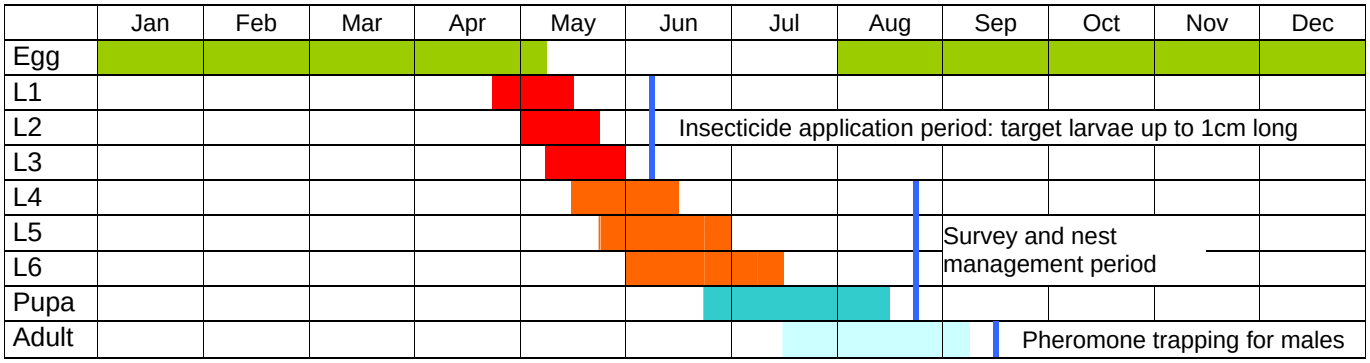
Survey and intervention in relation to different phases of the oak processionary moth life cycle.

To be used in conjunction with statutory notices served under the Plant Health (Forestry) Order 2005, as amended, and with more detailed advice on control, nest removal and use of protective clothing: Appendix 1

Life cycle of oak processionary moth (OPM): note that the timings of the various stages are approximate, reflecting the relative lack of precise information on larval and pupal development under British conditions. The stages are described in more detail in the Forest Research leaflet on OPM (http://www.forestresearch.gov.uk/pdf/fr_advice_note_oak_processionary_moth.pdf/$FILE/fr_advice_note_oak_processionary_moth.pdf).



Egg stage: This is the most difficult to survey for but, in the absence of detailed information on typical egg hatch periods in Great Britain, a search of branches for egg masses during the winter months is recommended. Any egg batches found can then be marked for regular inspection from late March onwards and used as indicators of egg hatch and appearance of the first stage larvae, which are the primary targets for insecticide applications.

Larval stage: There are six stages during the larval feeding cycle, with the larvae getting progressively bigger from one moult to the next. Two different strategies are recommended in relation to larval size, as size influences the susceptibility to insecticides, the risk of tree damage and irritation from the larval hairs.

Stages L1-L3: Larvae are very small when they hatch (around 2mm long) and are still less than 1 cm long by the time they reach the third stage. These three stages are the most susceptible to the insecticides approved for use against OPM. It is recommended that insecticide applications are applied only to the first three larval stages, with the expectation that the larvae will have become too big for effective control by around the end of May. Fourth stage and older larvae also remain mainly within their silken nests during the day where they are protected from chemical sprays. As a rule of thumb, larvae larger than 1 cm long should be regarded as too big or too well protected for insecticide application.

Stages L4-L6 and pupae: Larvae spin bigger silken nests and spend more time within these nests during the day as they grow larger. Eventually, the larvae moult to the pupal stage, again within the nest. By this stage the nest tends to be tougher and usually brown in colour, containing cast skins and shed hairs. Removing nests immediately after they are discovered will reduce further damage to trees and minimises risks from dislodging the irritating hairs. However, delaying nest removal until the larvae have completed feeding and have moulted to the pupal stage can be useful in destroying larvae/pupae within the nests. Large, old nests need to be removed with considerable care, as indicated in the operational safety advice, to reduce the likelihood of hairs being shed. During this phase of the life cycle, larvae may also be seen massing on the trunks and branches of trees and moving in the characteristic nose to tail processions that give the moth its common name.

Adult stage: Adults emerge and fly from around the middle of July to early September. Males are strong fliers, the females less so. Deployment of pheromone traps, baited with the female sex attractant pheromone of OPM, will provide an indication of population size and distribution. 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 OPM in the local area.

Appendix 1: Guidelines and Minimum Health & Safety Requirements for Management of Oak Processionary Moth (OPM) Larvae (Caterpillars) and Removal of Larval Nests

Personal Protective Equipment

Operators controlling Oak Processionary Moth (OPM) (*Thaumetopoea processionea)* larvae (caterpillars) or removing larval nests not only require Personal Protective Equipment (PPE) to minimise exposure to the chemical pesticide being applied, but must also have PPE that will prevent skin and eye contact, or inhalation, of the highly irritating hairs from the larvae. These hairs are about 0.2mm long and barbed, and they contain an urticating toxin, a protein, exposure to which can cause intense skin irritation and asthmatic-type symptoms. These symptoms may be more severe in some people than in others, and repeated exposure may lead to sensitisation or more severe effects.

OPM larvae possess irritating hairs from the 2nd moult onward, although it is the full-grown larvae that carry most hairs. The dorsal surface of these larger larvae carries patches of tens of thousands of the small hairs. The hairs are easily detached when the larvae are handled or disturbed, dispersing on air currents, especially in dry conditions. The silk nests produced by the larvae on the trunk and branches of the host tree, in which the larvae moult and eventually pupate, also contain dense concentrations of hairs that retain their toxicity for many months.

Minimum PPE for controlling larvae or removing nests shall include:

PPE	Protection	Standard
Face mask	to prevent inhalation	Filtering half mask FFP2 or FFP3 (European standard EN149: 2001), disposable, to protect against particles.
Goggles	to protect eyes	Goggles complying with European standard EN166 and either code 4 or code 5[1].
Disposable spray suit	to prevent skin contact	An impermeable protective suit suitable for insecticide spraying will also protect against the larval hairs[2].
Gloves	to prevent skin contact	Robust water and chemical resistant gloves, as used for spraying operations.
Boots	to prevent skin contact	Water proof and chemical resistant rubber boots, as used for spraying operations.
Climbing equipment for reaching nests high in a tree	to prevent skin contact	Ropes and harnesses used for climbing can retain hairs and, therefore, should only be handled with protective gloves. They should also be bagged after use and maintained solely for the purposes of removing nests.

There are some issues with PPE that may only be resolved with experience[1,2]:

It is very important that symptoms of ill health caused by exposure are reported immediately to line management and/or to medical practitioners, and action taken to prevent further exposure. Any

[1] Code 4 goggles have indirect ventilation (slits at the side) and this might result in some exposure to the larval hairs. Code 5 goggles have no ventilation, but may mist up. Should goggles and a half mask prove inadequate for preventing exposure to the hairs, particularly around the face, then a full hood with respirator (fitted with particle filters) might be necessary. This is more restrictive for the operator.

[2] There are problems with paper suits in that they cannot be washed down effectively after work, and removing the suit when it is dry may release hairs into the air that could then irritate the skin and eyes or be inhaled. Also experience has shown that they rip easily, especially when worn by tree climbers, and that hairs can penetrate the suits, reducing any protection that they provide. A full water-proof suit, which can be washed down after each control operation, is more appropriate, but such suits are very hot to work in for any length of time.

person who develops sensitivity after exposure, shall not take any further part in control operations, either against the larvae or to remove nests.

Insecticide control of young larvae

The following products are listed in the "UK Pesticide Guide 2008" as being suitable for professional use against caterpillars on amenity vegetation. This includes OPM (and brown-tail moth) in amenity situations. However, the status and availability of chemicals may change from year to year, so it is important to check the manufacturer's label to ensure that there is approval for the use intended.

Active ingredient	Product	Marketing Company	Comments
Bacillus thuringiensis (BT)	DiPel DF	Fargro	Biological agent. Requires follow up spray after 2 weeks.
Diflubenzuron	Dimilin Flo	Certis	Growth regulator. Approved for amenity vegetation & hedges. Requires follow up spray after 2 weeks.
Deltamethrin	Agriguard - deltamethrin Bandu Decis Decis Protech	Agriguard Headland Bayer Bayer	Fast acting, but broad spectrum pyrethroid insecticide

The following also has approval in the UK for use in ornamental plant production:

Active ingredient	Product	Marketing Company	Comments
Teflubenzuron	Nemolt	Fargro	Growth regulator. Would probably also need a second application after 2 weeks.

BT, diflubenzuron and teflubenzuron are most effective against the very young (1st-3rd stage) larvae and therefore timing of application is crucial. Larvae hatch from the eggs in late April and early May, and the young larvae will be present at least through to mid May.

NB: there are very limited data on the timing of larval development in GB and no data on how development might vary between years; it is recommended, therefore, that interested parties locate and monitor egg batches in the field to provide early warning of egg hatch in spring 2008.

BT and diflubenzuron are often favoured for control of pests because of their specificity against moth caterpillars and their relatively low environmental impacts. However, a single application of BT or diflubenzuron is regarded as not fully effective and a second, follow-up spray shall be applied after 2 weeks.

Deltamethrin is less selective, but kills on contact and is fast acting. It might be a more appropriate insecticide to use for more mature larvae that become less susceptible to BT and diflubenzuron as they age.

The fact that OPM larvae live in the canopies of large oak trees, particularly in parks and built-up areas, will mean that spraying operations will have to be targeted at tall, mature trees, very frequently in areas where the public have access, along roadsides and between buildings. Applying insecticides to tall trees is very difficult and coverage is not always satisfactory. Motorised sprayers tend only to deliver insecticide up to about 8m in the canopy. Removing larval nests, and to some extent spraying, will require access to the canopies of large trees, either by climbing or, preferably, by using hydraulic platforms (cherry-pickers). Working at height poses particular H&S problems and will

impose constraints on the selection of PPE and control options. **This work must, therefore, only be carried out by appropriately qualified, trained and equipped operators.**

Chemical insecticide control of mature larvae

BT and the growth regulating insecticides are less effective against older (4^{th}-6^{th} stage) larvae, whereas deltamethrin can still be applied, provided there is good coverage and spraying takes place while larvae are outside the nests. Therefore, deltamethrin is the preferred insecticide for dealing with older larvae, should the decision be made to continue with attempting to treat them directly, rather than removing the nests.

Older larvae congregate on the larger branches and trunk of the tree during the day, notably when they are about to form nests, and therefore spraying for older larvae needs to be directed as much to these areas as to the canopy, bearing in mind that the larvae must be outside the nests to be exposed to the insecticide spray.

More information on the behaviour of OPM larvae, particularly when and where they feed and at what times they aggregate on the stem, could increase the efficiency of insecticide application and might improve control.

A problem reported in France concerns large numbers of dead and dying 5^{th}-6^{th} instar larvae falling from trees that were recently sprayed with insecticide. This occurred at a picnic and camping site, and the result was increased contact between people and the larval hairs, which led to much greater health problems than had occurred before the larvae were disturbed to the point where the campsite had to be closed. Therefore, if it is decided to apply insecticides against the larger larvae that carry most of the irritating hairs, it is recommended that access to the area around the treated trees is restricted for some time after spraying, to ensure that the majority of dead larvae have fallen from the trees and while assessments are made of the potential need to dispose of the fallen larvae.

Removal of larval nests

The aggregation nests spun up by the larvae on the main branches and trunks of oak trees contain many hairs and pose a very significant health risk, either through direct contact with the nest material or through the release of hairs as the nests break up and disintegrate. The nests are quite persistent and, from experience on mainland Europe, may remain a hazard for up to 12 months or more until the hairs degrade through decay.

Destroying the nests during May and June, at the appropriate time of day, will kill the larvae in the nests, and destroying nests between late-June and the end of July should kill the pupae. Targeting nests containing pupae is likely to be the most effective strategy because there will be no further dispersal of larvae to the foliage to feed and, consequently, all the remaining life stages will be removed before emergence of the next adult generation.

Although there will be variation in local practice during nest removal, it is recommended that the nests are removed intact by first covering the nest with a plastic bag and then carefully pulling the nest off, which is then retained within the bag. The bag should be sealed immediately and any remaining fragments of nest that could contain hairs can be destroyed by topical application of a flame source. Use of a flame source directly to intact nests is not recommended since this will destroy the outer layers which could allow larvae or pupae inside to fall out.

This Guidance Note was prepared by Tree Health Division of Forest Research.