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SCIENTIFIC OPINION

Pest categorisation of *Lepidosaphes pineti*, *L. pini* and *L. piniphila*

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Lepidosaphes pineti* Borchsenius the pine oyster scale, *Lepidosaphes pini* (Maskell) the Oriental pine scale and *Lepidosaphes piniphila* Borchsenius (Hemiptera: Diaspididae) for the EU, following a commodity risk assessment of dwarfed *Pinus parviflora* grafted onto *P. thunbergii* from China in which the three *Lepidosaphes* species were identified as pests of possible concern to the EU. All three species are native to Asia. *L. pineti* is only known from China; *L. piniphila* occurs in China, Japan and Malaysia; and *L. pini* is present in China, Japan, South Korea, Taiwan, and has been introduced to the USA. All three species feed primarily on *Pinus* spp., including several important forestry and ornamental trees, and *L. pineti* and *L. pini* have adapted to feed on North American species of pine. *L. pineti* also feeds on *Torreya grandis*; *L. pini* on *Abies* sp., *Cunninghamia lanceolata*, *Cycas* spp., *Podocarpus* spp., *Taxus* sp. and *Torreya* sp.; and *L. piniphila* on *Podocarpus* spp. and *T. grandis*. All developmental stages occur on the foliage. Host plants for planting and cut branches with foliage could provide pathways into the EU. However, prohibitions on the import of *Pinus* close the main pathway. Certain dwarfed *Pinus* spp. from Japan are provided with a derogation for entry into the EU. The main hosts (*Pinus* spp.) occur throughout the EU in climate zones that match those where the three *Lepidosaphes* species occur in Asia. If any of the three *Lepidosaphes* species were to enter the EU, conditions in most of the EU are conducive to establishment. Following establishment, impacts on pines by *L. pineti* and *L. pini* would be expected. There are no published reports of *L. piniphila* causing damage to pine. *L. pineti* and *L. pini* satisfy the criteria that are within the remit of EFSA to assess for them to be regarded as potential Union quarantine pests. *L. piniphila* does not satisfy the criteria, as there is no evidence that it is harmful; however, there is a key uncertainty regarding whether it is synonymous with a closely related species, *L. pitysophila*, which is recorded as a pest of pine in China.

KEYWORDS

pest risk, pine, plant health, plant pest, quarantine

CONTENTS

1 | INTRODUCTION

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

1.1.1 | Background

The new Plant Health Regulation (EU) 2016/2031, on the protective measures against pests of plants, is applying from 14 December 2019. Conditions are laid down in this legislation in order for pests to qualify for listing as Union quarantine pests, protected zone quarantine pests or Union regulated non-quarantine pests. The lists of the EU regulated pests together with the associated import or internal movement requirements of commodities are included in Commission Implementing Regulation (EU) 2019/2072. Additionally, as stipulated in the Commission Implementing Regulation 2018/2019, certain commodities are provisionally prohibited to enter in the EU (high-risk plants, HRP). EFSA is performing the risk assessment of the dossiers submitted by exporting to the EU countries of the HRP commodities, as stipulated in Commission Implementing Regulation 2018/2018. Furthermore, EFSA has evaluated a number of requests from exporting to the EU countries for derogations from specific EU import requirements.

In line with the principles of the new plant health law, the European Commission with the Member States are discussing monthly the reports of the interceptions and the outbreaks of pests notified by the Member States. Notifications of an imminent danger from pests that may fulfil the conditions for inclusion in the list of the Union quarantine pest are included. Furthermore, EFSA has been performing horizon scanning of media and literature.

As a follow-up of the above-mentioned activities (reporting of interceptions and outbreaks, HRP, derogation requests and horizon scanning), a number of pests of concern have been identified. EFSA is requested to provide scientific opinions for these pests, in view of their potential inclusion by the risk manager in the lists of Commission Implementing Regulation (EU) 2019/2072 and the inclusion of specific import requirements for relevant host commodities, when deemed necessary by the risk manager.

1.1.2 | Terms of Reference

EFSA is requested, pursuant to Article 29(1) of Regulation (EC) No 178/2002, to provide scientific opinions in the field of plant health.

EFSA is requested to deliver 53 pest categorisations for the pests listed in Annex 1A, 1B, 1D and 1E (for more details see mandate M-2021-00027 on the Open.EFSA portal). Additionally, EFSA is requested to perform pest categorisations for the pests so far not regulated in the EU, identified as pests potentially associated with a commodity in the commodity risk assessments of the HRP dossiers (Annex 1C; for more details see mandate M-2021-00027 on the Open.EFSA portal). Such pest categorisations are needed in the case where there are not available risk assessments for the EU.

When the pests of Annex 1A are qualifying as potential Union quarantine pests, EFSA should proceed to phase 2 risk assessment. The opinions should address entry pathways, spread, establishment, impact and include a risk reduction options analysis.

Additionally, EFSA is requested to develop further the quantitative methodology currently followed for risk assessment, in order to have the possibility to deliver an express risk assessment methodology. Such methodological development should take into account the EFSA Plant Health Panel Guidance on quantitative pest risk assessment and the experience obtained during its implementation for the Union candidate priority pests and for the likelihood of pest freedom at entry for the commodity risk assessment of high risk plants.

1.2 | Interpretation of the Terms of Reference

Lepidosaphes pineti, L. pini and *L. piniphila* are pests listed in Annex 1C to the terms of reference (ToR) to be subject to pest categorisation to determine whether they fulfil the criteria of each being potential Union quarantine pests for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores, and so inform EU decision-making as to its appropriateness for potential inclusion in the lists of pests of Commission Implementing Regulation (EU) 2019/2072. If a pest fulfils the criteria to be potentially listed as a Union quarantine pest, risk reduction options will be identified.

1.3 | Additional information

This pest categorisation was initiated following the commodity risk assessment of bonsai plants from China consisting of *Pinus parviflora* grafted onto *P. thunbergii* (EFSA PLH Panel, 2022), in which *L. pineti, L. pini* and *L. piniphila* were identified as relevant non-regulated EU pests which could potentially enter the EU on *P. parviflora* and *P. thunbergii*.

2 | DATA AND METHODOLOGIES

2.1 | Data

2.1.1 | Literature search

A literature search on *L. pineti, L. pini* and *L. piniphila* 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. Papers relevant for the pest categorisation 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 scientific literature databases as referred above in Section 2.1.1.

The Europhyt and TRACES databases were consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network run by the Directorate General for Health and Food Safety (DG SANTÉ) of the European Commission as a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. TRACES is the European Commission's multilingual online platform for sanitary and phytosanitary certification required for the importation of animals, animal products, food and feed of non-animal origin and plants into the European Union and the intra-EU trade and EU exports of animals and certain animal products. Up until May 2020, the Europhyt database managed 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 Member States and the phytosanitary measures taken to eradicate or avoid their spread. The recording of interceptions switched from Europhyt to TRACES in May 2020.

GenBank was searched to determine whether it contained any nucleotide sequences for *L. pineti, L. pini* and *L. piniphila* which could be used as reference material for molecular diagnosis. GenBank® (www.ncbi.nlm.nih.gov/genbank/) is a comprehensive publicly available database that as of August 2019 (release version 227) contained over 6.25 trillion base pairs from over 1.6 billion nucleotide sequences for 450,000 formally described species (Sayers et al., 2020).

2.2 | Methodologies

The Panel performed the pest categorisation for *L. pineti, L. pini* and *L. piniphila*, following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018), the EFSA guidance on the use of the weight of evidence approach in scientific assessments (EFSA Scientific Committee, 2017) and the International Standards for Phytosanitary Measures No. 11 (FAO, 2013).

The criteria to be considered when categorising a pest as a potential Union quarantine pest (QP) is given in Regulation (EU) 2016/2031 Article 3 and Annex I, Section 1 of the Regulation. Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. In judging whether a criterion is met, the Panel uses its best professional judgement (EFSA Scientific Committee, 2017) by integrating a range of evidence from a variety of sources (as presented above in Section 2.1) to reach an informed conclusion as to whether or not a criterion is satisfied.

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, deemed to be a risk management decision, the Panel will present a summary of the observed impacts in the areas where the pest occurs, and make a judgement about potential likely impacts in the EU. While the Panel may quote impacts reported from areas where the pest occurs in monetary terms, the Panel will seek to express potential EU impacts in terms of yield and quality losses and not in monetary terms, in agreement with the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018). Article 3(d) of Regulation (EU) 2016/2031 refers to unacceptable social impact as a criterion for quarantine pest status. Assessing social impact is outside the remit of the Panel.

TABLE 1 Pest categorisation criteria under evaluation, as derived from 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 (article 3)
Identity of the pest (Section 3.1)	Is the identity of the pest clearly defined, 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 in a limited part of the EU or is it scarce, irregular, isolated or present infrequently? If so, the pest is considered to be not widely distributed.
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 for entry and spread.
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?
Available measures (Section 3.6)	Are there measures available to prevent pest entry, establishment, spread or impacts?
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.

3 | PEST CATEGORISATION

3.1 | Identity and biology of the pest

3.1.1 | Identity and taxonomy

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

Yes, the identities of the pests are established, and *Lepidosaphes pineti* Borchsenius, *L. pini* (Maskell) and *L. piniphila* Borchsenius are the accepted names. There is, however, a key uncertainty regarding whether *L. pitysophila* (Takagi), a pest of pine in China, is distinct or not from *L. piniphila***.**

Lepidosaphes species are insects within the order Hemiptera, suborder Sternorrhyncha, infraorder Coccomorpha, family Diaspididae (Kondo & Watson, 2022). The genus consists of 195 species of which 58 have been recorded from China and their taxonomy needs to be reviewed.

- ***Lepidosaphes pineti*** Borchsenius, 1958 (Figure 1A) was originally described from specimens collected in Beijing, China, on *Pinus* sp. (Borchsenius, 1958); it has a single synonym, *Insulaspis pineti* (Borchsenius), and is commonly known in China as pine oyster scale (Song, 2002). The EPPO code[1] (EPPO, 2019; Griessinger & Roy, 2015) for this species is LEPSPT (EPPO, online).
- ***Lepidosaphes pini*** (Maskell, 1897) (Figure 1B,C) was originally described from specimens collected in Miyanoshita, Honshu, Japan, on *Pinus densiflora* (Maskell, 1897); it has four synonyms, *Poliaspis pini* Maskell, *Chionaspis (Poliaspis) pini* (Maskell), *Mytilococcus pinorum* Lindinger and *Insulaspis pini* (Maskell); and is commonly known as the Oriental pine scale and pine oystershell scale. The EPPO code for this species is LEPSPN (EPPO, online).
- ***Lepidosaphes piniphila*** Borchsenius, 1958 (Figure 1D) was originally described from specimens collected in Guangzhou and Nankin, China, on *Pinus* sp. (Borchsenius, 1958); it has a single synonym, *Parainsulaspis piniphila* (Borchsenius), and no common name. The EPPO code for this species is LEPSPH (EPPO, online).

Tang (1986) suggested that *L. piniphila* and *L. pitysophila* (Takagi) (= *Paralepidosaphes pitysophila* (Takagi)) may be the same species, as they are morphologically similar and recorded on *Pinus* spp. at the same locations. This is pertinent to this categorisation, as Wu (2009) records *L. pitysophila* as a pest in mainland China, but not *L. piniphila*. Takagi (1970) described *L. pitysophila* from specimens collected on *Pinus* sp. in Taiwan. Tang (1986) stated that Takagi established his new species based on a comparison with *L. piniphila* specimens collected in Japan on *Podocarpus*, and some of the distinguishing characters were not described 'by Borchensius' rather poor description and illustration', making comparison between *L. piniphila* and *L. pitysophila* difficult. Miller et al. (2006) provided a morphological key that separates the two species, but they did not have specimens of *L. pitysophila* to study and only used Takagi's original description. Currently, both *L. piniphila* and *L. pitysophila* are valid names (García Morales et al., 2016); if they were found to be synonymous, *L. piniphila* would take precedence.

FIGURE 1 *Lepidosaphes* species on Pinaceae and Taxaceae: A, *L. pineti* females on *Torreya grandis* 'Merrillii', China; B, *L. pini* females at the base of *Pinus thunbergii* needles, USA; C, *L. pini*, scales on *Pinus*, USA; D, *L. piniphila* female on *Torreya grandis* 'Merrillii', China (*Source*: A and D: San-An Wu, Forestry College of Beijing University, China; B, Nancy Gregory, University of Delaware, Bugwood.org CC BY; and C, John. A. Davidson, Univ. Md, College Pk, Bugwood.org CC BY).

3.1.2 | Biology of the pest

Of the three *Lepidosaphes* spp. categorised here, only the biology of *L. pineti* has been studied in detail (Song, 2002). However, it is likely that the biology of all three species is similar. All Diaspididae (including all *Lepidosaphes* spp.) feed on the mesophyll and therefore do not egest honeydew (Kondo & Watson, 2022); first-instar nymphs are called 'crawlers' and have well-developed legs that enable them to disperse over the natal plant; subsequent stages, except adult males, are sessile; females have two nymphal instars, and males have four (including prepupal and pupal); adult males are usually winged, whereas adult females are larviform and wingless. Crawlers may be dispersed passively over long distances by wind or phoresis, attached to insects and birds. All stages may be transported with infested plant material (Watson, 2002).

- ***L. pineti*** is sexually reproductive. In China, there are two overlapping generations annually, and they overwinter as fertilised females or second-instar nymphs (Song, 2002). Adult females lay between 10 and 36 eggs beneath the protective scale cover in mid-April. Egg hatch occurs in early May and the crawlers disperse to find suitable feeding sites on the needles. They settle to feed, usually at the base of pine needles, and begin to secrete wax. The second-instar nymph starts to form a protective cover, consisting mainly of wax and exuviae. Adults appear from mid-June, mate and the females lay eggs. By mid-July, the second generation of eggs hatches. Adult males only live for 1–2 days and die after mating (Song, 2002).
- ***L. pini*** is sexually reproductive. In Japan, fertilised females overwinter and each female lays about 30 eggs in the spring. Adult males emerge in early August and mid-October (Murakami, 1970). In the USA, they overwinter as adults or eggs (Miller & Davidson, 2005; Stimmel, 1994), and there are one or two generations annually (Murakami, 1970; Stimmel, 1994). In New Jersey (USA), eggs are present in March and August, and crawlers observed in June and September (Miller & Davidson, 2005). The nymphs and adult females feed at the base of the pine needles (Stimmel, 1994). In Japan, there is a high mortality caused by the entomopathogenic fungus *Nectria coccophila* (Hypocreales: Nectriaceae) (Murakami, 1970).
- ***L. piniphila*** feeds at the base of pine needles, but there is almost no further specific information available on the biology of this species.

3.1.3 | Host range/species affected

All three *Lepidosaphes* species are most frequently reported feeding on *Pinus* spp. (Pinaceae) and the full list of host plant species is presented in Appendix A.

- ***L. pineti*** is commonly found on slash pine (*Pinus elliottii*), masson pine (*P. massoniana*), loblolly pine (*P. taeda*) and Japanese black pine (*P. thunbergii*) in China (Song, 2002). It also feeds on Chinese nutmeg yew (*Torreya grandis*, Taxaceae).

- ***L. pini*** feeds on two- and three-needled pines, with Japanese red pine (*P. densiflora*) and Japanese black pine (*P. thunbergii*) being the most frequently infested pines in the USA (Stimmel, 1994). It is also recorded feeding on *Abies* sp. (Pinaceae), *Cunninghamia lanceolata* (Cupressaceae), *Cycas* spp. (Cycadaceae), *Podocarpus* spp. (Podocarpaceae), *Taxus* sp. (Taxaceae) and *Torreya* sp.
- ***L. piniphila*** feeds on *Pinus* spp., *Podocarpus* spp. and *T. grandis*.

Wu (2009) records *L. pini* as primarily a pest of 'black pine' which she refers to as *Pinus nigra* in China. However, Song (2002) uses black pine as the common name for *P. thunbergii* in China and it is highly likely that the pine species Wu is referring to is Japanese black pine (*P. thunbergii*).

It is not known if *Pinus* species commonly found in Europe, such as European black pine (*Pinus nigra*), maritime pine (*P. pinaster*) and Scots pine (*P. sylvestris*), are suitable hosts for any of the three *Lepidosaphes* spp. discussed here. However, when *L. pini* was introduced to the USA, it was able to adapt to *P. palustris*, a native North American species, and *L. pineti* has adapted to native North American *Pinus* species (*P. elliottii* and *P. taeda*) grown in China.

The importance of the non-*Pinus* hosts, for example, whether they can sustain populations of any of the three *Lepidosaphes* spp. in the absence of *Pinus*, is not documented. Miller and Davidson (2005) reported that all specimens of *L. pini* collected in the USA, and those intercepted in quarantine on plants imported from the Bonin Islands, China, Japan, Korea and Taiwan were only found on *Pinus* spp., indicating that *L. pini* is rarely found on non-*Pinus* hosts.

3.1.4 | Intraspecific diversity

No intraspecific diversity has been reported for *L. pineti, L. pini* and *L. piniphila*.

3.1.5 | Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, there are methods available for the detection and morphological identification of *L. pineti, L. pini* and *L. piniphila*.

Detection

Stimmel (1994) reports that *L. pini* is extremely cryptic, living at the base of needles where it is not readily observed and easily overlooked (Figure 1B). This is likely to also apply to *L. pineti* and *L. piniphila* when populations occur at low density. Destructive sampling is usually required. Groups of needles need to be removed from the tree and pulled apart so that the inner base of the needles, including the part hidden by the sheath, can be carefully examined, preferably with a magnifying hand lens. Screening needles with a stereoscopic microscope in a laboratory is a more effective way of detecting *Lepidosaphes* at low density than field inspections. High-density populations, however, are conspicuous as the needles become smothered in scales (Figure 1C), and the tree will exhibit symptoms of infestation (described below).

L. pineti, *L. pini* and *L. piniphila* can be confused with other *Lepidosaphes* species (see section Description below), especially with species already established in the EU that feed on *Pinus* spp., for example, juniper oystershell scale *L. juniperi* Lindinger, Newstead's scale or pine oystershell scale *L. newsteadi* (Sulc) and mussel scale *L. ulmi* (Linnaeus).

Symptoms

L. pini causes chlorosis at the base of the needles (Stimmel, 1994). This is likely to also apply to *L. pineti* and *L. piniphila* as they feed in the same manner, by sucking the cell contents from the needles. Heavy infestations may cause yellowing of the needles and dieback.

Identification

The identification of all three *Lepidosaphes* spp. requires microscopic examination of slide-mounted adult females and verification of the presence of key morphological characteristics as described by Miller and Davidson (2005). All three species may be identified using the diagnostic key to the 25 species of *Lepidosaphes* recorded on conifers by Miller et al. (2006). Takahashi (1955) provides a key to the *Lepidospahes* found in Japan which includes a morphological description of adult female *L. pini*. Miller and Davidson (2005) provide a key for the identification of Diaspididae on trees and shrubs in North America, which includes a detailed morphological description and illustration, and colour photographs of *L. pini*. Tang (1977) provides descriptions and illustrations of scale insect pests of horticulture and forestry in China, which includes all three *Lepidosaphes* species (under the synonyms *Insulaspis pineti*, *I. pini* and *Parainsulaspis piniphilus*).

There are no specific diagnostic molecular protocols available for the three *Lepidosaphes* species but there are nucleotide sequences, including cytochrome oxidase subunit I (COI), available on GenBank for *L. pini* and *L. piniphila*, which may be used to identify the species.

Description

All three species are similar in appearance in the field (Figure 1). Adult female cover is about 2 mm long, oyster-shell shaped, straight or slightly curved, moderately convex, light brown; shed skins (exuviae) are marginal, light yellow. Male cover is shorter, about 1 mm long, narrower than female cover, same colour and texture; shed skins (exuviae) marginal, yellow. The body of adult female *L. pini* is white; eggs and crawlers are also white.

3.2 | Pest distribution

3.2.1 | Pest distribution outside the EU

All three species are native to Asia, and all are present in China. *L. pineti* is only known from China (Figure 2), whereas *L. piniphila* also occurs in Japan and Malaysia (Figure 3). *L. pini* is present in China, Japan, South Korea, Taiwan, and has been introduced to the USA (New Jersey) (Figure 4). For a detailed list of countries and regions where they are present, see Appendix B.

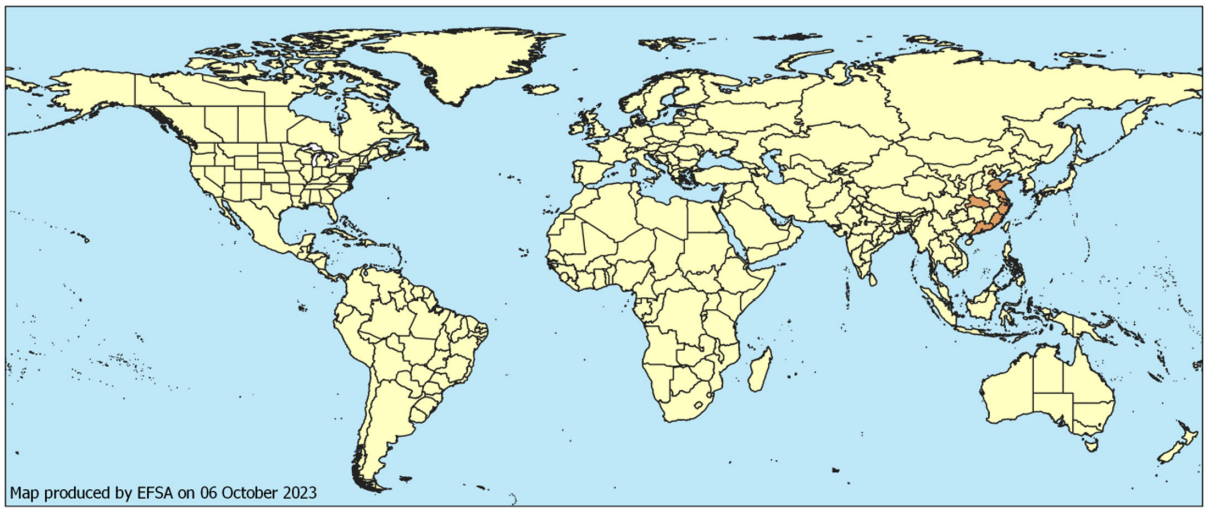

FIGURE 2 Global distribution of *Lepidosaphes pineti* (Source: Literature; for details see Appendix B).

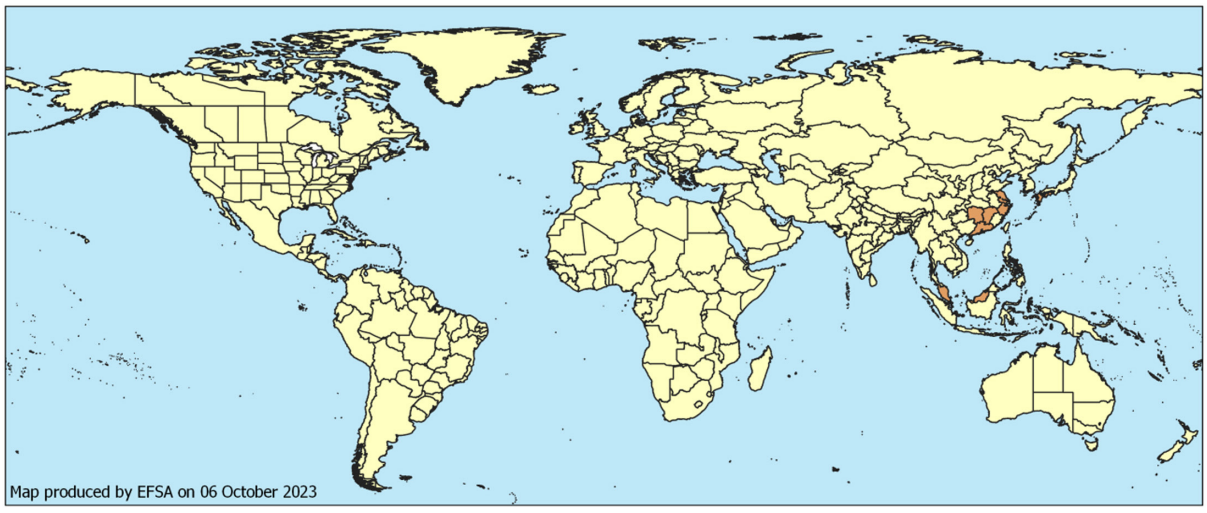

FIGURE 3 Global distribution of *Lepidosaphes piniphila* (Literature; for details see Appendix B).

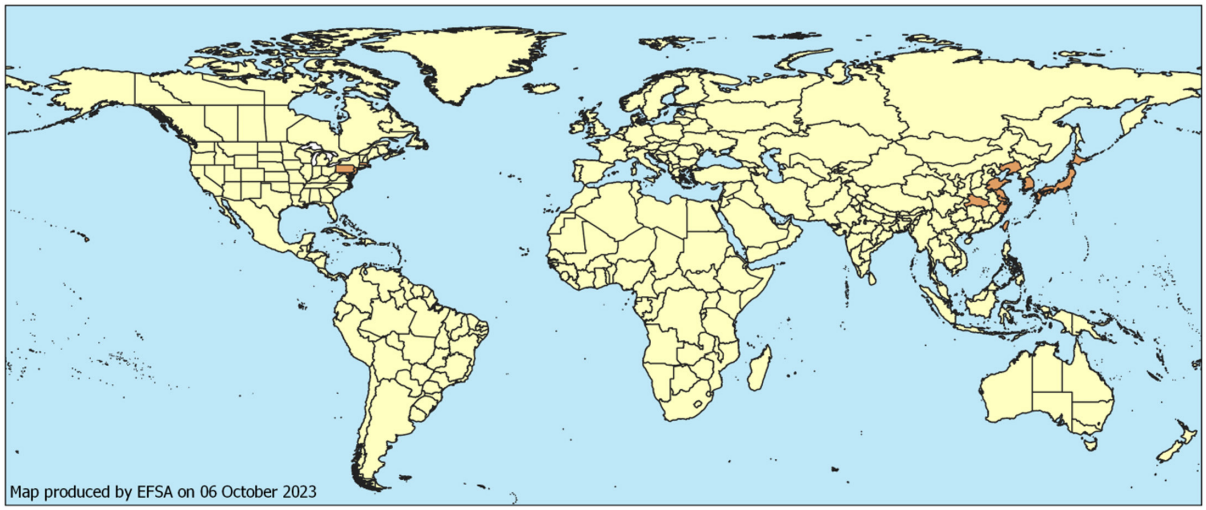

FIGURE 4 Global distribution of *Lepidosaphes pini* (Source: Literature; for details see Appendix B).

3.2.2 | Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest in a limited part of the EU or is it scarce, irregular, isolated or present infrequently? If so, the pest is considered to be not widely distributed.

No, *L. pineti, L. pini* and *L. piniphila* are not known to be present in the EU territory.

3.3 | Regulatory status

3.3.1 | Commission implementing regulation 2019/2072

L. pineti, L. pini and *L. piniphila* are not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072, an implementing act of Regulation (EU) 2016/2031, or in any emergency plant health legislation.

3.3.2 | Hosts or species affected that are prohibited from entering the union from third countries

As specified in Annex VI of Implementing Regulation 2019/2072, some plants which are also host plants for *L. pineti, L. pini* and *L. piniphila* (see Appendix A) are prohibited from entering the EU e.g. as plants for planting. Information on which plants are prohibited are shown in Table 2.

TABLE 2 List of plants, plant products and other objects that are *L. pineti, L. pini* and *L. piniphila* hosts whose introduction into the Union from certain third countries is prohibited (Source: Commission Implementing Regulation (EU) 2019/2072, Annex VI).

List of plants, plant products and other objects whose introduction into the union from certain third countries is prohibited			
	Description	CN code	Third country, group of third countries or specific area of third country
1.	Plants of *Abies* Mill., […], *Pinus* L., […], other than fruit and seeds	ex 0602 20 20 ex 0602 20 80 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 ex 0602 90 47 ex 0602 90 50 ex 0602 90 70 ex 0602 90 99 ex 0604 20 20 ex 0604 20 40	Third countries other than Albania, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Faeroe Islands, Georgia, Iceland, Liechtenstein, Moldova, Monaco, Montenegro, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo- Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Turkey, Ukraine and the United Kingdom

3.4 | Entry, establishment and spread in the EU

3.4.1 | Entry

Is the pest able to enter into the EU territory? If yes, identify and list the pathways.

Yes, all three *Lepidosaphes* species can enter the EU territory with plants for planting and cut branches with foliage.

Comment on plants for planting as a pathway.

Plants for planting are the main pathway for all three pest species to enter the EU (Table 3).

Table 3 lists potential pathways into the EU.

TABLE 3 Potential pathways for *L. pineti, L. pini* and *L. piniphila* into the EU.

Pathways (e.g. host/ intended use/source)	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI), special requirements (Annex VII) or phytosanitary certificates (Annex XI) within Implementing Regulation 2019/2072]
Plants for planting	Eggs, nymphs and adults	Some plants for planting that are hosts of *L. pineti, L. pini* and *L. piniphila* and are prohibited to import from third countries (Regulation 2019/2072, Annex VI). Details are in Table 2. Plants for planting from third countries require a phytosanitary certificate to be imported into the EU (Regulation 2019/2072, Annex XI, Part A).
Cut branches with foliage	Eggs, nymphs and adults	Annex VI prohibition

Host genera that are not prohibited from entering the EU include *Cunninghamia, Cycas, Podocarpus* and *Torreya*.

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in May 1994 and in TRACES in May 2020. As at 24 August 2024, there were no records of interception of *L. pineti, L. pini and L. piniphila* in the Europhyt and TRACES databases.

L. pini has been found at a commercial nursery in the UK on a bonsai Japanese white pine (*Pinus parviflora* var. *pentaphylla*) imported from Japan in June 1986 (Malumphy et al., 2012).

3.4.2 | Establishment

Is the pest able to become established in the EU territory?

Yes, the climate in EU countries and throughout most of Europe is suitable and there are many potential *Pinus* hosts that can support establishment.

Climatic mapping is the principal method for identifying areas that could provide suitable conditions for the establishment of a pest taking key abiotic factors into account (Baker, 2002). Availability of hosts is considered in Section 3.4.2.1. Climatic factors are considered in Section 3.4.2.2.

3.4.2.1 | *EU distribution of main host plants*

The main host plants of *L. pineti, L. pini* and *L. piniphila* are *Pinus* spp., including several important forestry and ornamental trees, and pines are commonly found throughout the EU territory. However, it is not known if the *Pinus* species commonly found in Europe, such as black pine (*Pinus nigra*), maritime pine (*P. pinaster*) and Scots pine (*P. sylvestris*), are suitable hosts for any of the three *Lepidosaphes* spp. discussed here.

L. pini has been introduced to North America where it is recorded on longleaf pine (*Pinus palustris*), a pine species native to the Southeastern United States. In China, *L. pineti* is a pest of *P. elliottii* and *P. taeda*, species native to North America. Therefore, there is the potential for all three *Lepidosaphes* spp. to expand their host range to include native European pines.

3.4.2.2 | *Climatic conditions affecting establishment*

The global Köppen–Geiger climate zones (Kottek et al., 2006) describe terrestrial climate in terms of average minimum winter temperatures and summer maxima, amount of precipitation and seasonality (rainfall pattern). *L. pineti, L. pini* and *L. piniphila* occur in temperate regions of Asia and all occur in climate types Cfa and Cfb (Figures 5–7). This indicates that all these species would be able to establish over most of the EU territory, with the exception of major areas in the south.

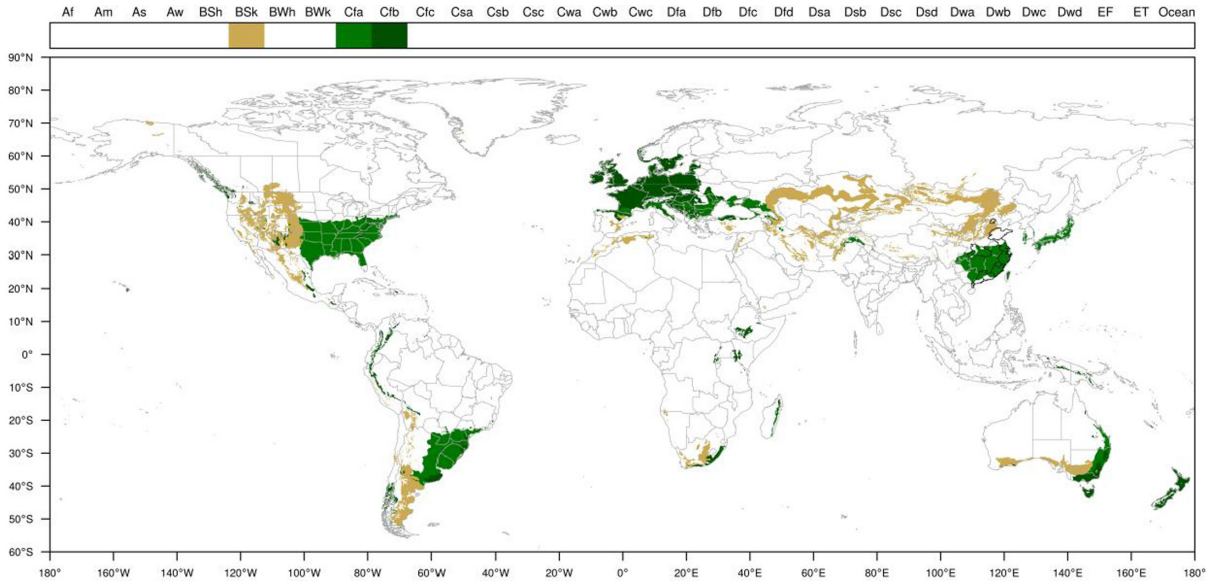

FIGURE 5 Distribution of Köppen–Geiger climate types that occur in the EU and in areas where *Lepidosaphes pineti* has been reported.

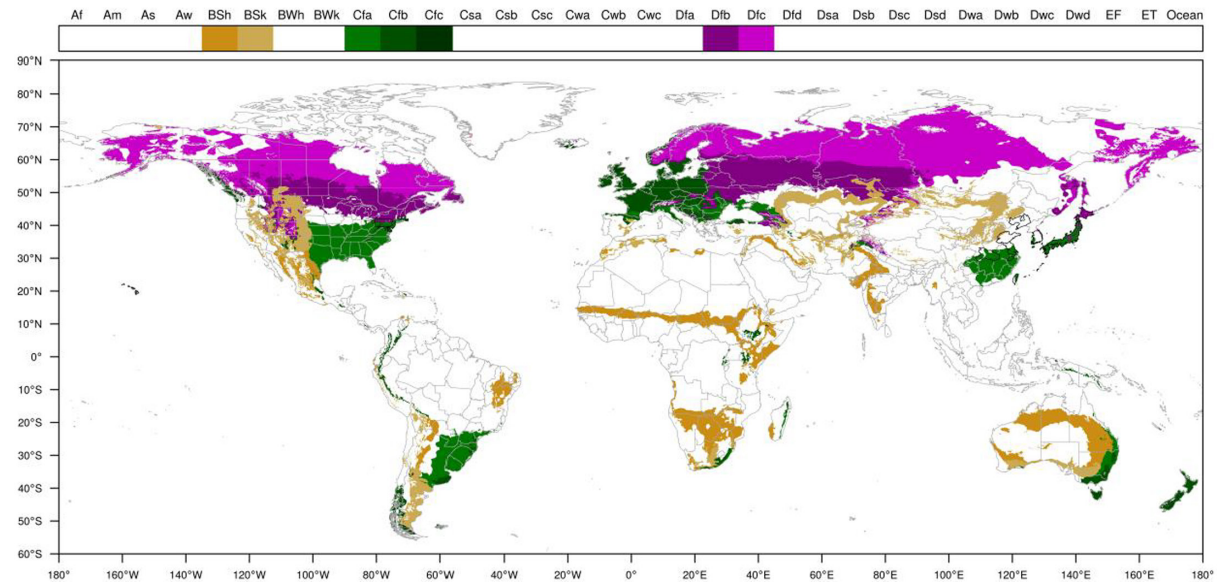

FIGURE 6 Distribution of Köppen–Geiger climate types that occur in the EU and in areas where *Lepidosaphes pini* has been reported.

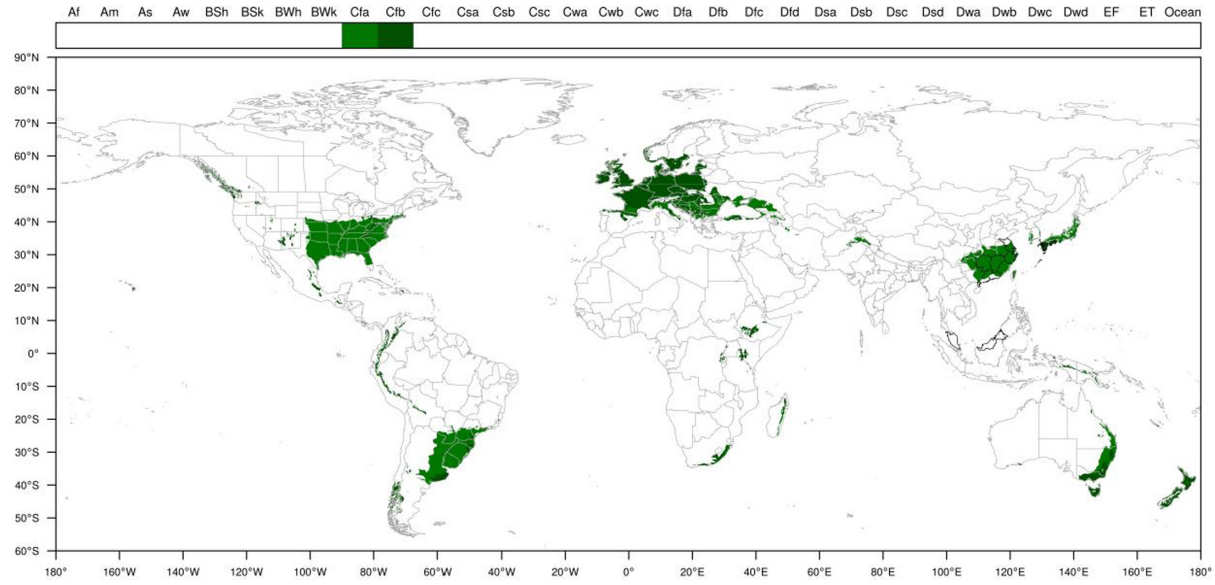

FIGURE 7 Distribution of Köppen–Geiger climate types that occur in the EU and in areas where *Lepidosaphes piniphila* has been reported.

3.4.3 | Spread

Describe how the pest would be able to spread within the EU territory following establishment?

Natural spread by first instars crawling or being carried by wind, other animals, or machinery, will occur locally and relatively slowly. All stages may be moved over long distances in trade of infested plant materials.

Comment on plants for planting as a mechanism of spread.

Plants for planting provide the main spread mechanism for *Lepidosaphes* spp. over long distances.

The three *Lepidosaphes* spp. are able to spread naturally by the crawlers which is the mobile stage of the insect. However, natural dispersal is likely to be slow. The same applies to passive spread on animals, clothes and machinery. The main pathway of spread over long distances is with trade of infested plants for planting.

3.5 | Impacts

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

Yes, if *L. pini* and *L. pineti* established in the EU, it is likely that they would have an economic and environmental impact on *Pinus* spp. in some areas. There is no evidence regarding the impact of *L. piniphila*, as it is not recorded as a pest.

L. pineti is a serious pest of pine in China, mainly harming *P. elliottii*, *P. massoniana*, *P. taeda* and *P. thunbergii* (Song, 2002; Wu, 2009). Song (2002) specifically mentions it being a pest in cities, where the trees may be stressed and therefore more susceptible. *L. pini* is also a pest of pines in China (Wu, 2009), and an occasional minor pest of *P. thunbergii* along the New Jersey coast, USA (Stimmel, 1994).

There are no published reports of *L. piniphila* as a pest in China (San-An Wu, personal communication in email, 23 August 2023). However, Tang (1986) suggested that *L. piniphila* and *L. pitysophila* may be the same species, and Wu (2009) recorded *L. pitysophila* as a pest of pines in China.

No impact has been recorded on the non-*Pinus* host plants.

3.6 | Available measures and their limitations

Are there measures available to prevent pest entry, establishment, spread or impacts such that the risk becomes mitigated?

Yes, although the existing phytosanitary measures identified in Section 3.3.2 do not specifically target *L. pineti*, *L. pini* or *L. piniphila*, they mitigate the likelihood of their entry into, establishment and spread within, the EU (see also Section 3.6.1).

3.6.1 | Identification of potential additional measures

Phytosanitary measures (prohibitions) are currently applied to some host plants for planting (see Section 3.3.2).

Additional potential risk reduction options and supporting measures are shown in Sections 3.6.1.1 and 3.6.1.2.

3.6.1.1 | *Additional potential risk reduction options*

Potential additional control measures are listed in Table 4.

TABLE 4 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.

Control measure/risk reduction option (blue underline = Zenodo doc, Blue = WIP)	RRO summary	Risk element targeted (entry/establishment/spread/impact)
Require pest freedom	Pest free place of production (e.g. place of production and its immediate vicinity is free from pest over an appropriate time period, e.g. since the beginning of the last complete cycle of vegetation, or past 2 or 3 cycles). Pest-free production site.	Entry/Spread
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
Roguing and pruning	Roguing is defined as the removal of infested plants and/or uninfested host plants in a delimited area, whereas pruning is defined as the removal of infested plant parts only without affecting the viability of the plant. Roguing (removal of infested plants) and pruning (removal of infested plant parts only without affecting the viability of the plant) can reduce the population density of the pest.	Entry/Spread/Impact
Biological control and behavioural manipulation	Pest control such as biological control. There are many parasitoid chalcid wasps recorded attacking *Lepidosaphes* species on *Pinus* in Europe and it may be possible to use these for the biological control of exotic *Lepidosaphes* species (Kosztarab & Kozar, 1988)	Spread/Impact
Chemical treatments on crops including reproductive material	Used to mitigate likelihood of infestation of pests susceptible to chemical treatments. The effectiveness of insecticide applications against Diaspididae may be reduced by the protective waxy cover of the adult female. Song (2002) reported that methidathion and fenvalerate were effective for control.	Entry/Establishment/Spread/Impact

3.6.1.2 | *Additional supporting measures*

Potential additional supporting measures are listed in Table 5.

TABLE 5 Selected supporting measures (a full list is available in EFSA PLH Panel, 2018) in relation to currently unregulated hosts and pathways. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk reduction options that do not directly affect pest abundance.

Supporting measure (blue underline = Zenodo doc, Blue = WIP)	Summary	Risk element targeted (entry/establishment/spread/impact)
Inspection and trapping	According to ISPM 5 (FAO, 2023), inspection is defined as the official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations. The effectiveness of sampling and subsequent inspection to detect pests may be enhanced by including trapping and luring techniques.	Entry/Spread
Laboratory testing	Examination, other than visual, to determine if pests are present using official diagnostic protocols. Diagnostic protocols describe the minimum requirements for reliable diagnosis of regulated pests.	Entry/Spread
Sampling	According to ISPM 31 (FAO, 2008), it is usually not feasible to inspect entire consignments, so phytosanitary inspection is performed mainly on samples obtained from a consignment. It is noted that the sampling concepts presented in this standard may also apply to other phytosanitary procedures, notably selection of units for testing. For inspection, testing and/or surveillance purposes the sample may be taken according to a statistically based or a non-statistical sampling methodology.	Entry
Phytosanitary certificate and plant passport	According to ISPM 5 (FAO, 2023), a phytosanitary certificate and a plant passport are official paper documents or their official electronic equivalents, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements: (a) Export certificate (import) (b) Plant passport (EU internal trade)	Entry/Spread
Certified and approved premises	Mandatory/voluntary certification/approval of premises is a process including a set of procedures and of actions implemented by producers, conditioners and traders contributing to ensure the phytosanitary compliance of consignments. It can be a part of a larger system maintained by the NPPO in order to guarantee the fulfilment of plant health requirements of plants and plant products intended for trade. Key property of certified or approved premises is the traceability of activities and tasks (and their components) inherent the pursued phytosanitary objective. Traceability aims to provide access to all trustful pieces of information that may help to prove the compliance of consignments with phytosanitary requirements of importing countries.	Entry/Spread
Certification of reproductive material (voluntary/official)	Plants come from within an approved propagation scheme and are certified pest free (level of infestation) following testing; Used to mitigate against pests that are included in a certification scheme.	Entry/Spread
Surveillance	Surveillance to guarantee that plants and produce originate from a pest-free area could be an option.	Spread

3.6.1.3 | *Biological or technical factors limiting the effectiveness of measures*

- Plants can be asymptomatic when infestation is low.
- All life stages are small and cannot easily be detected.
- Crawlers can easily spread via air currents, birds and mammals; sessile stages can be transported with plants for planting.

3.7 | Uncertainty

The main source of uncertainty is whether *L. pitysophila*, a pest of pine in China, is distinct or not from *L. piniphila*, which is not recorded as a pest.

There is also uncertainty regarding the magnitude of potential impact within the EU; however, there is no doubts about the occurrence of an impact by *L. pineti* and *L. pini*. Therefore, this is not a key uncertainty likely to change the conclusion.

4 | CONCLUSIONS

L. pineti and *L. pini* both satisfy all the criteria that are within the remit of EFSA to assess for them to be regarded as potential Union quarantine pests.

L. piniphila does not satisfy all the criteria; there is no evidence to suggest that it would cause impact in the EU (Table 6).

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	Key uncertainties
Identity of the pest (Section 3.1)	The identities of the pests are established, and *Lepidosaphes pineti* Borchsenius, *Lepidosaphes pini* (Maskell) and *Lepidosaphes piniphila* Borchsenius are the accepted names. There is, however, uncertainty regarding whether *Lepidosaphes pitysophila* (Takagi), a pest of pine in China, is distinct or not from *L. piniphila*.	Are *L. pitysophila* (a known pest) and *L. piniphila* (not recognised as a pest) the same species?
Absence/presence of the pest in the EU (Section 3.2)	None of the three *Lepidosaphes* species are known to be present in the EU territory	None
Pest potential for entry, establishment and spread in the EU (Section 3.4)	All three species are able to enter into, become established and spread within the EU territory. The main pathway is plants for planting.	None
Potential for consequences in the EU (Section 3.5)	The introduction of *L. pineti* and *L. pini* could result in damage to forest and ornamental pine trees.	None
Available measures (Section 3.6)	There are measures available to prevent entry, establishment and spread of the three Lepidosaphes species within the EU. Risk reduction options include inspections, and chemical treatments on plant material from infested countries and the production of plants for import in the EU in pest free areas.	None
Conclusion (Section 4)	*L. pineti* and *L. pini* both satisfy all the criteria that are within the remit of EFSA to assess for them to be regarded as potential Union quarantine pests. *L. piniphila* does not satisfy all the criteria; there is no evidence to suggest that it would cause impact in the EU.	Are *L. pitysophila* (a known pest) and *L. piniphila* (not recognised as a pest) the same species?
Aspects of assessment to focus on/scenarios to address in future if appropriate	It would be good to clarify if *L. pitysophila and L. piniphila* are the same species, and the whole *Lepidosaphes* genus is in need of revision.	

ABBREVIATIONS

EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
MS	Member State
PLH	EFSA Panel on Plant Health
PZ	Protected Zone
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, 2023)
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 2023)
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, 2023)
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2023)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2023)
Greenhouse	A walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products (PPPs) into the environment.
Hitchhiker	An organism sheltering or transported accidentally via inanimate pathways including with machinery, shipping containers and vehicles; such organisms are also known as contaminating pests or stowaways (Toy & Newfield, 2010).
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, 2023)
Pathway	Any means that allows the entry or spread of a pest (FAO, 2023)
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, 2023)

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, 2023)
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, 2023)

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CONFLICT OF INTEREST

If you wish to access the declaration of interests of any expert contributing to an EFSA scientific assessment, please contact interestmanagement@efsa.europa.eu.

REQUESTOR

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QUESTION NUMBERS

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APPENDIX A

Lepidosaphes pineti, L. pini and L. piniphila host plants/species affected

Source: literature

Lepidosaphes pineti

Host name	Plant family	Common name	Reference
Pinus	Pinaceae	Pine	García Morales et al. (2016)
Pinus elliottii	Pinaceae	Slash pine	Song (2002)
Pinus massoniana	Pinaceae	Masson pine or Chinese red pine	García Morales et al. (2016)
Pinus taeda	Pinaceae	Loblolly pine	Song (2002)
Pinus thunbergii	Pinaceae	Japanese black pine	Song (2002)
Torreya grandis	Taxaceae	Nutmeg yew	San-An Wu, personal communication (2023)

Lepidosaphes pini

Host name	Plant family	Common name	Reference
Abies	Pinaceae	Fir	García Morales et al. (2016)
Cunninghamia lanceolata	Cupressaceae	Chinese fir	García Morales et al. (2016)
Cycas	Cycadaceae	Cycad	García Morales et al. (2016)
Cycas revoluta	Cycadaceae	Sago palm	García Morales et al. (2016)
Pinus	Pinaceae	Pine	García Morales et al. (2016)
Pinus densiflora	Pinaceae	Japanese red pine	García Morales et al. (2016)
Pinus luchuensis	Pinaceae	Luchu pine	García Morales et al. (2016)
Pinus palustris	Pinaceae	Longleaf pine	García Morales et al. (2016)
Pinus parviflora var. *pentaphylla*	Pinaceae	Japanese white pine	Malumphy et al. (2012)
Pinus thunbergii	Pinaceae	Japanese black pine	García Morales et al. (2016)
Podocarpus	Podocarpaceae	Plum pine	García Morales et al. (2016)
Podocarpus macrophyllus	Podocarpaceae	Yew plum pine	García Morales et al. (2016)
Taxus	Taxaceae	Yew	García Morales et al. (2016)
Torreya	Taxaceae	Nutmeg yew	García Morales et al. (2016)

Lepidosaphes piniphila

Host name	Plant family	Common name	Reference
Pinus	Pinaceae	Pine	García Morales et al. (2016)
Pinus massoniana	Pinaceae	Chinese red pine	García Morales et al. (2016)
Pinus thunbergii	Pinaceae	Japanese black pine	García Morales et al. (2016)
Podocarpus	Podocarpaceae	Plum pine	García Morales et al. (2016)
Podocarpus macrophyllus	Podocarpaceae	Yew plum pine	García Morales et al. (2016)
Podocarpus nakaii	Podocarpaceae	Nakai yellowwood	García Morales et al. (2016)
Torreya grandis	Taxaceae	Chinee nutmeg yew	San-An Wu, personal communication (2023)

APPENDIX B

Distribution of *Lepidosaphes pineti, L. pini* and *L. piniphila*

Distribution records are based on the indicated sources.

Lepidosaphes pineti

Region	Country	Sub-national (e.g. state)	Status
Asia	China		García Morales et al. (2016)
	China	Beijing	García Morales et al. (2016)
	China	Fujian	Song (2002)
	China	Guangdong	García Morales et al. (2016)
	China	Hubei	García Morales et al. (2016)
	China	Jiangsu	Song (2002)
	China	Shandong	García Morales et al. (2016)
	China	Zhejiang	García Morales et al. (2016)

Lepidosaphes pini

Region	Country	Sub-national (e.g. state)	Status
North America	USA		García Morales et al. (2016)
	USA	Maryland	García Morales et al. (2016)
	USA	Massachusetts	García Morales et al. (2016)
	USA	New Jersey	García Morales et al. (2016)
	USA	Pennsylvania	García Morales et al. (2016)
Asia	Japan		García Morales et al. (2016)
	Japan	Hokkaido	García Morales et al. (2016)
	Japan	Honshu	García Morales et al. (2016)
	Japan	Kyushu	García Morales et al. (2016)
	Japan	Ogasawara or Bonin Islands	García Morales et al. (2016)
	Japan	Ryukyu Islands	Murakami (1970)
	Japan	Shikoku	García Morales et al. (2016)
	China		García Morales et al. (2016)
	China	Hubei	García Morales et al. (2016)
	China	Jiangsu	García Morales et al. (2016)
	China	Liaoning	García Morales et al. (2016)
	China	Shandong	García Morales et al. (2016)
	South Korea		García Morales et al. (2016)
	Taiwan		García Morales et al. (2016)
Oceania	USA	Hawaii	García Morales et al. (2016)

Lepidosaphes piniphila

Region	Country	Sub-national (e.g. state)	Status
Asia	China		García Morales et al. (2016)
	China	Guangdong	García Morales et al. (2016)
	China	Hunan	García Morales et al. (2016)
	China	Jiangsu	García Morales et al. (2016)
	China	Jiangxi	García Morales et al. (2016)
	China	Zhejiang	San-An Wu, personal communication (2023)
	Japan		García Morales et al. (2016)
	Japan	Kyushu	García Morales et al. (2016)
	Japan	Shikoku	García Morales et al. (2016)
	Malaysia		García Morales et al. (2016)