SCIENTIFIC OPINION

EFSA Journal

ADOPTED: 23 November 2017

doi: 10.2903/j.efsa.2017.5106

Pest categorisation of *Cephalcia lariciphila*

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Abstract

The Panel on Plant health performed a pest categorisation of the larch web-spinning sawfly *Cephalcia lariciphila* (Hymenoptera: Pamphiliidae) for the EU. The insect has been reported in 11 EU Member States (MSs). It is a quarantine pest listed in Annex IIB of Council Directive 2000/29/EC. Protected zones are in place in Ireland and the UK (Northern Ireland, Isle of Man and Jersey). *C. lariciphila* can feed on all species of the genus *Larix*. There have been reported outbreaks in the Czech Republic, Germany, the Netherlands and the UK (England and Wales) in plantations of European larch (*Larix decidua*) and Japanese larch (*Larix kaempferi = Larix leptolepis*). *C. lariciphila* is absent in the protected zones. The pest can enter the protected zones by human-assisted spread or by natural spread from EU areas where the pest is present. Plants for planting are considered the most important pathway for the pest. The pest can establish in the protected zones because the climatic conditions are similar to those of the 11 MSs where *C. lariciphila* is established, and the pest's main host plants are present. The prepupae overwinter in the litter, the adults emerge during May–June, and each female lays 30–40 eggs in slits in mature needles. The larvae feed on the needles through four instars. There is one generation per year; some of the prepupae undergo prolonged diapause for more than 1 year. The impact where the pest occurs is mainly related to the loss of tree growth following defoliation, while tree mortality was locally observed only after repeated defoliation. However, impact is likely to be mitigated by local biological control agents. All criteria assessed by EFSA above for consideration as a potential protected zone quarantine pest and as a potential regulated non-quarantine pest were met.

Keywords: European Union, European web-spinning larch sawfly, Pamphiliidae, pest risk, plant health, plant pest, quarantine

Requestor: European Commission

Question number: EFSA-Q-2017-00334

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Acknowledgements: The Panel on Plant Health wishes to acknowledge all European competent institutions, Member State bodies and other organisations that provided data for this scientific output.

Suggested citation: EFSA PLH Panel (EFSA Panel on Plant Health), Jeger M, Bragard C, Caffier D, Candresse T, Chatzivassiliou E, Dehnen-Schmutz K, Gilioli G, Jaques Miret JA, MacLeod A, Navajas Navarro M, Niere B, Parnell S, Potting R, Rafoss T, Rossi V, Urek G, Van Bruggen A, Van der Werf W, West J, Winter S, Battisti A, Kertész V, Aukhojee M and Grégoire J-C, 2017. Scientific Opinion on the pest categorisation of *Cephalcia lariciphila.* EFSA Journal 2017;15(12):5106, 24 pp. https://doi.org/10.2903/j.efsa.2017.5106

ISSN: 1831-4732

The EFSA Journal is a publication of the European Food Safety Authority, an agency of the European Union.

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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 categorizations 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 pests 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

Aleurocantus 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
Citrus tristeza virus (non-EU isolates)
Leprosis
Little cherry pathogen (non- EU isolates)
Naturally spreading psorosis
Palm lethal yellowing mycoplasm
Satsuma dwarf virus
Tatter leaf virus
Witches' broom (MLO)

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
16) *Rhagoletis completa* Cresson
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)
Guignardia laricina (Saw.) Yamamoto and Ito
Gymnosporangium spp. (non-EU)
Inonotus weirii (Murril) Kotlaba and Pouzar
Melampsora farlowii (Arthur) Davis
Mycosphaerella larici-leptolepis Ito et al.
Mycosphaerella populorum G. E. Thompson
Phoma andina Turkensteen
Phyllosticta solitaria Ell. and Ev.
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 (Kaltenbac

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

1.2. Interpretation of the Terms of Reference

Cephalcia lariciphila is one of a number of pests listed 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.

Since *C. lariciphila* is regulated in the protected zones only, the scope of the categorisation is the territory of the protected zone (Ireland and the United Kingdom: Northern Ireland, Isle of Man and Jersey); thus, the criteria refer to the protected zone instead of the EU territory.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on *C. lariciphila* was conducted at the beginning of the categorisation in the ISI Web of Science bibliographic database, using the scientific name of the pest as search term. Relevant papers were reviewed and further references and information were obtained from experts as well as from citations within the references and grey literature.

2.1.2. Database search

Pest information, on host(s) and distribution, was retrieved from the European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, 2017).

Data about the import of commodity types that could potentially provide a pathway for the pest to enter the EU were obtained from EUROSTAT (Statistical Office of the European Communities).

The Europhyt database was consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network launched by the Directorate General for Health and Consumers (DG SANCO) and is a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. The Europhyt database manages notifications of interceptions of plants or plant products that do not comply with EU legislation as well as notifications of plant pests detected in the territory of the MSs and the phytosanitary measures taken to eradicate or avoid their spread.

2.2. Methodologies

The Panel performed the pest categorisation for *C. lariciphila,* following guiding principles and steps presented in the EFSA guidance on the harmonised framework for pest risk assessment (EFSA PLH Panel, 2010) and as defined in the International Standard for Phytosanitary Measures No 11 (FAO, 2013) and No 21 (FAO, 2004).

In accordance with the guidance on a harmonised framework for pest risk assessment in the EU (EFSA PLH Panel, 2010), 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 ToR 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, in agreement with EFSA guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010).

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 regulated non-quarantine pest. (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?
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?

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
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 regulated non-quarantine pest 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 pest is established. It can be identified at species level using conventional entomological keys (Shinohara, 1997). However, Shinohara (1997) described two subspecies and there might be sibling species still to be considered (Section 3.1.3).

Cephalcia lariciphila is an insect of the order Hymenoptera, family Pamphiliidae. Its taxonomic position has been reviewed by Shinohara (1997), together with other species of the same family feeding on larch across Europe and Asia. Shinohara (1997) distinguished, on a morphological basis, two subspecies within the nominal species *C. lariciphila* (Wachtl, 1898), called *C. lariciphila lariciphila* (Wachtl, 1898) and *C. lariciphila japonica* (Shinohara, 1997). In addition, he provided elements to separate them from *Cephalcia koebelei* (Rohwer, 1910), another species feeding on *Larix* spp. in Japan and Siberia. The latter is considered a synonym of *Cephalcia baikalica* (Verzhutsskij, 1973), from Siberia. Accurate descriptions of the morphology of adults and other stages are provided by Röhrig (1954).

3.1.2. Biology of the pest

The biology of the pest is described by Röhrig (1954). Adults (8–11 mm long) emerge from the ground in spring (May–June, depending on the elevation/latitude), mate right afterwards close to the ground, then females either fly to the canopies or reach them through climbing the tree trunks. Females may live up to about 10 days, during which they feed on nectar/honeydew and lay eggs, in the number of 30–40 per individual. Further dispersal by flight may occur during oviposition. Eggs are laid individually on the fully grown needles, generally in the middle or upper part. Females have a short ovipositor with which they cut a slit on the needles epidermis, where a small part of the egg is inserted. The egg develops in about 3 weeks, changing colour from green to grey and getting larger. Larvae go through four instars and are about 2 cm long at maturity. They live individually in a loose silk shelter, using thoracic legs (prolegs are missing in pamphiliid larvae) and body movement to reach the needles on which they feed. The development takes 4 weeks, during which each larva eats about 500 needles. In July, the mature larva (15–20 mm long) drops to the ground, changes colour from greyish to yellow and quickly digs into the soil, at 5–20 cm depth, where it makes an earth-walled chamber and becomes a prepupa. Two types of prepupae are known and distinguishable by the end of the summer, the 'eonymph' and the 'pronymph', the latter being easily distinguished by large spots on each side of the head, corresponding to the eyes of the future pupa. Pronymphs are going to moult into pupae in the following spring, whereas eonymphs will stay in prolonged diapause for one or more years. Pupation precedes adult emergence about 2 weeks.

3.1.3. Intraspecific diversity

The species has considerable intraspecific variation that has induced Shinohara (1997) to describe two subspecies (*C. lariciphila lariciphila* and *C. lariciphila japonica*), and it probably requires further consideration for the separation of (yet unnamed) sibling species that likely exist in the complex of web-spinning sawflies associated with larch.

3.1.4. Detection and identification of the pest

Are detection and identification methods available for the pest?
Yes, a number of detection and surveillance methods are available for the web-spinning sawflies (Bell et al., 2014) and they could be potentially used also for *C. lariciphila* as well.

Yellow sticky and Malaise traps should be used from the middle of April for adults (Holuša and Drapela, 2004; Holuša, 2011). Traps with virgin females and dichloromethane extract of crushed virgin females can be also used (Borden et al., 1978), as a pheromone is not commercially available. Soil samples and soil emergence traps of different types can be also used, similarly to what has been described for spruce web-spinning sawflies (Battisti, 1994a,b). The pest can be identified at species level using conventional entomological keys (Shinohara, 1997).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

Outside the EU, *C. lariciphila* has been reported from Japan (Hokkaido), Russia (Eastern and Western Siberia and European Russia) and Switzerland according to the EPPO global database (Figure 1). It is, however, unclear to which species and subspecies, in the complex of the web-spinning sawflies associated to larch, these data refer to. The question of the pest distribution has to be revisited once the taxonomic position of the groups has been clarified, starting from the revision of Shinohara (1997).

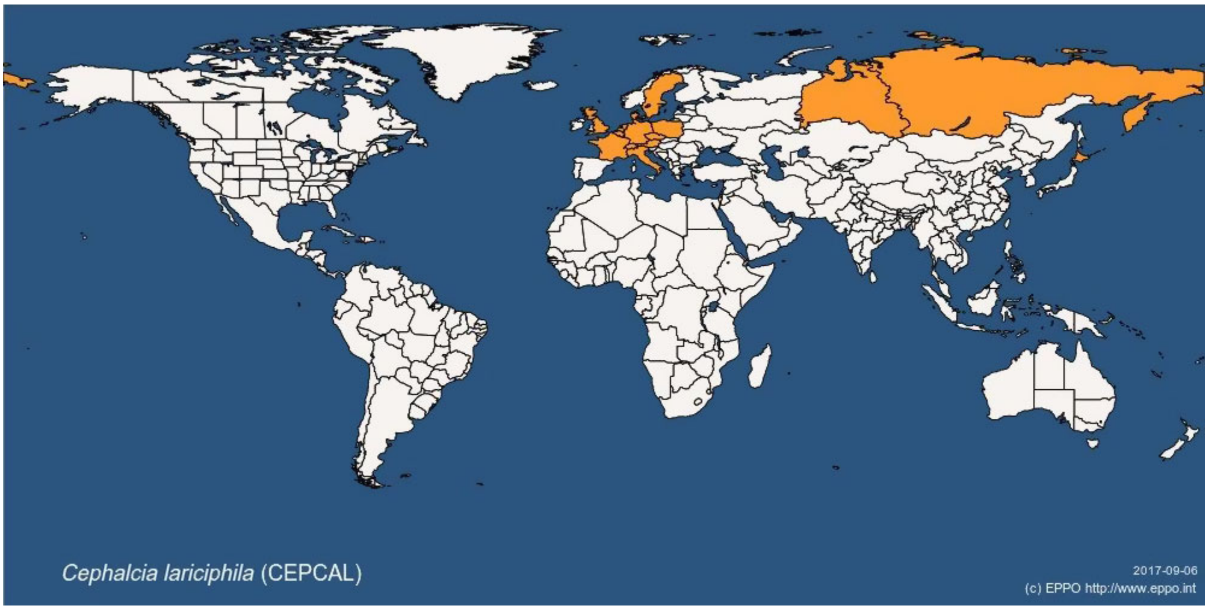

Figure 1: Global distribution map for *Cephalcia lariciphila* (extracted from the EPPO Global Database accessed on 6 September 2017)

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?

Yes, *C. lariciphila* is present in the EU and has been reported from 11 MS (Table 2). The pest is absent in the protected zones confirmed by survey (Ireland and the UK: Northern Ireland, Isle of Man and Jersey). It is generally occurring where larch species are grown, either within or outside of their native range, with a few exceptions.

Table 2: Current distribution of *Cephalcia lariciphila* in the 28 EU MS based on information from the EPPO Global Database

Country	EPPO Global Database Last update: 3 October 2016 Date accessed: 6 September 2017
Austria	Present, no details
Belgium	Present, no details
Bulgaria	No information
Croatia	No information
Cyprus	No information
Czech Republic	Present, widespread
Denmark	Present, restricted distribution
Estonia	No information
Finland	Absent, invalid record
France	Present, restricted distribution
Germany	Present, widespread
Greece	No information
Hungary	No information
Ireland	Absent, confirmed by survey
Italy	Present, restricted distribution
Latvia	No information
Lithuania	No information
Luxembourg	No information

Country	EPPO Global Database Last update: 3 October 2016 Date accessed: 6 September 2017
Malta	No information
Netherlands	Present, widespread
Poland	Present, no details
Portugal	No information
Romania	No information
Slovak Republic	Absent, unreliable record
Slovenia	No information
Spain	No information
Sweden	Present, no details
United Kingdom	England (Present, restricted distribution) Northern Ireland (Absent, confirmed by survey) Scotland (Present, restricted distribution) Jersey (Absent, confirmed by survey)

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

Cephalcia lariciphila is listed in Council Directive 2000/29/EC. Details are presented in Tables 3 and 4.

Table 3: *Cephalcia lariciphila* in Council Directive 2000/29/EC

Annex II, Part B	**Harmful organisms whose introduction into, and whose spread within, certain protected zones shall be banned if they are present on certain plants or plant products**		
(a)	Insects, mites and nematodes, at all stages of their development		
	Species	Subject of contamination	Protected zones
2.	*Cephalcia lariciphila*	Plants of *Larix* Mill., intended for planting, other than seeds	IRL, UK (Northern Ireland, Isle of Man and Jersey)

3.3.2. Legislation addressing the hosts of *Cephalcia lariciphila*

Table 4: Regulated hosts and commodities that may involve *Cephalcia lariciphila* 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
1.	Plants of [. . .], *Larix* Mill., [. . .], other than fruit and seeds	Non-European Countries

Annex IV, Part B	**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 certain protected zones**		
	Plants, plant products and other objects	Special requirements	Protected zone(s)
15.	Plants of Larix Mill., intended or planting, other than seeds	Without prejudice to the provisions applicable to the plants listed in Annex III(A)(1), Annex IV(A)(I)(8.1), (8.2), (10), Annex IV(A)(II)(5) and Annex IV (B)(7), (8), (9), (10), (11), (12), (13), official statement that the plants have been produced in nurseries and that the place of production is free from Cephalcia lariciphila (Klug.)	IRL, UK (Northern Ireland, Isle of Man and Jersey)

Annex V	**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**
Part A	Plants, plant products and other objects originating in the Community
Section II	Plants, plant products and other objects produced by producers whose production and sale is authorised to persons professionally engaged in plant production, other than those plants, plant products and other objects which are prepared and ready for sale to the final consumer, and for which it is ensured by the responsible official bodies of the Member States, that the production thereof is clearly separate from that of other products
2.1	Plants intended for planting other than seeds of the genera [...] *Larix* Mill. [...]

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

The larch web-spinning sawfly can feed on all species of the genus *Larix* and there is no evidence that its performance is affected by the tree species (Röhrig, 1954; Luitjies and Minderman, 1959; Pschorn-Walcher, 1982). European larch (*Larix decidua*) is a mountain species in its native range, although it has been planted at low elevation in regions with cold climate because of fast growth (plantations for timber) (Holuša and Drapela, 2004; Holuša and Kuras, 2010; Holuša et al., 2011). In addition, Japanese larch (*Larix kaempferi* = *Larix leptolepis*) has been planted all over Europe, under suitable climatic conditions (i.e. low elevation in the Alps and latitudes of central Europe) during the 20th century. There are no reports of the sawfly on *Larix sibirica* grown in the European territory, although it is likely that it could develop successfully on it as another closely related species is associated with the tree in Siberia (Shinohara, 1997). *C. lariciphila* has invaded the plantations likely starting from the native range or because of introduction with nursery material (Billany and Brown, 1980). The outbreaks in the Czech Republic (Holuša, 2011), Germany (Röhrig,1954), the Netherlands (Luitjies and Minderman, 1959) and the UK (Billany and Brown, 1980) known so far have concerned only the plantations at low elevation of both larch species. They typically start in medium age to mature stands and last for several years. The same pattern was observed in plantations of similar type in Japan (Ozaki et al., 2004).

3.4.2. Entry

> Is the pest able to enter the protected zones? If yes, identify and list the pathways!
>
> **Yes**, the pest can enter the protected zones by human assisted spread or by natural spread from EU areas where the pest is present.

The main pathways of entry are:

- Plants for planting of *Larix* spp. The pest can travel as eggs in the needles or cocoon in the litter
- Soil attached to plants or soil as such containing prepupae or pupae.

There are measures in place for EU internal trade of *Larix* spp. plants towards the protected zones. This pathway is closed for trade with non-European countries (Annex III A.1 of 2000/29/EC).

There were no records of interception or outbreak of *C. lariciphila* in the Europhyt database.

3.4.3. Establishment

> Is the pest able to become established in the protected zones?
>
> **Yes**, the pest is already established in 11 MS. The climate of the EU protected zones is similar to that of the MS where *C. lariciphila* is established, and the pest's main host plants are present (Figure 2).

3.4.3.1. EU distribution of main host plants

Larix spp. are widespread in the EU (Figure 2).

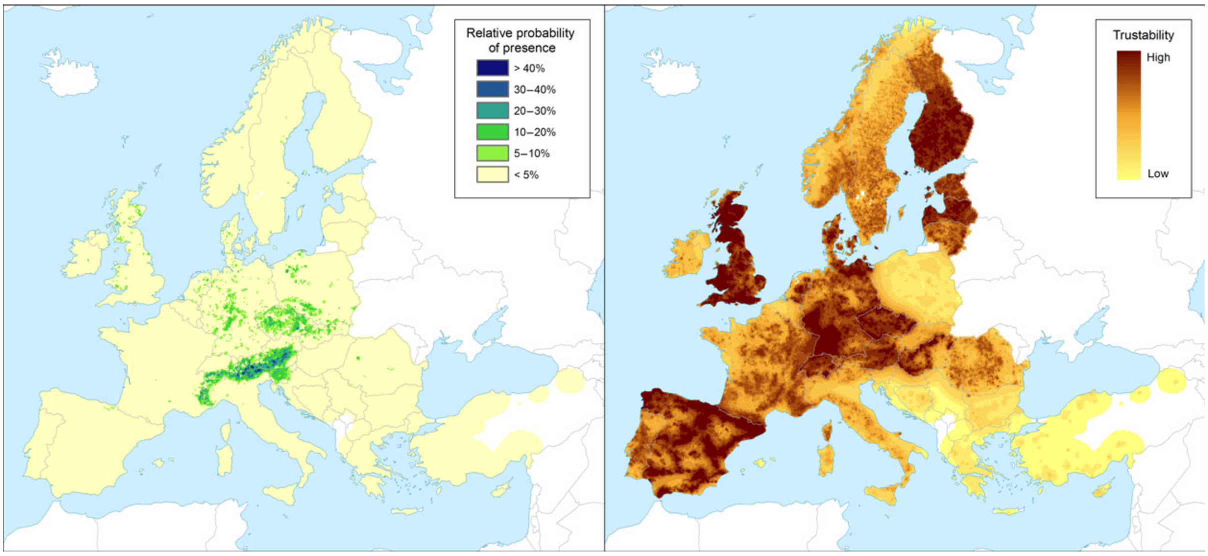

Figure 2: Left panel: Relative probability of presence (RPP) of the genus *Larix* (based on data from the species: *L. decidua, L. kaempferi, L. sibirica*) in Europe, mapped at 100 km^2 resolution. The underlying data are from European-wide forest monitoring data sets and from national forestry inventories 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)

3.4.3.2. Climatic conditions affecting establishment

Given the current distribution of *C. lariciphila*, the whole EU area (including the protected zones) is suitable for establishment. Figure 3 shows the Köppen–Geiger climate types (colours) and the presence of *C. lariciphila.*

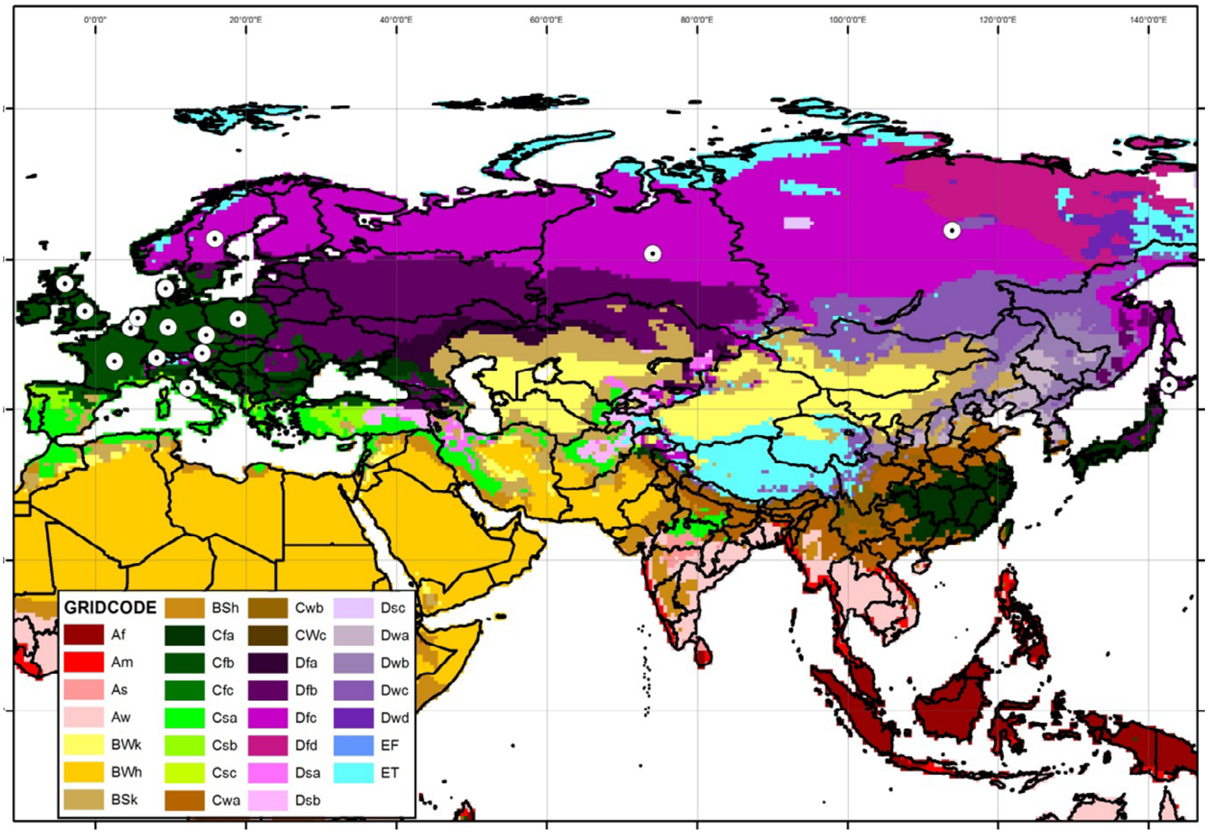

Figure 3: The current distribution of *Cephalcia lariciphila* presented by white dots on the Köppen–Geiger climate classification map (Kottek et al., 2006) of Eurasia

3.4.4. Spread

Is the pest able to spread within the protected zones following establishment? How?
Yes, *C. lariciphila* is able to spread by human assisted spread and by natural means.
RNQPs: Is spread mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects?
Yes, plants for planting are the most important pathway for the pest.

The pest may spread naturally because of adult female flight. Liston (1989) reports the catch of few females in traps far away from the nearest larch tree, although a systematic sampling was not carried out. In studies of the expansion of outbreak areas, establishment of satellite populations away from the core outbreak spot was not reported (Röhrig, 1954; Luitjies and Minderman, 1959; Billany and Brown, 1980), indicating that natural spread is limited. The same was observed for other *Cephalcia* spp. feeding on spruce (Rodeghiero and Battisti, 2000).

3.5. Impacts

Would the pests' introduction have an economic or environmental impact in the protected zones?

Yes. The impact where the pest occurs is mainly related to the loss of tree growth following defoliation, while tree mortality was locally observed only after repeated defoliation (Billany and Brown, 1980; Kapitola and Liska, 2001; Holuša and Drapela, 2004). However, impact is likely to be mitigated by local biological control agents (Section 3.6.3).

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?[4]

Yes, only in protected zones where plants of *Larix* spp. are used in forest plantations. For EU internal trade (excluding protected zones) the presence of the pest on plants for planting may not have a significant impact because the pest is already widespread in forest areas within the EU.

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 protected zones such that the risk becomes mitigated?

Yes, the material to be used in the protected zones has to be produced in pest-free areas or in nursery conditions that allow pest exclusion.

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

Yes, for trees produced in screened glasshouses in areas where the pest is present. Furthermore, pest free plants for planting may be guaranteed if trade is restricted to winter time (no needles on trees) and soil is removed from the plants (to prevent presence of prepupae and pupae).

3.6.1. Phytosanitary measures

- Production in pest-free area
- Production in protected nursery
- Movement of plants in the winter, without leaves and soil.

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

- If plants for planting are taken with soil, the probability to carry the sawfly is higher because of the potential occurrence of the dormant prepupae.
- The eggs in the needles are cryptic and difficult to survey.

3.6.3. Biological or technical factors limiting the ability to prevent the presence of the pest on plants for planting

Forest nurseries usually do not produce trees in protected cultivation.

3.6.4. Pest control methods

All outbreaks known so far have been contained by the uprising of natural enemies recruited among the local pool of species. They consist mainly of hymenopteran ichneumonid parasitoids and entomopathogenic nematodes. Several species are involved and are described in the literature as important factors reducing the population density to endemic level (Röhrig, 1954; Luitjies and Minderman, 1959; Georgis and Hague, 1979, 1980, 1981; Billany and Brown, 1980; Kapitola and Liska, 2001; Holuša et al., 2011). It is recommended to carry out surveillance of adult sawflies with yellow sticky traps in the stands considered at higher risk (pole stage and older) and to avoid to establish plantations at low elevation and in climatically mild conditions. It is possible that climate change will shift the area where outbreaks may occur, potentially affecting native stands at the lower edge of the native range of European larch.

[4] See Section 2.1 on what falls outside EFSA's remit.

3.7. Uncertainty

There is little uncertainty regarding the movements, impact and control of the pest. There is uncertainty on the effect of local natural enemies on reducing impact in the protected zones. There is uncertainty as to whether forest nurseries produce trees in protected cultivation.

From the history of *C. lariciphila* outbreaks, it is known that natural enemies contain population surges in newly colonised areas and maintain populations at low levels afterwards (Billany and Brown, 1980; Pschorn-Walcher, 1982). From the same events, it is also known that dispersal by natural flight is not important, whilst plants for planting play a central role.

4. Conclusions

All criteria assessed by EFSA for consideration as potential protected zone quarantine pest and as a potential RNQP were met (Table 5).

Table 5: 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 protected zone quarantine pest (articles 32–35)	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of the pest is established. It can be identified at species level using conventional entomological keys. However, Shinohara (1997) described two subspecies and there might be sibling species still to be considered	The identity of the pest is established. It can be identified at species level using conventional entomological keys	None
Absence/presence of the pest in the EU territory (Section 3.2)	*Cephalcia lariciphila* is present in the EU and has been reported from 11 MS. It is absent from the protected zones (Ireland and the UK: Northern Ireland, Isle of Man and Jersey)	*Cephalcia lariciphila* is present in the EU and has been reported from 11 MS. It is absent from the protected zones (Ireland and the UK: Northern Ireland, Isle of Man and Jersey)	From several MS, no information was available on pest presence confirmed by surveillance
Regulatory status (Section 3.3)	The pest is currently officially regulated by 2000/29/EC on plants of *Larix*, intended for planting other than seeds *C. lariciphila* is regulated as a quarantine pest in protected zones (Annex IIB): Ireland and the United Kingdom (Northern Ireland, Isle of Man and Jersey) Currently, there are no requirements for EU-internal trade outside protected zones	The pest is currently officially regulated by 2000/29/EC on plants of *Larix*, intended for planting other than seeds *C. lariciphila* is regulated as a quarantine pest in protected zones (Annex IIB): Ireland and the United Kingdom (Northern Ireland, Isle of Man and Jersey) Currently, there are no requirements for EU-internal trade outside protected zones	None
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	The pest can enter the protected zones by human assisted spread or by natural spread from EU areas where the pest is present Although *C. lariciphila* does not seem to fly long distances, it is theoretically able to disperse by natural spread in the absence of geographic barriers	Plants for planting are the most important pathway for the pest	None

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35)	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Potential for consequences in the EU territory (Section 3.5)	The impact is mainly related to the loss of tree growth following defoliation, while tree mortality was locally observed only after repeated defoliation. However, impact is likely to be mitigated by local biological control agents	For EU internal trade of forest plants, there is no significant impact because the pest is already present in most forest areas within the EU (excluding protected zones)	The effect of local natural enemies on reducing impact in the protected zones In relation to the RNQP status, the acceptable level of impact for forest nurseries cannot be judged by EFSA
Available measures (Section 3.6)	Entry on plants for planting can be prevented by allowing only the movement into protected zones of nursery plants with no soil attached and during the winter. Entry by natural dispersal can only be fully prevented when the protected zone is isolated by a geographical barrier, as is the case for the islands that make up the PZ	Production in pest-free nurseries or a restricted trade period (winter time) and movement without soil can mitigate the risk	None
Conclusion on pest categorisation (Section 4)	All criteria assessed by EFSA above for consideration as potential protected zone quarantine pest were met	All criteria assessed by EFSA above for consideration as potential regulated non-quarantine pest were met	The effect of local natural enemies on reducing impact in the protected zones In relation to the RNQP status, the acceptable level of impact for forest nurseries cannot be judged by EFSA
Aspects of assessment to focus on/ scenarios to address in future if appropriate	The effect of local natural enemies on reducing impact in the protected zones Clarification of the situation on subspecies/sibling species		

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Abbreviations

CLC	Corine Land Cover
C-SMFA	constrained spatial multi-scale frequency analysis
DG SANCO	Directorate General for Health and Consumers
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
MS	Member State
PLH	EFSA Panel on Plant Health
RNQP	regulated non-quarantine pest
RPP	Relative Probability of Presence
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference

Appendix A – Methodological notes on Figure 2

The relative probability of presence (RPP) reported here for *Larix* 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 geolocated plots by different forest inventories.

A.1. Geolocated plot databases

The RPP models rely on five geodatabases 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[5]. 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

[5] 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 preforms spatial frequency analysis of the geolocated 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 multiscale 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 multiscale 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 codominant 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.