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Pest categorisation of non-EU Scolytinae of coniferous hosts

EFSA Panel on Plant Health (PLH),
Claude Bragard, Katharina Dehnen-Schmutz, Francesco Di Serio, Paolo Gonthier, Marie-Agnès Jacques, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod, Christer Sven Magnusson, Juan A Navas-Cortes, Stephen Parnell, Roel Potting, Philippe Lucien Reignault, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen, Lucia Zappalà, Jean-Claude Grégoire, Virág Kertész, Franz Streissl and Panagiotis Milonas

Abstract

The Panel on Plant Health performed a pest categorisation of non-EU Scolytinae (Coleoptera: Curculionidae) of coniferous hosts (hereafter NESC). NESC occur worldwide, and some species are important forest pests. Species can be identified using taxonomic keys and molecular methods. Most NESC species (bark beetles) live in the inner bark of their hosts (phloem and cambium), while the remaining species mostly colonise the sapwood (ambrosia beetles). Bark- and ambrosia beetles are often associated with symbiotic fungi, which behave as pathogens towards the host trees, or are used as food by ambrosia beetle larvae. The larvae live in individual tunnels or in communal chambers. Pupation occurs in the wood or in the bark. Some species are semi- or multivoltine, others are monovoltine. Some species attack and kill living, apparently healthy trees. Other species specialise in weakened, dying or dead trees. The pathways for entry are cut branches, cones, round wood with or without bark, sawn wood with or without bark, wood packaging material, bark, manufactured wood items and wood chips and plants for planting (including seeds) of conifers. Availability of host plants and suitable climate would allow the establishment in the EU of NESC. Measures are in place to prevent their introduction through the pathways described above. NESC satisfy all the criteria to be considered as Union quarantine pests. As NESC are not present in the EU and plants for planting are not their major pathway for spread, they do not meet the criteria to be considered as regulated non-quarantine pests.

Keywords: Bark beetles, ambrosia beetles, European Union, pest risk, plant health, plant pest, quarantine

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Correspondence alpha@efsa.europa.eu

Panel members: Claude Bragard, Katharina Dehnen-Schmutz, Francesco Di Serio, Paolo Gonthier, Marie-Agnès Jacques, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod, Christer Sven Magnusson, Panagiotis Milonas, Juan A Navas-Cortes, Stephen Parnell, Roel Potting, Philippe L Reignault, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen and Lucia Zappalà.

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1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

1.1.1. Background

Council Directive 2000/29/EC[1] on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community establishes the present European Union plant health regime. The Directive lays down the phytosanitary provisions and the control checks to be carried out at the place of origin on plants and plant products destined for the Union or to be moved within the Union. In the Directive's 2000/29/EC annexes, the list of harmful organisms (pests) whose introduction into or spread within the Union is prohibited, is detailed together with specific requirements for import or internal movement.

Following the evaluation of the plant health regime, the new basic plant health law, Regulation (EU) 2016/2031[2] on protective measures against pests of plants, was adopted on 26 October 2016 and will apply from 14 December 2019 onwards, repealing Directive 2000/29/EC. In line with the principles of the above mentioned legislation and the follow-up work of the secondary legislation for the listing of EU regulated pests, EFSA is requested to provide pest categorisations of the harmful organisms included in the annexes of Directive 2000/29/EC, in the cases where recent pest risk assessment/pest categorisation is not available.

1.1.2. Terms of Reference

EFSA is requested, pursuant to Article 22(5.b) and Article 29(1) of Regulation (EC) No 178/2002[3], to provide scientific opinion in the field of plant health.

EFSA is requested to prepare and deliver a pest categorisation (step 1 analysis) for each of the regulated pests included in the appendices of the annex to this mandate. The methodology and template of pest categorisation have already been developed in past mandates for the organisms listed in Annex II Part A Section II of Directive 2000/29/EC. The same methodology and outcome is expected for this work as well.

The list of the harmful organisms included in the annex to this mandate comprises 133 harmful organisms or groups. A pest categorisation is expected for these 133 pests or groups and the delivery of the work would be stepwise at regular intervals through the year as detailed below. First priority covers the harmful organisms included in Appendix 1, comprising pests from Annex II Part A Section I and Annex II Part B of Directive 2000/29/EC. The delivery of all pest categorisations for the pests included in Appendix 1 is June 2018. The second priority is the pests included in Appendix 2, comprising the group of *Cicadellidae* (non-EU) known to be vector of Pierce's disease (caused by *Xylella fastidiosa*), the group of *Tephritidae* (non-EU), the group of potato viruses and virus-like organisms, the group of viruses and virus-like organisms of *Cydonia* Mill., *Fragaria* L., *Malus* Mill., *Prunus* L., *Pyrus* L., *Ribes* L., *Rubus* L. and *Vitis* L., and the group of *Margarodes* (non-EU species). The delivery of all pest categorisations for the pests included in Appendix 2 is end 2019. The pests included in Appendix 3 cover pests of Annex I part A section I and all pest categorisations should be delivered by end 2020.

For the above mentioned groups, each covering a large number of pests, the pest categorisation will be performed for the group and not the individual harmful organisms listed under "such as" notation in the Annexes of the Directive 2000/29/EC. The criteria to be taken particularly under consideration for these cases, is the analysis of host pest combination, investigation of pathways, the damages occurring and the relevant impact.

Finally, as indicated in the text above, all references to 'non-European' should be avoided and replaced by 'non-EU' and refer to all territories with exception of the Union territories as defined in Article 1 point 3 of Regulation (EU) 2016/2031.

[1] Council Directive 2000/29/EC of 8 May 2000 on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community. OJ L 169/1, 10.7.2000, p. 1–112.

[2] Regulation (EU) 2016/2031 of the European Parliament of the Council of 26 October 2016 on protective measures against pests of plants. OJ L 317, 23.11.2016, p. 4–104.

[3] Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. OJ L 31/1, 1.2.2002, p. 1–24.

1.1.2.1. Terms of Reference: Appendix 1

List of harmful organisms for which pest categorisation is requested. The list below follows the annexes of Directive 2000/29/EC.

Annex IIAI

(a) Insects, mites and nematodes, at all stages of their development

Aleurocanthus spp.
Anthonomus bisignifer (Schenkling)
Anthonomus signatus (Say)
Aschistonyx eppoi Inouye
Carposina niponensis Walsingham
Enarmonia packardi (Zeller)
Enarmonia prunivora Walsh
Grapholita inopinata Heinrich
Hishomonus phycitis
Leucaspis japonica Ckll.
Listronotus bonariensis (Kuschel)
Numonia pyrivorella (Matsumura)
Oligonychus perditus Pritchard and Baker
Pissodes spp. (non-EU)
Scirtothrips aurantii Faure
Scirtothrips citri (Moultex)
Scolytidae spp. (non-EU)
Scrobipalpopsis solanivora Povolny
Tachypterellus quadrigibbus Say
Toxoptera citricida Kirk.
Unaspis citri Comstock

(b) Bacteria

Citrus variegated chlorosis
Erwinia stewartii (Smith) Dye
Xanthomonas campestris pv. *oryzae* (Ishiyama) Dye and pv. *oryzicola* (Fang. et al.) Dye

(c) Fungi

Alternaria alternata (Fr.) Keissler (non-EU pathogenic isolates)
Anisogramma anomala (Peck) E. Müller
Apiosporina morbosa (Schwein.) v. Arx
Ceratocystis virescens (Davidson) Moreau
Cercoseptoria pini-densiflorae (Hori and Nambu) Deighton
Cercospora angolensis Carv. and Mendes
Elsinoe spp. Bitanc. and Jenk. Mendes
Fusarium oxysporum f. sp*. albedinis* (Kilian and Maire) Gordon
Guignardia piricola (Nosa) Yamamoto
Puccinia pittieriana Hennings
Stegophora ulmea (Schweinitz: Fries) Sydow & Sydow
Venturia nashicola Tanaka and Yamamoto

(d) Virus and virus-like organisms

Beet curly top virus (non-EU isolates)
Black raspberry latent virus
Blight and blight-like
Cadang-Cadang viroid
Tatter leaf virus
Witches' broom (MLO)
Citrus tristeza virus (non-EU isolates)
Leprosis
Little cherry pathogen (non- EU isolates)
Naturally spreading psorosis
Palm lethal yellowing mycoplasm
Satsuma dwarf virus

Annex IIB

(a) Insect mites and nematodes, at all stages of their development

Anthonomus grandis (Boh.)
Cephalcia lariciphila (Klug)
Dendroctonus micans Kugelan
Gilphinia hercyniae (Hartig)
Gonipterus scutellatus Gyll.
Ips amitinus Eichhof
Ips cembrae Heer
Ips duplicatus Sahlberg
Ips sexdentatus Börner
Ips typographus Heer
Sternochetus mangiferae Fabricius

(b) Bacteria

Curtobacterium flaccumfaciens pv. flaccumfaciens (Hedges) Collins and Jones

(c) Fungi

Glomerella gossypii Edgerton
Gremmeniella abietina (Lag.) Morelet
Hypoxylon mammatum (Wahl.) J. Miller

1.1.2.2. Terms of Reference: Appendix 2

List of harmful organisms for which pest categorisation is requested per group. The list below follows the categorisation included in the annexes of Directive 2000/29/EC.

Annex IAI

(a) Insects, mites and nematodes, at all stages of their development

Group of Cicadellidae (non-EU) known to be vector of Pierce's disease (caused by *Xylella fastidiosa*), such as:

1) *Carneocephala fulgida* Nottingham
2) *Draeculacephala minerva* Ball
3) *Graphocephala atropunctata* (Signoret)

Group of Tephritidae (non-EU) such as:

1) *Anastrepha fraterculus* (Wiedemann)
2) *Anastrepha ludens* (Loew)
3) *Anastrepha obliqua* Macquart
4) *Anastrepha suspensa* (Loew)
5) *Dacus ciliatus* Loew
6) *Dacus curcurbitae* Coquillet
7) *Dacus dorsalis* Hendel
8) *Dacus tryoni* (Froggatt)
9) *Dacus tsuneonis* Miyake
10) *Dacus zonatus* Saund.
11) *Epochra canadensis* (Loew)
12) *Pardalaspis cyanescens* Bezzi
13) *Pardalaspis quinaria* Bezzi
14) *Pterandrus rosa* (Karsch)
15) *Rhacochlaena japonica* Ito
17) *Rhagoletis fausta* (Osten-Sacken)
18) *Rhagoletis indifferens* Curran
19) *Rhagoletis mendax* Curran
20) *Rhagoletis pomonella* Walsh
21) *Rhagoletis suavis* (Loew)

(c) Viruses and virus-like organisms

Group of potato viruses and virus-like organisms such as:

1) Andean potato latent virus
2) Andean potato mottle virus
3) Arracacha virus B, oca strain
4) Potato black ringspot virus
5) Potato virus T
6) non-EU isolates of potato viruses A, M, S, V, X and Y (including Yo, Yn and Yc) and Potato leafroll virus

Group of viruses and virus-like organisms of *Cydonia* Mill., *Fragaria* L., *Malus* Mill., *Prunus* L., *Pyrus* L., *Ribes* L., *Rubus* L. and *Vitis* L., such as:

1) Blueberry leaf mottle virus
2) Cherry rasp leaf virus (American)
3) Peach mosaic virus (American)
4) Peach phony rickettsia
5) Peach rosette mosaic virus
6) Peach rosette mycoplasm
7) Peach X-disease mycoplasm
8) Peach yellows mycoplasm
9) Plum line pattern virus (American)
10) Raspberry leaf curl virus (American)
11) Strawberry witches' broom mycoplasma
12) Non-EU viruses and virus-like organisms of *Cydonia Mill., Fragaria L., Malus Mill., Prunus L., Pyrus L., Ribes L., Rubus L.* and *Vitis L.*

Annex IIAI

(a) Insects, mites and nematodes, at all stages of their development

Group of *Margarodes* (non-EU species) such as:

1) *Margarodes vitis* (Phillipi)
2) *Margarodes vredendalensis* de Klerk
3) *Margarodes prieskaensis* Jakubski

1.1.2.3. Terms of Reference: Appendix 3

List of harmful organisms for which pest categorisation is requested. The list below follows the annexes of Directive 2000/29/EC.

Annex IAI

(a) Insects, mites and nematodes, at all stages of their development

Acleris spp. (non-EU)
Amauromyza maculosa (Malloch)
Anomala orientalis Waterhouse
Arrhenodes minutus Drury
Choristoneura spp. (non-EU)
Conotrachelus nenuphar (Herbst)
Dendrolimus sibiricus Tschetverikov
Diabrotica barberi Smith and Lawrence
Diabrotica undecimpunctata howardi Barber
Diabrotica undecimpunctata undecimpunctata Mannerheim
Diabrotica virgifera zeae Krysan & Smith
Diaphorina citri Kuway
Heliothis zea (Boddie)
Hirschmanniella spp., other than *Hirschmanniella gracilis* (de Man) Luc and Goodey
Liriomyza sativae Blanchard
Longidorus diadecturus Eveleigh and Allen
Monochamus spp. (non-EU)
Myndus crudus Van Duzee
Nacobbus aberrans (Thorne) Thorne and Allen
Naupactus leucoloma Boheman
Premnotrypes spp. (non-EU)
Pseudopityophthorus minutissimus (Zimmermann)
Pseudopityophthorus pruinosus (Eichhoff)
Scaphoideus luteolus (Van Duzee)
Spodoptera eridania (Cramer)
Spodoptera frugiperda (Smith)
Spodoptera litura (Fabricus)
Thrips palmi Karny
Xiphinema americanum Cobb sensu lato (non-EU populations)
Xiphinema californicum Lamberti and Bleve-Zacheo

(b) Fungi

Ceratocystis fagacearum (Bretz) Hunt
Chrysomyxa arctostaphyli Dietel
Cronartium spp. (non-EU)
Endocronartium spp. (non-EU)
Mycosphaerella larici-leptolepis Ito et al.
Mycosphaerella populorum G. E. Thompson
Phoma andina Turkensteen
Phyllosticta solitaria Ell. and Ev.
Guignardia laricina (Saw.) Yamamoto and Ito
Gymnosporangium spp. (non-EU)
Inonotus weirii (Murril) Kotlaba and Pouzar
Melampsora farlowii (Arthur) Davis
Septoria lycopersici Speg. var. *malagutii* Ciccarone and Boerema
Thecaphora solani Barrus
Trechispora brinkmannii (Bresad.) Rogers

(c) Viruses and virus-like organisms

Tobacco ringspot virus
Tomato ringspot virus
Bean golden mosaic virus
Cowpea mild mottle virus
Lettuce infectious yellows virus
Pepper mild tigré virus
Squash leaf curl virus
Euphorbia mosaic virus
Florida tomato virus

(d) Parasitic plants

Arceuthobium spp. (non-EU)

Annex IAII

(a) Insects, mites and nematodes, at all stages of their development

Meloidogyne fallax Karssen

Popillia japonica Newman

Rhizoecus hibisci Kawai and Takagi

(b) Bacteria

Clavibacter michiganensis (Smith) Davis et al. ssp. *sepedonicus* (Spieckermann and Kotthoff) Davis et al.

Ralstonia solanacearum (Smith) Yabuuchi et al.

(c) Fungi

Melampsora medusae Thümen

Synchytrium endobioticum (Schilbersky) Percival

Annex I B

(a) Insects, mites and nematodes, at all stages of their development

Leptinotarsa decemlineata Say

Liriomyza bryoniae (Kaltenbach)

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

1.2. Interpretation of the Terms of Reference

Scolytinae spp. are listed as Scolytidae spp. (non-EU) in the Appendices to the Terms of Reference (ToR) to be subject to pest categorisation to determine whether it fulfils the criteria of a quarantine pest or those of a regulated non-quarantine pest (RNQP) for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States (MSs) referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores. Although the leading taxonomists in the 2000s (Wood, 1982; Bright and Skidmore, 2002) still considered the Scolytidae to be a family distinct from the Curculionidae according to morphological criteria, modern phylogenetics supports the position of scolytine beetles (Scolytinae) within the family Curculionidae (Knizek and Beaver, 2004; Hulcr et al., 2015). This is reflected by the growing number of citations in Scopus (2019) referring to Scolytinae (18 in 1990 vs. 210 in 2018), as opposed to citations referring to Scolytidae (50 in 1990 vs. 16 in 2018). The Scolytinae includes two subcategories, the 'bark beetles' which live in the phloem, and the 'ambrosia beetles' which live in the sapwood. This categorisation focused on non-EU Scolytinae as defined in the opinion on the 'List of non-EU Scolytinae of coniferous hosts' (EFSA PLH Panel, 2020). From the list of 705 non-EU Scolytinae on coniferous hosts identified in Appendix A of the 'List of non-EU Scolytinae of coniferous hosts', 222 species for which sufficient information regarding biology is available and which colonise conifer genera which are widely represented in Europe were selected as the basis for further pest categorisation. Further information on those 222 species can be found in Appendix B and in the supporting document which includes detailed data (link to the excel shortlist). The information about the feeding habits and host range of the remaining 483 species can be found in the supporting document (link to excel Full list).

2. Data and methodologies

2.1. Data

2.1.1. Literature search, data collection and selection of species for pest categorisation

The data for the current opinion are based on preparatory work (literature review and data collection) conducted by the University of Padova (Department of Agronomy, Food, Natural Resources, Animals and Environment) and on information provided by MSs on the distribution of Scolytinae species on territory. For further details we would like to refer the Scientific Opinion on the List of non-EU Scolytinae of coniferous hosts where all data are published (EFSA PLH Panel, 2002).

2.2. Methodologies

The Panel performed the pest categorisation for Scolytinae spp., following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018) and in the International Standard for Phytosanitary Measures No 11 (FAO, 2013) and No 21 (FAO, 2004).

This work was initiated following an evaluation of the EU plant health regime. Therefore, to facilitate the decision-making process, in the conclusions of the pest categorisation, the Panel addresses explicitly each criterion for a Union quarantine pest and for a Union RNQP in accordance with Regulation (EU) 2016/2031 on protective measures against pests of plants, and includes additional information required in accordance with the specific terms of reference received by the European Commission. In addition, for each conclusion, the Panel provides a short description of its associated uncertainty.

Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. All relevant criteria have to be met for the pest to potentially qualify either as a quarantine pest or as a RNQP. If one of the criteria is not met, the pest will not qualify. A pest that does not qualify as a quarantine pest may still qualify as a RNQP that needs to be addressed in the opinion. For the pests regulated in the protected zones only, the scope of the categorisation is the territory of the protected zone; thus, the criteria refer to the protected zone instead of the EU territory.

It should be noted that the Panel's conclusions are formulated respecting its remit and particularly with regard to the principle of separation between risk assessment and risk management (EFSA founding regulation (EU) No 178/2002); therefore, instead of determining whether the pest is likely to have an unacceptable impact, the Panel will present a summary of the observed pest impacts. Economic impacts are expressed in terms of yield and quality losses and not in monetary terms, whereas addressing social impacts is outside the remit of the Panel.

Table 1: Pest categorisation criteria under evaluation, as defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35)	Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest
Identity of the pest (Section 3.1)	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?
Absence/presence of the pest in the EU territory (Section 3.2)	Is the pest present in the EU territory? If present, is the pest widely distributed within the EU? Describe the pest distribution briefly!	Is the pest present in the EU territory? If not, it cannot be a protected zone quarantine organism	Is the pest present in the EU territory? If not, it cannot be a RNQP. (A regulated non-quarantine pest must be present in the risk assessment area)
Regulatory status (Section 3.3)	If the pest is present in the EU but not widely distributed in the risk assessment area, it should be under official control or expected to be under official control in the near future	The protected zone system aligns with the pest free area system under the International Plant Protection Convention (IPPC) The pest satisfies the IPPC definition of a quarantine pest that is not present in the risk assessment area (i.e. protected zone)	Is the pest regulated as a quarantine pest? If currently regulated as a quarantine pest, are there grounds to consider its status could be revoked?

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35)	Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	Is the pest able to enter into, become established in, and spread within, the EU territory? If yes, briefly list the pathways!	Is the pest able to enter into, become established in, and spread within, the protected zone areas? Is entry by natural spread from EU areas where the pest is present possible?	Is spread mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects? Clearly state if plants for planting is the main pathway!
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?	Would the pests' introduction have an economic or environmental impact on the protected zone areas?	Does the presence of the pest on plants for planting have an economic impact as regards the intended use of those plants for planting?
Available measures (Section 3.6)	Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated?	Are there measures available to prevent the entry into, establishment within or spread of the pest within the protected zone areas such that the risk becomes mitigated? Is it possible to eradicate the pest in a restricted area within 24 months (or a period longer than 24 months where the biology of the organism so justifies) after the presence of the pest was confirmed in the protected zone?	Are there measures available to prevent pest presence on plants for planting such that the risk becomes mitigated?
Conclusion of pest categorisation (Section 4)	A statement as to whether (1) all criteria assessed by EFSA above for consideration as a potential quarantine pest were met and (2) if not, which one(s) were not met	A statement as to whether (1) all criteria assessed by EFSA above for consideration as potential protected zone quarantine pest were met, and (2) if not, which one(s) were not met	A statement as to whether (1) all criteria assessed by EFSA above for consideration as a potential RNQP were met, and (2) if not, which one(s) were not met

The Panel will not indicate in its conclusions of the pest categorisation whether to continue the risk assessment process, but following the agreed two-step approach, will continue only if requested by the risk managers. However, during the categorisation process, experts may identify key elements and knowledge gaps that could contribute significant uncertainty to a future assessment of risk. It would be useful to identify and highlight such gaps so that potential future requests can specifically target the major elements of uncertainty, perhaps suggesting specific scenarios to examine.

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Identity and taxonomy

Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?

Yes, the identity of the pests is well established, and the non-EU Scolytinae are described in worldwide, regional or national catalogues and faunae.

The non-EU Scolytinae of coniferous hosts (hereafter NESC) are coleopteran insects belonging to the subfamily Scolytinae, a subgroup of the family Curculionidae (weevils). They have been fully listed in the world catalogue of (Wood and Bright, 1992) and in further publications (e.g. Bright and Skidmore, 2002; Bright, 2014), as well as in the online catalogue of Atkinson (2019) for species native to, or introduced in, North America. Keys and documentation have been published e.a. by Wood (1982, 2007), Gomez et al. (2018), respectively for North and Central America, and South America, and by (Schedl et al. (1981) for Central Europe.

3.1.2. Biology of the pest

A general introduction to the biology of bark- and ambrosia beetles is provided by Raffa et al. (2015) and Kirkendall et al. (2015). Out of the 705 NESC species, 580 species (*bark beetles*) are living in the inner bark of conifers (phloem and cambium) and often also slightly engraving the outer sapwood and 100 species are living in the sapwood. The remaining species are pith-feeding (*myelophagous*) or seed-feeding (*spermatophagous*). Although 15 of the sapwood-inhabiting species are *xylophagous* (i.e. feeds directly on the wood), the other 85 species are *xylomycetophagous*, feeding on symbiotic fungi that they grow in the galleries or the chambers that they excavate in the wood. They are called *ambrosia beetles*, because of their association with ambrosia fungi, a vernacular name for several fungal genera associated with wood boring insects (Alamouti et al., 2009). Some species are polygamous (harem polygyny): the males leave their natal system, create a new gallery and attract one or several females. In the monogamous species, each female initiates a new gallery and attracts one male.

Out of the 222 NESC species for which detailed biological information is available, 194 species (86.9%) are *outbreeding* (mate outside of their family) and 29 species (13%) are *inbreeding* (the females mate with a brother and initiates alone a new colony). Furthermore, 22 of these inbreeding species (10.3%) are *haplodiploid* (in the absence of males, the female parthenogenetically produces a male and afterward mates with her son). This differs very much from the general proportions within the Scolytinae, with 1627 inbreeding species (Kirkendall et al., 2015), corresponding to 26.9% of the 6056 Scolytinae species known so far (Hulcr et al., 2015).

Some species (e.g. in the genera *Dendroctonus* and *Ips*) attack and kill living, apparently healthy trees. Other species specialise in weakened, dying or dead trees. Scolytinae are associated with various symbionts that play a role in nutrient acquisition by the insects, including pathogenic fungi which contribute to overwhelming the defences of living trees (Raffa et al., 2015; Hofstetter et al. (2015)). The galleries or the brood chambers vary in shape and size between the different species, often creating specific patterns. Each female excavates an egg gallery or an egg chamber. The eggs are either laid individually in niches along the gallery, or in batches along the gallery or in a chamber. The larvae develop either in individual galleries at the end of which they pupate, or gregariously in a common chamber. In some species, the young adults must proceed to maturation feeding, before or after emergence from the natal tree. In this latter case, they may feed on fresh bark tissues or on young twigs. Dispersal occurs by flight, except for the males of many inbreeding species, which do not fly but are sometimes able to walk into a neighbouring gallery in the same tree.

The chemical ecology of Scolytinae is very complex (Raffa et al., 2015). Some species only respond to primary attractants from their hosts, such as alpha-pinene, and ethanol when the hosts are dying or dead and their tissues start to ferment. In addition to or instead of, primary attractants, many species produce aggregation pheromones that attract conspecifics of both sexes. This results in mass-colonisation of the hosts.

3.1.3. Intraspecific diversity

Some subspecies have been identified (e.g. *Pityophthorus buyssoni angeri*; *Pityophthorus buyssoni buyssoni*).

3.1.4. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, non-EU Scolytinae can be detected visually from external symptoms as well as from the shape of the galleries or brood chambers. Pheromones or other attractants are also available for detection for several species. Descriptions and illustrations are available for identification at species level. For some genera, molecular tools can also be used.

Bark and ambrosia beetles cause typical symptoms on the host plants including crown discoloration (yellow, red or grey), bark shedding, resin emission, white sawdust, brown sawdust, shoot tunnelling. They can also be detected by the shape of galleries or brood chambers.

They could also be detected using traps baited with pheromones or attractants originating from the host plants. Identification is based on taxonomic keys and descriptions and illustrations of the species are available. In some taxa, species can also be distinguished using molecular tools (Stauffer et al., 2001).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

Most of the 705 NESC occur in North America and Asia. In North America,401 species have been recorded and in Asia 222 (Figure 1). Moreover, 320 and 188 species are distributed exclusively in North America and Asia respectively (Figure 2). There are 102 species that occur in more than one continent, and one species (*Xyleborus perforans*) has a very wide distribution being recorded in 7 continents (Figure 3). Detailed information on distribution of these species and the corresponding references can be found in (EFSA PLH Panel, 2020).

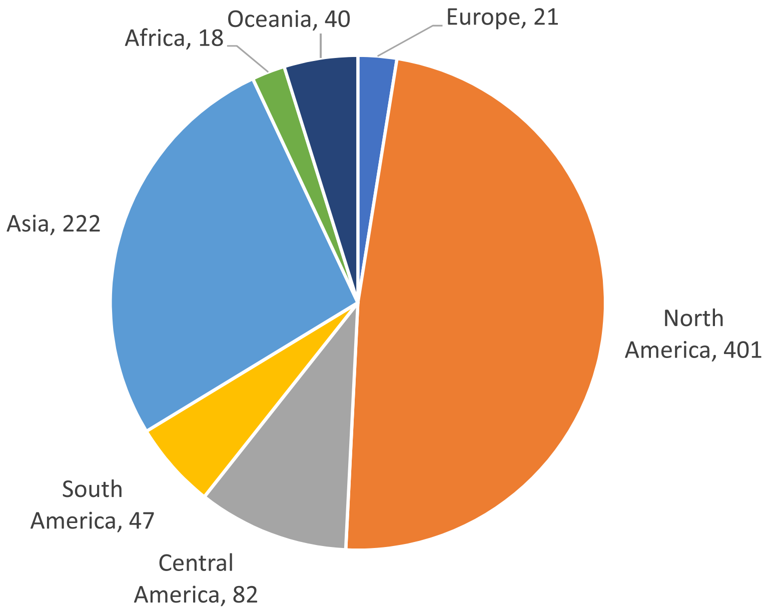

Figure 1: Number of non-EU Scolytinae reported from each continent

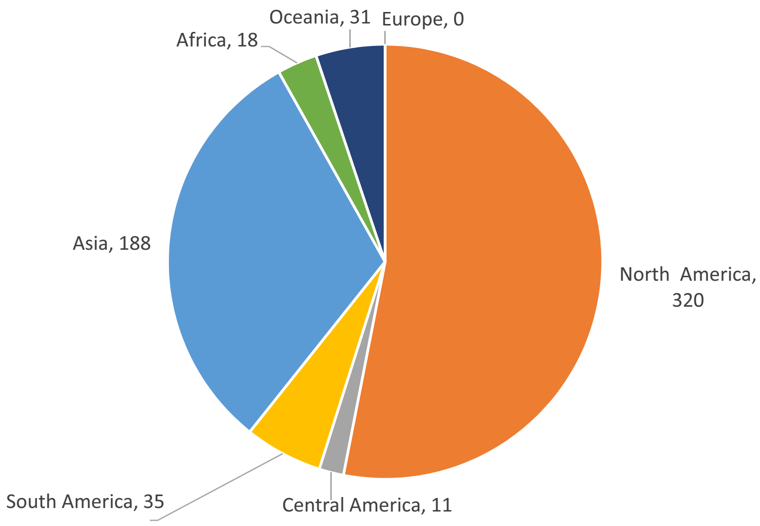

Figure 2: Number of species reported exclusively from one continent

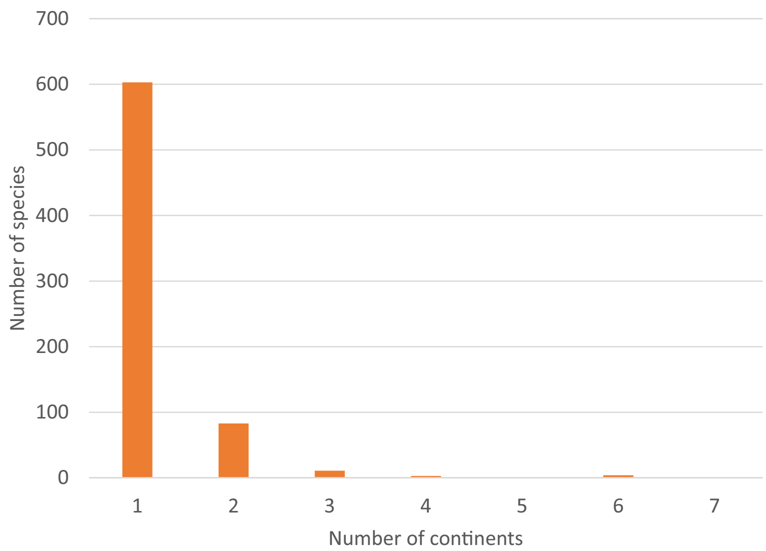

Figure 3: Number of species distributed in world continents

3.2.2. Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest widely distributed within the EU?
From the total of 705 non-EU Scolytinae there are 16 species that are present in the EU (in a few MSs).

There are 16 non-EU Scolytinae species that are also present in EU (Table 2). These species have limited distribution in up to three EU MSs. Eleven species occur in one EU MS, three species in two and two in three EU MSs. All these species are also present in other countries outside of the EU.

Table 2: Current distribution of non-EU Scolytinae in the 28 EU MS based on information from the EPPO Global Database and other sources

	Species	Presence in EU MS	Presence outside EU	Comments/ Uncertainties	Reference
1	*Carphoborus henscheli*	Cyprus	Georgia, Turkey, Israel, Syria		Alonso-Zarazaga et al. (2017), de Jong et al. (2014)

	Species	Presence in EU MS	Presence outside EU	Comments/ Uncertainties	Reference
2	*Carphoborus marani*	Greece, Hungary	European Russia	Presence in Hungary only mentioned once and never confirmed later (Milos Knizek, pers. comm.)	Alonso-Zarazaga et al. (2017), de Jong et al. (2014)
3	*Crypturgus dubius*	France, Spain	Turkey, Iran	Presence in France and Spain is doubtful	Alonso-Zarazaga et al. (2017), de Jong et al. (2014)
4	*Cyrtogenius luteus*	Italy	China, Japan, South Korea, South America	Introduced species	Atkinson (2019), Gomez et al. (2012)
5	*Hylastes batnensis batnensis*	Italy	Algeria, Morocco	Likely to be inroduced	Alonso-Zarazaga et al. (2017), de Jong et al. (2014)
6	*Orthotomicus tridentatus*	Austria	Turkey		Alonso-Zarazaga et al. (2017), de Jong et al. (2014)
7	*Phloeosinus armatus*	Greece, Italy, Cyprus	Turkey, Libya, Iran, Israel, Jordan, Lebanon, Syria		Alonso-Zarazaga et al. (2017), de Jong et al. (2014), Pennacchio (2013)
8	*Phloeosinus cedri*	Spain	Turkey, Algeria, Morocco, India	Introduced species	Alonso-Zarazaga et al. (2017), de Jong et al. (2014)
9	*Phloeosinus gillerforsi*	Azores (Portugal)	Canary Islands	May be endemic in either or both groups of Macaronesic archipelagos	Alonso-Zarazaga et al. (2017), de Jong et al. (2014)
10	*Pityogenes pennidens*	Greece, Cyprus	Russia, Israel, Syria		Alonso-Zarazaga et al. (2017), de Jong et al. (2014)
11	*Pityophthorus mauretanicus*	France	Algeria, Egypt, Libya, Morocco, Tunisia		Alonso-Zarazaga et al. (2017), de Jong et al. (2014)
12	*Pityophthorus pityographus cribratus*	Greece	Russia, Turkey		Alonso-Zarazaga et al. (2017), de Jong et al. (2014)
13	*Pityophthorus solus*	Spain	North America	Introduced species	Alonso-Zarazaga et al. (2017)
14	*Xyleborinus gracilis*	Azores (Portugal)	North America, Central America, South America	Introduced species	Atkinson (2019), Alonso-Zarazaga et al. (2017)
15	*Xyleborus perforans*	Azores (Portugal)	North America, Central America, South America, Asia, North Africa, Sub-Saharan Africa, Oceania		Alonso-Zarazaga et al. (2017)
16	*Xylosandrus compactus*	Italy, France, Greece	North America, Central America, South America, Asia, Sub-Saharan Africa		Wood and Bright (1992), Wood (2007), Spanou et al. (2019), Anses (2017), Garonna et al. (2012)

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

Non-EU Scolytinae species are listed in Council Directive 2000/29/EC as Scolytidae spp. (non-European). Details are presented in Tables 3 and 4.

Table 3: Non-EU Scolytinae spp. in Council Directive 2000/29/EC

Annex II, Part A	**Harmful organisms whose introduction into, and spread within, all member states shall be banned if they are present on certain plants or plant products**
Section I	**Harmful organisms not known to occur in the community and relevant for the entire community**

(a)	Insects, mites and nematodes, at all stages of their development	
	Species	Subject of contamination
28.	*Scolytidae* spp. (non-European)	Plants of conifers (*Coniferales*), over 3 m in height, other than fruit and seeds, wood of conifers (*Coniferales*) with bark, and isolated bark of conifers (*Coniferales*), originating in non-European countries

3.3.2. Legislation addressing the hosts of Scolytinae spp

Table 4: Regulated hosts and commodities that may involve Scolytinae spp. in Annexes III, IV and V of Council Directive 2000/29/EC

Annex III, Part A	**Plants, plant products and other objects the introduction of which shall be prohibited in all Member States**	
	Description	Country of origin
	Plants of *Abies* Mill., *Cedrus* Trew, [. . .], *Larix* Mill., *Picea* A. Dietr., *Pinus* L., *Pseudotsuga* Carr. and *Tsuga* Carr., other than fruit and seeds	Non-European countries
Annex IV, Part A	**Special requirements which shall be laid down by all member states for the introduction and movement of plants, plant products and other objects into and within all member states**	
Section I	**Plants, plant products and other objects originating outside the community**	
	Plants, plant products and other objects	Special requirements
1.5	Whether or not listed among the CN codes in Annex V, Part B, wood of conifers (Coniferales), other than in the form of: – chips, particles, sawdust, shavings, wood waste and scrap obtained in whole or part from these conifers, – wood packaging material, in the form of packing cases, boxes, crates, drums and similar packings, pallets, box pallets and other load boards, pallet collars, dunnage, whether actually in use or not in the transport of objects of all kinds, except dunnage supporting consignments of wood, which is constructed from wood of the same type and quality as the wood in the consignment and which meets the same Union phytosanitary requirements as the wood in the consignment, but including that which has not kept its natural round surface, originating in Russia, Kazakhstan and Turkey.	Official statement that the wood: (a) originates in areas known to be free from: — *Pissodes* spp. (non-European) The area shall be mentioned on the certificates referred to in Article 13.1.(ii), under the rubric 'place of origin,' or [. . .] or (c) has undergone kiln-drying to below 20% moisture content, expressed as a percentage of dry matter, achieved through an appropriate time/temperature schedule. There shall be evidence thereof by a mark 'kiln-dried' or 'K.D'. or another internationally recognised mark, put on the wood or on any wrapping in accordance with the current usage, or (d) has undergone an appropriate heat treatment to achieve a minimum temperature of 56 °C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including at its core). There shall be evidence thereof by a mark 'HT' put on the wood or on any wrapping in accordance with current usage, and on the certificates referred to in Article 13.1.(ii), or (e) has undergone an appropriate fumigation to a specification approved in accordance with the procedure laid down in Article 18.2. There shall be evidence thereof by indicating on the certificates referred to in Article 13.1.(ii), the active ingredient, the minimum wood temperature, the rate (g/m 3) and the exposure time (h), or (f) has undergone an appropriate chemical pressure impregnation with a product approved in accordance with the procedure laid down in Article 18.2. There shall be evidence thereof by indicating on the certificates referred to in Article 13.1.(ii), the active ingredient, the pressure (psi or kPa) and the concentration (%).

1.7	Whether or not listed among the CN codes listed in Annex V, Part B, wood in the form of chips, particles, sawdust, shavings, wood waste and scrap obtained in whole or in part from conifers (Coniferales), originating in — Russia, Kazakhstan and Turkey, — non-European countries other than Canada, China, Japan, the Republic of Korea, Mexico, Taiwan and the USA, where *Bursaphelenchus xylophilus* (Steiner et Bührer) Nickle et al. is `known to occur.	Official statement that the wood: (a) originates in areas known to be free from: — Pissodes spp. (non-European) The area shall be mentioned on the certificates referred to in Article 13.1.(ii), under the rubric 'place of origin,' or (b) has been produced from debarked round wood, or (c) has undergone kiln-drying to below 20% moisture content, expressed as a percentage of dry matter, achieved through an appropriate time/temperature schedule, or (d) has undergone an appropriate fumigation to a specification approved in accordance with the procedure laid down in Article 18.2. There shall be evidence of the fumigation by indicating on the certificates referred to in Article 13.1.(ii), the active ingredient, the minimum wood temperature, the rate (g/m 3) and the exposure time (h), or (e) has undergone an appropriate heat treatment to achieve a minimum temperature of 56 °C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including at its core), the latter to be indicated on the certificates referred to in Article 13.1.(ii).
8.1.	Plants of conifers (Coniferales), other than fruit and seeds, originating in non-European countries	Without prejudice to the prohibitions applicable to the plants listed in Annex III(A)(1), where appropriate, official statement that the plants have been produced in nurseries and that the place of production is free from *Pissodes* spp. (non- European).
Annex V, Part A	**Plants, plant products and other objects which must be subject to a plant health inspection (at the place of production if originating in the community, before being moved within the community in the country of origin or the consignor country, if originating outside the community) before being permitted to enter the community Plants, plant products and other objects originating in the community**	
Section II	**Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for certain protected zones, and which must be accompanied by a plant passport valid for the appropriate zone when introduced into or moved within that zone**	
1.11.	Isolated bark of conifers (Coniferales)	
Annex V, Part B	**Plants, plant products and other objects originating in territories, other than those territories referred to in part a**	
Section II	**Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community**	
2.	Parts of plants, other than fruits and seeds of: – conifers (*Coniferales*)	
5.	Isolated bark of: – conifers (*Coniferales*)	

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

All non-EU Scolytinae feeding on conifers attack plant species belonging mainly to four botanical families: Araucariaceae, Cupressaceae, Pinaceae and Taxaceae. The number of species reported to attack various conifer plants are shown in Figure 4. Most common host plants belong to the genera *Abies*, *Picea* and *Pinus* (Figure 4). Other host plants are from the genera *Cupressus*, *Larix*, *Juniperus*, *Cedrus*, *Chamaecyparis*, *Pseudotsuga*, *Tsuga* and *Thuja* (see Annex A of EFSA PLH Panel, 2020). The number of species reported here includes also those that have been reported from more than one plant genera. Specifically, 24% of the species are reported to attack more than one plant genus (Figure 5).

From the 397 species reported attacking *Pinus*, 117 are reported to attack other host genera as well. For 14 species only the plant family is reported and not specific host plant species or genera.

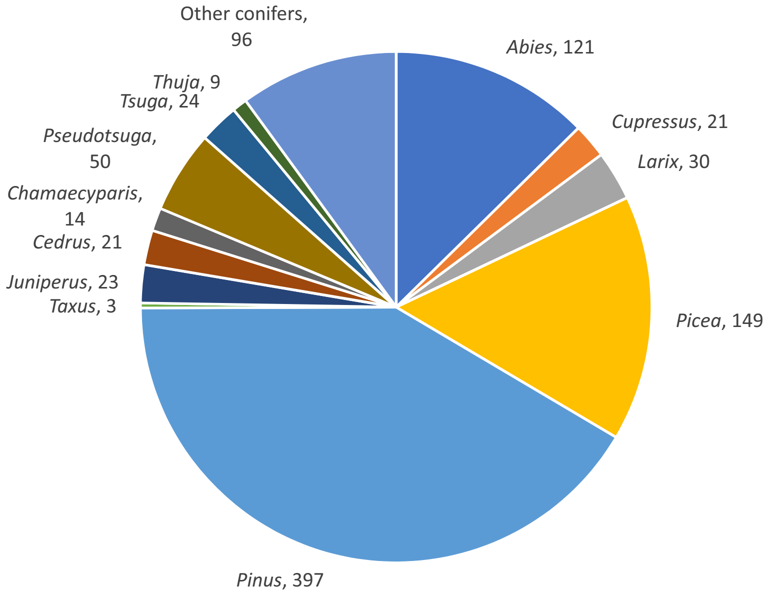

Figure 4: Species reported on each host plant genera

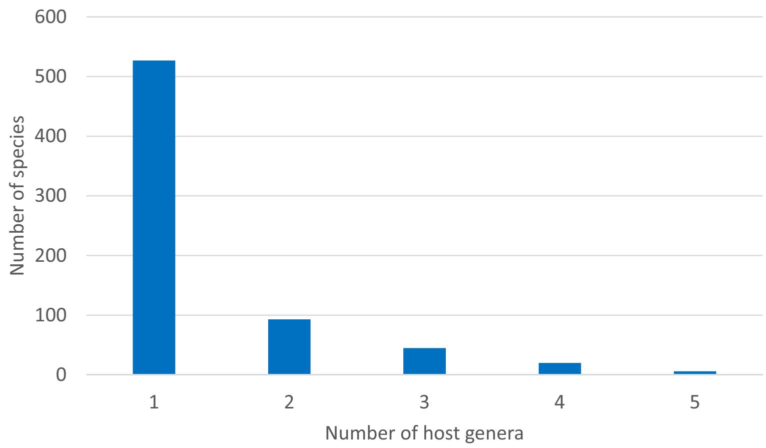

Figure 5: Number of species reported attacking one or more plant genera

3.4.2. Entry

> *Is the pest able to enter into the EU territory? If yes, identify and list the pathways.*
>
> ***Yes**, non-Eu Scolytinae are able to enter at any developmental stage on wood and plants for planting.*

The main pathways for entry of the non-EU Scolytinae are:

- plants for planting (including seeds) of conifers, with or without soil
- cut branches of conifer plants
- fruits (including cones of conifers) of conifer plants
- round wood with bark of conifer plants
- round wood without bark of conifer plants
- sawn wood without bark
- sawn wood with bark
- wood packaging material

- bark of conifers
- manufactured wood items
- wood chips.

For the pathways listed above, the following prohibitions (Annex III) or special requirements (Annex IV) are in place:

Plants for planting

- Plants of *Abies*, *Cedrus*, *Chamaecyparis*, *Juniperus*, *Larix*, *Picea*, *Pinus*, *Pseudotsuga*, *Tsuga*, are prohibited from non-European countries (Annex IIIA 1.)
- Plants of conifers other than fruit and seeds – special requirements for import (Annex IVAI 8.1., 8.2.)
- Plants of Pinus L., intended for planting, other than seeds – special requirements in relation to other pests (Annex IVAI 9.)
- Plants of *Abies*, *Larix*, *Picea*, *Pinus, Pseudotsuga, Tsuga,* intended for planting, other than seeds – special requirements in relation to other pests (Annex IVAI 10.)

Wood

- Wood of conifers – special requirements for import (Annex IVAI 1.1., 1.2., 1.3., 1.4., 1.5.)

Bark

- Isolated bark of conifers is prohibited from non-European countries (Annex IIIA 4.)
- Isolated bark of conifers – special requirements (Annex IVAI 7.3.)

There are also records of interception for several species around the world on various pathways (Brockerhoff et al., 2006; Haack, 2006). The most common pathway is round wood with bark followed by wood packaging material and sawn wood with bark (Figure 6).

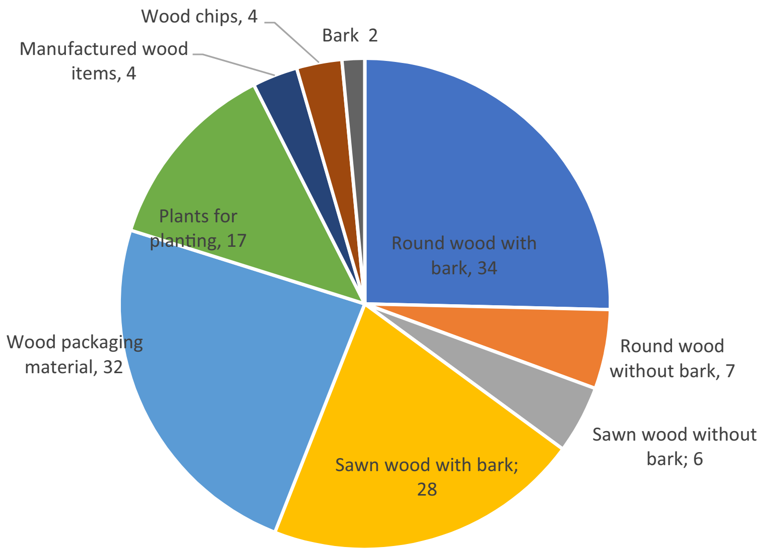

Figure 6: Number of species intercepted on different pathways worldwide

3.4.3. Establishment

Is the pest able to become established in the EU territory?
***Yes**, the Non-EU Scolytinae species are considered to be able to establish in the EU territory*

3.4.3.1. EU distribution of main host plants

Non-EU Scolytinae species feed on various coniferous hosts that are distributed throughout the EU territory (see Figures 7–12).

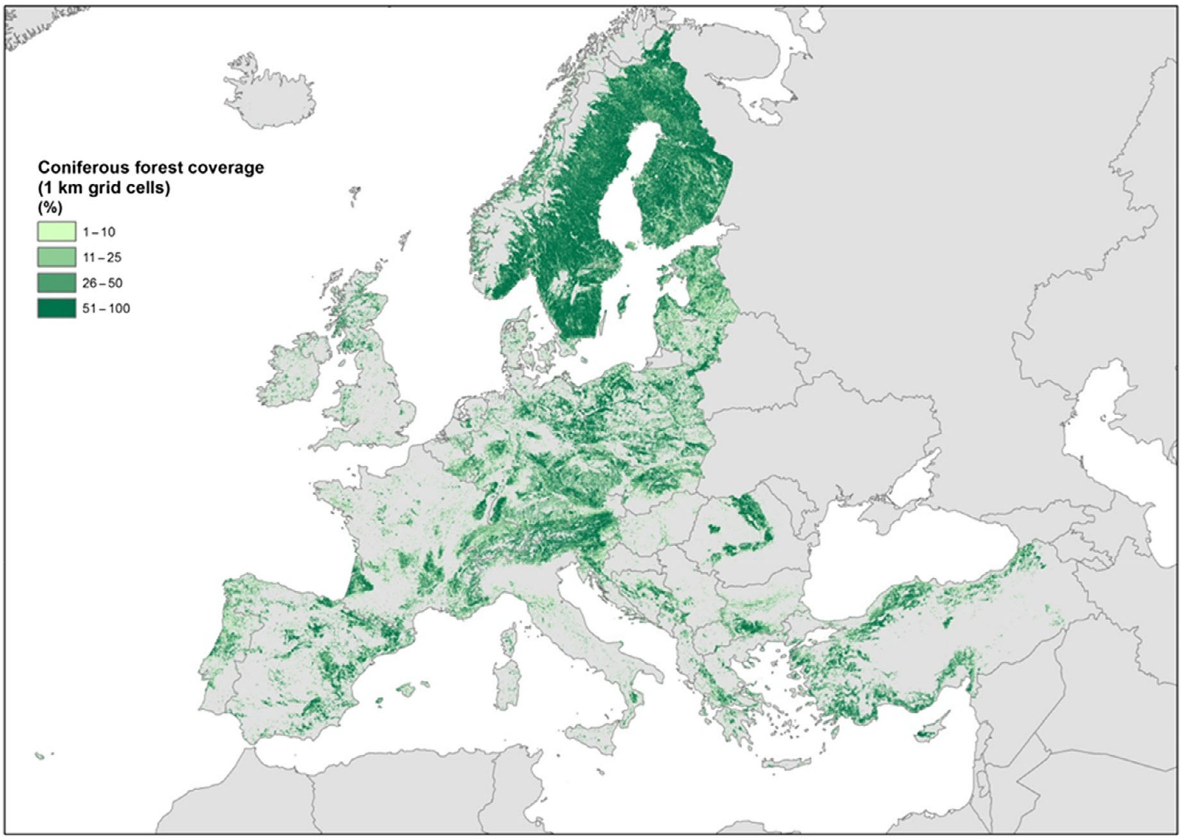

Figure 7: The cover percentage of coniferous forests in Europe with a range of values from 0 to 100 at 1 km resolution (source: Corine Land Cover year 2012 version 18.5 by European Environment Agency)

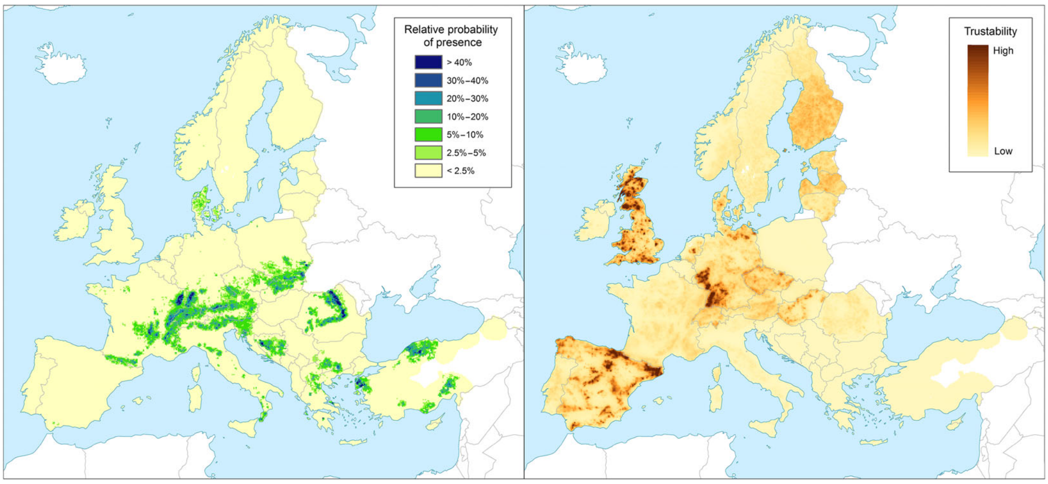

Figure 8: Left panel: Relative probability of presence (RPP) of the genus *Abies* (based on data from the species: *Abies alba, Abies cephalonica, Abies borisii-regis, Abies nordmanniana, Abies cilicica, Abies pinsapo, Abies numidica, Abies nebrodensis, Abies grandis, Abies procera*) in Europe, mapped at 100 km^2 resolution. The underlying data are from European-wide forest monitoring data sets and from national forestry inventories based on standard observation plots measuring in the order of hundreds m^2. RPP represents the probability of finding at least one individual of the taxon in a standard plot placed randomly within the grid cell. For details, see Appendix A (courtesy of JRC, 2017). Right panel: Trustability of RPP. This metric expresses the strength of the underlying information in each grid cell and varies according to the spatial variability in forestry inventories. The colour scale of the trustability map is obtained by plotting the cumulative probabilities (0-1) of the underlying index (for details see Appendix A)

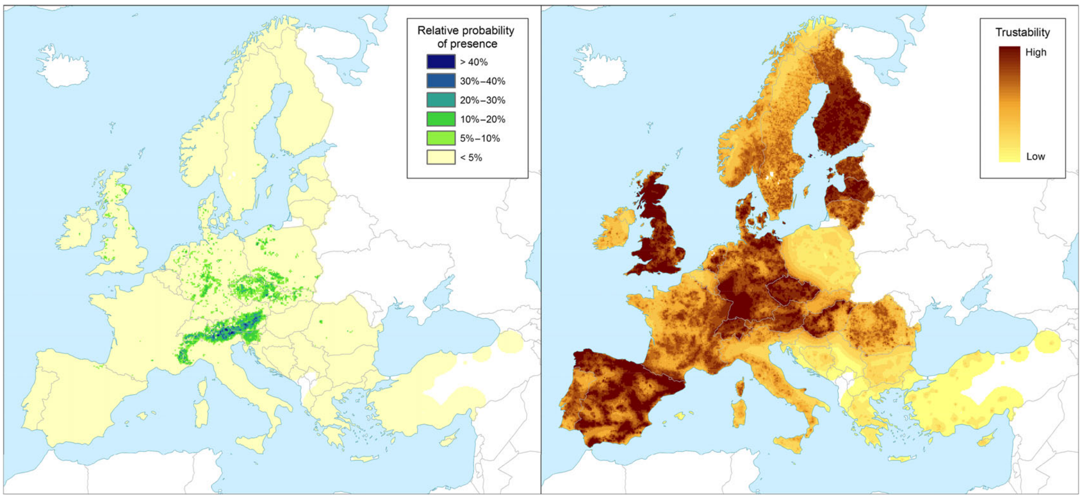

Figure 9: Left panel: Relative probability of presence (RPP) of the genus *Larix* (based on data from the species: *Larix decidua, Larix kaempferi, Larix sibirica*) in Europe, mapped at 100 km^2 resolution. The underlying data are from European-wide forest monitoring data sets and from national forestry inventories based on standard observation plots measuring in the order of hundreds m^2. RPP represents the probability of finding at least one individual of the taxon in a standard plot placed randomly within the grid cell. For details, see Appendix A (courtesy of JRC, 2017). Right panel: Trustability of RPP. This metric expresses the strength of the underlying information in each grid cell and varies according to the spatial variability in forestry inventories. The colour scale of the trustability map is obtained by plotting the cumulative probabilities (0–1) of the underlying index (for details see Appendix A)

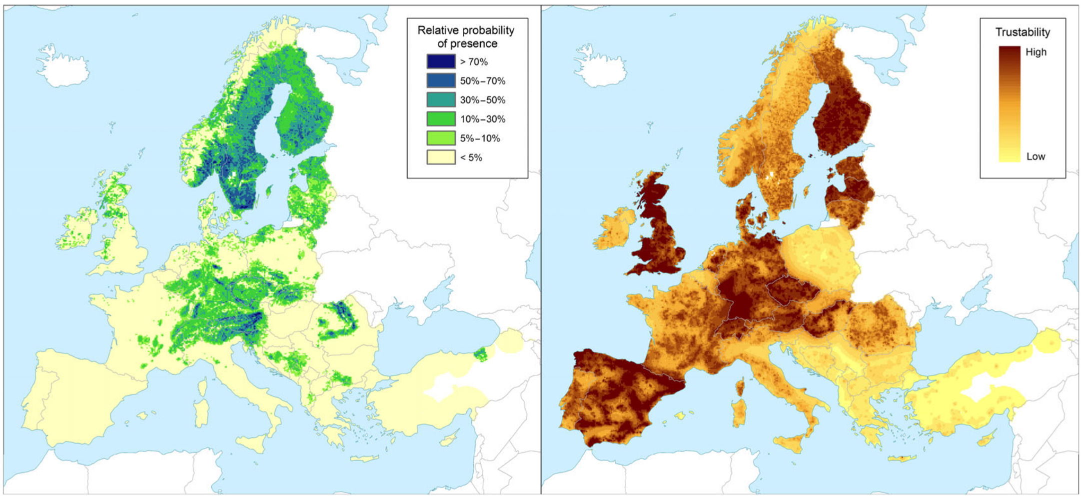

Figure 10: Left panel: Relative probability of presence (RPP) of the genus *Picea* (based on data from the species: *Picea abies, Picea sitchensis, Picea glauca, Picea engelmannii, Picea pungens, Picea omorika, Picea orientalis*) in Europe, mapped at 100 km^2 resolution. The underlying data are from European-wide forest monitoring data sets and from national forestry inventories based on standard observation plots measuring in the order of hundreds m^2. RPP represents the probability of finding at least one individual of the taxon in a standard plot placed randomly within the grid cell. For details, see Appendix A (courtesy of JRC, 2017). Right panel: Trustability of RPP. This metric expresses the strength of the underlying information in each grid cell and varies according to the spatial variability in forestry inventories. The colour scale of the trustability map is obtained by plotting the cumulative probabilities (0-1) of the underlying index (for details see Appendix A)

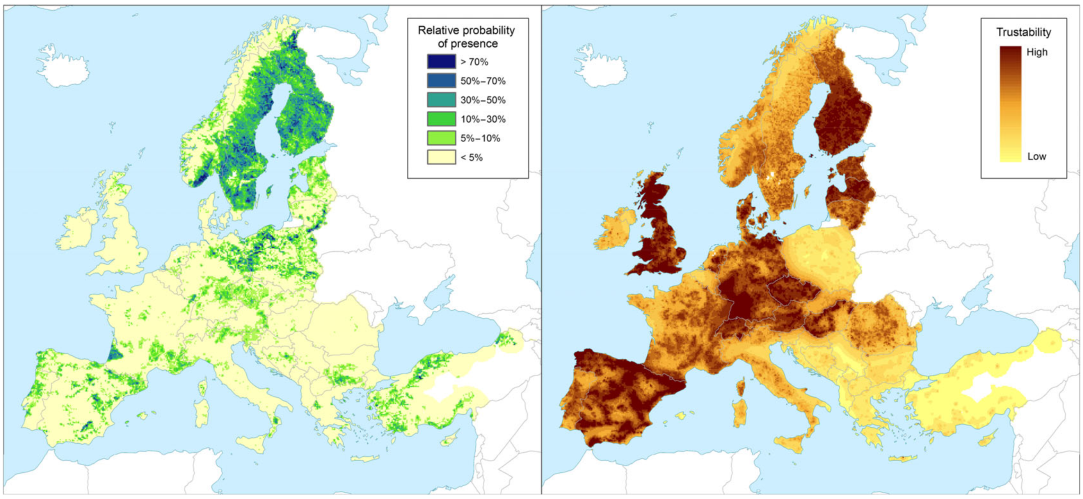

Figure 11: Left panel: Relative probability of presence (RPP) of the genus *Pinus* (based on data from the species: *Pinus sylvestris, Pinus pinaster, Pinus halepensis, Pinus nigra, Pinus pinea, Pinus contorta, Pinus cembra, Pinus mugo, Pinus radiata, Pinus canariensis, Pinus strobus, Pinus brutia, Pinus banksiana, Pinus ponderosa, Pinus heldreichii, Pinus leucodermis, Pinus wallichiana*) in Europe, mapped at 100 km^2 resolution. The underlying data are from European-wide forest monitoring data sets and from national forestry inventories based on standard observation plots measuring in the order of hundreds m^2. RPP represents the probability of finding at least one individual of the taxon in a standard plot placed randomly within the grid cell. For details, see Appendix A (courtesy of JRC, 2017). Right panel: Trustability of RPP. This metric expresses the strength of the underlying information in each grid cell and varies according to the spatial variability in forestry inventories. The colour scale of the trustability map is obtained by plotting the cumulative probabilities (0–1) of the underlying index (for details see Appendix A)

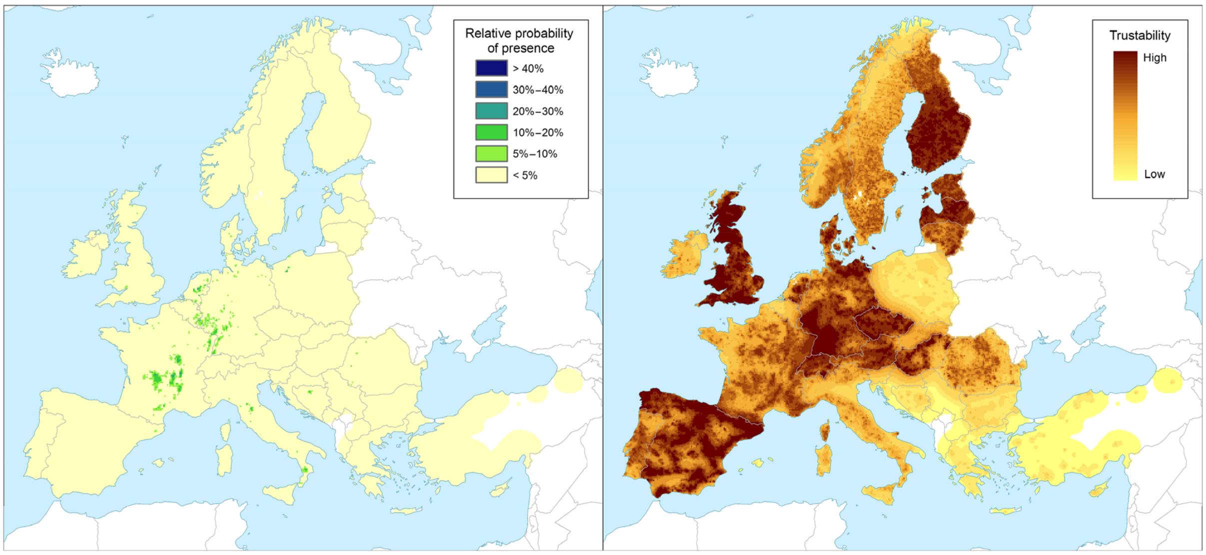

Figure 12: Left panel: Relative probability of presence (RPP) of the species *Pseudotsuga menziesii* in Europe, mapped at 100 km^2 resolution. The underlying data are from European-wide forest monitoring data sets and from national forestry inventories based on standard observation plots measuring in the order of hundreds m^2. RPP represents the probability of finding at least one individual of the taxon in a standard plot placed randomly within the grid cell. For details, see Appendix A (courtesy of JRC, 2017). Right panel: Trustability of RPP. This metric expresses the strength of the underlying information in each grid cell and varies according to the spatial variability in forestry inventories. The colour scale of the trustability map is obtained by plotting the cumulative probabilities (0–1) of the underlying index (for details see Appendix A)

3.4.3.2. Climatic conditions affecting establishment

Non-EU Scolytinae are distributed worldwide in all continents. Most of the species are present in North America where Koppen–Geiger climate zones (Figure 13) such as Cfb, Cfa and Csa occur. These climate zones also occur in large areas in the EU. Moreover, 31% of the non-EU Scolytinae are known to be distributed in Asia. Climatic zones such as Dfb, Cfa and Csa that occur in Asia also occur in EU (MacLeod and Korycinska, 2019). Climatic conditions are not expected to limit the ability for establishment of non-EU Scolytinae.

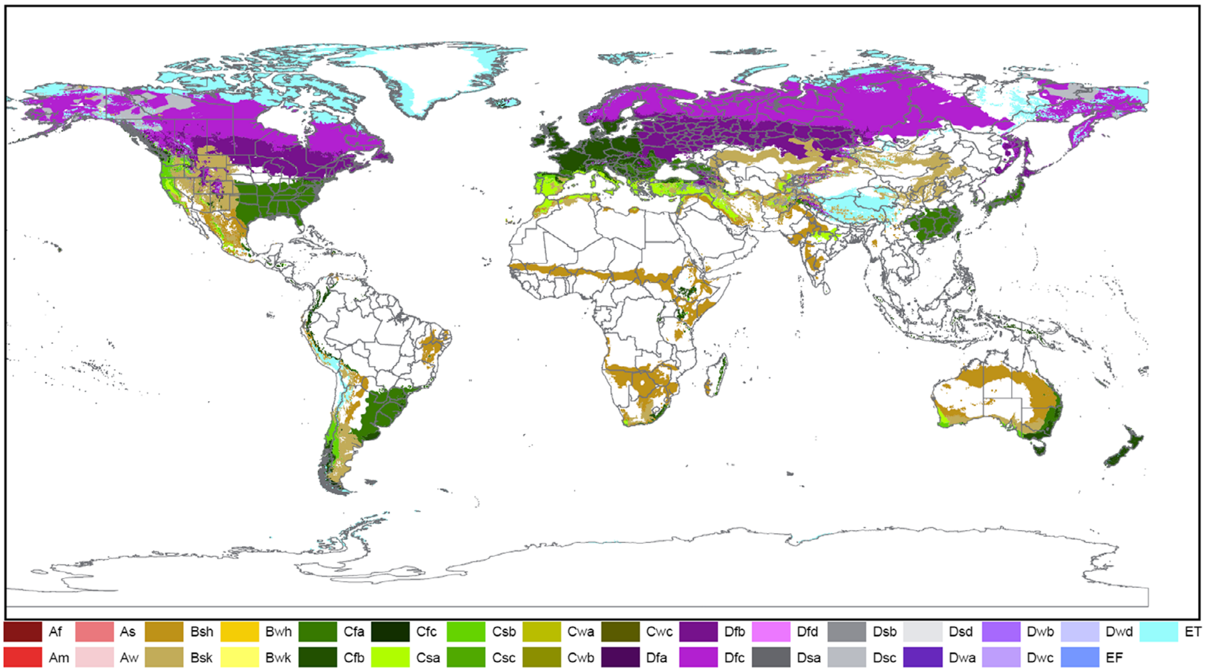

Figure 13: Köppen-Geiger climatic zones in Europe and worldwide, 13 climate types in EU 28: Bsh, Bsk, Cfa, Cfb, Cfc, Csa, Csb, Csc, Dfb, Dfc, Dsb, Dsc, ET (according to MacLeod and Korycinska (2019))

3.4.4. Spread

Is the pest able to spread within the EU territory following establishment?

Yes, non-EU Scolytinae are able to spread by natural flight, or with various commodities.

RNQPs: Is spread mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects?

Yes, a few species (e.g. *Xylosandrus compactus*) are spreading mainly via plants for planting.

Although generally little is known about the flight capacity of Scolytinae, for several species data have been collected with flight mills for several species (Eveden et al., 2014; Forsse and Solbreck, 1985) (Jactel and Gaillard, 1991), or direct observations (Nilssen, 1984; Chase et al., 2017). The species studied were able to cover 20–50 km by flight. In British Columbia, *Dendroctonus ponderosae* was observed by aerial captures with fixed balloons and weather radar measurements to cover 30–110 km per day up to 800 m above canopy (Jackson et al., 2008). Many species can also travel in all sorts of wood commodities (see Section 3.4.2 on entry). Bark- and ambrosia beetles travel in round wood with bark, firewood, wood chips and plants for planting; ambrosia beetles travel with debarked round wood, squared wood and objects made of wood; bark beetles can travel with bark alone. Since its first report in Germany in 1951, the Asian species *Xylosandrus germanus* spread to 21 neighbouring countries (Galko et al., 2019). Plants for planting are suspected to be the main pathway for *Xylosandrus compactus*, which rapidly spread all along the Tyrrhenian coasts up to France since its first occurrence in Italy (ANSES, 2017).

3.5. Impacts

Would the pests' introduction have an economic or environmental impact on the EU territory?

Yes, the introduction of non-EU Scolytinae species would have an economic or environmental impact on the EU territory.

RNQPs: Does the presence of the pest on plants for planting have an economic impact, as regards the intended use of those plants for planting?

Yes, the presence of the pest on plants for planting can have an economic impact, as regards the intended use of those plants for planting.

Tree killing is an obvious impact of Scolytinae species, *Dendroctonus ponderosae* has caused the most damaging outbreak in history, killing more than 450 million m^3 of *Pinus contorta* in British Columbia between 2000 and 2015 (British Columbia Government, 2019). In addition to killing trees, Scolytinae also reduce their commercial value, by the loss of mechanical properties and/or aesthetic value caused by the galleries of ambrosia beetles in the sapwood or the introduction of pathogenic or lignophagous associated fungi by bark and ambrosia beetles. Fungi associated with non-native bark- or ambrosia beetles could prove extremely dangerous for some new host plants colonised in a new area, as recently observed after the recent introduction into South-eastern USA of the Redbay ambrosia beetle, *Xyleborus glabratus* with a fungal symbionts, *Raffaelea lauricola,* that caused the death of millions of avocados, *Persea americana*, and redbay, *Persea borbonia* (Hughes et al., 2017) Other types of impacts include reduction of ecosystem services when forest biodiversity, water balance or soil properties are affected, or socio-economic impact when amenity trees or whole landscapes are modified by the disappearance of tree species (Grégoire et al., 2015).

Details about species with reported impact can be found in the short list excel file (see Annex B in EFSA PLH Panel, 2020). There are 566 species for which no information is available about their potential economic or environmental impact.

3.6. Availability and limits of mitigation measures

Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated?

Yes, the existing measures (see Sections 3.3 and 3.6.1) can mitigate the risks of entry, establishment, and spread of non-EU Scolytinae species within the EU

RNQPs: Are there measures available to prevent pest presence on plants for planting such that the risk becomes mitigated?

Yes, plants for planting from pest free areas and grown in isolation would mitigate the risk in case non-EU Scolytinae entered the EU.

3.6.1. Identification of additional measures

Phytosanitary measures are currently applied to coniferous plants (see Sections 3.3 and 3.4.2).

3.6.1.1. Additional control measures

Potential additional control measures are listed in Table 5.

Table 5: Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry/establishment/spread/impact in relation to currently unregulated hosts and pathways. Control measures are measures that have a direct effect on pest abundance

Information sheet title (with hyperlink to information sheet if available)	Control measure summary	Risk component (entry/establishment/spread/impact)
Growing plants in isolation	Description of possible exclusion conditions that could be implemented to isolate the crop from pests and if applicable relevant vectors. E.g. a dedicated structure such as glass or plastic greenhouses	Entry/spread
Chemical treatments on consignments or during processing	Use of chemical compounds that may be applied to plants or to plant products after harvest, during process or packaging operations and storage The treatments addressed in this information sheet are: a) fumigation; b) spraying/dipping pesticides; c) surface disinfectants; d) process additives; e) protective compounds	Entry/spread
Chemical treatments on crops including reproductive material	Application of insecticides on nurseries for plants for planting may be considered to reduce the presence of the pest	Entry/spread

3.6.1.2. Additional supporting measures

Since the import of conifers plants, wood and wood products are currently regulated no additional supporting measures are specified.

3.6.1.3. Biological or technical factors limiting the effectiveness of measures to prevent the entry, establishment and spread of the pest

There is always the possibility of recolonisation of wood commodities and plants for planting after a fumigation treatment.

3.7. Uncertainty

There are gaps in the scientific knowledge on the biology of many Scolytinae species (e.g. associations with a new host or with new pathogenic fungi). Therefore, it is difficult to know all the possible impacts that could be expected. Potential establishment of some species occurring in tropical areas is unknown.

4. Conclusions

Out of the 705 non-EU Scolytinae species which were considered for pest categorisation the panel identified 139 species of non-EU Scolytinae which meet all the criteria assessed by EFSA for consideration as potential quarantine pests for the EU territory. No information was available on the potential impact for 566 species. However, this does not exclude that those species could have an economic or environmental impact when they are introduced into a new environment (see for example the case of *Xyleborous glabratus* in Section 3.5).

Table 6: The Panel's conclusions on the pest categorisation criteria defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Identity of the pests (Section 3.1)	The identity of the NESC is well established and the 705 species considered in the pest categorisation are described in worldwide, regional or national catalogues and faunae	The identity of the NESC is well established and the 222 species considered in the pest categorisation are described in worldwide, regional or national catalogues and faunae	None
Absence/ presence of the pest in the EU territory (Section 3.2)	From the total of 705 species considered for the pest categorisation there are 16 species also present in a few EU Member States	From the total of 705 species considered for the pest categorisation there are 16 species also present in a few EU Member States	None
Regulatory status (Section 3.3)	Non-EU Scolytinae species are listed in Council Directive 2000/29/EC as Scolytidae (non European) in Annex II, Part A, Section I	Non-EU Scolytinae are regulated as quarantine pests and legislation is in place addressing the hosts of Scolytinae spp (Annex III, Part A and Annex IV, part A, Section I of Council Directive 2000/29/EC)	None
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	NESC are able to enter into the EU through plants for planting (including seeds) of conifers, with or without soil, cut branches of conifer plants, fruits (including cones of conifers) of conifer plants, round wood with bark of conifer plants, round wood without bark of conifer plants, sawn wood without bark, sawn wood with bark, wood packaging material, bark of conifers, manufactured wood items, wood chips. Establishment is possible as host plants are available and climatic conditions similar to their native range do occur in the EU. Dispersal by flight and movement of commodities are the main means for spread	The spread is mainly by natural flight or with various commodities. Some species are spread by plants for planting	Potential establishment of some species occurring in tropical areas is unknown
Potential for consequences in the EU territory (Section 3.5)	NESC would have an economic or environmental impact if they were introduced in the EU territory. For 566 species there is no information available about potential impact	Yes, the presence of the pest on plants for planting can have an economic impact, as regards the intended use of those plants for planting	For several species the potential impact is not known although impact is commonly observed for species outside from their native range
Available measures (Section 3.6)	Yes, the existing measures can mitigate the risks of entry, establishment, and spread within the EU	Yes, plants for planting from pest free areas and grown in isolation would mitigate the risk in case non-EU Scolytinae entered the EU	None

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Conclusion on pest categorisation (Section 4)	139 non-EU Scolytinae feeding on conifers meet all criteria assessed by EFSA above for quarantine pests. For 566 species information about impact is lacking and the panel was unable to conclude	The species considered in the current categorisation are non-EU Scolytinae (regulated in annex IIAI) and as such do not meet the corresponding criterion evaluated by EFSA to qualify as potential regulated non-quarantine pests	There are gaps in the scientific knowledge on the biology of many Scolytinae species.
Aspects of assessment to focus on/ scenarios to address in future if appropriate	–		

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Abbreviations

CLC	Corine Land Cover
C-SMFA	constrained spatial multi-scale frequency analysis
EPPO	European and Mediterranean Plant Protection Organization
EUFGIS	European Information System on Forest Genetic Resources
FAO	Food and Agriculture Organization
GD^2	Georeferenced Data on Genetic Diversity
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
MS	Member State
NESC	non-EU Scolytinae of coniferous hosts
PLH	EFSA Panel on Plant Health
PZ	Protected Zone
RNQP	regulated non-quarantine pest
RPP	relative probability of presence
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference

Glossary

Containment (of a pest)	Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 1995, 2017)
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 1995, 2017)
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2017)
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2017)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2017)
Impact (of a pest)	The impact of the pest on the crop output and quality and on the environment in the occupied spatial units
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO, 2017)
Measures	Control (of a pest) is defined in ISPM 5 (FAO, 2017) as 'Suppression, containment or eradication of a pest population' (FAO, 1995). Control measures are measures that have a direct effect on pest abundance. Supporting measures are organisational measures or procedures supporting the choice of appropriate Risk Reduction Options that do not directly affect pest abundance
Pathway	Any means that allows the entry or spread of a pest (FAO, 2017)
Phytosanitary measures	Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2017)
Protected zones (PZ)	A Protected zone is an area recognised at EU level to be free from a harmful organism, which is established in one or more other parts of the Union
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2017)
Regulated non-quarantine pest	A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party (FAO, 2017)

Risk reduction option (RRO)	A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A RRO may become a phytosanitary measure, action or procedure according to the decision of the risk manager
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO, 2017)

Appendix A – Methodological notes on Figures 7–12

The relative probability of presence (RPP) reported here for *Quercus* spp. in Figure 2 and in the European Atlas of Forest Tree Species (de Rigo et al., 2016; San-Miguel-Ayanz et al., 2016) is the probability of that genus to occur in a given spatial unit (de Rigo et al., 2017). In forestry, such a probability for a single taxon is called 'relative'. The maps of RPP are produced by means of the constrained spatial multi-scale frequency analysis (C-SMFA) (de Rigo et al., 2014, 2017) of species presence data reported in geo-located plots by different forest inventories.

A.1. Geolocated plot databases

The RPP models rely on five geo-databases that provide presence/absence data for tree species and genera: four European-wide forest monitoring data sets and a harmonised collection of records from national forest inventories (de Rigo et al., 2014, 2016, 2017). The databases report observations made inside geolocalised sample plots positioned in a forested area, but do not provide information about the plot size or consistent quantitative information about the recorded species beyond presence/absence.

The harmonisation of these data sets was performed within the research project at the origin of the European Atlas of Forest Tree Species (de Rigo et al., 2016; San-Miguel-Ayanz, 2016; San-Miguel-Ayanz et al., 2016). Given the heterogeneity of strategies of field sampling design and establishment of sampling plots in the various national forest inventories (Chirici et al. 2011a,b), and also given legal constraints, the information from the original data sources was harmonised to refer to an INSPIRE compliant geospatial grid, with a spatial resolution of 1 km^2 pixel size, using the ETRS89 Lambert Azimuthal Equal-Area as geospatial projection (EPSG: 3035, http://spatialreference.org/ref/epsg/etrs89-etrs-laea/).

A.1.1. European National Forestry Inventories database

This data set was derived from National Forest Inventory data and provides information on the presence/absence of forest tree species in approximately 375,000 sample points with a spatial resolution of 1 km^2/pixel, covering 21 European countries (de Rigo et al., 2014, 2016).

A.1.2. Forest Focus/Monitoring data set

This project is a Community scheme for harmonised long-term monitoring of air pollution effects in European forest ecosystems, normed by EC Regulation No. 2152/2003[4]. Under this scheme, the monitoring is carried out by participating countries on the basis of a systematic network of observation points (Level I) and a network of observation plots for intensive and continuous monitoring (Level II). For managing the data, the JRC implemented a Forest Focus Monitoring Database System, from which the data used in this project were taken (Hiederer et al., 2007; Houston Durrant and Hiederer, 2009). The complete Forest Focus data set covers 30 European Countries with more than 8,600 sample points.

A.1.3. BioSoil data set

This data set was produced by one of a number of demonstration studies performed in response to the 'Forest Focus' Regulation (EC) No 2152/2003 mentioned above. The aim of the BioSoil project was to provide harmonised soil and forest biodiversity data. It comprised two modules: a Soil Module (Hiederer et al., 2011) and a Biodiversity Module (Houston Durrant et al., 2011). The data set used in the C-SMFA RPP model came from the Biodiversity module, in which plant species from both the tree layer and the ground vegetation layer were recorded for more than 3,300 sample points in 19 European Countries.

A.1.4. European Information System on Forest Genetic Resources (EUFGIS)

EUFGIS (http://portal.eufgis.org) is a smaller geodatabase providing information on tree species composition in over 3,200 forest plots in 34 European countries. The plots are part of a network of

[4] Council of the European Union, 2003. Regulation (EC) No 2152/2003 of the European Parliament and of the Council of 17 November 2003 concerning monitoring of forests and environmental interactions in the Community (Forest Focus). Official Journal of the European Union 46 (L 324), 1–8.

forest stands managed for the genetic conservation of one or more target tree species. Hence, the plots represent the natural environment to which the target tree species are adapted.

A.1.5. Georeferenced Data on Genetic Diversity (GD^2)

GD^2 (http://gd2.pierroton.inra.fr) provides information about 63 species of interest for genetic conservation. The database covers 6,254 forest plots located in stands of natural populations that are traditionally analysed in genetic surveys. While this database covers fewer species than the others, it covers 66 countries in Europe, North Africa and the Middle East, making it the data set with the largest geographic extent.

A.2. Modelling methodology

For modelling, the data were harmonised in order to have the same spatial resolution (1 km^2) and filtered to a study area comprising 36 countries in the European continent. The density of field observations varies greatly throughout the study area and large areas are poorly covered by the plot databases. A low density of field plots is particularly problematic in heterogeneous landscapes, such as mountainous regions and areas with many different land use and cover types, where a plot in one location is not representative of many nearby locations (de Rigo et al., 2014). To account for the spatial variation in plot density, the model used here (C-SMFA) considers multiple spatial scales when estimating RPP. Furthermore, statistical resampling is systematically applied to mitigate the cumulated data-driven uncertainty.

The presence or absence of a given forest tree species then refers to an idealised standard field sample of negligible size compared with the 1 km^2 pixel size of the harmonised grid. The modelling methodology considered these presence/absence measures as if they were random samples of a binary quantity (the punctual presence/absence, not the pixel one). This binary quantity is a random variable having its own probability distribution which is a function of the unknown average probability of finding the given tree species within a plot of negligible area belonging to the considered 1 km^2 pixel (de Rigo et al., 2014). This unknown statistic is denoted hereinafter with the name of 'probability of presence'.

C-SMFA performs spatial frequency analysis of the geo-located plot data to create preliminary RPP maps (de Rigo et al., 2014). For each 1 km^2 grid cell, the model estimates kernel densities over a range of kernel sizes to estimate the probability that a given species is present in that cell. The entire array of multi-scale spatial kernels is aggregated with adaptive weights based on the local pattern of data density. Thus, in areas where plot data are scarce or inconsistent, the method tends to put weight on larger kernels. Wherever denser local data are available, they are privileged ensuring a more detailed local RPP estimation. Therefore, a smooth multi-scale aggregation of the entire arrays of kernels and data sets is applied instead of selecting a local 'best performing' one and discarding the remaining information. This array-based processing, and the entire data harmonisation procedure, are made possible thanks to the semantic modularisation which defines the Semantic Array Programming modelling paradigm (de Rigo, 2012).

The probability to find a single species (e.g. a particular coniferous tree species) in a 1 km^2 grid cell cannot be higher than the probability of presence of all the coniferous species combined. The same logical constraints applied to the case of single broadleaved species with respect to the probability of presence of all the broadleaved species combined. Thus, to improve the accuracy of the maps, the preliminary RPP values were constrained so as not to exceed the local forest-type cover fraction with an iterative refinement (de Rigo et al., 2014). The forest-type cover fraction was estimated from the classes of the Corine Land Cover (CLC) maps which contain a component of forest trees (Bossard et al., 2000; Büttner et al. 2012).

The resulting probability of presence is relative to the specific tree taxon, irrespective of the potential co-occurrence of other tree taxa with the measured plots, and should not be confused with the absolute abundance or proportion of each taxon in the plots. RPP represents the probability of finding at least one individual of the taxon in a plot placed randomly within the grid cell, assuming that the plot has negligible area compared with the cell. As a consequence, the sum of the RPP associated with different taxa in the same area is not constrained to be 100%. For example, in a forest with two co-dominant tree species which are homogeneously mixed, the RPP of both may be 100% (see e.g. the Glossary in San-Miguel-Ayanz et al. (2016), http://forest.jrc.ec.europa.eu/media/atlas/Glossary.pdf).

The robustness of RPP maps depends strongly on sample plot density, as areas with few field observations are mapped with greater uncertainty. This uncertainty is shown qualitatively in maps of

'RPP trustability'. RPP trustability is computed on the basis of the aggregated equivalent number of sample plots in each grid cell (equivalent local density of plot data). The trustability map scale is relative, ranging from 0 to 1, as it is based on the quantiles of the local plot density map obtained using all field observations for the species. Thus, trustability maps may vary among species based on the number of databases that report a particular species (de Rigo et al., 2014, 2016).

The RPP and relative trustability range from 0 to 1 and are mapped at a 1 km spatial resolution. To improve visualisation, these maps can be aggregated to coarser scales (i.e. 10 $\times$ 10 pixels or 25 $\times$ 25 pixels, respectively summarising the information for aggregated spatial cells of 100 and 625 km^2) by averaging the values in larger grid cells.

Appendix B – Non-EU Scolytinae species identified which meet all critera for quarantine pests

The appendix lists the 139 non-EU Scolytinae species for which sufficient information on their biology and impact is available to conclude that they meet all criteria for quarantine species. Their host plant family and the number of interceptions are listed for each species. More detailed data (e.g. on host plant species, the raw data and further details on their biology, capacity to spread, economic and environmental impact) can be found in the supporting publication. Annex B of EFSA, 2020.

ID	Species	Host plant family	Number of interceptions	Reference for interception
1.	*Carphoborus bifurcus*	Pinaceae	1	Haack and Rabaglia (2013)
2.	*Carphoborus costatus*	Pinaceae		
3.	*Carphoborus zhobi*	Pinaceae		
4.	*Cnestus mutilatus*	Pinaceae	8	Haack and Rabaglia (2013)
5.	*Conophthorus conicolens*	Pinaceae		
6.	*Conophthorus coniperda*	Pinaceae		
7.	*Conophthorus michoacanae*	Pinaceae		
8.	*Conophthorus monophyllae*	Pinaceae		
9.	*Conophthorus ponderosae*	Pinaceae		
10.	*Conophthorus radiatae*	Pinaceae		
11.	*Conophthorus resinosae*	Pinaceae		
12.	*Conophthorus teocotum*	Pinaceae		
13.	*Corthylus schaufussi*	Araucariaceae		
14.	*Cryphalus fulvus*	Pinaceae		
15.	*Cryphalus lipingensis*	Pinaceae		
16.	*Cryphalus montanus*	Pinaceae		
17.	*Cryphalus piceus*	Pinaceae		
18.	*Cryphalus ruficollis*	Pinaceae		
19.	*Crypturgus borealis*	Pinaceae	17	Brockerhoff et al. (2014)
20.	*Cyrtogenius luteus*	Pinaceae	10	Haack and Rabaglia (2013)
21.	*Dendroctonus adjunctus*	Pinaceae		
22.	*Dendroctonus approximates*	Pinaceae		
23.	*Dendroctonus armandi*	Pinaceae		
24.	*Dendroctonus brevicomis*	Pinaceae		
25.	*Dendroctonus frontalis*	Pinaceae	3	Haack and Rabaglia (2013)
26.	*Dendroctonus jeffreyi*	Pinaceae		
27.	*Dendroctonus mesoamericanus*	Pinaceae		
28.	*Dendroctonus mexicanus*	Pinaceae	28	Haack and Rabaglia (2013)
29.	*Dendroctonus murrayanae*	Pinaceae		
30.	*Dendroctonus parallelocollis*	Pinaceae		
31.	*Dendroctonus ponderosae*	Pinaceae	17	Brockerhoff et al. (2006)
32.	*Dendroctonus pseudotsugae barragani*	Pinaceae		
33.	*Dendroctonus pseudotsugae pseudotsugae*	Pinaceae	12	Brockheroff et al. (2003), Haack and Rabaglia (2013)
34.	*Dendroctonus punctatus*	Pinaceae		
35.	*Dendroctonus rhizophagus*	Pinaceae		
36.	*Dendroctonus rufipennis*	Pinaceae	11	Brockerhoff et al. (2006)
37.	*Dendroctonus simplex*	Pinaceae		
38.	*Dendroctonus terebrans*	Pinaceae		
39.	*Dendroctonus valens*	Pinaceae		
40.	*Dendroctonus vitei*	Pinaceae		

ID	Species	Host plant family	Number of interceptions	Reference for interception
41.	*Dryocoetes affaber*	Pinaceae	17	Brockerhoff et al. (2014)
42.	*Dryocoetes caryi*	Pinaceae		
43.	*Dryocoetes confuses*	Pinaceae		
44.	*Gnathotrichus retusus*	PInaceae	11	Brockerhoff et al. (2006)
45.	*Gnathotrichus sulcatus*	Pinaceae	62	Haack and Rabaglia (2013)
46.	*Hylastes gracilis*	Pinaceae		
47.	*Hylastes longicollis*	Pinaceae		
48.	*Hylastes macer*	Pinaceae		
49.	*Hylastes nigrinus*	Pinaceae	11	Brockerhoff et al. (2006)
50.	*Hylastes parallelus*	Pinaceae		
51.	*Hylastes porculus*	Pinaceae		
52.	*Hylastes salebrosus*	Pinaceae		
53.	*Hylastes tenuis*	Pinaceae		
54.	*Hylurdrectonus araucariae*	Araucariaceae		
55.	*Hylurgops longipillus*	Pinaceae		
56.	*Hylurgops pinifex*	Pinaceae		
57.	*Hylurgops porosus*	Pinaceae		
58.	*Hylurgops reticulatus*	Pinaceae		
59.	*Hylurgops rugipennis*	Pinaceae	6	Brockerhoff et al. (2014)
60.	*Hypothenemus seriatus*	Pinaceae		
61.	*Ips apache*	Pinaceae	9	Haack and Rabaglia (2013)
62.	*Ips avulsus*	Pinaceae	11	Brockerhoff et al. (2006)
63.	*Ips bonanseai*	Pinaceae	27	Haack and Rabaglia (2013)
64.	*Ips calligraphus*	Pinaceae	62	Brockerhoff et al. (2006)
65.	*Ips confuses*	Pinaceae	6	Brockerhoff et al. (2006)
66.	*Ips grandicollis*	Pinaceae	287	Brockerhoff et al. (2006), Lawson et al. (2018)
67.	*Ips hauseri*	Pinaceae		
68.	*Ips hoppingi*	Pinaceae		
69.	*Ips knausi*	Pinaceae		
70.	*Ips lecontei*	Pinaceae	43	Haack and Rabaglia (2013)
71.	*Ips nitidus*	Pinaceae	1	Brockerhoff et al. (2014)
72.	*Ips paraconfusus*	Pinaceae		
73.	*Ips perturbatus*	Pinaceae		
74.	*Ips pini*	Pinaceae	43	Brockerhoff et al. (2006);
75.	*Ips plastographus maritimus*	Pinaceae		
76.	*Ips plastographus plastographus*	Pinaceae	1	Brockerhoff et al. (2014)
77.	*Ips schmutzenhoferi*	Pinaceae		
78.	*Ips shangrila*	Pinaceae		
79.	*Ips stebbingi*	Pinaceae		
80.	*Ips subelongatus*	Pinaceae	1	Hellrigl (2002)
81.	*Ips tridens tridens*	Pinaceae		
82.	*Orthotomicus caelatus*	Pinaceae	45	Brockerhoff et al. (2014)
83.	*Orthotomicus chaokhao*	Pinaceae		
84.	*Orthotomicus latidens*	Pinaceae		
85.	*Orthotomicus tridentatus*	Pinaceae		
86.	*Pachysquamus subcostulatus*	Pinaceae		
87.	*Phloeosinus armatus*	Cupressaceae	1	Brockerhoff et al. (2006)
88.	*Phloeosinus cristatus*	Cupressaceae		

ID	Species	Host plant family	Number of interceptions	Reference for interception
89.	*Phloeosinus cupressi*	Cupressaceae		
90.	*Phloeosinus dentatus*	Cupressaceae		
91.	*Phloeosinus scopulorum scopulorum*	Cupressaceae		
92.	*Phloeosinus sequoia*	Cupressaceae		
93.	*Phloeosinus sinensis*	Cupressaceae		
94.	*Pityogenes japonicus*	Pinaceae		
95.	*Pityogenes pennidens*	Pinaceae	1	Brockerhoff et al. (2014)
96.	*Pityogenes scitus*	Pinaceae		
97.	*Pityogenes spessivtsevi*	Pinaceae		
98.	*Pityokteines marketae*	Pinaceae		
99.	*Pityokteines sparsus*	Pinaceae	11	Brockerhoff et al. (2014)
100.	*Pityophthorus absonus*	Pinaceae		
101.	*Pityophthorus cariniceps*	Pinaceae		
102.	*Pityophthorus carmeli*	Pinaceae		
103.	*Pityophthorus confertus*	Pinaceae		
104.	*Pityophthorus confuses*	Pinaceae		
105.	*Pityophthorus micrographus sibiricus*	Pinaceae		
106.	*Pityophthorus nitidulus*	Pinaceae		
107.	*Pityophthorus opaculus*	Pinaceae		
108.	*Pityophthorus orarius*	Pinaceae		
109.	*Pityophthorus pityographus cribratus*	Pinaceae		
110.	*Pityophthorus puberulus*	Pinaceae		
111.	*Pityophthorus pulchellus*	Pinaceae		
112.	*Pityophthorus pulicarius*	Pinaceae		
113.	*Pityophthorus sculptor*	Pinaceae		
114.	*Pityophthorus setosus*	Pinaceae		
115.	*Polygraphus jezoensis*	Pinaceae		
116.	*Polygraphus major*	Pinaceae		
117.	*Polygraphus Proximus*	Pinaceae	3	Haack and Rabaglia (2013)
118.	*Polygraphus rufipennis*	Pinaceae	125	Brockerhoff et al. (2006)
119.	*Pseudips mexicanus*	Pinaceae	6	Haack and Rabaglia (2013)
120.	*Pseudips orientalis*[(1)]	Pinaceae		
121.	*Pseudohylesinus nebulosus nebulosus*	Pinaceae	6	Brockerhoff et al. (2014)
122.	*Pseudohylesinus pini*	Pinaceae		
123.	*Pseudohylesinus sericeus*	Pinaceae		
124.	*Scolytus morawitzi*	Pinaceae		
125.	*Scolytus mundus*	Pinaceae		
126.	*Scolytus reflexus*	Pinaceae		
127.	*Scolytus subscaber*	Pinaceae		
128.	*Scolytus tsugae*	Pinaceae		
129.	*Scolytus unispinosus*	Pinaceae		
130.	*Scolytus ventralis*	Pinaceae		
131.	*Tomicus armandii*	Pinaceae		
132.	*Tomicus brevipilosus*	Pinaceae		
133.	*Tomicus yunnanensis*	Pinaceae		

ID	Species	Host plant family	Number of interceptions	Reference for interception
134.	*Xyleborus ferrugineus*	Pinaceae, Araucariaceae	16	Brockerhoff et al. (2006), Lawson et al. (2018)
135.	*Xyleborus intrusus*	Pinaceae	10	Brockerhoff et al. (2006)
136.	*Xyleborus perforans*	Pinaceae, Araucariaceae	205	Brockerhoff et al. (2003)
137.	*Xyleborus seriatus*	Cupressaceae, Pinaceae		
138.	*Xylosandrus compactus*	Cupressaceae, Pinaceae		
139.	*Xyloterinus politus*	Pinaceae	3	Brockerhoff et al. (2006)

(1): Cognato AI, 2000. Phylogenetic reveals new genus of Ipini bark beetle (Scolytidae). Annals of the Entomological Society of America, 93, 362–366. and the species *Ips* (=*Orthotomicus*) *orientalis* Wood & Yin, 1986 was moved under *Pseudips orientalis* (Wood & Yin, 1986). The recent catalogue of the Palaearctic species of Alonso-Zarazaga et al. (2017) adopts this new classification.

Appendix C – Non-EU Scolytinae species for which information on the impact is missing

The appendix lists the 83 non-EU Scolytinae species for which sufficient information on their biology and impact is available but for which no information on their impact is available. Their host plant family and the number of interceptions are listed for each species. More detailed data (e.g. on host plant species, the raw data and further details on their biology, capacity to spread) can be found in the supporting publication: Annex B of EFSA, 2020.

ID	Species	Host plant family	Number of interceptions	Reference for interception
1.	*Ambrosiodmus hagedorni*	Pinaceae		
2.	*Ambrosiodmus lecontei*	Pinaceae		
3.	*Ambrosiodmus lewisi*	Pinaceae		
4.	*Coccotrypes advena*	Pinaceae	1	Haack and Rabaglia (2013)
5.	*Cryphalus redikorzevi*	Pinaceae		
6.	*Cryphalus rubentis*	Pinaceae		
7.	*Dolurgus pumilus*	Pinaceae		
8.	*Dryocoetes granicollis*	Pinaceae		
9.	*Dryocoetes striatus*	Pinaceae	1	Brockerhoff et al. (2014)
10.	*Dryocoetes uniseriatus*	Pinaceae		
11.	*Euwallacea interjectus*	Pinaceae		
12.	*Euwallacea validus*	Pinaceae	24	Brockerhoff et al. (2006)
13.	*Gnathotrichus pilosus*	Pinaceae		
14.	*Hylastes obscurus*	Pinaceae		
15.	*Hylastes ruber*	Pinaceae		
16.	*Hylurgops inouyei*	Pinaceae		
17.	*Hylurgops interstitialis*	Pinaceae	1	Brockerhoff et al. (2014)
18.	*Hypothenemus crudiae*	Araucariaceae, Pinaceae		
19.	*Hypothenemus interstitialis*	Pinaceae		
20.	*Ips borealis borealis*	Pinaceae	6	Brockerhoff et al. (2006)
21.	*Ips borealis lanieri*	Pinaceae		
22.	*Ips borealis swainei*	Pinaceae		
23.	*Ips borealis thomasi*	Pinaceae		
24.	*Ips chinensis*	Pinaceae		
25.	*Ips cribricollis*	Pinaceae	39	Haack and Rabaglia (2013)
26.	*Ips emarginatus*	Pinaceae		
27.	*Ips integer*	Pinaceae	82	Haack and Rabaglia (2013)
28.	*Ips montanus*	Pinaceae	6	Haack and Rabaglia (2013)
29.	*Ips perroti*	Pinaceae		
30.	*Ips pilifrons pilifrons*	Pinaceae		
31.	*Ips pilifrons sulcifrons*	Pinaceae		
32.	*Ips pilifrons thatcheri*	Pinaceae		
33.	*Ips pilifrons utahensis*	Pinaceae		
34.	*Ips tridens engelmanni*	Pinaceae		
35.	*Orthotomicus nobilis*	Pinaceae		
36.	*Pachycotes grandis*	Araucariaceae		
37.	*Phloeosinus pini*	Pinaceae	6	Brockerhoff et al. (2014)
38.	*Phloeosinus scopulorum neomexicanus*	Cupressaceae		
39.	*Pityogenes carinulatus*	Pinaceae		
40.	*Pityogenes hopkinsi*	Pinaceae	17	Brockerhoff et al. (2014)

ID	Species	Host plant family	Number of interceptions	Reference for interception
41.	*Pityogenes knechteli*	Pinaceae		
42.	*Pityogenes seirindensis*	Pinaceae		
43.	*Pityokteines elegans*	Pinaceae		
44.	*Pityokteines minutus*	Pinaceae		
45.	*Pityophthorus balsameus*	Pinaceae		
46.	*Pityophthorus deletus*	Pinaceae		
47.	*Pityophthorus grandis*	Pinaceae		
48.	*Pityophthorus jucundus*	Pinaceae		
49.	*Pityophthorus lautus*	Pinaceae		
50.	*Pityophthorus murrayanae*	Pinaceae		
51.	*Pityophthorus serratus*	Pinaceae		
52.	*Pityophthorus solus*	Pinaceae		
53.	*Polygraphus verrucifrons*	Pinaceae		
54.	*Pseudips concinnus*	Pinaceae		
55.	*Pseudohylesinus tsugae*	Pinaceae		
56.	*Scierus pubescens*	Pinaceae		
57.	*Scolytoplatypus daimio*	Pinaceae, Taxaceae		
58.	*Scolytoplatypus raja*	Pinaceae		
59.	*Scolytoplatypus shogun*	Pinaceae		
60.	*Scolytoplatypus tycoon*	Pinaceae		
61.	*Scolytus oregoni*	Pinaceae		
62.	*Scolytus piceae*	Pinaceae		
63.	*Scolytus praeceps*	Pinaceae		
64.	*Tomicus pilifer*	Pinaceae		
65.	*Tomicus puellus*	Pinaceae		
66.	*Trypodendron proximum*	Pinaceae		
67.	*Trypodendron rufitarsus*	Pinaceae	1	Brockerhoff et al. (2006)
68.	*Trypodendron scabricollis*	Pinaceae		
69.	*Xyleborinus gracilis*	Pinaceae		
70.	*Xyleborinus linearicollis*	Araucariaceae		
71.	*Xyleborinus spinifer*	Pinaceae		
72.	*Xyleborus aquilus*	Pinaceae		
73.	*Xyleborus detectus*	Pinaceae		
74.	*Xyleborus emarginatus*	Pinaceae		
75.	*Xyleborus festivus*	Pinaceae		
76.	*Xyleborus pinicola*	Pinaceae	1	Browne (1980)
77.	*Xyleborus pubescens*	Pinaceae		
78.	*Xyleborus septentrionalis*	Pinaceae		
79.	*Xyleborus spinulosus*	Pinaceae		
80.	*Xyleborus volvulus*	Araucariaceae	15	Haack and Rabaglia (2013)
81.	*Xylechinosomus lucianae*	Araucariaceae		
82.	*Xylechinus araucariae*	Araucariaceae		
83.	*Xylechinus montanus*	Pinaceae		