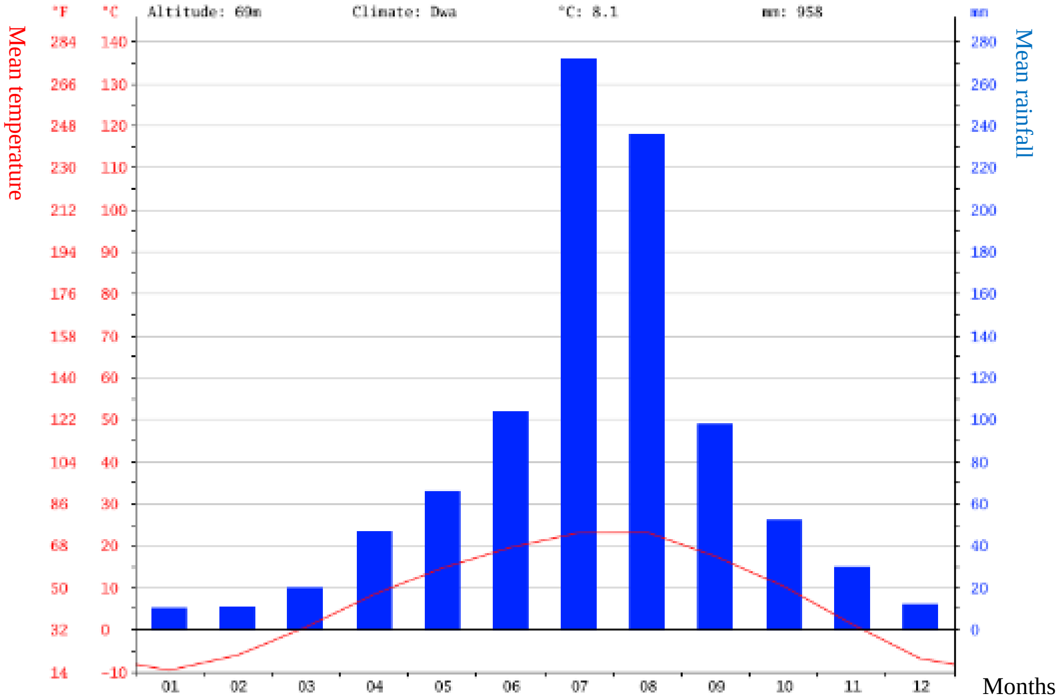
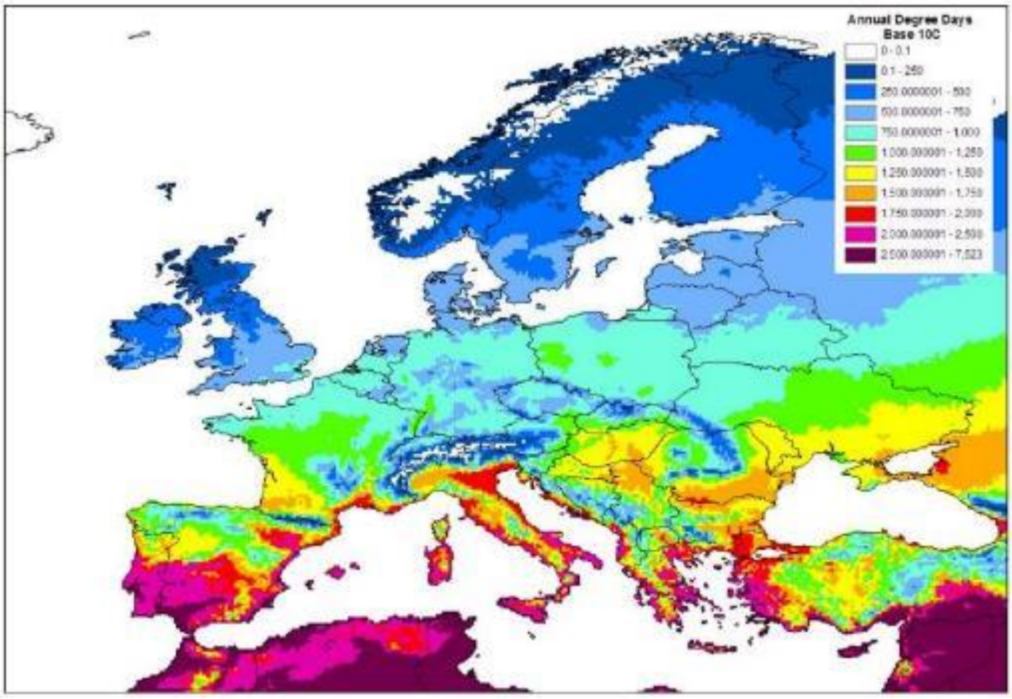


Fig 1b. Minimal, maximal and average climatic data for Fengcheng, Liaoning province, China (from Climate-Data.org, location 2278, data collected from 1982 to 2012)

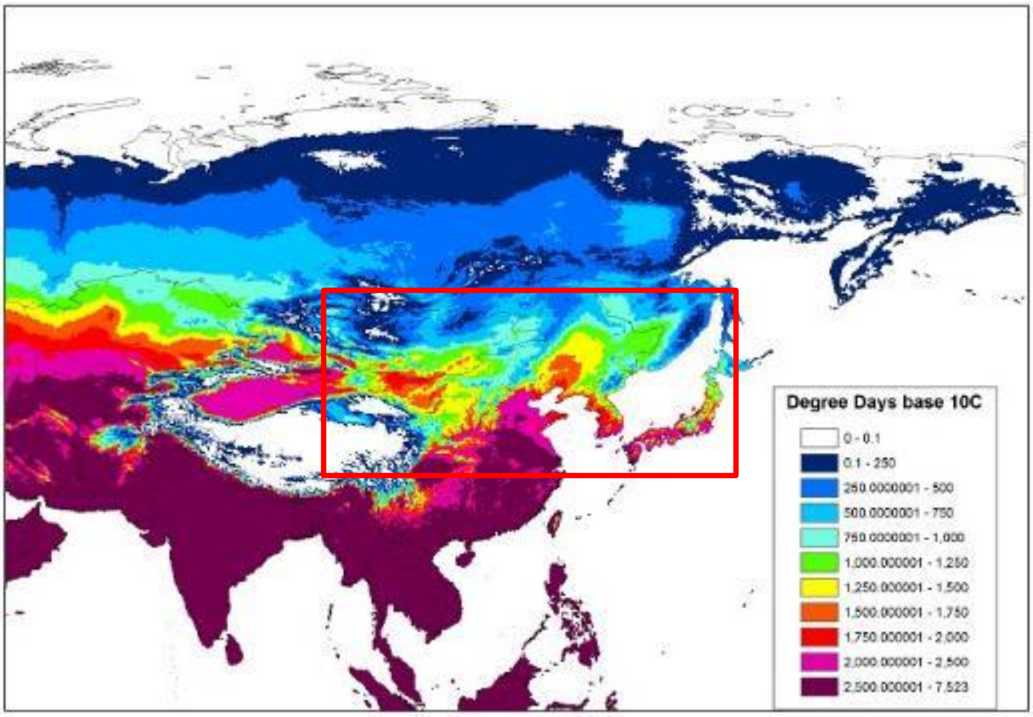
	January	February	March	April	May	June	July	August	September	October	November	December
Average temperature (°C)	-9.6	-6	0.6	8.4	14.8	19.7	23.2	23.3	17.6	10.4	1.4	-6.8
Minimal average temperature (°C)	-15.2	-11.6	-4.4	2.6	8.8	14.9	19.4	18.9	11.8	4.4	-3.6	-12
Maximal temperature (°C)	-4	-0.4	5.7	14.3	20.8	24.5	27	27.8	23.4	16.5	6.5	-1.6
Rainfall (mm)	10	11	20	47	66	104	272	236	98	52	30	12

Fig 2. Maps of average annual temperature accumulation (Degree Days) based on a threshold of 10°C using 1961–1990 monthly average maximum and minimum temperatures taken from the 10-minute latitude and longitude Climatic Research Unit database (New *et al*., 2002).

- **For Europe and Mediterranean**



- **For Asia**



Red square: *A. fleischeri* present here.

Fig 3. Comparison of plant hardiness zones: Thirty-year global plant hardiness zone map for the period 1978–2007
European and American Hardiness Zones updated by Magarey et al. (2008) (map extract)

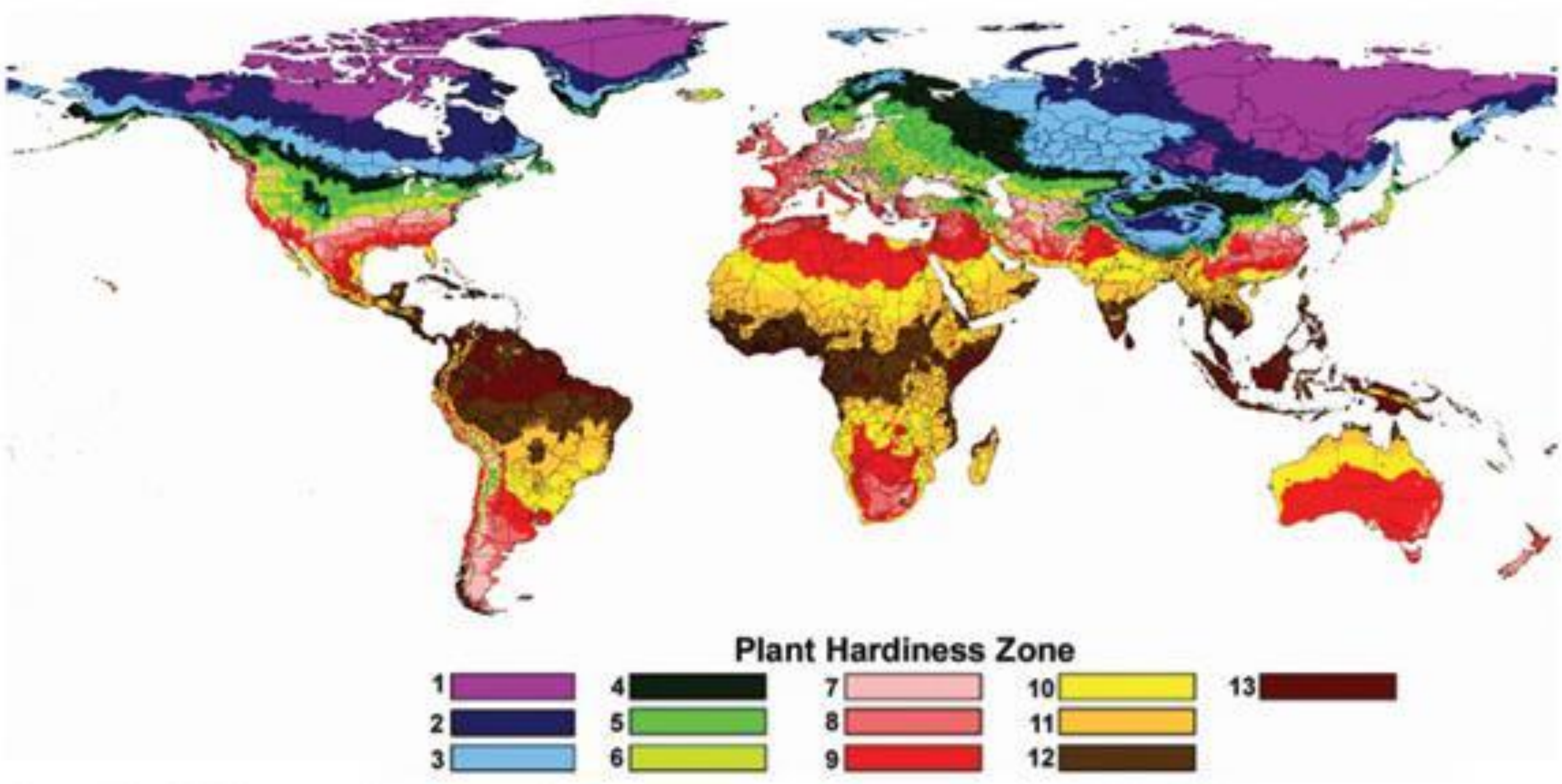


Fig 4.

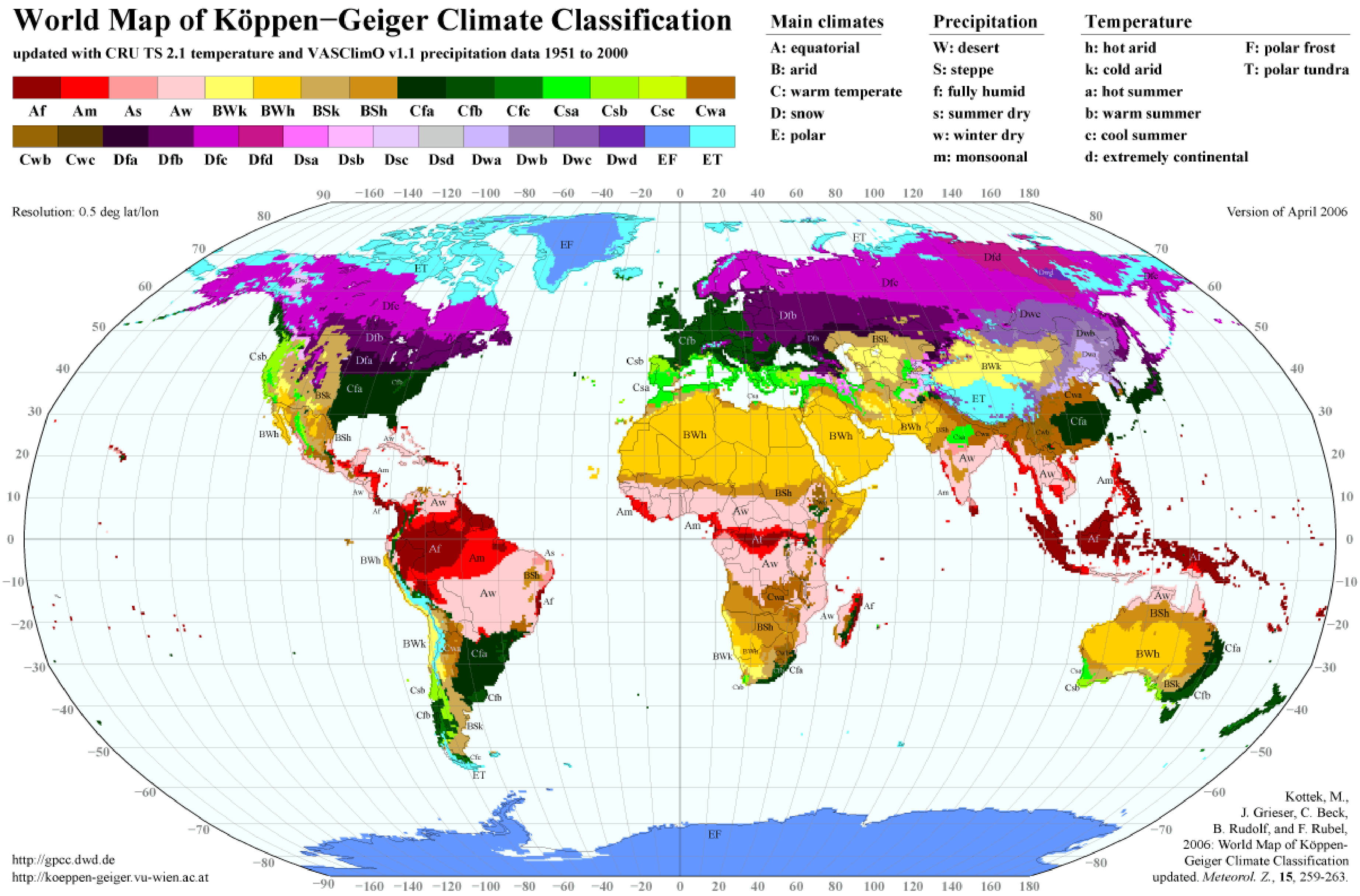
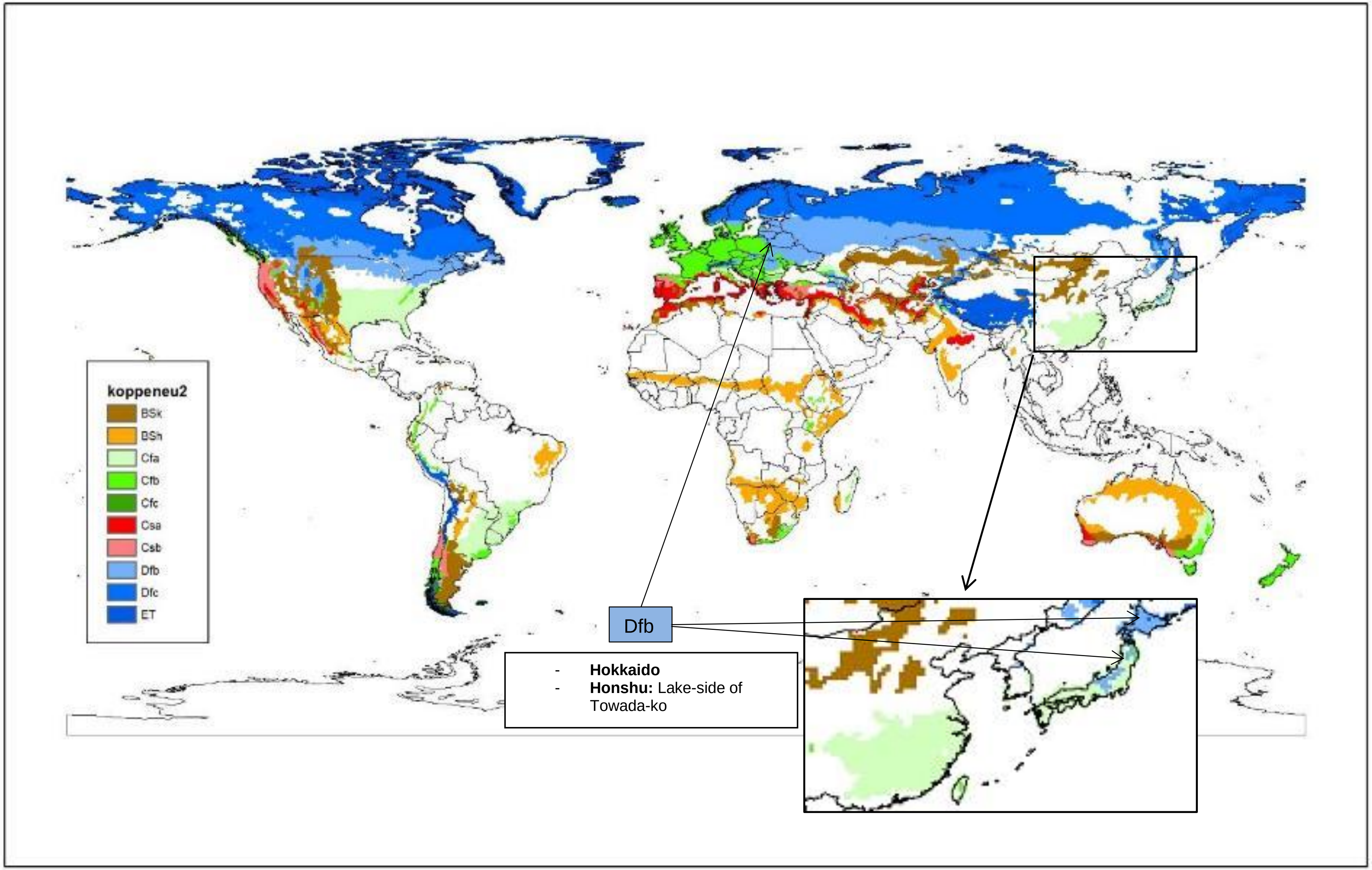

World Map of Köppen−Geiger Climate Classification
updated with CRU TS 2.1 temperature and VASClimO v1.1 precipitation data 1951 to 2000
Af Am As Aw BWk BWh BSk BSh Cfa Cfb Cfc Csa Csb Csc Cwa
Cwb Cwc Dfa Dfb Dfc Dfd Dsa Dsb Dsc Dsd Dwa Dwb Dwc Dwd EF ET
Main climates
A: equatorial
B: arid
C: warm temperate
D: snow
E: polar
Precipitation
W: desert
S: steppe
f: fully humid
s: summer dry
w: winter dry
m: monsoonal
Temperature
h: hot arid
k: cold arid
a: hot summer
b: warm summer
c: cool summer
d: extremely continental
F: polar frost
T: polar tundra
Resolution: 0.5 deg lat/lon
Version of April 2006
http://gpcc.dwd.de
http://koeppen-geiger.vu-wien.ac.at
Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: World Map of Köppen-Geiger Climate Classification updated. Meteorol. Z., 15, 259-263.

Fig 5. Updated Köppen-Geiger Climate Classification (Kottek et al., 2006) showing only the distribution of climates that occur in the EU



ANNEX 5. Definitions used in the EPPO Study on wood commodities (EPPO, 2015b)

Table 1. including existing definitions from ISPM 5 *Glossary of Phytosanitary Terms* for wood commodities and definitions developed as part of the Study

Commodity	Definition	Origin of definition
Bark (as a commodity)	Bark separated from wood	Glossary (ISPM 5)
Firewood except sawn wood, processing wood residues, wood chips, hogwood, processed wood material and post-consumer scrap wood	See 'round wood' definition	
Harvesting residues	Wood material consisting of any parts of trees left on the site after round wood harvesting	Proposed under the Study
Hogwood	Wood with or without bark in the form of pieces of varying particle size and shape, produced by crushing with blunt tools such as rollers, hammers, or flails	Proposed under the Study
Manufactured wood items	To be added when defined under the ISPM (under development) on 'International movement of wood products and handicrafts made of wood'	
Post-consumer scrap wood	Wide variety of wood material from ex-commercial, industrial and domestic use made available for recycling	Proposed under the Study
Processed wood material	Products that are a composite of wood constructed using glue, heat and pressure, or any combination thereof	Glossary (ISPM 5)
Processing wood residues	Parts of wood and bark that are left after the process of transforming round wood into sawn wood and further transformation of sawn wood	Proposed under the Study
Round wood	Wood not sawn longitudinally, carrying its natural rounded surface, with or without bark	Glossary (ISPM 5)
Sawn wood	Wood sawn longitudinally, with or without its natural rounded surface with or without bark	Glossary (ISPM 5)
Wood chips	Wood with or without bark in the form of pieces with a definable particle size produced by mechanical treatment with sharp tools	Proposed under the Study

ANNEX 6. Size of areas (ha) in selected countries of the PRA area where poplar and willow are grown

Table 1. Poplar; **Table 2.** Willow; **Table 3.** Mixed Poplar & Willow.

Table 1. Poplar (area in 1000 ha – for those countries reporting under the International Poplar Commission; FAO, 2008 & 2012)

Country	Category	2004				2007				2011			
		Area	Productive#	Protective*	Other	Area	Productive#	Protective*	Other	Area	Productive#	Protective*	Other
Belgium	Planted	35,0	33,3	1,8	0,0	32,5	30,9	1,6	0,0	32,9	32,9	0,0	0,0
Belgium	Indigenous	2,5	0,0	0,0	2,5	2,5	0,0	0,0	2,5	2,1	0,0	2,1	0,0
Bulgaria	Planted	18,6	13,1	5,5	0,1	18,9	13,1	5,6	0,2				
Bulgaria	Indigenous	1,3	0,3	1,0	0,0	1,0	0,3	0,7	0,0				
Bulgaria	Agroforestry and trees outside forests	0,3	0,2	0,2	0,0	0,2	0,2	0,0	0,0				
Croatia	Planted	13,0	12,1	0,9	0,0	12,0	11,2	0,8	0,0	13,1	12,4	0,7	0,0
Croatia	Indigenous	7,0	6,7	0,4	0,0	9,0	8,6	0,5	0,0	17,3	15,3	2,0	0,0
France	Planted	236,0	236,0	0,0	0,0	236,0	236,0	0,0	0,0				
France	Indigenous	39,8	12,0	27,9	0,0	39,8	12,0	27,9	0,0				
Germany	Planted	10,0	10,0	0,0	0,0	100,0	100,0	0,0	0,0	10,0	10,0	0,0	0,0
Germany	Indigenous	1,0	0,0	1,0	0,0	1,0	0,0	1,0	0,0	0,2	0,0	0,2	0,0
Germany	Agroforestry and trees outside forests	0,5	0,3	0,3	0,0	0,5	0,3	0,3	0,0	3,0	3,0	0,0	0,0
Italy	Planted	118,7	95,0	23,7	0,0	118,5	94,8	23,7	0,0	101,4	72,0	29,4	0,0
Italy	Indigenous									42,2	?	?	?
Morocco	Planted	4,2	3,6	0,4	0,2	4,3	3,8	0,3	0,2				
Morocco	Indigenous	2,5	0,5	2,0	0,0	2,5	0,5	2,0	0,0				
Morocco	Agroforestry and trees outside forests	0,7	0,1	0,6	0,0	0,7	0,1	0,6	0,0				
Romania	Planted	59,7	15,3	44,3	0,1	55,3	14,1	41,1	0,1	47,9	12,0	0,6	35,2
Romania	Indigenous	27,4	9,7	17,6	0,1	24,3	8,1	16,1	0,0	24,6	8,2	2,0	14,3
Romania	Agroforestry and trees outside forests	0,8	0,2	0,3	0,3	0,7	0,1	0,3	0,3	0,7	0,1	0,3	0,3
Russian Federation	Planted	26,0	25,0	1,0	0,0	26,0	25,0	1,0	0,0				
Russian Federation	Indigenous	21900	15330	6570	0,0	21536,1	15075,3	6460,8	0,0	24757,0	?	?	?
Russian Federation	Agroforestry and trees outside forests	5,0	0,0	5,0	0,0	5,0	0,0	5,0	0,0				
Serbia	Planted	33,1	31,5	1,7	0,0	33,1	31,5	1,7	0,0	33,1	31,5	1,6	0,0
Serbia	Indigenous	1,2	0,0	1,2	0,0	1,2	0,0	1,2	0,0	1,2	0,0	1,2	0,0
Serbia	Agroforestry and trees outside forests	3,2		3,2		3,2	0,0	3,2	0,0	0,1	0,0	0,1	0,0

Spain	Planted	94,0	84,6	4,7	4,7	98,5	88,7	4,9	4,9	105,0	99,8	5,2	0,0
Spain	Indigenous	22,0	3,3	17,6	1,1	25,0	3,8	20,0	1,3	8,1	0,0	8,1	0,0
Spain	Agroforestry and trees outside forests	6,0	0,9	4,8	0,3	6,5	1,0	5,2	0,3	6,5	?	?	?
Sweden	Planted	0,2	0,2	0,0	0,0	0,3	0,2	0,0	0,0	49,3	49,3	0,0	0,0
Turkey	Planted	125,0	125,0	0,0	0,0	125,0	125,0	0,0	0,0	125,0	75,0	37,5	12,5
Turkey	Indigenous									7,9	4,8	2,4	0,8
UK	Planted	1,3	1,3	0,0	0,0	1,3	1,3	0,0	0,0				

Table 2. Willow (area in 1000 ha – for those countries reporting under the International Poplar Commission; FAO, 2008 or 2012)

		2004				2007				2011			
Country	**Category**	**Area**	**Productive#**	**Protective***	**Other**	**Area**	**Productive#**	**Protective***	**Other**	**Area**	**Productive#**	**Protective***	**Other**
Belgium	Planted									5,7	0,0	5,7	0,0
Bulgaria	Planted	0,1	0,0	0,0	0,0	0,1	0,1	0,0	0,0				
Bulgaria	Indigenous	1,5	0,1	1,4	0,0	2,6	0,1	2,5	0,0				
Croatia	Planted	4,0	3,6	0,4	0,0	3,0	2,7	0,3	0,0	3,6	3,3	0,3	0,0
Croatia	Indigenous	7,0	5,0	2,0	0,0	10,0	7,1	2,9	0,0	13,2	10,2	3,0	0,0
France	Indigenous	66,6	20,0	46,6	0	66,6	20,0	46,6	0,0				
Garmany	Agroforestry & trees outside forests	0,5	0,3	0,3	0,0	0,5	0,3	0,3	0,0	2,0	2,0	0,0	0,0
Germany	Planted	1,0	1,0	0,0	0,0	1,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0
Germany	Indigenous	1,0	0,0	1,0	0,0	1,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0
Italy	Planted									20,0	0,0	20,0	0,0
Italy	Indigenous									16,0	?	?	?
Romania	Planted	21,1	4,5	16,6	0,0	20,4	4,4	16,0	0,0	19,5	2,2	17,2	0,1
Romania	Indigenous	16,8	1,9	14,9	0,0	15,2	1,4	13,8	0,0	15,5	3,2	17,2	0,1
Russian Federation	Indigenous	285,0	199,5	85,5	0,0	242,1	169,5	72,6	0,0	6568,0	?	?	?
Serbia	Planted	6,9	5,3	1,7	0,0	6,9	5,3	1,7	0,0	6,9	5,3	1,6	0,0
Serbia	Indigenous	7,5	0,0	7,5	0,0	7,5	0,0	7,5	0,0	7,5	0,0	7,5	0,0
Serbia	Agroforestry & trees outside forests	0,7	0,0	0,7	0,0	0,7	0,0	0,7	0,0	0,0	0,0	0,0	0,0
Spain	Planted	2,0	0,4	1,6	0,0	2,5	0,5	2,0	0,0	0,7	?	?	?
Spain	Indigenous	6,0	0,1	5,7	0,2	25,0	3,8	20,0	1,3	4,6	0,0	4,6	0,0
Sweden	Planted	15,0	14,9	0,0	0,2	15,0	14,9	0,0	0,2	11,1	11,1	0,0	0,0
UK	Planted	2,0	2,0	0,0	0,0	2,0	2,0	0,0	0,0				

Productive purposes: plantation for production of wood products.

* Protective purposes: plantation for use as windbreaks, for crop protection, or for stabilization of riverbanks.

Table 3. Mixed Poplar and Willow (area in 1000 ha – for those countries reporting under the International Poplar Commission; FAO, 2008 & 2012)

		2004				2007				2011			
Country	**Category**	**Area**	**Productive#**	**Protective***	**Other**	**Area**	**Productive#**	**Protective***	**Other**	**Area**	**Productive#**	**Protective***	**Other**
Bulgaria	Planted	0,5	0,4	0,0	0,0	0,4	0,3	0,0	0,0				
Bulgaria	Indigenous	1,6	0,7	0,9	0,0	1,8	0,7	1,2	0,0				
Croatia	Planted	2,0	1,7	0,3	0,0	2,0	1,7	0,3	0,0	0,1	0,1	0,0	0,0
Croatia	Indigenous	0,0	0,0	0,0	0,0	14,0	9,8	4,2	0,0	0,1	0,1	0,0	0,0
Germany	Indigenous	0,5	0,0	0,5	0,0	0,5	0,0	0,5	0,0	0,2	0,0	0,2	0,0
Romania	Planted	2,4	1,5	0,9	0,0	1,8	0,4	1,4	0,0	0,0	0,0	0,0	0,0
Romania	Indigenous	9,1	2,1	7,0	0,0	8,1	1,6	6,5	0,0	8,8	3,0	5,8	0,0
Spain	Indigenous	10,0	0,5	9,0	0,5	12,0	0,6	10,8	0,6	30,3	0,0	30,3	0,0
Spain	Agroforestry & trees outside forests	2,0	0,1	1,8	0,1	2,0	0,1	1,8	0,1	2,0	?	?	?

Productive purposes: plantation for production of wood products.

***** Protective purposes: plantation for use as windbreaks, for crop protection, or for stabilization of riverbanks.

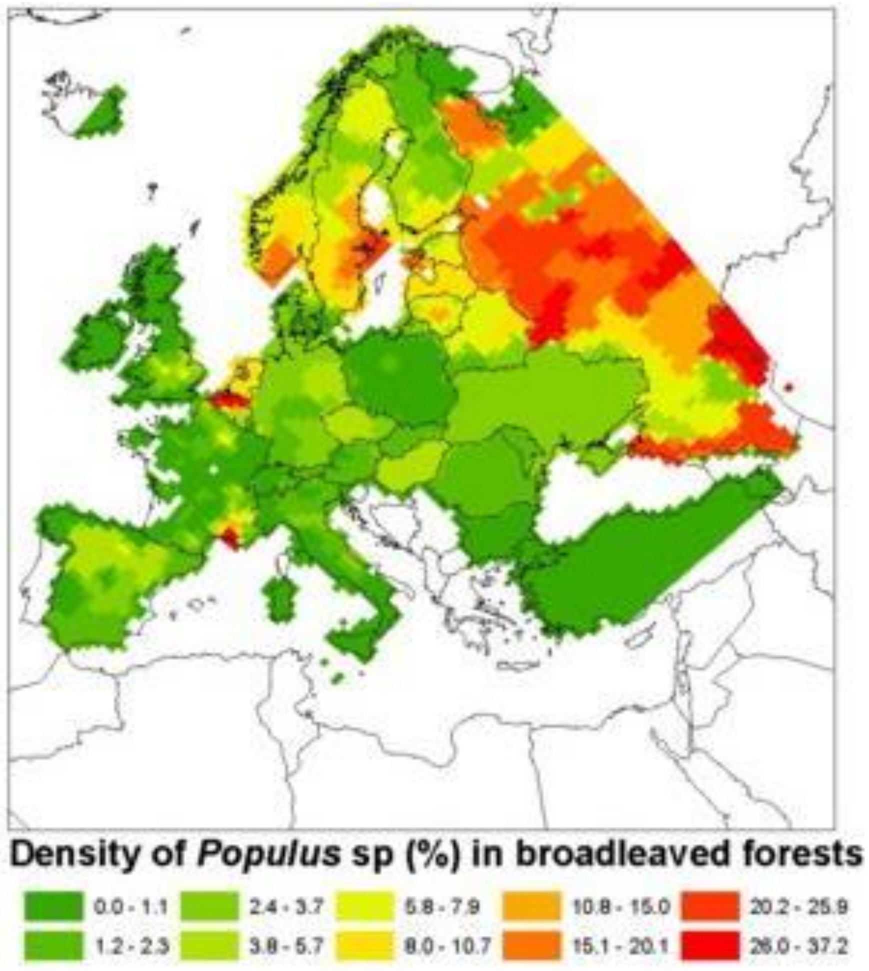
ANNEX 7. Maps of distribution of host species/genus and some related species in the PRA area

Maps were extracted from the following sites:

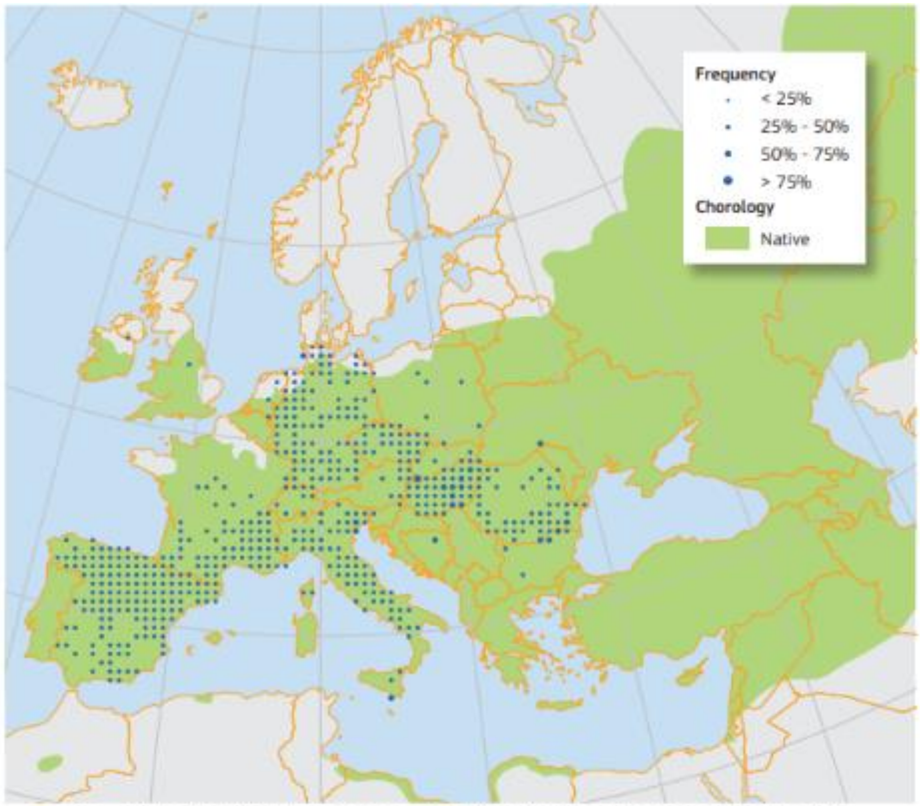
- Tree species inventories (Skjøth et al., 2008). Marked with @ after plant name
- JRC. © European Union, 2016 http://forest.jrc.ec.europa.eu/european-atlas-of-forest-tree-species/atlas-download-page/ Marked with # after plantname
- Eurasian distribution map (Caudulo et al., 2017). https://figshare.com/articles/Populus_tremula_chorology/5113963 Marked with ^ after plantname

Maps 1 – Populus

1a. *Populus*@

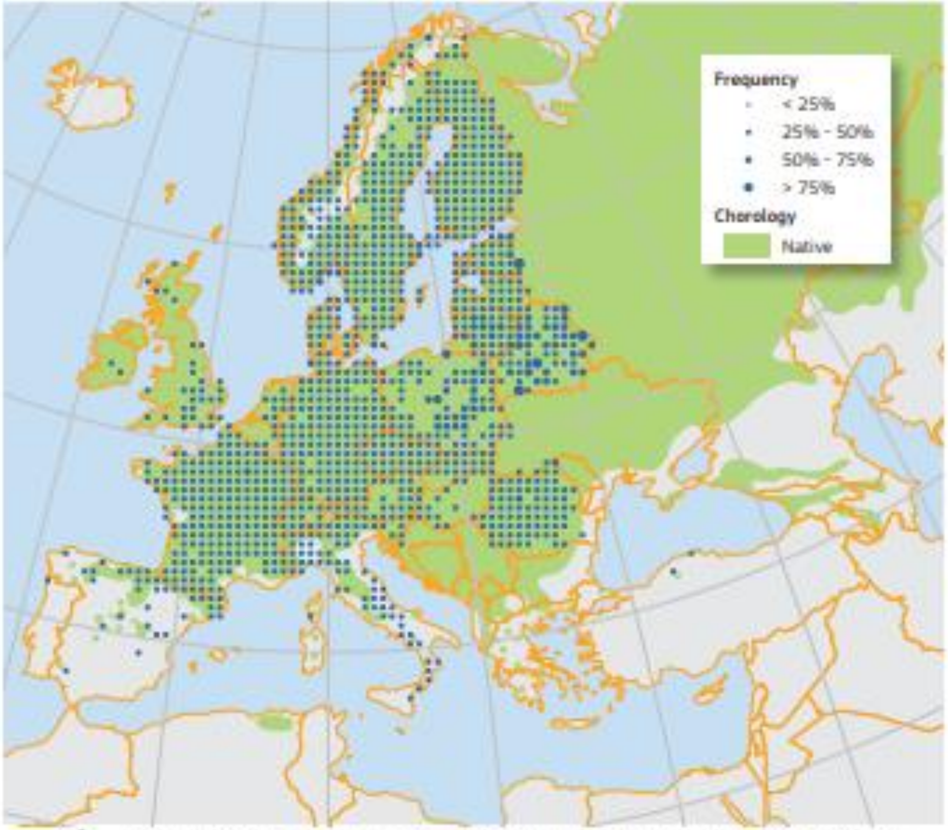


1b. *Populus nigra*#



Map 1: Plot distribution and simplified chorology map for *Populus nigra*. Frequency of *Populus nigra* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *P. nigra* is derived after EUFORGEN[32].

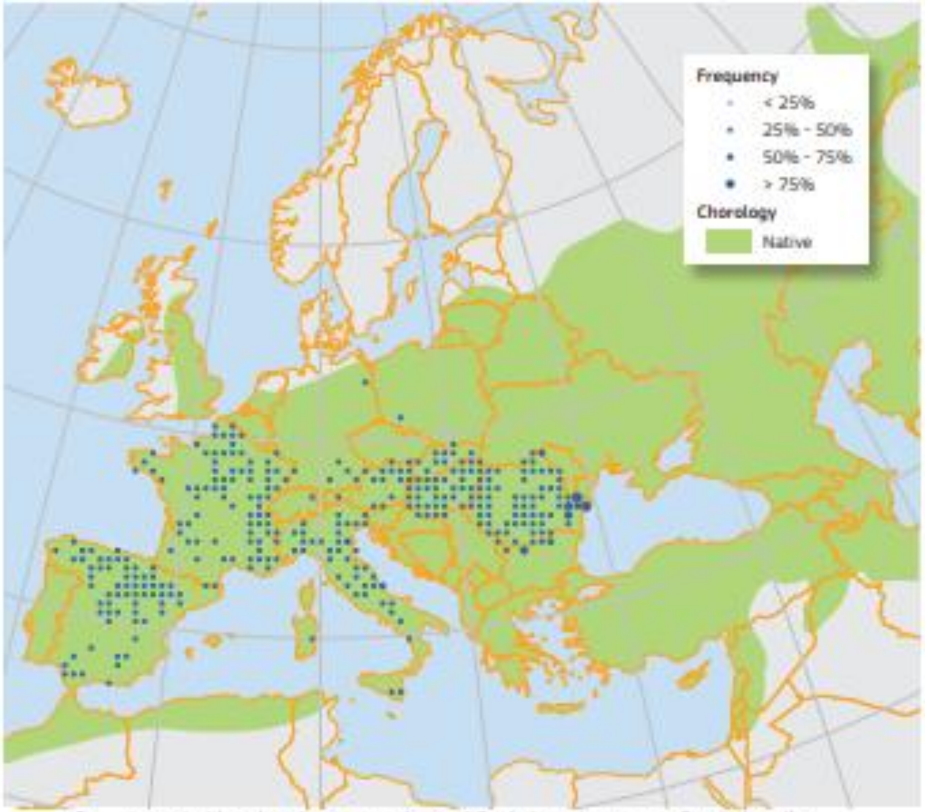
1c. *Populus tremula* (map1#, map2^)



Map 1: Plot distribution and simplified chorology map for *Populus tremula*. Frequency of *Populus tremula* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *P. tremula* is derived after several sources[5, 30, 31].

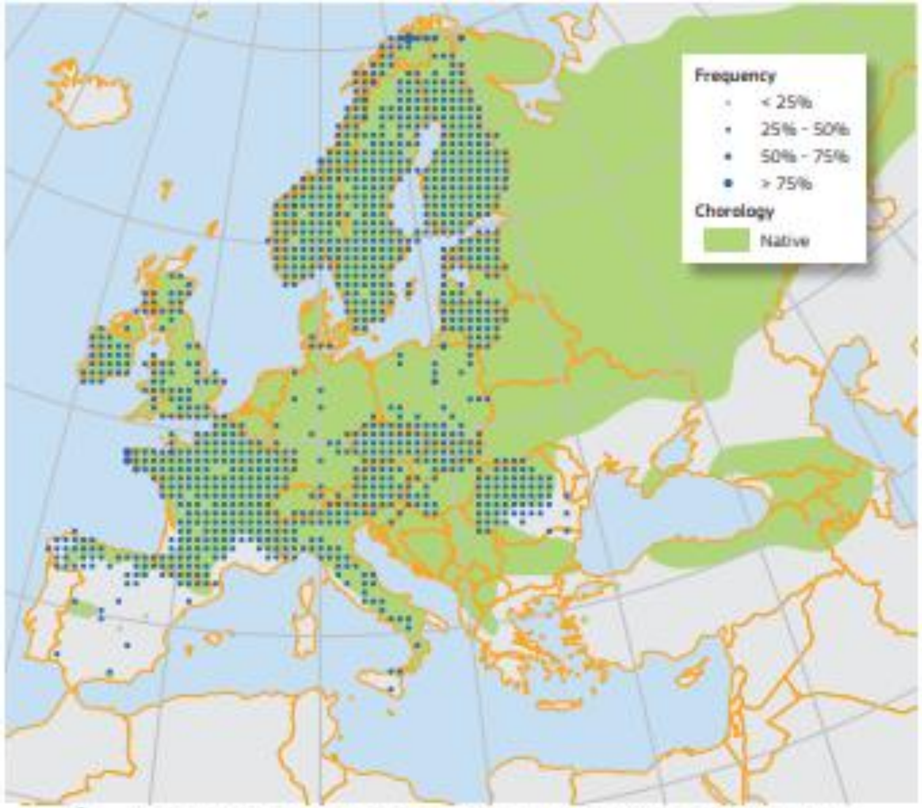
Maps 2 – Salix

1a. ***Salix alba***[#]



Map 1: Plot distribution and simplified chorology map for *Salix alba*.
Frequency of *Salix alba* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *S. alba* is derived after Meusel and Jäger, and Skvortsov[20, 21].

1b. ***Salix caprea***[#]



Map 1: Plot distribution and simplified chorology map for *Salix caprea*.
Frequency of *Salix caprea* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *S. caprea* is derived after several sources[9, 32-36].

ANNEX 8. Import of wood from countries where the pest occurs

Table 1. Import of poplar and aspen (*Populus* spp.) *'in the raw, whether or not stripped of bark or sapwood or roughly squared*' (EU CN code 44039700) into EU members in 2012-2017 (quantity in 100 kg). Note: EU countries for which there was no import where deleted from the table below.

Partner	**Russian Federation**
Reporter/Period	**2017**
GERMANY	13 023
FINLAND	1 459 981
LATVIA	1 986
POLAND	1 076
ROMANIA	5 486
SWEDEN	318 496

**China, Japan, Kazakhstan, N Korea, S Korea, Mongolia: no data available*
No data available for the period 2012–2016

Table 2. Import of poplar wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness exceeding 6 mm (44079991) into EU members in 2013–2017 (quantity in 100 kg) Note: EU countries for which there was no import where deleted from the table below.

Partner	**China**					**Russian Federation**				
Reporter/Period	**2013**	**2014**	**2015**	**2016**	**2017**	**2013**	**2014**	**2015**	**2016**	**2017**
CYPRUS	:	:	:	:	:	662	395	134	842	:
CZECH REPUBLIC	357	:	532	175	:	:	:	:	:	:
GERMANY	:	:	30	:	:	3 202	2 625	6 091	4 383	:
UNITED KINGDOM	1 167	3 586	8	28	:	:	:	:	:	:
ITALY	:	382	250	510	:	:	:	:	254	:
LITHUANIA	:	:	:	:	:	:	:	430	16	:
LATVIA	:	:	:	:	:	414	:	:	:	:
MALTA	:	234	216	97	:	:	:	:	:	:
SLOVENIA	:	:	:	:	:	:	:	:	158	:

**Japan, Kazakhstan, N Korea, S Korea, Mongolia: no data available*

Table 3. Imports/exports of poplar and willow round wood and wood chips (data extracted for countries of the PRA area from Table 6, p65 of FAO. 2008)

Country	Category	m^3	tonnes	Countries of origin/destination (in order of importance)
Bulgaria	Import wood chips		516	Romania
Belgium	Import round wood	228.000		Netherlands, France, Germany
Bulgaria	Import round wood	34.223	6.800	Romania, Serbia, Ukraine
Croatia	Import round wood		18.701	Serbia, Hungary, UK, Macedonia, Bosnia and Herzegovina
Italy	Import round wood	457.000		Hungary, France
Spain	Import round wood	5.400		France, Portugal, Ukraine
France	Import round wood		242.449	Italy, Spain, Morocco
Bulgaria	Import others	12.206	8.300	Romania
Spain	Import others	1218		USA, Romania, Brazil, Ukraine
Belgium	Export round wood	209.000		France, Italy, Netherlands, North Africa
Croatia	Export round wood		13.560	Italy, Slovenia, Bosnia and Herzegovina, Austria, Bulgaria
Italy	Export round wood	1500		Hungary, France
Romania	Export round wood	44.429		Bulgaria, Syria
Spain	Export round wood	12.886		France, Portugal
Serbia	Export round wood		106.013	Italy
France	Export round wood		127.380	Belgium, Luxembourg, Spain, Germany
Spain	Export others	69		Portugal, Romania

Table 4. Import of ‘wood in chips or particles (excl. those of a kind used principally for dying or tanning purposes, and coniferous wood)’ (EU CN code 44012200) into EU members in 2013–2017 (quantity in 100 kg). Note: EU countries for which there was no import where deleted from the table below, as well as years without positive import.

Partner	China					Japan		Korea, Republic of (South Korea)					Kazakhstan	Russian Federation				
Reporter/Period	**2013**	**2014**	**2015**	**2016**	**2017**	**2013**	**2017**	**2013**	**2014**	**2015**	**2016**	**2017**	**2017**	**2013**	**2014**	**2015**	**2016**	**2017**
BELGIUM	:	361	0	:	:	39	0	856	1 117	1 230	633	29	:	:	:	:	0	:
GERMANY	6	:	:	60	46	:	:	:	:	:	:	:	:	:	:	:	:	:
DENMARK	15	8	30	134	308	:	:	:	:	:	4	:	:	17 502	18 897	16 085	98 275	227 986
ESTONIA	:	:	:	:	:	:	:	:	:	:	:	:	:	1 990	15 608	95 678	180 370	247 462
SPAIN	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	2	:
FINLAND	:	:	1	1	0	:	:	:	:	:	:	:	:	2 601 771	2 851 618	2 865 524	2 379 078	2 684 962
FRANCE	:	21	:	:	0	:	:	:	:	:	:	:	:	:	:	:	:	:
UNITED KINGDOM	7	:	45	21	44	:	:	:	:	:	:	:	:	:	:	:	:	:
CROATIA	0	:	:	:	7	:	:	:	:	:	:	:	:	:	:	:	:	:
HUNGARY	:	:	3	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
LITHUANIA	:	:	:	:	:	:	:	:	:	:	:	:	139	:	:	:	:	:
LATVIA	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	205
MALTA	:	:	:	1	:	:	:	:	:	:	:	:	:	:	:	:	:	:
NETHERLANDS	353	176	159	195	284	0	2	:	:	0	:	0	0	:	243	:	:	0
POLAND	:	:	:	:	:	:	:	:	:	:	:	:	:	156	:	:	:	2
SWEDEN	2	6	0	54 158	:	:	:	:	:	:	:	:	:	:	0	:	155 594	274 667
SLOVAKIA	:	:	:	:	:	:	:	:	:	:	:	:	:	:	71	:	0	:

** N Korea, Mongolia: no data available*

Table 5. Import of '*wood waste and scrap (whether or not agglomerated in logs, briquettes or similar forms (excl. sawdust and pellets)*' (EU CN 44013980) into EU members in 2013–2017 (quantity in 100 kg). Note: EU countries for which there was no import where deleted from the table below, as well as years whithout positive data.

Partner	China				Japan			Korea, Republic of (South Korea)		Russian Federation			
Reporter/Period	**2013**	**2014**	**2015**	**2016**	**2013**	**2014**	**2015**	**2014**	**2015**	**2013**	**2014**	**2015**	**2016**
AUSTRIA	:	:	:	:	:	:	:	:	:	:	:	:	:
BELGIUM	52	133	41	29	:	:	:	:	:	456	122 161	72 095	940 735
BULGARIA	:	69	:	:	:	:	:	:	:	:	:	:	:
CYPRUS	:	:	:	:	:	:	:	:	:	482	:	:	:
CZECH REPUBLIC	:	:	:	:	:	:	:	:	:	2 224	:	:	:
GERMANY	2	13	:	8	:	:	:	:	:	0	13 870	:	:
DENMARK	0	1	:	:	:	:	:	:	:	1 280	5 712	638	50 088
ESTONIA	:	:	:	:	:	:	:	:	:	34 102	29 174	58 077	38 607
FINLAND	:	:	:	:	:	:	:	:	:	1 856 223	1 440 445	1 447 867	1 092 307
FRANCE	22	24	56	3	:	:	:	:	:	:	:	:	2 641
UNITED KINGDOM	338	2	1	747	:	:	0	:	:	:	:	713	5 161
GREECE	:	:	:	:	:	:	:	:	:	:	210	:	:
HUNGARY	:	:	:	:	:	:	:	:	:	:	:	10	211
ITALY	555	:	3	9	:	:	:	:	:	:	:	659	221
LITHUANIA	:	:	0	221	:	:	:	:	:	20 452	47 384	49 833	55 253
LATVIA	:	0	:	:	:	:	:	:	:	1 292	653	6 168	9 351
NETHERLANDS	95	53	281	:	:	:	:	:	4	:	:	:	451
POLAND	147	7	0	20	18	43	3	:	:	1 525	422	336	26 958
SWEDEN	3	965	504	501	:	:	:	72	:	61 441	456	90	31
SLOVAKIA	:	:	:	:	:	:	:	:	:	:	:	9	:

ANNEX 9. Other **Agrilus** *on* **Populus** *and* **Salix** *in the EPPO region*

***Agrilus suvorovi* Obenberger**
This pest is present in France, Germany, Italy, Spain and central Europe.
Adults (6.5–9.3 mm) are metallic green.
Eggs (1.25 x 0.7 mm) are laid on the bark, in groups which generally contain 7 or 8 eggs (with a minimum of 2 and a maximum of 17) and are covered with a characteristic white secretion (ovature).
Larvae (2–20 mm) penetrate immediately into the bark after hatching. The larvae dig sinuous galleries in the cambial area which can be up to 50 cm long and 2.5 mm wide. Larvae spend the winter in a pupal cell located in the outer xylem.
This species colonizes only poplars. Published host plants for *A. suvorovi* are *Populus alba* L., *Populus alba* var. *pyramidalis* Bunge, *Populus balsamifera* L., *Populus x canadensis* Moench, *Populus deltoides* W. Bartram ex Marshall, *Populus nigra* L., *Populus nigra* var. *italica*, *Populus suaveolens* Fisch. and *Populus tremula* L. (Jendek & Poláková, 2014).
This insect attacks young trees, and can cause damage to poles following transplantation (Monferrato, 1964; Rougon, 1998).

***Agrilus ater* Linné (=*Agrilus sexguttatus*)**
This species is common in Europe, Russia and Asia Minor. It was newly identified in Belgium and the Netherlands. The species is not known from Portugal, Great Britain, Ireland, Denmark, Norway, Sweden and Luxembourg (Schaefer, 1949; Bílý, 1982; Curletti, 1994; Jendek, 2006; Niehuis, 2004).
Adults (6.5–12 mm) are metallic black, green or blue, with six whitich or yellowich spots on the elytra.
Eggs are laid on the bark and covered with a white secretion.
Larvae (2.2–25 mm) penetrate immediately into the bark after hatching. The larvae dig sinuous galleries in the cambial area and outer xylem which can be up to 90 cm long and 2.5 mm wide. They colonize the trunk and main branches.
Pupation occurs in a pupal cell located in outer xylem or bark (Schaefer, 1949).
This species can colonize both willows and poplars (Rougon, 1998; Teunissen & Vendrig, 2017). Published host plants for *A. ater* are *Populus alba* L., *Populus alba* var. *pyramidalis* Bunge, *Populus balsamifera* L., *Populus* x *canadensis* Moench, *Populus nigra* L., *Populus nigra* var. *italica* Koehne, *Populus tremula* L., *Salix alba* L., *Salix caprea* L. and *Salix cinerea* L. (Jendek & Poláková, 2014).
This insect prefers plants over 5 year-old and weakened or decaying hosts (Schaefer, 1949; Rougon, 1998; Teunissen & Vendrig, 2017).

Other *Agrilus* species, that can colonize Salicaceae but are of lower economic importance (Jendek & Poláková, 2014):
Agrilus guerini Lacordaire – restricted to *Salix*;
Agrilus lineola lineola Kiesenwetter – restricted to *Salix*;
Agrilus massenensis Schaefer – colonize *Populus* and *Salix*;
Agrilus pratensis Ratzeburg – colonize *Populus* and probably *Salix*;
Agrilus pseudocyaneus – colonize *Populus*;
Agrilus salicis Frivaldski – restricted to *Salix*;
Agrilus subauratus Gebler – colonize *Populus* and *Salix*;
Agrilus tschitscherini Semenov – colonize *Populus* and *Salix*;
Agrilus viridis Linné – restricted to *Salix*.

Other economically significant Buprestidae that can colonize Salicaceae trunks:

***Trachypteris* (Melanophila) picta decostigma** F.
This species is distributed throughout southern, central and eastern Europe, Near East and North Africa.
Adults (9–14 mm long) are bronzed with yellow spots on the elytra, and very different from *Agrilus* sp.
Eggs are laid in bark crevices or around buds in the lower part of the trunk.
Larvae have the typically enlarged and flat thorax of buprestid larvae but do not have urogomphi. The larvae create feeding galleries that can be up to 10 cm long, firstly in the inner bark then into the sapwood. The last larval instar overwinters in the sapwood. In spring larvae molt into a pre-pupa, followed by a pupa. The last molt occurs in a pupal cell located in the bark or outer xylem.
This insect mostly colonizes freshly killed or felled poplars and willows but can also infest weakened hosts, especially trees experiencing a water deficit. This buprestid is also considered a major pest of young poplars

in plantations or nurseries in the Mediterranean area, especially in Greece and the Iberian Peninsula, but also in central Europe and Middle East (Sallé, 2016).