Department for Environment Food & Rural Affairs

New information supplementary to the 2015 Rapid Pest Risk Analysis (PRA) for *Thaumetopoea pityocampa*

April 2022

Background

This document provides updated information to the 2015 UK Pest Risk Analysis on *Thaumetopoea pityocampa*. It is not a stand-alone document and must be read in conjunction with the 2015 PRA, as only information available since 2015 is included here. The 2015 PRA can be found online via a link on the pest page in the UK plant health risk register, or via a link on the species page on the UK plant health information portal.

What is the name of the pest?

Thaumetopoea pityocampa (Lepidoptera, Thaumetopoeidae).

Pine processionary moth (PPM).

What initiated this new information supplement?

The UK has regulated this pest for several years. The legislation which currently applies in the UK is as follows:

- In Great Britain, PPM is listed under the legislation Plant Health (Phytosanitary Conditions) (Amendment) (EU Exit) Regulations 2020. It is included in Annex 2 (part A) as a quarantine pest. There are specific requirements on imported *Pinus*

and *Cedrus* trees for planting, designed to mitigate against its risk of introduction, in Annex 7 (part A).

- In Northern Ireland the legislation which applies is Commission Implementing Regulation (EU) 2019/2072. PPM is included in Annex III, where Northern Ireland is a protected zone for this pest (as is the Republic of Ireland). Specific requirements on *Pinus* and *Cedrus* plants for planting are contained in Annex X.

Early in 2022, findings were made of PPM larvae in Great Britain on imported pine trees, suggesting that the current mitigations are not wholly effective at preventing entry. This update to the 2015 PRA was requested to research any new relevant information which is pertinent to the risk assessment. This update, together with the 2015 PRA, will help to inform whether any update to the existing regulations for Great Britain is appropriate.

What is the pest's current geographical distribution?

This update focuses on new or more detailed information available since 2015. For full details of distribution, please refer to section 5 in the 2015 PRA.

Since the last PRA update in 2015 PPM was recorded in 2021 in the Hauts-de-France region in Tupigny near the border with Belgium and at the time of writing is the most northerly record of PPM (gbif.org). Previously it was recorded in Brittany, Orléans, the outskirts of Paris and Normandy in mainland France.

Findings of the pest in the UK since 2015

Details of findings of PPM before 2015 can be found in section 6 of the 2015 PRA. Since then, there have been no suspected or confirmed establishments or incursions of this pest. However, there have been some findings of non-breeding populations. This section provides details of the records known to the Plant Health services in the UK between 2015 and the end of March 2022.

Adults

There have been several records of isolated adults, assumed to be natural migrants. It is almost certain that natural migrants will all be male. Female moths have much more limited flight capacity and are very unlikely to be capable of crossing the English Channel. However, the sex of the moth trapped is not always reported.

In July 2016, a single adult (almost certainly male) was detected in a pheromone trap in Jersey (Defra, unpublished information received from Jersey).

In August 2017 an adult was trapped in Weymouth in the south of England (reported on the flight totals page on Atropos flight arrivals, last updated April 2021).

In July 2018 a single moth, apparently a male, was found in a light trap in Hailsham in the south east of England (reported on Twitter).

In July 2019 a single moth was trapped in Aylesham, again in the south-east of England (reported on Twitter). However, the Atropos flight totals website states that the 2019 record – assumed to refer to this one – was erroneous.

Larvae

Larvae have been found moving associated with traded plant material.

In December 2020, one live PPM larva was intercepted on cut *Pinus strobus* foliage. The interception was made in Scotland, and the infested foliage was sold via a German company. This interception was classified as reasonably low risk as the branches were cut and the relatively immobile larvae would have difficulty finding and transferring to a growing host.

In February 2022 the Plant Health and Seeds Inspectorate (PHSI) found nests and live larvae of PPM on imported pine trees. The relatively large trees originated from a supplier in France and had been imported into a nursery in England. Following laboratory confirmation of PPM, the infested trees were destroyed. Further destruction of host trees from the same supplier in France as the original finding has taken place. More infestations of PPM (at more than one UK nursery) were found in other trees from the same supplier. The known infested host species across all UK sites were *Pinus nigra, P. ponderosa* and *P. sylvestris*. The PHSI found that inspections from the ground were not effective at detecting PPM, as detailed inspections of the top branches could not be made. However, later inspections of trees carried out at height did find nests and larvae. Tracing activity has been carried out to identify the UK destinations of all PPM host trees from the same French supplier. Further surveillance activity is planned around the sites which have received host trees linked to those known to be infested, including monitoring for any potential adult emergence later in the year.

What are the pest's natural and experimental host plants?

The genus *Pinus* is most susceptible to attack, and the following species are recorded as hosts: *P. nigra* var. *austriaca* & *P. nigra* var. *laricio* (Austrian pine)*, P. sylvestris* (Scots pine)*, P. pinea* (stone pine)*, P. halepensis* (Jerusalem pine)*, P. pinaster* (cluster pine), *P. contorta* (lodgepole pine), *P. radiata* (Monterey pine), *P. brutia* (Turkish pine), *P. longaeva* (bristlecone pine), *P. pumila* (Siberian dwarf pine), *P. heldreichii* (Heldreich's pine), *P. attenuata* (knobcone pine), *P. peuce* (white pine), *P. mugo* (dwarf mountain pine), *P. densiflora* (Japanese red pine), *P. coulteri* (Coulter pine), *P. roxburghii* (chir pine), *P. ponderosa* (ponderosa pine), and *P. canariensis* (Canary Island pine) EPPO (2021), Tiberi (1999), Petrakis (2005), Roques (2015), Carillo_Gavilan (2021). Given the wide range of pine species recorded as hosts, all pine species should be considered as potential hosts.

There are a number of primary literature sources that list *Cedrus* as a host (Yousfi 1990, Sebti & Chakali 2014, Sbabdji *et al.* 2015, Rousselet *et al.* 2013, Rossi *et al.* 2016). The

highest infestations of PPM on *Cedrus* are reported from study areas in North Africa. There are also records of PPM feeding on *Cedrus* from the more northerly parts of the moths' range in France. *Cedrus* is a host of PPM, albeit one that is apparently less preferred than *Pinus* (at least in France). PPM has been recorded as feeding on the following *Cedrus* species: *C. atlantica* (Atlas cedar), *C. deodara* (Himalayan cedar) and *C. libani* (Lebanese cedar).

Larix decidua (European larch) is listed by CABI and EPPO databases as a host for PPM, and *Larix* is often listed in publications and host lists for PPM. However, from the literature searched, only two *Larix* species were identified as potential hosts. They are: *L. decidua* and *L. kaempferi* (Japanese larch).

The original EPPO reference for *L. decidua* as a host (Demolin 1969) lists species that would have optimal characteristics in French forests. These hosts would have diameter and structure of leaves (needles) that would be most suitable to PPM females to lay eggs on and are not necessarily species recorded from feeding observations. *Larix decidua* is on the list as being "structurally favourable"[1] for oviposition on needles and twigs and has been observed as an "exceptional case in one location in Valley of the Tinee, Alpes-Maritimes". It would seem that *L. decidua* in this context is an exceptional host under certain conditions that were observed in the original paper.

Larix kaempferi seems to be an experimental host only, from a study by Devkota & Schmidt (1990). Larvae can feed on *L. kaempferi* under controlled experimental conditions when fresh cuttings are regularly provided, but as soon as the needles start to drop the larvae are unable to feed and complete their lifecycle or spin nests on the wilting needles. It was observed that as soon as the needles started to wilt the larvae avoided them and wandered around the enclosure until fresh material was introduced. The larvae expended much of their energy on having to constantly spin new webs resulting in delayed moulting and high mortality, larvae did not survive beyond the second instar on this host. The conclusion on *L. kaempferi* as a host for PPM from the 1990 study by Devkota & Schmidt is that the larvae fed unwillingly on the wilting needles and that, the young stage caterpillars could not properly spin their nests on the deciduous needles. *Larix* species which are deciduous and lose their needles during winter are not suitable hosts for insects whose larvae are needle feeding during the winter. However, summer developing populations of PPM such as the ones found in Portugal, would most likely be able to feed on the summer growth of *Larix* species.

Abies concolor is listed as an occasional host in the EPPO Datasheet for PPM but not in the host list on the EPPO global database. No original sources were given for *Abies* as a host for PPM on the datasheet, with other publications and factsheets about PPM listing

[1] The parameters for being structurally favourable are set out earlier in the paper: needle diameter between 1.5 and 2 mm, leaves (needles) close to each other and a rough structure allowing optimal insertion of the claws, the paper then concludes that "pine tree" is the only plant that can offer these preferred characteristics.

EPPO as the reference for *Abies* as a host. A search of the literature did not find specific papers that refer to feeding on *Abies* by PPM. A paper by Ricciardi *et al* (2021) on the reactions of urticating setae on forestry workers in Sicily has a case study of a forestry worker having an allergic reaction “due to the presence of PC (processionary caterpillars) in conifer trees, the trees mentioned in the paper were the Sicilian fir (*Abies nebrodensis*). Older papers such as Hase (1939) mention PPM feeding on “pines and firs” throughout its range, a lot of these early papers were not accessible so could not be interrogated further but it appears that most of these references just include *Abies* in with conifers as hosts rather than focus on specific instances of PPM feeding on *Abies*.

Pseudotsuga menziesii (Douglas fir) is also listed as an occasional host for PPM. with observations of feeding and tenting in Switzerland (in the Valis and Lake Geneva areas) reports from the Swiss Federal Research Institute. Dubach *et al.* (2020) states that while feeding in the crown does occur it is mostly insignificant and the damage is negligible, at least in the sites observed in Switzerland. In the Southwest of France there have been increasing reports of PPM feeding on *P. menziesii*. Early instar caterpillars can fully develop when fed on *P. menziesii* in laboratory settings, but there is some suggestion that in the wild, *P. menziesii* is a less favourable host due to physical aspects, such as the structure of the needles which may be less favourable for tent building, and it is also believed that the foliage structure of needles makes *P. menziesii* unsuitable for oviposition (Spiecker, H *et al*. (eds.) (2019).

Summary of pest biology and/or lifecycle

Most information in this section is taken from Roques (2015), unless otherwise cited.

This moth has an unusual lifecycle, with larvae (caterpillars) of most populations actively feeding over winter. Lifecycle timings vary depending on the geographical location (including effects of altitude). The following timings are approximations only and individual locations may vary substantially. In the typical winter-developing populations, adults fly in late summer. Eggs are laid in clusters round conifer needles and hatch in early autumn. Larvae feed communally through autumn and winter in silken nests they spin. The nests of older instars are typically found on branches exposed to the sun. As a result of sunshine hitting the nest, daytime temperatures inside the nest can be considerably higher than the ambient temperature outside. Larvae feed on foliage mostly at night and return to their nests to digest the material during the day. When full grown, larvae leave the canopy in a procession to pupate in the soil. This may be as early as December or as late as May depending on location. Prepupal larvae seek suitable pupation sites in the soil, typically travelling some distance to do so. Uemura *et al.* (2020) found that the average distance travelled by PPM larvae from the assumed host tree was around 15 m. Larvae appear to prefer soils in open areas, not under forest canopy, and pupate in a group. Some adults will emerge after several months in the late summer, but a variable proportion of pupae undergo extended diapause, remaining in the soil as pupae for two or more years.

There are a number of recorded summer-developing populations where larvae develop over the summer instead of the winter. Such populations occur at least in Portugal

(Godefroid *et al*., 2016) and Bulgaria (Zaemdzhikova & Doychev, 2020). As the name suggests, adults fly in early summer, laying eggs which quickly hatch into larvae. Larvae feed in the summer, pupating in early autumn and overwintering as pupae in the soil.

What pathways provide opportunities for the pest to enter and transfer to a suitable host?

The pathways assessed in the 2015 UK PRA were plants for planting (moderately likely with low confidence), wood, hitchhiking and natural spread (all very unlikely, with medium or high confidence). This update presents some new information. It adds to the 2015 assessment of plants for planting using information from the 2022 larval interceptions. A new pathway of cut plant parts is discussed, based on the 2020 larval interception.

Plants for planting

Given the 2022 interceptions of larvae on trees for planting, this pathway is a viable one. However, the 2015 PRA considered that the main risk was from pupae in the soil. Eggs are not present for long and are found in summer when trees are less likely to be moved. The 2015 PRA considered that larval nests are quite conspicuous and this should reduce their chance of association with the plants.

New information from the findings in 2022 demonstrate that nests may not, in fact, be so easy to detect in larger trees (height greater than 1.4 m, or 1.7 m including the rootball). The 2022 consignment of infested trees had been imported with a phytosanitary certificate including an official statement that the plants had been produced in nurseries which, along with their vicinity, had been found free from *Thaumetopoea pityocampa* on the basis of official inspections and official surveys carried out at appropriate times, i.e. option c of the requirements laid out in schedule 7, Annex 7 part A, number 57 of The Plant Health (Phytosanitary Conditions) (Amendment) (EU Exit) Regulations 2020. In addition to the nests not being detected pre-export, they were also not always initially detected at inspections in the UK following their import. The infested trees were quite large, some considerably over head height. Therefore, for larger trees it seems that inspections from the ground, even using binoculars, are not sufficient to reliably detect nests of PPM.

Cut plant parts

This pathway was not considered in the 2015 PRA. However, the finding in 2020 demonstrates that PPM can at least enter the UK on this pathway and so it should be assessed.

Eggs could be associated with cut branches, as they are laid round the needles in a flat mass and are inconspicuous. However, eggs are only present for a relatively short period of time. Larval nests are quite conspicuous and it seems likely that nests would be detected on smaller cut branches during the process of harvesting, particularly as nests tend to be located on the outer parts of the tree so as to maximise the sunshine received.

Larger cut trees could potentially contain undetected nests, similar to the risk of larger trees for planting, but the number of larger cut trees which are imported is likely to be extremely low. Isolated larvae may be found away from the nests and be associated with cut branches, especially as the act of cutting branches may dislodge larvae from their nests elsewhere in the tree. However, the numbers of larvae would probably be quite low and if the foliage is dispersed quickly after import, the chances of sufficient numbers of larvae remaining together and able to find one another after emerging as adults is small. Pupae will not be associated with cut plant parts as PPM pupates in soil. Adults would only be incidentally associated with foliage and would probably fly off at the disturbance from cutting and packing the foliage.

Cut branches will not have a long lifespan before they start to dry out and deteriorate, and conifer branches are less likely to be stored in water to extend their shelf life than many other floristry species. *Pinus* are not commonly used as Christmas trees (it is more likely to be *Abies* spp.), but even cut trees stored in water will deteriorate significantly over time and are unlikely to allow larvae to complete their development unless they can find a new host or the larvae are almost ready to pupate when the foliage was cut. Any larvae on cut plant parts may be able to feed on the needles for a while, but the quality of the food will deteriorate as time passes. Larvae will ultimately need to leave the cut plant parts and find a suitable growing host in order to continue development. While larvae do seek out new food sources and establish new nests as part of their normal development (Roques, 2015), they will be unable to move long distances to establish on a growing host. It is also unclear how easily they would be able to detect a suitable host in the wider environment, i.e. would the search strategy be random or are they able to detect host volatiles or similar and move in a more targeted manner? Cut branches for ornamental wreaths used indoors would almost certainly not enable larvae to find a suitable growing host. However, evergreen decorations may be hung outdoors (e.g. on front doors), and this end use would allow more opportunities for the larvae to find a new host.

Christmas and other mid-winter festivals are traditionally associated with evergreen foliage for decorations. As a result, large amounts of conifer foliage, including hosts of PPM, are likely to be imported in late November and throughout December, and this is the period when larvae are present and feeding. Branches for domestic end use are likely to be widely dispersed and pose a low risk, even if used outdoors, as the numbers of larvae on any particular decoration would be very low. Of more concern would be outdoor festive displays, e.g. commercial outdoor Santa’s Grottoes especially if in more rural sites. The amount of foliage used for decorations in a single site can be very significant, leading to potentially greater numbers of larvae remaining together in a single site. If this is in a woodland location, the chances of larvae being able to find a suitable growing host nearby are substantially larger. Some festive displays may cut their own conifer branches locally, but the number of sites which may import foliage for use as decorations is not known. Indeed, the number of seasonal decorated sites is not known, and thus the risk from these cannot properly be ascertained.

Overall, mainly due to difficulties of transfer, this pathway of cut plant parts is considered unlikely. However, a lot of assumptions are being made and this judgement is made with low confidence.

What are the risk management options?

The 2015 PRA demonstrates that PPM would be capable of establishing in at least southern parts of the UK and causing impacts. PPM therefore meets the criteria to be a quarantine pest in Great Britain (or a protected zone pest in Northern Ireland), and continued exclusion remains the preferred option for the UK. PPM is not known to be present in any part of the UK and follow up surveys are planned following the 2022 larval interceptions to ensure that no larval nests escaped detection.

There have been demonstrable difficulties in detecting PPM nests on large imported trees, despite repeated inspections. This has highlighted the practical difficulties of ensuring that the place of production and its immediate vicinity (which may include large trees) are free from PPM as required in the legislation. The mitigation provided by inspections for PPM may therefore be substantially less than was hoped for when the legislation was written.

There has also been a finding of a larva on cut *P. strobus* foliage in Scotland. This demonstrates that cut foliage is a viable route of entry to the UK. While domestic use of cut foliage is unlikely to be a viable pathway, the risk from outdoor festive displays is greater due to the volume of foliage used at some sites. It may be worth considering some controls on cut plant parts of PPM hosts, to supplement the existing controls on plants for planting.

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