

more than an average of six eggs at one time. Egg-laying continued, however, after crawlers hatched and escaped. The crawlers settle on the underside of the needles and produce copious white secretions. By the time the insects reach maturity, an infestation can be so heavy that the trees have a whitewashed appearance. In Maryland active crawlers of all developmental stages of both males and females are present throughout an entire year. If the species has become established on conifers in Britain, its presence should be easily recognizable.

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THIRD STAGE LARVAE OF SIX SPECIES OF APHIDOPHAGOUS SYRPHIDAE (DIPTERA)

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Despite their economic importance and popularity the larval stages of many aphidophagous Syrphidae are either poorly described or unknown (Rotheray, 1987a). Larval stages can be obtained either by collecting them from aphid colonies or by rearing them from captured gravid females. Both methods have been used to obtain larval stages of the six species described in this paper.

Larvae found in the field were fed on the same species of aphid from whose colony they were collected. Aphid species used to rear larvae obtained from ova are listed below. Rearing took place either with individual larvae in 25 × 75 mm, corked glass tubes or with groups of 4–5 larvae in 90 mm diameter Petri dishes. Pieces of aphid-infested vegetation were added so that there was always an excess of available prey. Aphids were supplied until larvae expelled the black contents of their hind guts which signalled the end of the feeding stage. Larvae were subsequently photographed and described and a few individuals of each species preserved in 70% alcohol after being fixed in a 60°C water bath (Dixon, 1960). Other larvae were transferred individually to separate glass tubes and wrapped in tissue paper that was kept well moistened. Tubes were inspected regularly until emergence of the adult stage. Rearing took place in an outdoor insectary. Adults were identified using Stubbs & Falk (1983) and by comparison with named material in the collections of the Royal Museum of Scotland. Morphological terms follow Dixon (1960) and Rotheray (1986).

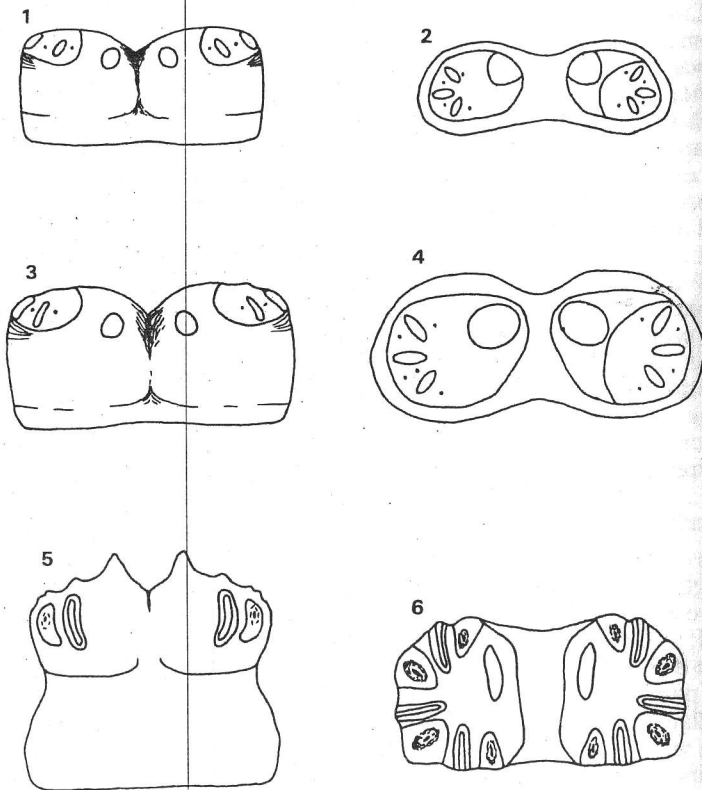
Description of the third stage larva

Platycheirus angustatus (Zetterstedt)

Length 7–9 mm; width 1.75 mm; height 1.5 mm; subrectangular in cross-section; long, narrow larva tapering only from thorax to head; truncate posteriorly; outline smooth from above; anal segment dorso-ventrally flattened 1.75 × 0.50 mm; anal segment with one pair of anal lobes at tip; dorsal vestiture of dome-shaped papillae, ventral papillae confined to narrow mid-ventral strip; larva with a pair of pinkish brown mid-dorsal stripes that fuse on the first abdominal segment and continue to the apex of the mesothorax; overlying these stripes are chevron-shaped pale pinkish brown markings on abdominal segments 2–7; lateral to these chevrons is a pair of similarly coloured stripes on segments 1–8 consisting of particles of adipose tissue; upper lateral stripes present; lateral margins with inclined stripes on abdominal segments 1–8; posterior respiratory process (prp) (Fig. 1): broader

than long; pale brown and shiny; spiracular plates sloping inwards; median groove down the sides of the prp; dorsal spurs absent; spiracular slits on a pale spiracular plate which darkens on formation of the puparium; spiracular slits short and not extending over the sides of the prp (Fig. 2). Overall appearance: a long narrow larva with pinkish brown stripes.

Description based on seven larvae reared on *Caveriella* sp. aphids from *Heracleum sphondylium* L. Larvae obtained from eggs laid by a female swept from ground-layer vegetation at Fairy Isles Scottish Wildlife Trust Nature Reserve, Knapdale Forest, Argyll (NR 7688) on 6.vii.1987 by D. M. Robertson.



Figs 1-6. Third stage syrphid larvae. 1, 2, *Platycheirus angustatus*: (1) posterior respiratory process (prp), anterior view; (2) prp, dorsal view. 3, 4, *Platycheirus scambus*: (3) prp, anterior view; (4) prp, dorsal view. 5, 6, *Leucozona (Ischyrosyrphus) laternaria*: (5) prp, anterior view; (6) prp, dorsal view.

Platycheirus scambus (Staeger)

Length 10-12 mm; width 2.25 mm; height 2.15 mm; subrectangular in cross-section; long narrow larva tapering only from thorax to head; truncate posteriorly; outline smooth from above; anal segment dorso-ventrally flattened 1.50×0.35 mm; anal segment with one pair of anal lobes at tip; dorsal vestiture of dome-shaped papillae, ventral papillae confined to narrow mid-ventral strip; larva with a pair of pale brown mid-dorsal stripes that fuse on the first abdominal segment and continue to the apex of the mesothorax; overlying these stripes are chevron-shaped pale brown markings on abdominal segments 2-7; lateral to these chevrons is a pair of similarly coloured stripes on segments 1-8 consisting of particles of adipose tissue; underlying these stripes is a rufous-coloured pair of stripes that fade to a pale brown colour in larvae that have finished feeding; upper lateral stripes present; lateral margins with inclined pale brown stripes on abdominal segments 1-8; prp (Fig. 3): broader than long; pale brown and shiny; spiracular plates sloping inwards; median groove down the sides of the prp; dorsal spurs absent; spiracular slits on a pale spiracular plate which darkens on formation of the puparium; spiracular slits short and not extending over the sides of the prp (Fig. 4). Overall appearance: a long narrow larva with pale brown stripes.

Description based on four larvae reared on *Caveriella* sp. aphids from *Heracleum sphondylium* L. Larvae obtained from eggs laid by a female swept from ground layer vegetation at Fairy Isles Scottish Wildlife Trust Nature Reserve, Knapdale Forest, Argyll (NR 7688) on 6.vii.1987 by D. M. Robertson.

Platycheirus larvae can be distinguished from other syrphid larvae by their subrectangular shape, dorsal field with chevrons consisting of particles of adipose tissue, short spiracular slits on a broader than long prp and the absence of apical setae on sensilla of the anal lobes. Two groups can be recognised, those with indistinct chevrons and prominent stripes (*angustatus*, *clypeatus*, *fulviventris* and *scambus*) and those with indistinct stripes but prominent chevrons (*albimanus*, *manicatus*, *peltatus* and *scutatus*). At present no reliable characters have been found to separate those species with dominant stripes.

Leucozona (Ischyrosyrphus) laternaria (Müller)

Length 9-11 mm; width 3 mm; height 1.5-2.5 mm; subtriangular in cross-section; tapering anteriorly; truncate posteriorly; outline smooth from above; integument translucent and covered with dome-shaped papillae except on ventral surface which is clear and shiny; larva translucent with a pair of broad whitish dorsal stripes from the posterior margin of abdominal segment 7 to the metathorax where they merge and end on the mesothorax; lateral field flecked white with adipose tissue; anal segment with two pairs

of lobes; dorsal sensilla on these lobes mounted on prominent papillae with apical setae absent; prp (Fig. 5): about as long as apically broad; lightly wrinkled basally, clear and shining at apex; spiracular slits mounted on pale carinae and extending down the sides of the prp (Fig. 6); carinae not differentiated in colour from the rest of the prp; dorsal spurs about half as high as the length of the first spiracular slit; spiracular plates sloping outward; interspiracular ornamentation mounted on ridges. Overall appearance: a somewhat flattened, tapering, translucent larva with broad white stripes.

Description based on nine larvae collected from *Caveriella* sp. aphids on *Angelica sylvestris* L. at Crichton Glen, Midlothian (NT 3762) on 29.vii.1986. The larvae were found below the aphid colonies in curled leaf bases. They overwintered as larvae and adults emerged during the period 21–29.vi.1987. Larval stages of the three British *Leucozonia* species can be recognised and identified using the following key.

- 1 Larva subtriangular in cross-section; translucent with chevrons or stripes; anal segment with two pairs of lobes at the tip, the median pair of which with dorsal sensilla mounted on papillae (*Leucozonia*) 2
- Larva not like this rest of Syrphinae
- 2 Whitish stripes along the sides of most abdominal segments 3
- Sides of the abdomen flecked with whitish particles of adipose tissue not aggregated into stripes *Leucozonia (I.) laternaria* (Müller)
- 3 prp longer than broad *Leucozonia (L.) lucorum* (L.)
- prp as long as or shorter than broad *Leucozonia (I.) glauca* (L.)

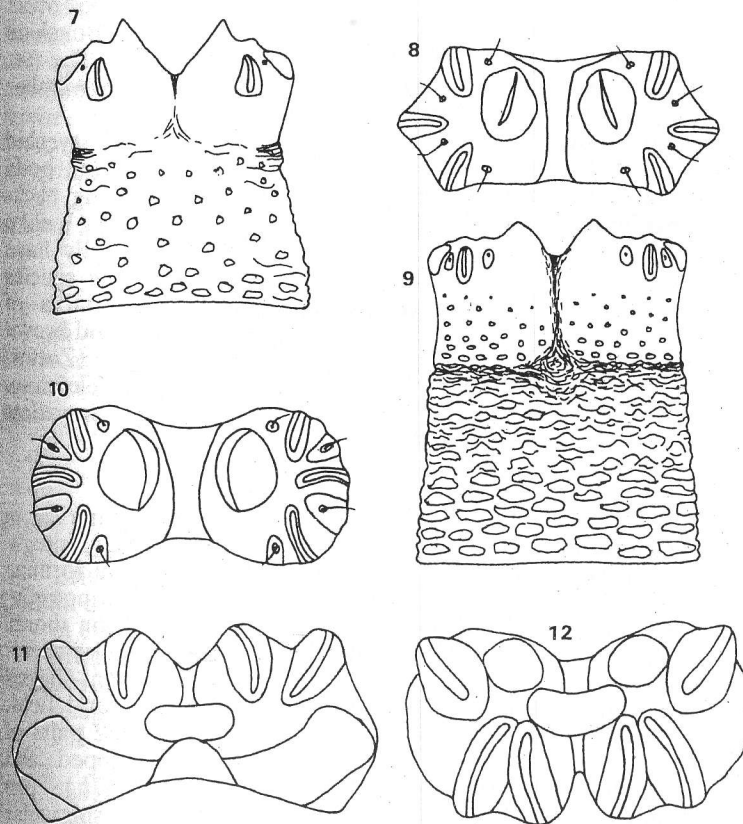
Melangyna arctica (Zetterstedt)

Length 7.0–8.5 mm; width 1.75–2.50 mm; height 1.5–2.5 mm; flattened posteriorly in cross-section; tapering anteriorly; truncate posteriorly; outline smooth from above; integument translucent and covered with dome-shaped papillae; larva dark brown dorsally and laterally due to particulate adipose tissue; distinctive arrow-shaped whitish to pale brown marking on mid-dorsal anterior margin of abdominal segment 5 and reaching back to the posterior margin of abdominal segment 6; lower lateral whitish to pale brown stripe on abdomen; anal segment with two pairs of lobes at tip; prp (Fig. 7): 1.5 × as long as broad at tip; broader at base than tip; dark brown at apex, paler at base; nodulate in basal half, matt and smooth apically; mid-point constriction present; spiracular plates sloping outward; dorsal spurs about half as length of first spiracular slit; spiracular slits mounted on dark carinae and extending down the sides of the prp (Fig. 8). Overall appearance: a dark brown larva with a pale arrow-shaped marking posteriorly.

Description based on 19 larvae beaten from *Pterocallis ulni* (DeGeer) aphid colonies on *Alnus glutinosa* (L.) Gaertner at Caerlaverock Marshes NNR, Dumfriesshire (NX 0165) on 14.vi.1987. Adults emerged 1–8.vii.1987.

Melangyna quadrimaculata (Verrall)

Length 7.0–8.5 mm; width 1.75–2.50 mm; height 1.5–2.5 mm; flattened posteriorly in cross-section; tapering anteriorly; truncate posteriorly; outline smooth from above; integument translucent and covered with dome-shaped papillae; larva dark brown dorsally and laterally due to particulate adipose tissue; 4 or 5 distinctive



Figs 7–12. Third stage syrphid larvae. 7, 8, *Melangyna arctica*: (7) posterior respiratory process (prp), anterior view; (8) prp, dorsal view. 9, 10, *Melangyna quadrimaculata*: (9) prp, anterior view; (10) prp, dorsal view. 11, 12, *Metasyrphus nielsenii*: (11) prp, anterior view; (12) prp, dorsal view.

square-shaped whitish markings on abdominal segments 2/3-6 increasing in size towards segment 6; lower lateral whitish stripe on abdomen; infrequent pale flecking in lateral field; anal segment with two pairs of lobes at the tip; prp (Fig. 9): about $1.6 \times$ as long as broad at tip; light brown at tip, paler towards base; as broad at base as tip; nodulate to just below spiracular slits; spiracular plates almost straight; dorsal spurs about half as high as length of the first spiracular slit; spiracular slits mounted on dark carinae (Fig. 10), and extending over the sides of the prp; interspiracular ornamentation mounted on cones. Overall appearance: a dark brown larva with square-shaped markings on the abdomen.

Description based on three larvae beaten from colonies of an unidentified adelgid on *Abies alba* Miller opposite Bonskied House, Pitlochry, Perthshire (NO 8961) on 27.vii.1986. The one larva that was reared through the winter pupated in November 1986 and an adult emerged on 23.iii.1987.

Melangyna larvae can be distinguished from other syrphid larvae by their flattened cross-section posteriorly, smooth body outline, partially nodulate prp and anal segment lacking backwardly directed projections but with two pairs of lobes. Unlike many other syrphine genera within which species usually have similar colour patterns, the larval stages of *Melangyna* species seem to have species-specific colour patterns. The larva of *Melangyna umbellatarum* (Fabricius) is white or white and brown (Rotheray, 1986). The larva of *Melangyna lasiophthalma* (Zetterstedt) is mottled orange, brown and yellow (Goeldin de Tiefenau, 1974). The colour patterns of *M. arctica* and *M. quadrimaculata* distinguish these two species.

Metasyrphus nielsenii Dušek & Láska

Length 9-11 mm; width 2 mm; height 2 mm; subcylindrical in cross-section; tapering anteriorly; truncate posteriorly; integument translucent except for dark dome-shaped papillae forming aggregations mid-dorsally and dorso-laterally but these not contributing to the overall colour pattern; dorsal sensilla on thorax with pointed apical setae, apical setae club-tipped elsewhere; dorsally on abdominal segments 1-6 pale yellow crescent-shaped markings, one per segment; flecked white in the lateral field; otherwise larva sandy orange; anal segment with three pairs of lobes at tip; locomotory prominences well developed and U-shaped grasping organ present (Rotheray, 1987b); prp (Fig. 11): twice as broad as long; dorsal spurs absent; spiracular slits mounted on dark carinae and almost reaching base of prp; first pair of spiracular slits shorter than the other two pairs and mounted on a higher carina; spiracular plates fused in centre (Fig. 12). Overall appearance: narrow, sandy-coloured larva.

Description based on five larvae reared from eggs laid by a female captured at Rothiemurchus Forest, Speyside (NO 0891) on

19.vi.1987. The female was resting on a branch of a young *Pinus sylvestris* L. which was infested with *Cinara pinea* (Mordvilko) aphids. Larvae were reared using mostly *Schizolachnus pineti* (Fabricius) aphids with small numbers of *C. pineti* aphids occasionally supplied as available.

Metasyrphus larvae can be distinguished from other syrphid larvae by the subcylindrical shape in cross-section, presence of U-shaped grasping organ and the aggregated groups of dark papillae on the dorsal surface. *M. nielsenii* can be separated from other *Metasyrphus* larvae by its sandy colour, sensilla with club-tipped setae and dome-shaped, rather than pointed, papillae on the dorsal surface.

Within the British Isles, *M. nielsenii* is known mostly from pine forests in the Scottish Highlands (Stubbs & Falk, 1983). It probably specialises on conifer aphids, a suggestion strengthened by the finding that, contrary to many other aphidophagous syrphid larvae, the larva of *M. nielsenii* would not feed on *Brachycaudus* sp. aphids from *Silene dioica* Clairv. and *Caveriella* sp. aphids from *H. sphondylium*. If it does specialise on pine aphids then, at least on *P. sylvestris*, the sandy coloured larva is well camouflaged among its branches and flowers.

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