Forestry Commission

Contingency Plan for the Pine Processionary Moth (*Thaumetopoea pityocampa*)

Introduction and scope

Introduction

1. Serious or significant pests require strategic-level plans developed at a national level describing the overall aim and high-level objectives to be achieved, and the response strategy to either eradicate or contain an outbreak.
2. The Plant Health Risk Group (PHRG) has commissioned, following identification by the Risk Register, Pest-Specific Contingency Plans for those pests that pose the greatest risk and require stakeholder consultation. The Forestry Commission is also prioritising other plans that require updating, including that for pine processionary moth.
3. The purpose of these Pest-Specific Contingency Plans is to ensure a rapid and effective response to outbreaks of the pest or diseases described.
4. Contingency planning starts with the anticipation and assessment of potential threats, includes preparation and response, and finishes with recovery.

Anticipation

5. Researching sources of information and intelligence about the pest, including surveillance and horizon scanning.

Assessment

6. Identifying concerns and the preparation of plans.
7. Set outbreak objectives.

Preparation

8. Ensuring that staff and stakeholders are familiar with the pest.

Response

9. Determining the requirements for either contain or eradicate including work to determine success.

Recovery

10. Identifying when the response strategy has been effective or when the response is not considered feasible, cost effective or beneficial.

11. The Defra Contingency Plan for Plant Health in England (in draft) gives details of the teams and organisations involved in pest response in England, and their responsibilities and governance. It also describes how these teams and organisations work together in the event of an outbreak of a plant health pest.

Scope

This contingency plan was prepared by the Forestry Commission's cross-border Plant Health Service to be used at country and national (GB) levels. It should be used in England in conjunction with the Defra Plant Health Contingency Plan, which was developed by Defra/APHA, and which provides details as to the level of response required and by whom, depending on the scenario. Forestry Commission England's Forest Services will use OGB17b 'Managing Incidents in the Forestry Commission' for relevant incidents. Forestry Commission Scotland and the Welsh Government will develop similar documents detailing their management of outbreaks. When an outbreak becomes of UK or Great Britain-wide concern, the UK Chief Plant Health Officer will form an outbreak management team to co-ordinate the activities in the different countries.

This contingency plan falls into three main parts:

- official action following a presumptive diagnosis;
- official action following the confirmation of an outbreak; and
- background information about the pest.

This contingency plan covers outbreaks of *Thaumetopoea pityocampa* in all situations where pine (*Pinus* species) and other suitable host species are planted or occur naturally, i.e. forestry, natural and semi-natural habitats, agricultural landscapes, urban environments, and parks and gardens. It is designed to help government agencies anticipate, assess, prepare for, prevent, respond to, and recover from outbreaks of the pest.

This plan will be updated following new information, lessons identified from outbreaks of other pests, or changes in policy or contact details. (Last updated March 2016.)

Objectives of this plan

- To raise awareness of the potential threat posed by *T. pityocampa,* and therefore ensure that stakeholders are aware of how to identify the various life stages and the symptoms caused by infestation of the host tree by this pest.
- To provide guidance on steps to be taken whenever the pest or symptoms of attack by *T. pityocampa* are observed.
- To ensure that infestations of *T. pityocampa* are managed promptly with the aim of eradicating pioneer populations of the moth or, if a population is found to be established, slowing the rate of spread and lessening its impact.
- To ensure that all relevant Forestry Commission staff, other government agencies and local authorities are conversant with the contents of this contingency plan so that effective and immediate action is implemented.
- To ensure that good communications are put in place so that all stakeholders (including the media) are kept fully informed of the scale of infestation both at regional and national levels.

Anticipation and Assessment

1.1. *Thaumetopoea pityocampa* (Denis & Schiffermüller, 1775) (Lepidoptera, Notodontidae, Thaumetopoeinae), commonly known as the pine processionary moth, is a highly destructive species affecting pine across Europe and North Africa.

1.2. Its current geographic range extends from North Africa to southern Europe, from the Atlantic coast to western parts of Turkey.

1.3. Hosts include a range of *Pinus* and *Cedrus* species. It has also been observed on other conifer species, including those in the genera *Larix* and *Pseudotsuga.*

1.4. It is a serious defoliator of pine and cedar, causing significant reductions in tree growth, and has the potential to cause tree mortality, particularly in young plantations (EPPO 2004).

1.5. It can pose a risk to human and animal health because the larvae have irritating hairs that can cause skin problems, conjunctivitis, respiratory congestions and asthma in humans. Contact with larvae, cocoons, nests and debris-infested pine trees can cause dermatitis and other symptoms.

1.6. The hairs can become detached and carried into contact on air currents, so proactive contact is not necessary to cause health problems.

1.7. It is officially absent from the UK, although a transient population of larvae was found in a UK nursery in 1995 on Scots pine plants which had been imported from Italy in 1994 (Starzewski, 1998). After treatment and follow up, survey results were negative, emphasising the transient nature of the population.

Preparation

2.1. *Thaumetopoea pityocampa* is not currently listed in the EC Plant Health Directive, nor is it on the EPPO quarantine listings. It has a mitigated risk rating in the UK Plant Health Risk Register of 60/125, with current mitigations of 'research' and 'regulation' proposed as further mitigating actions.

2.2. The pest has been increasing its range northwards in France, and is now present to the north of Paris as well as in parts of Brittany.

2.3. Defra has produced and consulted on a Rapid Pest Risk Assessment (December 2015) for this species. Based on modelling work with the limited data available, it is judged to be possible for the pest to establish in the UK. It is expected that any colonies would likely to be restricted to Cornwall, the southern coast of England, coastal Pembrokeshire and London and would be smaller, due to the marginally favourable climate, and thus overall survival would also be lower. High levels of defoliation over large areas only appear

to be reported from more southerly parts of France, and thus it is expected that, in the UK, economic and environmental damage through tree defoliation will be minimal apart from in exceptionally mild sunny winters when higher levels of damage could be sustained. The Rapid PRA recommends that PZ status is sought for the UK.

2.4. An EPPO datasheet is available on the pest.

Response

Legislation

3.1. A list of all the relevant legislation which might be pertinent to a *T. pityocampa* outbreak is given in Appendix 3.

Trigger

3.2. The key indicators which would trigger a response are findings or reports of:

- characteristic silken (candy floss-like) nests observed in the canopy of host trees;
- egg masses, larvae or pupae being discovered in association with live plants imported for planting;
- a live insect or insects found in the wider environment; or
- findings in a light trap (single females or multiple males).

Official action following a presumptive diagnosis

Communication

3.3. In England, a duty officer (from Forestry Commission England or the Animal & Plant Health Agency (APHA) will act as a point of contact for incidents, and it is their job to assign a response officer to incidents when they occur. Similar arrangements are expected to be in place in Scotland and Wales. The response officer investigates and reports back to the Defra Contingency Core Group. For outbreaks in Scotland and Wales, respective country teams will fully manage the outbreak as per their own generic contingency plans, but will provide updates to the Defra Contingency Core Group for information

purposes, and for Defra to report to ministers and the European Commission (EC).

3.4. The response officer will gather information including the location, likely origin, host or commodity, level of damage, extent of outbreak and chance of spread. Based on the information fed back to the Contingency Core Group, in England it will decide upon the alert status given (black, amber or red), which will determine the level of response. (See Appendix 2 for alert status table.) In Scotland and Wales, the Core Contingency Group can advise on alert status and the appropriate response. If required, the Contingency Core Group will request the relevant organisation/s to set up an Incident Management Team to resolve the incident.

Holding consignments and movement / planting restrictions

3.5. Until further investigation, no material shall leave the site, and local operations will be halted until the suspected case is confirmed as a false alarm.

Preliminary trace forward / trace backward

3.6. The most likely source of entry into the UK is the importation of live trees from continental Europe. Depending upon the pathway of entry tracing forwards and backwards to identify suspect material will be conducted to identify other potentially contaminated stock or sites. This will include suppliers, propagators and wholesalers, including any potentially contaminated stocks, where appropriate.

How to survey to determine whether there is an outbreak

3.7. An outbreak of *T. pityocampa* is most likely to be detected through general surveillance or following a report from the public of pine trees showing silken nests, larval processions leaving the nest, or significant needle loss (Appendix 1). Another indication could come from multiple catches in a light trap. Confirmation that *T. pityocampa* is present will require expert examination of samples and follow-up inspections.

3.8. Follow-up inspections should gather information about:

- the likely origin of the pest and, if a consignment of plants or plant products is suspected to be the origin of the outbreak, details such as other points of destination;
- geographical location and ownership of the affected site, including any other factors that might influence the outbreak, e.g. public access, accessibility for machinery to remove trees, etc. Include detailed maps and GPS location if possible;
- hosts infested at the site (species, variety, development stage, etc.);
- when and how the pest was detected and identified (including photographs of symptoms);
- level of pest incidence and, where appropriate, life stages present;
- extent and impact of damage (including part of host affected);
- recent importation or movement of host plants or host plant products into and out of the affected site;
- movement of people, products, equipment and vehicles, where appropriate;
- accessibility to the site for machinery to remove trees;
- relevant treatments applied to host plants that may affect development of symptoms or detection and diagnosis of the pest;
- history of the pest at the site, place of production, or in the area; and
- likely biodiversity impacts of any control, including any duty of care obligations under the Natural Environment and Rural Communities (NERC) (2006) Act.

3.9. **Nests or larvae should not be approached without proper training and equipment because of the health risks posed by the irritating hairs.**

Suspect material from infected trees in the wider environment should be either:

(a) triple-wrapped in robust plastic bags; or

(b) double-wrapped in robust plastic bags and the bags placed inside a secure box or vial and sent immediately to the Tree Health Diagnostic & Advisory Service at Forest Research for diagnosis. Suspect insects should be preserved in alcohol and sent in a similar manner. The samples should be accompanied by information about the date when the samples were collected, the location (address, postcode, GPS) and contact details of the person collecting the samples. The address is: Tree Health Diagnostic & Advisory Service, Forest Research, Alice Holt Lodge, Gravel Hill Road, Wrecclesham, Farnham, Surrey, GU10 4LH.

Samples collected from nurseries by APHA's PHSI staff should be sent to Fera Science Limited for analysis.

Confirming a new outbreak

Diagnostic procedures

3.10. Positive identification of *T. pityocampa* can only be made in the laboratory and it will be based on morphological characteristics (see factsheet in Appendix 1 and EPPO diagnostic guidance, 2004) and/or DNA sequencing of adults, larvae or pupae. However on-site inspection by a Forest Research or Fera entomologist or an experienced tree health officer from the Forestry Commission, Natural Resources Wales or APHA is part of the confirmation process. Samples should not be removed from the site unless done so by an individual trained, and with the relevant safety equipment, to do so.

Criteria for determining an outbreak

3.11. An outbreak of *T. pityocampa* should be declared when a positive identification is associated with:

(1) the discovery of living life-stages in established pine trees;

(2) the discovery of living life-stages in plants for planting, and from which adults have, or might have, emerged; or

(3) the capture of live adults of *T. pityocampa* in circumstances indicating that the adults might have had the opportunity to escape into the wider environment, such as light trap finds by amateur entomologists.

The discovery of dead specimens would not automatically trigger an outbreak response. However, it should be followed up with a trace forward/back exercise, possibly resulting in a survey of trees and woodlands to provide further information on the location of specimens, numbers of individuals, etc.

Official action to be taken following the confirmation of an outbreak

Strategic actions on confirmation

3.12. On positive confirmation, the following should be initiated:

- notification of ministers and senior officials, including those in the three devolved administrations;
- establishment of regular (frequency determined by scale of outbreak and time of year) Lead Government Department (LGD) meetings to keep partners aware of current status, actions and possible future requirements, and to agree communications strategy;
- notification of EU and other countries; and
- discussions with stakeholders.

Communication

3.13. In most instances the Forestry Commission (England and Scotland) is likely to appoint an Incident Controller and an Incident Management Team. In Wales the Welsh Government would take the lead. Forestry Commission England Forest Services have developed a specific Response Plan for Plant Health Pest and Disease Outbreaks that will be enacted in response to a confirmed PPM outbreak. Forestry Commission Scotland and the Welsh Government will have similar documents detailing their management of outbreaks.

3.14. The incident controller will set up a management structure to implement incident management functions. The outbreak will determine the size and nature of the management structure. Identification of and liaison with key stakeholders are crucial parts of this process. Depending on the location, these would include Forestry Commission England, Forestry Commission Scotland, the ICF, Confor, the Scottish Government, SNH, the Environment Agency, Natural England and other members of the Defra group, the Welsh Government, Natural Resources Wales, Woodland Trust, the Country Land & Business Association, Scottish Land & Estates, National Farmers' Unions and relevant local authorities.

3.15. Initial efforts will be directed towards eradication of new outbreaks following the procedures set out below. If eradication proves impossible, efforts will concentrate upon containment.

Demarcated zones

3.16. A statutory regulated area should be established as soon as possible after the discovery of an outbreak of *T. pityocampa*, to help minimise spread of the pest within the infested area, and to prevent human-assisted transport to areas outside it. An initial regulated area of at least 2 kilometres around the infested trees will need to be established, within which measures to prevent the movement of potentially infested pine material should be implemented. These measures should include a prohibition on the movement of host plant materials and plants, and pine plants for planting, from the infested area to the rest of the regulated area, and from the regulated area to regions outside the regulated area. Because *T. pityocampa* pupates in the soil, this prohibition should also apply to any movements of soil both within and, subsequently, out with the regulated area. Subsequently, the size of the regulated area might need to be increased, depending on the spread of *T. pityocampa*. Relevant parties will be informed via the communications lead in the incident management team. These would include the stakeholders listed above in paragraph 3.12 as well as local community councils, schools, landowners and neighbours.

3.17. Plant nurseries within the 2km demarcated zone will be inspected for the presence of *T. pityocampa* and have their plant passporting for pine plants (and other host plants, including *Larix, Cedrus and Pseudotsuga*)

suspended until the presence or absence of *T. pityocampa* both within the nursery and within the 2km zone can be determined.

Surveillance

3.18. To determine the extent of the outbreak all pine trees (and other potential host trees, *Larix, Cedrus and Pseudotsuga*) within a 2km radius of infected pine trees are to be inspected for signs of *T. pityocampa*. Nests or larvae should not be approached without proper training and equipment because of the human health risk posed by the irritating hairs.

3.19. Deployment of pheromone traps, baited with the female sex attractant pheromone of *T. pityocampa*, will help to provide an indication of population presence in the vicinity. However, the traps only capture males and, since they are strong fliers, it is uncertain whether the distribution of captures in the traps is an accurate reflection of the local distribution of the breeding population of the moth. Consequently, captures soon after initial adult emergence will tend to provide the most accurate measure of the distribution of *T. pityocampa* in the local area, (However, timing of the lifecycle might differ in the UK, and so accurate information on emergence might be difficult to obtain in the early years of an outbreak). Pheromone and light traps should be utilised for several years after nest removal to assess whether any moths remain present in the area. It is unclear at this stage how many traps would be needed, and where in the canopy they should be sited. Advice should be sought from Forest Research, and methods might require modification once data collection begins to refine the approach.

3.20. Other surveillance includes a follow-up survey to identify any missed nests, and to determine the outer extent of the outbreak. There is scope here to use the extensive network of amateur moth recorders using light traps, and for them to report any findings. The public can be encouraged to look for any signs of outbreaks, while also being warned of the health implications through information notes, leaflets and posters at sites of high public usage. (Guidance in place for Oak processionary moth could be adapted).

3.21. Reporting on the outbreak should be done through regular situation reports. The frequency of these will be determined by the outbreak

management team, and will be used as the basis to inform ministers, stakeholders and the media.

3.22. There is no formal survey protocol in place for surveying *T. pityocampa* in the UK. The methodology described above should therefore be viewed as a first version based on the guidance available, and might require modification and refinement in future.

Tracing forwards / backwards

3.23. Depending upon the confirmed pathway(s) of entry, tracing forwards and backwards to identify suspect material will be conducted to identify other potentially contaminated stock or sites.

Pest management procedures

3.24. The management programme should focus on monitoring and the phased removal of nests from the worst affected pine trees (and/or other host trees), with the aim of eradication or, if established, to reduce the *T. pityocampa* population and minimise the rate of spread, particularly during the flight period. In flight mill tests from France, the average flying distance of 47 females was 1.7km, with a maximum of 10.5km (Robinet *et al*., 2007). However, it is unclear whether the species would be capable of flying such distances, due to climatic differences, should there be an outbreak in the UK. Longer distances of female flight have been recorded in other laboratory based flight-mill experiments, with a mean of 5-6km and a maximum recorded distance of 27km (Battisti *et al*., 2015).

3.25. Depending on the location of the new outbreak, Statutory Plant Health Notices will be issued either by the Forestry Commission (in woodland situations in England and Scotland) or Natural Resources Wales for woodland sites in Wales. In non-woodland situations then APHA will responsible in England and Wales and Scottish Government Horticulture & Marketing Unit in Scotland. Timely issue of and response to these and subsequent actions are essential if new outbreaks are to be contained and eradicated. It should be made clear at the outset that the costs of any remedial actions required will be borne by the landowner. The Forestry

Commission or APHA will need to consider whether direct intervention by government to ensure a rapid response to reduce the risk of spread and impact on human and animal health is required.

3.26. New trees found to be infested will need to be sprayed from the ground for a minimum of two years. Where infested trees have been identified, all potential host trees within 50m will be sprayed. A mixture of application methods will be employed to ensure maximum control capacity during the small window of opportunity for spraying. (This is essentially the period in autumn between larval hatching and construction of the winter nests). For large areas of pine woodland, aerial spraying with *Bacillus thuringiensis* (Bt) is the most effective method of control, because it can be difficult to see nests in the upper canopy of dense woodland. In order for Bt to be effective it must be ingested by the larvae, so spraying should ideally take place when temperatures are warm enough for caterpillars to be out feeding. Bt is also more effective when ingested by smaller larvae, so applications should be done as early in the larval stage as possible. The approval process for aerial spraying is lengthy, and should be sought through the Chemical Regulations Directorate of the Health & Safety Executive and consultation with other relevant statutory agencies e.g Natural England and the Environment Agency. There has been no evidence that Bt has an impact on vertebrates, and although it might affect other Lepidoptera species, this impact is short lived.

3.27. Although Bt should be used for general control, deltamethrin could be used in exceptional circumstances, such as the earliest stage of an outbreak where its use might prevent a population becoming established. However, it is only suitable for isolated locations well away from water because of the threat it poses to aquatic species. There are no toxic effects on vertebrates and, like Bt, any impacts on Lepidoptera are short lived. There might also be scope to use deltamethrin in nurseries where only small areas are to be sprayed, and where application conditions can be tightly controlled.

3.28. Larvae and nests may be removed manually, by vacuum equipment or by hand, in the autumn and winter. Removal of nests can be very effective in reducing *T. pityocampa* populations, but this method alone is unlikely to lead to eradication, because it might not be possible to find and locate every last nest or larva. Eradication of *T. pityocampa* is most likely to be

achieved by a combination of methods which includes correctly timed applications of insecticide that treat the whole of the tree canopy. If insecticide application is not considered effective for whatever reason, infested trees should be removed and destroyed promptly to ensure eradication can be achieved and costs minimised.

Public outreach

3.29. It is crucial to have public support for the management programme and to help with general surveillance and awareness of the health implications. Engaging the public will require the provision of timely, balanced and accurate information about monitoring and control. It is important that a careful balance is struck between providing sufficient information and avoiding public alarm about the health implications. It can also provide opportunities for the public to participate in monitoring and reporting suspect trees using the Tree Alert reporting tool. The Observatree voluntary tree health surveillance network could also be deployed. Information, subject to available budget, can be made available through newspapers, radio, TV, publicity materials, the internet and social media. It should be targeted locally, especially within the infested and regulated areas and, where appropriate, nationally. There is also scope to raise amateur moth trappers' awareness and to advise them to report any catches they have of the species.

3.30. It is important to provide appropriate information to the public and stakeholders about:

- the location and size of the infested and regulated areas;
- statutory and voluntary responsibilities;
- rates of spread;
- management options;
- pathways and how the pest might have arrived and could be transported;
- the prospects for British forestry; and
- what people can do to help, especially in terms of monitoring.

Managing this level of public engagement will require a central administration office capable of handling a large numbers of enquiries, and able to provide

general and specific information. Liaison with communications and press offices from other countries and organisations might be required for cross- border outbreaks.

Disposal plan

3.31. *T. pityocampa* larval and nest material would be classified as hazardous waste, and its transport and destruction regulated. Current practice would be to destroy the material by burning at a licensed incinerator, or by burying it deeply in the ground at an approved landfill site.

3.32. Pine trees (or other host trees) felled to reduce *T. pityocampa* infestation should be destroyed within the infested area by incineration. If burning is used for disposal, no more than 10 tonnes can be burned in a 24-hour period, in accordance with Environment Agency, Scottish Environment Protection Agency (SEPA) SEPA and Natural Resources Wales guidelines. All tree material and debris found to contain *T. pityocampa* life-stages, or showing signs of infestation, should be destroyed in the same way. All equipment used in the disposal of *T. pityocampa*-infested trees should undergo thorough cleaning between sites in accordance with standard biosecurity protocols.

3.33. For previous plant health outbreaks in England, Forestry Commission England has put in place framework incineration contracts with prior agreement from the Environment Agency, allowing it to exceed the 10 tonnes/day limit. Such contracts might be required in the event of a *T. pityocampa* outbreak. In terms of burning, a site-by-site agreement process would be good practice with the Environment Agency, SEPA or Natural Resources Wales, whether seeking approval to exceed 10 tonnes/day or not.

Review measures in the cases of prolonged official action

3.34 Where efforts to eradicate the pest prove ineffective, efforts should shift to containment. A review of the management programme should be undertaken regularly (*e.g.* annually) to determine the success and cost-effectiveness of the measures in the longer term. This review will involve consultation with stakeholders and should include:

- evaluation of the effectiveness of current measures;
- evaluation of the economic impact and cost-effectiveness of continuing existing measures;
- consideration of further measures to strengthen containment and eradication actions;
- consideration of statutory obligations and impact on import and export procedures;
- consideration of alternative approaches or the cessation of statutory action; and
- consideration of short and long-term biodiversity impacts following control.

3.35. This and other contingency plans will be reviewed on an annual basis to accommodate any significant changes in pest/pathogen distribution, dispersal, refinement of surveillance techniques, legislation changes or changes in policy. When and if policy makers in the country/countries affected deem that eradication is no longer a viable option then there will be a move towards containment. The criteria for such a determining such a break point could be based on a % of host species lost, a set number of hectares lost, number of individual outbreaks, resources needed or a combination of these but this will be determined by the policy makers in the country/countries affected. Further details can be found in the Defra Generic plan.

In circumstances where official action is no longer considered appropriate, stakeholders should be consulted and a timetable and mechanism agreed for the removal of official measures, and for the dissemination of pest management information as appropriate.

Criteria for declaring a change of policy

3.36. Policy changes to be considered in light of the following:

- changes in the geographic distribution of *T. pityocampa,* e.g. the pest is found to be very widespread and spreading rapidly by natural means;

- new or updated research information on control methods or the pest's life cycle or impact; and
- identification of new pathways.

Evaluation and review of the contingency plan

3.37. The plan will be reviewed annually to take account of:

- any new legislative measures, or amendments to measures, implemented to reduce the risk of introduction;
- changes in the geographic distribution of *T. pityocampa*;
- new or updated research information on the range and life cycle of *T. pityocampa,* including a revised PRA;
- identification and evaluation of most endangered areas;
- any new pathways identified; and
- lessons identified from other outbreaks which will improve this plan and any Standard Operating Procedures (SOPs) or Operational Guidance.

The plan should only be re-consulted upon if significant new information is presented which affects the approach to the management of an outbreak.

Recovery

4.1 Eradication of *T. pityocampa* in the wider environment should be possible if it is discovered at an early stage and dealt with in a timely manner. A site can be deemed as recovered from an outbreak if, after three years of monitoring, there are no indications of pest presence at any stage of the lifecycle. However, consideration needs to be given to the possibility of the pupal phase of *T. pityocampa* undergoing a long diapause (a period of suspended development), which can extend over many years. A recent paper on *T. pityocampa* suggests a prolonged pupal diapause of up to seven years is possible (Salman *et al* 2016). Any introduction of *T. pityocampa* into the UK is likely to mean the pest is at its

northernmost limit, so we would expect to see unusual patterns in the length of the pupal diapause. Therefore, low-level monitoring for the presence of this pest for at least seven years after the last specimen was detected might be appropriate.

Appendix 1: Factsheet for *T. pityocampa*

Background information on pest

Identity of organism and quarantine status

Species name: *Thaumetopoea pityocampa* (Denis & Schiffermüller, 1775) (Lepidoptera: Notodontidae; Thaumetopoeinae)

Synonyms: *Bombyx pityocampa*, *Cnethocampa pityocampa*

Common name: Pine processionary moth

UK Plant Health Risk Register rating: Unmitigated 60/125, Mitigated 60/125

EU status: *T. pityocampa* is not currently listed on the EC Plant Health Directive

EPPO status: Not listed

Hosts

The genus *Pinus* is most susceptible to attack and the following species are particularly susceptible: *P. nigra* (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) and *P. canariensis* (Canary Island pine) (EPPO, 2004). Other recorded hosts include the conifers *Cedrus atlantica* (Atlas cedar), *Larix decidua* (European larch) (EPPO, 2004) and *Pseudotsuga menziesii* (Douglas fir) (Battisti *et al.,* 2005).

Life history of pest (source EPPO datasheet)

The life cycle of *T. pityocampa* is normally annual but may extend over 2 years at high altitude or in northern latitudes for part or the whole of the population. The

life cycle has two phases, the adult, egg and caterpillar being aerial and the pupa hypogeal.

Development lasts 6 months under the most favourable conditions, but the 4th and 5th instars may be prolonged in the winter. The pupal stage can be prolonged considerably by diapause which adjusts, at a given location and within certain limits, to ensure constant adult emergence dates each year. Effects of altitude and latitude are discussed by Demolin (1969b), explaining the variation in behaviour at different sites.

Daily average sunshine plays an important role in defining the northern limit of distribution. Androic (1957) proposed the isohelia of 2000 h for the northern border; this is a good aproximation but varies with other climatic factors. Adult emergence dates are earlier at northern latitudes and at higher altitudes. In general, the emergence period lasts less than 1 month for vigorous populations and 1.5 months for weakened populations in regression. In most ecological conditions, the adults fly in July.

A few hours after emergence and mating, the females oviposit on the nearest pines. They can, however, fly several kilometres, and quickly extend outbreaks over large areas. The eggs are laid in cylindrical masses in a helicoid arrangement around pairs of needles. A large proportion of the egg masses are generally laid on the peripheral shoots of the crown and contain 70-300 eggs, according to the feeding conditions of the caterpillars (Geri, 1980).

After 30-45 days the young larvae bore an opening in the chorion that can be recognized easily. They aggregate in colonies and spin silken nests which enlarge until the 4th instar when the definitive winter nest is built. In general, this is situated at the branch tips in the upper part of the crown. The caterpillars change colour at each moult and at the 3th instar urticating hair patches appear (Demolin, 1963). If the autumn is warm and sunny, the caterpillar can reach the 5th instar in early winter.

The pupation 'processions', which occur in late winter and early spring, are a spectacular expression of the social behaviour. The caterpillar at the head of the procession is commonly a future female, leading the colony in a file searching for a suitable site to tunnel underground and pupate in the soil. The processions occur at temperatures of 10-22°C; at lower temperatures the colonies regroup

and at higher temperatures they bury themselves wherever soil texture allows. Consequently, the cooler the soil, the more extensive is the spread of pupation sites at forest edges. At higher temperatures, the procession moves towards trunk bases in the shade of trees and may even bury itself close to the base of the original tree (Demolin, 1969c). A colony was observed to travel 37 m in 2 days in a cold mountainous area of Spain, the first 35 m being covered during the first day (Robredo, 1963).

Pupation takes place at a depth of about 10 cm and the pupae enter diapause, which always breaks 1 month before adult emergence. Some pupae or the whole colony may not yield adults in the year of pupation, the diapause period extending until the following year or longer.

Note: *In Portugal, where temperatures are generally higher throughout the year, the cycle from egg to pupation can take place within year 1. For the purposes of this contingency plan it has been assumed that if T. pityocampa did gain a foothold in the UK it is most likely to follow the former lifecycle, i.e. bridging two years.*

Identification of the organism

The four life stages of *T. pityocampa* are eggs, larvae, pupae and adults.
Eggs are usually less than 1mm long, orange coloured, laid in batches of 150-350 on pine needles or twigs, and covered with scales produced by the female (Figure 1).

Figure 1 – Egg mass of *T. pityocampa*. Source L. Nageleisen, Department de la Sante des forets.

There are five larval instars (stages). The first instar is a dull, apple-green colour (Figure 2), but the later larval instars are hairy and coloured orange-brown with blue bands, and the head capsule is black. The larvae tend to move about in

nose-to-tail processions, and when fully developed they can measure approximately 40mm long. From the third instar, larvae develop urticating setae (hairs) which can cause symptoms varying from itching skin rashes and eye irritations to severe allergic reactions in humans and other animals, including dogs.

Figure 2 – *T. pityocampa* first instar larvae. Source D.D Cadahia, Subdireccion General de Sanidad Vegetal

Figure 3 – *T. pityocampa* laterinstar larval stages. Source: *Bugwood.org - J.H. Ghent USDA Forest Service; W. Ciesla, Forest Health Management International*

The larvae feed through the winter months, provided the temperature is above 0°C, and build silken tents (resembling cotton wool) for protection, usually towards the top of the tree canopy (Figure 4). They tend to feed on the needles during the night, and rest in the tents by day. Clumps of frass often gather at the bottom of the nests.

Figure 3 – *T. pityocampa* larvae nests. Source D.D Cadahia, Subdireccion General de Sanidad Vegetal

Typically between February and May, the mature larvae descend the host tree in a characteristic head-to-tail procession and dig into the soil to a depth of 5-20cm where they subsequently spin cocoons. The cocoons are oval in shape, up to 20mm long, and chocolate brown in colour. The pupa, or chrysalis(Figure 4) forms within the cocoons. Depending on temperature, the pupae remain in the soil until June to September, when the moths emerge. However, a proportion of the pupae will enter a prolonged diapause, which in some circumstances can extend over many years.

Figure 4 – *T. pityocampa* pupae. Source: D.D. Cadahia, Subdireccion General de Sanidad Vegetal

Figure 5 – Adult *T. pityocampa*. Source: W. George, flickr.com

Figure 6 – Adult *T. pityocampa*. Source: D.D. Cadahia, Subdireccion General de Sanidad Vegetal

Distribution of the organism

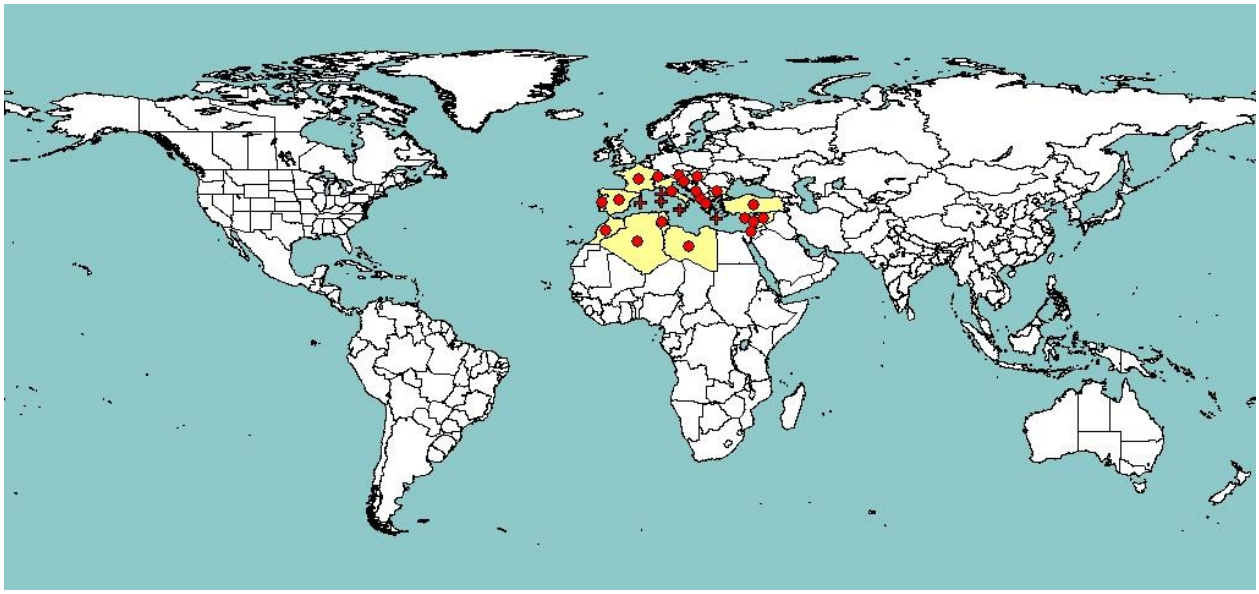
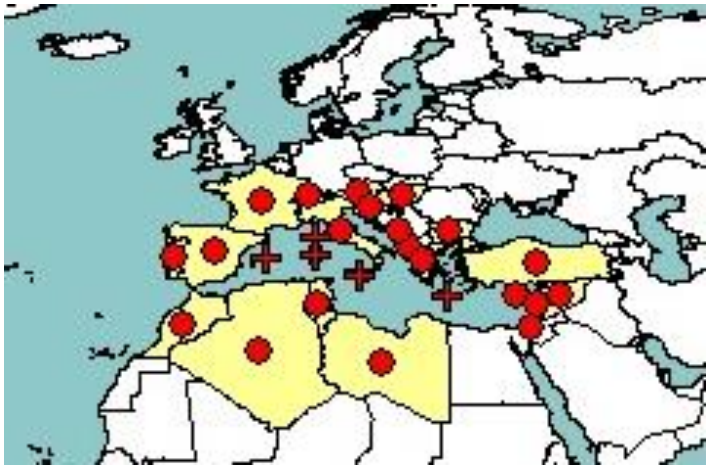


Figure 7. Current distribution of *T. pityocampa* circles as of November 2015 - present (national record) crosses - present (subnational record) - (EPPO PQR database). It is not known to be present outside Europe and North Africa. Records in the Middle East refer to the closely related species, *T. wilkinsoni*.



Damage, impact and control methods. From Defra PRA (2015)

The pest can be a serious defoliator of *Pinus* species in Mediterranean Europe where it can occur in high densities. Controlling for the effects of climate, Laurent-Hervouët (1986) found that in southern France defoliation could, in severely infested years, affect the trees to such an extent that visible growth rings were absent. However, in Corsica, the pattern of infestation was different and only affected tree growth in 2 of the 28 years studied (Laurent-Hervouët, 1986). Impacts on *Pinus sylvestris nevadensis* in the Sierra Nevada Mountains in southern Spain included reduced tree growth, but severely affected trees also produced fewer and lighter seeds thus potentially affecting regeneration of the forest for years to come (Hódar *et al.*, 2003). Arnaldo *et al.,* 2010, report that in north-eastern Portugal T. pityocampa was calculated to have caused an economic loss of around €100 per hectare in *Pinus pinaster* after heavy defoliation. There is also some evidence (again from Portugal) that trees weakened by *T. pityocampa* become more vulnerable to attack by other biotic agents, particularly bark beetles (Arnaldo *et al* 2010).

Figure 8 – typical defoliation damage caused by *T. pityocampa*: Source D.D. Cadahia, Subdireccion General de Sanidad Vegetal

Additionally, social impacts are caused by the urticating hairs of the older larvae which become detached from the larvae and contaminate the environment more widely. If they come into contact with skin, these setae cause severe rashes in both humans and other mammals due to a toxic protein they contain. If airborne setae are inhaled, they may cause breathing difficulties, e.g. asthma. If the setae enter the eye, severe corneal inflammation can occur (Portero *et al*., 2012). The larval nest also contains shed hairs that continue to pose a risk to those that handle it for months or even years afterwards (Arditti *et al* 1988).

Signs and symptoms of infestation are described in the published PRA for *T. pityocampa* and the EPPO datasheet.

Main pathways for entry and further spread

One of the potential pathways for arrival in Great Britain of *T. pityocampa* is via pupae transported in soil with plants for planting. (The soil can accompany either pine plants, other host plants, or any plants that have been growing in the vicinity of infested plants before export). Both the egg and larval stages could also be transported on plants for planting.

Once introduced and established, natural dispersal is the most likely means of spread. Adults have wings, and both sexes can fly. Reports have been made of possible migrants to the UK (Starzewski, 1998; Waring & Townsend, 2003). However, natural dispersal depends on the flight capacity of female moths, which is lower than that of males. Robinet *et al*. (2011) conducted experiments to estimate female flight capacity in laboratory conditions. The average flying distance recorded was 1.7km, with the maximum being 10.5 km. Further experimental work has demonstrated that average female flight could be as much as 5.1-5.6km, with maximum values of up to 24 and 27km being measured in artificial environments (Battisti *et al*., 2015). This experimental

data is consistent with the rate of spread of this moth in the south of the Paris Basin, which has been reported as 5.6km per year (Battisti *et al.*, 2005; Robinet *et al*., 2007). Based on the moth's current known distribution, the risk of natural spread is still low compared to its rate of movement with plants for planting. However, the increasing northwards movement does increase the chance of natural spread to the UK.

Information on pathways is summarised in the published PRA for *T. pityocampa* (Fera, 2012).

Import controls

Pine plants for planting imported from the EU into Great Britain must be notified to the relevant Plant Health Authority. There are currently no requirements for imported plants to be free of this pest. See guidance for importation of trees.

Pine plants imported from the EU must be plant passported to confirm that they are free from Dothistroma Needle Blight (DNB).

Pine plants from non-European countries are prohibited from being imported into Great Britain.

Pine plants from non-EU European countries are controlled and must be accompanied by a phytosanitary certificate stating that the plants are free from serious pests and diseases.

Appendix 2 – Alert status categories – (based on alert status levels for draft Defra generic contingency plan).

ALERT	STATUS	COMMAND LEVEL
White	Plant pest or disease with potential for limited geographical spread	Instigation of incident management plan involving operational command at appropriate level, and implementation of Standard Operating Procedures or scientific advice where applicable
Black	Significant plant pest or disease with potential for limited geographical spread	Instigation of incident management plan, usually involving joint tactical and operational command at appropriate level. Implementation of plant pest/disease-specific response plans where applicable
Amber	Serious plant pest or disease with potential for relatively slow, but extensive, spread leading to host death and/or major economic, food security or environmental impacts	Instigation of incident management plan, usually involving joint strategic and tactical command, and plant pest/disease-specific response plans where applicable
Red	Serious or catastrophic plant pest or disease with potential for rapid and extensive geographical spread leading to host death and/or major economic, food security or environmental impacts	Instigation of incident management plan involving strategic, tactical and operational command, and implementation of plant pest/disease-specific response plans where applicable

Appendix 3: Relevant legislation

Domestic:

The Waste Management Licensing (Scotland) Regulations 2011
The Environmental Permitting (England and Wales) Regulations 2010
Natural Environment and Rural Communities Act 2006
Plant Health (Forestry) Order 2005
Plant Health Act 1967
Forestry Act 1967

European:

EC Council Directive 2000/29/EC

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