Hoverflies in winter leaf litter

Contents

 Queries and comments to gwilkinson15@googlemail.com.

INTRODUCTION

This guide is for those who may have experience of adult hoverflies but would like to learn more about identifying, recording, and rearing their larval stages. Not many people pay close attention to the early stages which is a great shame considering how interesting and important they are. After all, the adult is the product of months and sometimes years spent as a larva.

To introduce the subject, we will use a subset of taxa with larvae that can be found in winter leaf litter. This group of hoverflies are mostly aphid predators and overwinter as full-grown larvae in diapause. They are easier to examine and photograph when in diapause than when actively feeding during the summer.

Some larvae can be identified to species without rearing an adult. However, some larvae can only be identified to genus and a reared adult is needed for species identification.

Experience gained with this group of hoverflies will be helpful for tackling a wider range of aphid predatory syrphines that are active during the summer.

IDENTIFICATION

Colour, shape, and the characteristics of the posterior respiratory process (PRP) are the most useful features for identification. The PRP can be very rich in species specific characters such as dimension, texture and the presence or absence of dorsal spurs. Most of the features used in this guide are best view dorsally. You may have to tilt the larva downward posteriorly to get a flush view of the PRP to better judge its dimensions or discern the presence of dorsal spurs.

The taxa accounts include a written description of the larva and key features for identification. Some magnification can be helpful, for example, by using a x10 lens or the zoom feature on a camera / phone. Also included are a few characters that are best viewed at x20 magnification using a stereomicroscope.

These accounts have been written with a bias toward taxa that are most likely to be encountered in winter leaf litter. For example, *Episyrphus balteatus* larvae have been omitted from this guide as they do not yet overwinter in Britain. However, they are very common in aphid colonies in summer and could be confused with *Meliscaeva*.

The plates complement the taxa accounts and include images of the larva and selected drawings of the posterior respiratory process and other important identification features mentioned in the text. There are taxa accounts and plates for selected Diptera larvae that also occur in winter leaf litter. You can also make use of the numerous photographs in the Media Section of the UK Hoverflies Larval Facebook Group.

Once you have reached a determination, please do share a supporting image on the UK Hoverflies Larval Facebook Group for verification and as feedback on this guide.

Variation in size

Even when the same age and species, larval size varies considerably. This is largely due to variation in food quality and quantity. Therefore, size measurements given in the taxa account represent a rough upper limit.

Syrphus larvae, both mature 3rd instar and in diapause ranging from 16 to 8 mm in length.

Colouration

Aphid predatory hoverflies are unusual among flies in possessing cryptic colour patterns. These colours likely evolved so larvae are less visible on foliage to visual predators such as birds. Larvae can be translucent with black, white, or orange markings (*Syrphus*, *Epistrophe*); others green with white stripes (*Epistrophe*, *Sphaerophoria*); and some are brown or mottled grey and black (*Dasysyrphus*). Many larvae change colour as they enter diapause; sometimes it is a simple dulling of their original colours, or a more dramatic change as can be seen in *Epistrophe grossulariae*.

LIFE CYCLE

Eupeodes luniger laying an egg.

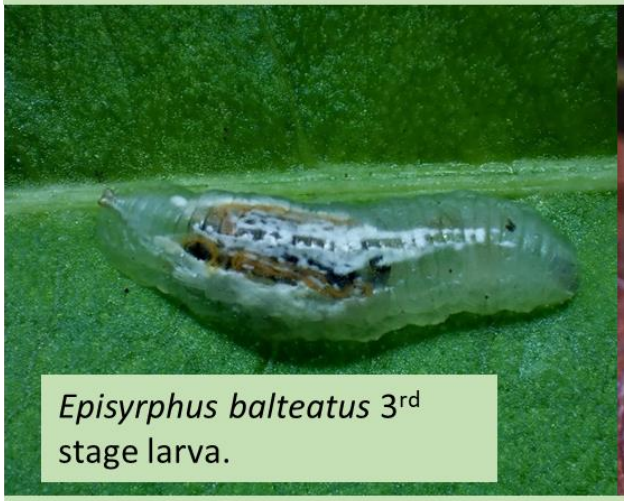
Adult

The function of the adult is to breed and disperse, and to survive long enough to achieve these goals.

Melangyna lasiophthalma egg.

Egg

Eggs typically hatch within a week.



Episyrphus balteatus 3rd stage larva.

Larva

The function of the larva is to feed. There are 3 instars: 1st & 2nd instar last days or weeks.

The 3rd instar can last weeks, months or years depending on individual, species, generation, food quality or other environmental factors.

The majority of British species overwinter in larval stage.

Melangyna cincta puparium.

Pupa

The pupa forms inside the hardened and swollen skin of the 3rd instar larva which is referred to as the 'puparium'.

This stage lasts from a few weeks to several months depending on species. Only a small proportion such as some *Eupeodes* overwinter as puparia.

IS IT A HOVERFLY LARVA?

There is not an easy set of characters that distinguish the larvae of true flies from other invertebrates, but the presence or absence of the characters below are a short-cut to recognising Hoverfly larvae (Plate 1).

- The body is without jointed legs. They may have locomotory prominences, but they are clearly not jointed.
- There is no hardened head capsule or jaws as seen in caterpillars. The head is mostly inverted within the thorax and only obviously represented by a dark head skeleton that can sometimes be seen through the skin.
- The rear breathing tubes emerge from the body into a single fused projection called the 'Posterior Respiratory Process', abbreviated to 'PRP' - a feature unique to hoverflies.

There is an important exception to the above character. In aphid predatory larvae, the PRP does not form until the 3rd instar. In the 1st and 2nd instar the rear breathing tubes emerge as paired disc or thorn-like projections.

The following features are unique to aphid predatory Hoverflies:

- The pointed apex of the mouthparts is flanked by a pair of tiny black triangular sclerites which are deployed to help grasp aphids during hunting and feeding. They are best seen ventrally with the larva placed on a glass slide and viewed under at least x10 magnification. Sometimes this feature can be captured in photos.
- Many aphid predatory larvae have colour patterns which is rare among other 'true flies.'

TAXA ACCOUNTS

Syrphus Plate 2.1 – 2.4

Characters. ~15 mm length. Body translucent with white, red, yellow, or brown chevrons or patches that can merge into paired stripes. The PRP is characteristic in appearance: broader than long, rather bulbous and has a pair of dorsal spurs (Pl. 7.1 – 7.2). **Identification.** Larvae can be identified to genus from a good photo showing the colour pattern and it can be helpful to show the PRP at x10 magnification. Species identification usually requires a reared adult. **Biology.** Aphid predator, associated with a broad range of aphids from herb layer to tree canopy, both broadleaved and conifer. Several generations with larvae in autumn overwintering until pupariation in the spring. **Notes.** They are often the most numerous taxa to be found in Sycamore leaf litter and the shape of the PRP and the variable colour patterns soon become familiar.

Melanostoma Plate 2.5 – 2.6

Characters. ~10 mm length. Body typically bright and uniformly green though can have a weak pair of stripes or rarely entirely translucent. The PRP is obviously shorter than broad and has no dorsal spurs. **Identification.** Larvae can be identified from a good photo showing colour and overall larval shape and at least x10 magnification of the PRP. Species identification requires a reared adult. Given the ongoing taxonomic upheaval in this genus it would be useful for reared adults to be retained as voucher specimens. **Similar taxa.** *Sphaerophoria* can be bright green but have strong pair of pale dorsal stripes and their PRP is longer than broad. **Biology.** Little is known of their biology. The few rearing records suggest they are predators of a range of soft-bodied insects, including aphids (though they are scarcely found at colonies). Most records relate to *M. scalare* found in winter leaf litter preying on cohabiting fly larvae including Lauxaniids, Lonchopterids.

Several generations with larvae in autumn overwintering as predators in leaf litter or in diapause until pupariation in the spring.

Epistrophe grossulariae **Plate 3.1 – 3.3**

Characters. ~15 mm length. In feeding phase, body green with a lighter green dorsal stripe or fish-bone pattern that is bisected by three or more black dashes. In diapause, the colour changes to autumnal hues of orange and yellow, with a prominent yellow chain-link or line. A rather flattened and broad larva, increasingly so when approaching diapause. The PRP is about as long as broad and has a pair of dorsal spurs (Pl. 7.3). **Identification.** Larvae can usually be identified from a good photo showing the unique dorsal colour pattern. **Biology**. Aphid predator, strongly associated with Sycamore but has also been found on crack willow, birch and phragmites. Single generation July to November with larvae overwintering in diapause until pupariation in the summer. A small number of larvae may remain in diapause for several years. **Notes:** Displaced larvae can be found on structures, such as fence posts and gravestones, under Sycamore in the autumn.

Dasysyrphus **Plate 3.4**

Characters. ~ 10 mm length. Body brown or grey with pink or black, serrated lateral margins and segmentally arranged mid-dorsal projections. Anal segment has a pair of long tapering projections that immediately distinguishes the genus. **Identification**. Larvae can be identified to genus but with exception to *D. albostriatus* a reared adult is usually required for reliable species identification. Where possible the puparium and the reared adult/or photo should be retained to enable future taxonomic work. It is likely that the shape and dimensions of the PRP are species-specific, but more research and voucher specimens are required. **Biology.** Aphid predators, mostly arboreal with some restricted to conifers. Several generations with autumn larvae overwintering in diapause until spring.

Dasysyrphus albostriatus **Plate 3.4**

Characters. ~10 mm length. The PRP is dark, at least twice as long as basal width and with two long and strongly divergent dorsal spurs creating a V-shaped gap between them (Pl. 7.4). **Identification.** Larvae can be identified from a good photo showing the dorsal body shape and at least x10 magnification of the PRP. **Biology.** Aphid predators, on a wide range of aphids *mostly* in shrub to tree canopy layer, both broadleaved and conifer. **Notes:** Displaced larvae can be found on structures, such as fence posts and gravestones, under Sycamore in the autumn.

Parasyrphus punctulatus **Plate 3.5 – 3.6**

Characters. ~10 mm length. A rather flattened larva, long and narrow and not tapering anteriorly. They have wide dorsal stripes of pale brown, and laterally marked with a flecking of fat particles that form a chain-link pattern. The PRP is 1 ½ times as long as basal width, with a pair of dorsal spurs. The length of the PRP is longer than other described *Parasyrphus* with dorsal stripes. **Identification**. Larvae can be identified from a good photo showing the dorsal colour pattern and at least x10 magnification of the PRP. **Biology.** Aphid predator, on a wide range of aphids mostly in the shrub and tree layer, both broadleaved and conifer. Single generation with larvae overwintering in diapause until pupariation in the spring.

Leucozona glaucia **Plate 4.1 – 4.2**

Characters. ~15 mm length. Body translucent with dense particles of red fat forming a fish-bone pattern that can become orange in diapause. A rather flattened larva that recalls *Epistrophe grossulariae* in diapause. **Identification.** Larvae can usually be identified from a good photo showing the dorsal colour pattern. **Similar taxa.** *Leucozona lucorum* can look similar if their colour pattern becomes

pink but they are not so flattened in shape and mostly of different colour (yellow, green, cream). In doubtful cases, view the anal segment under at least x10 magnification: *L. lucorum* will have two pairs of papillae with apical setae whilst this feature is entirely absent in *L. glaucia* (Pl. 6.5). **Biology.** Not much is known of their biology. They are aphid predators strongly associated with Sycamore but with records from birch. **Notes.** Displaced larvae can be found on structures, such as fence posts and gravestones, under Sycamore in the autumn.

Melangyna cincta **Plate 4.3 – 4.4**

Characters. ~8 mm length. Body translucent, can be poorly or strongly marked with green or yellow pattern and in the latter can form a fish-bone pattern that is narrower than the larger and broader bodied *Leucozona glaucia*. The colour pattern can turn yellow or orange in diapause. The PRP is twice as long as its basal width and with a pair of dorsal spurs (Pl. 7.6). **Identification.** Larvae can usually be identified from a good photo showing the dorsal colour pattern and overall body shape. **Biology.** Aphid predator, strongly associated with Woolly Beech Aphid *Phyllaphis fagi* with fewer records from other broadleaved trees such as oak, Sycamore and lime. Two generations with autumn larvae overwintering in diapause until pupariation in the spring. A small number of larvae may remain in diapause for several years.

Epistrophe eligans **Plate 4.5 – 4.6**

Characters. ~10 mm in length. In feeding phase, body green usually with a prominent mid-dorsal white stripe. Rather broad and flattened, becoming more so in diapause where the colour changes to orange or light red. The PRP is comparatively narrow, at least twice as long as its basal width and with a pair of dorsal spurs (Pl. 8.1). **Similar taxa**. other *Epistrophe* are similar, but the PRP is shorter and less narrow in all other species. **Identification**. Larvae can be identified from a good

photo showing the dorsal colour pattern and the dimensions of the PRP. **Biology**. Aphid predator, on a wide range of aphids mostly herb to shrub layer. Single generation with larvae overwintering in diapause until pupariation in the spring. A small number of larvae may remain in diapause for several years. **Notes.** Larvae may overwinter under plant pots, plastic trays, or similar coverings on the ground under or not far from previously aphid-colonised foliage.

Meligramma euchromum **Plate 5.1 – 5.2**

Characters. ~10 mm length. Body flattened, strongly serrated laterally with colour pattern of yellow and green changing to orange or pink in diapause. The PRP is three times longer than its basal width and is without dorsal spurs (Pl. 8.2). **Identification.** Larvae can usually be identified from a good photo showing the unique dorsal colour pattern and serrated edges of the body; a view showing the dimensions of the PRP would also be useful. **Biology.** Aphid predator, particularly on fruit trees such as cherries. Single generation with larvae overwintering in diapause until pupariation in the spring. **Notes.** Larvae may overwinter under plant pots, plastic trays, or similar coverings on the ground under or not far from previously aphid-colonised foliage, especially fruit trees.

Meliscaeva cinctella **Plate 5.3 – 5.4**

Characters. ~10 mm length. Body translucent to orange or red tinged and with a pair of pale parallel dorsal stripes. Internally, the breathing tubes are strongly tinted black as they approach the PRP, the darkening is far less extensive in *M. auricollis*. The PRP is unique, the spiracular area slopes backward with the spiracular openings very low down compared to other taxa (view in profile) (Pl. 8.3). **Identification**. Larvae can be identified from a good photo showing the dorsal colour pattern and the PRP *in profile*. **Similar taxa**: *Meliscaeva auricollis* is superficially similar but differs in dimensions of the PRP. **Biology.** Aphid predator, mostly broadleaved and conifer trees. Several

generations with autumn larvae overwintering in diapause until pupariation in the spring.

Meliscaeva auricollis **Plate 5.5 – 5.6**

Characters. ~10 mm length. Body translucent with pair of pale dorsal stripes that extends much of the way along the body. Internally, the breathing tubes are tinted dark for a short length as they converge on the PRP. The PRP is two times longer than its basal width, has a basal rim and a pair of dorsal spurs (Pl. 8.4). **Identification.** Larvae can be identified from a good photo showing the dorsal colour pattern and the PRP at x10. **Similar taxa**. See *Meliscaeva cinctella*. **Biology.** Aphid predator, associated with a broad range of aphids from herb layer to canopy, both broadleaved and conifer. Several generations with larvae in autumn overwintering until pupariation in the spring.

Sphaerophoria **Plate 6.1 – 6.2**

Characters. ~10 mm length. Body bright green with a pair of well-defined pale stripes. The PRP is at least as long as its basal width, up to 2x longer in *S. scripta* and is without dorsal spurs (Pl. 8.5). **Identification.** Larvae can be identified from a good photo showing the dorsal colour pattern and the PRP at x10 at an angle that accurately shows its dimensions. **Similar taxa.** See *Melanostoma*. **Biology.** Aphid predator, mostly associated with aphids in herb layer. Several generations with larvae in autumn overwintering until pupariation in the spring.

Leucozona lucorum **Plate 6.3 – 6.4**

Characters. ~12 mm length. Body translucent with dense particles of yellow, green, cream or pink fat forming a fish-bone pattern. **Identification.** Larvae can usually be identified from a good photo showing the dorsal colour pattern. **Similar taxa.** See *Leucozona glaucia.* **Biology.** Aphid predator, mostly found in herb and shrub

layer, especially Broad-leaved Dock. One and second partial generation with larvae in autumn overwintering until pupariation in the spring.

TAXA ACCOUNTS FOR OTHER FLIES FOUND IN WINTER LEAF LITTER

Lauxaniidae — Plate 9.1 – 9.2

Characters. ~5 mm length. No hardened head capsule or jaws, internal head skeleton with mouthparts. Translucent to greenish opaque, rear breathing tubes emerge as short, paired structures though closely approximated (can look fused into single structure). Skin can look smooth and shiny (e.g., *Meiosimyza*) or dulled by covering of spicules (e.g., *Pseudolyciella*). Head skeleton characteristically shaped when viewed dorsally. When feeding has characteristic lunging movement when gleaning microbes from the biofilm of decaying leaves. **Biology**. Feeds on microbes suspended in liquid that coat moist decaying leaves. Feeds throughout the winter and can be numerous in leaf litter. Pupariates in the spring. **Notes**. Larvae are prey of *Melanostoma* and can be used to rear them in captivity, only needing a few moist decaying leaves to sustain them.

Fannidae — Plate 9.3 – 9.4

Characters. ~5 mm length. No hardened head capsule or jaws, internal head skeleton with mouthparts. Body brown and distinctly hardened, flattened dorso-laterally with prominent segmentation, serrated lateral margins bearing branched lateral processes and widely separated rear breathing tubes. **Biology.** Same as Lauxaniidae. **Notes.** Also prey of *Melanostoma* larvae.

Lonchopteridae **Plate 9.5 – 9.6**

Characters. ~3 mm length. No hardened head capsule or jaws, internal head skeleton with mouthparts. Small. Body grey and distinctively hardened dorsally with 7 visible and prominent body segments, first two and final abdominal segment bear pairs of long hair-like processes. **Biology.** same as Lauxaniidae. **Notes.** Also prey of *Melanostoma* larvae.

***Phaonia*, Muscidae** **Plate 10.1 – 10.2**

Characters. ~10 mm length. No hardened head capsule or jaws, internal head skeleton with mouthparts. A rather pale larva that can be partially translucent, pale opaque or green tinged. The body is smooth, definably segmented, and noticeably tapers anteriorly. The head skeleton is characteristic possessing accessory sclerites and sickle-shaped mouthparts, best appreciated under x20 or more magnification in lateral view. The rear breathing tubes emerge as a pair of short disc or thorn-like projections on a round-faced posterior. **Biology.** Predator of a variety of soft-bodied invertebrates in leaf litter and is active throughout the winter pupariating in the spring. Despite smaller size, can prey on *Syrphus* in diapause.

PARASITOID WASPS

Field-collected larvae may host parasitoid wasps. Aphid predatory larvae suffer the highest proportion of parasitoids in the family due to their life among aphid colonies on exposed foliage. Parasitoid wasps are an interesting but sadly neglected group and play an important role in the population dynamics of hoverflies. Rearing records provide valuable information and add to our knowledge of parasitoids and hoverflies. However, they are exceptionally diverse and are a difficult group to identify with voucher specimens invariably required.

Diplazontinae (Hymenoptera, Ichneumonidae) (Pl. 11) are the most frequently reared parasitoids of hoverfly larvae. The female lays an egg in the larva and it completes its life cycle without any obvious signs of parasitism. When the puparium is formed, they are typically less teardrop shaped and darker in hue than non-parasitised individuals. A single wasp larva usually occupies each host.

Encyrtid wasps (Pl. 11), such as *Bothriothorax*, are frequently reared from *Syrphus* larvae. These diminutive wasps lay dozens of eggs inside the larva, and some eventually cause the larval skin to warp and harden, and through the skin you may see dozens of pupae. The adults escape by chewing out one or two exit holes, and it can be surprising just how many emerge from a single larva.

FINDING LARVAE

When larvae have finished feeding, they often end up in the litter layer. During the autumn, many larvae fall to the ground prematurely, especially tree dwelling species during high winds. If they are still hungry, they will climb up nearby structures such as fence posts or tree trunks. Aphids are often dislodged too and will also climb up these structures where they are pursued by syrphine larvae. There will be many 1st and 2nd instar larvae but, except for *Melanostoma*, these die before winter from lack of food or exposure to frost. Mostly, you will only find mature 3rd instar larvae in the winter.

Most larvae overwinter in diapause and pupariate in the spring or summer. A small number may delay pupariation for several years. Diapause is characterised by slow movement and poor responses to stimuli such as light and even prodding. However, they can be provoked into bursts of activity and will move up and down the leaf layers in response to excessive water or frost. Larvae that enter diapause have some tolerance to freezing. The purpose of diapause is to conserve energy and escape predictable periods of unfavourable conditions ready for pupariation in the spring or summer. *Melanostoma* are an exception as many will continue feeding on cohabiting fly larvae such as Lauxaniids and *Lonchoptera*, throughout the winter.

Larvae can be found anywhere in the litter layer that is not saturated with water. Places where leaves accumulate to form damp compacted layers often prove most productive. *Melanostoma* can be found in damper conditions where their prey prefer to feed.

Sycamore leaves are a good place to start. The leaves are quite big, resist decomposition well into the winter and can host large aphid

colonies, even in autumn. Beech and Oak leaf litter are more likely to host species like *Melangyna cincta* that prefer these trees. Deciduous leaves that have drifted under conifers are worth examining for conifer specialists dislodged by high winds. You will usually find some larvae after examining 500 or so leaves. There are many other invertebrates to be found to sustain your interest if syrphines are proving hard to find.

Larvae can be found by hand-searching individual leaves over a white tray and under a strong light. This can be done *in situ,* or a sample bag can be taken home for examination (though you may end up with a room full of escaping invertebrates!). Leaves can be gently peeled apart and their folds unfurled to expose any larvae present. The white tray is useful for catching larvae that roll out (Pl. 12.1 – 12.2). A bright light can be helpful, especially for smaller and more cryptic coloured larvae.

There are other methods for examining invertebrates among leaves such as Tullgren funnels and filtering litter through water, but they do increase the risk of larvae getting injured or killed.

Larvae can be found hiding under plastic or other objects such as bottles or seed trays left on the ground especially near trees and plants that have previously been colonised by aphids, such as cherry trees.

REARING TECHNIQUES

Care of larvae

Larvae can be reared using a variety of containers such as plastic tubs capped with mesh, Petri dishes, etc. A good container is one that can simultaneously prevent larvae from escaping but is not so airtight that condensation builds up. (Pl. 12.3 – 12.4).

A lining of crumpled kitchen roll provides somewhere for larvae to hide and can be moistened to maintain appropriate humidity. It is helpful that some part of the container is transparent so you can quickly assess the condition of the larvae / puparia, their environment and check for any emerged adults.

Containers should experience as near normal winter temperatures as possible or at the very least an unheated shed or room. Some species, such as *Syrphus*, are very responsive to temperature and can progress into adulthood if kept warm; then you will have adults in the middle of winter all revved up and with nowhere to go!

Each container should be clearly labelled with date, location name, grid reference and provisional identification of larva if possible. A note on micro-habitat - e.g., leaf litter would be a useful addition. A complimentary code could be included such as “2023/1” on a label that relates to information stored on a spreadsheet or in a notepad.

It is important to keep containers clean of mould, excessive condensation and to remove any dead larvae. As washing detergent may leave residues harmful to larvae it is recommended containers are cleaned in hot water.

Larvae can be moved by using a moistened fine brush or pair of stork-bill forceps. Pipettes and fine misters can be used to add a little water to containers as appropriate (Pl. 12.5).

You can rear several larvae together in a single container when they are in diapause (when not in diapause cannibalism is a concern). If you only wish to rear for recording purposes this is fine.

However, if you want to collect correctly identified puparia or link parasitoid wasps unambiguously to their host puparium, then larvae should be reared individually, or puparia removed from communal containers and reared individually.

Care of puparia

Puparia can be transferred to a fresh container supplied with a few pieces of kitchen roll. Loose puparia are best secured between two sheets to stop them rolling about the container and make it easier for adults to emerge and get free.

Normally, the puparium is stuck down posteriorly, and it is best to leave them in their container and move everything else out. If you must move them, the adhesive holding the puparium down can be moistened with water and very gently worked loose with a fine brush.

When adults are nearing emergence, it is often possible to see their colours and eyes developing through the skin. Emergence is achieved by adults pushing their heads against the puparium which breaks away on predefined weakened lines. Emergence is a fraught process, even in nature, and many adults get stuck half-way out and eventually perish. If they are delayed in getting out, the wings can set deformed.

RECORDING LARVAE

There are several places to enter records, so they are available to the Hoverfly Recording Scheme and other interested groups. Only one platform should be used at any one time to prevent confusion and duplicated records across the system. The preferred platforms for recording include:

1. **Hoverfly Recording Scheme Spreadsheet**
2. **Syrphboard**
3. **iRecord**
4. **iNaturalist**

When recording larvae or puparia it is important to include the life stage on the recording form you are using so they can be separated from each other and the adult stage. On the HRS Spreadsheet this means adding 'Larva' or 'Puparium' to the 'Gender' column. On iRecord there is a 'Stage' box, and you can choose 'Larva' or 'Pupa.' On iNaturalist, under 'Add Observation' you will need to go to 'Fields' > 'Add a Field' > 'Insect life stage' then select either 'Larva' or 'Pupa.'

If you have identified a larva to genus and then reared an adult to make a species identification, the method is the same as above. The details of location and date relate to when and where the larva was found with the reared adult used only to make an identification. On the above platforms, there is a place for making comments and this is where you add details relating to rearing, for example, 'female reared May 2023'.

GLOSSARY

Anal segment	The last segment of the body with the PRP on the dorsal surface
Chevron	Sergeant-stripe pattern of fat on the dorsal surface of aphid predatory larvae, sometimes triangular
Development diapause	Suspended development characterised by a torpid state for conserving energy until favourable environmental conditions return.
Diapause	See development diapause
Dorsal spurs	A pair of projections on dorsal surface of PRP
Feeding phase	The phase during which larvae are actively feeding
Head skeleton	Hardened structure withdrawn within the thorax that includes the mouthparts and is often visible through the translucent larval skin
Instar	Stage between successive skin-shedding
Lappet	A fleshy projection of the anal segment, can be several pairs
Locomotory prominences	Paired structures on the ventral surface of the abdomen and thorax involved in locomotion; distinguished from prolegs in that they do not contain musculature
Papillae	A small, fleshy projection of the skin
Parasitoid	Insect, usually wasp or fly, that feeds as a larva in or on the body of its host, which provides all its nourishment; the host dies at the end of the association, and the wasp or fly emerges as a larva or adult to become free-living.
Posterior Respiratory Process	One of the defining features of Hoverfly larvae resulting from the fusion of the two breathing tubes at the rear end and appearing as a hardened structure from the dorsal surface of the anal segment.

PRP	see Posterior Respiratory Process
Pupariation	The process of forming a puparium
Puparium	The final skin of the 3rd instar larva that hardens to form a protective shell around a developing pupa and from which emerges the adult
Rear breathing tubes	Two breathing tubes emerging posteriorly from the body usually appearing as a paired structure, like rose-thorns or discs, and different from the PRP in that they are not fused into a single structure.
Setae (pl) seta (s)	A small "hair"
Spiracular openings	The point on the PRP where the breathing tubes open to the air
Spiracular slits	see Spiracular openings
Triangular sclerites	A distinguishing feature of aphid predatory larvae (Syrphinae + Pipizini), a pair of hardened small triangulars attached to the outside of the thorax that appear to flank the pointed apex of the mouthparts and are deployed to help grip aphids during feeding.

FURTHER INFORMATION

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Photo credits

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p.4	Episyrphus balteatus	GW
p.4	Melangyna cincta puparium	LI
p. 14	Diplazon laetatorius (Hymenoptera, Ichneumonidae)	GW
p. 14	Encyritid wasp (Hymenoptera)	GW
p. 16	Epistrophe eligans	ER
p. 16	Epistrophe eligans	Ere
Plate 1.1	Epistrophe eligans	AK
Plate 1.2	Dasysyrphus albostriatus	GW
Plate 1.3	Epistrophe eligans, PRP	JB
Plate 1.4	Melangyna	JB
Plate 1.5	Syrphus, 2nd instar	GW
Plate 1.6	Melanostoma scalare	GW
Plate 2.1	Syrphus	GW
Plate 2.2	Syrphus	GW
Plate 2.3	Syrphus	GW
Plate 2.4	Syrphus	GW
Plate 2.5	Melanostoma	GW
Plate 2.6	Melanostoma	GW
Plate 3.1	Epistrophe grossulariae	NG
Plate 3.2	Epistrophe grossulariae	NG
Plate 3.3	Epistrophe grossulariae	GW

Plate 3.4	Dasysyrphus albostriatus	GW
Plate 3.5	Parasyrphus punctulatus	GW
Plate 3.6	Parasyrphus punctulatus	GW
Plate 4.1	Leucozona glaucia	SS
Plate 4.2	Leucozona glaucia	NG
Plate 4.3	Melangyna cincta	GW
Plate 4.4	Melangyna cincta	GW
Plate 4.5	Epistrophe eligans	GW
Plate 4.6	Epistrophe eligans	NG
Plate 5.1	Meligramma euchromum	NG
Plate 5.2	Meligramma euchromum	NG
Plate 5.3	Meliscaeva cinctella	NG
Plate 5.4	Meliscaeva cinctella	GW
Plate 5.5	Meliscaeva auricollis	GW
Plate 5.6	Meliscaeva auricollis	GW
Plate 6.1	Sphaerophoria	NG
Plate 6.2	Sphaerophoria	NG
Plate 6.3	Leucozona lucorum	NG
Plate 6.4	Leucozona lucorum	NG
Plate 6.5	Leucozona lucorum and L. glaucia	GW
Plate 9.1	Lauxaniidae	SS
Plate 9.2	Lauxaniidae	NG
Plate 9.3	Fannia (Fanniidae)	TE
Plate 9.4	Fannia (Fanniidae)	UK
Plate 9.5	Lonchoptera (Lonchopteridae)	NG
Plate 9.6	Lonchoptera (Lonchopteridae)	GW
Plate 10.1	Phaonia (Muscidae)	NG
Plate 10.2	Phaonia (Muscidae)	GW
Plate 11.1	Diplazon laetatorius (Hymenoptera, Ichneumonidae)	GW
Plate 11.2	Melangyna, puparia	NG
Plate 11.3	Syrphus puparium, Diplazon exit hole	GW
Plate 11.4	Encyritid wasp (Hymenoptera)	GW
Plate 11.5	Syrphus puparium, hosting Encyritid wasp	GW
Plate 11.6	Syrphine puparium, hosting Encyritid wasps	KL

PLATE 1: IS IT A HOVERFLY LARVA?

1. *Epistrophe eligans*, dorsal view, a) Posterior respiratory process (PRP)

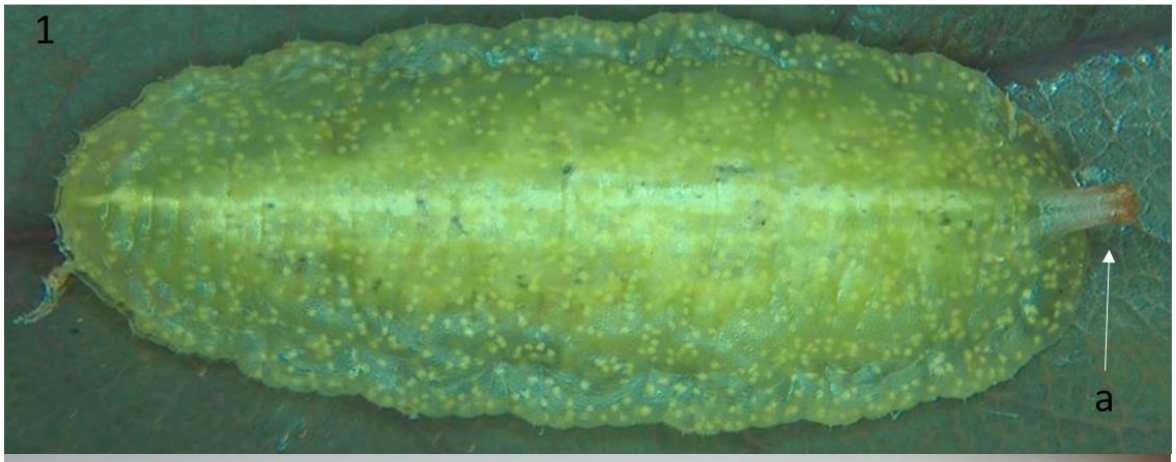
2. *Dasysyrphus albostriatus*, profile view, a) Posterior respiratory process, note that it emerges from the body at an angle.

3. *Epistrophe eligans*, dorsal view of Posterior respiratory process, note the pair of dorsal spurs.

4. *Melangyna umbellatarum*, tip of the Posterior respiratory process, note the three pairs of slit-like spiracular openings.

5. *Syrphus* 2nd instar, dorsal view. Note the rear breathing tubes emerge as a pair of disc or thorn-like structures.

6. *Melanostoma scalare*, ventral view, a) pair of tiny black triangular sclerites which flank the pointed apex of the mouthparts, b) the head skeleton which includes the mouthparts.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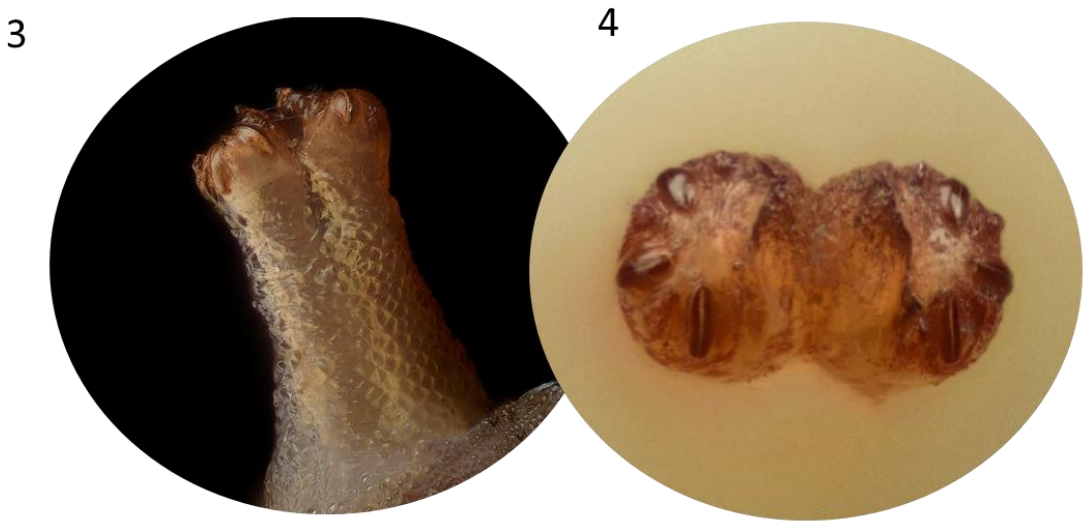
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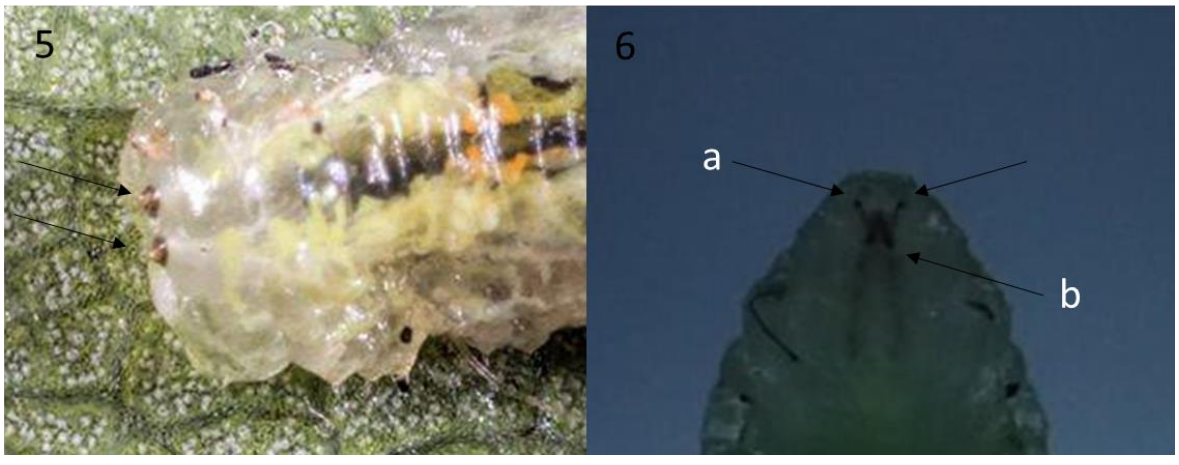
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PLATE 2: TAXA ACCOUNTS

1. *Syrphus*, feeding phase - still retains waste material in gut hence the darkening along the mid dorsal line.

2. *Syrphus*, diapause - without waste material in gut hence transparent mid dorsal line.

3. *Syrphus*, feeding phase - still retains waste material in gut hence the darkening along the mid dorsal line.

4. *Syrphus*, diapause - without waste material in gut hence transparent mid dorsal line.

5. *Melanostoma*, typical bright green individual.

6. *Melanostoma*, atypical translucent individual with weak green pigmentation.

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PLATE 3: TAXA ACCOUNTS

1. *Epistrophe grossulariae*, feeding phase.

2. *E. grossulariae*, transition from feeding phase to diapause.

3. *E. grossulariae*, diapause.

4. *Dasysyrphus albostriatus*, genus all look similar and differ in minor details, in particular the shape and dimension of the PRP are often species specific.

5. *Parasyrphus punctulatus*, feeding phase.

6. *P. punctulatus*, diapause

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PLATE 4: TAXA ACCOUNTS

1. *Leucozona glaucia*, diapause.

2. *L. glaucia*, diapause.

3. *Melangyna cincta*, feeding phase.

4. *M. cincta*, diapause.

5. *Epistrophe eligans*, feeding phase.

6. *E. eligans*, diapause.

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PLATE 5: TAXA ACCOUNTS

1. *Meligramma euchromum*, feeding phase.

2. *M. euchromum,* diapause.

3. *Meliscaeva cinctella*, feeding phase.

4. *M. cinctella*, diapause.

5. *Meliscaeva auricollis*, feeding phase.

6. *M. auricollis,* diapause.

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PLATE 6: TAXA ACCOUNTS

1. *Sphaerophoria*, feeding phase.

2. *Sphaerophoria*, diapause.

3. *Leucozona lucorum*, with green/yellow colour pattern.

4. *L. lucorum*, with cream colour pattern.

5. *Leucozona lucorum* and *L. glaucia*, dorsal view of anal segment. Note two pairs of papillae with apical setae. These are absent in *L. glaucia*.

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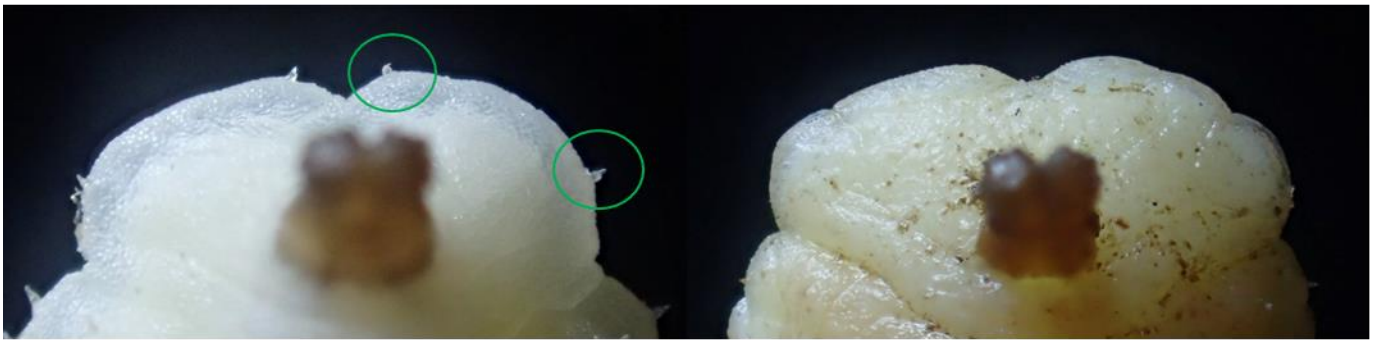

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PLATE 7: POSTERIOR RESPIRATORY PROCESS

1. *Syrphus*, PRP in dorsal view. Note the pair of dorsal spurs. Angle of view is critical and may only be seen clearly by tilting the larva downward posteriorly.

2. *Syrphus*, PRP view of spiracular area at tip. Note the three pairs of spiracular openings (sometimes referred to as spiracular slits or orifices) and that this is their typical arrangement.

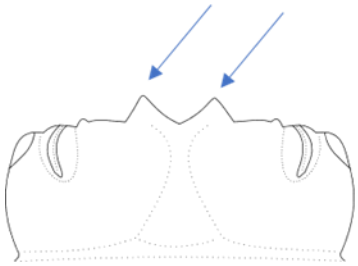
3. *Epistrophe grossulariae*, PRP in dorsal view.

4. *Dasysyrphus albostriatus*, PRP in dorsal view. Note the prominent dorsal spurs and how they strongly diverge compared with D. tricinctus.

5. *D. tricinctus,* PRP in dorsal view.

6. *Melangyna cincta*, PRP in dorsal view. (*Parasyrphus punctulatus* is similar in structure and dimension).

Dorsal spurs



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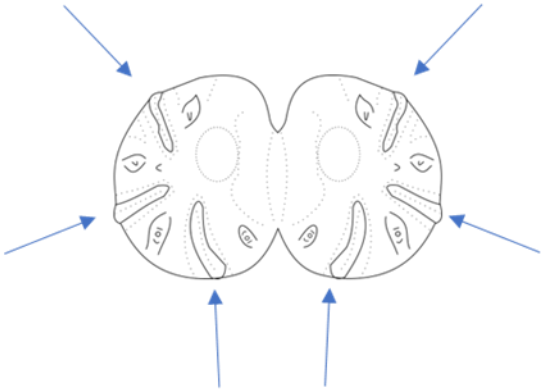

Spiracular openings

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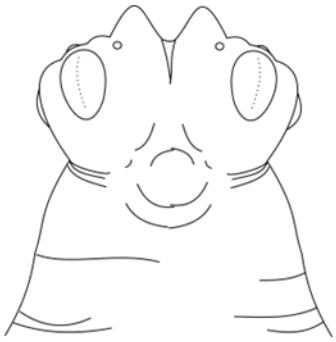

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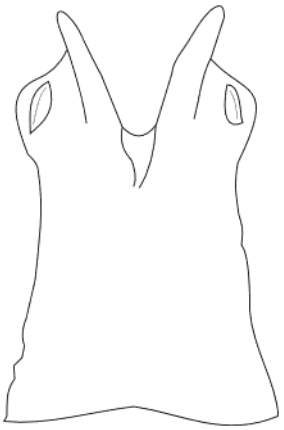

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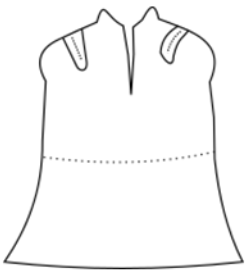

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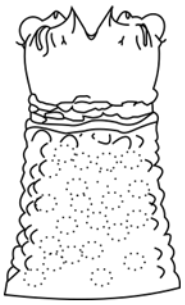

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PLATE 8: POSTERIOR RESPIRATORY PROCESS

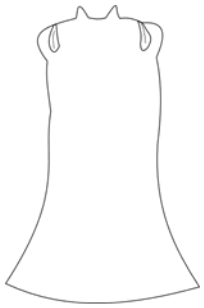
1. *Epistrophe eligans,* PRP in dorsal view.

2. *Meligramma euchromum*, PRP in dorsal view.

3. *Meliscaeva cinctella,* PRP in profile view.

4. *Meliscaeva auricollis*, PRP in dorsal view. Note the basal rim or band (blue arrow) and the pair of dorsal spurs. The latter can be difficult to see in some specimens and angle of view is critical.

5. *Sphaerophoria scripta*, PRP in dorsal view.



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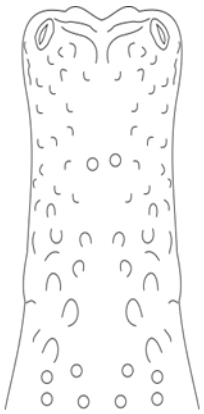

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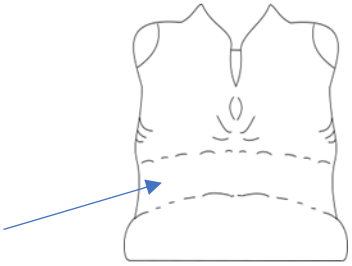

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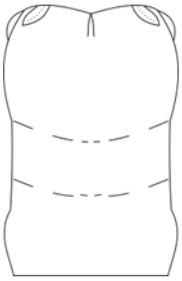

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PLATE 9: A SELECTION OF OTHER FLY LARVAE FOUND IN WINTER LEAF LITTER

1. Lauxaniidae, dorsal view of larva. Note the pimpled appearance of the skin that some species in this family have, such as in *Pseudolyciella*. Also, the pair of obvious lappets sticking out laterally on the anal segment.

2. Lauxaniidae, dorsal view of larva. Note the smooth appearance of the skin that some species have, such as in *Meiosimyza*.

3. *Fannia* (Fanniidae), dorsal view of larva.

4. *Fannia* (Fanniidae), dorsal view of larva.

5. *Lonchoptera* (Lonchopteridae), dorsal view of larvae.

6. *Lonchoptera* (Lonchopteridae), lateral view of larva.

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PLATE 10: A SELECTION OF OTHER FLY LARVAE FOUND IN WINTER LEAF LITTER

1. *Phaonia* (Muscidae), dorsal view of larva. Note the rear breathing tubes are short and emerge as a pair.

2. *Phaonia* (Muscidae), eating a Lauxaniid larva.

3. *Phaonia* (Muscidae), tip of abdomen showing paired nature of rear breathing tubes.

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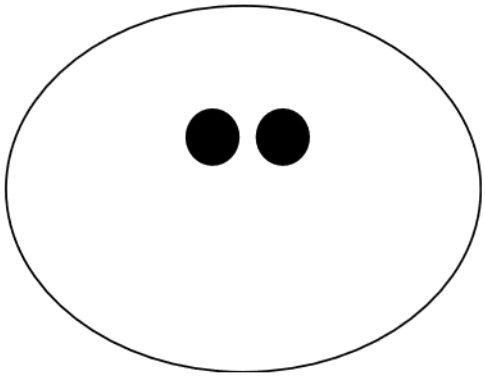

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PLATE 11: PARASITOID WASPS

1. *Diplazon laetatorius* (Ichneumonidae), a frequent species reared from syrphine larvae.

2. *Melangyna* puparia, the bottom puparium hosts a parasitoid and is darker and slenderer than the non-parasitised individual above.

3. *Syrphus*, the emerging *Diplazon* has chewed a round exit hole from the puparium.

4. Encyrtid wasp egg laying into *Syrphus* larva.

5. *Syrphus*, the larva is host to Encyrtid wasps that warp and harden the skin.

6. *Syrphus*, puparium hosting multitudes of Encyrtid wasps have exited several tiny holes.

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PLATE 12: FINDING AND REARING LARVAE FOUND IN WINTER LEAF LITTER

1. Leaf litter from under solitary trees or from woodland can be collected into bags for searching through at home or *in situ* using a white tray.

2. A white tray and a strong light can be helping in finding larvae and catching those that roll out when unfurling leaves.

3. A range of containers can be used to rear larvae, such as plastic tubes, Petri dishes, yoghurt pots and plastic glasses capped with kitchen roll or muslin netting.

4. When using Petri dishes, it can be useful to bind them together with an elastic band.

5. Various tools such as pipettes for dispensing water and fine brushes or stork-bill forceps for moving larvae, and kitchen roll for bedding inside containers.

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