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Swedish University of Agricultural Sciences

SLU Risk Assessment of Plant Pests

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Risk assessment of *Crisicoccus pini* for Sweden

1 Background

Crisicoccus pini (Kuwana) [EPPO code: DACLPI] is a species in the family Pseudococcidae (mealybugs, *sv.* ullsköldlöss) native to Japan. It is a pest of mainly *Pinus* but also other genera of the Pinales. National risk assessments for this species have been done for Italy, UK and Australia (Bugiani and Finelli 2018; Australian Government 2019; Lloyd 2019. EPPO listed the pest as not proposed for regulation in 2019 based on the Italian PRA (EPPO 2021), but it was added to the EPPO Alert List to raise awareness (M. Suffert, personal communication). It has been included in pest surveys in Sweden both during 2021 and 2022 but has so far not been detected (pers. comm. Swedish Board of Agriculture). A pest categorisation of *C. pini* was performed by EFSA (2021), where they concluded that the pest fulfils all the criteria of an EU quarantine pest that are within the remit of EFSA to assess.

SLU Risk Assessment of Plant Pests was requested by the Swedish Board of Agriculture to conduct a risk assessment of *C. pini* for Sweden. The FinnPRIO model was chosen for the risk assessment mainly due to its suitability to compare the risk that different pests constitute to a country, which in turn can be used to guide prioritization of resources (Heikkilä et al. 2016).

2 Methodology

The risk assessment was performed using a graphical user interface of the risk ranking model FinnPRIO (Heikkilä et al. 2016; Marinova-Todorova et al. 2019). The FinnPRIO model follows the basic structure of a full PRA and is based on semi-quantitative assessments. In short, assessments for the components 'likelihood of introduction' (which takes into account the effect of the current legislation, e.g. requirements placed on certain commodities, on the likelihood of the pest entering into Sweden), 'likelihood of establishment and spread', 'potential impact' and 'manageability' are made by answering questions with standardized answer options. The answer options are clearly defined and assigned a value that is used to calculate a score for each component. The uncertainty of the assessments is included by assigning not only the most likely answer options but also the plausible minimum and maximum answer options. The answers are used to define a PERT probability distribution subsequently used in Monte Carlo simulations to obtain a probability distribution of each component score then used to calculate the mean values and the 5th and 95th percentiles of each probability distribution. For further details, see the full description of the FinnPRIO model in Heikkilä et al. (2016).

Minor adjustments of the instructions were made in order to make them applicable for Swedish assessments (Boberg et al. in progress). The model was run using a lambda value of 4 and 25 000 iterations following Heikkilä et al. (2016) using the setting where equal weight is given to i) the economic impact and ii) to the combined environmental and social impact. Figures were made using JMP® Software.

Information about *C. pini* was obtained from both articles in scientific journals and from other types of sources. Searches were performed in ISI Web of Sciences, Google Scholar and different specific databases (SLU Artdatabanken, Scalenet.org, gbif.org) using the currently accepted name and synonyms, i.e. *Crisicoccus pini*, *Dactylopius pini* and *Pseudococcus pini* (EPPO 2022).

3 FinnPRIO assessment

The FinnPRIO assessment sheet of *C. pini*, including the answers to the model questions and justifications are available in Table 1.

The uncertainties associated with the assessments were rather large. *Pinus sylvestris* is not a known host but it was assessed as most likely that *C. pini* can utilize it as a host species since many pine species are known to be hosts and since *C. pini* has extended its host range to new species after its arrival to Europe. However, if that is not the case *C. pini* will be restricted to confirmed hosts, which mostly are found in urban areas. Thus, whether *P. sylvestris* can be utilized as a host or not will have a large implication, especially on the potential impact. Similarily, it was assessed as likely that *C. pini* can establish in areas with suitable ecoclimatic conditions in Sweden but it is uncertain how much the rather cold climate in Sweden influence the population densities and thus the damage levels.

Table 1. FinnPRIO assessment sheet of *C. pini* with the model questions and answers together with the justifications.

Species	*Crisicoccus pini* [DACLYPI]
Date	28.03.2022
Name of assessors	Johanna Boberg and Niklas Björklund
Quarantine status in the PRA area	Non-quarantine
Taxonomic group	Insects
Hosts	Most frequently found on *Pinus* and the following species have been reported as hosts; *Pinus coulteri, Pinus densiflora, Pinus halepensis, Pinus koraiensis, Pinus massoniana, Pinus nigra, Pinus parviflora, Pinus pinaster, Pinus pinea, Pinus radiata, Pinus tabuliformis, Pinus thunbergii* (EFSA et al. 2021; EPPO 2022). Plants of *Abies, Keteleeri*a and *Larix* have also been reported as hosts in China (EFSA et al. 2022 citing Chen et al. 2005; EPPO 2022).

Question	Answer options	Likely	Plausible Min	Plausible Max	Justification
ENT1: How wide is the current global geographical distribution of the pest? (pathways A-F)	a. Small				*Crisicoccus pini* is reported from Japan (native), China, North Korea, South Korea, Taiwan, Russia (far east), USA (California and District of Columbia), Italy and Monaco (Kosztarab 1996; EPPO 2022). Possibly the pest is also found in Hawaii (Germain and Matile-Ferrero 2006 citing personal communication).
	b. Medium	X	X	X	
	c. Large				
Pathway 1	**Plants for planting**				***i.e. of hosts (Pinus, Abies, Larix, Keteleeria)***
ENT2A					Question not assessed (based on a decision by the Swedish Board of Agriculture which is applicable for all Swedish FinnPRIO-assessments).
ENT2B: As in ENT2A, but taking into account current official entry management measures	a. No it cannot				*Crisicoccus pini* is a mealybug and this group of insects are frequently transported with trade, e.g. the Australian Government (2019) reports that there have been more than 3 100 mealybug interceptions events from the plant import pathway to Australia between 1986 and 2015. *Crisicoccus pini* is native in Japan but has spread to other countries in North America, Asia and Europe. In USA the earliest record is from 1918 (Miller et al. 2005) and in Europe the pest was detected in Monaco in 2006 in a Japanese garden (EPPO 2019) and in Italy in 2015 (Boselli and Pellizzari 2016). There are no interceptions recorded in the EU (Europhyt 2020). However, Pseudococcidae (mealybugs) were intercepted on bonsai plants of *Pinus pentaphylla* from Japan in 2013 (EPPO 2013). EFSA (2022) interprets these as seemly likely *C. pini* from the description. *Crisicoccus pini* has been intercepted at US ports of entry on *Pinus* and *Taxus* from Japan (Miller 2014). Import into the EU of plants of *Pinus* as well as *Abies* and *Larix* originating from certain third countries (Monaco is not included) is prohibited ((EU) 2019/2072). There are, however, derogations for bonsai of *Pinus* from Japan ((EU) 2020/1217). In addition, import of plants of Keteleeria is not prohibited, but requires a phytosanitary certificate ((EU) 2019/2072)). Movement of plants of host species within the EU is also allowed, but requires a plant passport ((EU) 2019/2072, Annex XIII).
i) be transported in international trade with the host plant commodity considered in the pathway (pathways A-E)?	b. It can, but it is very unlikely				
ii) be transported from one country to another with other than host plant commodity, transport or passengers (pathway F)?	c. It can, but it is unlikely				
iii) spread naturally to the PRA area from its current ranges during the next ten years (pathway G)?	d. It can, and it is likely	X	X	X	
iv) be intentionally introduced to the PRA area (pathway H)?	e. It can, and it is very likely				

ENT3: How large a volume[1] of the considered host plant commodity is traded into the PRA area annually? (pathways A-E)	a. Non-existent				On average in total 4 million seedlings of *Pinus sylvestris* are traded into Sweden annually as propagation material from where all, or almost all, came from the EU-countries. (Widenfalk et al. 2022). The annual trade of open field plants, trees and bushes for ornamental purposes is on average 21 005 tons (Widenfalk et al. 2022), but it is unknown how much of this constitutes of confirmed host species of the pest.
	b. Small				
	c. Medium	X	X		
	d. Large			X	
ENT4: Can the pest transfer to a suitable habitat after entering the PRA area via the pathway?	a. It cannot				The pest arrives directly to suitable habitats with the pathway plants for planting. *Pinus sylvestris* is a very common tree species in Sweden, but its host status is not known. Confirmed hosts are mostly found in urban areas. Distance of natural spread is short.
	b. It can, but it is very unlikely				
	c. It can, but it is unlikely		X		
	d. It can, and it is likely	X			
	e. It can, and it is very likely			X	
Pathway 2	**Other living plant parts**	**Likely**	**Plausible Min**	**Plausible Max**	***Cut branches and cones of hosts***
ENT2A					Question not assessed (based on a decision by the Swedish Board of Agriculture which is applicable for all Swedish FinnPRIO-assessments of this question).
ENT2B: As in ENT2A, but taking into account current official entry management measures	a. No it cannot				The pest feeds on needles and could thus be associated with cut branches traded for ornamental purposes, e.g. Christmas decorations. Import into the EU of plants of *Pinus* as well as *Abies* and *Larix* originating from certain third countries (Monaco is not included) is prohibited ((EU) 2019/2072). Import of cut branches of Keteleeria is not prohibited, but requires a phytosanitary certificate ((EU) 2019/2072, Annex XI, Part A3). It is not known whether the pest is associated with pine cones. Fresh cones of Pinales requires a phytosanitary certificate ((EU) 2019/2072), but it is not known to what extent fresh cones are traded. Dry cones of Pinales do not require a phytosanitary certificate.
i) be transported in international trade with the host plant commodity considered in the pathway (pathways A-E)?	b. It can, but it is very unlikely	X	X		
ii) be transported from one country to another with other than host plant commodity, transport or passengers (pathway F)?	c. It can, but it is unlikely			X	
iii) spread naturally to the PRA area from its current ranges during the next ten years (pathway G)?	d. It can, and it is likely				
iv) be intentionally introduced to the PRA area (pathway H)?	e. It can, and it is very likely				

[1] According to the instructions, the total volume traded into Sweden should be used for this assessment, i.e. not only the volume of trade from areas where the pest occurs (Heikkilä et al. 2016).

ENT3: How large a volume of the considered host plant commodity is traded into the PRA area annually? (pathways A-E)	a. Non-existent				On average 3195 tons of Christmas trees are traded into Sweden annually (Widenfalk et al. 2022), but only a small part is assumed to be confirmed hosts (e.g. *Abies*). 602 tons of softwood branches is traded into Sweden annually (Widenfalk et al. 2022).
	b. Small	X	X	X	
	c. Medium				
	d. Large				
ENT4: Can the pest transfer to a suitable habitat after entering the PRA area via the pathway?	a. It cannot		X		Cut trees and branches used for ornamental purposes arrive during the winter. They are likely discarded outdoors, but it is not known whether the pest would be able to survive until environmental conditions improve. The pest would have to transfer to a fresh host and the distance of natural spread is very short.
	b. It can, but it is very unlikely	X		X	
	c. It can, but it is unlikely				
	d. It can, and it is likely				
	e. It can, and it is very likely				
Pathway 3	**Wood and wood products**	**Likely**	**Plausible Min**	**Plausible Max**	***Wood with bark and isolated bark of hosts***
ENT2A:					Question not assessed (based on a decision by the Swedish Board of Agriculture which is applicable for all Swedish FinnPRIO-assessments).
ENT2B: As in ENT2A, but taking into account current official entry management measures	a. No it cannot				The pest feeds on the needles but may be associated with bark e.g. during overwintering as nymphs (EFSA et al. (2021) citing others). Isolated bark of Pinales originating in third countries (not incl. Monaco) must be treated (fumigation or heat treatment) ((EU) 2019/2071, Annex VII, 82). Wood with associated bark, e.g. round wood or wood chips, of Pinales is in many cases also treated to prevent the introduction of other pests, e.g. with heat treatment, fumigation or chemical pressure impregnation (EU) 2019/2072). The requirements include commodities from China, Japan, Korea, USA (but only from states were *B. xylophilus* is present). The treatments are assumed to efficiently eliminate *C. pini*, but may not apply to all areas were the pest occurs.
i) be transported in international trade with the host plant commodity considered in the pathway (pathways A-E)?	b. It can, but it is very unlikely	X	X	X	
ii) be transported from one country to another with other than host plant commodity, transport or passengers (pathway F)?	c. It can, but it is unlikely				
iii) spread naturally to the PRA area from its current ranges during the next ten years (pathway G)?	d. It can, and it is likely				
iv) be intentionally introduced to the PRA area (pathway H)?	e. It can, and it is very likely				

ENT3: How large a volume[2] of the considered host plant commodity is traded into the PRA area annually? (pathways A-E)	a. Non-existent				The volume isolated bark of Pinales traded into Sweden is not known. Large amounts of wood products of different conifers are traded into Sweden every year. The following categories of wood are assumed most likely to include some bark; on average 3 467 686 tons of roughly sawn wood of *P. sylvestris*, 272 663 tons of roughly sawn wood of other softwood and 1 610 367 tons of softwood wood chips and saw dust are traded into Sweden annually (Widenfalk et al. 2022). Only a very small proportion of these volumes are likely to consist of bark but according to the instructions this question is related to the volume of material in the whole commodity, i.e. "wood with bark".
	b. Small				
	c. Medium				
	d. Large	X	X	X	
ENT4: Can the pest transfer to a suitable habitat after entering the PRA area via the pathway?	a. It cannot		X		It is not known whether the pest would be able to survive in bark during handling after entry. The pest would have to transfer to a living host after entry and the distance of natural spread is very short.
	b. It can, but it is very unlikely	X		X	
	c. It can, but it is unlikely				
	d. It can, and it is likely				
	e. It can, and it is very likely				
EST1: Could the pest reproduce and overwinter in the PRA area taking into account the climate and production conditions?	a. No it could not				A climate mapping performed by EFSA et al. (2021) show that the pest is found in regions with a Köppen-Geiger climate zones Dfb and Dfc, which is also found in Sweden. Composite match index (CMI) calculated using CLIMEX, indicate that some, but not all areas where the pest is found established has a CMI above 0.7. The pest is mainly found in subtropical and temperate regions in the USA and in Asia (EFSA et al. 2021). In Japan, *C. pini* was observed by Kuwana (1902) in the southern islands and it is unclear whether the pest occurs in the northern island. Lloyd (2019) did not find any source that the species is found in Hokkaido, the northern island of Japan. The record in Russia is from Khasan region, the most southern part of Primorye (Danzig and Gavrilov 2010; EPPO 2022).
	b. It could, but it is unlikely		X		
	c. It could, and it is likely	X			
	d. It could, and it is very likely			X	
EST2: In how large an area do the pest's host plants grow or are cultivated in the PRA area?	a. Not at all				Many different *Pinus* spp. are recorded as hosts and plants of other genera within the Pinaceae (i.e. *Acer, Larix, Keeteleria*) has also been recorded as hosts (EPPO 2022). Some of the known host species are planted as ornamental plants in Sweden, e.g. *P. nigra* (SLU Artdatabanken 2022), but the prevalence is not known. *Pinus sylvestris* has not been recorded as a host and thus the susceptibility is not known. However, the pest is polyphagous and it has extended its host range to new *Pinus* species after its arrival to Europe, e.g., to *P. pinea* in Italy (Boselli & Pellizzari 2016).
	b. Very small				
	c. Small		X		
	d. Medium	X			
	e. Large			X	
EST3: How quickly would the pest likely spread in the PRA area?	a. Very slowly		X		Natural spread by crawling nymphs or nymphs carried by the wind or animals is local. Spread by movement of infested plants may provide means of long distance spread (see ENTRY section). However, such spread appears to be rare based on the few occasions where the pest have spread to new countries and that spread in the regions where it has been introduced appear to be slow. The pest has been established in the US for more than 100 years and is only reported from two states.
	b. Rather slowly	X			
	c. Rather quickly			X	
	d. Quickly				

[2] According to the instructions, the total volume traded into Sweden should be used for this assessment, i.e. not only the volume of trade from areas where the pest occurs (Heikkilä et al. 2016).

EST4: Does the pest have characteristics that could assist in its establishment or spread in new areas?	a. No it does not				It is unclear how many offsprings arise from one female, but mealybugs generally lay hundreds of eggs (Flint 2016). The pest has a history of spreading and adapting to new environments/hosts.
	b. It has characteristics that could assist to some extent				
	c. It has characteristics that could assist to a great extent		X		
	d. It has characteristics that could assist to a very great extent	X		X	

IMP1: How significant are the direct economic losses that the pest would cause in the PRA area?	a. It would not cause losses in the PRA area				According to a review of the impact of mealybugs they only rarely kill trees (Australia Government 2019). *Crisicoccus pini* causes yellowing and partly necrotic needles and development of sooty moulds due to the excreted honey dew (EPPO 2019). It is not considered a pest in the US according to Miller (2005) while considered a minor pest on *P. radiata* and *P. thunbergii* in California by Germain and Matile-Ferrero (2006 citing personal communication). Further, Danzig and Gavrilov (2010) state that "it is known to cause damage to ornamental pine-trees" in California. In Qingdao, China, it is considered a major pest of *P. densiflora* and *P. thunbergii* since 1998 (EFSA et al. (2021) citing others). In Italy, the pest has been observed to cause tree mortality in *P. pinea* and *P. pinaster* and Boselli et al. (2018) reported a few hundred infested trees had died in 2015. The outbreak was reported from pine trees in an urban environment, e.g. parks, tree rows but also in adjacent natural pine forest and had spread over 51 ha (Boselli & Pellizzari 2016; Boselli et al. 2018). During a four year period of the outbreak the management costs reached around 142 000 Euros (Bugiani and Finelli 2018). It is not known how suitable the ecoclimatic conditions in Sweden are for the pest and whether high populations of the pest would be able to develop. Confirmed hosts are found mainly in urban areas, but the prevalence is not known (see EST2). *Pinus sylvestris* is the second most common tree species in Sweden, constituting 1 390 million m^3 standing volume and an annual gross felling value of 11 117 million SEK (Widenfalk et al. 2022). Around 2.2% of the total forest land in Sweden is located close to urban areas (i.e. within a distance of 200-7500 m from urban areas) (Skogsdata 2009). However, it is not known whether *P. sylvestris* is susceptible to damage. Damage and mortality of trees in streets, parks and private garden could lead to costs of control and removing and replanting of trees. The cost of replacing a park tree or a street is equivalent to 3000-7000 € per tree (Widenfalk et al. 2022). A loss of 0.1 - 1% of *P. sylvestris* in near urban forests would generate losses of 0.024 - 0.24 million € annually, however, most likely the impact is local and mainly damages is expected on ornamental trees in urban areas. Only direct economic impact is included here whereas different types of indirect impact are assessed in the next question.
	b. < 0.05 million € per year		X		
	c. 0.05-0.1 million € per year	X			
	d. 0.1-0.2 million € per year			X	
	e. 0.2-0.4 million € per year				
	f. 0.4-0.8 million € per year				
	g. 0.8-1.5 million € per year				
	h. 1.5-3 million € per year				
	i. 3-6 million € per year				
	j. 6-12 million € per year				
	k. 12-25 million € per year				
	l. 25-50 million € per year				
	m. > 50 million € per year				

IMP2: Would the pest cause the following indirect economic impacts in the PRA area?		**Likely**	**Plausible Min**	**Plausible Max**	*Crisicoccus pini* is not regulated in the EU and it does not appear to be regulated elsewhere either except for that it is regulated at the genus level in USA (IPPC (2020) citing USDA (2022)). It should however be noted that this source is not exhaustive. In a PRA for Australia, *C. pini* was identified to require further assessment as a quarantine pest (Australian Government 2019). *Crisicoccus pini* was not considered further as a vector of viruses in a PRA done in Australia (Australian Government 2019). Different species of mealybugs are found as pests on trees in Sweden (Jordbruksverket 2015), but it is not known to what extent they cause damage in the production of plants and whether the potential establishment of *C. pini* would imply additional control measures. In general, mealybugs are difficult to control (Nedstam 2007).
	1. Would the pest impact foreign trade?	No	No	Yes	
	2. Is the pest a vector for other pests?	No	No	No	
	3. Would the pest have a significant impact on the profitability of some plant production sector?	Yes	No	Yes	
IMP3: How much direct impact would the pest have on the natural ecosystems in the PRA area?	a. No impact		X		No native plant species in Sweden is a confirmed host. There is uncertainty as to whether *P. sylvestris* is susceptible to damage and whether the ecoclimatic conditions in Sweden would lead to high pest population densities. No decrease in any host-plant population which would lead to hindering of ecosystem functions are expected.
	b. Moderate impact	X		X	
	c. Significant impact				
	d. Very significant impact				
IMP4: Would the pest have the following environmental or social impacts in the PRA area?		**Likely**	**Plausible Min**	**Plausible Max**	No significant social/cultural impact is expected. Infested trees in urban areas, such as along streets, in parks and private gardens could lead to aesthetic impacts. *Pinus sylvestris* is one of the most common tree species in Sweden and thereby has an important position in Swedish culture. Nevertheless, the pest is not expected to cause a decrease of the population of pines in Sweden.
	1. Cultural impacts	No	No	No	
	2. Significant aesthetic impacts	Yes	No	Yes	
	3. An impact on plants which have an important, recognized position in the Swedish culture	Yes	No	Yes	

MAN1 (Preventability): Can the pest spread naturally to the PRA area from its current range during the next ten years?	a. No it cannot	X	X	X	*Crisicoccus pini* is reported in Europe only from Italy and Monaco (EPPO 2022).
	b. It can, but it is unlikely or very unlikely				
	c. It can, and it is likely or very likely				
MAN2 (Preventability): Is the pest present in the area of the European Union?	a. No it is not				*Crisicoccus pini* is reported as present with restricted distribution in Italy (EPPO 2022).
	b. Yes in a small area	X	X	X	
	c. Yes in a large area				
MAN3 (Preventability): How difficult is it to detect the pest during inspections?	a. Easy				The pest may be difficult to detect since it overwinters as nymphs in cracks and crevices in bark on branches or lower part of the stem (EFSA et al. (2021) citing others). Presence of the pest on needles and symptoms can be detected but may be difficult to tell apart from other pests. Morphological or molecular analysis is required to separate *C. pini* from other *Crisicoccus* and *Pseudococcus* spp. (EFSA et al. 2022).
	b. Difficult	X	X		
	c. Nearly impossible			X	
MAN4 (Controllability): How difficult would it be to eradicate the pest from the PRA area?	a. Easy				Phytosanitary measures have been implemented in Italy. In infested sites, severely infested trees were destroyed, insecticide was used on remaining trees and biocontrol using a predator was implemented (Boselli et al. 2018). Potential hosts are however found on large areas (see EST2). The results appear to be positive with reduction of the pest populations observed. Generally, mealybugs are difficult to control (Nedstam 2007).
	b. Rather difficult				
	c. Very difficult	X	X		
	d. Impossible			X	
MAN5 (Controllability): How difficult would it be to survey the pest's occurrence in the PRA area?	a. Easy				High populations of the pest can be observed as groups of females with waxy covers, sooty mould, yellowing and necrosis of needles and dieback of trees (EPPO 2019; EFSA et al. 2021). However, detecting hosts with low population densities of the pest is more difficult. Potential hosts are widespread but the pest natural spread is very low.
	b. Rather difficult	X	X	X	
	c. Very difficult				
	d. Impossible				

4 FinnPRIO scores and risk ranking

The results of the FinnPRIO calculations for *C. pini* is presented together with the preliminary scores of 48 other assessed pests mainly represented by EU quarantine pests (except *Agrilus fleischeri* and *Contarinia pseudotsugae,* which are not regulated within the EU). The risk is visualized as the estimated ‘invasion scores’ (Entry score × Establishment & Spread score) plotted against the impact scores (Figure 1) and also as the calculated risk score (Entry × Establishment & Spread × Impact; Figure 2). In addition, all the scores for each component of the FinnPRIO model are presented separately (Figure 3).

Crisicoccus pini received an invasion score of 0.16 as a mean value (0.10 – 0.22 (5th and 95th percentiles); see Figure 1 (all scores in FinnPRIO are on a scale from 0 – 1)). In comparison to the 48 other assessed pests *C. pini* received a relatively high invasion score. The main potential pathway for *C. pini* was assessed to be plants for planting of hosts (Table 1). The pest has previously managed to spread to several areas outside its native range. Trade of most plants of hosts into Sweden from areas where the pest is present is prohibited, but it should be noted that the pest is also present within the EU, i.e., in Italy.

The mean value of the impact score received by *C. pini* was 0.30 (0.24 – 0.35 (5th and 95th percentiles)) and compared to the other assessed pests the impact score was average. Impact appears mainly to be observed locally in ornamental trees in urban areas and large-scale damage is not expected in Sweden.

The preventability and controllability scores were neither relatively high nor relatively low. The former due to that it is possible to detect the presence of *C. pini* on needles but may be difficult to distinguish it from other pests. The latter due to the difficulty of eradicating *C. pini* when it has established.

Figures. Note that the figures should be interpreted carefully especially since, (i) it is based on quick answers to a limited set of specific qustions and (ii) since the absolut values *per se* that a specific pest obtains provides limited information and that the main aim with FinnPRIO is to enable ranking of pests. It should also be noted when interpreting the figures that the absolut position of *C. pini* in the plots will not change depending on which other pests that are included in the analysis, but its relative position, and thereby the interpretation, may be influenced by which other pests that are included.

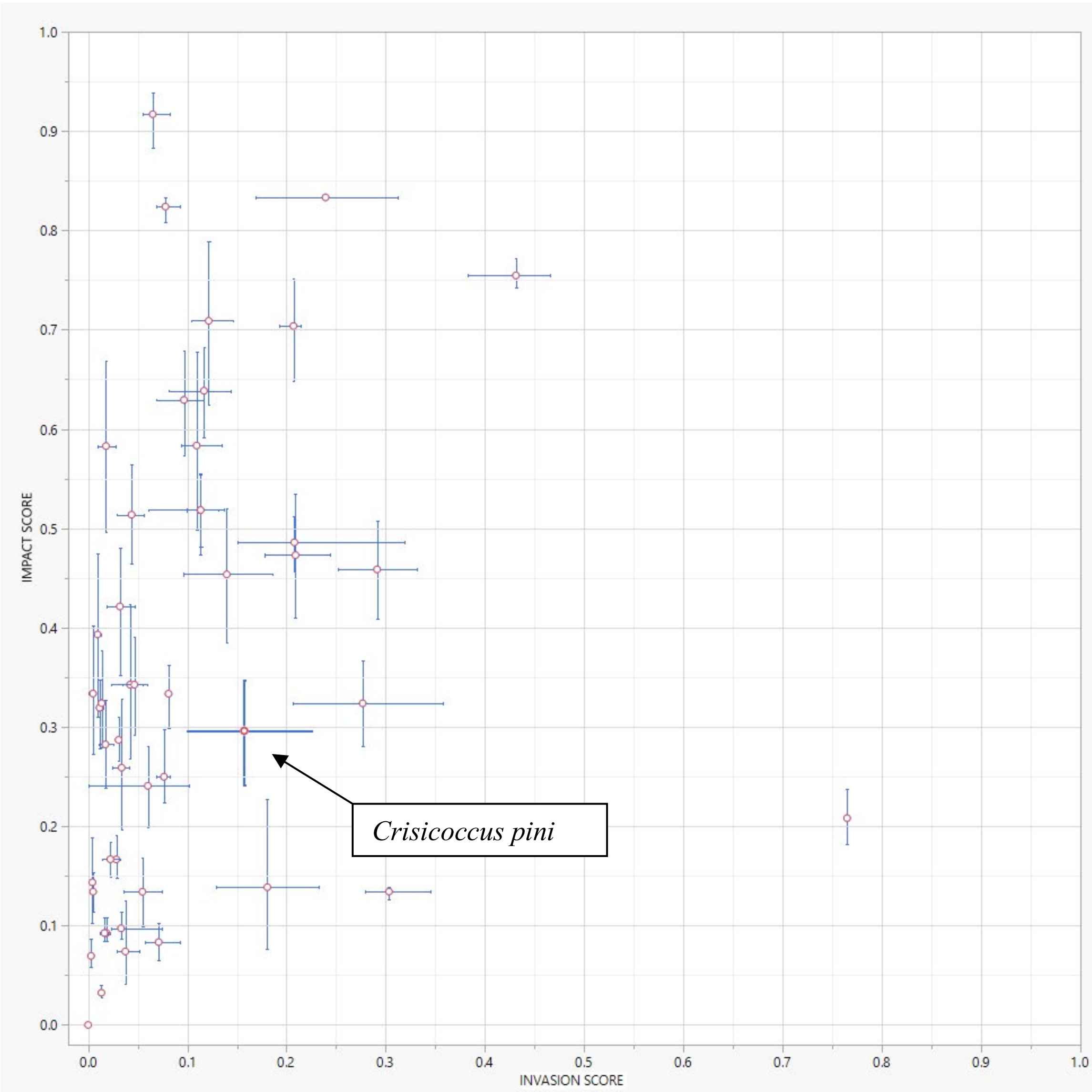

Figure 1. FinnPRIO likelihood of invasion scores (Entry × Establishment and Spread) plotted against the impact scores for the assessed pests. The dots represent the mean values and the whiskers represents the 5th and 95th percentiles of the probability distributions. Pests with the lowest risk is found in the left lower corner while the closer a pest is to the upper right corner of the plot the higher risk it constitutes. More information about the interpretation of this figure is provided in section 3.

Figure 2. FinnPRIO risk score for the assessed pests (i.e. Entry score × Establishment & Spread score × Impact score). For *B. xylophilus*, "FC" stands for future climate whereas "CC" stands for current climate. Note that the scores for preventability and controllability are not included in the risk score (scores of these factors are provided in Figure 3). The dots represent the mean values and the whiskers represents the 5th and 95th percentiles of the probability distributions and the assessed pests are here sorted according to the mean values.

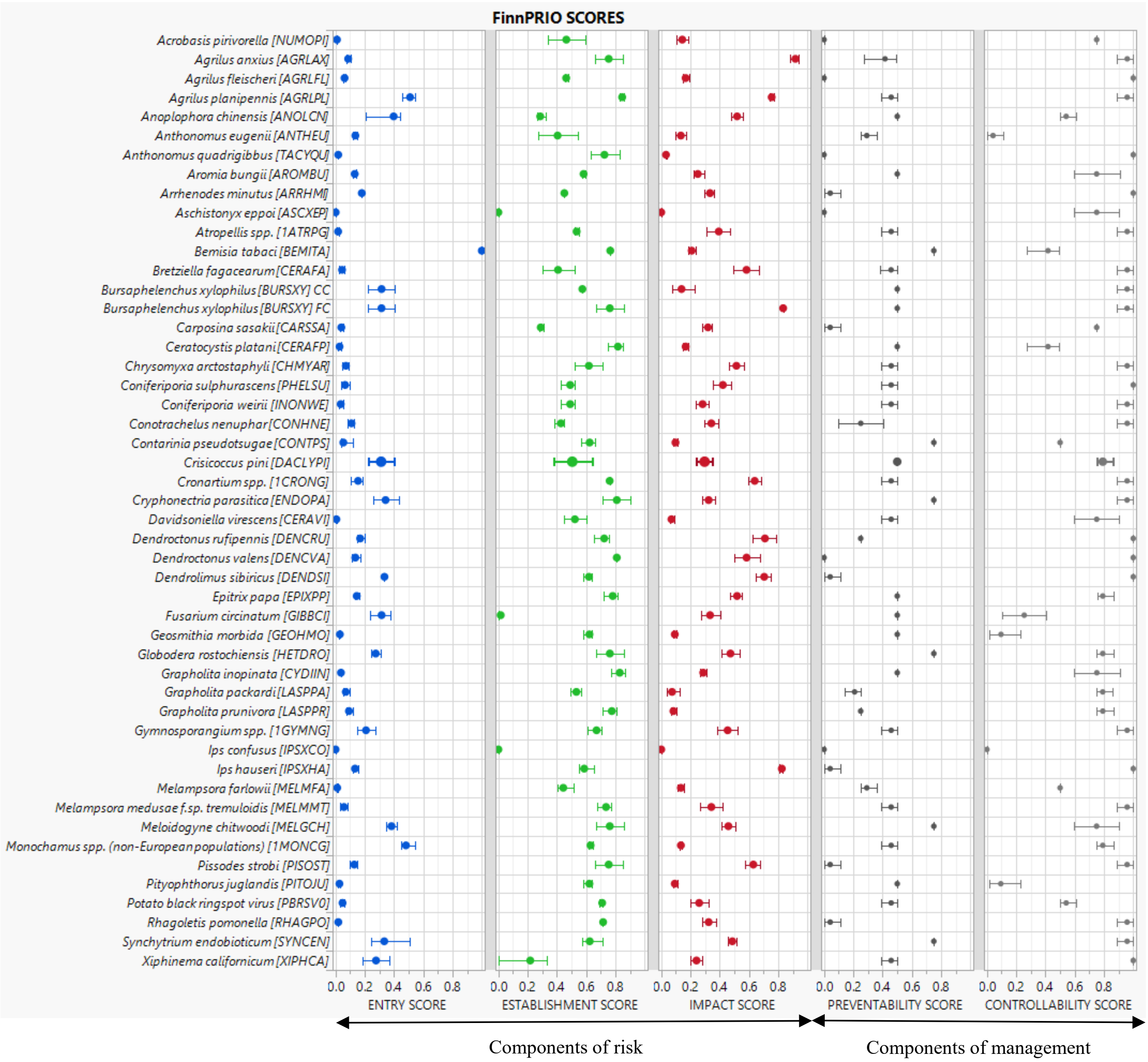

Figure 3. FinnPRIO scores for each component of the FinnPRIO model. High scores reflect (from left to right in the figure) high likelihood of entry, high likelihood of establishment (and spread), high impact, and the relative difficulty to prevent and control the pest, respectively. The dots represent the mean values and the whiskers represents the 5th and 95th percentiles of the probability distributions. It should be noted that the absolut values *per se* that a specific pest obtains provides little information and that the aim with FinnPRIO is to enable ranking of pests, e.g. a maximum score for Controllability should not be interpreted as support for that it is impossible to control the pest. More information about the interpretation of this figure is provided in section 3.

5 Authors

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