Forestry Commission

Monitoring the oak processionary moth with pheromone traps

Practice Note

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The oak processionary moth is a serious forestry pest that is capable of causing complete defoliation of oak trees. Its caterpillars are also a hazard to health. Breeding populations of the moth were discovered for the first time in the UK in London in 2006 and these initial infestations have since spread and the moth has become more widely established. Controlling the moth is important, to protect trees from defoliation that can lead to decline and tree death, and to prevent risks to health. Control measures are most effective when applied at an early stage, before populations have started to increase. Effective control depends on monitoring the spread of the moth and detecting new outbreaks as soon as these arise, and also keeping track of abundance in areas where it is known to be present. There are a number of methods that can be used for monitoring but one of the most effective methods is to use pheromone traps. This Practice Note describes how these traps are used to capture oak processionary moths and what to do when moths are caught. It is aimed at forest and woodland managers, forestry practitioners, local authority tree and woodland officers, arboriculturalists and others who are actively involved with managing oak trees.

Introduction

The oak processionary moth is an important forest pest in Europe and in the UK and is listed under the Plant Health (Forestry) Order 2005. Anyone suspecting they have spotted the moth is obliged under the Order to report the sighting immediately to the Forestry Commission (see page 8). Oak processionary moth larvae (caterpillars) feed on the foliage of oak trees and when abundant the larvae can defoliate oak trees completely. Trees become weakened after two or more years of defoliation and become susceptible to attack by fungal pathogens and other insect pests. This may lead to oak decline and in some cases, tree death. Both English oak (*Quercus robur*) and sessile oak (*Q. petraea*) are at risk; Turkey oak (*Q. cerris*) is also affected where this occurs.

Oak processionary moth larvae also present a risk to human and animal health. The older larvae are covered in tiny (0.3 mm) barbed hairs, which contain a protein that acts as an irritating toxin. These small hairs are easily detached when the larvae are touched or disturbed, and if lodged in the skin they cause an unpleasant and persistent rash. If the hairs come into contact with the eyes or are inhaled, they can lead to severe irritation and asthmatic-type symptoms.

The oak processionary moth is native to central and southern Europe, but in recent years high populations have occurred in the Netherlands, Belgium and parts of Germany and northern France. In 2006, larvae were found for the first time in the UK at two sites in west London*. An intensive programme of monitoring and control was quickly established to limit the infestation and prevent spread of the moth into surrounding areas; southeast and central England are climatically suitable for the moth and it has the potential, if left unchecked, to colonise oak trees throughout this region.

Effective management of the oak processionary moth depends on both monitoring spread and detecting new outbreaks, and being aware of increases and decreases in abundance in areas where the moth is known to be present. There are a number of monitoring and detection methods but one of the most effective is the use of pheromone traps. This Practice Note describes how to use these traps to capture oak processionary moths and what to do when moths are caught. It is aimed at forestry practitioners, local authority tree officers, woodland officers, plant health inspectors, arboriculturalists, and land owners and managers.

*Up-to-date distribution maps of the oak processionary moth can be found at www.forestry.gov.uk/opm

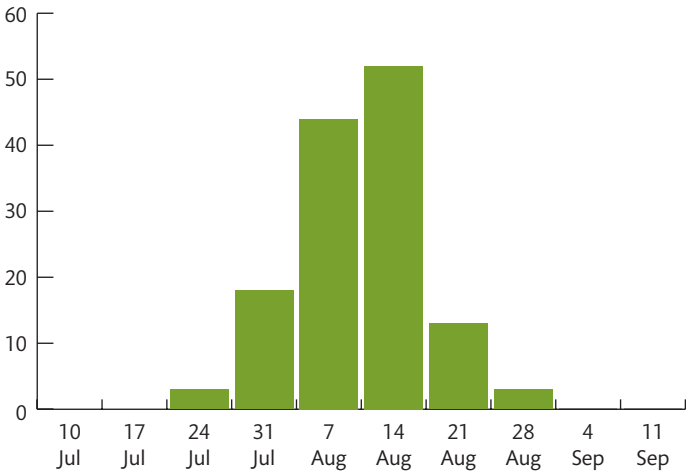
Biology and life cycle

The oak processionary moth has one generation per year. Eggs are laid in flat batches fixed to the twigs and small branches of oak trees, usually in the upper canopy. The eggs remain dormant over the winter and hatch in the following April or May at about the same time that oak trees break into leaf.

Larvae feed on leaves from April to June (although some may still be present in July), during which time they pass through six developmental stages. The larvae stay together and feed as a colony, and when not feeding they congregate in a communal nest made of silk webbing, which is attached to the underside of a branch or the main stem of the tree. The larvae have a distinctive habit of following one another in long nose-to-tail processions when moving to and from the nest to their feeding sites in the canopy, and it is this behaviour that gives the moth its common name.

The larvae pupate inside the nest from mid June to late July and the adult moths emerge 3–4 weeks later. They fly at night and are strongly attracted to light. The majority of adults are active during the first and second weeks of August (Figure 1), although the peak in flight activity can be delayed if the weather is cool and wet. Some individuals may not emerge until early September.

Figure 1 The numbers of adult male moths caught each week in pheromone traps in the Royal Botanic Gardens at Kew in London during 2009.



Data courtesy of RBGK.

Most adults live for around two-to-three days. Females do not travel far from the tree on which they have emerged, the majority flying less than 500 m. Male moths, in contrast, fly further and disperse more widely, and can sometimes be found several kilometres away from the nearest infested tree.

Survey and monitoring

The main methods for detecting and monitoring oak processionary moth are to search for larvae and nests on oak trees or to use light or pheromone traps to attract and capture the adult moths. If searches and trapping are carried out in a standardised manner from year to year, then it is possible to monitor whether populations are increasing or decreasing.

Visual surveys

Visual surveys for larvae and nests are the only way to locate individual infested trees that may require treatment, but these surveys are time-consuming and therefore expensive. A large oak tree can take two people 15–20 minutes to search from the ground by eye with the aid of binoculars.

The optimum time to carry out visual surveys is between late May and the end of July, when larvae and nests are well developed and are relatively easy to spot in the trees. Surveys carried out later in the season, when the larvae have completed their development, miss the opportunity to remove and destroy the nests before the adults have emerged.

However, surveys in the autumn and winter are useful for identifying infested trees that may need insecticide treatment in the following spring and so that old nests can be removed – these contain shed larval skins and hairs, which can remain a health hazard for months or even years.

Light traps

Standard light traps will capture both male and female oak processionary moths and can be a good way of detecting whether the pest is present in an area. However, light traps are non-selective and will capture a wide range of other moth species that will need sorting through before any oak processionary moths can be identified. This can be a time-consuming process and, combined with the fact that light traps require a power source and are more expensive than pheromone traps, means that their use in monitoring programmes is more limited.

Pheromone traps

Female oak processionary moths release a sex pheromone soon after emergence to attract males for mating. The chemical components of this pheromone have been identified and can be manufactured synthetically and incorporated into artificial lures. These lures, when placed in pheromone traps, will attract male oak processionary moths and can provide a relatively specific and cost-effective monitoring system.

Particular consideration needs to be given as to when and where to place the traps to maximise the chances of capturing the male moths, as the oak processionary moth sex pheromone does not appear to be as potent as the pheromones released by other moth species. However, pheromone traps are relatively inexpensive and have the advantage that large numbers can be deployed over a wide area.

Using pheromone traps

Types of trap

A wide variety of commercially produced pheromone traps are available for monitoring insect pests. The main types used to capture moths are delta traps and funnel traps.

Delta traps are made from waxed-cardboard or corrugated white plastic sheet folded length-ways into a triangular shape (Figure 2). The trap is deployed by suspending it by a wire or string tie from a tree branch. A sticky cardboard insert is slid into the trap to capture and retain the moths that are attracted to the pheromone lure, which is placed in a small plastic receptacle inside the trap.

Figure 2 A delta trap in use.

Plastic funnel traps are more robust and therefore last longer, but are more expensive. There are a number of designs, but one of the commonest types consists of a plastic 'bucket' with a lid under which there is a receptacle for the lure. Male moths attracted to the lure fall down through a funnel into the body of the trap. These traps are available in yellow, clear or green plastic, but green funnel traps are preferred for monitoring the oak processionary moth, particularly in urban situations, as they are more discrete (Figure 3).

Figure 3 A funnel trap in use.

Funnel traps should be part filled with 250 ml of 12% salt (saline) solution* to kill and retain the moths and partially preserve them. A couple of drops of liquid detergent should also be added to break the water tension and allow the moths to sink into the solution.

Funnel traps can be used without adding any liquid, but the moths caught in dry traps remain alive and become damaged as they flutter about, and once they have died, are vulnerable to destruction by predatory and scavenging insects. Adult oak processonary moths also tend to be contaminated with larval hairs, which they pick up as they emerge from the pupal nest. The presence of these hairs in dry traps can cause health problems.

Both delta and funnel traps capture adult oak processionary moths when primed with the appropriate pheromone lure, but field trials have shown that funnel traps catch six times as many adult males as delta traps. Therefore, funnel traps are likely to be more effective at detecting oak processionary moths at low population densities.

Pheromone lures

Oak processionary moth pheromone lures are available from various suppliers, but it is very important to use lures that contain all the necessary chemical components of the sex pheromone. The main component of the pheromone (Z,Z 11,13 hexadecadienyl acetate) is not sufficient to attract the adult males if used on its own. Several minor chemical components also need to be present in the correct ratio for the lures to be effective. Not all of the lures marketed for the oak processionary moth contain these other components so it is important to source lures from a reliable supplier.

Pheromone lures (Figure 4) are supplied in airtight packaging, in batches or in individual sachets, and these need to be kept unopened in a freezer at –20°C until used. Allow the pheromone dispensers to reach room temperature in the original packaging before opening.

It is also important to use lures that have been manufactured recently. The lures have a relatively short shelf life and new lures should be purchased at the start of every season. Do not use lures left over from the previous year.

Figure 4 Pheromone lures consist of a rubber septum impregnated with the oak processionary moth sex pheromone.

Timing

Traps should be placed outdoors from the middle of July to mid September, to coincide with the flight period of the adult moths (Figure 1).

The traps should be inspected at least every two weeks, more often if possible. Leaving the traps for longer than two weeks runs the risk of the moths deteriorating, especially in warm weather, which makes it difficult to count the numbers caught and to check their identity.

The sticky insert in delta traps will need to be replaced when the traps are inspected, especially if large numbers of moths have been caught or if the numbers caught per interval are being recorded. The saline solution in funnel traps should be changed at each visit.

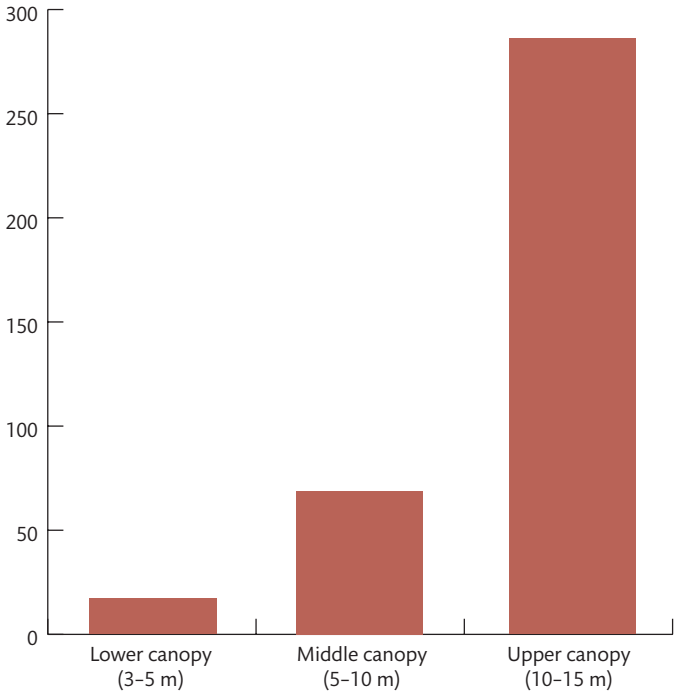
Pheromone lures should be replaced after four weeks. Consequently, two lures are required for each trap during each season.

* A 12% salt solution can be made up by adding 3 kg of salt to 25 litres of water.

Placement

Pheromone traps for oak processionary moths need to be placed 10–15 m above the ground in the canopy of oak trees. Traps at this height catch many more adult moths than traps placed lower in the canopy (Figure 5). Traps placed below 5 m catch very few moths and are generally ineffective for monitoring the oak processionary moth.

Figure 5 Total number of adult male oak processionary moths captured in the lower, middle and upper canopy of large oak trees.



Securing a pheromone trap at 10–15 m can be achieved using either a mobile elevated work platform or by climbing the tree, or by throwing a weighted line over a branch in the canopy. The trap can be attached directly to a branch at the required height, but it is more efficient to suspend the trap from a line passed over a branch or through a sling or pulley attached to the tree, which can then be raised or lowered when the trap needs to be inspected. The lower ends of the line can be tied off on a suitable branch at about 3 m (above the reach of passers-by) from where it can be untied using a step-ladder.

The oak processionary moth has a preference for oak trees growing in open, sunny habitats and therefore traps placed in these situations have a greater chance of catching adult moths than traps placed inside a densely-shaded block of woodland. Car parks, visitor centres and other recreational sites often have oak trees growing in relatively open conditions, and these are ideal places to locate traps. Traps in these locations also have the advantage of providing an early warning of potential problems in areas of high public access.

In a wooded area, pheromone traps are best placed in oak trees along tracks and rides or next to other open spaces. This also makes the traps more accessible. The traps need to be spaced out, with at least 50 m between one trap and the next. This is because an individual pheromone trap will attract adult males from a considerable distance and traps closer together than 50 m will end up competing for the same moths. It is more efficient to cover a larger area by spreading the traps out more widely.

When moths are captured

The majority of moths caught in the pheromone traps will be male oak processionary moths. These have a wingspan of 30–32 mm and grey forewings suffused with lighter and darker grey markings (Figure 6). Specimens trapped in saline solution will need to be dried out to show their correct colours. Battered and damaged specimens can be difficult to identify and these may require specialist help to confirm that they are oak processionary moths. Contact details are provided on page 8 if help is needed with identification.

Correctly identifying the moths is important, because individuals of other species sometimes turn up in pheromone traps baited with oak processionary moth lures and some of these can look very similar. These other species often enter the traps simply because they are looking for somewhere to hide during the day and they get trapped by mistake. Expert help may be required to correctly determine the species.

Figure 6 The adult male oak processionary moth has grey forewings suffused with lighter and darker grey markings.

Transport and storage of trap catches

It may be necessary to transport or store the moths caught in the pheromone traps – for example if the moths need to be sent to a specialist to confirm their identity. If this is the case, then adult moths caught in delta traps are best left on the sticky boards and each board placed inside a clear plastic (A4) document folder. Alternatively, the boards can be covered with plastic sheets cut from a heavy-duty plastic bag. The boards can then be packaged flat, without crushing, either to be sent away or for longer term storage. It is best to store the boards with the moths still attached in a freezer to prevent the specimens from decaying.

Moths caught in funnel traps should initially be left in the saline solution. The volume of liquid can be reduced and then the remaining solution, with the moths, poured into a 250 ml screw-top plastic pot. These samples can be kept for some days in a cool fridge. If the moths need to be kept for longer, especially if they are to be sent for identification, then it is best to extract the moths from the liquid and thoroughly air dry them on filter paper or a paper towel (avoiding loss of wing-scales onto the paper as much as possible). The moths can then be re-packaged with cotton-wool in dry containers or sample tubes. The moths will keep for a considerable period as long as they remain dry.

Note that adult oak processionary moths pick up larval hairs when they emerge from the pupal nest. As a result, specimens and used pheromone traps should be handled with care, preferably with gloves. It may be necessary to wear protective clothing and a face respirator if a large quantity of material is being handled.

Clean used traps thoroughly at the end of the season if they are going to be re-used in the following year.

Reporting and further action

The capture of an adult male oak processionary moth in a pheromone or light trap indicates that the moth is present in the general area. The nest from which the adult emerged (Figure 7) could be close by, but because adult males can fly several kilometres, the nest might have been located on a tree at some considerable distance away. It is important that the oak tree from which the adult emerged is located, if possible, so that the nest can be removed and control treatments applied in the following year. Oak processionary moth populations can increase rapidly over three-to-four years and controls are more effective, and ultimately less costly, if the infestation is detected and treated at an early stage.

Figure 7 A late nest with shed larval skins and pupal cases.

Figure 8 Oak processionary moth larvae on an oak twig (*Quercus robur*).

Guidance on reporting and further action is set out in the following steps:

1. Report any oak processionary moths caught outside the known area of distribution and send specimen(s) to Forest Research for confirmation (see page 8 for contact information). Captures outside of the current known area of distribution are significant as they indicate that the moths may have spread into new areas. Samples should be packaged as described in this Note and details provided of when and where the moth was caught (i.e. site name and post code, or grid reference, or GPS code). An up-to-date map of the known area of distribution can be found at www.forestry.gov.uk/opm.

2. If oak trees in the area were not thought to be infested, then the oak tree containing the pheromone trap and all other oak trees within 200 m should be inspected as soon as possible to try to locate any larval nests (Figure 7). It is a good idea to inspect the trees a second time later in the year, during the autumn or winter, when there are no leaves on the trees and it is easier to see the branches.

3. If an oak processionary moth nest is found, mark the tree and record its location. The nest should be removed, but only by a qualified arboriculturist or tree care expert wearing appropriate personal protective equipment as the nests are a health hazard. Oak processionary moth nest material is classified as hazardous waste and reference should be made to the Environment Agency guidelines on movement and disposal of hazardous waste (www.environment-agency.gov.uk/business/topics).

4. Plan ahead to apply control treatments in the following year. Key actions are to:

   - Apply an insecticide to the canopy of the oak trees in April or early May, just after the trees have broken into leaf, to kill newly emerged larvae.
   - Conduct follow-up surveys for oak processionary moth larvae (Figure 8) and larval nests during June and July. Remove any larvae or nests that are found or treat the larvae with insecticide.
   - Continue to monitor using light or pheromone traps, preferably with a larger number of traps.

5. If no infested trees are found, wait until the following year and re-inspect the trees for larvae and larval nests during June or July. Repeat the pheromone trapping and consider setting a greater number of traps. Further advice on control measures is available at www.forestry.gov.uk/opm.

Useful sources of information

Publications

Forestry Commission Pest Alert: Oak processionary moth

Research articles and other literature

Williams, D.T., Straw, N., Townsend, M., Wilkinson, A.S. and Mullins, A. (2013). Monitoring oak processionary moth *Thaumetopoea processionea* L. using pheromone traps: the influence of pheromone lure source, trap design and height above the ground on capture rates. *Agricultural and Forest Entomology* **15**, pp126–134.

Contacts

For information on pheromone lures and traps, and help with identifying moths:

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To report captures of the oak processionary moth outside the known areas of infestation:

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Websites

For information on the disposal of hazardous waste:

- Environment Agency – www.environment-agency.gov.uk/business/topics

For information on protecting trees and other tree health issues:

- Biosecurity – www.forestry.gov.uk/biosecurity
- Pests and diseases – www.forestry.gov.uk/pestsanddiseases
- Plant health – www.forestry.gov.uk/planthealth
- Research – www.forestry.gov.uk/fr/protectingtrees

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