European and Mediterranean Plant Protection Organisation
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

Pest Risk Analysis record for *Thaumetopoea processionea*

PEST RISK ANALYSIS FOR *THAUMETOPOEA PROCESSIONEA*			
Pest risk analyst(s):	Forest Research, Tree Health Division		Dr Hugh Evans
			This PRA is for the UK as the PRA area. It has been developed in response to concerns arising from infestations of oak processionary moth in Europe and, from 2006, in London. It has been carried out at the request of the Outbreak Management Team, coordinated by the UK Forestry Commission.
Date: 17 June 2007			
Stage 1: Initiation			
1 What is the reason for performing the PRA?			An infestation of *Thaumetopoea processionea* has been identified in London, where it is causing tree damage on a range of oak (*Quercus*) species. The PRA is to determine whether the pest requires statutory action.
2 Enter the name of the pest			*Thaumetopoea processionea*, oak processionary moth.
2a Indicate the type of the pest			Insect
2b Indicate the taxonomic position			Lepidoptera, Notodontoidea, Thaumetopoeidae
3 Clearly define the PRA area			UK, including Northern Ireland and the Channel Islands
4 Does a relevant earlier PRA exist?			No
5 Is the earlier PRA still entirely valid, or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest, for another area with similar conditions)?			

Stage 2A: Pest Risk Assessment - Pest categorization		
Identify the pest (or potential pest)		
6 Does the name you have given for the organism correspond to a single taxonomic entity which can be adequately distinguished from other entities of the same rank?	yes	
7 Even if the causal agent of particular symptoms has not yet been fully identified, has it been shown to produce consistent symptoms and to be transmissible?		
Determining whether the organism is a pest		
8 Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?	Yes	Heavy defoliation, accompanied by human and animal health problems from urticating hairs from the larvae, confirm the pest status of oak processionary moth; for example it is regarded as a contributor to oak decline in Germany (Müller 2006)
9 Does the organism have intrinsic attributes that indicate that it could cause significant harm to plants?	Yes	The larval stages cause heavy, sometimes complete, defoliation of oak trees. It is known to feed on other genera (see 12), but there is little information available on the scale of damage other than on oak.
Presence or absence in the PRA area and regulatory status (pest status)		
10 Does the pest occur in the PRA area?	Yes	Larval stages of the pest were found in London during 2006 and again in spring 2007 (see www.forestresearch.gov.uk)
11 Is the pest widely distributed in the PRA area?	No	The pest is currently restricted to parts of London
Potential for establishment and spread in the PRA area		
12 Does at least one host-plant species (for pests directly affecting plants) or one suitable habitat (for non parasitic plants) occur in the PRA area (outdoors, in protected cultivation	Yes	*T. processionea* is known to attack various species of the genus *Quercus* and, occasionally, the genera *Betula, Carpinus, Castanea Corylus* and *Fagus.*

or both)?		
13 If a vector is the only means by which the pest can spread, is a vector present in the PRA area? (if a vector is not needed or is not the only means by which the pest can spread go to 14)	Not relevant	
14 Does the known area of current distribution of the pest include ecoclimatic conditions comparable with those of the PRA area or sufficiently similar for the pest to survive and thrive (consider also protected conditions)?	Yes	Although the pest is regarded as a having a southern European range, it has progressed northwards during the 20th Century and is now firmly established in Belgium and The Netherlands where it is causing extensive defoliation (Moraal, Jagers op Akkerhuis & van der Werf 2002).
Potential for economic consequences in PRA area.		
15 With specific reference to the plant(s) or habitats which occur(s) in the PRA area, and the damage or loss caused by the pest in its area of current distribution, could the pest by itself, or acting as a vector, cause significant damage or loss to plants or other negative economic impacts (on the environment, on society, on export markets) ?	Yes	*T. processionea* causes extensive defoliation to a range of oak and, occasionally, other broadleaved tree species. This defoliation can be cyclic and result in almost complete defoliation of affected trees when the outbreaks peak. This has been particularly apparent in The Netherlands where the moth was first recorded in 1991 (Moraal *et al.* 2002). Additional societal impacts arise from the extreme irritation that can arise from contact with the urticating hairs of mature larvae. This affects both humans and animals (Gottschling & Meyer 2006).
Conclusion of pest categorization		
16 This pest could present a risk to the PRA area.	Yes	
17 The pest does not qualify as a quarantine pest for the PRA area and the assessment for this pest can stop (summarize the main reason for stopping the analysis)		

Section 2B: Pest Risk Assessment - Probability of introduction/spread and of potential economic consequences		
1. Probability of introduction **Introduction, as defined by the FAO Glossary of Phytosanitary Terms, is the entry of a pest resulting in its establishment.**		
Probability of entry of a pest		
Identification of pathways Note: If the most important pathway is intentional import, do not consider entry, but go directly to establishment. Spread from the intended habitat to the unintended habitat, which is an important judgement for intentionally imported organisms, is covered by questions 1.33 and 1.35.		
1.1 Consider all relevant pathways and list them		The relevant potential pathways are: • Plants for planting of woody hosts of *T. processionea* These will be principally in the genus *Quercus* and are linked mainly to presence of overwintering egg masses that can be present from September to April. They are, therefore, likely to be present during the dormant period of the host plant which is the most likely period for trade and international movement of plants for planting. Larval stages on plants with leaves could also provide a pathway. • Cut branches of host plants of *T. processionea* Eggs are laid on the bark of host trees, principally in the small branches in the canopy. This could represent a possible pathway, but it is thought that trade in this commodity is unlikely.

		• Roundwood of oak with bark present Depending on the time of year, there could be nests containing larvae present on the bark of cut stems of oak. • Natural spread The adult male is a strong flier and is known to be able to fly from France to the UK. However, the female is not such a strong flier and is unlikely to be able to migrate directly to the PRA area.
1.2 Estimate the number of relevant pathways, of different commodities, from different origins, to different end uses.	Few	Mainly relating to the genus *Quercus* moving along the plants for planting route.
1.3 Select from the relevant pathways, using expert judgement, those which appear most important. If these pathways involve different origins and end uses, it is sufficient to consider only the realistic worst-case pathways. The following group of questions on pathways is then considered for each relevant pathway in turn, as appropriate, starting with the most important.		
Pathway n°:1		Plants for planting of host-plants
Probability of the pest being associated with the individual pathway at origin.		
1.4 How likely is the pest to be associated with the pathway at origin?	Likely	Plants for planting in a nursery or other site of production in an area where the pest is present could be a source for egg masses and, when nests are present, larval or pupal stages of the moth.
1.5 Is the concentration of the pest on the pathway at origin likely to be high, taking into account factors like cultivation practices, treatment of consignments	Moderately likely	This is not currently a regulated pest and since the moth flies in mid-summer and deposits eggs which would be present and not easy to detect during the plant dormant period it is unlikely to be detected and could be present at moderately high concentration, especially in outbreak years.
1.6 How large is the volume of the movement along the pathway?	Moderate	There is increasing movement of plants for planting of a wide range of plant genera throughout the EU and from the rest of the EU to the PRA area. Of particular concern is

		the increasing trade in semi-mature trees for 'instant' landscape use where presence of egg masses is more likely to escape detection. Provisional estimates are that up to 50 million plants enter the UK annually
1.7 How frequent is the movement along the pathway?	Often	There is an increasing volume and frequency of movement.
Probability of survival during transport or storage		
1.8 How likely is the pest to survive during transport /storage?	Very likely	The most likely stage is the egg stage, which survives well from September to April, when the larvae hatch.
1.9 How likely is the pest to multiply/increase in prevalence during transport /storage?	Very unlikely	The only likelihood of increase is if adults emerge during transit, mate and lay eggs. This is considered to be very unlikely.
Probability of the pest surviving existing pest management procedures		
1.10 How likely is the pest to survive or remain undetected during existing phytosanitary measures?	Likely	*T. processionea* is not currently a regulated pest and so there are no regulations or inspection regimes for this pest. It would, therefore, remain undetected unless there was an issue with presence of old nests and urticating hairs causing irritation from those while handling the plants.
1.11 In the case of a commodity pathway, how widely is the commodity to be distributed throughout the PRA area?	Widely	It is assumed that plants for planting would be distributed anywhere within the PRA area.
1.12 In the case of a commodity pathway, do consignments arrive at a suitable time of year for pest establishment?	Yes	Most plants for planting are shipped during the dormant season of the plant which is linked to the overwintering egg stage of the pests. In this case the eggs would hatch when the trees commence growing in the spring.
1.13 How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	Very likely	Since the principal pathway is plants for planting, larvae hatching from eggs will be able to feed immediately on a suitable host plant.
1.14 In the case of a commodity pathway, how likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	Very likely	Planting is the intended use and it is very likely to aid transfer.

Consideration of further pathways		
1.15 Do other pathways need to be considered?	Yes	
Pathway n°:2		Roundwood of oak with bark present
Probability of the pest being associated with the individual pathway at origin.		
1.4 How likely is the pest to be associated with the pathway at origin?	Moderately Likely	During severe infestations the trunks of affected trees may have extensive nests produced by the feeding larvae of OPM. These nests may still be present when the tree is felled and, from May to late July, these could contain viable larvae or pupae.
1.5 Is the concentration of the pest on the pathway at origin likely to be high, taking into account factors like cultivation practices, treatment of consignments	Moderately likely	This pathway will be concerned most with mature trees sawn for export. The concentration of the pest could be high in locations where there are large outbreaks. However, the presence of the pest would be likely to affect felling practice because of the irritating hairs of the larvae and this may result in avoidance of affected trees. There are no hard data on this but, combined with the relatively short duration of larvae/pupae associated with nests on the trunks (as opposed to larvae feeding in the crowns) the concentration of the pest will only be sporadically high.
1.6 How large is the volume of the movement along the pathway?	Moderate	There is trade of high quality oak logs with various EU Member States where the moth is present.
1.7 How frequent is the movement along the pathway?	Often	There is a well established trade in oak roundwood and, within the EU, this is not regulated for any pest species.
Probability of survival during transport or storage		
1.8 How likely is the pest to survive during transport /storage?	Moderately likely	If either larval or pupal stages are present in nests of the moth they will survive the journey provided that the duration is within approximately a month of felling the tree. Younger larvae that may be present in nests would need to emerge to feed and this would reduce their chances of surviving the journey. The most likely stage to survive is the fully fed final instar larva or the pupa. In both cases the duration of the stage is approximately two weeks, which would limit survival.
1.9 How likely is the pest to multiply/increase in prevalence during transport /storage?	Very unlikely	The only likelihood of increase is if adults emerge during transit, mate and lay eggs. This is considered to be very unlikely because the adult moths only lay eggs on branches of trees, which would be absent during transit.

Probability of the pest surviving existing pest management procedures		
1.10 How likely is the pest to survive or remain undetected during existing phytosanitary measures?	Unlikely	Although *T. processionea* is not currently a regulated pest and so there are no regulations or inspection regimes for this organism, the presence of nests on this pathway are likely to be detected during normal handling of the commodity.
1.11 In the case of a commodity pathway, how widely is the commodity to be distributed throughout the PRA area?	Widely	The end users of this commodity could be anywhere in the country.
1.12 In the case of a commodity pathway, do consignments arrive at a suitable time of year for pest establishment?	Yes	This commodity could be shipped at any time of the year. However, the actual risk is limited to the period May to July when there could be viable larvae or pupae present.
1.13 How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	Moderately likely	The likelihood of larvae moving from the pathway to a suitable host is low because of the need to move to suitable hosts to re-commence feeding. Pupae represent a higher risk because they could emerge as adults and, provided that the emergent adults are able to mate, this could result in oviposition on suitable hosts nearby.
1.14 In the case of a commodity pathway, how likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	Unlikely	The end point of this high value commodity is conversion into timber or veneer which would result in complete destruction of the pest during the process.
Consideration of further pathways		
1.15 Do other pathways need to be considered?	No	
Conclusion on the probability of entry		
The overall probability of entry should be described and risks presented by different pathways should be identified.		Plants for Planting: It is considered that probability of entry is medium to high in relation to likelihood of eggs being transported on plants for planting originating in areas where the pest is known to be present. The increasing distribution of the pest in Europe means that more countries that trade plants for planting to the PRA area are likely to have populations of oak processionary moth present. Roundwood of oak with bark: It is considered that the probability of entry is low both

		because of the limited time window of the identified risk and also for the end use of the commodity, which would result in complete destruction of any viable larvae or pupae present.
Probability of Establishment		
<u>Availability of suitable hosts or suitable habitats, alternate hosts and vectors in the PRA area</u>		
1.16 a Specify the host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants) present in the PRA area.		Host plants include the genus *Quercus* and, to a lesser extent, the genera *Betula, Carpinus, Castanea Corylus* and *Fagus.*
1.16 b Estimate the number of host plant species or suitable habitats in the PRA area.	Many	These genera are very common forestry, woodland or ornamental trees. For example, there are over 220,000 ha of oak woodlands in Great Britain (Source: National Inventory of Trees and Woodlands, Forestry Commission, 2006), which combined with trees in urban and peri-urban situations, has been estimated to total in excess of 400 million oak trees..
1.17 How widespread are the host plants or suitable habitats in the PRA area? (specify)	Widely	Widespread throughout the PRA area in both urban and rural locations.
1.18 If an alternate host is needed to complete the life cycle, how widespread are alternate host plants in the PRA area?	Not relevant	
1.19 If the pest requires another species for critical stages in its life cycle such as transmission, (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers), how likely is the pest to become associated with such species?	Not relevant	
<u>Suitability of the environment</u>		
1.19A Specify the area where host plants (for pests directly affecting plants) or suitable habitats (for non parasitic plants) are present		Mainly the southern half of the PRA area, although climate change is regarded as increasing the potential eco-climatic range of the pest.

(cf. QQ 1.16-1.19). This is the area for which the environment is to be assessed in this section. If this area is much smaller than the PRA area, this fact will be used in defining the endangered area.		
1.20 How similar are the climatic conditions that would affect pest establishment, in the PRA area and in the current area of distribution?	Completely similar.	The climatic conditions in the UK, especially the southern half, are very similar to northern France, Belgium and The Netherlands where the pest has already established in recent years. The moth has survived at least one winter and summer season in London since it was first recorded in 2006.
1.21 How similar are other abiotic factors that would affect pest establishment, in the PRA area and in the current area of distribution?		There are no known other abiotic factors that would affect establishment of the pest.
1.22 If protected cultivation is important in the PRA area, how often has the pest been recorded on crops in protected cultivation elsewhere?	Not relevant	
1.23 How likely is that establishment will not be prevented by competition from existing species in the PRA area?	Likely	There are other defoliators on oak that could affect food availability for young larvae of oak processionary moth. However, it is unlikely that this would affect establishment unless there was complete coincidence of life cycle and direct competition for limited food resources on the same plant.
1.24 How likely is that establishment will not be prevented by natural enemies already present in the PRA area?	Very likely	Generalist natural enemies could have some impact on pest population build up, but this is not likely during the establishment phase.
<u>Cultural practices and control measures</u>		
1.25 To what extent is the managed environment in the PRA area favourable for establishment?	Highly favourable	The linkage to plants for planting as the main pathway and the fact that many of these plants are located in urban environments that tend to provide stressed conditions for the host plants and locally higher average temperatures all favour establishment of the moth. There is already evidence from London that is has found suitable conditions for survival and rapid larval development.
1.26 How likely is it that existing control or	Very likely	Although there is an element of post-planting care of the host trees, this will tend to miss

husbandry measures will fail to prevent establishment of the pest?		the incipient populations of the moth during an early establishment phase. The trend of population growth apparent after the moth established in The Netherlands also indicates that it is not easy to find during the endemic phase but this then leads to highly apparent damaging populations in the epidemic phase.
1.27 How likely is it that the pest could survive eradication programmes in the PRA area?	Moderately likely	Oak processionary moth is difficult to spot during the early establishment phase but, if populations can be located, then application of insecticides to the young larvae, supplemented by removal of nests during the pupal stage, could result in eradication. However, this is dependent on location of all incipient populations.
Other characteristics of the pest affecting the probability of establishment		
1.28 How likely is the reproductive strategy of the pest and the duration of its life cycle to aid establishment?	Moderately likely	Although the pest only has one generation per year, the cryptic habit of the overwintering egg stage makes it very difficult to spot low density populations, which could then build up in separate locations. Fortunately, the female stage does not fly long distances but, nevertheless, local dispersal could result in many foci of infestation and these would all be liable to result in viable populations.
1.29 How likely are relatively small populations or populations of low genetic diversity to become established?	Likely	It is apparent from experiences in The Netherlands and, recently, from London that small local populations of the moth are viable and that genetic diversity is, therefore, not likely to be a restriction on establishment.
1.30 How adaptable is the pest?	High	The pest has spread northwards during the 20th Century and this has been attributed to its ability to adapt to changing climatic conditions. It feeds on many species in the genus *Quercus*, as evidenced by observations in the arboretum at Kew Gardens.
1.31 How often has the pest been introduced into new areas outside its original area of distribution? (specify the instances, if possible)	Often	Although it is not known precisely how the pest has moved northwards in Europe, the fact that is has extended its original area of distribution very widely and has also bred successfully in London indicates that is easily moved to new locations.
1.32 Even if permanent establishment of the pest is unlikely, how likely are transient populations to occur in the PRA area through natural migration or entry through man's activities (including intentional release into the environment) ?	Likely	As indicated, plants for planting is the most likely pathway for establishment of both permanent and transient populations. It is not yet known whether the populations in London are transient but extrapolation from its northward progression in Europe suggests strongly that there are no major barriers to establishment. It is unlikely, but possible at low probability, that gravid female moths could fly or be blown from continental Europe. However, this is felt to be insignificant compared with the plants for planting pathway.

Conclusion on the probability of establishment		
The overall probability of establishment should be described.		The pest is already established in a restricted part of the PRA area. Climatic conditions in the PRA region are suitable and host plants are widely distributed. The probability of establishment is, therefore, considered to be high.
Probability of spread		
1.33 How likely is the pest to spread rapidly in the PRA area by natural means?	Likely	There is strong evidence from its expanding range in Europe that the moth can spread rapidly through a combination of increasingly suitable climate and the wide distribution of host trees in the genus *Quercus*.
1.34 How likely is the pest to spread rapidly in the PRA area by human assistance?	Very likely	Plants for planting are moved both nationally and internationally which, combined with the cryptic nature of the overwintering egg stage, could result in rapid movement of the pest within the PRA area.
1.35 How likely is it that the spread of the pest will not be contained within the PRA area?	Moderately likely	The likelihood of containing the pest within the currently identified infested area depends on whether the extent of the infestations can be identified quickly in order to attempt eradication in the near future. If it is felt that the infested areas are limited then consideration would need to given to phytosanitary containment measures to prevent further spread or further arrivals from Europe.
Conclusion on the probability of spread		
The overall probability of spread should be described.		The probability of spread is high if it is not possible to eradicate or severely contain the moth in its current known infested area.
Conclusion on the probability of introduction and spread		
The overall probability of introduction and spread should be described. The probability of introduction and spread may be expressed by comparison with PRAs on other pests.		The overall probability of introduction and spread is high, taking particular account of the successful breeding of the moth in London.

Conclusion regarding endangered areas		
1.36 Based on the answers to questions 1.16 to 1.35 identify the part of the PRA area where presence of host plants or suitable habitats and ecological factors favour the establishment and spread of the pest to define the endangered area.		The pest feeds on many species in the genus *Quercus*. This genus is widespread in the PRA area, both in urban and rural environments. Although formal climate matching has not been carried out, the presence of very large populations of the moth in Belgium and The Netherlands indicates that it is unlikely to be climatically limited in the UK, at least in the southern half of the country.
2 Assessment of potential economic consequences		
2.0 In any case, providing replies for all hosts (or all habitats) and all situations may be laborious, and it is desirable to focus the assessment as much as possible. The study of a single worst-case may be sufficient. Alternatively, it may be appropriate to consider all hosts/habitats together in answering the questions once. Only in certain circumstances will it be necessary to answer the questions separately for specific hosts/habitats.		Oak as both a timber tree and as an important amenity tree, is the main host considered in relation to economic and other consequences.
Pest effects		
2.1 How great a negative effect does the pest have on crop yield and/or quality to cultivated plants or on control costs within its current area of distribution?	Major	The impacts of the moth in its range, both traditional and expanding, in Europe are through loss of growth increment as a result of complete defoliation of host trees and also the human and animal health consequences. Although the consequences of defoliation have led to frequent insecticide applications, there are no economic analyses of the direct impacts of the moth (Müller 2006). A measure of impact, however, is the frequent use of *Bacillus thuringiensis* as a control measure (Martin & Bonneau 2006). Although difficult to quantify in economic terms, the additional consequences of effects on human and animal health have had a considerable bearing on the need to control the moth in its native and expanding range (Gottschling & Meyer 2006).
2.2 How great a negative effect is the pest	Major	Similar damage and effects on human and animal health would occur in the PRA area.

likely to have on crop yield and/or quality in the PRA area?		
2.3 How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area?	Major	Increased surveillance and increased referral to health authorities arising from the effects of the urticating hairs is likely to increase costs of management of both the control measures directly on oak and on the human and animal health sectors.
2.4 How great a reduction in consumer demand is the pest likely to cause in the PRA area?	Moderate	There will be some loss of production of oak but the largest effects will be avoidance of infested oaks in relation to the threat from contact with urticating haris.
2.5 How important is environmental damage caused by the pest within its current area of distribution?	Moderate	As a periodic pest of oak there are some years when severe defoliation reduces the viability of oak trees and, in combination with other biotic and abiotic factors (such as climate change) the moth would contribute to the general syndrome of oak decline (Thomas, Blank & Hartmann 2002).
2.6 How important is the environmental damage likely to be in the PRA area?	Minor	For example, the UK Forest Condition survey that has been carried out for the past 25 years identifies oak, an important plant in the EPPO region, as the only tree genus that has suffered a consistent decline in crown density (Hendry *et al.* 2005). Attack on *Quercus* would cause environmental damage by adding to this decline.
2.7 How important is social damage caused by the pest within its current area of distribution?	Major	The interaction of people and trees is in increasingly important element in determining the potential of social damage arising from biotic, abiotic or anthropogenic influences (Cheng, Kruger & Daniels 2003). Defoliation of trees would be a significant social issue where they are valued highly as part of the landscape and the various episodes of defoliation from OPM and other defoliating species have received considerable attention in Europe, leading to frequent applications of pesticides to protect the trees.
2.8 How important is the social damage likely to be in the PRA area?	Major	The importance of trees in urban and rural environments in the UK is an increasingly high factor in the social and health agendas (O'Brien 2005). If the levels of defoliation experienced on continental Europe were experienced here, there would be both social and health problems that would require active intervention.
2.9 How likely is the presence of the pest in the PRA area to cause losses in export markets?	Unlikely	Since the pest is already widespread in Europe, which would represent the main market for any plants for planting originating in the UK, the effects on export markets would be small.
2.9A As noted in the introduction to section 2, the evaluation of the following questions may not be necessary if any of the		

responses to questions 2.2, 2.3, 2.4, 2.6 2.8 or 2.9 is “major or massive” or "very likely” or "certain". You may go directly to point 2.16 unless a detailed study of impacts is required.		
2.10 How easily can the pest be controlled in the PRA area?		
2.11 How likely is it that natural enemies, already present in the PRA area, will not suppress populations of the pest if introduced?		
2.12 How likely are control measures to disrupt existing biological or integrated systems for control of other pests or to have negative effects on the environment?		
2.13 How important would other costs resulting from introduction be?		
2.14 How likely is it that genetic traits can be carried to other species, modifying their genetic nature and making them more serious plant pests?		
2.15. How likely is the pest to act as a vector or host for other pests?		
2.15A Do you wish to consider the questions 2.1 to 2.15 again for further hosts/habitats?	No	
Conclusion of the assessment of economic consequences		
2.16 Referring back to the conclusion on endangered area (1.36), identify the parts of the PRA area where the pest can establish and which are economically most at risk.		The economic and social impacts are likely to be periodically high, depending on the cyclicity of defoliation episodes, as observed in continental Europe.
Degree of uncertainty		

Estimation of the probability of introduction of a pest and of its economic consequences involves many uncertainties. In particular, this estimation is an extrapolation from the situation where the pest occurs to the hypothetical situation in the PRA area. It is important to document the areas of uncertainty and the degree of uncertainty in the assessment, and to indicate where expert judgement has been used. This is necessary for transparency and may also be useful for identifying and prioritizing research needs. It should be noted that the assessment of the probability and consequences of environmental hazards of pests of uncultivated plants often involves greater uncertainty than for pests of cultivated plants. This is due to the lack of information, additional complexity associated with ecosystems, and variability associated with pests, hosts or habitats.		Although it has not been shown unequivocally, there is a very high probability that the existing 'hot spots' of the moth in London are associated with new plantings of imported specimen trees from infested areas of Europe. It seems highly likely that further incursions of the moth via this pathway are likely, particularly when populations of OPM in Europe are high (as is the case during 2007). There is, therefore, little uncertainty about the likely pathway of introduction. The fact that the moth is already breeding in London and appears to have very similar life cycle timing compared with populations in Europe indicates strongly that it is likely to persist under UK conditions. However, there is still relatively little experience of the biology and ecology of the moth in the PRA area and this would require more detailed observation and research.
Conclusion of the pest risk assessment		
Entry: Evaluate the probability of entry and indicate the elements which make entry most likely or those that make it least likely. Identify the pathways in order of risk and compare their importance in practice.		Probability of entry is high • Plants for planting of host plants is a high risk pathway • Round Wood of host plants of *T. processionea*: low to medium, depending on the time of year. The probability of entry is considered high because there is active trade in the high risk pathway and populations of the moth reach high levels at approximately five year intervals in Europe. The northward spread of the moth in continental Europe is also a

		strong indicator that climatic factors will not restrict either establishment or longer term survival and expansion.
Establishment Evaluate the probability of establishment, and indicate the elements which make establishment most likely or those that make it least likely. Specify which part of the PRA area presents the greatest risk of establishment.		Probability of establishment is high for southern Britain. Further assessment is required to determine the likelihood of establishment in more northerly parts of Britain.
Economic importance List the most important potential economic impacts, and estimate how likely they are to arise in the PRA area. Specify which part of the PRA area is economically most at risk.		The economic impact is high Main impact is on wood quality but there would be an impact on, for example, tourism in areas such as the New Forest, the Forest of Dean and Sherwood Forest which have significant oak components.
Overall conclusion of the pest risk assessment The risk assessor should give an overall conclusion on the pest risk assessment and an opinion as to whether the pest or pathway assessed is an appropriate candidate for stage 3 of the PRA: the selection of risk management options, and an estimation of the pest risk associated.		The pest poses a major threat to oak forests and woodlands in both urban and rural situations and, therefore, represents a significant phytosanitary threat that, alone, would indicate the need for appropriate action to attempt eradication or longer-term management of the pest. The additional serious threats to human and animal health through reactions to the urticating hairs provide additional reasons for initiation of measures to manage the pest.
This is the end of the Pest risk assessment		

Stage 3: Pest risk Management		
3.1. Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combination an acceptable risk?	No	
Pathway n°1		Plants for planting of host plants
3.2. Is the pathway that is being considered a commodity of plants and plant products?	Yes	
Existing phytosanitary measures		
3.10. Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest	No	The oak processionary moth is not a regulated pest within the EU and, therefore, there are no existing phytosanitary measures against this or any similar pests that would prevent introduction.
Identification of appropriate risk management options		
Options for consignments		
Detection of the pest in consignments by inspection or testing		
3.11. Can the pest be reliably detected by a visual inspection of a consignment at the time of export during transport/storage or at import?	Yes	Careful visual examination of Plants for Planting for the presence of egg masses during the dormant season should reveal the presence of infestation. The presence of nests either on the trees themselves or in the immediate vicinity of the place of production would also be an indicator of possible contamination with eggs.
3.12. Can the pest be reliably detected by testing (e.g. for pest plant, seeds in a consignment)?	No	
3.13. Can the pest be reliably detected during post-entry quarantine?	Yes	Visual inspection for eggs during the dormant season would provide a measure for detection of the presence of the moth. An additional measure could be to require post-entry quarantine to determine whether any larval infestations (indicated by defoliation and presence of nests) become apparent in the period from April to late June.
Removal of the pest from the consignment by treatment or other phytosanitary procedures		

3.14. Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?	No	There is no proven measure to remove eggs, other than physical removal or topical application of contact insecticides. This is not considered to be practical.
3.15. Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment? (This question is not relevant for pest plants)	No	Eggs on branches are the means of transfer along this pathway and removal of branches would severely damage or even kill the plants.
3.16. Can infestation of the consignment be reliably prevented by handling and packing methods?	No	Live plants have to be moved with root balls and soil. There is no measure related to handling and packing methods that could be used.
Prevention of establishment by limiting the use of the consignment		
3.17. Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?	No	Not for this pathway
Options for the prevention or reduction of infestation in the crop		
Prevention of infestation of the commodity		
3.18. Can infestation of the commodity be reliably prevented by treatment of the crop?	Yes	Insecticide treatment of the plants at the time of adult flight could act as a preventative measure. However, there are no data to support this approach and it would require verification. Routine application of a contact insecticide to the bare branches could also be an option but, again, this would need to be tested and would not be a measure of choice because of the difficulty of ensuring adequate coverage and efficacy.
3.19. Can infestation of the commodity be reliably prevented by growing resistant cultivars? (This question is not relevant for pest plants)	No	There is growing evidence that many species of oak are susceptible (e.g. recent observations in Kew Gardens).

3.20 Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water...)?	Yes	Area freedom from the pest may be feasible, but this would require that only nurseries in areas well north of current infestations could comply. Since the risk is linked to oviposition by female moths flying into the crop, measures to attract females from the sites could be tested, but there are no data to indicate whether these would prove reliable. The use of screened greenhouses may be an option.
3.21. Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?	No	Plants for planting could have live stages of the moth at any time of the year. The nature of trade in this pathway tends to favour the dormant season when there are no leaves on the trees and this is the stage when it is most difficult to spot the moth (i.e, the egg stages).
3.22. Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?	Yes	It is conceivable that a rigorous regime of inspection in both the vicinity (to detect moth populations on standing trees) and, especially, in the place of production could allow a clean plant regime to be developed.
Establishment and maintenance of pest freedom of a crop, place of production or area		
3.23. Has the pest a very low capacity for natural spread?	No	
3.24. Has the pest a low to medium capacity for natural spread?	Yes	Females of the moth are not regarded as strong fliers and thus pest-free areas or place of production and a defined immediate vicinity options may be appropriate.
3.25. Has the pest a medium capacity for natural spread?	No	
3.26. The pest is of medium to high capacity for natural spread	No	
3.27. Can pest freedom of the crop, place of production or an area be reliably guaranteed?	No	The ability of the females to fly a low number of kilometres, which constitutes a low to medium capacity for natural spread, would still make it difficult to guarantee that a place of production or area would be free of the pest. However, nurseries in the north of Europe in countries where the moth is not yet recorded to be breeding would comply.
Consideration of other possible measures		

3.28. Are there effective measures that could be taken in the importing country (surveillance, eradication) to prevent establishment and/or economic or other impacts?	Yes	Surveillance and eradication is a possibility, but would require concerted action and could be demanding of resources.
Evaluation of risk management options		
3.29. Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest?	Yes	Inspection combined with either a pest-free area or place of production and (defined) immediate vicinity freedom.
3.30. Taking each of the measures identified individually, does any measure on its own reduce the risk to an acceptable level?	No	There would need to be a combination of inspections and possible direct measures to ensure place of production freedom.
3.31. For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?	Yes	See above.
3.32 If the only measures available reduce the risk but not down to an acceptable level, such measures may still be applied, as they may at least delay the introduction or spread of the pest. In this case, a combination of phytosanitary measures at or before export and internal measures (see question 3.29) should be considered.		
3.33. Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.	Medium	Any measures would interfere with the current internal market of the EU.. Plants intended for planting, of *Quercus* spp., already require to be accompanied by a plant passport in accordance with Annex VAI, point 2.1. However, many of these are believed to come from parts of the EU where the pest is known to occur and thus, the ability for these places of production to continue to supply plants would be limited. As the pest has not been recorded outside the EU and neighbouring countries, including North Africa,, there is little or no predicted impact on imports from third countries.

3.34. Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.	High	The measures would be cost-effective if further incursions of the moth could be prevented, while allowing the incipient populations in London to be managed or, ideally, eradicated.
3.35. Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?	Yes	The combination of either pest-free areas or places of production and immediate vicinity freedom, inspection and generally raised awareness by the exporters should result in minimal interference with international trade. In fact, the increased surveillance should reduce the likelihood of contact with urticating hairs by the staff at the place of production, reducing the social effects.
3.37. Have all major pathways been analyzed (for a pest-initiated analysis)?	No	
Pathway n°2		Round wood of host plants
3.2. Is the pathway that is being considered a commodity of plants and plant products?	Yes	
Existing phytosanitary measures		
3.10. Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest	No	Within the EU, there are no existing phytosanitary measures.
Identification of appropriate risk management options		
Options for consignments		
Detection of the pest in consignments by inspection or testing		
3.11. Can the pest be reliably detected by a visual inspection of a consignment at the time of export during transport/storage or at import?	Yes	The presence of nests on the bark of cut logs should be detectable by visual inspection.
3.12. Can the pest be reliably detected by testing (e.g. for pest plant, seeds in a consignment)?	N/A	

3.13. Can the pest be reliably detected during post-entry quarantine?	Yes	Inspection for presence of nests.
Removal of the pest from the consignment by treatment or other phytosanitary procedures		
3.14. Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?	Yes	Fumigation, heat treatment, kiln drying, debarking, physical removal of nests. Unless there is a more pressing phytosanitary reason, either debarking or physical removal of nests are the only measures that are cost- or environmentally-effective for OPM.
3.15. Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment? (This question is not relevant for pest plants)	Yes	Depending on the final use of the logs, removal of the bark could be done without reducing the value. However, this carries an intrinsic cost.
3.16. Can infestation of the consignment be reliably prevented by handling and packing methods?	No	
Prevention of establishment by limiting the use of the consignment		
3.17. Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?	Yes	The presence of larvae of pupae in nests of OPM only presents a risk during the period April to July. Importations outside this period are free of risk.
Options for the prevention or reduction of infestation in the crop		
Prevention of infestation of the commodity		
3.18. Can infestation of the commodity be reliably prevented by treatment of the crop?	Yes	Application of insecticides is often carried out and could result in low or nil larval populations on treated trees. This would reduce the risk of nests being formed on the bark.
3.19. Can infestation of the commodity be reliably prevented by growing resistant cultivars? (This question is not relevant for pest plants)	No	

3.20 Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water...)?	No	
3.21. Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?	Yes	If the trees are felled outside the larval or pupal periods there is little or no risk of infestation on the main trunk.
3.22. Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?	No	This pathway is associated with large trees and it would be difficult to establish general freedom from the pest.
Establishment and maintenance of pest freedom of a crop, place of production or area		
3.23. Has the pest a very low capacity for natural spread?	No	
3.24. Has the pest a low to medium capacity for natural spread?	Yes	Females of the moth are not regarded as strong fliers and thus pest-free areas or place of production and a defined immediate vicinity options may be appropriate.
3.25. Has the pest a medium capacity for natural spread?	No	
3.26. The pest is of medium to high capacity for natural spread	No	
3.27. Can pest freedom of the crop, place of production or an area be reliably guaranteed?	No	The ability of the females to fly a low number of kilometres, which constitutes a low to medium capacity for natural spread, would still make it difficult to guarantee that a place of production or area would be free of the pest. However, nurseries in the north of Europe in countries where the moth is not yet recorded to be breeding would comply
Consideration of other possible measures		

3.28. Are there effective measures that could be taken in the importing country (surveillance, eradication) to prevent establishment and/or economic or other impacts?	Yes	Surveillance and eradication is a possibility, but would require concerted action and could be demanding of resources.
Evaluation of risk management options		
3.29. Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest?	Yes	Inspection for presence of nests or importation only during the period when no larvae or pupae are likely to be present. Possible direct treatment or debarking.
3.30. Taking each of the measures identified individually , does any measure on its own reduce the risk to an acceptable level?	Yes	Importation outside the larval/pupal period.
3.31. For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?	Yes	Inspection for absence of OPM nests and/or debarking.
3.32 If the only measures available reduce the risk but not down to an acceptable level, such measures may still be applied, as they may at least delay the introduction or spread of the pest. In this case, a combination of phytosanitary measures at or before export and internal measures (see question 3.29) should be considered.		
3.33. Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.	Low	The measures are not likely to interfere with international trade. If inspection and possible debarking is applied, this will carry an additional cost. Importation outside the larval/pupal period carries no additional cost.
3.34. Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.	High	The measures are generally nil to low cost and are cost-effective.

3.35. Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?	Yes	Importation outside the larval/pupal period, or inspection for presence of nests, or requirement for bark-free wood.
3.37. Have all major pathways been analyzed (for a pest-initiated analysis)?	Yes	
3.40 Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment		
3.41. All the measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners.		
3.42. In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) may be required for certain commodities. The PC is an attestation by the exporting country that the requirements of the importing country have been fulfilled. In certain circumstances, an additional declaration on the PC may be needed (see EPPO Standard PM 1/1(2): Use of phytosanitary certificates)		

Conclusion of Pest Risk Management. Summarize the conclusions of the Pest Risk Management stage. List all potential management options and indicate their effectiveness. Uncertainties should be identified.		Measures have been selected for all pathways • Plants for planting Inspection for the absence of the egg stages of OPM is a feasible process that would need to be combined with measures to establish pest free place or area of production. The ability of the female to fly a low number of kilometres means that pest-free place of production would be difficult to establish. However, direct inspection of plants for export combined with knowledge, based on surveys, of the degree of infestation on standing trees in the general area of the place of production should provide a high level of protection. • Round wood Export only during the period of the year when no larvae or pupae are likely to be present in any nests present on the wood. Inspection at origin for the presence of nests of OPM. Requirement for bark-freedom **The degree of uncertainty is low to medium:** There is strong circumstantial evidence that the infestations in London were initiated through importation of plants for planting for street and amenity plantings. Methods for determining place of production freedom would need to be determined and tested.

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