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SCIENTIFIC OPINION

Pest categorisation of *Shirahoshizo flavonotatus*

EFSA Panel on Plant Health (PLH) | Claude Bragard | Paula Baptista | Elisavet Chatzivassiliou | Francesco Di Serio | Paolo Gonthier | Josep Anton Jaques Miret | Annemarie Fejer Justesen | Christer Sven Magnusson | Panagiotis Milonas | Juan A. Navas-Cortes | Stephen Parnell | Roel Potting | Philippe Lucien Reignault | Emilio Stefani | Hans-Hermann Thulke | Wopke Van der Werf | Antonio Vicent Civera | Jonathan Yuen | Lucia Zappalà | Jean-Claude Grégoire | Chris Malumphy | Alex Gobbi | Virag Kertesz | Andrea Maiorano | Oresteia Sfyra | Alan MacLeod

Correspondence: plants@efsa.europa.eu

Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Shirahoshizo patruelis* (Voss, 1937) (Coleoptera: Curculionidae), following the commodity risk assessment of bonsai plants from China consisting of *Pinus parviflora* grafted on *P. thunbergii*, in which *S. patruelis* was identified as a pest of possible concern to the European Union (EU). This categorisation refers to *S. flavonotatus*, which is the pest's current valid scientific name. It is native to China and has never been recorded in the EU. It completes from 2 to 3 generations per year. Eggs are laid in cracks and crevices of trunks and branches with bark thickness of approximately 0.6–1.2 cm. The pest overwinters as an adult or as a mature larva under the bark. Plants for planting, wood with bark and wood products provide pathways for entry. Although the weevil has been reported to carry the nematode *Bursaphelenchus xylophilus,* it is not considered a vector. Climatic conditions and availability of host plants in some EU countries would allow *S. flavonotatus* to establish and spread. Impact on *Pinus* spp. is anticipated. Recognising that the weevil is reported to attack both weakened and healthy trees, there is uncertainty on the magnitude of impact. Its recorded capacity to attack non-Asian *Pinus* species also indicates its ability to adapt and expand the range of trees it can utilise as hosts, which could include European *Pinus* species. Phytosanitary measures are available to reduce the likelihood of entry and spread. *S. flavonotatus* meets the criteria that are within the remit of EFSA to assess for this species to be regarded as a potential Union quarantine pest.

KEYWORDS

pest risk, *Pinus*, plant health, plant pest, quarantine, weevil

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

Shirahoshizo flavonotatus is one of a number of pests relevant to Annex 1C of the Terms of Reference (ToR) to be subject to pest categorisation to determine whether it fulfils the criteria of a potential Union quarantine pest (QP) 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 QP, 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 on *P. thunbergii* performed by EFSA (EFSA PLH Panel, 2022). Information provided by China for the assessment referred to *S. patruelis*, whose current valid name is *S. flavonotatus*. This species was identified as a relevant non-regulated EU pest which could potentially enter the EU on bonsai plants.

2 | DATA AND METHODOLOGIES

2.1 | Data

2.1.1 | Literature search

A literature search on *S. flavonotatus* 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

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 *S. flavonotatus* which could be used as a 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 *S. flavonotatus*, 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 et al., 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 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 et al., 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. Whilst 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 identity of the pest is established and ***Shirahoshizo flavonotatus*** (Voss) is the accepted name.

Shirahoshizo flavonotatus (Voss, 1937) is an insect within the order Coleoptera, family Curculionidae, subfamily Cryptorhynchinae. Voss (1937) described *Cryptorhynchidius flavonotatus* and *C. patruelis* as two different species. Morimoto (1962) described the new genus *Shirahoshizo* to include some species, already previously grouped under *Cryptorhynchus* or *Cryptorhynchidius*, including the two species described by Voss. The synonymy between *S. patruelis* and *S. flavonotatus* was established by Chen (1991) and *S. flavonotatus* is the current valid name for this weevil (Alonso-Zarazaga et al., 2017; Chen, 1991).

The EPPO code[1] (EPPO, 2019; Griessinger & Roy, 2015) for this species is: SHIRPA (EPPO, online).

3.1.2 | Biology of the pest

Very little information is available on the biological traits of this species; however, some elements can be extrapolated from the studies carried out by Yoshikawa (1977, 1981, 1983) and Yoshikawa et al. (1986) on three congenerics: *Shirahoshizo insidiosus*, *S. pini* and *S. rufescens* in Japan. *Shirahoshizo* is a genus of weevils belonging to the tribe Cryptorhynchini, including 18 species, all distributed in Asia (China, Korea and Japan) (Alonso-Zarazaga et al., 2017), many of which feed on conifers, mostly *Pinus* spp. *Shirahoshizo* spp., similarly to *Pissodes* spp. (Coleoptera: Curculionidae), develop under the bark of weakened trees at the larval stage (Hagihara & Nakashima, 1970). However, Cui et al. (2008) and Chen et al. (2013) report *S. flavonotatus* attacking healthy trees. No information is available on the adult feeding habits. *Pissodes* and *Shirahoshizo* frequently attack the same trees, but they have different preferences for bark thickness, as *Shirahoshizo* attack the thickest bark (from 0.58 to 1.22 cm, as seen in bait logs) preferably along the trunk and near the ground, laying their eggs in cracks and crevices; for this reason, they do not oviposit on the top part where the bark is too thin (Yoshikawa, 1977, 1981, 1983). Furthermore, *Shirahoshizo* also need larger subcortical areas than *Pissodes* for larval development and the formation of pupal cells, which are dispersed and isolated (Yoshikawa, 1977). *S. flavonotatus* has four development stages: egg, larva (six instars), pupa, adult, and completes 2 to 3 generations/year, overwintering as an adult in the case of two generations and as a mature larva in the case of three generations (Chen et al., 2013). Flight distance of the adults of the *Shirahoshizo* species studied by Yoshikawa (1983) has been estimated to be about 50 m from release-recapture experiments. Adults

[1]An EPPO code, formerly known as a Bayer code, is a unique identifier linked to the name of a plant or plant pest important in agriculture and plant protection. Codes are based on genus and species names. However, if a scientific name is changed the EPPO code remains the same. This provides a harmonised system to facilitate the management of plant and pest names in computerised databases, as well as data exchange between IT systems (EPPO, 2019; Griessinger & Roy, 2015).

are nocturnal. In Japan, three flight peaks were observed, (i) in early spring (overwintering adults), (ii) after the rainy season (June to mid-July) (adults developed from overwintering larvae) and (iii) in early autumn (new adults) (Hagihara & Nakashima, 1970).

S. flavonotatus has also been reported as able to carry the pine wood nematode (PWN) *Bursaphelenchus xylophilus* (Steiner & Bührer) Nickle (Chen et al., 2013; Cui et al., 2008), although, no *B. xylophilus* was isolated from *S. flavonotatus* collected on PWN infested trees (Chu et al., 2021).

According to Linit (1988), the nematode is transmitted almost exclusively by cerambycid beetles in the genus *Monochamus*. Other families of beetles have been shown to carry PWN, but none has been shown to transmit it (Akbulut & Stamps, 2011; Kobayashi et al., 1984; Linit et al., 1983).

3.1.3 | Host range/species affected

The hosts of *S. flavonotatus* include *Pinus massoniana* Lamb., *P. taiwanensis* Hayata, *P. thunbergii* Parl., *P. armandii* Franch., *P. elliottii* Engelm., *P. taeda* L., *P. kesiya* var. *langbianensis* (Chen et al., 2013; Duan et al., 2007).

3.1.4 | Intraspecific diversity

No intraspecific diversity is known.

3.1.5 | Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, detection is possible, and a morphological description of the adult is available to allow identification. No specific molecular ID method has been developed yet.

Detection

S. flavonotatus larvae tunnel into the bark of the host's trunks and branches. *Shirahoshizo* spp. colonise the thickest bark (bark thickness in bait logs from 0.58 to 1.22 cm) preferably along the stem and near the ground, laying their eggs in crevices; for this reason, they do not oviposit, and the larvae do not develop on the top part of the trees where the bark is too thin (EFSA PLH Panel, 2022).

Traps, with attractive substances, including terpenes, acetaldehyde and acetone as the main components, are available to catch adults (Lianqin et al., 1992; Zhou et al., 2013), besides, bait logs can also be used (Yoshikawa, 1977, 1981, 1983).

Symptoms

Little specific information on symptoms caused by *S. flavonotatus* is available. Due to the feeding activity of larvae into the bark of the host trunks and branches, the flow of sap may be affected, leading in case of high infestation to withering and death of the host.

These symptoms are similar to those caused by other weevils (e.g. *Pissodes* spp.) and cannot be considered as diagnostic. However, although *Pissodes* and *Shirahoshizo* frequently attack the same trees, they have different preferences for bark thickness (see Section 3.1.2 above).

Identification

Detailed adult morphological description of *S. flavonotatus* is available (Hong et al., 2011). No specific protocol has been developed for molecular identification, and only one DNA sequence is available in GenBank (COX1 gene).

Description

No data are available for juveniles.

Adult—6.2 mm long (excl. rostrum). Body black with rostrum and antennae reddish brown. Elytra with a long spot before the middle and one behind the middle. Underside of body and partially on femora with brownish grey scales (Hong et al., 2011).

3.2 | Pest distribution

3.2.1 | Pest distribution outside the EU

S. flavonotatus is present in China (Fujian, Guandong, Guizhou, Guangxi, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Shaanxi, Shandong, Shanghai, Yunnan and Zhejiang), Japan, Taiwan and Korea (e.g. Gangwon-do) (Figure 1) (Alonso-Zarazaga et al., 2017; EFSA PLH Panel, 2022; Hong et al., 2011; Schoch et al., 2020).

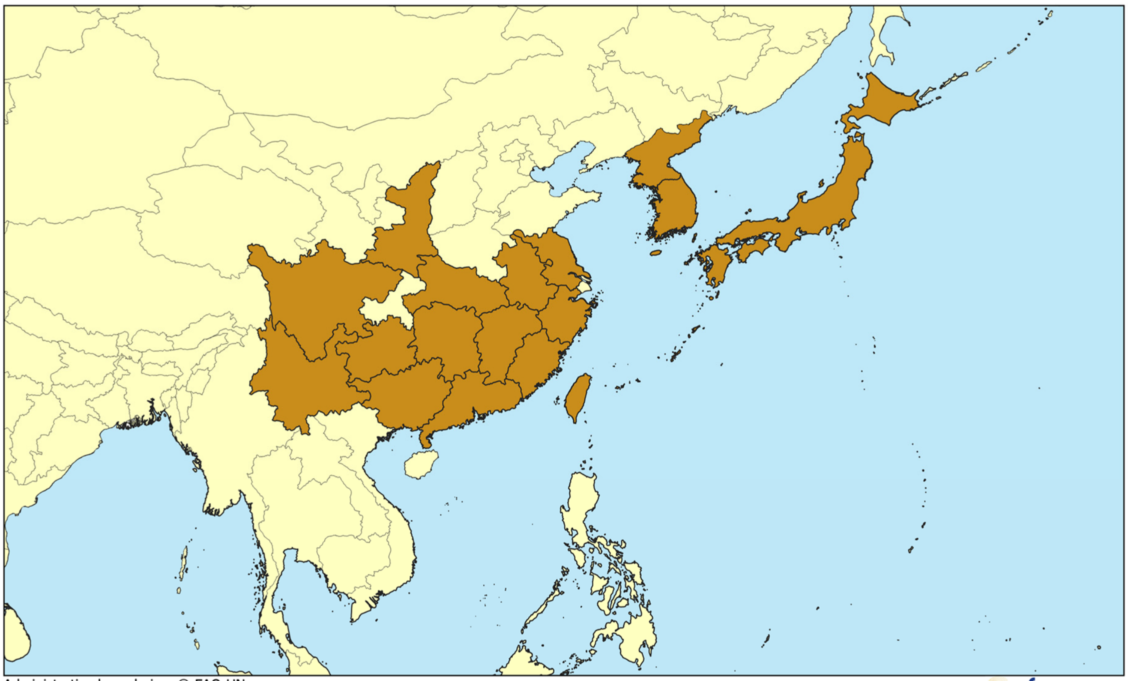

FIGURE 1 Global distribution of *Shirahoshizo flavonotatus* (*Source*: literature; for details see Appendix B).

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, *Shirahoshizo flavonotatus* is not known to be present in the EU territory.

3.3 | Regulatory status

3.3.1 | Commission Implementing Regulation 2019/2072

S. flavonotatus is 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

According to the Commission Implementing Regulation (EU) 2019/2072, Annex VI, introduction of plants of *Pinus*, host of *S. flavonotatus*, in the Union from certain third countries is prohibited (Table 2).

TABLE 2 List of plants, plant products and other objects that are *Shirahoshizo flavonotatus* 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 […] *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, Türkiye, Ukraine and the United Kingdom

3.3.3 | Legislation addressing the organisms vectored by *S. flavonotatus* (Commission Implementing Regulation 2019/2072)

S. flavonotatus has been reported by Cui et al. (2008) and Chen et al. (2013) to carry *B. xylophilus*, which is listed in Annex II, part B of the Commission Implementing Regulation 2019/2072. However, *S. flavonotatus* is not known to vector *B. xylophilus*.

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, *S. flavonotatus* could enter the EU territory. Possible pathways of entry are plants for planting, cut branches, solid wood packaging and wood with bark.

Comment on plants for planting as a pathway.

The pest could enter the EU territory with plants for planting. Although *Pinus* spp. from third countries where *S. flavonotatus* is present are prohibited (Table 2), potential derogations might occur, e.g., from Japan (Commission Implementing regulation (EU) 2020/1217).

Potential pathways for *S. flavonotatus* are presented in Table 3.

There is an uncertainty about the listed commodities being pathway for *S. flavonotatus* because of the thickness of the bark required for oviposition and pupation (see Section 3.1.2).

TABLE 3 Potential pathways for *Shirahoshizo flavonotatus* into the EU 27.

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, larvae, pupae, adults	A list of plants for planting that are hosts of *S. flavonotatus* are prohibited to import from third countries (Regulation 2019/2072, Annex VI), is reported in Table 2
Solid wood packaging material	Eggs, larvae, pupae, adults	ISPM 15; Implementing Regulation 2019/2072
Woody host plants for planting (excluding seeds)	Eggs, larvae, pupae, adults	EU 2018/2019 (High risk plants prohibition), phytosanitary certificate
Cut branches	Eggs, larvae, pupae, adults	Implementing Regulation 2019/2072, Annex XI, part A
Round wood with bark	Eggs, larvae, pupae, adults	Implementing Regulation 2019/2072, Annex VII, e.g. points 76, 79 and 80

A commodity risk assessment for bonsai plants from China consisting of *Pinus parviflora* grafted on *P. thunbergii*, indicated with 95% certainty, that between 99.33% and 100% of imported plants would be free from *S. flavonotatus* (EFSA PLH Panel, 2022). No derogation for this commodity from China is in place, however a derogation exists for artificially dwarfed plants for planting of *Chamaecyparis*, *Juniperus* and certain species of *Pinus*, originating in Japan where the weevil is present.

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in May 1994 and in TRACES in May 2020. As at 19 March 2024, there were no records of interception of *S. flavonotatus* in the Europhyt and TRACES databases.

3.4.2 | Establishment

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

Yes. Following entry on plants for planting, *S. flavonotatus* could become established in the EU as the hosts are available and the climate is suitable.

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*

S. flavonotatus is an oligophagous species feeding on *Pinus* spp. The presence of the hosts in the EU is reported in Figure 2.

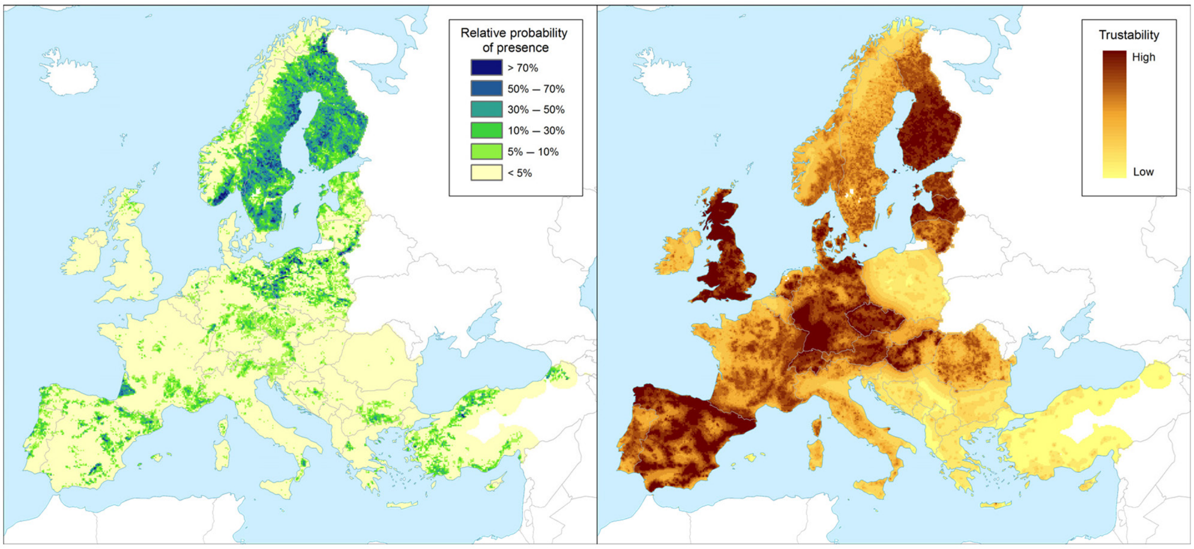

FIGURE 2 Left panel: Relative probability of the presence (RPP) of the genus *Pinus* in Europe, mapped at 100 km^2 resolution. The underlying data are from European-wide forest monitoring data sets and from national forestry inventories based on standard observation plots measuring in the order of hundreds 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 C (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 on methodology, see Appendix C).

3.4.2.2 | *Climatic conditions affecting establishment*

Some climate types (Kottek et al., 2006) that occur in the EU are also found in countries where *S. flavonotatus* occurs, for example Cfa (temperate, humid sub-tropical), Cfb (temperate oceanic climate or subtropical highland climate), Dfb (warm-summer, humid continental), Bsh (Hot semi-arid climate) and Bsk (cold arid climate) (Figure 3).

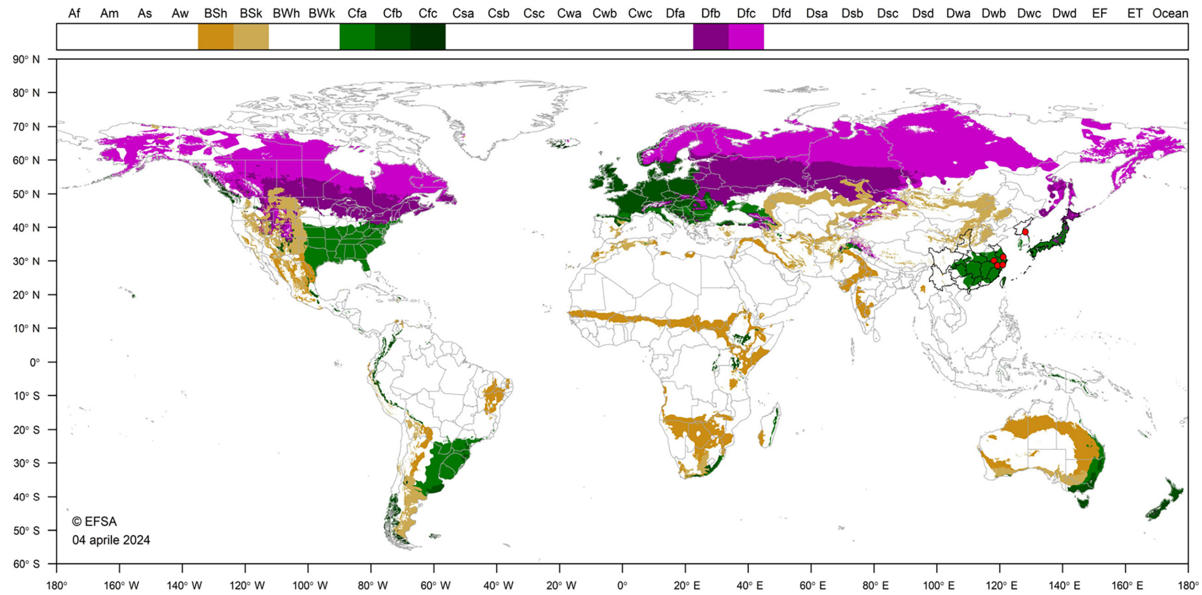

FIGURE 3 World distribution of 7 Köppen–Geiger climate types that occur in the EU and in countries where *Shirahoshizo flavonotatus* occurs.

3.4.3 | Spread

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

Natural spread by flying adults can occur. In addition, all stages can be moved over long distances via infested plant material, specifically plants for planting, and also wood with bark.

Comment on plants for planting as a mechanism of spread.

Plants for planting provide a main spread mechanism for *S. flavonotatus* over long distances.

Although no specific data on the flight distance of *S. flavonotatus* is available, in release and recapture experiments with log baits, species of the genus *Shirahoshizo* were seen to be able to fly up to 50 m (Yoshikawa, 1983).

3.5 | Impacts

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

Yes, if *S. flavonotatus* established in the EU, impact on *Pinus* spp. is anticipated. As the species is said to attack weakened trees, its impact on healthy trees could be limited.

The tunnels bored by *S. flavonotatus* larvae into the bark of the host's trunks and branches, forming irregular holes, may affect the flow of sap and the quality of the wood. In the case of heavy infestation, it may lead to the death of the tree (Chen et al., 2013), although Hagihara and Nakashima (1970) report the species to attack already weakened trees. No data are though available on impact on European *Pinus* species. Recognising that the weevil is reported to attack both weakened and healthy trees, there is uncertainty on the magnitude of impact. Its recorded capacity to attack non-Asian *Pinus* species also indicates its ability to adapt and expand the range of trees it can utilise as hosts, which could include European *Pinus* species. Besides, the weevil has also been reported as able to carry the pine wood nematode, *B. xylophilus*, although not being a vector of it (see Section 3.3.3).

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 *S. flavonotatus*, they mitigate the likelihood of its entry, 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 two or three cycles). Pest free production site	Entry/spread/impact
Growing plants in isolation	Some host plants (e.g. for the production of bonsai plants) could be grown in dedicated structures such as glass or plastic greenhouses with insect-proof screens, taking into consideration though that adults of *Shirahoshizo* species have strong mandibles, capable of gnawing the wood and could be able to pierce the net (EFSA PLH Panel, 2022)	Entry/spread/impact
Managed growing conditions	Used to mitigate likelihood of infestation at origin. Plants collected directly from natural habitats, have been grown, held and trained for at least two consecutive years prior to dispatch in officially registered nurseries, which are subject to an officially supervised control regime	Entry/spread
Use of resistant and tolerant plant species/varieties	Different *Pinus* species might have different susceptibility depending on their different resin flow (Yoshikawa, 1977)	Entry/establishment/impact
Roguing and pruning	By removing infested plants and infested plant parts it can reduce infestation	Entry/spread/impact
Biological control and behavioural manipulation	Pest control such as: a) Biological control Larval (*Spathius razayanus* Ratzeburg (Hymenoptera: Braconidae), *Rhopalicus tutela* Walker) (Pteromalidae) and pupal (*Dolichomitus* sp. (Ichneumonidae)) parasitoids as well as predators (*Temnochila japonica* Reitter (Coleoptera: Trogositidae)) were recorded as limiting factors for species belonging to the genus *Shirahoshizo* together with disease causal agents (Yoshikawa, 1977). No data are available for *S. flavonotatus* b) Mass trapping Traps, with attractive substances, such as terpenes, acetaldehyde and acetone as main components, are available to capture adults (Lianqin et al., 1992; Zhou et al., 2013), besides, bait logs can also be used to trap adults (Yoshikawa, 1977, 1981, 1983)	Entry/establishment/impact
Chemical treatments on crops including reproductive material	Spray of contact insecticides can kill adult beetles that are present on the plants at the time of spraying Uncertainties: – Insects are not killed when they are in egg and in larval stage – Insects cannot be reached by the insecticide when they are hidden in bark crevices	Entry/establishment/impact

TABLE 4 (Continued)

Control measure/risk reduction option (Blue underline = Zenodo doc, Blue = WIP)	RRO summary	Risk element targeted (entry/establishment/spread/impact)
Chemical treatments on consignments or during processing	Use of chemical compounds that may be applied to plants or to plant products after harvest, during process or packaging operations and storage The treatments addressed in this information sheet are: a) fumigation; b) spraying/dipping pesticides; c) surface disinfectants; d) process additives; e) protective compounds The measure is expected to have an effect although specific info for the pest is not available	Entry/spread
Physical treatments on consignments or during processing	This measure deals with the following categories of physical treatments: irradiation/ionisation; mechanical cleaning (brushing, washing); sorting and grading; and removal of plant parts (e.g. debarking wood). This information sheet does not address: heat and cold treatment (information sheet 1.14); roguing and pruning (information sheet 1.12) The measure is expected to have an effect although specific info for the pest is not available	Entry/spread
Heat and cold treatments	Controlled temperature treatments aimed to kill or inactivate pests without causing any unacceptable prejudice to the treated material itself, including: autoclaving; steam; hot water; hot air; cold treatment The measure is expected to have an effect although specific info for the pest is not available	Entry/spread
Controlled atmosphere	Treatment of plants by storage in a modified atmosphere (including modified humidity, O_2, CO_2, temperature, pressure) The measure is expected to have an effect although specific info for the pest is not available	Entry/spread (via commodity)
Post-entry quarantine and other restrictions of movement in the importing country	This measure covers post-entry quarantine (PEQ) of relevant commodities; temporal, spatial and end-use restrictions in the importing country for import of relevant commodities; Prohibition of import of relevant commodities into the domestic country 'Relevant commodities' are plants, plant parts and other materials that may carry pests, either as infection, infestation, or contamination	Establishment/spread

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	ISPM 5 (FAO, 2023) defines inspection 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	Establishment/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/establishment

(Continues)

TABLE 5 (Continued)

Supporting measure (Blue underline = Zenodo doc, Blue = WIP)	**Summary**	**Risk element targeted (entry/establishment/spread/impact)**
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/establishment
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/establishment
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/establishment
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/establishment/spread
Delimitation of Buffer zones	ISPM 5 (FAO, 2023) defines a buffer zone as 'an area surrounding or adjacent to an area officially delimited for phytosanitary purposes in order to minimize the probability of spread of the target pest into or out of the delimited area, and subject to phytosanitary or other control measures, if appropriate'. The objectives for delimiting a buffer zone can be to prevent spread from the outbreak area and to maintain a pest free production place (PFPP), site (PFPS) or area (PFA)	Spread
Surveillance	Surveillance to guarantee that plants and produce originate from a Pest Free Area could be an option	Entry/spread

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

- Eggs are laid in bark crevices and the larvae bore galleries under bark and are therefore hard to detect.
- Limited effectiveness of insecticides due to the hidden habits of the larvae.

3.7 | Uncertainty

There are no key uncertainties identified.

4 | CONCLUSIONS

S. flavonotatus satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest (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 identity of *S. flavonotatus* is established. Morphological description of adults is available	None
Absence/presence of the pest in the EU (Section 3.2)	*S. flavonotatus* is not known to occur in the EU	None
Pest potential for entry, establishment and spread in the EU (Section 3.4)	*S. flavonotatus* is able to enter, become established and spread within the EU territory. The main pathways are plants for planting, wood with bark and wood products	None
Potential for consequences in the EU (Section 3.5)	The introduction of the pest could cause damage to *Pinus* spp., especially to weakened trees, although no specific data for European *Pinus* species is available	None
Available measures (Section 3.6)	There are measures available to prevent entry, establishment and spread of *S. flavonotatus* in the EU. Risk reduction options include inspections, chemical and physical treatments on consignments of fresh plant material and wood, from infested countries and the production of plants for import in the EU in pest free areas	None
Conclusion (Section 4)	*S. flavonotatus* satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest	None
Aspects of assessment to focus on/scenarios to address in future if appropriate		

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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PANEL MEMBERS

Claude Bragard, Paula Baptista, Elisavet Chatzivassiliou, Francesco Di Serio, Paolo Gonthier, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod, Christer Sven Magnusson, Panagiotis Milonas, Juan A. Navas-Cortes, Stephen Parnell, Roel Potting, Philippe L. Reignault, Emilio Stefani, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen and Lucia Zappalà.

MAP DISCLAIMER

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APPENDIX A

Shirahoshizo flavonotatus host plants/species affected

Source: literature as indicated

Host status	Host name	Plant family	Common name	References
Cultivated hosts	*Pinus densiflora*	Pinaceae	Japanese red pine	EFSA PLH Panel (2022)
	Pinus elliottii	Pinaceae	American pitch pine	Cui et al. (2008)
	Pinus kesiya	Pinaceae	Benguet pine	EFSA PLH Panel (2022)
	Pinus massoniana	Pinaceae	Chinese pine	Cui et al. (2008)
	Pinus taiwanensis	Pinaceae	Taiwan red pine	Zhou et al. (2013)
	Pinus thunbergii	Pinaceae	Japanese black pine	EFSA PLH Panel (2022)

APPENDIX B

Distribution of *Shirahoshizo flavonotatus*

Distribution records based on literature.

Region	Country	Sub-national (e.g. state)	Status	References
Asia	China	Anhui	Present, no details	Zhao et al. (2002)
		Fujian	Present, no details	Alonso-Zarazaga et al. (2017)
		Guandong	Present, no details	Alonso-Zarazaga et al. (2017)
		Guizhou	Present, no details	Alonso-Zarazaga et al. (2017)
		Guangxi	Present, no details	Alonso-Zarazaga et al. (2017)
		Hubei	Present, no details	Alonso-Zarazaga et al. (2017)
		Hunan	Present, no details	Alonso-Zarazaga et al. (2017)
		Jiangsu	Present, no details	Alonso-Zarazaga et al. (2017)
		Jiangxi	Present, no details	Alonso-Zarazaga et al. (2017)
		Sichuan	Present, no details	Alonso-Zarazaga et al. (2017)
		Shaanxi	Present, no details	Alonso-Zarazaga et al. (2017)
		Shanghai	Present, no details	Alonso-Zarazaga et al. (2017)
		Yunnan	Present, no details	Alonso-Zarazaga et al. (2017)
		Zhejiang	Present, no details	Alonso-Zarazaga et al. (2017)
	Japan		Present, no details	Alonso-Zarazaga et al. (2017)
	Dem. Republic of Korea		Present, no details	Alonso-Zarazaga et al. (2017)
	Republic of Korea	Gangwon-do	Present, no details	Hong et al. (2011)
	Taiwan		Present, no details	Alonso-Zarazaga et al. (2017)

APPENDIX C

Methodological notes on Figure 2

The relative probability of presence (RPP) reported here and in the European Atlas of Forest Tree Species (de Rigo et al., 2016; San-Miguel-Ayanz et al., 2016) is the probability of a species, and sometimes a genus, occurring in a given spatial unit (de Rigo et al., 2017). The maps of RPP are produced by spatial multiscale frequency analysis (C-SMFA) (de Rigo et al., 2014, 2016) of species presence data reported in geolocated plots by different forest inventories.

Geolocated plot databases

The RPP models rely on five geo-databases that provide presence/absence data for tree species and genera (de Rigo et al., 2014, 2016, 2017). The databases report observations made inside geo-localised 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 as activity 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). All data sets were harmonised 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/).

European National Forestry Inventories database This data set 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).

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.[2] 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 & Hiederer, 2009). The complete Forest Focus data set covers 30 European Countries with more than 8600 sample points.

BioSoil data set This data set was produced by one of a number of demonstration studies initiated 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 was recorded for more than 3300 sample points in 19 European Countries.

European Information System on Forest Genetic Resources (EUFGIS) is a smaller geo-database that provides information on tree species composition in over 3200 forest plots in 34 European countries. The plots are part of a network of 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 EEUFGIS (online).

Georeferenced Data on Genetic Diversity (GD^2) is a smaller geo-database as well. It provides information about a 63 species that are of interest for genetic conservation. It counts 6254 forest plots that are located in stands of natural populations that are traditionally analysed in genetic surveys. While this database covers fewer species than the others, it does covers 66 countries in Europe, North Africa and the Middle East, making it the data set with the largest geographic extent (INRA, online).

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 that comprises 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 heterogenous 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.

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, it 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

[2]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.

of selecting a local 'best preforming' 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 define Semantic Array Programming modelling paradigm (de Rigo, 2012).

The probability to find a single species in a 1 km^2 grid cell cannot be higher than the probability of presence of all the broadleaved (or coniferous) species combined, because all sample plots are localised inside forested areas. Thus, to improve the accuracy of the maps, the preliminary RPP values were constrained to not exceed the local forest-type cover fraction (de Rigo et al., 2014). The latter was estimated from the 'Broadleaved forest', 'Coniferous forest' and 'Mixed forest' classes of the Corine Land Cover (CLC) maps (Bossard et al., 2000; Büttner et al., 2012), with 'Mixed forest' cover assumed to be equally split between broadleaved and coniferous.

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 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 it (de Rigo et al., 2014, 2016).

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