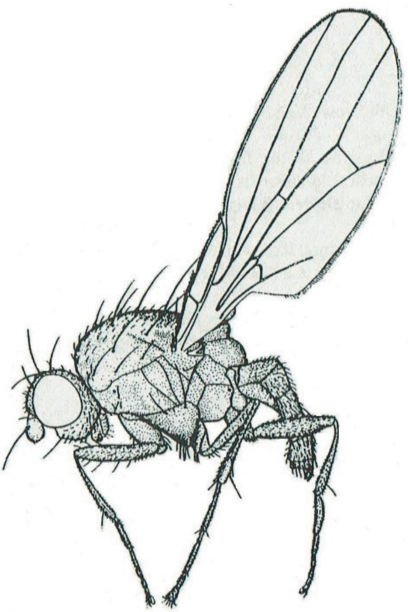
Dipterists Digest

2020 Vol. 27 No. 2

Cover illustration: *Phasia aurigera* (Egger, 1860) (Tachinidae), male, 14 June 2019 at Denge Wood, Kent (photo Michael Baldock); see article by Chris Raper on pages 189-192.

Dipterists Digest



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- new and improved techniques (e.g. collecting, rearing etc.);
- the conservation of flies;
- records and assessments of rare or scarce species and those new to regions, countries etc.;
- local faunal accounts and field meeting results, especially if accompanied by ecological or natural history interpretation;
- descriptions of species new to science;
- notes on identification and deletions or amendments to standard key works and checklists.

Articles should be in A5 format with text in 9-point and Times New Roman font, title 12 point and author's name 10.5 point, with 1.27cm (narrow) side margins. Figures should be drawn in clear black ink, about 1.5 times their printed size and lettered clearly. Colour photographs will also be welcomed. Figures and photographs should be supplied separately as hard copy or as jpegs at 300dpi.

Style and format should follow articles published in recent issues. A short Summary (in the form of an Abstract) should be included at the beginning of each article. References to journals should give the title of the journal in full. **Scientific names should be italicised.** Authors of scientific names should be given in full and nomenclature should follow the most recent checklist, unless reflecting subsequent changes. Descriptions of new species should include a statement of the museum or institution in which type material is being deposited.

Authors will be provided with a pdf of their contribution and, if requested, up to 5 separate copies of papers of two or more pages in length.

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Two species of *Chrysotus* (Diptera, Dolichopodidae) new to the British list

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Summary

Chrysotus angulicornis Kowarz, 1874 had been deleted from the British list but is reinstated here, based on specimens agreeing with the current concept of this species collected in southern England. A key and figures are given to help distinguish it from *C. collini* Parent, 1923 and *C. gramineus* (Fallén, 1823) which it resembles. *Chrysotus tricaudatus* Negrobov, Barkalov & Selivanova, 2014 was known only from Siberia; a large population found in northern England represents a remarkable addition to the European fauna and is thought to be a recent immigrant.

Introduction

Chrysotus are small to tiny shiny green flies, of which 16 are included in the latest update of the British check list (Chandler 2020). Worldwide there are about 300 species, and new ones are being described frequently from the Palaearctic (Yang *et al*. 2006). The west European fauna is moderately well known, with 28 species listed in Fauna Europaea (Pollet 2011) and *Chrysotus dischmaensis* added by Naglis (2010). The numerous synonyms testify to the difficulties in the taxonomy; 66 species names are given in the PESI portal (2020) for Europe. In the process of writing new keys to the British dolichopodids, I have found several unresolved issues within *Chrysotus*, and here I deal with the easiest: two species new to the British fauna whose identities are uncontentious. One of these, *C. angulicornis* Kowarz, 1874 reintroduces a name previously used on the British list, but which had been deleted as a misidentification. Its reintroduction to the British literature is bound to cause confusion. The second species, *C. tricaudatus* Negrobov, Barkalov & Selivanova, 2014 is a remarkable addition to the fauna of temperate Europe.

Results

Chrysotus angulicornis Kowarz, 1874

This species has a long history on the British list of dolichopodids. Verrall (1901, 1905) first recorded *C. angulicornis* in Britain, and d'Assis-Fonseca (1978) followed Parent (1938) in distinguishing it from Kowarz's (1874) two similar species, *C. microcerus* and *C. varians*. Cole (1987) noticed that specimens agreeing with these determinations had genitalia identical to those of *C. gramineus* (Fallén), and variation in antennal shape and leg colour was within the range for this particularly variable species. This led to their synonymy with *C. gramineus* in the British check list (Chandler 1998). Negrobov and Pont (2005) re-examined Kowarz's specimens of several species in an effort to establish the identity of his described species, and designated a lectotype for the only specimen of *C. angulicornis* that they could find. This is housed in the Kowarz Collection at Oxford University Museum of Natural History, Oxford, UK. The essential characters needed to confirm the identity are the antennae and genitalia, which were later reported to be missing, the end of its abdomen apparently having been snipped off and now lost; it was in this condition when Jon Cole examined it in 1981 (Negrobov and Chandler 2006). None of this would matter if the species was unambiguously *C. gramineus*, but Negrobov and Chandler (2006) retained the name for an externally similar species with markedly different genitalia to those of *C. gramineus*, using Kowarz's name *C. angulicornis* to maintain stability. The lectotype was therefore no help in characterising the species which could then be recognised only from drawings of the genitalia, both published in the same year, of specimens from the Czech Republic and

Georgia (Negrobov and Chandler 2006) and from Finland (Kahanpää and Grichanov 2006). Naglis (2015) provided photographs of the male genitalia of *C. collini* Parent, 1923, *C. gramineus* (Fallén, 1823), and *C. angulicornis*. None of the authors explained how they deduced that their genitalia belonged to *C. angulicornis*, although Kahanpää and Grichanov stated that their specimen had a 'subtriangular postpedicel', and Negrobov and Chandler noted that the genitalia of British specimens that they examined were the same as that illustrated by Kahanpää and Grichanov. So whether or not Kowarz's lectotype is genuinely *C. angulicornis*, the species is now defined by these genitalia drawings alone. All the British specimens purporting to be *C. angulicornis* (that is, having a triangular antennal segment) examined by Negrobov and Chandler had the genitalia of *C. gramineus*, so they removed *C. angulicornis* from the British list. I examined the lectotype and concluded that, compared to my specimens of *C. angulicornis*, several important characters more closely resemble those of *C. gramineus*. These include the strongly bristled anterior fringe of the hind tibia, which is equal to the shaft's width and individual hairs are 1.5 times the shaft's width, and the fringe continues strongly onto the dorsal surface of the basitarsus; the front tibia has a strong fringe on all faces except ventrally and with a very long pale posteroventral fringe; and the marginal setae on the second and third tergites are at least half the tergites' lengths.

Recognition

In southern England, I collected specimens whose genitalia match these drawings of *C. angulicornis*. In lateral view the phallus is slender and has only slight bumps in its profile at the tip of the sheath that encloses the aedeagus, but in ventral or dorsal view the end of the sheath has a characteristic slightly expanded, more or less symmetrical, rounded tip with an apical double notch partially obscured by the aedeagus (Fig. 1a, b). In comparison, the tip of the sheath in the similar species *C. gramineus* and *C. collini* has conspicuous leaf-shaped appendages (Fig. 1c-e, h, i). While the genitalia of *C. gramineus* have been illustrated by several authors, the only published illustration of the genitalia of *C. collini* is a photograph in Naglis (2015). Buchmann's (1961) illustration of *C. angulicornis* is clearly that of *C. gramineus*.

In the keys most likely to be used to identify western Palaearctic *Chrysotus*, these species (*angulicornis*, *collini*, *gramineus*) are grouped together in neighbouring couplets as they closely resemble each other (Parent 1938; d'Assis-Fonseca 1978; Negrobov *et al*. 2000; Grichanov 2006, 2007). Using the keys by Negrobov *et al*. (2000) and Grichanov (2007), all three species may be correctly identified if comparative material is available, as deciding whether the tibia has 'dense hairs' or is 'densely ciliated' (to distinguish *C. gramineus* from *C. collini*) is subjective – the hairs are about equally numerous, but longer in *C. gramineus* than in *C. collini*. Grichanov's chaetotaxy for the hind tibia does not work for British *C. collini* which may have one to four strong posterodorsal setae, thus not agreeing with '2 pairs of dorsal setae', although all my specimens do have only two anterodorsal setae. This range overlaps with that in weakly bristled *C. gramineus*. These keys will also be problematic for occasional specimens of *C. gramineus* in which the postpedicel is large and triangular, which could be identified as *C. angulicornis*. Grichanov's 2006 key omits *C. collini* as it was not known from the area covered by the publication. The key by Parent (1938) will work for *C. collini*, although the chaetotaxy he described for the mid tibia does not match some of my specimens. One is more likely to arrive at an inaccurate identification with specimens of *C. angulicornis* as the hair fringe on the hind tibia only doubtfully can be described as 'une ciliation remarquable'; it is indeed long in the basal half but decidedly shorter apically, and varies between individuals from long to unremarkable. The source of this error may be that Parent's description of *C. angulicornis* could be of *C. gramineus* as there are too many features that appear to describe the wrong species, so his key becomes unreliable. Even if he had the right species, the key still goes wrong with specimens whose hind tibia is mainly yellow, as in one of my specimens. The key by d'Assis-Fonseca is essentially Parent's with non-British species removed, so has the same problems.

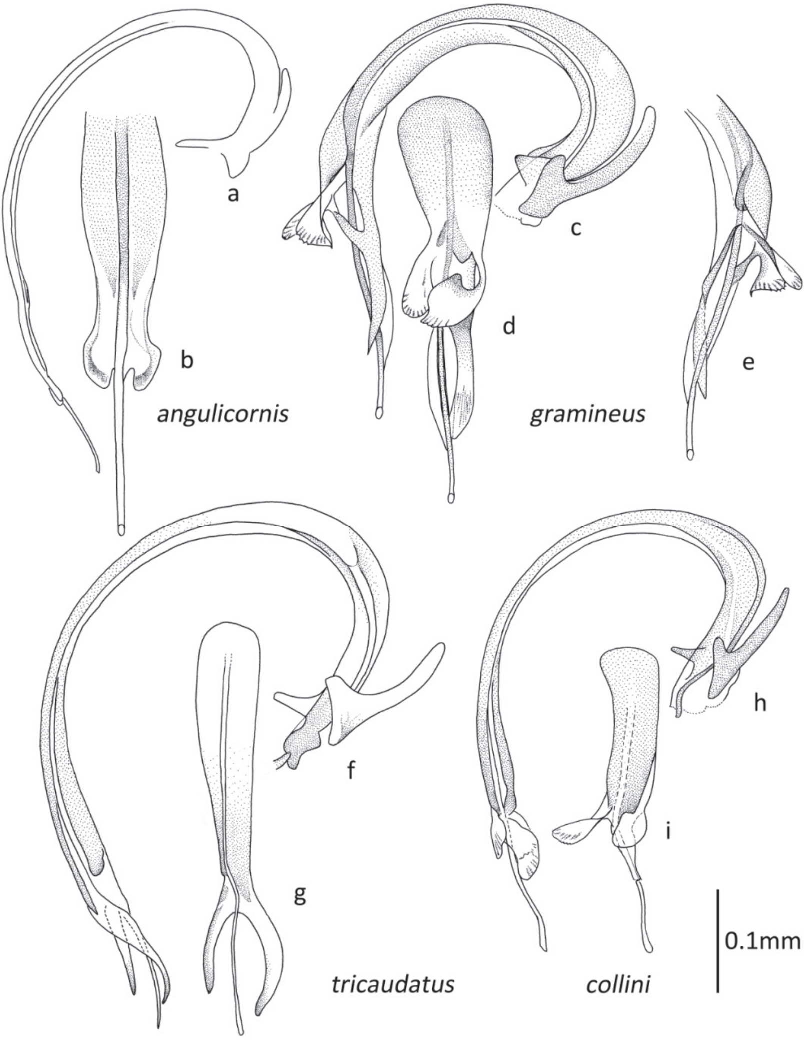

Fig. 1. Phalli of *Chrysotus* in lateral and ventral view: a, b) *C. angulicornis*; c, d, e) *C. gramineus* (lateral views from both sides); f, g) *C. tricaudatus*; h, i) *C. collini*. All at same scale except ventral view of *C. angulicornis* at twice the magnification of the others.

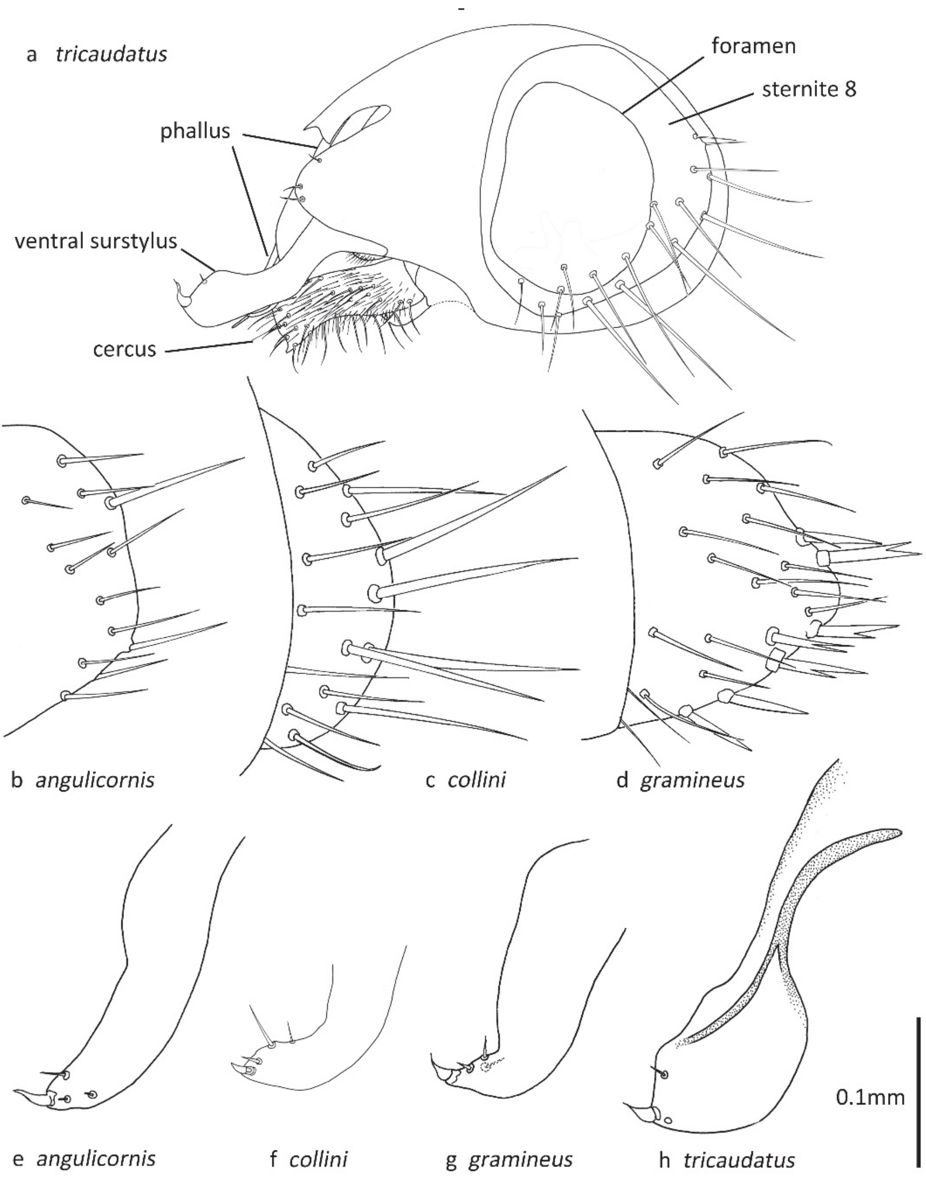

Fig. 2. Genitalia (a, left lateral), sternite 8 (b-d, right lateral) and surstyli (e-h, left lateral) of *Chrysotus*: a, h) *C. tricaudatus*; b, e) *C. angulicornis*; c, f) *C. collini*; d, g) *C. gramineus*.

Here I give alternative couplets to replace d'Assis-Fonseca's (1978) couplets 15 onwards that includes the last four species in his key (*angulicornis*, *collini*, *gramineus*, *melampodius*

Loew), noting that *microcerus* Kowarz and *varians* Kowarz are considered synonyms of *gramineus*. My couplets 2-3 can replace Grichanov's (2007) couplet 20 and may supplement Negrobov *et al*. (2000) at couplet 55 but will not lead to the following couplets in that key. I start with the most reliable characters, which are not necessarily the easiest to see, but later characters that are plainly visible are more variable. I make no excuse for beginning the couplets with the genitalia as they are completely diagnostic and often the only character illustrated for species of *Chrysotus* described since Negrobov (1980) recognised their value in his first revision of the Palaearctic fauna. The tip of the phallus can often be seen when the capsule is pulled out from the enclosing tergites; gently squeezing the base of the capsule in fresh material can sometimes extrude the phallus so it is more clearly seen. Fig. 2a labels parts of the genitalia. The conditions of the postpedicel shape and hair fringes on the hind and front tibia overlap between species but the descriptions in the couplets apply to most specimens. Additional features are given in square brackets.

The use of the setae on sternite 8 as a key character needs some explanation as it does not appear to have been mentioned before. Sternite 8, which looks superficially like the last tergite, is a small gently dished sclerite that covers the foramen of the genital capsule and is visible without dissection or having to extend the capsule (Fig. 2b-d). It provides a reliable method of separating the abundant and widespread *C. gramineus* from all other British species. In most *Chrysotus*, all the setae on sternite 8 are simple, pointed and unremarkable, although some may be longer; *C. collini* and *C. angulicornis* have the usual long fine setae (Fig. 2b, c), whereas *C. gramineus* is unusual in having, in addition to simple setae, 4-6 short stout setae with forked tips that are visible using normal binocular examination (Fig. 2d). If there are short but apparently simple setae, the specimen may need to be viewed from different angles to see whether they are forked. Even specimens in which the setae are not clearly forked under a binocular microscope (x45 magnification) will be seen to be so under a compound microscope (x100 magnification) in a temporary mount in alcohol. The only other British *Chrysotus* with modified setae on sternite 8 is *C. neglectus* (Wiedemann) in which the setae are raggedly blunt-ended, as though broken off; in *C. blepharosceles* Kowarz the setae are short and stout but simple-pointed.

I use the term 'fringe' in place of 'ciliation' of other authors to describe the more conspicuous rows of longer hairs on leg segments. On the hind tibia, the fringe is composed of two to three anterior to anteroventral rows whose overlap gives a slightly confused texture – dense or remarkable of other authors – and to describe its size it is therefore easier to estimate the width of the whole fringe as the distance from the edge of the leg shaft to the outer boundary of the hairs, rather than as the size of individual hairs. As the hairs lie at an angle to the shaft, they are longer than the fringe's width.

1 Front and mid tibiae brownish black. ....…… *C. melampodius*
\- Front and mid tibiae yellow. 2
2 Sternite 8 with 4-6 short stout setae with forked tips (Fig. 2d); tip of phallus, in addition to two conspicuous leaf-like appendages, with pair (apparently single) of lanceolate appendages ventral to tip of aedeagus reaching to two-thirds length of protruding aedeagus (Fig. 1c-e) (the 'exposed' tip of the aedeagus is unusually short among British *Chrysotus*); hind tibia with anterior fringe as wide as shaft's width along entire length, with individual hairs 1.5x shaft's width (Fig. 4f); front tibia with individual hairs almost as long as shaft's width on at least one of dorsal, ventral or posterior faces (Fig. 4b). [Tergite hind marginal setae on midline about ¾ tergite length, giving slightly spiky appearance; postpedicel usually rounded on anterior face (Fig. 3e)]. .... *C. gramineus*
\- Sternite 8 with all setae simple and sharply pointed (Fig. 2b, c); tip of phallus with two leaf-like or simple flat appendages but without long ventral lanceolate appendage; hind tibia, at

least in apical half, with anterior fringe narrower than shaft's width, with individual hairs in apical half not longer than shaft's width (Fig. 4d, e); front tibia with all hairs shorter than shaft's width (Fig. 4a) ………………………………………………………………… 3

3 Tip of phallus with two asymmetrical protruding leaf-like appendages visible from all angles of view (Fig. 1h, i); surstylus gently curved and tapered to a triangular tip before apical tooth (Fig. 2e); postpedicel triangular, as long as deep, tip slightly produced below arista insertion (Fig. 3f); hind tibial anterior fringe longer in basal half, individual hairs longer than shaft's width, shorter in apical half with hairs shorter than shaft's width (Fig. 4d); tergite setae about ¾ tergite length, giving slightly spiky appearance. .... *C. angulicornis*

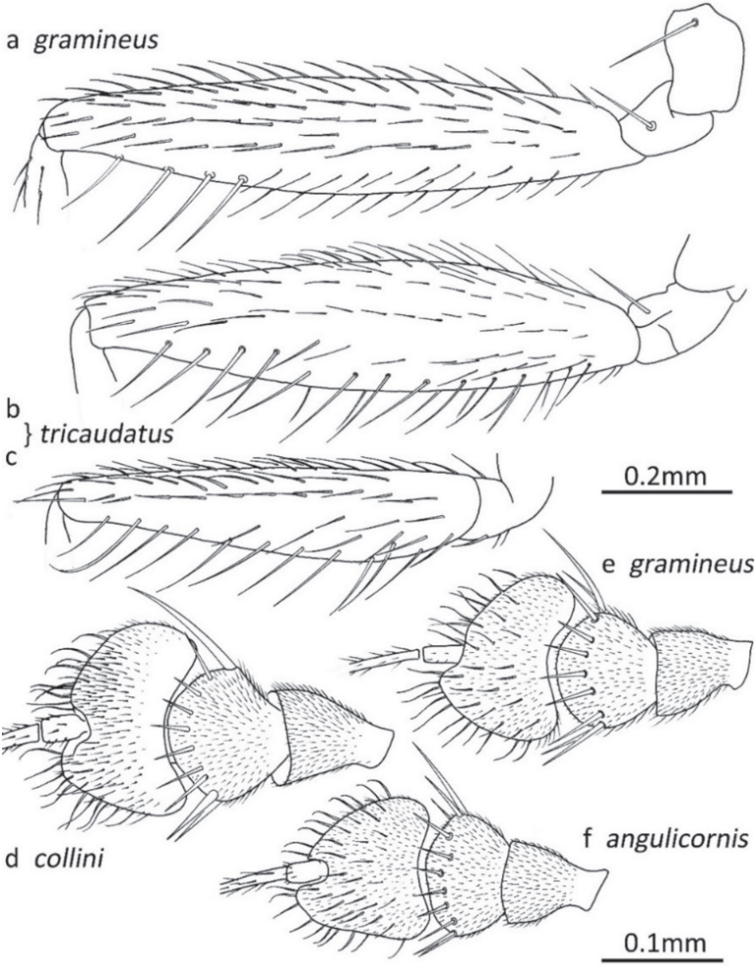

Fig. 3. Femora, anterior face of hind leg (a, b), posterior face of front leg (c), and antennae outer face (d-f) of *Chrysotus*: a) *C. gramineus* hind; b) *C. tricaudatus* hind; c) *C. tricaudatus* front; d) *C. collini*; e) *C. gramineus*; f) *C. angulicornis*.

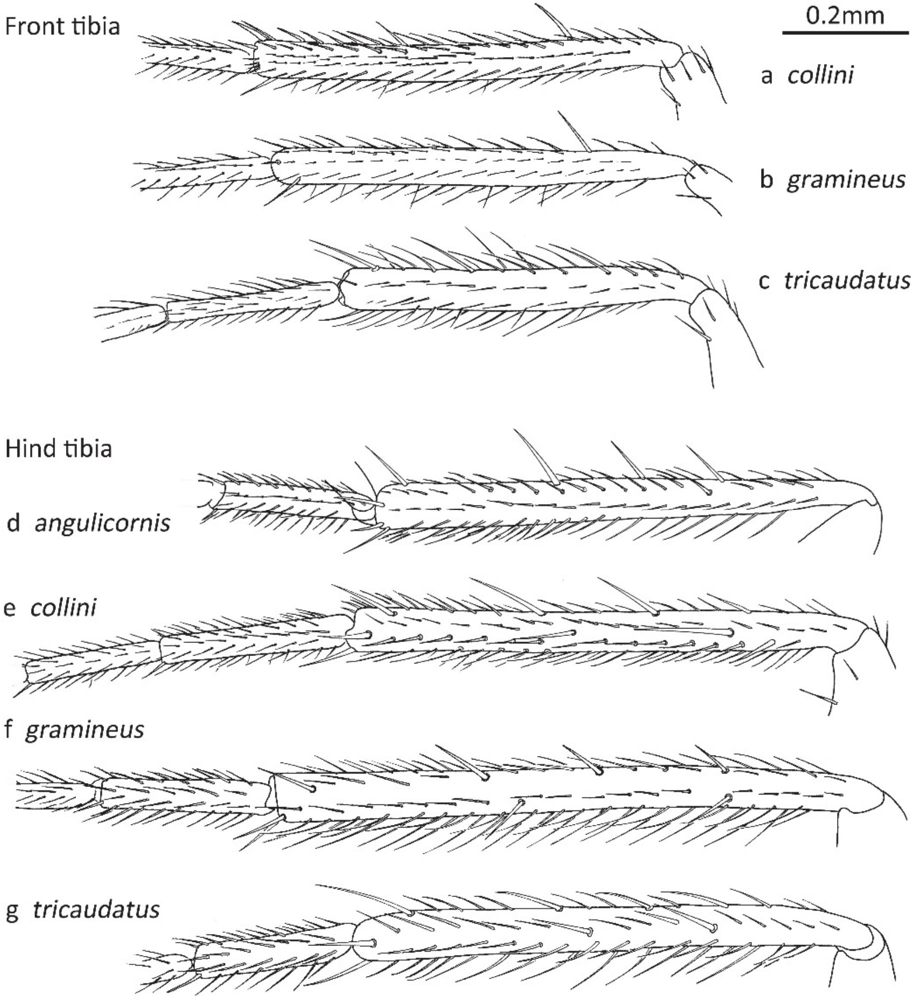

Fig. 4. Front tibiae (a-c) and hind tibiae (d-g) of *Chrysotus*: a, e) *C. collini*; b, f) *C. gramineus*; c, g) *C. tricaudatus*; d) *C. angulicornis*. Hind tibia viewed from above and slightly anteriorly so the anterior-to-anteroventral fringe shows its maximum width; it is not ventral as could be supposed from these drawings.

- Tip of phallus with simple rounded appendage in ventral or dorsal view but almost indistinguishable in lateral view (Fig. 1a, b); surstylus strongly curved and with blunt, almost square tip (Fig. 2f); postpedicel slightly reniform to rounded-triangular, almost twice as deep as long, tip not obviously produced as a point below arista insertion (Fig. 3d); hind tibial anterior fringe narrower than shaft's width along entire length (Fig. 4e); tergite setae less than ⅔ tergite length, giving a rather smooth appearance. .... *C. collini*

Habitat

The soft-rock coastal cliff in Dorset on which *C. angulicornis* was collected is part of the Jurassic Coast World Heritage Site, which was designated for its outstanding geology, but the habitat is also of great entomological interest. The Spittals and Black Ven are the western and eastern names for the same contiguous block of slumping cliffs. Constant seepages emerge from shales and mudstones of the Charmouth Mudstone Formation (early Jurassic) which are interspersed with multiple layers of limestones so the site is base-rich. Solifluxion keeps much of the cliff from developing dense vegetation. Indeed, the site where several *C. angulicornis* were collected resembles more a building site than a nature reserve; only one specimen was collected from waterlogged permanent pasture above the land-slipped mudstones. Specimens were found on these soft-rock cliffs over several years, representing a small but stable population. The assemblage of dolichopodids is not particularly species-rich but dominated by uncommon species. The most frequent include *Melanostolus melancholicus* (Loew), *Diaphorus nigricans* Meigen in a colour form that differs consistently from those collected on inland mires, *Chrysotus suavis* Loew and *Rhaphium brevicorne* Curtis, with *Campsicnemus marginatus* Loew and *Tachytrechus notatus* (Stannius) being less frequently found. The second site in East Sussex was a disused clay pit on the Cretaceous Weald Clay. It had numerous small pools set in vegetation that was often sparse and dominated by ruderals developing on the worked-over clay. Among the less common wetland dolichopodids recorded here were *Achalcus flavicollis* (Meigen), *Chrysotus suavis*, *Diaphorus oculatus* (Fallén), *Lamprochromus bifasciatus* (Macquart), *Rhaphium antennatum* (Carlier), *R. micans* (Meigen) and *Thrypticus tarsalis* Parent. This site has since been destroyed by housing development. Both sites shared the same strongly disturbed soil, fine-scale mosaic of dry and wet soil, and sparse vegetation, although with such a small sample this may be irrelevant.

Material examined. 1♂, England: Dorset, Black Ven, SY355931, 15 June 2003, from seepages on soft-rock coastal cliffs; 3♂, same site, SY356931, 21 June 2006; 1♂, England: Dorset: The Spittals, SY348960, 18 June 2018, bare mud and sand dominated by *Equisetum telmateia* on soft-rock coastal cliffs; 1♂, same site, SY344929, 18 June 2018, saturated pasture at top of soft-rock cliffs; 1♂, England: East Sussex, Burgess Hill, TQ323191, 4 June 2004, in a disused clay pit from the margin of a *Salix*-shaded pond dominated by *Typha latifolia* (reedmace), *Juncus* (rushes), flooded grass and bare clay margins sparsely colonised by ruderals including *Tussilago farfara* (coltsfoot). All swept by C.M. Drake.

Chrysotus tricaudatus Negrobov, Barkalov & Selivanova, 2014

Recognition

The males were identified by their unusual genitalia illustrated by Negrobov *et al*. (2014). They may be identified using the key to Palaearctic *Chrysotus* (Negrobov *et al*. 2000) with the modification given in Negrobov *et al*. (2014). Using d'Assis-Fonseca (1978) they fall out at couplet 5 that includes *suavis* and *palustris* Verrall, but their hairy femora are unlike these species (discussed below).

There are small differences between the description and my specimens but these probably fall within the range of variation that might be expected from specimens collected about 5000 kilometres apart. The lack of illustrations of some characters make the descriptive comparators difficult to use; for instance, the diagnosis says 'hind tibia without long setae or hairs' but the key to Siberian species later in the same paper has the couplet 'Hind tibiae darkened, with long anterior hairs' (as opposed to 'without long anterior hairs'), leading to *C. tricaudatus*. The generally hairy appearance of the legs of my specimens is not well reflected in the description.

Within the British *Chrysotus* known to me (I have not dissected the genitalia of *melampodius* Loew, *monochaetus* Kowarz or *verralli* Parent), the genitalia of *C. tricaudatus* are unusual in several respects. Their apically enlarged surstyli with a narrow waist when viewed obliquely (Fig. 2h) differs from the usual tapered or parallel-sided shaft of most British species (e.g. *C. angulicornis*, *C. collini* and *C. gramineus*, Fig. 2e-g). The cerci are rectangular (Fig 2a) with the usual long pale bristles only at the apex rather than spread over most of the surface, where instead there are dense short hairs rather than scattered tiny hairs or points found in most species. The species was presumably named for its apparently three-pronged phallus; the central appendage is the tip of the aedeagus, flanked by two slender almost parallel-sided but slightly tapered appendages that curve inwards (Fig. 1f, g). The apical appendages of the phallus take a wide variety of forms in *Chrysotus* but, within the known British species, none resembles those of *C. tricaudatus*. *Chrysotus suavis* has two long narrow appendages but these splay outwards, as illustrated by Pârvu (1995). However, *C. tricaudatus* is amply different on obvious external characters; notably the legs have predominantly pale hairs and fringes, rather than black hairs as in most species of British *Chrysotus*, and the long anterior and posteroventral fringes on the front and mid femora, and the particularly hairy front tibiae, are unique among British species (Fig. 3b, c). *Chrysotus blepharosceles* also has particularly long femoral hairs compared to other British species but they are shorter than those of *C. tricaudatus*. The hind femur of *C. gramineus* is shown for comparison as it is typical of British *Chrysotus* (Fig. 3a) other than *C. blepharosceles*. My specimens of *C. tricaudatus* have hind tibiae that vary from black to dark yellow. Sternite 8 has long simple-pointed setae.

Females were not described by Negrobov *et al*. (2014) but many specimens presumed to be those of *C. tricaudatus* were collected, along with numerous *C. suavis*. Assuming both species are present in this sample of about 40 individuals, they share the following characters: yellow hairs and setae on the front coxae, dark coxae and femora, entirely yellow tibiae, well developed setae on the mid tibia, and pale-tipped palps. I will not presume that I can distinguish females of *C. tricaudatus*. Differentiating them is made more difficult by d'Assis-Fonseca's (1978) key to females, that attempts to separate the trio of species *laesus* (Wiedemann), *palustris* and *suavis* at couplets 4 and 5, is wrong for *C. laesus* and unworkable for the other two species. Therefore, there is no point in trying to incorporate *C. tricaudatus* into this key.

Habitat

Chrysotus tricaudatus was found at two sites separated by about 12km in sheltered saltmarshes of the sandy estuaries of Morecambe Bay Special Area of Conservation (SAC) in Cumbria. At both sites, the saltmarsh was limited in extent, that at Roudsea Wood being about 2 ha in a long narrow strip and at Grubbins Wood being a triangle of about 3 ha, although at least 1000ha of *Puccinellia* / *Festuca* saltmarsh communities exist within the SAC. Other species found along with *C. tricaudatus* at the saltmarsh at Grubbins Wood included species typical of the habitat in Britain: *Campsicnemus armatus* (Zetterstedt), *Dolichopus clavipes* Haliday, *D. diadema* Haliday, *Hydrophorus oceanus* (Macquart), *Rhaphium consobrinum* Zetterstedt and *Thinophilus flavipalpis* (Zetterstedt) at its northern extremity in Britain. *Chrysotus suavis* was frequent, and *C. cilipes* Meigen present in small numbers. The same species were present at Roudsea Wood along with *D. sabinus* Haliday, *Machaerium maritimae* Haliday and *Syntormon filiger* Verrall.

Finding *C. tricaudatus* in Britain was completely unexpected. I believe it was known only from the type locality, Taimyr Reserve, and a nearby site, in northern Siberia (Negrobov *et al*. 2014, Maslova and Negrobov 2016), which is an area of continual permafrost at 72°N (Cumbria is at 54°N). The Siberian sites are river banks close to sea level but some distance from the sea. There appears to be no ecological similarity between the Siberian and British sites. Interestingly, another dolichopodid, *Micropygus vagans* Parent, which was frequent away from the coast at Roudsea Wood originated from even further away, in New Zealand (Chandler 1999). Whereas *Micropygus* may have been imported with plants for the horticulture industry, *C. tricaudatus* is more likely to have been introduced by migrating wildfowl, although it seems improbable that a fly, its puparium or larva would survive on, say, a migrating widgeon (*Anas penelope* Linnaeus) which is one of the commoner birds known to migrate between Siberia and Britain. There seems little doubt that this conspicuous species of *Chrysotus* is not a long-undiscovered resident but is a recent arrival. What is also surprising was its abundance (see Material examined), suggesting that the oceanic climate of western Britain is not a constraint.

Material examined: 4♂, England: Cumbria, New Barns, near Grubbins Wood, SD444778, 8 July 2013, saltmarsh and muddy creeks; 27♂, about 40♀ (probably including *C. suavis*), England: Cumbria, Roudsea Wood National Nature Reserve, SD329816, 10 July 2013, upper saltmarsh with *Phragmites australis* (reed), *Bolboschoenus maritimus* (sea club-rush) and shorter vegetation around brackish pools and channels. All swept by C.M. Drake. Two specimens from Roudsea Wood were sent to Dr Oleg Negrobov, who confirmed my identification.

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Tachypeza fuscipennis (Fallén) (Diptera, Hybotidae) new to Devon and East Gloucestershire, with a discussion of habitat requirements

– The British distribution of this Nationally Scarce hybotid (Falk, S.J. and Crossley, R. 2005. A review of the scarce and threatened flies of Great Britain Part 3: Empidoidea. *Species status* No.**3**. Joint Nature Conservation Committee, Peterborough) is centred on the largely inland vice-counties of southern England, from Herefordshire to West Suffolk, with a few outlying records in the north. Its discovery in East Gloucestershire is not therefore surprising – it was reported from West Gloucestershire by David Gibbs (2005. *Dipterists Digest* (*Second Series*) **12,** 69-74) – but Devon provides an extension to this known range: V.C. 3, South Devon: Ausewell Wood, Ashburton (SX7372), 2 females from a flight interception trap inside the hollow base of a collapsed ash *Fraxinus* tree in an area of mixed broadleaf woodland, 20.viii–10.ix.2019. V.C.33 East Gloucestershire: Crickley Hill Wood (SO9316), 1 female, 21.v–24vii.2019 and 1 male, 24.vii–17.ix.2019, from a flight trap positioned on an old field maple *Acer campestre* coppice stool with rot-holes.

Falk and Crossley (*op. cit.*) stated that most reported localities are old broad-leaved woodland or fen situations where there has been continuity of dead wood. The two sites detailed above are certainly broad-leaved woodlands, although only Crickley Hill Wood is ancient woodland, Ausewell Wood being an old plantation on a former moorland common. I have only taken the species twice previously, both sites being traditional orchards: V.C. 37, Worcestershire: Rough Hill Orchard, Birlingham (SO9244), a female from flight trap by rot-hole in old apple tree *Malus*, 19.v–10.vii. and another 10.vii–20.viii.2013; with a further female from a different trap inside a hollow apple tree, 10.vii–20.viii.2013; V.C. 36, Herefordshire: Lower House Farm Orchards, Swinmore, Bosbury (SO6841): 1 male and 2 females in one trap, 15.vii–26.viii.2014, 1 male in a second trap, same dates, and 2 males in a third trap, the first on the same dates again but a second 26.viii–4.xi.2014; all traps on veteran apple trees. My largest catches have come from the Swinmore orchards and Rough Hill Orchard also produced specimens from two different trees. In contrast, the species was only found in one trap of the many operated in the two woodland sites. This suggests that traditional orchards may provide better habitat conditions for the species than conventional woodland.

Martin Drake (*pers. comm.*) says that his records are from trees in open places such as along rivers, on washlands, and Adrian Plant (*pers. comm.*) adds that records in the Empidoidea recording scheme include open sandy heathland, often with scrub and a few trees not far away, although his personal experience suggests very wet and preferably old woodland with lots of decaying branches, etc, is best for the species. He suggests it is probably a dead wood/detritus feeder much as *T. nubila* (Meigen), and will eventually be found in a wide variety of situations where decayed wood is available. The latter species appears to be able to utilise even small fragments of buried wood and often emerges from woodland soils, he says, so perhaps any situation with advanced decay offers suitable conditions. He wonders if *T. fuscipennis* is more discerning and not able to use such widely available fragments of decomposition, perhaps favouring larger and more specific sites such as rot-holes, larger branches, etc.

Falk and Crossley (2005) listed rearings from willow *Salix*, horse chestnut *Aesculus*, beech *Fagus* and oak *Quercus*. My four records of trapped adults are from ash *Fraxinus*, field maple *Acer* and apple *Malus*. The recording scheme records add hornbeam *Carpinus* (Adrian Plant *pers. comm.*). All known records are therefore associated with broad-leaved trees and it seems likely that tree species is not important, only the availability of decaying wood from broad-leaved trees. Although no records distinguish the type of wood-decay it seems likely that the species favours white-rotten heartwood rather than red-rot, and especially trees with rot-holes available.

These surveys were commissioned by the local offices of the National Trust (Ausewell and Crickley) and Natural England (Swinmore), and by the People's Trust for Endangered Species (Rough Hill); the flies were identified by Peter Chandler; my thanks to Martin Drake, Adrian Plant, Peter Chandler, Ivan Perry and Steve Hewitt for comments on an earlier draft **– KEITH N.A. ALEXANDER,** 57 Treffry Road, Truro TR1 1WL

Dipterists Digest 2020 **27,** 139-142

Hexomyza cecidogena (Hering) (Diptera, Agromyzidae) new to Britain

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Summary

The discovery of the agromyzid fly *Hexomyza cecidogena* (Hering, 1927) from Carmarthenshire, South Wales is reported and its identification discussed.

Introduction

In 2019, I conducted a brief survey of Coed Bach, east of Kidwelly Carmarthenshire, South Wales. In a sample from an area largely dominated by sallow and alder scrub was a single specimen of *Hexomyza*, a genus that I have only rarely encountered. The specimen from Coed Bach has the costa extending only just past R_{4+5}, so *H. sarothamni* (Hendel, 1923) and *H. schineri* (Giraud, 1861) were readily ruled out. External features used in the available keys are variable and often difficult to interpret, so identification relies on the dissected male genitalia. The distiphallus of *Hexomyza* can also be variable but the Coed Bach specimen does not match the other two British species with the costa stopping at R_{4+5}, *H. simplicoides* (Hendel, 1920) and *H. simplex* (Loew, 1869). The latter species has a very different distiphallus, and was formerly placed in *Ophiomyia* until transferred to *Hexomyza* by von Tschirnhaus (2000). *Hexomyza simplicoides*, while having a rather similar aedeagus, differs in many details from the Coed Bach specimen. Among European species, this leaves only *H. cecidogena* (Hering, 1927), and the aedeagus was certainly a reasonably close match. As I had no examples of *H. simplicoides* available to me, I sent photographs of the aedeagus to Barry Warrington, who was able to compare them with a dissected *H. simplicoides* and agreed with my diagnosis.

Identification

Without genitalia dissection, *Hexomyza* is not readily distinguished from those *Ophiomyia* that lack a vibrissal fasciculus or facial keel between the antennae. In Britain *O. beckeri* (Hendel, 1923)*, O. cunctata* (Hendel, 1920)*, O. pulicaria* (Meigen, 1830) and *O. orbiculata* (Hendel, 1931) fall into this category. Comparing these four *Ophiomyia* with *H. cecidogena* and *H. sarothamni*, I can see no characters that can separate them; if anything, the antennae are more separated in *Hexomyza* than in these four *Ophiomyia*, seemingly contradicting the keys. However, *H cecidogena* differs from all of the four *Ophiomyia* mentioned above in that the costa does not extend to M_{1+2} (at least faintly so in the four *Ophiomyia*), and the gena and parafrontals are distinctly wider. Even given the variation found in members of the genus, the meso-distiphallus complex of the aedeagus of *Hexomyza* is distinctive, being bilaterally symmetrical when viewed from above/below, whereas it is asymmetrical in *Ophiomyia* (Papp and Černý 2015). In *H. cecidogena* perhaps the most easily appreciated character is the form of the basiphallus. The sclerotised part is attached to the phallophorus by a short membranous area, much shorter than half the length of the basiphallus sclerite (Fig. 1). In *H. simplicoides* the membranous area joining the basiphallus to the phallophorus is about as long as the sclerite of the basiphallus (Fig. 2).

Distribution

Hexomyza cecidogena is widespread across central Europe with records from Austria, Belgium, Czech Republic, Denmark, France, Germany, Hungary, Italy, Lithuania and Slovakia (Papp and Černý 2015), European Russia (Kolomoec *et al*. 1989), Portugal (Černý *et al*. 2018), Switzerland (Černý and Bächli 2015) and Sweden (Wahlgren 1951, Hedqvist 1972). Further afield it is known from China (Papp and Černý 2015) and Japan (Sasakawa 2014).

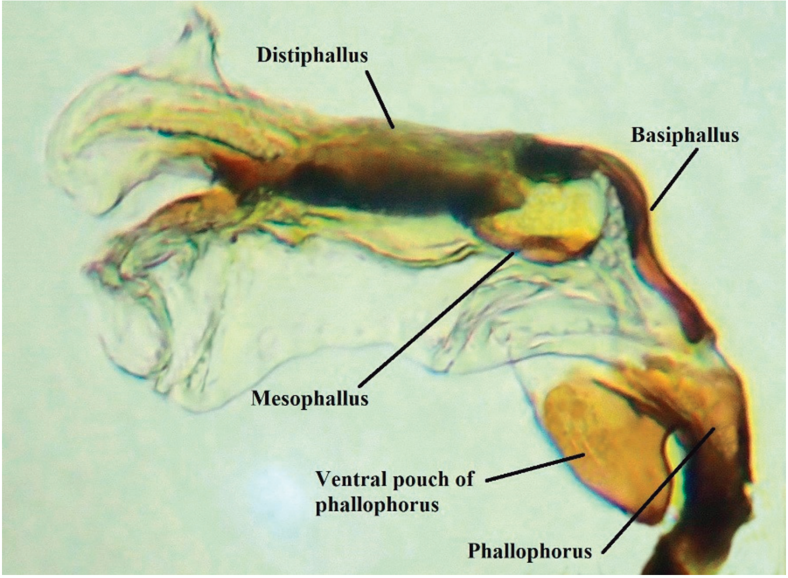

Fig. 1. Left lateral view of aedeagus of *Hexomyza cecidogena*.

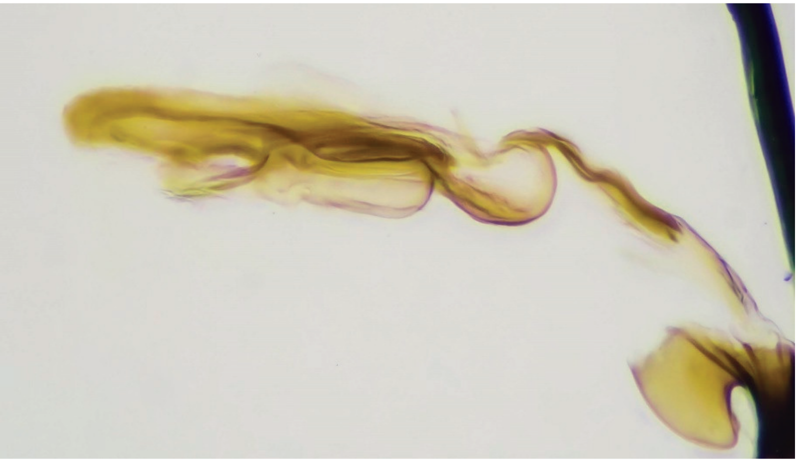

Fig. 2. Left lateral view of aedeagus of *Hexomyza simplicoides*.

The British specimen was swept from an area of tall sallow scrub colonising damp fen grassland. Much of the habitat at Coed Bach is likely to be of recent origin because the land has been used for industrial purposes in the recent past. However, here in west Wales it seems more likely that this is an overlooked native species rather than a recent introduction. Like most species in the genus, *H. cecidogena* larvae form slender, spindle-shaped galls on small twigs of their host plant. Galls have been reported from *Salix aurita* and *S. repens* (Černý *et.al*. 2018); Tomasi (2014) also mentioned *S. viminalis*.

Material examined

BRITAIN, Carmarthenshire, V.C. 44, Coed Bach, Kidwelly SN4206, 1♂ swept 5 June 2019 (leg. and det. D.J. Gibbs and confirmed from photo by B. Warrington) in coll. DJG.

Taxonomic Note

Hexomyza cecidogena belongs in the *Hexomyza schineri* (Giraud, 1861)-group, established by Becker (1903: 189). In a recent paper (Lonsdale 2014) the genus *Hexomyza* has been synonymised with *Ophiomyia* including *sarothamni* and *simplex*. The other British species currently placed in *Hexomyza*, *cecidogena*, *schineri* and *simplicoides* are recombined in a new genus *Euhexomyza*. "Old World" specialists in Agromyzidae are not following the erection of the new genus for the long-established *H. schineri*-group, nor the synonymy of *Hexomyza* with *Ophiomyia*.

Acknowledgements

I would like to thank Barry Warrington for taking the time to examine photographs of the specimen, for permitting use of his photograph (Fig. 2) and for bringing the Lonsdale paper to my notice. I am also very grateful to Michael von Tschirnhaus for much additional information and explanation.

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Confirmation of a Herefordshire population of *Systenus tener* Loew (Diptera, Dolichopodidae) and additional records – C.M. Drake (2018. *A review of the status of the Dolichopodidae flies of Great Britain - Species Status No.30*. Natural England Commissioned Reports, Number 195) stated that *Systenus tener* Loew, 1859, has been recorded from only four hectads since 1990 and three previously, in a small band from Hampshire to the London area with an old outlier in Herefordshire. He goes on to state that the outlying site is Haugh Wood, Herefordshire (V.C. 36) (1907,1908) and that, in view of its isolated position, this record may refer to the more common *S. bipartitus* (Loew, 1850). I can now confirm that this Near Threatened species does indeed occur in Herefordshire: a female was taken in a flight interception trap positioned by a rot-hole on a veteran apple tree *Malus* in a cluster of traditional apple orchards at Lower House Farm Orchards, Swinmore, Bosbury (SO6841), 26.viii–4.xi.2014. A female *S. bipartitus* was also taken at the same time. This location is about 10km to the east of Haugh Wood. Despite mentioning a rearing record from apple, Drake (2018) associated the species with ancient woodland and parkland; traditional orchards now need to be added as also providing suitable habitat. On further investigation, this apple record arose from two males and a female reared from rot-hole debris from an apple tree in the orchard in the very large garden of Waltham Place, White Waltham, Berkshire (David Gibbs *pers. comm.*).

I also have two further recent records from the species' core area in the S.E.: Dallington Forest, East Sussex (V.C. 14; TQ6520), a male in a trap by a cavity in the trunk of a veteran beech tree *Fagus* within ancient woodland, 29.v–30.vi.2018; and Kempshott Park, Dummer, North Hampshire (V.C. 12; SU5947), a female in a trap by a trunk scar from a large ripped-out lateral branch on a veteran parkland beech, 2.vii–13.viii.2019. Dallington adds Sussex to its known English distribution.

The 2018 review omitted a record from Windsor Forest: South Forest (SU945705), a female from Malaise trap samples, 27.vii–11.viii.1992, leg. K. Porter, det. C.M. Drake. Interestingly the same trap also caught *S. pallipes* (von Roser, 1840), *S. leucurus* Loew, 1859 and *S. scholtzii* (Loew, 1850), in contrast to Peter Chandler's experiences in the Forest where he has only found *S. pallipes,* at Highstanding Hill in 2014 and 2018 and near Bishopsgate in 2018. He adds that the Rotherfield Park record of *S. tener* referred to in the review was a male that he swept in woodland, 3.vii.2002; no more precise details were recorded.

These surveys include commissions from the local office of Natural England (Swinmore) and from Jamie Simpson (Dallington) and the flies were all identified by Peter Chandler. Thanks are due to Martin Drake, Dave Gibbs, Andy Godfrey and Peter Chandler for additional information **– KEITH N.A. ALEXANDER,** 57 Treffry Road, Truro TR1 1WL

Dipterists Digest 2020 **27,** 143-154

Effects of tissue hardness on larval feeding in the holly leaf miner, *Phytomyza ilicis* Curtis (Diptera, Agromyzidae)

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Summary

Certain characteristics of the final stage larva of the holly leaf-miner, *Phytomyza ilicis* Curtis (Diptera, Agromyzidae) stand in contrast to those of two species of leaf-miners in the genus *Amauromyza* Hendel (Meigen) (Diptera, Agromyzidae). These differences correlate to feeding on particular levels of tissue hardness in leaves of their food plants.

Introduction

Cyclorrhaphan larvae feed by extending the mandibles or equivalent structures to gather a portion of food into an oral cavity from where it is sucked up by the pump in the head skeleton. This primary mechanism is retained and modified across the Cyclorrhapha into a wide array of specialisations. Critical influences on these specialisations are variables associated with accessing food and biomechanical challenges of gathering it; the results are a source of diversity within lineages and feeding modes (Rotheray and Lyszkowski 2015, Rotheray 2019a).

Biomechanical challenges concern gathering food that varies in viscosity, hardness and tear-ability and most larvae are specialised for gathering food within narrow ranges of these continua. Diverse sets of features correlate to, for example, feeding on watery versus oily fluids, soft versus hard solids and tender versus tough tissue, etc. (Rotheray 2019a). Access has to do with the physical barriers larvae face in reaching food. For instance, within leaves space is severely restricted and a common access mechanism in leaf-mining cyclorrhaphan larvae is sideways feeding which for larvae that lack mandibles opposed to each other enables more effective feeding lunges (Hering 1951, Rotheray 2019b). Various features correlate to sideways feeding and include elliptical-shaped to longer than wide, abdominal segments with arrangements of spicules on their lateral margins that engage the upper and lower leaf margins and prevent slippage during movement and feeding, adaptations to the anterior spiracles that protect them from inundation and abrasion and diverse modifications to the shapes and structures of the thorax and head that facilitate tissue fragmentation at the mine face (Dempewolf 2001, Rotheray 2019b).

The holly leaf miner, *Phytomyza ilicis* Curtis (Diptera, Agromyzidae), is a common species in northern Europe. In May and June eggs are inserted into the midrib, indicated by a characteristic scar (Fig. 1a), and the first stage larva tunnels along it before penetrating the leaf blade in December where subsequent stages make a blotch mine. Pupariation takes place within the leaf from late February onwards (Miall and Taylor 1907, Cameron 1939, Ellis 2000) (Fig. 1b). *Phytomyza ilicis* belongs to a species group within *Phytomyza* Fallén that is associated chiefly with Aquifoliaceae (Scheffer and Wiegmann 2000, Lonsdale and Scheffer 2011). As emphasised by Ellis (2000) the evergreen leaves of holly, *Ilex aquifolium* (Aquifoliaceae), are tough, leathery, nutrient-poor and toxic and although these characteristics may explain the paucity of species that mine its foliage, how *P. ilicis* overcomes these barriers is unknown.

Phytomyza ilicis larval data in Miall and Taylor (1907), de Meijere (1926), Dempewolf (2001), and descriptions and images of its mines and early stages at the websites, British leafminers (www.leafmines.co.uk) and Plant Parasites of Europe (https://bladmineerders.nl/) provide a background to the work reported in this paper which addresses the question of whether the feeding structures and mechanisms of *P. ilicis* are modified for dealing with hard leaf tissue. Based on comparisons of larvae feeding on soft and hard solids (Rotheray 2019a), the larva of *P. ilicis* is predicted to possess a relatively robust mandible with short, broad hooks, a heavily sclerotised head skeleton with fused components and short, powerful feeding lunges. If such features are present, they counter the assumption that larval morphology is too uniform and highly convergent by function to be a source of analysable data (Ferrar 1987, Meier and Lim 2009, Rotheray 2019a).

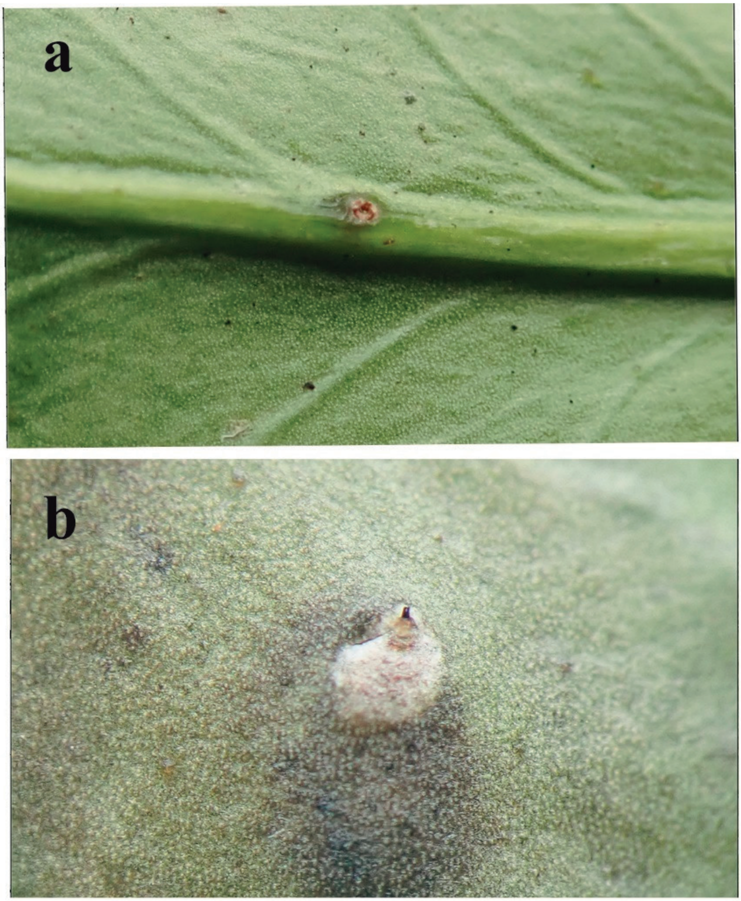

Fig. 1. *Phytomyza ilicis*: a, egg scar in the midrib on the adaxial side of an *Ilex aquifolium* leaf; b, pupariation site, pale tissue is the leaf epidermis cleared by the larva in preparation for pupariation, dark brown anterior spiracles are projecting from a hole on the upper margin of the cleared epidermal area.

Materials and methods

Trees and bushes of *I. aquifolium* were examined during the period 25 February to 15 March 2020, on the Boreland Hills (NX 5856) and at Castramon Wood (NX 5860) in the Fleet Valley, Dumfriesshire, Scotland. About 30 mined leaves per sampling trip were cut from plants at the petiole and placed in a cloth bag.

Within 2-3 hours of collection the contents of mines were assessed by shining a light under the leaf. Mines with live larvae (active and translucent, Fig. 2a), dead larvae (inactive and often discoloured, Fig. 2b), puparia (Fig. 1b) and those that were empty with a crescent-shaped tear in the mine (due to bird predation, Heads and Lawton 1983, Fig. 2c) were separated. Some mines were photographed from the adaxial or upper surface. The course of mining was assessed by examining live feeding, the shape and position of mines, frass patterns and tissue remnants. Several live larvae were removed from their mines and examined immediately using binocular microscopy. This was because they retain a life-like state in flexible body sections that often becomes less clear in preserved larvae, especially at the rostral or head end. After initial examination larvae were fixed in hot water, preserved in 70% alcohol and used for morphological assessment of rigid structures, such as integumental spicules, spiracles and head skeletons.

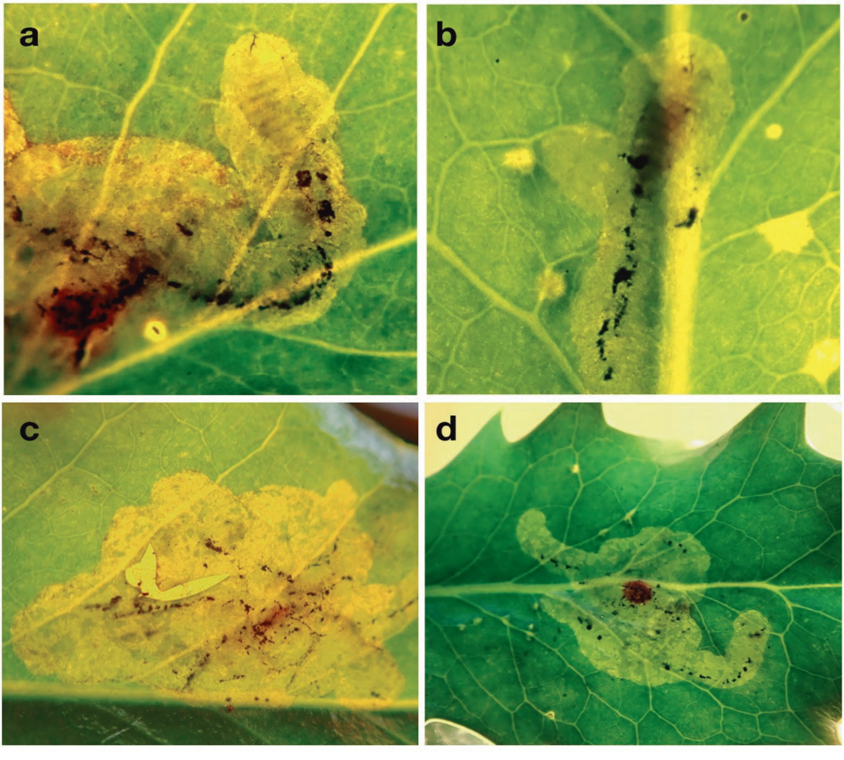

Fig. 2. ***Phytomyza ilicis*: a, live third stage larva feeding at a mine face; b, dead third stage larva in a mine; c, characteristic tear in a mine due to bird predation; d, red frass spot adjacent to the midrib.**

Head skeletons were extracted from larvae and puparia. The front end of a preserved larva was cut off and whole puparia minus sections loosened by the emerging adult were placed in a solution of potassium hydroxide for about 20 minutes and pins used to free head skeletons. To prevent further clearing they were washed in acetic acid and stored in 70% alcohol. Head skeletons in situ were also examined. The front end of a preserved larva was cut across the metathorax and the cut section cleared in potassium hydroxide for up to 15 minutes and obscuring tissue removed with pins and forceps. Sections were washed in acetic acid and preserved in 70% alcohol. The morphology of the head skeleton was assessed using binocular microscopy. Measurements of head skeleton components and larval and mine features were made using an eyepiece graticule or from images using the morphometrics freeware, ImageJ v1.51a (ImageJ 2016).

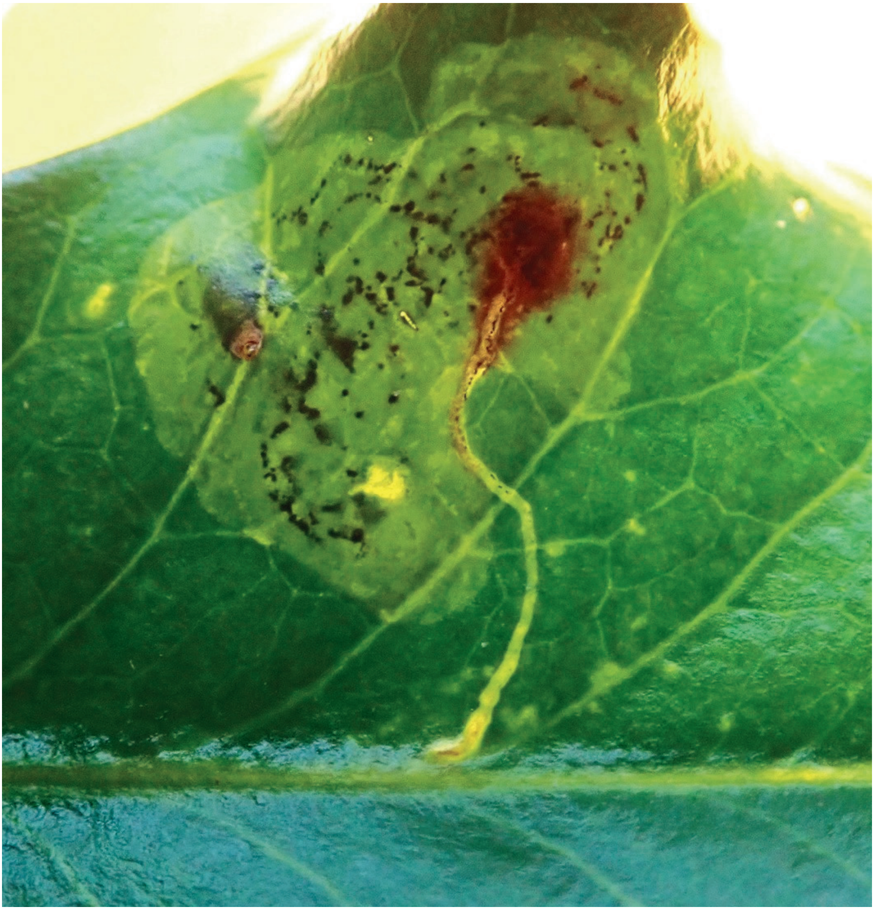

Fig. 3. *Phytomyza ilicis* frass spot in the leaf blade and connected to the midrib by a serpentine mine, radiating lines of black frass surround the frass spot.

To assist in recognising contrasts in trophic features, *P. ilicis* mines and larval morphology were compared with those of two previously assessed agromyzids, *Amauromyza flavifrons* (Meigen) (Diptera, Agromyzidae) that were examined mining the relatively soft leaves of *Silene dioica* (Caryophyllaceae) and *Amauromyza labiatarum* (Hendel) (Diptera, Agromyzidae) that were mining similarly soft leaves of *Stachys* sp. (Lamiaceae) (Rotheray 2019b).

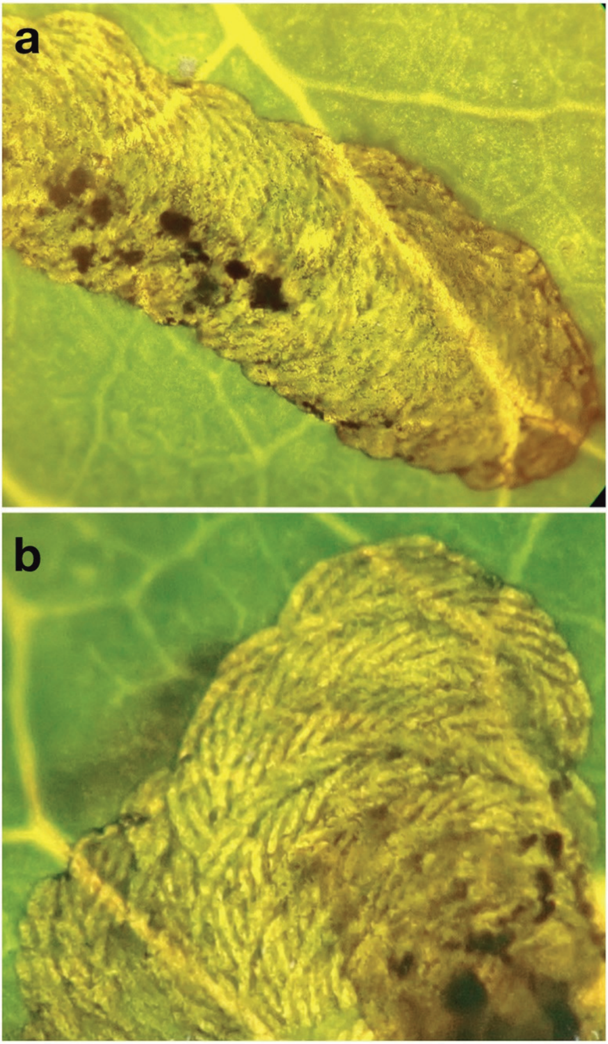

Fig. 4. ***Phytomyza ilicis*** **feeding remnants in structured mining, short arcs within successive gouges, black marks are frass particles: a, apex of a lobe; b, blotch extension.**

Results

Mines

148 *P. ilicis* mines in 133 leaves were assessed, i.e. most leaves had a single mine (89.9%), the remainder had two mines except for one with three. Mines were most conspicuous from the adaxial or upper side. A few (<7%) contained a section that was inconspicuous from both sides. A concentration of frass, the frass spot (Ellis 2000), was present and usually obvious by the red colour of the overlying epidermis (Fig. 2d). Often included with the frass was the cast cuticle of

the second stage larva. Most frass spots were adjacent to the midrib (85.8%) (Fig. 2d). The remainder were further out on the leaf blade (Fig. 3), but none was at the leaf edge. A short, narrow, serpentine section made by the first stage larva was sometimes visible and connected the midrib to the frass spot (Fig. 3). Frass spots were most frequent in the middle third of the leaf (52.7%) followed by the basal third (33.2%) and the apical third (14.1%). No leaf was mined out, even the smallest leaves, about 40mm length along the midrib. Rates of *P. ilicis* survival were low, only 13 mines (8.7%) contained live larvae and 23 (15.5%) had reached the puparium stage. A third of mines (33.1%) were predated by birds and 42.5% contained dead larvae.

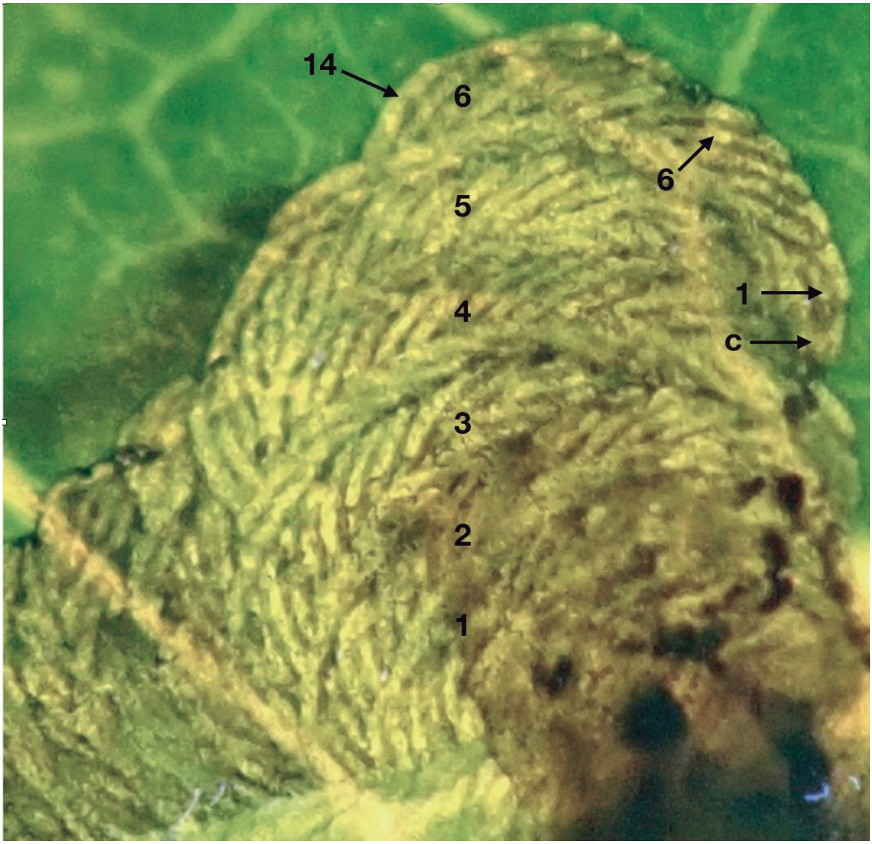

Fig. 5. ***Phytomyza ilicis*** **sequences of arcs and gouges in structured feeding, numbers 1 to 6 are a stack of gouges; c is a cleared patch at the start of a gouge; in order of appearance numbers 1, 6 and 14 with arrows are individual arcs from gouge number 6; dark patch in lower right hand corner is the edge of the frass spot, smaller black marks are frass particles.**

Mines of *A. flavifrons* and *A. labiatarum* differed in the following characteristics: mines were initiated from eggs placed in the leaf blade, not the midrib; mines were conspicuous from both leaf sides; *S. dioica* leaves infested by *A. flavifrons* were sometimes mined out; frass spots were absent and, first stage serpentine sections were longer. The presence of *P. ilicis* puparia in mines confirms that feeding is completed. In contrast, mines of *A. flavifrons* and *A. labiatarum* were complete when larvae quit them to pupate. Completed *P. ilicis* mines were significantly smaller than mines of the two *Amauromyza* species (*P. ilicis* mean area of mine 2.2 ± 0.5sq cm v *A. flavifrons* 3.3 ± 0.4 v *A. labiatarum* 3.4 ± 0.5, n = 12 per species, *P. ilicis* significantly different at $P<0.05$ in SNK tests after one way ANOVA indicated significance at $P<0.05$).

Feeding mechanism

Based on feeding observations and morphological assessments, the feeding mechanism of the *P. ilicis* third stage larva consists of placing the mandible hooks into the mine face and pivoting the head skeleton. Due to connections between the mandibles and the rest of the head skeleton this draws the hooks through the tissue and loosens fragments which gather between the mandibular teeth and are sucked up by the head pump.

The mandibles articulate with the apex of the intermediate sclerite and, at rest, a narrow gap exists between them. As the hooks penetrate the mine face the pressure closes the gap. Simultaneously, the muscles at the apex of the oral plate which curves back from the base of the oral cavity, contract and due to the connection between the oral cavity and the base of the mandibles, the latter pivot against the fulcrum of the connection with the intermediate sclerite. This increases downward pressure at the hook end of the mandibles and helps to insert and keep them in tissue as the head skeleton pivots.

Feeding occurred in structured and unstructured ways. Unstructured feeding occurred when scoops of tissue were removed from a mine face without an obvious pattern. Structured feeding involved nested sequences of shorter, prothorax bends within longer bends from the front of the abdomen that left behind on the adaxial leaf surface, a pattern of remnants: short, successive arcs within longer and successive crescent-shaped gouges (Figs 4-5). Each arc was made by a continuous sequence of head skeleton pivots. Gouges were started by a scoop in the mine face, which was followed by a series of arcs of gradually changing angle, corresponding to the body arching up and round from the front of the abdomen (Fig. 5). In a t test the mean number of arcs per mm measured over 5 separate millimetres in each of 2 mines per species was significantly greater in *P. ilicis* (mean 8.3, range 7.1-11.1) than *A. labiatarum* (mean 5.5, range 2.7-8.3), ($t = 2.49$, $P < 0.05$). Due to lack of clarity, arcs could not be counted reliably in *A. flavifrons*.

Feeding pattern

Frass was usually deposited in a linear sequence off-centre in feeding tracks which corresponds to the body arching feeding mechanism described above (Figs 2a-b, 6c-d). Showing the course of mining frass spots were often surrounded by patterns of radiating frass lines (Fig. 3). If the angle of approach was more or less at a right angle, mines crossed the midrib and prominent lateral veins that lead off from it to the leaf edge. Oblique approaches tended to follow leaf veins and mines were contained by them. In about a third of mines, the outline of the blotch was relatively smooth (Figs 3, 6a) and in the remaining two thirds, lines and crescents of frass led into lobes, up to seven per mine, that extended the mine away from the frass spot (Figs 2d, 6b). Occasionally longer, serpentine sections were present (Figs 6c, d). In mines with more than one lobe, larvae must stop mining, move out and change direction. It was not clear if these changes were inherent behaviour or were due to factors, such as disturbance.

Morphological features of the third stage larva

As with both *Amauromyza* species, the abdominal segments of the *P. ilicis* larva are elliptical in cross-sectional shape with encircling spicule bands that are wider on the lateral margins. The size, density and arrangement of spicules in these bands varies between the three species. The paired anal lobes adjacent to the anus are not as developed in *P. ilicis*. The larval thorax tapers in all three species, but dorso-ventral tapering is less in *P. ilicis* and in larvae freshly removed from a mine, the prothorax is highly compressed along the lateral margins and hence, is noticeably wedge-shaped. Furthermore, the antero-ventral prothoracic margin extends further forward than the head, a shape due to the head being retracted into the upper half of the thorax. This arrangement is not as developed in the *Amauromyza* species whose dorsal and ventral prothoracic margins each possess a transverse fleshy lobe. These lobes are absent in *P. ilicis*. The oral cavity which houses the mandibles is membranous, not fleshy as in most cyclorrhaphan larvae, and supports the mandibles in a fixed, upright position, but in *P. ilicis* the lateral margins of the oral cavity are dark and lightly sclerotised.

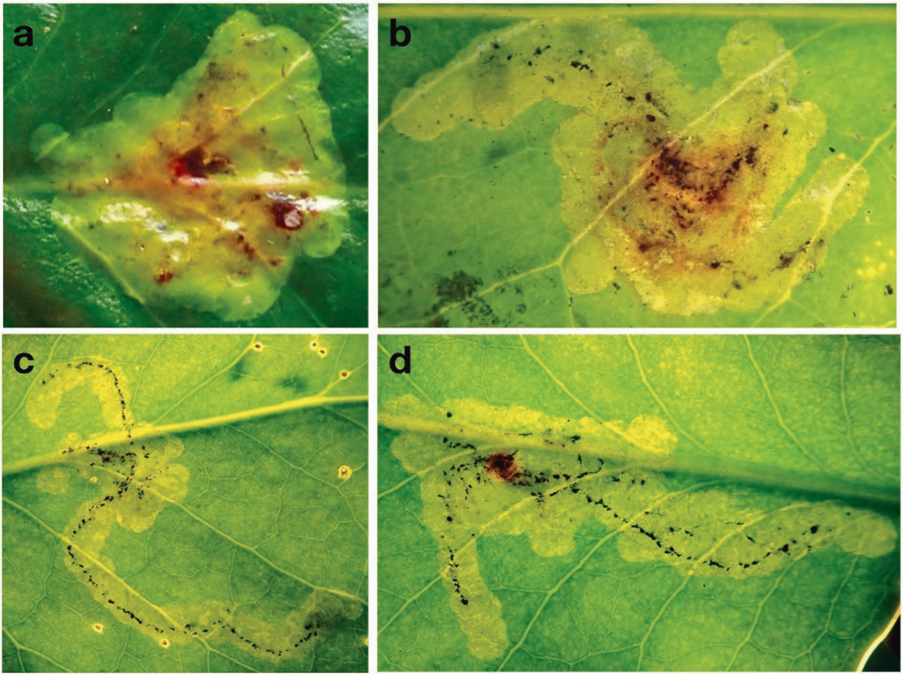

Fig. 6. *Phytomyza ilicis* mine shapes: a, even-sided blotch; b, blotch with radiating lobes; c, blotch with longer serpentine sections with lines of frass, larva at the apex of the longest section on the lower side; d, blotch with a different arrangement of lobes and serpentine sections.

The head skeletons of the three species share the general agromyzid form of a bar-shaped intermediate and basal sclerite that is backwards sloped and a ventral cornu that is shorter than the dorsal cornu, but that of *P. ilicis* had some distinctive features. For instance, the two pairs of mandibular hooks are in a different relationship and are not interspersed as they are in the *Amauromyza* species. In *P. ilicis* the lower hook of the right-hand mandible is opposite to that of the upper hook of the left-hand mandible. The upper, right-hand hook is well developed while the lower, left-hand hook is underdeveloped. Compared to the *Amauromyza* mandibles, those of *P. ilicis* are more substantial (Fig. 7). Furthermore, the intermediate sclerite of *P. ilicis* is completely sclerotised dorsally and ventrally from just anterior to the ventral bridge to the apex and the basal sclerite is wider and more heavily sclerotised (Fig. 7). Excluding the mandibles, the length of the head skeleton of *P. ilicis* as a proportion of the length of the second abdominal segment is significantly greater, more than half as long again, as those of the *Amauromyza* species: *P. ilicis* mean proportional length 1.38, range 1.36-1.43; *A. flavifrons* 0.86, range 0.82-0.89; *A. labiatarum* 0.82, range 0.81-0.83, n = 5 per species, *P. ilicis* significantly different at P<0.05 in SNK tests after one way ANOVA indicated significance at P<0.05).

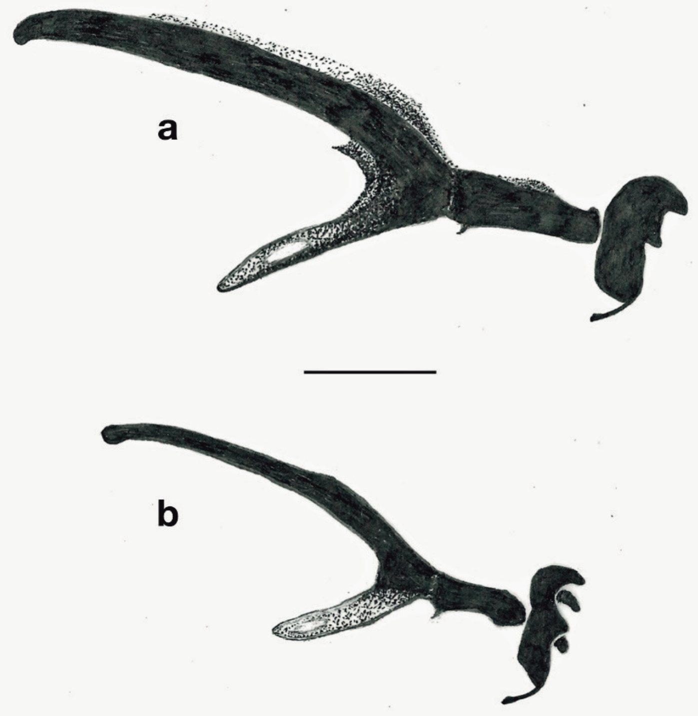

Fig. 7. Head skeletons, lateral view, mandibles to the right, curved lines from the mandible bases are the oral plates that insert on the oral cavity not the mandibles, scale line 0.1mm; a, *P. ilicis*, upper hook of the left hand mandible matches the lower hook of the right and the lower hook of the left mandible is undeveloped, hence left mandible hooks are not visible; b, *A. labiatarum*, hooks of both mandibles visible.

The form of the paired anterior spiracles is highly distinctive in *P. ilicis*. In the *Amauromyza* species they are separate, short and fixed in an upright position either side of the prothoracic midline. Those of *P. ilicis* are approximated, mounted at the apices of flexible, backwardly directed, tubular bases that are mounted on a fleshy lobe that projects from the midline of the prothorax (Fig. 8a). Another difference is that just prior to pupariation, both the anterior and posterior spiracles of *P. ilicis* become black and sclerotised (Fig. 8).

Discussion

The red colour of the epidermis over the frass spot is a response of the plant to damage and variable in hue. It is usually confined to the frass spot, but can be more extensive or absent altogether. Some other leaf mining larvae make a frass spot, such as the larva of *Pegomya laticornis* (Fallén) (Anthomyiidae), and this larva apparently retreats to it for defence (Plant Parasites of Europe, https://bladmineerders.nl/). This may be the function of the frass spot in *P.*

ilicis since apart from frass, the frequent presence of the cuticle of the second instar larva suggests time spent at this location. Not all *P. ilicis* mines have a frass spot (B. Warrington *pers comm*).

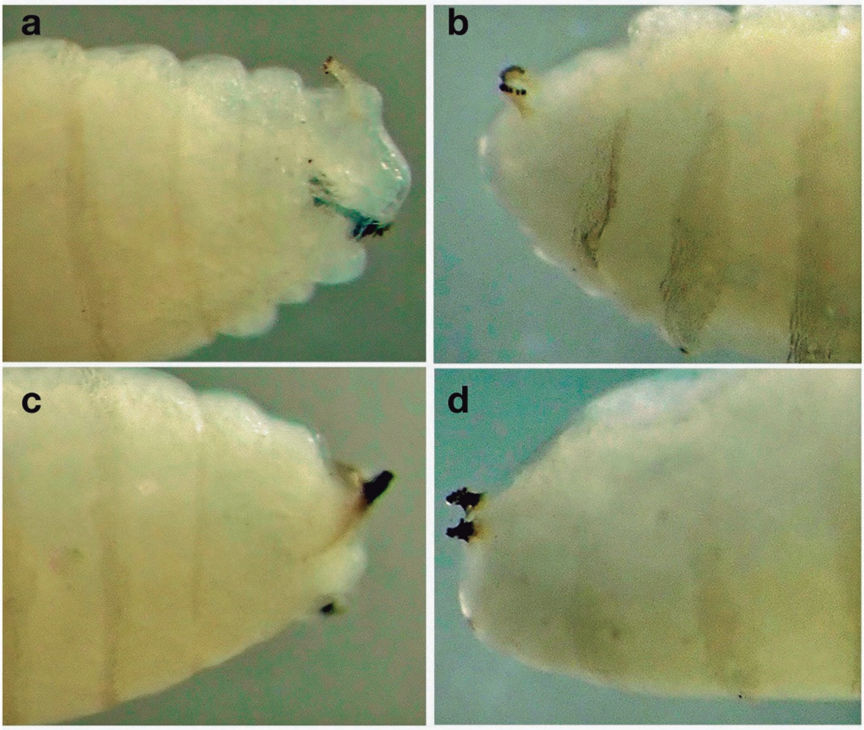

Fig. 8. ***Phytomyza ilicis*** **third stage larva, anterior and posterior spiracles, lateral view: a-b, without sclerotisation in a larva not ready to pupariate, a, anterior spiracles, b, posterior spiracles; c-d, black and sclerotised in a larva ready to pupariate, c, anterior spiracles, d, posterior spiracles.**

Although Potter and Kimmerer (1989) and Potter and Redmond (1989) reported that leaves of *I. aquifolium* are tough and leathery, quantified comparisons of leaf hardness between the three foodplant species assessed in this study have not been made. Suggesting that *Amauromyza* foodplant leaves are softer, their green tissues appeared on dissection to be less dense and more watery than those of *I. aquifolium*. Visual comparison of cross-sections showed that leaves of *I. aquifolium* are also thicker, and Potter and Kimmerer (1989) found that palisade tissue in *I. aquifolium* consists of three layers. Ellis (2000) reported that the *P. ilicis* larva feeds mainly, but not exclusively, in the middle layer. Harder, thicker leaf tissue in *I. aquifolium* may explain the smaller leaf mines of *P. ilicis*. Hard, thick tissue may contain more nutrition per unit volume than watery, thinner tissue, but differences in mine areas may be due to other factors, such as differences in body size, assimilation efficiency, etc.

Compared with the *Amauromyza* foodplants the overlying epidermal layers in *I. aquifolium* are firmer and, presumably, more resistant to *P. ilicis* larval movement, especially at the mine face. The distinctive wedge-shape of the prothorax in *P. ilicis* facilitates feeding lunges in this firm, restricted space. Harder, drier tissue also means that in *P. ilicis* the characteristic fleshy lobes on the upper and lower prothoracic margins of the *Amauromyza* species that help contain tissue fluids and fragments are less important. The extendable, antero-ventral section of the *P. ilicis* prothorax may be an alternative means of retaining fragmented food within reach of the head pump.

The firmness of the *I. aquifolium* epidermal layers helps stabilise the position of the puparium. The sclerotisation of the spiracles in the third stage larva just prior to pupariation prepares the anterior spiracles for the remarkable process of projecting them through a hole made by the larva in the leaf epidermis. The process of shuffling back and forth to project them through the hole was described by Miall and Taylor (1907). These features mimic those of the pupa in certain cyclorrhaphans that undergo a similar set of shuffling movements to project the pupal spiracles into the air through weakened spots in the puparium (Keister 1953). In pupae this is a hazardous process and a cause of mortality (Rotheray 2019a). Suggesting that it too may be a cause of mortality the anterior spiracles of about 18% of *P. ilicis* puparia were found not projecting freely. They either missed the hole and were foreshortened, deflected under the epidermis, or their openings were overlain and possibly blocked by torn parts of it.

In the two *Amauromyza* species the initial linear shape of the mine is maintained by the larva twisting the thorax or flipping the body so that both margins at the mine head are removed. As the larva grows and strengthens, an ability develops to bend and hold the body from the base of the abdomen which enables it to excavate from one side of the mine and it changes to a blotch (Rotheray 2019b). Confirming these behaviours in the larva of *P. ilicis* was not possible since only large second and third stages were observed and like those of the two *Amauromyza* species, these stages rarely twisted or turned during feeding bouts. Unstructured feeding extended blotch mines, but structured feeding also occurred and created lobes and longer serpentine sections leading from it. The diversity of individual mine shapes created by *P. ilicis* is remarkable (Fig. 6), and may represent a means of complicating searching mines or deterring search image formation by insectivorous birds.

The greater relative size, width and modified arrangement of *P. ilicis* mandible hooks that include a pair opposite each other rather than the typical agromyzid state of being interspersed may be a response to the greater space available in thick *I. aquifolium* leaves, but tissue hardness is also a factor. Compared to the *Amauromyza* species, the mandibles of *P. ilicis* fragment harder tissue and the forces required are greater and their mandible hooks are not only relatively robust, they represent a concentration of cutting points. The proportionally large head skeleton with well sclerotised intermediate and basal sclerites also correlates to enhanced robustness. Furthermore, as is usual in agromyzid larvae, the mandibles are mechanically supported by the oral cavity, but in *P. ilicis* the sides of the oral cavity are sclerotised, which provides presumably a higher level of support. A consequence of shorter, wider mandible hooks is, however, reduced reach and this may explain the greater number of feeding arcs per millimetre in *P. ilicis* than the *Amauromyza* species. Although not investigated, *P. ilicis* rates of feeding and development are probably relatively slow due to coping with hard tissue and winter development, these features facilitated by the evergreen nature of holly leaves.

The *P. ilicis* trophic features examined here are consistent with those in phytophagous larvae feeding on hard food in other cyclorrhaphan families, such as the Anthomyiidae and Tephritidae (Rotheray 2019a). This suggests that the larva of *P. ilicis* is similarly adapted, but within the Agromyzidae how independent these adaptations are is unclear. Containing more than 570 species (B. Warrington *pers. comm.*), *Phytomyza* is the largest lineage within the Agromyzidae and it is biologically diverse and apart from leaf miners, it includes stem, root and seed feeders (Spencer 1973). Larval mandibles in *Phytomyza* are poorly sampled, but those few illustrated and described in Dempewolf (2001) reveal a diversity of form. This suggests multiple responses to the biomechanical challenges of gathering plant tissue. If diverse mandibles in *Phytomyza* larvae are confirmed they increase the likelihood of independent adaptation.

In summary, the trophic structures and mechanisms of *P. ilicis* stand in contrast to those of two *Amauromyza* species and are suggested as responses to harder and softer leaf tissues respectively. Specialisation for particular points along a continuum of tissue hardness appears able to explain many agromyzid features, but only further investigation will fully determine its significance in this role.

Acknowledgments

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Molophilus (Molophilus) zonzensis sp.n. (Diptera, Limoniidae) from Corsica

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Summary

A new species of short-palped cranefly, *Molophilus (Molophilus) zonzensis* **sp.n**, is described. This fly was one of several hundred other craneflies collected in Corsica during 2019 by Marc Pollet and others as part of the “Our Planet Reviewed – Corsica 2019-21” expedition. A description of the fly is given, along with a comparison with a very similar species, and their male terminalia are illustrated.

Introduction

During the winter of 2019, a large box of approximately 800 cranefly specimens was received by the first author from Marc Pollet (Research Institute for Nature and Forest (INBO)) from the “Our Planet Reviewed – Corsica 2019-21” expedition organised by the Muséum National d’Histoire Naturelle (MNHN – Paris, France). Within the samples were six male *Molophilus* specimens that initially were suspected to be *Molophilus* (*Molophilus*) *baezi* Theowald, 1981, due to the comparative likeness of the male terminalia and body coloration (Theowald 1981, de Jong 1987; illustrations via Oosterbroek 2019). The distribution of *M. baezi* is currently known to be restricted to the island of Madeira, Portugal (Eiroa and Báez 2002, Starý 2014) and La Gomera in the Canary Islands, Spain (Báez and García 2004). The second author had previously examined *M. baezi* and confirmed some differences as species-specific for the two species, and on further examination found the original published images of *M. baezi* not to be entirely representative, therefore we include comparative images of both species here. The new illustration of *M. baezi* (Fig 3) is based upon specimens from North Madeira, but the paratypes from La Gomera were also examined.

Previous to the description of this new fly, seven *Molophilus* (*Molophilus*) species were known from Corsica, cited by Edwards (1928): *M. ater* (Meigen, 1804), *M. bifidus* Goetghebuer, 1920, *M. corniger* de Meijere, 1920, *M. griseus* (Meigen, 1804), *M. medius* de Meijere, 1918, *M. obscurus* (Meigen, 1818), and *M. pleuralis* de Meijere, 1920. Of these, *M. bifidus* and *M. obscurus* also occurred in the survey material. This new species is therefore the 8th for the island.

The morphological terminology adopted here essentially follows McAlpine (1981). Some special parts of the male terminalia of *Molophilus*, especially the various lobes of the gonocoxite, are referred to by Starý (2011).

Description

Molophilus (Molophilus) zonzensis sp.n.

Diagnosis. Medium-sized species within *Molophilus* (length 4.35mm), with uniformly brown body coloration throughout. Wing length 3.75–5.00 mm. Legs yellowish brown. Three closely related West Palaearctic species, two of these *M. appendiculatus* (Staeger, 1840), and *M. armatissimus* Bangerter, 1947, clearly differing by their bright yellow body coloration. Very similar externally to *M. baezi* (also all brown and similar size), differing only on characters of male terminalia.

Description. Male terminalia (Figs 1-2, cf. Fig. 3). Gonocoxite comparatively broad in lateral view, with dorsal lobe rounded and lateral lobe more conspicuous (gonocoxite rather slender in *M. baezi,* with dorsal lobe more or less conical and lateral lobe less developed). Ventral lobe slightly bent dorsally (straight in *M. baezi*). Gonostyli darkly pigmented towards tips only (about final third of both gonostyli when viewed laterally) and stouter (darkly pigmented for all their lengths in *M. baezi* and more delicate). Outer gonostylus directed downwards, turning down at close to 90° when viewed laterally and microscopically serrate at outer margin (visible under high magnification) (both gonostyli directed rearward in *M. baezi* and both serrate at their outer margins). Aedeagus long and slender, in general straight, bent only at contact with aedeagal plate; the latter oval, with microsetae (aedeagus much the same in *M. baezi*, with aedeagal plate appearing smaller).
Female unknown.

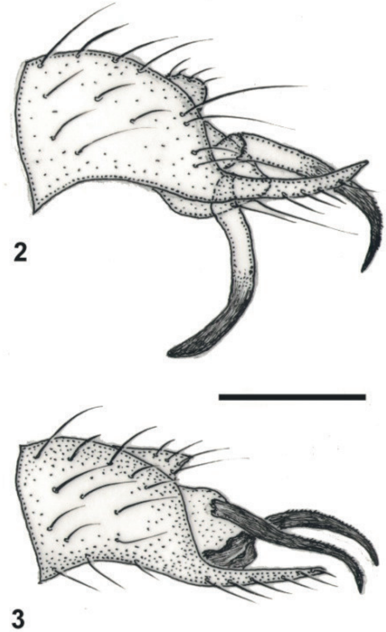

Fig. 1. ***Molophilus zonzensis*** **sp.n., genitalia: lateral view (photo John Kramer & PB). Figs 2-3: Gonocoxite with gonostyli, lateral view: 2,** ***Molophilus zonzensis*** **sp.n. (paratype) (image JS); 3,** ***Molophilus baezi*** **Theowald, 1981 (North Madeira) (image JS). Scale bar = 0.25 mm.**

Material examined: **Holotype** ♂: (Site 112) FRANCE: Corsica. Zonza, Samulaghia (on rocky seep in Sapinière forest (edge of fir forest) at 1231m above sea level (a.s.l.), leg. Marc Pollet. 24-vi-2019 – 28-vi-2019, in yellow pan trap. **Paratypes**: (Site 124) FRANCE: Corsica. Zicavo, Ponte di Valpine, at seep on beech forest slope at 1286m a.s.l, leg. Marc Pollet (2 ♂) 25-vi-2019 – 29-vi-2019, in yellow pan trap. (Sites 150/151); FRANCE: Corsica. Serra di Scopamène, Castellu d'Ornucciu, in shady sites along stream in pozzine landscape at 1568m a.s.l, leg. Marc Pollet (3 ♂) 26-vi-2019 – 30-vi-2019, (Site 150; yellow pan trap, Site 151; white pan trap). All specimens are preserved in alcohol and will be returned to the Muséum National d'Histoire Naturelle in due course with the exception of a single specimen retained by the authors from site 150. Figures used in this paper will be made available for the Catalogue of the Craneflies of the World (Oosterbroek 2019).

Etymology. The fly takes its name from the nearest named location to the capture site of the holotype, the small village of Zonza. An adjective in nominative singular.

Fig. 4. Pozzine landscape at Serra di Scopamene, Corsica (Olivier Vandebeulque – Google Street View).

Habitat and collection site details

Specimens of the fly were taken at shaded calcareous seepages at the edge of fir forest ('Sapinière') and beech forest (Sites 112 and 124 respectively), and at a shaded site along a stream within a 'pozzine' landscape (Sites 150/151 – note the naming of these two different site locations refers to different trapping techniques at the same site – Site 150 was the location of a yellow pan trap and 151 a white pan trap). Pozzines are water-holding depressions, usually found in wide valleys in mountainous regions of Corsica (and elsewhere) that are caused by the flow of snow melt water - ('pozzine' is derived from the local word "*pozzi*" meaning 'well'). It is assumed that the shady area was along the edge of the pozzine landscape. Fig. 4 shows a photograph from Google Street Maps (www. maps.google.com), showing the habitat approximately 200m to the north from the capture site 150/151. The underlying geology at Sites 124 and 150/151 is calcareous granodiorite (‘granodiorite’ in which the usual potassium-rich feldspar component of granite is calcium-rich instead). Site 112 has underlying similarly calcareous igneous rocks (‘plutonisme alcalin’) (Hannah Townley *pers. comm.*, Carmignani *et al.* 2016).

Acknowledgements

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Records of some uncommon Sphaeroceridae, including *Trachyopella kuntzei* (Duda) new to Britain

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Summary

Trachyopella kuntzei (Duda, 1918) is recorded as new to Britain, and notes on its known biology and distribution are given. The occurrence of some other scarce Sphaeroceridae is reported and their biology and distribution is summarised. The habits of Sphaeroceridae are discussed in general and with particular reference to Chippenham Fen NNR, Cambridgeshire.

Introduction

In early 2019, IP passed a batch of Sphaeroceridae to DB for identification. Amongst the material were a number of scarce species, some with only one previous British record and included *Trachyopella kuntzei* (Duda, 1918), a species new to Britain. Most of the specimens were collected from sites in eastern England and included species which had not been reported from that region before, having previously been known only from northern and western Britain.

Records

Minilimosina alloneura (Richards, 1952)
Walberswick NNR (TM453727), Suffolk, 15 August 2016, 1 male swept from a heathland ride which had recently been cut, leaving grass and bracken on the ground. This species was new to Britain in 1983/4 when it was found in numbers in traps baited with cow dung at Silwood Park, Berkshire (Pitkin 1986). It is widespread throughout Europe (Roháček *et al*. 2001) and also known from Lebanon (Gatt 2007).

Minilimosina baculum Marshall, 1985
Southwold (TM495760), Suffolk, 27 September 2018, 1 male from coastal grazing marsh containing cattle. Recorded as new to Britain from material caught in pitfall traps in northern England (Pitkin 1988) and found at nine sites in Wales during the Welsh Peatland Invertebrate Survey (WPIS) (Holmes *et al*. 1991), this appears to be the first record from eastern England. It has also previously been recorded from Canada, USA, Finland, Sweden and Spain (Roháček *et al*. 2001).

Minilimosina bicuspis Roháček, 1993
Shatterford Bottom (SU345062), New Forest, Hampshire, 16 July 2016, 2 males from edge of bog, heavily poached by ponies. This species was first found in Britain from mires and ombrotrophic bogs during the WPIS (Holmes *et al*. 1991) and recorded tentatively as *M. trogeri* Roháček, 1983. Described from material found in the former Czechoslovakia, Sweden and Finland (Roháček 1993), with some of the records from Sweden coming from pitfall traps in grass refuse and compost (Florén 1989). Also recorded from Spain, Germany, Slovakia and Norway (Marshall *et al*. 2011).

Minilimosina gemella Roháček, 1983
Flitwick Moor NR (TL046353), Bedfordshire, 17 March 2016, 1 female swept from woodland ride. First identified in Britain from pitfall traps in northern England (Pitkin *et al*. 1985), it was found to be widespread during the WPIS (Holmes *et al*. 1991). A Holarctic species (see Marshall *et al*. 2011) considered to be boreo-alpine in Europe (Roháček 1993); however, there is a previous record from eastern England, with two males found in pitfall traps from the Norfolk Breckland (Withers 1989).

Opalimosina calcarifera (Roháček, 1975)
Chippenham Fen NNR (TL645693), Cambridgeshire, 4 June 2016, 1 male. A male found during the WPIS (Holmes *et al*. 1991) at a site in Caernarfon was the first British record and we are unaware of any others. It has a widespread distribution throughout Europe and is also recorded from Pakistan (Roháček *et al*. 2001). This species is believed to be primarily coprophagous (Roháček 1983).

Opalimosina simplex (Richards, 1929)
Chippenham Fen NNR (TL645693), Cambridgeshire, 4 June 2016, 2 males; 26 August 2016, 1 male, 1 female. Described as a variety of *grenstedi* (which is synonymous with *O. collini*) from two females collected on cow dung in Epping Forest, Essex on 18 September 1927 (Richards 1930); there appear to have been no subsequent British records. In the former Czechoslovakia it has been collected from the dung of various mammals (Roháček 1983). It is widespread throughout Western Europe (Roháček *et al*. 2001), is closely related to *O. calcarifera,* and is also primarily coprophagous (Roháček 1983).

Phthitia spinosa (Collin, 1930)
Chippenham Fen NNR (TL645693), Cambridgeshire, 26 August 2016, 1 male, 1 female, swept from edge of a fen ride which had recently been cut, leaving the resulting vegetation on the ground. Described from a male found in Burwell Fen, Cambridgeshire on 20 March 1910 (Collin 1930), it does not appear to have been seen in this country since. In the former Czechoslovakia (now in the Czech Republic) it has been collected by sifting moss and grass in a lowland boggy meadow and an upland peatbog meadow (Roháček 1983). It has been widely recorded in Western Europe (Roháček *et al*. 2001) and appears to be flightless, with some specimens being slightly brachypterous (Roháček 2012), terricolous and confined to space-limited micro-habitats (Roháček 1983).

Trachyopella bovilla Collin, 1954
Walberswick (TM498753), Suffolk, 6 June 2018, 1 male; Southwold (TM495760), Suffolk, 28 August 2018, 1 male, both swept from grazing marsh by the river Blyth. Added to the British list from nine specimens at eight sites during the WPIS (Holmes *et al*. 1991), where it was found in a variety of habitats from heath to rich-fen. Specimens of this Holarctic species have been found under cow dung (Collin 1954, in Roháček and Marshall 1986), on carrion (Andersson 1967, in Roháček and Marshall 1986) and various types of decaying matter, including grass, garbage and forest litter (Roháček and Marshall 1986).

Trachyopella kuntzei (Duda, 1918)
Flitwick Moor NR (TL046353), Bedfordshire, 2 June 2018, 1 male swept from a bog containing common cottongrass *Eriophorum angustifolium* and *Sphagnum*. The area where it was found contained several heaps of cut vegetation and it appears to be particularly associated with

decaying vegetation, such as rotting hay and cut grass, although it is also recorded from refuse heaps and on horse and sheep dung (Roháček and Marshall 1986). Widely distributed on the Continent with records from Central Europe north to Sweden; it is also known from the Nearctic Region (Canada: New Brunswick) (Roháček and Marshall 1986). The specimen was determined using Roháček and Marshall (1986), with the shape of the postgonites being particularly distinctive once the abdomen had been cleared in 10% KOH.

Discussion

Because many of the Sphaeroceridae are difficult to identify, with some needing to be dissected for certainty, they have largely been ignored by British dipterists. The standard means of identifying species (Pitkin 1988) is now somewhat out of date, as there have been several major revisions of many of the genera at a European and World level and these need to be taken into account when determining specimens. These advances in the taxonomy have resulted in the addition of several species to the British List and it is likely that many more await discovery. In favourable conditions, Sphaeroceridae can be very numerous, requiring many hours of patient sorting under the microscope and although all the specimens listed in this article were obtained by sweepnetting, pitfall traps and suction devices have proved to be very effective in obtaining some of the rarer species. Several species were first noted in this country from pitfall traps, operated in upland areas of northern England (Pitkin *et al*. 1985) and in Wales (Holmes *et al*. 1991) and this may have given the impression that they were absent from lowland England. This paper shows that some at least are present in suitable habitat in the south, although our knowledge of the true distribution of many species is very inadequate.

One locality that is proving to be very productive for Sphaeroceridae, with over fifty species recorded there in recent years, is Chippenham Fen NNR, Cambridgeshire. Here the mix of spring-fed fenland habitats, with patches of bare saturated peat and carr woodland, can be very prolific. The North Meadows are grazed by cattle during the summer and there is a small resident herd of water buffalo, which are moved around the various compartments during the year, both providing opportunities for coprophagous species. Some other compartments have their vegetation cut and collected up into piles, which provide another habitat exploited by Sphaeroceridae. Searching these heaps in winter can be rewarding and J.E. Collin, who visited the Fen regularly during his lifetime, wrote "Species of Borboridae are exceedingly numerous in heaps of cut sedge in winter and early spring" and "a splendid day's collecting of this sort has been known to be had on a Christmas Bank Holiday, a fine bright day after a slight frost" (Collin 1904). He described *Sphaerocera eximia* Collin, 1902, later a synonym of *Lotobia pallidiventris* (Meigen, 1830), in part from material found at Chippenham Fen on 31 January 1898, 26 December 1893 and 27 May 1895 (Collin 1902). It is pleasing to be able to report that over a hundred years later, *L. pallidiventris* is still present at Chippenham Fen, with two males collected there by IP in a heap of vegetation on 23 December 2017.

Acknowledgements

IP would like to thank the following organisations for permission to collect Diptera on their properties: The Bedfordshire, Cambridgeshire and Northamptonshire Wildlife Trust for Flitwick Moor, Forestry England for the New Forest and Natural England for Chippenham Fen NNR and Walberswick NNR.

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Two records of *Fannia aequilineata* Ringdahl in Buckinghamshire (Diptera, Fanniidae) – *Fannia aequilineata* Ringdahl, 1945 was assessed as provisionally Nationally Scarce by S. Falk and A.C. Pont (2017. A Provisional Assessment of the Status of Calypterate flies in the UK. *Natural England Commissioned Reports*, no. 234), who listed records from 19 counties from the south coast north to Yorkshire, and including Buckinghamshire. They comment that "There are several post-1960 records, but the species is uncommon, occurring in low numbers wherever it is encountered" and give the main habitat as "ancient broad-leaved woodland".

My first encounter with this species was a specimen caught in a Vane trap positioned in an orchard, consisting mostly of damson trees. These included some relatively old trees with partially decayed limbs and trunks, and small rot holes. The record details are: location Nash Lee orchard (SP846092, vice-county Buckinghamshire), one female *Fannia aequilineata* from a trap that was in position from 14 to 23 July 2019.

On 11 April 2020, a gardening task involved toppling a large plastic compost bin to make use of the well-rotted compost at the base of the bin. I took the opportunity to remove some of the contents from the bin, containing fairly well-rotted but still fibrous material, and put this into a Berlese funnel arrangement. By the following day several flies had emerged, including the heleomyzids *Heteromyza rotundicornis* (Zetterstedt, 1846) and *Tephrochlamys rufiventris* (Meigen, 1830), as well as a male of *Fannia aequilineata*. Record details: Great Kimble (SP820062, vice-county Buckinghamshire), one male emerged on 12 April 2020 from compost collected the previous day.

The Falk and Pont status review says that this fly "has been reared from rotten wood and wood detritus, several fungi, various birds' nests, the detritus in a wasp nest, and the nests of small mammals". The compost heap certainly contained small pieces of rotting wood and thick plant stems, had probably had small mammals burrowing in it, and no doubt contained fungal mycelia, so it appears to offer a substitute for more natural situations with rotting wood in trees.

Fannia aequilineata is proving more frequent and widespread from recent records than the status review might suggest. Females regularly visited a sap run on oak in Devon (Wolton, R. and Luff, M. 2016. *Dipterists Digest* (*Second Series*) **23,** 119-136; fig. 7 shows a female feeding at sap), and it was trapped near a sap run on ash at Leigh Woods, Bristol (Fleetwood, R.N. and Chandler, P.J. 2020. *British Journal of Entomology & Natural History* **33,** 17-32). It had been reared from wood detritus from a decaying elm at Bromley, Kent in 1967 (Chandler, P.J. 1973. *Entomologist's Gazette* **24,** 329-346).

Other recent records are from Bushy Park, Middlesex (Chandler, P.J. 2015. *Dipterists Digest* (*Second Series*) **22,** 69-110), visiting *Bupleurum* flowers in a garden at Lode, Cambridgeshire (Perry, I. 2016. *Dipterists Digest* (*Second Series*) **22,** 181), and a photograph of a male caught by a Vane trap at Attingham Park, Shropshire in August 2016 was posted on Flickr by Nigel Jones.

Keith Alexander has often found this species in traps placed on decaying trees, including published records from Somerset and Kent (Alexander, K.N.A. 2017. *Dipterists Digest* (*Second Series*) **24,** 67-70, 71-77), and other records in his succeeding note below.

Peter Chandler (*pers. comm.*) has identified it from a trap placed by a dying whitebeam at Aston Rowant NNR, Oxfordshire in 2014 (survey by Judy Webb for Natural England), from Windsor Great Park, Berkshire (netted near Bishopsgate, 4.vi.2015, and near Virginia Water, 19.vi.2018), and from three sites in Ireland surveyed by Buglife (Breen Wood, Co. Antrim, 2017; Cladagh Glen, Co. Fermanagh, 2018; Ballyogan, Co. Clare, 2018). There were earlier Irish records from near Lahinch in Co. Clare (Nash, R. and Chandler, P.J. 1978. *Proceedings of the Royal Irish Academy* **77,** B(2), 13-43) and trapped at a badger's sett in Co. Cork (Sleeman, D.P., Bond, K.G.M. and Barnes, D.K.A. 2003. *Entomologists' Gazette* **54,** 167-170) – **MARTIN C. HARVEY,** Evermor, Bridge Street, Great Kimble, Aylesbury, HP17 9TN, kitenetter@googlemail.com

Recent records of *Fannia aequilineata* Ringdahl (Diptera, Fanniidae) from England, Wales, Scotland and Northern Ireland

– S. Falk and A.C. Pont (2017. A Provisional Assessment of the Status of Calypterate flies in the UK. *Natural England Commissioned Reports*, no. 234) listed records of *Fannia aequilineata* Ringdahl, 1945 from 19 British counties from the south coast north to Yorkshire. My own recording work has generated new records from 22 British sites in 20 hectads and one Northern Irish site over the past 13 years and these include five counties additional to those listed by Falk and Pont (2017), who were unaware of any records from Wales or Scotland. All records are from flight interception traps.

Herefordshire (V.C. 36): Swinmore Orchards (SO6841), 3♂ & 1♀, from two traps in traditional apple orchards, 2014; Hereford area (SO43 & 44), 13♂ & 8♀, from 10 traps positioned by rot-holes on veteran oak trees within a large hedgerow network, 2016.

Cheshire (V.C. 58): Hampers Wood, Lyme Park (SJ9682), 4♂ from a trap on a standing dead birch in wood pasture, 2013.

Monmouthshire (V.C. 35): Piercefield Woods (ST5396), 10♂ & 1♀ from four traps on veteran trees, 2018; more in 2019; Lower Wyndcliff Wood (ST5297), 1m from trap on old hazel coppice stool, 2018; Coppice Mawr (ST4994), 1♂ & 14♀ from two traps & Kite's Bushes (ST5093), 11♂ & 47♀ from four traps, 2019; Dingestow Court Park (SO4509), numerous specimens from four traps, 2019.

Denbighshire (V.C. 50): Chirk Castle Park (SJ2638), 1♂ & 4♀ from 4 traps on veteran parkland oaks, 2018.

Lanarkshire (V.C. 77): Cartland Crags (NS870444), 1♀ from trap placed amongst an accumulation of fallen oak branches in oak woodland, 2012.

County Derry (V.C. H40): Banagher Glen (C6709), from trap hung from a lateral branch of a mature oak in a typical area of oak and hazel, more or less closed-canopy, high forest woodland, 20.v.-8.vii.2007.

My sites include traditional orchards (Swinmore), old hedgerow networks (Hereford and elsewhere) as well as historic parklands (Chirk and Lyme) and so – like Harvey (this issue) – would question the habitat association stated in Falk and Pont (2017) as ‘ancient broad-leaved woodland’. Of my 23 sites only 9 are ancient woodlands – less than half – the rest are ancient wood pastures (5), historic parklands (5), veteran trees in ancient hedgerows (2) and traditional orchards (1). This fly is very clearly associated with concentrations of veteran trees, wherever these occur, and an association with sites with long continuity of suitable habitat, although possible, is unproven.

These surveys include commissions from the local offices of Natural England (Swinmore Orchards), Natural Resources Wales (Monmouthshire), Scottish Natural Heritage (Cartland Crags) and the National Trust (Chirk Park) and the flies were all identified by Peter Chandler – **KEITH N.A. ALEXANDER,** 57 Treffry Road, Truro TR1 1WL

Dipterists Digest 2020 **27,** 165-172

Limnophyes wickenensis sp. n. (Diptera, Chironomidae) from Wicken Fen, Cambridgeshire

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Summary

The male, female, pupal and larval exuviae of *Limnophyes* Pe 1a (in Langton 1991) reared from shallow pools and ditches at Wicken Fen National Nature Reserve, Cambridgeshire, UK, is described as a new species *Limnophyes wickenensis*.

Introduction

During 1977 I carried out a survey of the Chironomidae of Wicken Fen National Nature Reserve, Cambridgeshire, by collecting floating pupal exuviae and netting larvae for rearing to adults. The larvae were placed in individual plastic containers with transparent lids containing 3-4mm depth of tap water and a pabulum derived from the mulm in a tropical fish tank that was first sterilised with boiling water. A species of *Limnophyes* Eaton was reared from shallow pools and ditches, the adult of which was tentatively assigned to *L. scalpellatus* Brundin 1947 and the pupa termed *Limnophyes* Pe 1a (Langton 1991). A slide of a reared adult male was sent to O.A. Sæther for inclusion in his revision of the genus *Limnophyes* (Sæther 1990). He concluded that it was an aberrant specimen of *L. asquamatus* Andersen (Sæther 1990) and returned the slide labelled "*Limnophyes asquamatus* Søgaard Andersen det. O.A. Sæther 1986". A recent remark by M. Spies prompted an investigation into this specimen. Under *L. asquamatus* in my collection is a series of 12 males and 8 females reared from Wicken Fen during April, May and June 1977 and an adult male swept from vegetation on 18 April 1979, all with the characteristic differences from *L. asquamatus* in the adult male noted by Sæther (1990) and in the pupa by Langton (1991). Sæther suggested that the Wicken specimen 'could conceivably represent a different species' (*op. cit*., p. 33). It is here described as *L. wickenensis*.

Limnophyes wickenensis **sp. n.**

Etymology

The specific epithet is derived from the name of the type locality, Wicken Fen, Cambridgeshire, England. It is to be treated as adjectival for the purposes of nomenclature.

Holotype male: ENGLAND: Wicken Fen, Cambridgeshire (TL552708), pool under trees, larva 30 April 1977 (adult emerged 13 May 1977); larval and pupal exuviae and adult male, slide mounted in euparal. To be deposited in the University Museum of Zoology, Cambridge.

Paratypes: All collected in shallow water habitats at the holotype site, or nearby (TL5670): 30 April 1977, 3 adult males with larval exuviae and pupal exuviae, 5 adult males with pupal exuviae, 1 pharate adult male, 1 adult female with larval and pupal exuviae, 5 adult females with pupal exuviae; 1 June 1977, 2 adult males with pupal exuviae, 1 pharate adult male, 1 adult female with larval and pupal exuviae, 1 pharate adult female; 18 April 1979, 1 adult male swept from vegetation. All paratypes in coll. PHL.

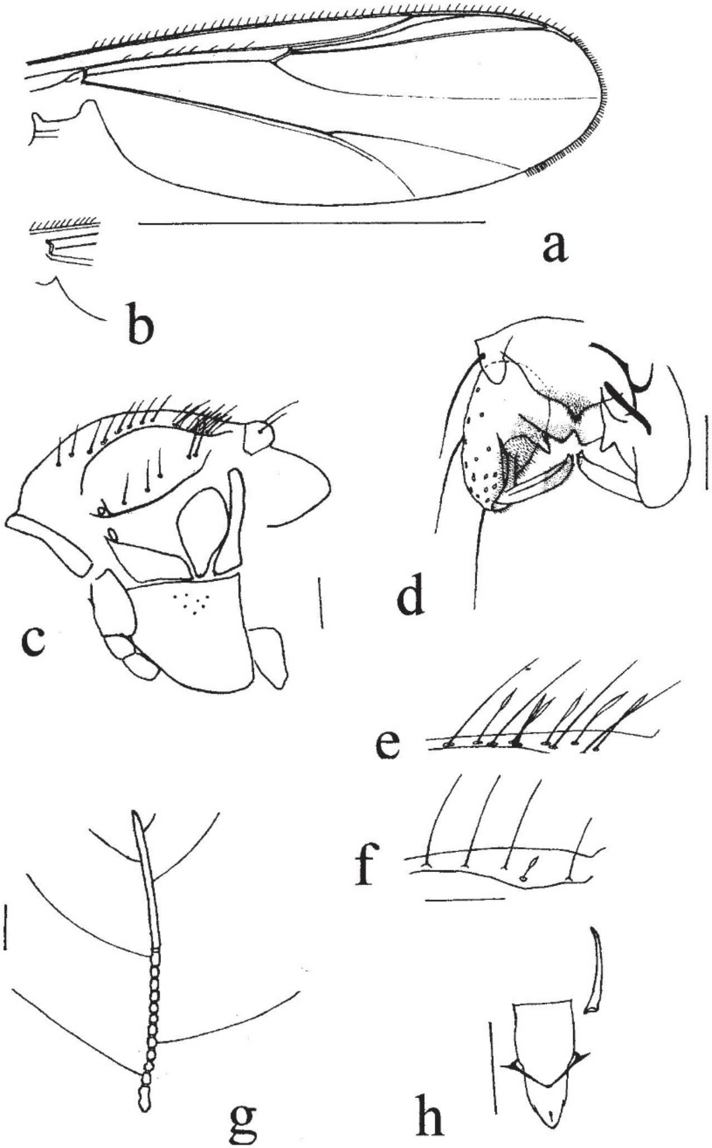

Fig. 1. *Limnophyes wickenensis* **sp. n., adult male: a, wing; c, thorax, lateral; d, hypopygium, dorsal view left, ventral right; e, prescutellar setation; g, antenna; h, tentorium and stipes.** *L. asquamatus*, **adult male: b, part of wing; f, prescutellar setation. Scale lines: a, 1mm; c, d, g 0.1mm; e, f, h 0.01mm.**

Descriptions. These are modelled on the descriptions in Sæther's (1990) revision of the genus *Limnophyes.* Adult terminology is as in Sæther (1980) and pupal terminology as in Langton (1991).

Adult male. Dark brown with yellow-brown legs and antennae. Total length 2.2-2.8mm (m=2.0mm, n=11). Wing length 1.3-1.6mm (m=1.42mm, n=11). Total length/wing length 1.6-1.9 (m=1.7, n=11). Wing length/length of profemur 1.7-2.6 (m=2.4, n=10).

Head (Fig. 1g, h). AR 1.0-1.2 (m=1.06, n=11). Antenna (Fig. 1g) with 13 flagellomeres, groove beginning at flagellomere 4, sensilla chaetica on flagellomeres 2-4, ultimate flagellomere 380-440µm (416µm, n=10) long without apical sensilla chaetica. Temporal setae 3-7 (m=4.4, n=8), including 0-1 inner (m=0.13), 0-2 outer verticals (m=1.6, n=8) and 2-5 postorbitals (m=2.4, n=8). Clypeus with 11-20 setae (m=15, n=9). Tentorium (Fig. 1h) 120-160µm long (m=134µm, n=8), 40-80µm wide (m=63µm, n=8); stipes 124-140µm long (m=135µm, n=3), 20-22 µm wide (m=21µm, n=3). Palp segment lengths in µm (n=11): 20-40 (m=27); 36-50 (m=43); 66-104 (m=88); 60-80 (m=72.5); 70-120 (m=104)

Thorax (Fig. 1c, e). 2 median antepronotal setae; laterals not detected. Humeral pit small round without distinct rim. Simple acrostichals present on mid scutum. Dorsocentrals 18-28 (m=21, n=11), including 1-3 non-lanceolate humerals (m=2.5, n=11) and 5-10 lanceolate prescutellars (m=6.7, n=9). 4-8 acrostichals (m=6.4, n=8). Prealars 1-4 (m=2.8, n=10). Supraalars 0-2 (m=1.8, n=10). Dorsal preepisternals 1-11 (m=5.4, n=9); anterior preepisternals 0. Posterior anepisternum II and epimeron II without setae. Scutellum with 2-5 setae (m=3.8, n=5).

Wing (Fig. 1a). Anal lobe rounded rectangular. VR 1.1-1.3 (m=1.2, n=8). C extension 40-100µm (m=67µm, n=11). R with 3-9 setae (m=5, n=9), R_1 without setae. Squama with 2-6 setae (m=3.6, n=9).

Legs. Spur of front tibia 48-72µm long (m=56, n=11); spurs of middle tibia 16-24 (m=20) and 8-20 (13, n=11) µm long; of hind tibia 40-60 (47, n=11) and 12-20 (m=15, n=11) µm long. Comb of 10-15 setae (m=12.6, n=10); shortest seta 12-28 µm long (m=19.6µm, n=9); longest seta 16-40µm long (m=33, n=9). Sensilla chaetica observed on tarsus 2 of midleg. Lengths in micrometres and proportions of legs (n=11):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
p_1	504-592 (540)	640-760 (712)	320-392 (361)	200-240 (227)	136-160 (150)	80-88 (83)	72-88 (81)	0.47-0.54 (0.51)	2.8-3.2 (3.0)	3.3-3.7 (3.4)	1.0-2.5 (1.9)
p_2	536-640 (580)	496-680 (604)	240-360 (274)	136-192 (118)	80-168 (108)	48-64 (57)	56-80 (73)	0.40-0.60 (0.46)	3.1-4.0 (3.7)	3.2-4.8 (4.3)	1.1-2.5 (1.8)
p_3	560-640 (552)	640-760 (704)	320-376 (356)	168-208 (176)	152-176 (164)	40-88 (70)	40-88 (76)	0.46-0.54 (0.50)	3.2-3.6 (3.3)	3.3-4.0 (3.7)	1.7-3.0 (2.2)

Abdomen. Each tergite I-VIII with many setae, the setae about 0.5x the length of the tergite.

Hypopygium (Fig. 1d). Anal point 14-36 µm long (m=21.5µm, n=11), pubescent. Tergite IX with no long setae; laterosternite IX with 2-7 setae (m=4.6, n=11). Phallapodeme 52-72µm long (m=64µm, n=9). Transverse sternapodeme 80-100µm long (m=89µm, n=8). Virga 12-14µm long (m=13µm, n=4). Gonocoxite 150-200µm long (m=168µm, n=11); ventral lobe of inferior volsella broad, rounded, extending about two thirds the length of the coxite; dorsal lobe with a triangular pubescent projection, apex pointed, smooth. Gonostylus 88-104µm long (m=98µm, n=11); crista dorsalis very narrow, but expanded as a tooth by the megaseta; megaseta 10-14µm long (m=12µm, n=11). HR 1.53-1.9 (m=1.7, n=11); HV 2.0-2.9 (m=2.4, n=11).

Adult female. Total length 2.0-2.2mm (m=2.1mm, n=6). Wing length 1.2-1.4mm (m=1.3mm, n=8). Total length /wing length 1.4-1.7 (m=1.6, n=6). Coloration as in male.

Head. Antennae of 6 flagellomeres, or 5; when 6, AR 0.19, 0.33 (m=0.26, n=2), when 5, 0.51-0.69 (m=0.61, n=4): when 6, length of flagellomeres in µm 40/50, 40/50, 44/50, 44/52, 44/48, 80/92 (n=2), when 5, 40-44 (m=41), 40-48 (m=43), 44-60 (m=50), 44-60 (m=51), 100-132 (m=113) (n=4). Temporal setae 2-4 (m=3, n=5), including 0 inner verticals, 1-2 outer verticals (m=1.2, n=6) and 1-3 postorbitals (m=2, n=5). Clypeus with 14-18 setae (m=17, n=5). Tentorium 90-130µm long (m=117µm, n=6), 30-50µm wide (m=42µm, n=5). Stipes 110µm long, 12µm wide (n=1). Palpomeres 1-5, lengths in µm: 20-34 (m=26), 28-40 (m=35), 60-72 (m=65), 42-76 (m=52), 78-108 (m=99) (n=8). Coronal suture complete.

Thorax. Antepronotum with 2,4 median and 2 lateral setae (n=2). Humeral pit as in male. Dorsocentrals 17-22 (m=19), including 2/3 non-lanceolate humerals and 5-9 (m=7) lanceolate prescutellars (n=8). Simple acrostichals 4-7 (m=5, n=6). Prealars 1-4 (m=3, n=6). Supraalars 1 or 2 (n=5). Preepisternum with 9-28 dorsocentral setae (m=16, n=6). Scutellum with 2 setae (n=1).

Wing. VR 1.1-1.3 (m=1.25, n=8). C extension 100-160 µm (m=133µm, n=8). Anal lobe rounded, not projecting. R with 11-15 setae (m=13, n=7); R_1 with 5-7 setae (m=6, n=7). Squama with 3-6 setae (m=3.6, n=7).

Legs. Spur of front tibia 20-30µm long (m=23.5µm, n=8) plus on one tibia an extra spur 12µm long; spurs of mid tibia 10-20µm (m=18µm, n=8) and 8-16µm (m=13µm, n=8) long; of hind tibia 20-56µm (m=42µm, n=8) and 6-40µm (m=20µm, n=8) long. Comb of 10-16 setae (m=12, n=8); shortest seta 10-20µm long (m=17µm, n=7), longest seta 22-36µm long (m=28µm, n=7). Sensilla chaetica observed on ta_1 of mid leg. Lengths in µm and proportions of legs (n=7):

	fe	ti	ta_1	ta_2	ta_3
p_1	440-488 (450)	472-568 (528)	240-288 (267)	144-184 (163)	112-136 (119)
p_2	432-496 (465)	472-552 (505)	184-216 (202)	104-120 (112)	72-88 (81)
p_3	440-520 (488)	448-600 (551)	264-296 (283)	128-168 (146)	120-160 (139)

	ta_4	ta_5	LR	BV	SV
p_1	48-64 (59)	64-80 (73)	1.0-1.3 (1.2)	2.8-3.5 (3.1)	3.6-4.0 (3.7)
p_2	48-64 (59)	48-80 (65)	1.0-1.2 (1.1)	3.7-4.1 (3.9)	4.6-5.0 (4.8)
p_3	48-64 (66)	54-80 (66)	1.0-1.2 (1.1)	3.0-3.4 (3.3)	3.3-3.8 (3.7)

	BR
p_1	1.2-2.0 (1.5)
p_2	1.2-2.0 (1.7)
p_3	1.8-2.1 (1.9)

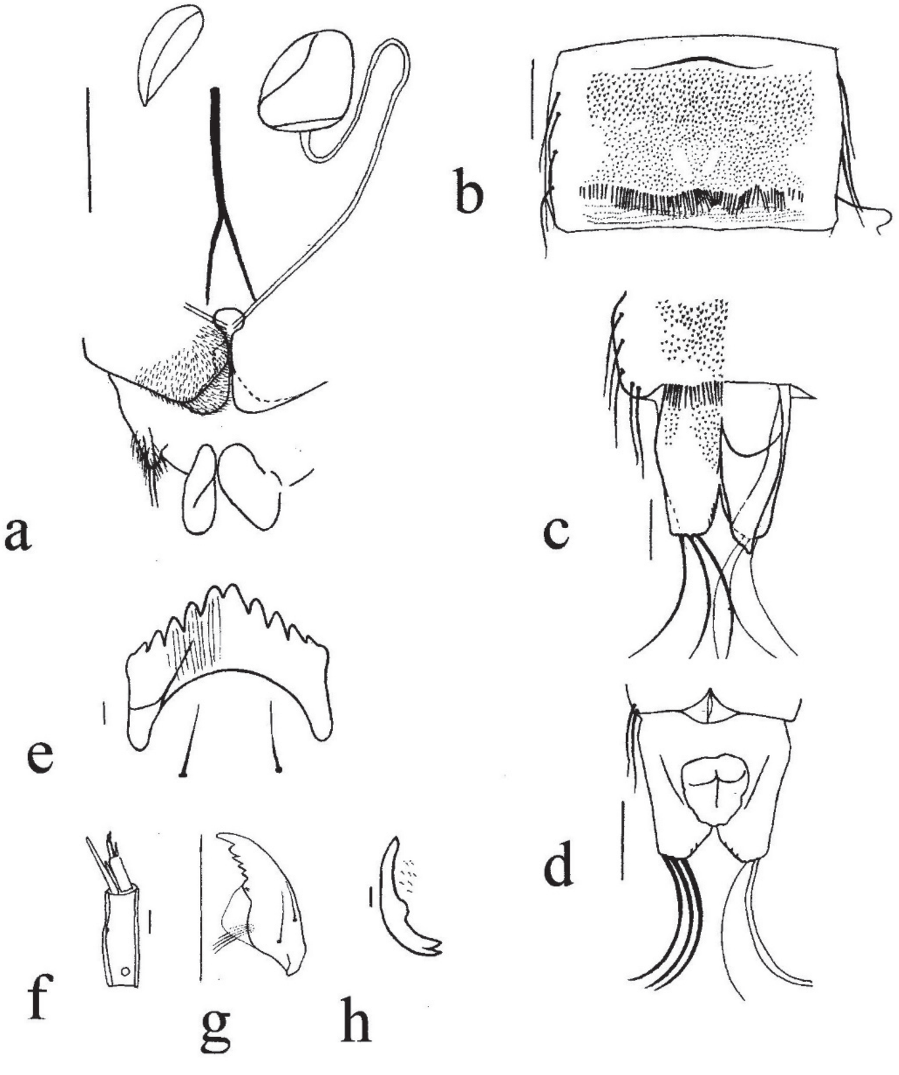

Fig. 2. ***Limnophyes wickenensis*** **sp. n.: a, female genitalia, ventral view left, dorsal right; b-d, pupal exuviae: b, segment IV dorsal; c, apex of female abdomen, dorsal view left, ventral right; d, female segment IX, ventral; e-h, larva: e, mentum region; f, antenna; g, mandible; h, premandible. Scale lines a-d, g 0.1mm; e, f, h 0.01mm.**

Abdomen. Tergites evenly covered with setae 0.6x the length of the tergite.

Genitalia (Fig. 2a). Gonocoxite IX 56-80µm long (m=65µm, n=7) with 2 or 3 long and 3-10 much shorter setae. Tergite IX weakly emarginate, with 14-25 setae (m=19, n =6). Cercus

66-80µm long (m=72µm, n=6). Seminal capsule 90-134µm long (111µm, n=7), including 10-20µm long neck, 60-110µm wide (m=80µm, n=6). Notum 80-100µm long (m=91µm, n=6).

Pupa. Total length 2.5-3.5mm (m=2.85mm, n=18). Antennal sheath length male 520-960 µm (m=690µm, n=8); female 336-400µm (m=365µm, n=8). Wing sheath length 0.68-0.8mm (m=0.76mm, n=15). Wing length / wing sheath length 1.6-2.0 (m=1.82, n=15).

Cephalothorax. Frontal setae 30-70µm long (m=54µm, n=15). Median antepronotal setae 34-60µm long (m=43µm, n=7). Lateral antepronotals 20-30µm long (m=25µm, n=4). Precorneal setae 38-76µm (m=51µm, n=9), 30-76µm (m=43µm), 22-76µm (m=39µm) (n=9) long. Dorsocentral setae 30-64µm long (m=44.5µm, n=7).

Abdomen (Fig. 2b-d). Tergite I unarmed. Tergites II-VIII covered with points, larger anteriorly, and with a posterior row of long spines; number of spines on II 30-72 (m=50.5, n=16), longest 46-78µm long (m=60µm, n=16), III 29-87 (m=52, n=15), 40-80µm long (m=59µm, n=17), IV 40-67 (m=50, n=15), 44-66µm long (m=58µm, n=17), V 33-58 (m=42, n=16), 40-70 µm long (m=56µm, n=16), VI 30-50 (m=41, n=16), 50-64µm long (m=58µm,n=16), VII 21-50 (m=34, n=18), 46-74µm long (m=59µm, n=18), VIII 18-31 (m=23, n=18), 50-66µm long (m=55µm, n=18). Conjunctives II/III to VI/VII armed with minute points. Points of tergite IX much smaller than those on VIII. Longest lateral setae on segments: IV 90-160µm (m=129µm, n=12), V 60-160µm (m=120µm, n=13), VI 80-200 µm (m=129µm, n=12), VII 60-160µm (m=126µm, n=14), VIII 106-200µm (m=145µm, n=12). Anal lobe male 240-280µm long (m=260µm, n=10), female 220-260µm long (m=238µm, n=8), ALR male 2.0-2.6 (m=2.3, n=8), female 1.7-2.1 (m=1.9, n=8), anal macrosetae male 220-300µm long (m=250µm, n=10), female 240-304µm long (m=271µm, n=8). Genital sac of male overreaching anal lobe by 32-56µm (m=42µm, n=10); genital sac of female ending 28-64µm short of tip of anal lobe (m=54µm, n=8).

Larva. (Larval exuviae only: some characters not available.) Head capsule length 224-300µm (m=253µm, n=4).

Head. Antenna as in Fig. 2f. Length of antennal segments in µm: 34-40 (m=38.5), 12-18 (m=15), 6-16 (m=9.5), 2-6 (m=4), 2 (n=4). AR 0.9-1.7 (m=1.4, n=4). Basal antennal segment 12-16µm wide (m=13.5µm, n=4); distance from base to ring organ 6/10µm (n=2); to basal mark of seta 10-26µm (m=19µm, n=3). Blade 22-28µm long (m=24.5µm, n=4); accessory blade 14-16µm long (m=14.7µm, n=3). Lauterborn organ 10µm long (n=2); apical style of second segment 8µm long (n=1). SI not detected; SII 22µm long (n=1). Premandible (Fig. 2h) 70/90µm long (n=2); brush indistinct. Mandible (Fig. 2g) 100-110µm long (m=106µm, n=4), with 4 branches in seta interna. Mentum as in Fig. 2e. Postmentum 144-160µm long (m=152.5µm, n=4).

Abdomen. Procercus 90 µm high (n=1); 84 /100µm wide (n=2), with 5-9 anal setae (m=6, n=4), 260-480µm long (n=4). Supraanal seta 360µm long (n=1); length of supraanal seta/length of anal setae 0.75 (n=1). Posterior parapods 36-44µm long (m=40µm, n=4). Anal tubules not detected. Longest body setae 110-140µm long (m=129µm, n=4).

Habitat. Wicken Fen in Cambridgeshire, England, is an area of relic fen, a Site of Special Scientific Interest and a National Nature Reserve, managed and mostly owned by the National Trust (Friday 1997). The larvae were collected in pools, ponds and ditches 4cm to just over a metre deep. No evidence was obtained for the species' occurrence in larger, deeper water bodies, e.g. the main brick pit and Wicken Lode. The type locality was a shallow (4cm deep), shaded pool in deep mud, the larvae living in a mat of pale green algae, floating at the surface. Most of the specimens reared were obtained there. The other water bodies (ponds and ditches to just over a metre deep) were not shaded, the larvae occurring near the surface only. *Limnophyes* *wickenensis* may be classified as an 'aquatic' species, because damp moss collected in the reserve generated the largely 'semi-terrestrial' *L. minimus* (Meigen) instead.

Distribution
Known only from Wicken Fen in England.

Discussion
Limnophyes wickenensis is very like *L. asquamatus* as observed by Sæther (1990) (note: on page 27 he recorded the wrong date for the specimen he saw, the label states ‘1.vi.77’). On page 33 he noted ‘The highest number of dorsocentrals (24) and the most distinctly lanceolate setae are found in a specimen from England (Wicken) reared from a pupa. This specimen also differ [sic] slightly in having a longer “anal point” and perhaps slightly in the digitiform dorsal lobe of the inferior volsella, and could conceivably represent a different species. If it belongs to a different species, the species obviously is closely related to *L. asquamatus*. The second highest number [sic] of dorsocentrals (18 and 16) are found in some specimens from Greenland. These also show the second highest number of lanceolate setae. In the remaining 18 examined specimens [of *L. asquamatus*] the variation in dorsocentrals is 8-14.” He added “As the only male pupa belong [sic] to an aberrant male, the association of the female may appear uncertain.” It is clear that Sæther had some doubt as to the conspecificity of this specimen with *L. asquamatus*. The pupal exuviae is different from those of reared *L. asquamatus* in my collection, thus was included in Langton (1991) as *Limnophyes* Pe 1a, and in Langton and Visser (2003) as *Limnophyes* pe1a. A new *Limnophyes* species has recently been discovered on the coast of Dorset by P.D. Armitage. It has a pupa similar to Pe 1a. Keys for pupal exuviae and adult males from Britain and Ireland are to be presented in the forthcoming paper on the Dorset species.

The adult male of *L. wickenensis* differs from that of *L. asquamatus* in the greater number of dorsocentral setae (17-28 in *L. wickenensis* (Fig. 1e) as compared with 8-14/18 in *L. asquamatus* (Fig. 1f)), while the corresponding body-length ranges overlap widely (2.2-2.8 versus 1.94-2.68mm), in the more angular anal lobe of the wing (Figs 1a, b), and the sharply pointed dorsal lobe of the inferior volsella (Fig. 1d) (rounded in *L. asquamatus* in Sæther 1990, fig. 3).

Since Sæther’s (1990) revision, according to Ashe and O’Connor (2012), 16 new species have been described in the genus, the bulk from the far eastern Palaearctic, one from South America and three from the West Palaearctic: *L. roquehautensis* Langton & Moubayed, 2001, *L. inanispatina* Langton & Moubayed, 2001 and *L. platystylus* Murray, 2007. There has been one further species described from the West Palaearctic since: *L. tyrrheneus* Moubayed-Breil, 2013. None of these four species has been found away from their type localities since their description. The first two were collected on a 40-metre-high basaltic lava outcrop in southern France, *L. platystylus* by a temporary woodland pool in Co. Meath in Ireland and *L. tyrrheneus* from pozzines at high altitude in Corsica, and none has been encountered since. *Limnophyes roquehautensis* resembles *L. wickenensis* in having an anal point, many dorsocentral setae and preepisternal setae restricted to the posterodorsal area, but it has lanceolate setae on the humeral region of the scutum and on the postnotum, and the dorsal projection of the inferior volsella is circularly expanded. *Limnophyes inanispatina* has no distinct anal point and the preepisternal setae form a vertical anterior band, *L. platystylus* is unique for the flattened apical extension of the crista dorsalis on the gonostyle, and *L. tyrrheneus* has few dorsocentral setae with no lanceolate setae anywhere on the thorax.

I initially identified the Wicken specimens as *L. scalpellatus* Brundin, which has been treated as a nomen dubium since Sæther (1990), because he had been unable to locate the type. It was a misidentification on my part, for Brundin (1947) described *L. scalpellatus* as having lanceolate setae on the humerus and an AR of only 0.7.

Limnophyes wickenensis was recorded for Wicken Fen by Friday and Harley (2000) as *L. asquamatus*. The record for *L. asquamatus* needs to be replaced by *L. wickenensis*, as *L. asquamatus* has not yet been found at Wicken Fen.

Acknowledgement
I am indebted to Martin Spies for initiating this study.

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Limnophyes axillapilosis sp. n. (Diptera, Chironomidae) from southern England

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Summary

The male, female and pupal exuviae of a *Limnophyes* Eaton from an acidic seep in south Dorset are described as a new species *Limnophyes axillapilosis*.

Introduction

On 29 June 2019, PDA sampled an unusually acid seepage on the cliffs near Lulworth Cove, Dorset (SY8156280019) and collected some *Limnophyes* larvae, from which he reared four adults, two males and two females, plus a number of pharate adults that had died without eclosing. As they appeared to him to be somewhat different from any other species recorded for Britain, he sent some material to PHL for his opinion; the conclusion was that the species was new to science. On 29 June 2019, PDA returned to the site and swept some adult males. These confirmed PHL's opinion.

Limnophyes axillapilosis **sp. n.**

Etymology

The Latin word axilla was used for the armpit. The specific epithet *axillapilosis* i.e. 'of the hairy armpit' refers to the characteristic densely setose posterodorsal area of the preepisternum, just below the insertion of the wing. For the purpose of nomenclature, the epithet is a noun in the genitive case.

Holotype male: ENGLAND: St. Oswald's Seep, Dorset (SY8156280019), 25 June 2019, leg. P.D. Armitage. To be deposited in University Museum of Zoology, Cambridge.
Paratypes: One adult male coll. PDA and five adult males coll. PHL, collected with the holotype; one adult female, one pharate adult male and six pharate adult females, 15 May 2019, same site, in coll. PHL.

Descriptions

The following descriptions of the adult sexes are modelled on the descriptions in Sæther's (1990) revision of the genus *Limnophyes.* Adult terminology is as in Sæther (1980) and pupal terminology as in Langton (1991).

Adult male

7 imagos, 1 pharate adult.
Dark brown with yellow-brown legs and antennae. Total length 1.6-2.3mm (m=1.9mm, n=7). Wing length 0.8-1.4mm (m=1.1mm, n=8). Total length/wing length 1.36-2.0 (m=1.77, n=7). Wing length/length of profemur 2.16-3.4 (m=2.58, n=7).

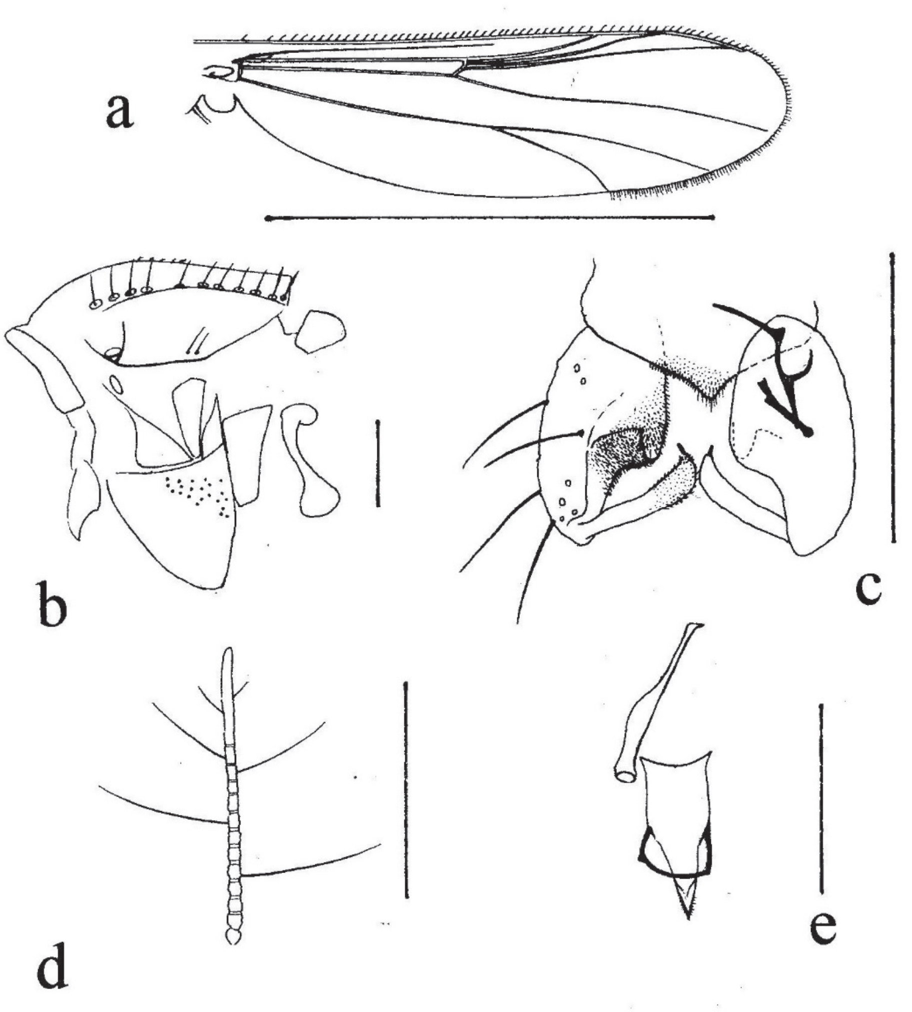

Fig. 1. ***Limnophyes axillapilosis*** **sp. n., adult male: a, wing; b, thorax, lateral; c, hypopygium, dorsal view left, ventral right; d, antennal flagellum; e, tentorium and stipes. Scale lines: a, 1mm; b-e, 0.1mm.**

Head (Fig. 1d, e). AR 0.48-0.7 (m=0.64, n=8). Antenna with 11 flagellomeres, ultimate flagellomere 188-280µm long (m=230µm, n=7) without sensilla chaetica. Temporal setae 1-2 (n=3), including 1 inner vertical, 1-2 outer verticals and 0-1 postorbitals. Clypeus with 8-14 setae (m=11, n=5). Tentorium 100-124µm long (m=108.5µm, n=4); 36-50µm wide (m=45.5µm, n=4). Stipes 108-124µm long (m=116µm, n=5), 10-14µm wide (m=12µm, n=5). Palp segment lengths (in µm, n=6): 26-40 (m=34); 24-60 (m=41); 42-60 (m=52); 70-100 (m=80).

Thorax (Fig. 1b). Antepronotal setae not detected. Humeral pit small oval. Dorsocentrals 10-12 (m=10.4, n=6): 1-4 humerals (m=2.5, n=6), 7-10 prescutellars (m=8, n=6) of which usually

2 are weakly lanceolate. Simple acrostichals 5/6 (n=2). Prealars 2-4 (n=4). Supraalars 0-1 (n=4). Posterodorsal preepisternals 12-18 (m=15, n=5); anterior preepisternals 0. Posterior anepisternum II with 2,3 setae (n=2). Scutellum with 4 setae (n=5).

Wing (Fig. 1a). Anal lobe moderately developed, obtuse. C extension 40-80µm (m=60µm, n=4). R with 1,2 setae (n=2), R_1 without setae. Squama with 1,2 setae (m=1.75, n=4).

Legs. Spur of front tibia 32-40µm long (m=35µm, n=6); spurs of middle tibia 14-20µm (m=16µm, n=6) and 12-18µm (m=13µm, n=6) long; of hind tibia 30-48µm (m=35µm, n=6) and 12-28µm (m=18µm, n=6) long. Comb of 8-15 setae (m=12.5, n=6); shortest seta 12-20µm long (m=14µm, n=6); longest seta 20-40µm long (m=27.7µm, n=6). 5 or 6 sensilla chaetica observed on tarsus 1 of foreleg, 1/2 on tarsus 2 of midleg.

Lengths in micrometres and proportions of legs (n=6):

	fe	ti	ta_1	ta_2	ta_3
p_1	360-480 (424)	456-512 (495)	208-280 (237)	144-176 (156)	88-128 (108)
p_2	384-480 (427)	360-504 (431)	176-232 (195)	96-136 (107)	64-104 (81)
p_3	400-520 (438)	432-576 (472)	184-312 (214)	96-152 (120)	80-160 (117)

	ta_4	ta_5	**LR**	**BV**	**SV**
p_1	48-72 (59)	64-72 (68)	0.43-0.5 (0.48)	2.77-3.15 (2.96)	3.64-4.54 (3.86)
p_2	40-48 (45)	48-64 (56)	0.5-0.59 (0.55)	3.59-3.97 (3.73)	4.22-4.95 (4.51)
p_3	40-80 (53)	56-80 (68)	0.42-0.56 (0.52)	2.98-3.82 (3.26)	3.47-4.74 (3.75)

	BR
p_1	0.75-1.7 (1.3)
p_2	1.3-2.4 (1.7)
p_3	1.9-2.9 (2.3)

Abdomen. Each tergite I-VIII with many setae, the setae about 0.3x the length of the tergite.

Hypopygium (Fig.1c). ‘Anal point’ well defined, broadly triangular, beset with macrotrichia. Tergite IX with no long setae; laterosternite IX with 1-3 setae. Phallapodeme 48-60µm long (m=53µm, n=5). Virga 24µm long (n=1). Gonocoxite 120-166µm long (m=144µm, n=6); ventral lobe of inferior volsella broad, rounded, extending about two thirds the length of the coxite; dorsal lobe large, triangular, with a thumb-shaped projection, apically bare, directed posteriad. Gonostylus 68-86µm long (m=75µm, n=6); crista dorsalis absent; megaseta 6-12µm long (9µm, n=6). HR 1.67-2.3 (m=1.92, n=6); HV 2.22-2.79 (m=2.48, n=6).

Adult female.

Six pharate adults.

Total length 2.5-3.2mm (m= 2.8mm, n=6). [Note: the abdomen of a pharate adult when lightly compressed under a cover slip becomes fully extended; the lengths of post teneral adult females will be less than that recorded here for pharate specimens.] Wing length 1.1-1.6mm (m=1.3mm, n=5) (calculated from pupal wing sheath length (Langton 2002)). Coloration as in the male.

Head. AR 0.48-1.0 (m=0.7, n=3). Lengths of flagellomeres in micrometres: 30/40, 36/40, 24/44, 44, 76/80 (n=2). Apical antennal segment without sensilla chaetica. Temporal setae 4,5, including 1,2 inner verticals, 1 outer vertical and 2 postorbitals (n=4). Clypeus with 14-19 setae (n=3). Tentorium 80,84µm long, 40,56µm wide (n=2). Stipes 100-110µm long, 11-16µm wide (n=3). Palpomeres 14-20, 30-32, 40-52, 40-56, 80µm long (n=2).

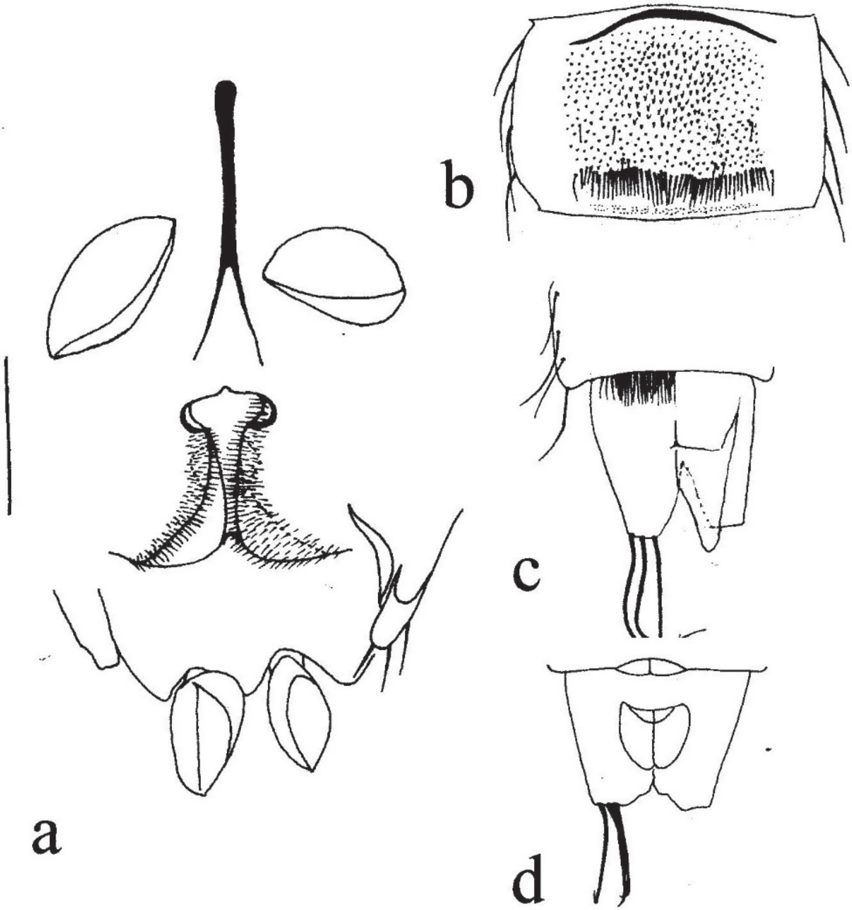

Fig. 2. ***Limnophyes axillapilosis*** **sp. n.: a, female genitalia, ventral view left, dorsal right; b-d, pupal exuviae: b, segment IV, dorsal; c, apex of female abdomen, dorsal view left, ventral right; d, female segment IX, ventral. Scale line 0.1mm.**

Thorax. Antepronotum with 1 median and 4-13 lateral setae (m=8, n=5). Humeral pit as male. Simple acrostichals present on mid scutum. Dorsocentrals 14-21 (m=16, n=5); 4-6 non-lanceolate humerals (m=5, n=5), 8-17 prescutellars (m=13, n=5), 1-4 of which are narrowly lanceolate. Prealars 3-6 (m=5, n=5). Supraalars 0. Posterodorsal preepisternals 20-30 (m=24, n=5); anterior preepisternals 0. Posterior anepisternum II with 2 setae (n=4). Scutellum with 4-9 setae (m=7, n=6).

Wing. Squama with 2,3 setae (n=2). All other detail obscured.

Legs. Spur of front tibia 24,25μm long (n=3); spurs of middle tibia 12-26μm (m=18.5μm, n=4) and 10-16μm (m=14.5μm, n=4) long; of hind tibia 18-30μm (m=25μm, n=3) and 12-14μm (n=2) long. Comb of 12-14 setae (n=3), shortest seta 16μm long (n=3); longest 28-34μm long (m=30μm, n=3). Sensilla chaetica not observed.

Lengths in micrometres and proportions of legs (n=1):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	**LR**	**BV**	**SV**
p_1	340	484	228	152	108	72	60	0.47	2.16	3.61
p_2	320	400	400	100	80	48	68	1.0	3.78	1.8
p_3	448	440	232	108	120	52	64	0.53	3.26	3.83

Abdomen. Each tergite II-VIII covered with setae c. 0.3x the length of the tergite.

Genitalia (Fig. 2a). Gonocoxite 32-50µm long (m=39µm, n=6), with 3-6 setae (m=4, n=6). Tergite IX with 9-29 setae (m=19, n=6). Cercus 40-70µm long (m=57µm, n=6). Seminal capsule 64-80µm long (m=71µm, n=6), 38-54µm wide (m=48µm, n=4). Notum 128-150µm long (m=140µm, n=6).

Pupa.

6 pharate adults.

Total length 2.9-3.3mm (m=3.0mm, n=4).

Cephalothorax. Frontal setae 56µm long (n=1). Cephalothorax setae not detected.

Abdomen (Fig. 2b-d). Tergite I with or without a narrow posterior transverse band of points. Tergites II-VIII covered with points, larger anteriorly, and with a posterior row of long spines; number of spines on II 40-90, 40-60µm long, III 80-99, 34-52µm long, IV 67-90, 40-50µm long, V 59-88, 40-48µm long, VI 53-81, 40-50µm long, VII 40-58, 40-48µm long, VIII 38-53, 40-50µm long (n=3/4). Conjunctives II/III to VI/VII armed with minute points. Points of tergite IX much smaller than those on VIII and regularly arranged. Longest lateral setae on segments: IV 94µm, V 100-106µm, VI 100-104µm, VII 100-110µm, VIII 120-156µm (n=1-3). Anal lobe 200-240µm long (m=224µm, n=5), ALR 4.3-5.4 (m=4.6, n=4), anal macrosetae 220-250µm long (n=3). Genital sac of male overreaching anal lobe by 40µm (n=1), of female ending 50-56µm short of apex of lobe (n=3).

Habitat (Fig. 3)

The chironomid larvae were collected and reared to adults and pharate adults from an acidic seepage (pH 3.9) on the cliff just above St. Oswald's Bay near Lulworth in Dorset, UK. The acidity is generated principally by the aqueous microbial oxidation of iron pyrites in the surrounding sedimentary rock (for more details on the geochemical aspects see Tan *et al*. 2018). The larvae were living in a fine iron-rich detritus containing dense populations of euglenoid algae covered with up to 10mm of water.

Distribution

Known only from the type locality in southern England.

Discussion

Limnophyes axillapilosis runs to *L. asquamatus* Andersen in Langton and Pinder (2007) and nearest to *L. asquamatus* in Sæther (1990), but differs in a number of respects. Both species have the preepisternal setae restricted to the postero-dorsal area. However, *L. axillapilosis* has more of them, even though the average male body length is slightly lower (1.6-2.3mm *versus* 1.94-2.68 in *L. asquamatus*). Sæther (*op. cit*. p. 27) in his 'Diagnostic characters' for *L. asquamatus* states 'few preepisternals in dorsocentral to posterocentral position' and in the description that follows 'preepisternals 0-6, 3 (31)' (*op. cit.* p. 29). Langton and Pinder's (2007) fig. 60A shows 11 preepisternals. A trawl through the specimens of *L. asquamatus* in coll. PHL gives a range of 0-8, the 11 referred to above being an extreme variant. A confirmatory character for the specific identity of *L. axillapilosis* is that *L. asquamatus* has the crista dorsalis of the gonostylus enlarged to form a triangular tooth alongside the megaseta (Sæther 1990, figs 2, 3; Langton and Pinder 2007, fig. 164D), whereas in the new species there is no such tooth. The following couplets inserted in Langton and Pinder's (2007, p. 114) key to the species in *Limnophyes*, replacing former couplets 8-9, will serve to identify the three recent additions to the British and Irish lists:

8. Prescutellar lanceolate setae numerous (12-35); humeral lanceolate setae also numerous [Langton and Pinder Vol. 1 (2007, fig. 60B). Hypopygium Langton and Pinder Vol. 2 (2007, fig. 164B)] ……………………………….... **Limnophyes brachytomus** (Kieffer)
\- Prescutellar lanceolate setae less numerous (2-10); humeral lanceolate setae numerous, few or absent …………………………………………………………………………… 9

9. Humeral lanceolate setae numerous (10-35) [Langton and Pinder Vol. 1 (2007, fig. 60C); Hypopygium Langton and Pinder Vol. 2 (2007, fig. 164C)] .. **Limnophyes edwardsi** Sæther
\- Humeral lanceolate setae few (0-8) …………………………………………................... 9a

9a. Crista dorsalis with a broad, spatula-like extension overpassing megaseta apically. [Hypopygium Murray (2007, fig. 6)] …………………... **Limnophyes platystylus** Murray
\- Crista dorsalis absent or extended as a tooth by megaseta ……………………………... 9b

9b. Dorsocentral setae numerous (18-28), including many lanceolate prescutellars [Langton (2020, fig. 1 c, e). Hypopygium Langton (2020, fig. 1d)] …………………………………. ……………………………………………………….. **Limnophyes wickenensis** Langton
\- Dorsocentral setae less numerous, with fewer, or 0, lanceolate prescutellars …………….. 9c

9c. Preepisternum with fewer posterodorsal setae (0-11). Crista dorsalis of gonostylus projecting apically as a triangular tooth. [Hypopygium Langton and Pinder Vol. 2 (2007, fig. 164D)] ………………………………………..... **Limnophyes asquamatus** Andersen
\- Preepisternum with more posterodorsal setae (12-18). Crista dorsalis of gonostylus without apical tooth. Hypopygium Fig. 1c ……………………….. **Limnophyes axillapilosis sp. n.**

Sæther (1990 p.33) remarked concerning the female of *L. asquamatus* 'as in all other species of *Limnophyes* association is very easy. The thorax chaetotaxy and the shape of the humeral pit makes association of females with their conspecific males nearly as certain as identifying conspecific males.' This is equally true for *L. axillapilosis*, the females recorded here having an even greater number of posterodorsal preepisternals (20-30).

Two of the species discussed above are known to have pupae that run to *L.* Pe 1a in Langton (1991), subsequently called '*L.* pe1a' in Langton and Visser (2003): *L. wickenensis* and *L. axillapilosis*. These can be separated by the following key couplets inserted in place of couplet 148 in Langton (1991) and of 758b in Langton and Visser (2003):

148. Four long lateral setae on segment VIII, the fourth very small and inconspicuous ……………………………………………………… **Limnophyes pumilio** (Holmgren)
\- Five long lateral setae on segment VIII (*Limnophyes* Pe 1a) ………………………… 148a

148a. Posterior spines on abdominal tergites in a dense band 3-4 spines deep ……………………. …………………………………………………….. **Limnophyes axillapilosis sp. n.**
\- Posterior spines on abdominal tergites mainly in a single row ………………………………. …………………………………………………... **Limnophyes wickenensis** Langton

Notes

1. Some *L. asquamatus* pupal exuviae could slip past an earlier couplet and key out as *L. wickenensis*. Longest lateral setae on segment IV in *L. asquamatus* are shorter than 100µm, in *L. wickenensis*, mostly longer. [The parametric data for *L. asquamatus* in Langton (1991) and Langton and Visser (2003) were based on a mixed series.]

2. For many *Limnophyes* species the pupal exuviae have not been described or associated. Thus, there may be additional species with exuviae of the *L.* Pe 1a morphotype. Reared or pharate adult males will be necessary for positive specific identifications.

Fig. 3. St. Oswald's seep, type locality of *Limnophyes axillapilosis* sp. n.

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Microdon analis (Macquart) (Diptera, Syrphidae) in southern Scotland – On 15 June 2020, I was walking along a farm track next to the Big Water of Fleet at Upper Rusko in the Fleet Valley, Dumfriesshire (NX5761). At a sunny spot, I encountered several microdontine syrphids on exposed stones embedded in the track. In the manner typical of many syrphid adults, they undertook short flights and interacted with one another before settling back on to the stones. The reflective colours of their thoracic pile flashed gold in the bright sun and they made a conspicuous and colourful spectacle. I caught one of them and in the keys of A.E. Stubbs and S.J. Falk (2002. *British Hoverflies, an illustrated identification guide.* BENHS) it was readily identified as *Microdon analis* (Macquart, 1842) (Diptera, Syrphidae).

Microdon analis is unusual for its disjunct distribution in Great Britain, with isolated centres of population in the highlands of Scotland and southern England (Ball, S.G., Morris, R.K.A., Rotheray, G.E. and Watt, K. 2011. *Atlas of the Hoverflies of Great Britain (Diptera, Syrphidae).* Wallingford, Biological Records Centre). According to the Scottish Hoverfly Records Database managed by Kenn Watt, the most southern Scottish records for *M. analis* are Glen Lonan, Argyll and Bute (NM9628) and about equally as far south, the nearby, Isle of Mull. The capture of this species in Dumfriesshire extends its distribution south in Scotland.

The predatory larva of *M. analis* is associated with nests of saproxylic ants in fallen trees and stumps of *Pinus* and *Betula* (Ball *et al*., *op. cit*.). On one side of the Upper Rusko track are conifer plantations of various ages and sizes and broad-leaved woodland is on the other side, comprising chiefly *Quercus*, *Fraxinus*, *Fagus* and by the river, *Alnus*. As components of broadleaved woodland in the Fleet Valley, *Betula* is scarce to frequent and *Pinus* is occasional. Less than a half a kilometre north of the *M. analis* site are, however, large tracts of mature conifer plantation, mainly *Picea*, some parts of which have been felled. In this area and at the Upper Rusko site, fallen conifers are not unusual. Hence, apparently suitable habitat for ant hosts is available in the area. These circumstances make the status of the specimens reported here difficult to evaluate. They might be part of a long-established population in the Fleet Valley that, apparently, has not been noticed previously or the species may have been accidentally introduced with the conifers. Another possibility is that they are the result of dispersal from populations elsewhere which suggests that this species is under-recorded and/or its distribution is changing. Only further investigation and assessment will resolve these issues. I am grateful to Kenn Watt for kindly providing me with *M. analis* data held in his Scottish Hoverfly Records Database – **GRAHAM E. ROTHERAY**, 16 Bracken Wood, Gatehouse of Fleet, Dumfriesshire, DG7 2FA; grahamrotheray@googlemail.com

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Recent records of *Australachalcus melanotrichus* Mik (Diptera, Dolichopodidae) and observations on its habitat associations and range in Britain and Ireland

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Summary

Recent British records of *Australachalcus melanotrichus* Mik, 1878, are presented together with comments on their habitat associations and British distribution. The species is associated with the standing trunks and stumps of veteran broad-leaved trees – live or dead - and appears to develop in accumulations of wood mould and decayed wood in rot-holes and inside trunk cavities generally. The species of tree is not important only that fungal decay of the white-rot type has occurred, and that the resulting debris has composted and presumably remained moist or even wet. Tree situation appears not to be important; the species is found in a wide range of vegetation structures from open-grown trees in parkland and traditional orchards through to closed-canopy woodland. The British range appears to encompass the whole of England and Wales, with just two Scottish records known. Published Irish records are few, all from central and eastern counties.

Introduction

The conservation status of *Australachalcus melanotrichus* Mik, 1878 has had a mixed history in Britain from Notable (Falk 1991), then removed altogether (Falk and Crossley 2005), and most recently upgraded to Nationally Rare but this status then moderated to Nationally Scarce (Drake 2018). This in part at least reflects poor knowledge of the species' distribution and habits in Britain. The explanation given by Falk and Crossley (2005) for down-grading was that it was known from 14 counties. Drake (2018) comments that it is widely distributed in lowland England and scarce in north England and Wales. His data collation produced records from a total of 33 hectads of which 21 only had records pre-1989 and only 14 with records between 1990 and 2012, with two hectads having records from both periods. He commented that "the decline is not considered specific enough in terms of threat to yet warrant NT" although the figures of 14 and 24 are not of course directly comparable as they cover widely different time periods – around 20 years compared with over 100, respectively. There is only one published record from Scotland, from Leith (Robertson 2002), but the Empid and Dolichopodid recording scheme is aware of a second record, from North Aberdeenshire (C.M. Drake *pers. comm.*).

The habitat of this dolichopodid explains this difficulty in assessing status to a considerable degree as it is believed to primarily develop in rot-holes in veteran trees. The adult fly is also a small species and may have a restricted period of flight activity – Speight (1987) found that his reared specimens were active only late in the afternoon and in the evening. Sweep-netted specimens under field conditions, however, may have been taken in late afternoon but certainly not evening – most recording activity takes place during the working day (C.M. Drake *pers. comm.*).

My own records, primarily from flight interception trapping studies – using the four-bottle design of trap (Alexander *et al*. 2016) – have been steadily accumulating and now comprise 14 sites across 11 counties, in England, Wales and Northern Ireland – doubling the national Great Britain total reported by Drake (2018) for the 1990-2012 period. These include 8 new vice county records, and the first reports from the South-west and North-west of England and also Northern Ireland; first vice county records are marked with an asterisk in the following details.

V.C. 1 West Cornwall*
Godolphin Hall (SW5931), from a trap placed at the entrance to a rot-hole in a veteran apple *Malus* in the remains of a traditional orchard, operated between 27.v and 14.vii.2008; Trelissick Park (SW8339), two females trapped inside a large old but live hollow ash *Fraxinus* in the centre of a large open area of parkland, 20.v-24.vi.2009.

V.C. 5 South Somerset*
Pixton Park, Dulverton (SS9227), one female in a trap placed inside a standing dead hollow beech *Fagus*, 4.v-12.vii.2017.

V.C. 11 South Hampshire
Sites south-east of Totton, Southampton, a female in a trap in the entrance to a hollow oak *Quercus* on an external wood bank (SU30), 4.vi-9.vii.2019, and another from a trap in front of a rot-hole in a hedgerow oak with sap-runs (SU40), 9.vii-1.x.2019. These sites are from an area of pastoral farmland outside of the New Forest National Park.

V.C. 16 West Kent
Ashenbank Wood, Cobham (TQ6769), a male from a trap hung against a re-erected decaying sycamore *Acer* trunk strapped to a mature oak to maintain standing deadwood habitat, on edge of a large area of old wood pasture, 28.vi-13.ix.2016.

V.C. 33 East Gloucestershire*
The Scrubbs, Crickley Hill (SO9316), a female from a trap on a veteran whitebeam *Sorbus* within former beech-dominated wood pasture, 21.v-24.vii.2019.

V.C. 35 Monmouthshire*
Pierce Wood, Chepstow (ST538963), a male in a trap at the entrance to a basal hollow of a veteran oak on the lower edge of valley-side woodland, 6.iv-26.vi.2018.

V.C. 36 Herefordshire
Breinton (SO4740), a male in a trap on an ancient oak pollard in hedgerow, 8.vi-24.vii.2018.

V.C. 50 Denbighshire*
Chirk Castle Park (SJ277374), a male in a trap by extensive tears in the trunk of a parkland hornbeam *Carpinus*, 11.vii-16.x.2018.

V.C. 53 South Lincolnshire
Belton Park (SK9239), one male and one female in a trap against a torn and rotted area on the trunk of a parkland sycamore, 20.v-30.vii.2008. Andy Godfrey (*pers. comm.*) has also found this species here more recently, in 2018.

V.C. 57 Derbyshire*
Calke Park (SK3622), three males from a trap inside hollow small-leaved lime *Tilia cordata*, two males and a female on the decayed side of a horse chestnut *Aesculus*, and one female in a third trap, also on the decayed trunk of a horse chestnut, all 1.vi-11.vii.2012; Kedleston Park: Pleasure Ground Wood (SK302403) one male from a trap at the entrance to a cavity in a common lime *Tilia vulgaris*, and Hay Wood (SK312413), one male in a trap at the entrance to a rot cavity in a beech, 7.vii-20.x.2015. Andy Godfrey (*pers. comm.*) has also found this species in Calke Park more recently, in 2019, associated with beech, sycamore and horse chestnut.

V.C. 70 Cumberland*

Thorneythwaite Fell, Borrowdale (NY2413), two males from a trap in a decayed sycamore with the bracket fungus *Ganoderma australe*, 10.v-17.vii.2017.

V.C. H36 Tyrone*

Caledon Park (H7543), a female at white-rot exposed on the trunk of an open-grown parkland ash tree, 16.vi.2006.

Discussion

The new records reported here associate the species with oak (4 examples), sycamore (3), ash (2), beech (2), horse chestnut (2), lime (2), and hornbeam, whitebeam and apple (1 each), although of course the individual flies were not necessarily developing in the trees where they were captured. Dyte (1959) pointed out that both Verrall and Laurence had reared larvae from rotten debris in lime, elm *Ulmus* or horse chestnut trees. Allen (1982) reared it from wood mould taken from an elm stump. Speight (1987) had reared it from birch *Betula* and oak. Pollet (1996) commented that, thus far, beech, birch, elm, horse chestnut, lime, oak and poplar *Populus* have been recorded as host trees. The obvious conclusion is that the species of tree is not important, although no records have been reported from conifers.

All of the new records detailed above come from standing trees, mostly living, with rot-holes or cavities giving access to hollow interiors. The exceptions were one example each of a standing dead hollow tree and a re-erected fallen trunk, the latter aimed at increasing the amount of standing deadwood available on the site. The traps had all been targeted at standing deadwood. Records from the literature and from the recording scheme tend to arise from Malaise trapping or sweep-netting, but in the cases where a tree association is noted it is from a standing veteran tree or a decayed stump. Chandler (1973) noted a male and female on rotten heartwood of elm with *Pleurotus cornucopiae* and has found a male at a wound on a horse chestnut trunk (Peter Chandler *pers. comm.*); he also reports finding a male on an elm log, which constitutes the first reported association with fallen wood, albeit not proof of development there. An association with standing dead wood makes sense for a species which is primarily associated with rot-holes and larger tree cavities – to what extent fallen trees with these features remain suitable is unclear. Only two species of decay fungi have been reported in association with the fly – the bracket fungus *Ganoderma australe* and oyster mushroom *Pleurotus*; both convert dead woody tissues via white-rot to provide the wood mould in which the larvae develop. White rot does seem to be the key factor in proving suitable habitat conditions. The debris arising accumulates in the base of the cavities where it composts. Moisture is assumed to be important for larval development although there appear to have been no studies examining the degree of wetness favoured.

The new sites detailed above include historic parklands (8), wood bank/edge (4), hedgerow trees (3), ancient wood pasture (2) and traditional orchard (1). It may be significant that no specimens have been taken in traps situated within the interior of conventional woodland – certainly all of the new records detailed above come from veteran trees growing in open or semi-open situations. Speight's (1987) sites were - in contrast - all from woodland including secondary birchwood on drained bog. While some were in shaded woodland, distinctly under the canopy, others were in more open locations (M. Speight *pers. comm.*). The obvious conclusion is that the situation of the veteran tree in which the species develops is not important, but given that veteran trees are more a feature of open countryside the species is more likely to be found in the types of situation outlined above.

Trapping records come from the full length of the field season, being captured in traps operated from April into October, although the precise dates of capture are not known of course.

Acknowledgements

These surveys include commissions from the local offices of Natural England (Pixton Park), Natural Resources Wales (Pierce Wood), the Northern Ireland Environment Agency (Caledon Park), the National Trust and Woodland Trust (Ashenbank) and the flies were all identified by Peter Chandler except the Caledon Park specimen, which was identified by Dave Gibbs. Martin Drake kindly made the data from the Empid & Dolichopodid recording scheme available. My thanks are also due to Peter Chandler, Martin Drake, Andy Godfrey and Martin Speight for their comments on an earlier draft.

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Recent records of freeloader flies (Diptera, Milichiidae)

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Summary

Recent British records of four species of Milichiidae are presented: *Madiza britannica* Hennig, 1937, *M. pachymera* Becker, 1908, *Phyllomyza donsithorpei* Schmitz, 1923, and *P. securicornis* Fallén, 1823, together with comments on their habitats and British distribution.

Introduction

Milichiidae tend to be under-recorded and this must at least partly reflect their small size and inconspicuous habits. Alexander and Perry (2013) reported on some modern records for the little-known *Madiza britannica* Hennig, 1937 and made some suggestions about its ecology in Britain. Its British status has subsequently been provisionally confirmed as Vulnerable (Falk *et al*. 2016). Three additional records have been made by the author since the 2013 paper, all in the south-west of England. *Madiza pachymera* Becker, 1908 has provisionally been assessed as Nationally Scarce. The conservation status of two further species – *Phyllomyza donisthorpei* Schmitz, 1923 and *P. securicornis* Fallén, 1823 – has not been assessed. Two of the three records for *M. britannica* reported here are referred to in Falk *et al.* (2016) but the full details were not then provided. The following records all arise from the use of flight interception traps of the four-bottle design (Alexander *et al*. 2016).

V.C. 5 South Somerset: Pixton Park, Dulverton (SS9227), a single female *M. britannica* was taken in a trap placed over a split multi-stemmed ash tree on the eastern park boundary, operated 4.v–12.vii.2017. Pockets of white-rot decay were evident here and an old bracket of the fungus *Inonotus hispidus* was found; this is the typical white-rot-forming fungus associated with veteran ash trees. A single male *M. pachymera* was taken in another trap placed inside a standing dead hollow beech tree within the open parkland in the same period.

V.C. 6 North Somerset: Leigh Woods NNR (ST5673), a single female *M. britannica* was taken in a trap positioned inside the hollow pollard head of an ancient oak in this expanse of ancient wood pasture, 12.ix–1.xi.2016.

V.C. 12 North Hampshire: Kempshott Park (SU5947), one male and one female *M. pachymera* were taken in a trap positioned in front of the scar from a ripped out large lateral branch on a parkland beech tree, 15.v–3.vii.2019.

V.C. 16 West Kent: Ashenbank Wood, Cobham (TQ6769), single females of *M. britannica* and *P. securicornis* were taken in a flight interception trap hung inside the white-rotted interior of a large hollow ash tree of in excess of 5m girth, 18.v–28.vii.2016.

V.C. 17 Surrey: Barrowhills, Chertsey (SU9865), 2 male and 5 female *M. pachymera* from a trap hung across the hollow base of a fallen veteran oak of about 4m trunk girth lying in deep shade within an old abandoned Japanese garden developed within old parkland/wood pasture and within the extent of the ancient Windsor Forest. The tree had many brackets of *Ganoderma australe* indicating white-rot development within its dead heartwood tissues, 3.vi–3.viii.2015. A large number of winged mature brown tree ant *Lasius brunneus* (Latreille, 1798) were also trapped, suggesting that there was a nest inside this tree.

V.C. 37 Worcestershire: Rough Hill Orchard, Birlingham (SO9244), a single female *Phyllomyza donisthorpei* in a trap placed immediately below a medium-sized branch-scar rot-hole in the upper trunk of a veteran apple tree, 19.v–12.vii.2013; and a single *M. britannica* in the same trap, 20.viii–30.x.2013. Although there was no sign of any bracket fungi at the time, fresh growth of *Polyporus squamosus* had developed by the time of the July visit.

V.C. 70 Cumberland: Thorneythwaite Fell, Borrowdale (NY251133), one male *P. securicornis* from a trap placed over the wood mould in the top of a standing dead holly pollard, 10.v–17.vii.2017.

Two further records of *M. britannica* have been kindly provided by Andy Godfrey, both new county records:

V.C. 27 East Norfolk: Blickling Estate (TG179295), one female, 1.vi, and one male, 2.vi.2017, from a hollow oak with nesting tawny owl, leg. D. Brice and P. Littler, det. AG.

V.C. 53 South Lincolnshire: Belton Park (SK9239), three walking slowly on the exposed sapwood close to dry sappy exudations at the damaged base of a horse chestnut tree in Western Avenue, leg. & det. AG.

Discussion

The continued addition of *M. britannica* records suggests that this species might be better assessed as Nationally Scarce. The author has now found it in seven sites across six vice-counties since 2008 with the species being added to the lists for South Somerset, West Kent, Worcestershire, Derbyshire and Cheshire for the first time. The discovery of the fly in a traditional orchard adds another veteran tree habitat type and highlights a large area of potential habitat across the extensive traditional orchard country of the Three Counties Area (Worcestershire, Gloucestershire and Herefordshire), where the Diptera of traditional orchards have hardly been studied at all. It is clearly potentially more widespread than previously appreciated. The bracket fungus *Inonotus hispidus* provides a third white-rot fungus species with which it has been associated, adding further evidence for an association with white-rot in general rather than a particular decay fungus species.

The discovery of *M. pachymera* in Pixton Park, on the southern edge of Exmoor National Park, extends its known range south-westwards, with all previous records coming from midland and south-eastern England, from Dorset and the New Forest across to the Cambridgeshire Fens and north to Shropshire and Nottinghamshire. Ivan Perry (*pers. comm.*) has found *M. pachymera* at two sites in 2019, Denny Wood in the New Forest (SU334069) on 12.vi. and 14.vi. swept from elder flowers, and Waresley Wood, Huntingdonshire (TL262548) on 22.vi. Interestingly, *M. pachymera* has been found at the famous southern saproxylic sites of the New Forest and Windsor Forest but not *M. britannica* – until *M. britannica* was discovered in Ashenbank Wood there had been no records for that species from the far south-eastern counties. Such apparent distribution patterns or anomalies may of course merely be an illusion based on under-recording.

Phyllomyza donisthorpei has been found in a nest of jet ant *Lasius fuliginosus* (Latreille, 1798) situated in the sandhills at Birkdale in 1905 and subsequently with the same ant at Wellington College, Darenth Wood and Oxshott (Donisthorpe 1927). The larvae develop in the chambers and galleries at the bottom of the ant nests. Ivan Perry (*pers. comm.*) has also only found it in association with *L. fuliginosus*, at two sites on the Suffolk coast in 2013: at Minsmere (TM478665) on 25.vi, 1.vii and 19.viii, and at Dunwich (TM477675) on 25.vi and 1.vii, all records based on males. The apple tree in Rough Hill Orchard was, however, inhabited by brown tree ant *Lasius brunneus*, and no *L. fuliginosus* were detected across the orchard, so this appears to be a new host ant association.

Phyllomyza securicornis has so far been found in the four-bottle traps on just two occasions. In contrast, Andy Godfrey (*pers. comm.*) regards it as the most frequently encountered milichiid in his experience. This presumably reflects his use of Malaise traps and water traps, which are sampling general flight activity away from larval habitat. Peter Chandler (*pers. comm.*) regards it as the most commonly encountered milichiid by general sweeping in woods, grassland and dunes throughout the British Isles. Similarly, Ivan Perry comments (*pers. comm.*) that the two *Madiza* species are rarely found by sweep-netting and are more easily obtained through rearing. The four-bottle traps have been used by the present author in a very targeted manner by positioning them close to potential larval saproxylic habitat, and presumably capturing adults either as they arrive for mating and oviposition or else immediately after emergence as they set off to colonise new habitat. The poor showing of the most frequently encountered milichiid in the four-bottle traps is a good indication that this species is not associated with decaying wood. An ant association for this species has not been confirmed.

Acknowledgements

These surveys include commissions from the local offices of Natural England (Pixton Park), the National Trust (Leigh Woods & Borrowdale) and Woodland Trust (Ashenbank) as well as by the People's Trust for Endangered Species (Rough Hill Orchard) and the flies were all identified by Peter Chandler. My thanks are also due to Andy Godfrey and Ivan Perry for their comments on an earlier draft and for making additional records available.

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***Estheria bohemani* (Rondani) (Diptera, Tachinidae) and other Diptera in Sutherland –** In July 2019, I spent a week on the north coast of Sutherland and made five visits between 20 and 25 July to the sand dunes at Borgie (NC688617), formerly part of Invernaver NNR. The sand here is base-rich and gives rise to a herb-rich flora. Because of its exposed position, some of the sand gets blown up onto the fringing low cliffs, creating calcareous conditions and, where there are seepages, a *Schoenus nigricans* mire develops. The site is unusual in having typical montane plant communities growing almost at sea level and is considered to be a classic example of altitude descent with increasing latitude and oceanicity. Because of its exposed position, bush growth is restricted to low growing species such as *Salix repens* and a dwarf form of *Juniperus communis*.

One of the reasons for my visit was to see if I could locate *Estheria bohemani* (Rondani, 1862), which had been recorded at Invernaver by Peter Chandler on 28 July 1972. There had previously been a record from 1877 at an unknown locality in Sutherland, possibly the same site, collected by W.A. Vice (Wainwright, C.J. 1928. The British Tachinidae. *Transactions of the Entomological Society of London* **76,** 139-254). I was pleased to find that it is still present and proved to be quite widespread on the dunes and cliffs. It favoured bare or sparsely vegetated areas of sand, particularly where these were damp from seepages on the low cliffs. Both sexes were present, although many of the females were teneral. I never saw it visiting flowers and many of the specimens were obtained by sweeping. On the Continent it is found as far north as Sweden and is said to prefer mountains up to 1900 metres, being locally frequent in the Alps (Tschorsnig, H.-P. and Herting, B. 1994. Die Raupenfliegen (Diptera: Tachinidae) Mitteleuropas: Bestimmungstabellen und Angaben zur Verbreitung und Ökologie der einzelnen Arten. *Stuttgarter Beiträge zur Naturkunde Serie A (Biologie)* **506,** 170 pp). It is strange that it appears to be, for now at least, restricted to just this one site in this country and has never been recorded from one of the mountain ranges further south. The host is unknown, although other species of *Estheria* are known to be parasitoids of the larvae of Scarabaeidae (Coleoptera).

The dunes and low cliffs at Borgie proved to be a rich locality for Diptera and other notable species found included – *Dicranomyia stylifera* Lackschewitz, 1928 (Limoniidae), one male 23 July, four males 25 July swept from pools and seepages with *S. nigricans*; *Botanophila tuxeni* (Ringdahl, 1953) (Anthomyiidae), one male 21 July, one male 23 July; *Helina arctata* Collin, 1953 (Muscidae) frequent on the fore dunes; *H. quadrinotata* (Meigen, 1826) (Muscidae), two males, two females, 20 July; *Bellardia pubicornis* (Zetterstedt,1838) (Calliphoridae), one male 25 July; *Calliphora uralensis* Villeneuve, 1922 (Calliphoridae), one female 21 July; *Sarcophaga vicina* Macquart, 1835 (Sarcophagidae), one male 23 July; *Ceranthia lichtwardtiana* (Villeneuve, 1931) (Tachinidae), one male 21 July, one female 23 July; *Graphogaster brunnescens* Villeneuve, 1907 (Tachinidae) one female 25 July.

I was surprised to find *Helina arctata* numerous on the fore dunes at Borgie. In July 2018, when I visited the dunes at Embo (NH815931) and Dornoch (NH804891), on the east coast of Sutherland, that same position was occupied by a very similar species, *H. intermedia* (Villeneuve, 1899), which appeared to be absent from Borgie. When J.E. Collin described *H. arctata* in 1953, he did so in part from localities such as Chippenham Fen and Woodditton Wood in Cambridgeshire, sites with which I am very familiar; however, it was a species that I had never encountered before and it seems to have completely gone from Cambridgeshire. I suspect that it may be a species that has had a negative response to Global Warming and has retreated northwards.

I would like to thank Michael Ackland for help with the identification of *Botanophila tuxeni* – **IVAN PERRY,** 27 Mill Road, Lode, Cambridge, CB25 9EN

Dipterists Digest 2020 **27,** 189-192

Ectophasia crassipennis (Fabricius) and *Phasia aurigera* (Egger) (Diptera, Tachinidae) new to the British fauna in 2019

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Summary

Two species of Phasiinae, *Ectophasia crassipennis* (Fabricius, 1794) and *Phasia aurigera* (Egger, 1860), are newly recorded in Britain. Both species are evidently recent colonisers that appear to be becoming established.

Ectophasia crassipennis (Fabricius, 1794) (Figs 1 and 2) is a parasitoid in the subfamily Phasiinae, whose primary hosts are Pentatomidae (Hemiptera). It has traditionally been recorded from “Southern Europe and warmer parts of Central Europe” (Tschorsnig and Herting 1994) but has been expanding its range, being first recorded in the Channel Isles in 1997 (Charles David *pers. comm.*). It was expected to make a fairly rapid jump across the Channel to mainland Britain but none had been seen until a post in the “UK Diptera” group on the Facebook web-site on 25.vi.2019 by Paul Taylor alerted us to a fly in East Devon that he couldn’t identify. On examination, it was clearly a female *Ectophasia* species, and the only logical deduction was that it was *E. crassipennis* but the females are very difficult to identify without a specimen. However, we didn’t have to wait long before a spate of records started to come in via social media of similar flies all along the south coast from Devon to Suffolk. These included males and for the first time I could then confirm the identification of *E. crassipennis*.

Ectophasia species are fairly distinctive because they lack the median-vein petiole that is so characteristic of *Phasia* species. In the field, male *Ectophasia* will usually appear slightly smaller than *Phasia hemiptera* (Fabricius, 1794) and more orange with a more speckled wing pattern. Females of *Ectophasia* are easy to determine in the field because they have a single dark spot in the middle of the wing and have an orange and black abdomen with a pale-dusted tip.

Phasia aurigera (Egger, 1860) (Fig. 3 and cover photograph) is another parasitoid in the subfamily Phasiinae, whose hosts are Pentatomidae and Coreidae (Hemiptera). It was noted as locally common in “warmer Central Europe” with a range of “Europe to Central France” (Tschorsnig and Herting 1994). A few years ago, I was told that it was extending its range north “by about 120km/year” and that it would undoubtedly reach Britain eventually (Theo Zeegers *pers. comm.*). In June 2019, I spotted an unusual “*Phasia hemiptera*” record in the iRecord online biological recording web-site and immediately realised that it was *P. aurigera*. This record was from Denge Wood, Kent, by Michael Baldock on 14.vi.2019 but later that year we also had further records from West Sussex and Suffolk, confirming another species that had made a significant range expansion to the British Isles.

Both sexes of *Phasia aurigera* lack the ginger hairs of the thoracic pleura present in *P. hemiptera* but in other respects they can look very similar in size and morphology. The males though have a golden dusted spot in the middle of the thoracic dorsum and so should be quite easy to distinguish in the field when fresh. Female *P. aurigera* will look very similar to females of *P. hemiptera* but again check for ginger hairs and the difference should be clear.

It is expected that both species will now become resident in Britain and spread further north in the summer of 2020 so I would urge dipterists to look out for them and to double-check any records for “*Phasia hemiptera*”.

Figs 1-2. ***Ectophasia crassipennis*** **(Fabricius): 1, male (photo Su Reed); 2, female (photo Paul Taylor).**

The following table lists all of the records received by the Tachinidae Recording Scheme for both species in 2019 and one record so far for 2020:

Name	Source	Location	Date	Recorder
Phasia aurigera (male)	iRecord	Denge Wood, Kent (TR097503)	14/6/2019	Michael Baldock
Ectophasia crassipennis (female)	Facebook	Venn Ottery, Devon	25/6/2019	Paul Taylor
Ectophasia crassipennis (male)	Email / iRecord	Ventnor, Isle of Wight, SZ576777	27/6/2019	Keith Fowler
Ectophasia crassipennis (male)	iNaturalist	Poole, Dorset	21/6/2019	Jim Gardner
Ectophasia crassipennis (male)	Facebook	East Suffolk	15/8/2019	Alan Cornish
Ectophasia crassipennis (male)	FBM	Brighton, Sussex	20/8/2019	Graeme Lyons
Ectophasia crassipennis (male)	Facebook	Torbay, Devon	24/8/2019	Tony Mathews
Ectophasia crassipennis (male)	Facebook	Dartington Hall Estate, Devon	24/8/2019	Steve Fuller
Ectophasia crassipennis (male)	Facebook	Pett, East Sussex	25/8/2019	Alan Kenworthy
Ectophasia crassipennis (male)	iNaturalist	Whitfield, Dover, Kent	31/8/2019	Shelagh Wright
Phasia aurigera (female)	iRecord	Donnington garden, West Sussex	10/9/2019	Andrew Thrasher
Phasia aurigera (male)	FBM	King's Forest, Suffolk, TL828758	10/9/2019	Tony Davis
Ectophasia crassipennis (male)	Facebook	Dunsford Meadow, SX784890	29/9/2019	Bill Deakins
Ectophasia crassipennis (male)	Facebook	Horsham, West Sussex	16/6/2020	Su Reed

Acknowledgements
I am grateful to Su Reed and Paul Taylor for the inclusion of their photographs of *E. crassipennis* and to Michael Baldock for those of *P. aurigera*.

Fig. 3. ***Phasia aurigera*** **(Egger), male (photo Michael Baldock).**

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Dipterists Digest 2020 **27,** 193-197

Cerodontha (*Xenophytomyza*) *vinokurovi* Zlobin (Diptera, Agromyzidae) new to western Europe, with first description of its male

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Summary

Cerodontha (*Xenophytomyza*) *vinokurovi* Zlobin, 1994 is reported as a species new to western Europe based upon male specimens collected in East Yorkshire, England. Details of the discovery are provided, along with morphological notes and illustrations of the previously unknown male and its genitalia. Notes on possible host plant genera and a provisional key to the British species of the subgenus *Xenophytomyza* are also included.

Introduction

In late May 2020, three male *Cerodontha* (*Xenophytomyza*) were collected from the edge of a newly created flood alleviation site in East Yorkshire (V.C. 61), England. Upon initial external examination, using the keys by Spencer (1972, 1976) and Papp and Černý (2016), the specimens run to *Cerodontha* (*Xenophytomyza*) *atronitens* (Hendel, 1920): costa ending before vein M_{1+2} and the second cross-vein absent. However, all three specimens possess obviously pale wings [similar to those of *Phytomyza albipennis* Fallén, 1823], a feature not present in *C.* (*Xenophytomyza*) *atronitens* or the other known *Xenophytomyza* [= *biseta* (Hendel, 1920) and *venturii* Nowakowski, 1967] present in Britain.

When dissected, the male is seen to possess a phallus similar to *C.* (*Xenophytomyza*) *atronitens* but the distiphallus shows a distinct ‘break’; in *C.* (*Xenophytomyza*) *atronitens*, the dark sclerotisation of the distiphallus is continuous, unbroken. Although *C.* (*Xenophytomyza*) *biseta* and *C.* (*Xenophytomyza*) *venturii* both possess a distiphallus which is ‘broken’, both species show slight but important differences from the specimens discussed here. Based on the wing colour and venation, along with the male genitalia, the collected males were considered not to be one of the three known British *Xenophytomyza* species.

Xenophytomyza is a small subgenus within the Agromyzidae, comprising only ten species. Within the Palaearctic, excluding the three species mentioned above, the following six species are known: *C.* (*X.*) *bisetosa* Zlobin, 1994; *C.* (*X.*) *lacerata* Zlobin, 1994; *C.* (*X.*) *leptophallus* Papp, 2016; *C.* (*X.*) *obliqua* Zlobin, 1994; *C.* (*X.*) *unica* Zlobin, 1994 and *C.* (*X.*) *vinokurovi* Zlobin, 1994. Elsewhere, *C.* (*X.*) *illinoensis* (Malloch, 1934) is known only from the Nearctic Region. Using Boucher (2003), Papp and Černý (2016) and Spencer and Steyskal (1986), the wing detail and male genitalia do not agree with *C.* (*X.*) *illinoensis* or *C.* (*X.*) *leptophallus*. The remaining five species are all described by Zlobin in his excellent *Xenophytomyza* review paper (1994). This paper is in Russian; upon translation, the specimens immediately run to couplet 2, then, owing to the ‘wings with milky-white shade [=Крылья с молочно-белым оттенком]’, they fit *C.* (*X.*) *vinokurovi* and not the similar *C.* (*X.*) *atronitens* [wings normal, hyaline].

Zlobin described *C.* (*Xenophytomyza*) *vinokurovi* from a single female, with the male being unknown. Detailed comparison of the three males with Zlobin’s description confirmed that the specimens are *C.* (*X.*) *vinokurovi*, representing the first known record for western Europe and the first observation of its male.

Identification
A relatively large species for the subgenus, with a wing length of 2.5mm in male, to 2.7mm in female, costa ending shortly after vein R_{4+5}, wing membrane distinctly pale, milky-white (Fig. 2). Veins M and R_{4+5} noticeably pale, whitish, vein M_{1+2} much thinner than radial veins. Second cross vein absent. Third antennal segment relatively large, with a forwardly and upwardly stretched blunt upper corner. Eye egg-shaped and slightly slanting; 2 *ors* and 2 *ori*; orbits wide with reclinate, somewhat sparse, orbital setulae, in two asymmetric rows. Ocellar triangle rather long, almost stretching to lower *ors*. Mesonotum with 3+1 *dc*; presutural *dc* only slightly longer than *acr*. A mostly dark species; ocellar triangle with very faint yellow surround, jowls brownish. Legs all black. Epandrium with well-developed caudal projection (Fig. 1, right).

Fig. 1. *Cerodontha* (*Xenophytomyza*) *vinokurovi* Zlobin: left, male in lateral view; right, caudal projection of epandrium in left lateral view.

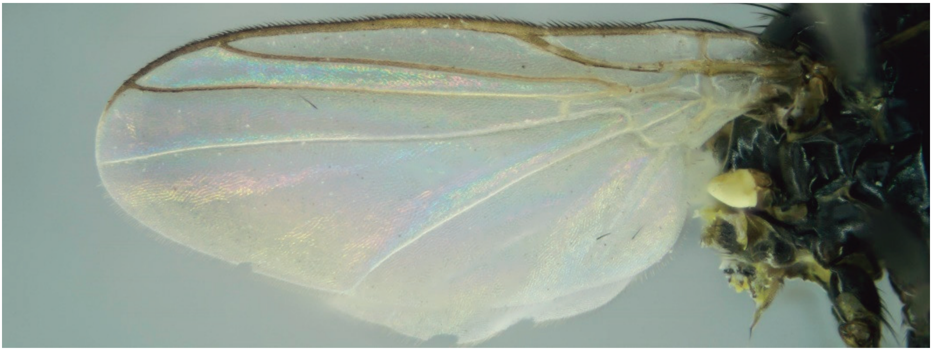

Fig. 2. *Cerodontha* (*Xenophytomyza*) *vinokurovi* Zlobin: wing detail.

Cerci rounded apically, with medium-long setae. Ventral appendage of subepandrial sclerite (Fig. 3, left) strongly curved. Phallus (Fig. 4) distinctive; distiphallus long [slightly longer than basiphallus and mesophallus combined], mostly straight with clear break in dark sclerotisation distad of centre section, tip of distiphallus slightly up-curved. Hypophallus large, relatively broad and strongly sclerotised, with little membranous matter. Ejaculatory apodeme (Fig. 3, right) with small, asymmetrical blade and rather broad but short bulb.

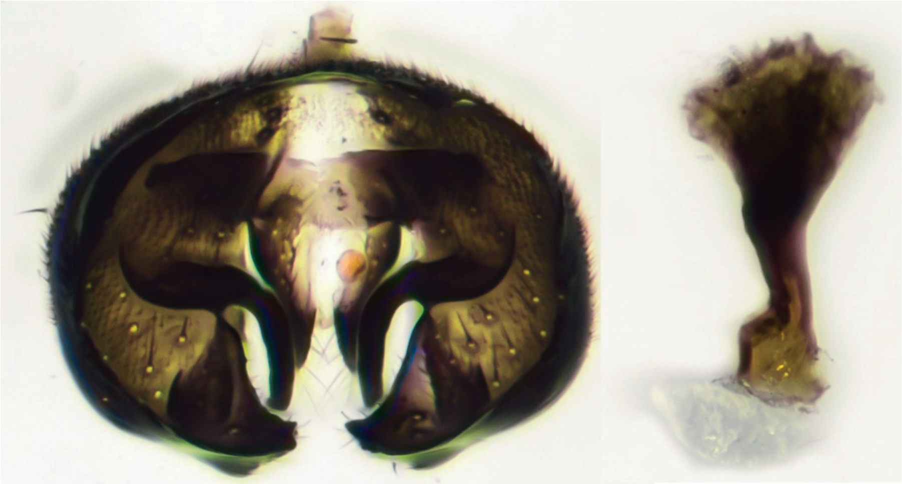

Fig. 3. ***Cerodontha*** **(*****Xenophytomyza*****)** ***vinokurovi*** **Zlobin: left, epandrium internal view; right, ejaculatory apodeme [not to scale].**

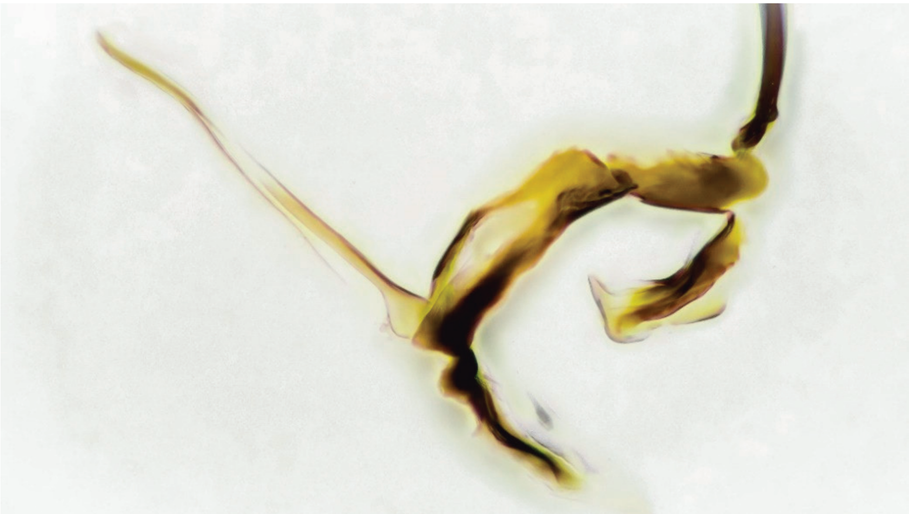

Fig. 4. ***Cerodontha*** **(*****Xenophytomyza*****)** ***vinokurovi*** **Zlobin: phallus in left lateral view.**

Biology

Lifestyle unknown; however, it is assumed that, as in its congeners, the host will be within the Poaceae. The specimens were collected from dense areas of Poaceae, which contain the following genera: *Agrostis*, *Alopecurus*, *Anisantha*, *Arrhenatherum*, *Bromus*, *Cynosurus*, *Dactylis*, *Festuca*, *Lolium*, *Phalaris*, *Phleum* and *Poa*. Although only further studies will confirm its host plant genus/genera, it should be noted that one male was collected from a large stand of reed canary-grass (*Phalaris arundinacea*).

The lifestyle of the subgenus *Xenophytomyza* was unknown until von Tschirnhaus (1991) discovered that the female [of *C.* (*X.*) *venturii*] penetrates the leaf sheath with her ovipositor and lays her eggs into a young, hidden node of the grass stem [which later produces the flowers]. At this stage, the stem is still inside the sheath but the female immediately finds the hidden node. The first larval instar feeds, very slowly, inside the node then tunnels downwards inside the flower stem [not in the hollow space but behind a thin cell layer]. Pupariation occurs above the root neck of the flower stem, which must rot to allow the adult to escape. In his study, von Tschirnhaus submerged larvae in distilled water [to replicate natural flooding] and found that they could survive many months before pupariation.

Distribution

Cerodontha (*Xenophytomyza*) *vinokurovi* was described by Zlobin (1994) from a single female collected in eastern Siberia; 'Yakutia, Suntar region, Kutana village 04 July 1987' [details also cited in Nartshuk and Bagachanova (2010)]. No further records or specimens are known. It would be reasonable to assume that this is a very rare species, rather than being overlooked; the strikingly pale wings, distinctive wing venation and male genitalia are features unlikely to be missed by other workers on the Agromyzidae.

Additional information

Upon examination of previously undetermined *Cerodontha* species in my private collection, a single male of *C.* (*X.*) *vinokurovi* was discovered; the specimen agrees exactly with Zlobin's description and the specimens discussed within this manuscript, with genitalia identical to Figs 3 and 4. This male was collected on 23 June 2017 from a lush, relatively damp, hay meadow [containing all the Poaceae genera listed in the biology section], located 2km east of the site where the other specimens were obtained.

Cerodontha (*X.*) *vinokurovi* is a relatively easy species to identify, owing to its morphological features discussed here; it is unlikely to be confused with any other known *Xenophytomyza* species.

Provisional key to the British *Xenophytomyza* species

1. Costa ending between veins R_{4+5} and M_{1+2} ………………………………………………… 2
- Costa reaching strongly to vein M_{1+2} ………………………………………………… 3
2. Wings conspicuously pale, milky-white; distiphallus with distinct 'break' …………………
   ………………………………………………… ***C.* (*X.*) *vinokurovi***
- Wings normal, hyaline; distiphallus unbroken ………………………… ***C.* (*X*). *atronitens***

3. Ultimate section of vein M_{3+4} at most 1½ times that of penultimate; distiphallus straight,
   broken………………………………………………… ***C.* (*X*). *venturii***
- Ultimate section of vein M_{3+4} more than 1½ times that of penultimate; distiphallus with
   distal tubules strongly up-curved ………………………………………… ***C.* (*X*). *biseta***

Zlobin, when describing *C.* (*X.*) *vinokurovi*, mentioned that ‘Although the male is not yet described, large angular third segment of antennae, wide orbits and parafacials, narrow genae, whitish colour on wing and some veins, large body dimensions point to a self-sufficient type’; based on the male described within this manuscript, I can confirm that *C.* (*X.*) *vinokurovi* is a distinct species.

Acknowledgements

I would like to thank Steve Charlton (East Riding Infrastructure & Facilities, UK) for granting access to the collection site, Maria Sitnikova (York, UK) for taking the time to translate key Russian literature, Joshua Styles (Manchester Metropolitan University, UK) and Jonathan Mitchley (University of Reading, UK) for identifying Poaceae species and Michael von Tschirnhaus (University of Bielefeld, Germany) for providing additional references.

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Dipterists Digest 2020 **27,** 198-200

Liriomyza taurica Zlobin (Diptera, Agromyzidae) new to Great Britain

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Summary

Liriomyza taurica Zlobin, 2003 (Diptera, Agromyzidae) is reported as a species new to Great Britain based on a single male from a Malaise trap. A description of the adult and circumstances of the discovery are given, along with European distribution details.

Introduction

A single male *Liriomyza* was given to me as part of a small batch of unidentified Agromyzidae specimens by Phil Porter in March 2019. The specimen was obtained from a Malaise trap operated in a private garden during June 2018 in Lincolnshire, TF125627. Using the key in Papp and Černý (2017), the specimen runs readily to couplet 29, with *L. flaveola* (Fallén, 1823) and *L. taurica* Zlobin, 2003 being the possibilities. Owing to the specimen having the ultimate section of vein M_{3+4} 3.3 times that of the penultimate, the specimen was considered to be *L. taurica*. The key by Zlobin (2003) was also utilised, with the specimen running to couplet 6, where again, the length of the ultimate section of vein M_{3+4} suggested *L. taurica*. The male was dissected with the genitalia conforming with *L. taurica*.

An image of the genitalia was sent to Miloš Černý, who confirmed that the specimen is *Liriomyza taurica*, which represents the first known occurrence of this species in Britain.

Identification

Liriomyza taurica is a relatively small species, with a wing length of <2mm. Frons 1.9 times width of the eye, with orbits narrowly projecting above the eye in profile. There are usually 2 equal reclinate *ors* and 2 equal, long *ori*, with the orbital setulae short, sparse and reclinate. Third antennal segment is small, rounded with a tuft of short but distinct pubescence present at the upper corner. Frons, orbits, antenna and palp bright yellow, with the hind margin of eye black, both *vt* on dark background but *vti* at margin of yellow. Mesonotum deep black, distinctly shining with obvious yellow patches at hind corners with *ipa* seta on yellow ground, with 3+1 *dc* and *acr* in 4-5 irregular rows, extending to first *dc*.

Mesopleuron black in lower front corner, extending down lower margin but not reaching upper and hind margins, with all mesopleural bristles on yellow ground. Legs mostly dark, with all knees yellow for a distance greater than the width of femora (long series in the collection of M. von Tschirnhaus: 1/4 to 1/3 length of femur). Tibiae narrowly yellowish basally, largely black, with tarsi somewhat paler, dark-brownish. Wing hyaline, veins brown, hind cross-vein oblique and sometimes absent in specimens of the von Tschirnhaus collection). Squamae yellow with margin and fringe blackish. Abdomen black with tergites broadly yellow laterally.

Male postabdomen: epandrium rounded in profile, covered with long, sparse bristles on upper half only. Surstylus not developed, cercus (Fig. 1) very large and broad. Epandrium with extremely long epandrial process on each side, which possesses a dark, narrow, rectangular-shaped, projection on its ventral margin (Fig. 1), much different to other Palaearctic species in the *flaveola*-group.

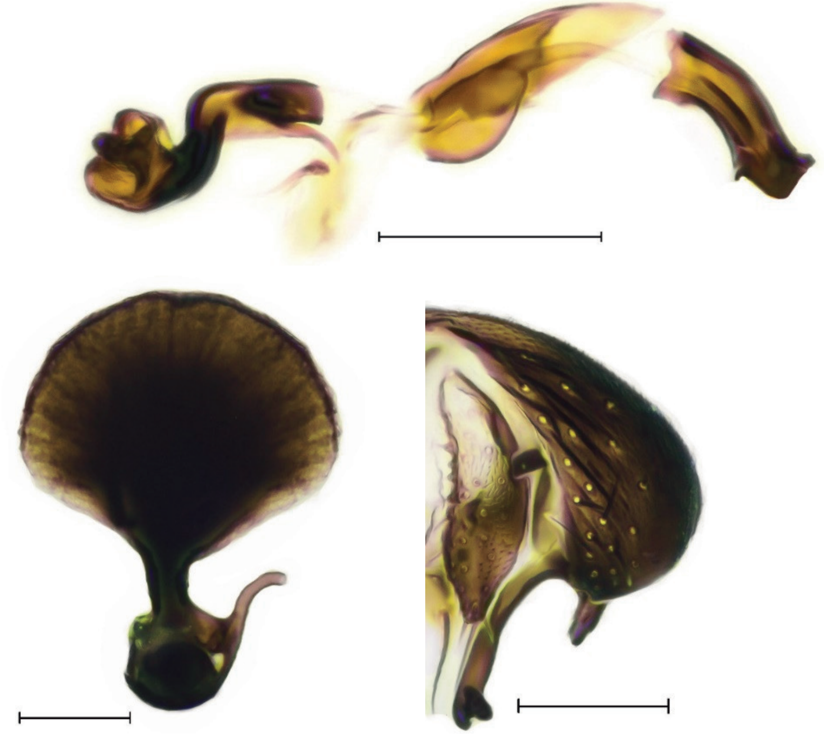

Fig. 1. ***Liriomyza taurica*** **Zlobin, male genitalia: upper, phallus in rest position; lower left, ejaculatory apodeme left lateral view; lower right, epandrium (right half), epandrial process and cercus caudal view. Scale bar: 0.01mm.**

Male genitalia: subepandrial sclerite species-specific, much higher than broad, dorsal arms narrow, parallel in their basal half, in apical half gently divergent, ventral arms very short rounded, subapically with a pair of long setae. Mesophallus curving down with bulb of sperm duct long. Hypophallus predominantly membranous.

Distiphallus (Fig. 1) with a genicular basal part and a broader apical part composed of a pair of rounded lobes and a subdivided sagittal lobe. Ejaculatory apodeme extremely large with a black melanised dorso-ventrally flattened bulb, a sclerotised first section of the ductus ejaculatorius and a large rounded black blade.

In most instances, female *Liriomyza* are extremely difficult to determine; however, *L. taurica* is the only species in the *flaveola*-group (and a rare exception in *Liriomyza* worldwide) to possess a distinctly laterally compressed oviscape, detected by von Tschirnhaus (1981) who treated this species under the nomen nudum "*L. poacearum* sp. n.". In his collection females outnumber males which could hypothesise parthenogenesis.

Biology

The biology and larva of this species is unknown, but as *L. taurica* belongs in the grass-feeding *flaveola*-group, it is reasonable to assume that Poaceae will be utilised.

Distribution

This species was described by Zlobin (2003) based upon a male caught in Karadag, Ukraine, 8.v.1992. *Liriomyza taurica* is also known from Andorra (Černý 2007), Czech Republic (Černý *et al*. 2006, Černý 2009), Germany (von Tschirnhaus 2007), Greece (Černý 2011), Hungary (Papp and Černý 2017) and Switzerland (Černý and Bächli 2018). A female in the von Tschirnhaus collection is a first record from Croatia, collected by Thomas Tischler, 29.ix.1972, along the river mouth of Cetina in Omiš, 15 km ESE Split, 43°26'23"N, 16°41'07"E.

Acknowledgements

I would like to thank Miloš Černý (Halenkovice, Czech Republic) for confirming the determination, Phil Porter for providing collecting details and allowing me to retain the specimen in my private collection and Michael von Tschirnhaus (University of Bielefeld, Germany) for supplying additional literature references.

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An unexpected record of *Lucilia cuprina* (Wiedemann) (Diptera, Calliphoridae) from Britain

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Summary

The first, and unexpected, record of *Lucilia cuprina* (Wiedemann, 1830) from Britain is reported. The morphological characters to distinguish the adults from closely related species are described. The available knowledge of the biology and habitat preferences of this species are assessed.

Introduction

Lucilia cuprina (Wiedemann, 1830), commonly known as the Australian blow fly, is a widespread species recorded from tropical and warmer temperate climates in the Afrotropical, Oriental, Australian, Neotropical and Nearctic Regions, and also from North Africa (Egypt) (James 1970, 1977; Pont 1980; Schumann 1986; Kurahashi 1989; Rognes 1994, 2002; Kurahashi and Kirk-Spriggs 2006). In the 1980s it was introduced to New Zealand and subsequently became established in that country (Heath and Bishop 2006). In 1994 it was reported for the first time in Europe, from Pina de Ebro in Spain (Rognes 1994). Subsequently, it was also reported from the Czech Republic (Fischer and Vicha 2003) and Izmail in the Odessa Region, Ukraine (Verves and Khrokalo 2010) (none of these specimens have been examined by me). The larvae feed on carrion, but they can also infest live animal tissues (including human). The infestation of sheep and cattle makes this species particularly important for economic reasons (Zumpt 1965; Stevens and Wall 1997; Heath and Bishop 2006; Ahadizadeh *et al*. 2015). *Lucilia cuprina* has been used in forensic entomology to establish the minimum post-mortem interval (PMImin) (Greenberg and Kunich 2002; Byrd and Castner 2010; Szpila 2012) and has also been used in medicine for maggot therapy (also called maggot debridement therapy - MDT) (Paul *et al*. 2009).

Lucilia cuprina has been shown to occur together with *L. sericata* (Stevens *et al*. 2002; Rognes 2004). The two species have been successfully cross-bred in laboratory conditions (Mackerass 1933; Ullyett 1945; Waterhouse and Paramonov 1950). Hybrids of *L. cuprina* and *L. sericata* have been collected from the wild, but it is unlikely they can be identified confidently using morphological characters. Williams and Villet (2014) distinguished *L. sericata* and *L. cuprina* hybrids from *Lucilia cuprina* using the number of hairs on the scutellum, postpronotal lobe (humerus) and notopleuron. Only a small number of specimens (6 hybrids, 6 *L. cuprina* and 12 *L. sericata*) and only females were used in this study. A more comprehensive study involving a larger range of specimens of both sexes from different geographical regions is needed to confirm and validate this identification method. However, both *Lucilia* species and their hybrids can be reliably identified using molecular techniques (Stevens and Wall 1997; Stevens *et al*. 2002; Tourle *et al*. 2009; DeBry *et al*. 2010; Williams and Villet 2013, 2014).

Identification

In addition to *Lucilia cuprina*, seven other species from the genus *Lucilia* Robineau-Desvoidy, 1830 occur in Britain. Only two of those species have a pale basicosta like *L. cuprina*: *L. richardsi* Collin, 1926 and *L. sericata* (Meigen, 1826). *Lucilia richardsi* can be identified by having 2–3 anterodorsal bristles on the middle tibia, whereas *L. sericata* and *L. cuprina* have a single anterodorsal bristle. The morphological characters that distinguish *L. cuprina* from the very common *L. sericata* are listed in Table 1. There is also a considerable difference in the appearance of the male genitalia (see Rognes 1994, Szpila 20012 and Sivell *in prep.* for figures). A more exhaustive list of distinguishing characters, accompanied by photographs, was given by Williams and Villet (2014).

	Lucilia cuprina	***Lucilia sericata***
Front femur	Shiny pale green	Dark blue, green, brown or black, only slightly shiny or completely matt
Upper frons – boundary between dusted and undusted areas	Sharply defined (under most angles of view)	Blurred
Number of paravertical bristles on either side of the head	1–2	2–8
Number of hairs on posterior part of postpronotal lobe (=humerus), in addition to large bristles	Bare or with 1–4 hairs	6–8 hairs
Number of hairs on posterior edge of notopleuron	2–5 hairs	8–16 hairs
Frontal vitta (anterior view)	Narrow: ♂ as wide as a single fronto-orbital plate ♀ as wide as, or slightly wider than a single fronto-orbital plate (less than twice the width of a single fronto-orbital plate)	Wide: ♂♀ twice the width of a single fronto-orbital plate
Metasternum	Bare	Hairy
Scutellum – number of hairs within rectangular surface between discal bristles and anterior edge	Less than 25	More than 35

Table 1. Characters for distinguishing between *L. cuprina* and *L. sericata*. Morphological terminology follows Kirk-Spriggs and Sinclair (2017).

The record

A single female specimen of *Lucilia cuprina* (Figs 1 and 2) was among a number of unidentified Calliphoridae from the Hunterian Museum, University of Glasgow, that were loaned to the author by Geoff Hancock. The specimen was correctly labelled as *L. cuprina* but with no indication of the determiner or the date of identification. The specimen label reads as follows: "26/7/1991: TALKIN | RESTING AROUND FARM | J. Pavely". A specimen of *Lucilia sericata*, also in the collection of the Hunterian Museum, was collected at the same location, on the same date and by the same person as the *Lucilia cuprina* specimen. Entomology students at the University of Glasgow were required to make small collections of insects, which were then deposited in the Zoology Museum (G. Hancock *pers. comm.*). Jonathan Pavely (J. Pavely) was such a student and graduated with a Masters in Applied Entomology in December 1991 (Glasgow University degrees and awards 1991). Talkin is located in Cumbria, approximately 15 km east of Carlisle.

Fig. 1. *Lucilia cuprina* from Talkin farm (female, dorsal view). Hunterian Museum, University of Glasgow (Zoology Mus Glahm Hug Z343; 162747). Photograph O. Sivell, courtesy of Angela Marmont Centre for UK Biodiversity at the Natural History Museum in London.

Discussion

The occurrence of a warmth-loving species in Talkin is puzzling. It is almost certainly an accidental introduction, although its origin remains unclear. Talkin is in a fairly remote location, approximately 65 km in a straight line from the nearest international airport (Newcastle International Airport).

Lucilia cuprina was bred at the Weybridge Veterinary Laboratory (specimens imported from Australia) and at the Durham University laboratory (stock originating from Weybridge) in the 1950s (L. Davies' specimens, currently in the author's collection). These colonies were bred to study the olfactory responses of blow flies causing sheep-strike. Some *L. sericata* and *L. cuprina* were reared on live sheep, while others were reared on fresh blood or raw liver. The procedure for sheep-bred specimens was as follows: *When the maggots had finished feeding, they were removed from the sheep and placed in peat moss. At this stage, they were sent to Durham where they were kept until the emergence of the adult insects* (Cole 1955: 76). Two *L. cuprina* cultures bred on sheep were discarded once the eggs gained from them hatched (Cole 1955). The laboratory culture of *L. cuprina* was maintained for at least two and a half years (Cragg and Cole 1956). There is no information on measures that might have been taken to prevent the escape of flies during these experiments, including those bred on living animals. Although an escape from the laboratory seems a possibility it would be temporally and geographically distant from the Talkin record.

Fig. 2. *Lucilia cuprina* from Talkin farm (female, lateral view). Hunterian Museum, University of Glasgow (Zoology Mus Glahm Hug Z343; 162747). Photograph O. Sivell, courtesy of Angela Marmont Centre for UK Biodiversity at the Natural History Museum in London.

In the late 1980s, Zakaria Erzinçlioğlu described all the larval stages of this species, using material originating from South Africa and Australia. The research was carried out at the University of Cambridge and partly at the University of Durham, where *L. cuprina* had been bred previously. Erzinçlioğlu mentioned that the specimens were preserved in alcohol or acetic alcohol, but it is not clear whether they were delivered dead (already preserved) or alive (Erzinçlioğlu 1987, 1989). In 1989, Erzinçlioğlu wrote that *sufficient material of the early instars has now become available* (Erzinçlioğlu 1989: 1133). He did not explain by which means the material was obtained – by post (dead or alive?) or bred at the laboratory from either freshly delivered specimens or from a previously established colony? No other information about possible laboratory colonies of this species has been found.

Interestingly, the records of *L. cuprina* reported by Rognes (1994) from Spain are from September 1990 and 1991 (the Talkin specimen was collected in late July 1991) and no earlier records of this species are known from that area. Rognes wrote: *Possibly, the occurrence of* L. cuprina *in Spain is due to a recent invasion* (Rognes 1994: 41). If that were the case, the occurrence of this species in Cumbria could be associated with the same wave of expansion (or be a secondary movement from Spain, if the species became established there), but due to the harsher climate *L. cuprina* may have been unable to establish itself in Britain.

No other specimens of *L. cuprina* have been collected from Britain to date. Taking into account the warmth-loving nature of this species, it is highly unlikely that it has become established in Britain, and the Talkin specimen should be treated as an accidental introduction. Nevertheless, caution should be exercised when identifying *Lucilia* species with a pale basicosta.

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The author is grateful to Geoff Hancock for providing the specimens for examination and sharing insightful information; Nigel Wyatt for confirming the identification of the specimen; Chris Raper, Florin Feneru and Christina Fisher of the Angela Marmont Centre for UK Biodiversity at the Natural History Museum in London for providing access to the photographic stacking equipment; Martin Hall and Peter Chandler for their valuable comments.

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Corrections and changes to the Diptera Checklist (44) – Editor

It is intended to publish here any corrections to the text of the latest Diptera checklist (publication date was 13 November 1998; the final 'cut-off' date for included information was 17 June 1998) and to draw attention to any subsequent changes. All readers are asked to inform me of errors or changes and I thank all those who have already brought these to my attention.

Changes are listed under families; names new to the British Isles list are in bold type. The notes below refer to loss of one species due to synonymy, and addition of 13 species, resulting in a new total of **7216** species (of which 41 are recorded only from Ireland).

An updated version of the checklist, incorporating all corrections and changes that have been reported in *Dipterists Digest*, is available for download from the Dipterists Forum website. It is intended to update this regularly following the appearance of each issue of *Dipterists Digest*.

Ceratopogonidae. A World Catalogue has been published (Borkent, A. and Dominiak, P. 2020. Catalog of the Biting Midges of the World (Diptera: Ceratopogonidae). *Zootaxa* **4787**(1)**,** 1-377, https://www.mapress.com/j/zt/) and I am grateful to Richard Lane for a summary of differences from the British checklist.

Some changes result to the subfamily and tribal classification. Justification is provided for inclusion of the subfamily Dasyheleinae in Forcipomyiinae as a tribe Dasyheleini, and the genera *Atrichopogon* and *Forcipomyia* now constitute the tribe Forcipomyiini. Within the other subfamily Ceratopogoninae, the five tribes recognised in the checklist remain as constituted except that *Neurohelea* is transferred from Ceratopogonini to Heteromyiini, and an additional tribe Johannsenomyiini is recognised for *Mallochohelea* and *Probezzia*, which are transferred from Sphaeromiini. Subgenera are not distinguished in *Atrichopogon*, *Dasyhelea* and *Bezzia*, although they are useful to retain in the European fauna (Art Borkent *pers. comm*.).

There are some changes to the composition of subgenera in *Culicoides*. The subgenus *Oecacta* is split into four subgenera, with the species distributed as follows:

GROGANOMYIA Szadziewski & Dominiak, 2019 (Haematophagous biting midges of the extant genus *Culicoides* Latreille (Diptera, Ceratopogonidae) evolved during the mid-Cretaceous. *Zootaxa* **4648**(4)**,** 535-548) (includes *C. cameroni*)

OECACTA Poey, 1853 (date corrected) (includes *C. albicans*, *C. brunnicans*, *C. clintoni*, *C. furcillatus*, *C. pictipennis*, *C. picturatus* (transferred from subgenus *Silvaticulicoides*), *C. tbilisicus*, *C. truncorum*, *C. vexans*)

SENSICULICOIDES Shevchenko, 1977 (Bloodsucking Midges. *Fauna Ukraini* **13,** 1-251 [in Russian]) (includes *C. alazanicus*, *C. cataneii*, *C. clastrieri*, *C. duddingstoni*, *C. festivipennis*, *C. griseidorsum*, *C. heliophilus*, *C. kibunensis*, *C. maritimus*, *C. poperinghensis*, *C. simulator*)

WIRTHOMYIA Vargas, 1973 (raised from synonymy with *Oecacta*) (includes *C. minutissimus*, *C. reconditus*, *C. segnis*)

Culicoides pallidicornis Kieffer, 1919 is moved from subgenus *Silvaticulicoides* to "unplaced species in the *stonei* group"

Other corrections necessary are:
PROFORCIPOMYIA Saunders, 1957 (date corrected)
SYNTHYRIDOMYIA Saunders, 1957 (date corrected)
Atrichopogon muelleri (Müller, 1905) (authorship corrected)
Bezzia ***solstitialis*** (Winnertz, 1852 – *Ceratopogon*) (= *B. circumdata*: authors, misident.) is restored as the valid name, while *B. circumdata* is returned to synonymy with *B. annulipes*
Brachypogon hyperboreus (Clastrier, 1961 – *Ceratopogon*) (parentheses added)
Culicoides saevanicus Dzhafarov, 1960 is not a synonym of *C. griseidorsum* and should be deleted from the list
Dasyhelea turficola Kieffer, 1925 (authorship corrected)
Forcipomyia pulchrithorax Edwards in Saunders, 1924 (authorship corrected)
Forcipomyia radicicola Edwards in Saunders, 1924 (authorship corrected)
Forcipomyia squamigera Kieffer in Thienemann & Kieffer, 1916 (authorship corrected)
Kolenohelea ***calcarata*** (Goetghebuer, 1920 – *Monohelea*) (= *sharpi* (Edwards, 1929 – *Stilobezzia*) (specific name restored, not a misidentification)

Chironomidae. The following species are added in the present issue:
Limnophyes ***axillapilosis*** Langton & Armitage, 2020
Limnophyes ***wickenensis*** Langton, 2020

Dolichopodidae. The following species are added in the present issue:
Chrysotus ***angulicornis*** Kowarz, 1874
Chrysotus ***tricaudatus*** Negrobov, Barkalov & Selivanova, 2014

Lonchaeidae. The following change results from I. MACGOWAN (2020. *Earomyia argenta* sp. nov. (Diptera: Lonchaeidae) from Sweden with a revised checklist and province catalogue. *Entomologisk Tidskrift* **140**(3-4)(2019)**,** 167-174):
Lonchaea affinis Malloch, 1920 = *L. laxa* Collin, 1953, new synonymy.

The following species is added in the present issue:
Lonchaea ***deutschi*** Zetterstedt, 1837

Agromyzidae. The following species are added in the present issue:
Cerodontha (*Xenophytomyza*) ***vinokurovi*** Zlobin, 1994
Hexomyza ***cecidogena*** (Hering, 1927 – *Melanagromyza*)
Liriomyza ***taurica*** Zlobin, 2003

Sphaeroceridae. The following species is added in the present issue:
Trachyopella ***kuntzei*** (Duda, 1918 – *Limosina*)

Calliphoridae. The following, probably adventive, species is added in the present issue:
Lucilia ***cuprina*** (Wiedemann, 1830 – *Musca*)

Sarcophagidae. The following species is added in the present issue:
Sarcophaga (*Heteronychia*) ***bulgarica*** (Enderlein, 1936 – *Helicobia*)

Tachinidae. The following genus and species are added in the present issue:
ECTOPHASIA Townsend, 1912
Ectophasia ***crassipennis*** (Fabricius, 1794 – *Syrphus*)

Phasia ***aurigera*** (Egger, 1860 – *Alophora*)

Some changes result from J.E. O'HARA, S.J. HENDERSON and D.M. WOOD (2020. Preliminary checklist of the Tachinidae (Diptera) of the World. Version 2.1. PDF document, 1039 pp). *http://www.nadsdiptera.org/Tach/WorldTachs/Checklist/Worldchecklist.html* (accessed 13 September 2020). Chris Raper is thanked for advising on the following changes that are relevant to the British list.

A new tribe Freraeini is recognised in DEXIINAE for FRERAEA Robineau-Desvoidy, 1830 (ex Dufouriini)

CYRTOPHLOEBA Rondani, 1856 [= CYRTOPHLEBA Rondani, 1857; emended spelling not accepted] [DEXIINAE, tribe Voriini]

RAMONDA Robineau-Desvoidy, 1863 becomes a subgenus of PERISCEPSIA Gistel, 1848 [DEXIINAE, tribe Voriini], resulting in the following new combinations: *Periscepsia latifrons* (Zetterstedt, 1844); *P. prunaria* (Rondani, 1861); *P. spathulata* (Fallén, 1820)

HUBNERIA Robineau-Desvoidy, 1847 [= HUEBNERIA Marschall, 1873; emended spelling not accepted] [EXORISTINAE, tribe Eryciini]

CHETOGENA Rondani, 1856 [= DIPLOSTICHUS Brauer & von Bergenstamm, 1889, new synonymy] [EXORISTINAE, tribe Exoristini], resulting in the following new combination: *Chetogena janitrix* (Hartig, 1838)

ALLOPHOROCERA Hendel, 1931 [= ERYCILLA Mesnil, 1957] [EXORISTINAE, tribe Gonini], this synonymy resulting in the following new combination: *Allophorocera ferruginea* (Meigen, 1824)

TIMAVIA Robineau-Desvoidy, 1863 becomes a synonym of SMIDTIA Robineau-Desvoidy, 1830 [EXORISTINAE, tribe Winthemiini], resulting in the following new combination: *Smidtia amoena* (Meigen, 1824)

A new tribe Gymnosomatini is recognised in PHASIINAE for the following genera CISTOGASTER Latreille, 1829; CLYTIOMYA Rondani, 1861; ECTOPHASIA Townsend, 1912; ELIOZETA Rondani, 1856; GYMNOSOMA Meigen, 1803 (all ex Phasiini)

PANZERIA Robineau-Desvoidy, 1830 is recognised as a valid generic name [TACHININAE, tribe Ernestiini] (although ERNESTIA has page priority and the tribal name Ernestiini is still used), with APPENDICIA, ERNESTIA, EURITHIA and FAUSTA as synonyms, resulting in the following new combinations: *Panzeria anthophila* (Robineau-Desvoidy, 1830); *P. caesia* (Fallén, 1810); *P. connivens* (Zetterstedt, 1844); *P. consobrina* (Meigen, 1824); *P. intermedia* (Zetterstedt, 1844); *P. laevigata* (Meigen, 1838); *P. nemorum* (Meigen, 1824); *P. puparum* (Fabricius, 1794); *P. rudis* (Fallén, 1810); *P. truncata* (Zetterstedt, 1838); *P. vagans* (Meigen, 1824); *P. vivida* (Zetterstedt, 1838)

Tribe Linnaemyiini is no longer recognised: CHRYSOSOMOPSIS Townsend, 1916 and LINNAEMYA Robineau-Desvoidy, 1830 are placed in Ernestiini

A new tribe POLIDEINI is recognised in TACHININAE, to include LYPHA and LYDINA (ex Linnaemyiini)

APHANTORHAPHOPSIS Townsend, 1926 and CERANTHIA Robineau-Desvoidy, 1830 become subgenera of SIPHONA Meigen, 1803 [TACHININAE, Siphonini], resulting in the following new combinations: *Siphona verralli* (Wainwright, 1928); *S. abdominalis* (Robineau-Desvoidy, 1830); *S. lichtwardtiana* (Villeneuve, 1931); *S. tenuipalpis* (Villeneuve, 1921); *S. tristella* (Herting, 1966)

A new tribe Germariini is recognised in TACHININAE for GERMARIA Robineau-Desvoidy, 1830 (ex Tachinini)

Tribe Triarthriini [TACHININAE] is renamed as Bigonichetini, which has priority: only including TRIARTHRIA Stephens, 1829

An occurrence of *Freraea gagatea* Robineau-Desvoidy (Diptera, Tachinidae) in Northamptonshire – Whilst sweeping limestone grassland at TL051978 on the Beds, Cambs & Northants Wildlife Trust reserve at Ring Haw, Northamptonshire (V.C. 32) on 1 July 2020, I encountered a strange-looking, very black fly with darkened wings (Fig. 1) that I did not recognise and could not even place in a family! On later examination, it proved to be a female of the tachinid *Freraea gagatea* Robineau-Desvoidy, 1830.

Fig. 1. *Freraea gagatea* Robineau-Desvoidy, 1830, female; scale line = 1mm.

A check of its distribution on the NBN Atlas suggested that it is a rather rare species with only 17 records listed there and is rated as "Rare (RDB3)" by JNCC (Falk, S.J. 1991. A review of the scarce and threatened flies of Great Britain - Part 1. Research & survey in nature conservation, No. 39. JNCC, Peterborough). I reported the record to the Tachinid Recording Scheme via an e-mail to Chris Raper and he pointed me to the species account on the Scheme's web site at http://tachinidae.org.uk/blog/?page_id=343&q=freraea&t=name. The information summarised there suggests that the main larval hosts are adult ground beetles (Carabidae, Coleoptera) and it is found in grassland and heathland habitats. The flight period in Britain is late June and July and there is probably a single generation per year. This would appear to be the most northerly recent record according to the NBN Atlas, although R. Belshaw (1993. Tachinid flies (Diptera: Tachinidae). *Handbooks for the Identification of British Insects*, Vol. **10,** Part 4a(i)**,** 169 pp. Royal Entomological Society, London) mentioned a Scottish record from Pitlochry (Perth) **– STUART G. BALL,** 255 Eastfield Road, Peterborough PE1 4BH; stuart.ball54@gmail.com

Dipterists Digest 2020 **27,** 211-216

The biting midge *Atrichopogon pavidus* Winnertz (Diptera, Ceratopogonidae) uses *Iris pseudacorus* flowers as a mating platform

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Summary

Atrichopogon pavidus Winnertz was found to have a 'clumped' distribution on flowers of *Iris pseudacorus* at Slapton Ley in S.W. England. It is concluded that the midges are using the flowers as mating sites in addition to feeding sites.

Introduction

The use of specific locations for mating has been recorded in many species of Diptera. These include feeding sites, such as flowers (e.g. Inoyue *et al.* 2015), dung, carrion or the hosts of blood-sucking flies and oviposition sites, such as fruits, dung or carrion. The phenomenon of swarming or similar aggregations, including leks, in Diptera is well known (e.g. Downes 1969, Yuval 2006).

Following an initial observation of midges on the flowers of the yellow flag (*Iris pseudacorus*) during a field survey at Slapton Ley in SW England, a study was made to determine whether there was any evidence of midges aggregating on these flowers and using them as a mating site.

Study site

The study was made at Slapton Ley, South Devon, UK, a National Nature Reserve around the largest freshwater lake in south-west England (grid reference SX821442; coordinates 50.2772° N, 3.6487° W). The lake is surrounded by extensive *Phragmites* reedbeds, marshes and deciduous woodlands. *Iris pseudacorus* plants were scattered throughout the vegetation along the lake margins; they were not present in large stands as is sometimes observed in other locations. Observations were made on 15 June 2019, between 14.00 and 16.00 hrs. The weather was sunny with showers and the temperature was 17°C.

Methods

Individual flowers of *Iris pseudacorus* along a 150m transect of fen, locally known as "the causeway", were examined for midges (Fig. 1). *Iris pseudacorus* were either growing individually or in groups of 2-3 plants among the *Phragmites* and *Typha* beds. All flowers were examined, whether in full sun or in the shade of shrubs such as *Salix* spp. The midges on each flower of an individual plant, were collected with a small aspirator, firstly on the three large petals and base of the flower and then by carefully lifting the recumbent lower petals (Fig. 2) and searching in the tubular nectaries at the base of the main petals (several midges were found in and around these nectaries). Only fully open flowers were examined, following the observation earlier in the day in which only opened flowers were seen with midges. Often *Bombus* spp visited the flowers, with and without midges, during examination of the flowers. Interestingly, despite their very much larger size and boisterous activity, the *Bombus* did not dislodge the *Atrichopogon* from their flowers. Midges were also sought on nearby yellow flowers, either low-growing *Ranunculus* species or hawksbeard (*Crepis* sp.) at the same height as *I. pseudacorus* to determine if the midges were specific to *Iris* at this site. The number of midges on each flower was recorded.

Fig. 1. View of transect along which *Iris pseudacorus* (Linnaeus) flowers were examined for *Atrichopogon* midges. Arrows indicate *Iris* among the vegetation.

Results

Midges were identified as *Atrichopogon pavidus* Winnertz, 1852 using an unpublished key by John Boorman. This small dark species is separated from other British *Atrichopogon* by the distinctive male genitalia. In a review of the *A. pavidus* group, Szadziewski (2001) formally synonymised *A. pollinivorus* Downes, 1955 on the grounds that when several samples from continental Europe were examined (but not Scotland, the type locality of *A. pollinivorus*), the variation was such that *A. pollinivorus* could not be unambiguously distinguished. In the original description of *A. pollinivorus,* Downes (1955a) was clear that the specimens of *A. pollinivorus* he observed in the field and described were significantly different to Winnertz's *pavidus* though he did recognise that other specialists at the time referred to his species (*A. pollinivorus*) as *A. pavidus*. He went on to demonstrate subtle morphological differences between populations of "*pollinivorus*" on honeysuckle (*Lonicera*), hawthorn (*Crataegus*) and iris and suggested that they might well be separate species. It is most likely that Downes' "iris" was *Iris pseudacorus*, which is widespread in the British Isles, rather than *I. foetidissima* which is rarely found in Scotland. Boorman (1969) recorded *A. pavidus* (as *pollinivorus*) on *Lonicera* flowers and leaves and noted they "correspond fairly closely" to the Scottish honeysuckle form in microtrichia distribution on the wings and male genitalia. Until detailed studies are made on these host-defined populations, using DNA analysis for example, the exact status of these ecological forms, including *pollinivorus* itself, remains enigmatic. Voucher specimens from the present study will be deposited in the Natural History Museum, London.

Females of *Atrichopogon pavidus* are unusual in that they feed directly on the contents of pollen, by piercing pollen grains rather than just seeking plants for nectar (Downes 1955a; as *A. pollinivorus* on honeysuckle *Lonicera periclymenum*). Boorman (1969) went on to demonstrate for the first time that eggs could develop from the female feeding on pollen grains.

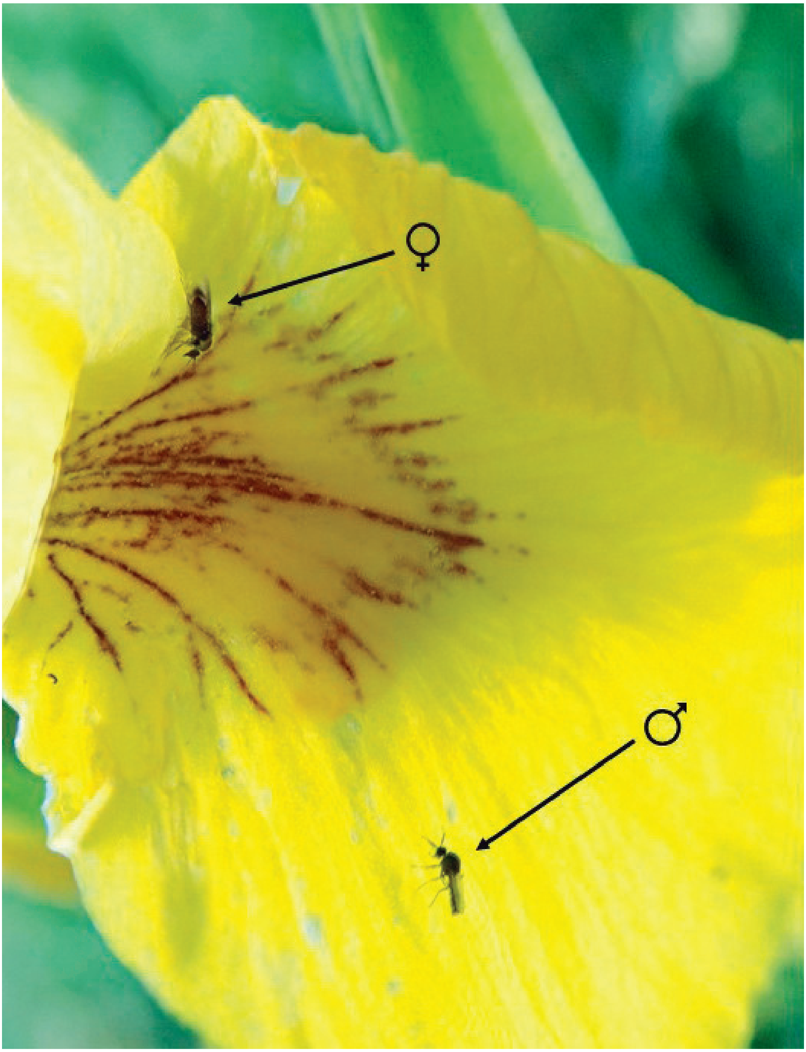

Fig. 2. Male and female *Atrichopogon pavidus* (Winnertz) on petals of *Iris pseudacorus*.

Midges were only found on *I. pseudacorus* flowers, not on any other yellow flowers in the area. Although a few midges were seen on the pedicels immediately below *Iris* flowers, they were not seen on leaves as Downes (1955a) records for *A. pavidus* on *Crataegus* (hawthorn) where the flowers are small and in close proximity to flowers or on *Lonicera* flowers and surrounding leaves (Downes 1955b, pp 225-226; Boorman 1969).

Thirty-one flowers of *I. pseudacorus* were examined. The distribution of midges between flowers is given in Fig. 3. The distribution of flies on *I. pseudacorus* flowers showed a very 'clumped' or 'over-dispersed' distribution (χ^2 = P<0.005).

There was no consistent difference in the number of midges on flowers in the sun or shade. Where flowers had only one or two flies, these were males, presumably scouting potential sites. Males and females '*in copula'* were observed on three occasions. On each occasion they were on flowers with at least six midges.

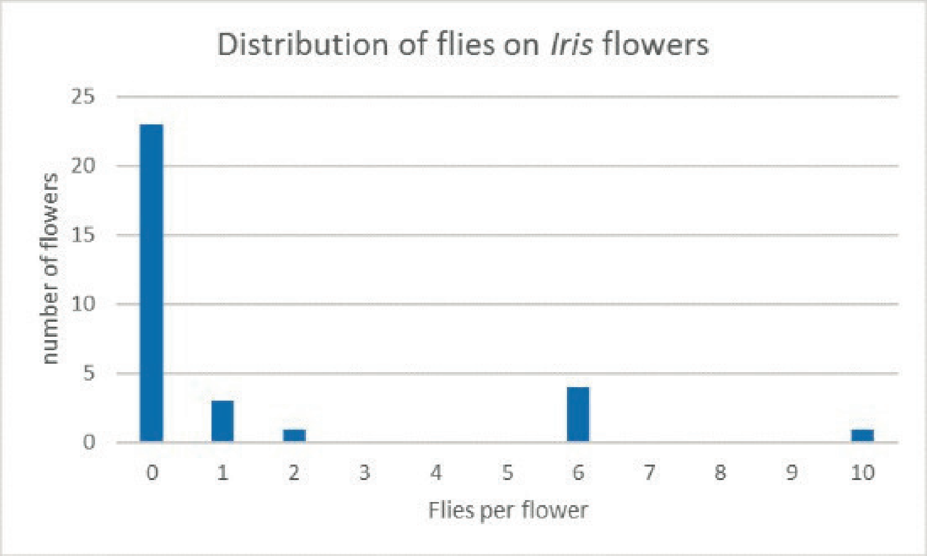

Fig. 3. Frequency distribution of *Atrichopogon pavidus* midges on open flowers of *Iris pseud*acorus along a transect in Slapton Ley national nature reserve, S.W England.

Sex ratio: Of 31 flies collected, 17 were males and 16 females.

Other observations: of particular interest is that three species of predaceous ceratopogonids were caught on *I. pseudacorus* flowers during the transect study; *Clinohelea unimaculata* (Macquart) (1♂) and two species of *Palpomyia: P. serripes* (Meigen) (1♂, 1♀) and *P. flavipes* (Meigen) (1♀). Presumably, the females were hunting midges, although predaceous midges were not actually seen capturing *Atrichopogon.*

Conclusions

The non-random distribution of flies on *I. pseudacorus* flowers showed that flies actively sought some flowers over others. What makes some flowers more attractive to midges than others is not obvious. Superficially, they appeared to be the same and, as mentioned above, *Bombus* were seen feeding on flowers with and without midges, indicating that nectar was readily available in many of the open *Iris* flowers. Furthermore, there was no appreciable difference in the number of midges on flowers in sunlight or shade. Flies were seen on and within the petals, occasionally on the stems immediately below the flowers. They were not seen on the anthers, as might be expected if they were on the flowers just to feed on pollen as observed by Downes (1955a).

Three pairs of flies were observed *in copula*, on each occasion they were on flowers with six or more flies. This strongly indicates that the flies were accumulating on the flowers to mate. *Atrichopogon pavidus* has been recorded on the flowers of many species (Boorman 1969, Downes 1955a, Downes 1955b, Krzywiński 1987, Szadziewksi 2001 who listed 9 genera) which suggests they might be important in pollination of a wide range of plants. No quantitative studies have been made previously of *A. pavidus* (other than presence) on plants.

There is very little information on mating in ceratopogonids other than swarming prior to mating, in both the vertebrate blood feeding (e.g. *Culicoides*; Yuval 2006) and insectivorous ceratopogonids (Downes 1978). Specifically, there is little evidence of non-*Culicoides* ceratopogonids mating on potential feeding sites, such as *Iris* flowers. In his comprehensive study on pollen and nectar feeding in this species, Downes (1955a) did not specifically record mating in *A. pavidus* (as *pollinivorus* Downes), although he mentioned (1955a, p. 442) that mating might take place by males and females during "chance encounters" when walking over flowers or leaves. He subsequently described (Downes 1955b) further details of how males approached and mated with females. He concluded that this species does not swarm, citing the slightly reduced antennae in males of this species and in other Diptera which do not swarm, compared to their taxonomic relatives (Downes 1969, p 289).

How midges find flowers with potential mates is an interesting question. It is possible that a volatile sex pheromone is used to assemble potential mates, as has been identified in another midge, *Culicoides nubeculosus* (Meigen) (e.g. Kremer *et al*. 1979, Mordue Luntz *et al*. 2002) and possibly in *Culicoides impunctatus* Goetghebuer (Blackwell *et al.* 1994). Alternatively, but less likely, is they key into volatiles from the plants in a similar manner that the Meloidae beetle feeding *Atrichopogon* (*Meloehelea*) might use cantharidin to both locate potential mates as well as hosts in a similar manner to that seen in the beetles themselves (see Nikbakhtzadeh *et al*. 2007).

Acknowledgements

Thanks are due to Tom Pinches, for permission to collect samples at Slapton Ley NNR, to Dr Rob Wolton for organising the visit of the Devon Fly Group to the site, and to John Boorman for use of his unpublished key. Art Borkent and Patrycja Dominiak made helpful comments on an earlier draft, for which I am most grateful.

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Rainieria calceata **(Fallén) (Diptera, Micropezidae) in Middlesex –** On 14 June 2017, I swept a distinctive-looking long-legged fly in Denham Lock Wood, a rather scrappy piece of marshy woodland just north of the busy A40 Western Avenue near Ickenham in West London. It was easily identified as the micropezid *Rainieria calceata* (Fallén, 1820). This scarce fly was first recorded in Britain from Windsor Forest in 1929, and is only known from a small area of central England, with previous records from seven hectads extending from Burnham Beeches, Buckinghamshire to Priory Park, Reigate, Surrey, with one previous record for the vice-county of Middlesex at Bushy Park in 2013 (Chandler, P.J. 2015. Diptera recording at Bushy Park, Middlesex. *Dipterists Digest* (*Second Series*) **22,** 69-110). The site at Ickenham is close to this hub of localities; it is the second record for the vice-county of Middlesex, and a north-eastern extension of the fly's known range in England.

The woodland (centred on OS grid reference TQ054863), is roughly 6 hectares, and is managed as a nature reserve by the London Wildlife Trust. It comprises wet woodland, with ditches, marshy areas and a relatively dense understorey. It is surrounded by water – a fishing lake, a backwater, and the Frays River. Although not full of ancient over-mature trees as might suit a saproxylic Windsor speciality fly, the sodden nature of the ground, and its inaccessibility has meant that it has remained virtually untouched and unmanaged for the last 100 years, and there is an abundance of mouldering stumps, trunks, branches and other fallen timber.

Other interesting damp woodland flies recorded were: *Brachyopa pilosa* Collin, *Chalcosyrphus nemorum* (Fabricius) and *Orthonevra brevicornis* (Loew) (all Syrphidae), *Trigonometopus frontalis* (Meigen) (Lauxaniidae), *Chorisops nagatomii* Rozkošný (Stratiomyidae) and *Solva marginata* (Meigen) (Xylomyidae) **– RICHARD A. JONES,** 135 Friern Road, East Dulwich, London SE22 0AZ

Dipterists Digest 2020 **27,** 217-219

Lonchaea deutschi Zetterstedt (Diptera, Lonchaeidae) new to the British Isles

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Summary

Lonchaea deutschi Zetterstedt, 1837 is added to the British list on the basis of specimens captured in Scotland. Comparisons are made between it and other British species and its geographical range is discussed. The current status of the British lonchaeid fauna is reviewed.

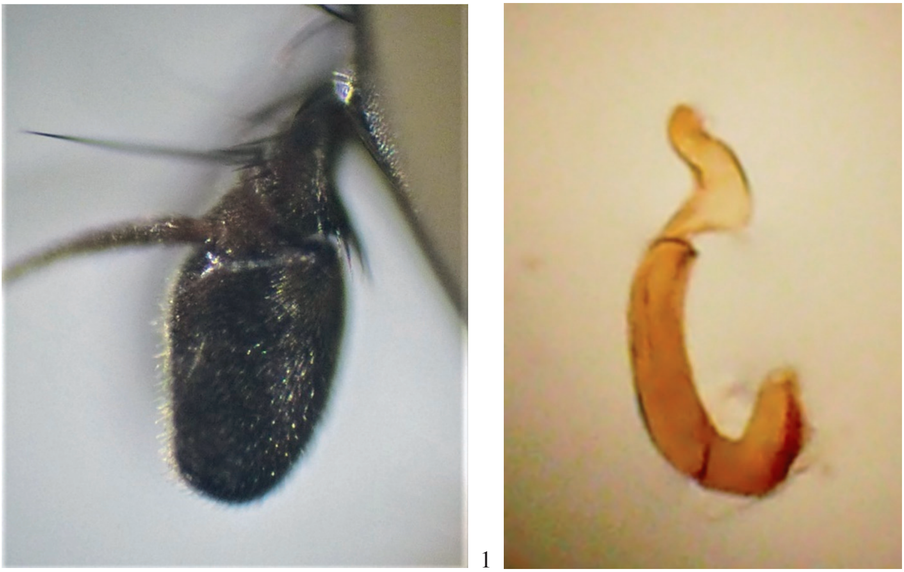
One of the most productive methods of capturing adult lonchaeids is by sweeping tree foliage in the spring months. This is most effective in ancient woodlands where there is a substantial amount of dead wood which provides a larval substrate for many species. On 15 May 2020, I visited Fungarth Wood (NO0442) near Dunkeld. Fungarth Wood on the southern margin of the Highlands is notified as an SSSI mainly due to its extensive juniper scrub but it also includes a substantial area of old birch woodland with a few scattered ash and oak. I spent a couple of hours sweeping the birch foliage with a long-handled net which allows me to reach some 4.5m into the canopy. On examining the catch later, I saw a small dark *Lonchaea* species which I did not immediately recognise. On checking the available literature, I established it was a male of *Lonchaea deutschi* Zetterstedt, 1837; this was later confirmed by examination of the terminalia. In subsequent days three females of this species were also encountered.

In the Handbook to British Lonchaeidae (MacGowan and Rotheray 2008) *L. deutschi*, with its bare eyes, single row of anterior genal setulae, entirely black legs and black fringe to the calypters, would key out to *L. sylvatica* Beling, 1873. Indeed, there are only three Palearctic species of *Lonchaea* which have this combination of features: *L. sylvatica*, *L. deutschi* and a newly recognised German species (MacGowan 2020b). The status of *L. deutschi* was reviewed by McAlpine (1958), who re-examined the Zetterstedt type specimens. He designated and fully described a lectotype, providing detailed drawings of the male terminalia and female aculeus.

Lonchaea deutschi is separated from *L. sylvatica* by the following characters. Antennal postpedicel less than 1.5x as long as deep (Fig. 1); orbital plate with one or more setulae in addition to the orbital seta (can be absent in some females). Wing: length approximately 3.4mm; light fumose especially in males, intercostal section greater than 2x length of cross vein r-m. Male terminalia: phallus bi-segmented; distiphallus sinuous but very short (Fig. 2); surstylus with inner surface densely covered with stout setae. Female aculeus: apical segment dorsally with basal and almost apical pairs of setae, the basal pair being the longest. In *L. sylvatica* there is only one pair of dorsal setae, situated almost medially. The new German species usually has two setae on the proepimeron and the bi-segmented phallus has a very broad basiphallus and a sinuous distiphallus; it is currently only known from a few specimens. There may possibly also be confusion with the bare-eyed form of *L. corusca* Czerny, 1934 but this again has multiple setae on the proepimeron.

Lonchaea deutschi may be considered to have a boreo-alpine distribution. In Europe it is known from Sweden, Finland, France and Switzerland. In Sweden, *L. deutschi* is relatively common, having been recorded from 13 Provinces from Skåne in the south to Torne Lappmark in the north, beyond the Arctic Circle (MacGowan 2020a). In France, it has been recorded from the Doubs and Jura departments near the Swiss border (Withers and MacGowan 2014). Nothing is known specifically about the larval habitat of *L. deutschi* but it is probable that in common with the great majority of Palearctic *Lonchaea* species, they are saproxylic. The habitat in which adults have been captured both in Britain and continental Europe would suggest that birch (*Betula* spp.) is a likely host tree. In light of this discovery, specimens considered to be *L. sylvatica*, particularly those taken in the spring or in northern areas of the British Isles, should be examined with care.

Records. Scotland, Perthshire, Fungarth Woods SSSI, NO0442, 15.v.2020, 1♂; 26.v.2020, 1♀; 30.v.2020, 2♀ leg. I. MacGowan. Specimens in collections of National Museums of Scotland.



Figs 1-2. *Lonchaea deutschi*: 1, antennal postpedicel; 2, phallus.

The addition of *Lonchaea deutschi* brings the number in the British lonchaeid fauna to 48 species in 5 genera: *Dasiops* Rondani, 1856, 8 species; *Protearomyia* McAlpine, 1962, 2 species; *Earomyia* Zetterstedt, 1842, 4 species; *Lonchaea* Fallén, 1820, 33 species and *Silba* Macquart, 1851, 1 species. This represents an increase of 2 species from the 46 listed by MacGowan and Rotheray (2008) and also incorporates a change in name of one of the genera.

The changes include the addition of *Protearomyia withersi* MacGowan, 2014 (MacGowan, 2015) and *Lonchaea carpathica* Kovalev, 1974 (Godfrey 2017). The change to a generic name is due to *Silba fumosa* (Egger, 1862) being recognised as the new combination for *Setisquamalonchaea fumosa* (Egger, 1862) (MacGowan and Okamoto 2013). One species has been removed from the list with the recognition of *Lonchaea laxa* Collin, 1953 as a junior synonym of *Lonchaea affinis* Malloch, 1920 (MacGowan 2020a).

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Anthalia beatricella Chandler (Diptera, Hybotidae) new to Wales and a Devon record – S. Falk and R. Crossley (2005. A review of the scarce and threatened flies of Great Britain Part 3: Empidoidea. *Species status* No.**3**. Joint Nature Conservation Committee, Peterborough) knew *Anthalia beatricella* Chandler, 1992 from just four localities in Britain, all in England, and assessed its conservation status as Near Threatened. Recent survey work by the author using flight interception trapping has produced a female at each of two new sites, one in Denbighshire, Wales, the other in Devon, both more than 100km from any of the previously known sites, considerably extending the known range.

The first specimen was taken in a trap placed on a large old oak in Chirk Castle Park, Denbighshire (V.C. 50), operated 23.v–10.vii.2018. This oak stands in an area of open parkland with thinly scattered ancient oaks and hawthorns, and the trap was placed to hang in front of a large cavity in which red-rotten heartwood was extensively developed. This is the first record from Wales (M. Howe *pers. comm.*). The second specimen was taken in a trap hung in the fork between the main trunk and a large side branch of a fallen large old maiden oak within mature oak woodland along the floodplain of the River Dart in Ausewell Wood (SX7372), Ashburton, South Devon (V.C. 3), 18.iv–2.vii.2019.

The open parkland habitat of Chirk is broadly similar to conditions at one of the previously known sites, Castle Hill Wood in North Yorkshire, which contains large old former parkland oaks and many hawthorns, albeit now partially engulfed within conifer plantations – the 'wood' name refers to the modern forestry usage rather than the historic landscape. The Devon site is also an oak site although with younger trees (150-200 years old) and growing in approaching closed canopy conditions, with an absence of hawthorn in the immediate vicinity. This 'wood' was formerly open common land on the edge of Dartmoor until planted up with oaks and beeches in the early part of the 19th century. It is assumed that these two new records suggest proximity to development habitat – decaying wood – rather than the better-known adult feeding habitat of spring-flowering shrubs. The known sites now include a broader range of 'woodland' types making the rarity of the species even more difficult to explain.

These surveys were both commissioned by the local offices of the National Trust and the flies were identified by Peter Chandler **– KEITH N.A. ALEXANDER,** 57 Treffry Road, Truro TR1 1WL

Dipterists Digest 2020 **27,** 220-222

Recent sightings of *Chrysosomopsis aurata* (Fallén) (Diptera, Tachinidae)

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Summary

Two new records of *Chrysosomopsis aurata* (Fallén, 1810), from south-east England, are reported.

During the summer of 2019, there were two new county sightings of the very rare *Chrysosomopsis aurata* (Fallén, 1810) in East and West Sussex. Very little is known about the ecology of this species but the few documented hosts suggest that it attacks the larvae of Geometridae (Lepidoptera) and prefers warm, dry habitats (Tschorsnig and Herting 1994). It looks remarkably similar to the common spring tachinid *Gymnocheta viridis* (Fallén, 1810); however, *C. aurata* occurs much later in the year and has yellow palps which easily distinguishes this species from *G. viridis* (Belshaw 1993).

The first sighting of 2019 was on 13 September by Mike Kerry when a single female was photographed nectaring on Hogweed (*Heracleum sphondylium*) (Fig. 1) in a field adjacent to Blatchington Golf course and reservoir (TQ48890219), Bishopstone, East Sussex. Images were posted on the Facebook "UK Diptera" group, where Chris Raper determined the record as *C. aurata*.

Fig.1. ***Chrysosomopsis aurata*** **feeding on hogweed flowers (photo Mike Kerry).**

The second sighting was a week later on 20 September 2019 on Chantry Hill (TQ083126), Storrington, West Sussex by RM. The site is located in the South Downs National Park and comprises chalk grassland with areas of deciduous woodland and scrub surrounding the site (Fig. 2). A single male was seen resting on grass and was taken as a voucher so that the identification could be confirmed. Another species of *Chrysosomopsis* had recently been discovered in Europe (Zeegers *et al*. 2016) and it was imperative that this was ruled out. The males can be separated by examination of the terminalia but currently the females of these species cannot be recognised. Of the limited material available to be examined *C. macrocercus* Zeegers, Ziegler & Tschorsnig, 2016 appears to be restricted to central Europe and the Altai mountains. Chris Raper and Theo Zeegers examined the specimen (see Fig. 3) and confirmed the identification as *C. aurata*. This finding, combined with the known distribution of *C. macrocercus,* suggests that we only have *C. aurata* in Great Britain.

Figs 2-3. 2, Chalk grassland at Chantry Hill, Storrington, West Sussex; 3, terminalia of *Chrysosomopsis aurata* (photos Ryan Mitchell)

Currently the Tachinidae Recording Scheme has five British records, including the two mentioned here. The first British record of *C. aurata* was in 1943 on 17 July at South Rodborough, Gloucestershire, and the voucher is deposited in the museum in Bristol (Belshaw 1993). The second record was also from Gloucestershire in 2002 by David Gibbs, taken at Scotland Bank, Woodchester Park (SO8300). These two records taken nearly 60 years apart suggested that there is a small, stable, colony to the south of Stroud. The third British record was made on 1 July 2018 by Paul Cook near Folkestone, Kent, which, when taken with the two new Sussex records, suggests a newer colony in South East England.

In 2019, two species of Phasiinae new to Britain (Raper 2020) were also discovered near the south coast. Both species have been extending their range north across Europe in recent years and so their arrival was not a great surprise. The two recent sightings of *C. aurata* were found close to the coast, though it seems unlikely that they were part of any large migration as the species is not known to migrate; it has always been a rare species with a restricted distribution throughout Europe, and there have been no reports of any significant increase in continental records. It also seems unlikely that the Gloucestershire colony has expanded its range to the south-east, so it is presumed that the colony there is a recent range expansion for this species, from a colony in France. It will be very interesting to plot the progress of this new south-eastern colony and to see whether it expands its range further north and west.

Acknowledgements
Both authors are very grateful for information on the other records of *Chrysosomopsis aurata* supplied by David Gibbs and Paul Cook. Also to Mike Kerry for supplying his photograph for inclusion here and other information on his recent record.

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Dipterists Digest 2020 **27,** 223-229

First records of *Sarcophaga* (*Heteronychia*) *bulgarica* (Enderlein) (Diptera, Sarcophagidae) from Great Britain

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Summary

Sarcophaga (*Heteronychia*) *bulgarica* (Enderlein, 1936) is recorded from Great Britain for the first time, from sites in Bedfordshire, Kent and East Sussex in SE England. The species is compared with the closely related *S.* (*H.*) *haemorrhoa* Meigen, 1826, with which it has possibly been confused in the past, and diagnostic features for their separation are provided.

Introduction

Approximately 310 species of flesh flies are so far known to occur in Europe (Pape *et al.* 2015). A relatively small proportion of these (approximately 20%) occur in the British Isles, due to the geographic position and geological history of the islands and to the predominantly thermophilous habits of these flies. A similarly low proportion of species belonging to the subgenus *Sarcophaga* (*Heteronychia* Brauer & Bergenstamm, 1889) is known to occur in Great Britain and Ireland, with Chandler (2020a) listing eight out of the 89 species currently considered as valid (Whitmore *et al.* 2013). Species of *Heteronychia* whose larval biology is known are predators of terrestrial snails (see Coupland and Barker 2004; Whitmore 2010; Fendane *et al.* 2018). This biology is recorded in the literature for five of the species occurring in the British Isles, whereas the larval feeding habits of *S.* (*H.*) *depressifrons* Zetterstedt, 1845, *S.* (*H.*) *pumila* Meigen, 1826 and *S.* (*H.*) *vicina* Macquart, 1835 are unknown or unsubstantiated (Whitmore 2010).

Here we record, for the first time, a ninth species of *Sarcophaga* (*Heteronychia*) from the British Isles, *S.* (*H.*) *bulgarica* (Enderlein, 1936), based on ten male specimens collected in Bedfordshire, Kent and East Sussex, SE England, between 2009 and 2020. We provide characters allowing to distinguish between both sexes of *S.* (*H.*) *bulgarica* and *S.* (*H.*) *haemorrhoa* Meigen, 1826, the British species morphologically most similar to it.

Methods

Specimens of *S.* (*H.*) *bulgarica* were collected by sweep net, killed in ethyl acetate fumes or in a freezer and double-mounted on plastazote stages with micropins. The images for Figs 1–2 were obtained by stacking with an Olympus TG 5 camera in Microscope Mode. The images for Fig. 3 were taken with a Zeiss Axio Zoom.V16 with AxioCam HRc attached (Natural History Museum, London) and stacked in Helicon Focus version 6.3. Figures 4–7 and 9–12 are reproduced from Richet *et al.* (2011) with permission from Pensoft Publishers and were taken by René Richet (Jaligny-sur-Besbre, France) using an HP Photosmart 912 digital camera attached to an Optica monocular microscope. Editing of final images and figure plate composition were done in Adobe Photoshop CS5. Geographic information is listed from the highest administrative level to the lowest, followed by the OS grid reference. Habitat descriptions are given in square brackets. The following abbreviations are used: CBC = Chris Bentley private collection, Rye; LCC = Laurence

Clemons private collection, Sittingbourne; NHMUK = Natural History Museum, London; SPC = Stephen Plummer private collection, Lidlington; V.C. = Vice County; WML = World Museum, Liverpool. The terminology used for external morphology follows Cumming and Wood (2017); terminology of the male terminalia follows Whitmore *et al.* (2013).

Fig. 1. *Sarcophaga* (*Heteronychia*) *bulgarica* (Enderlein, 1936), male from Marston Thrift (SPC).

Records of *S.* (*H.*) *bulgarica*

United Kingdom, England. **East Sussex, V.C. 14**: 1 male, Rye, Rye Harbour Nature Reserve, TQ94401878, 15.06.2020, C. Bentley leg. (CBC); 1 male, Rye, Rye Harbour Nature Reserve, TQ93091936, 17.08.2020, C. Bentley leg. (CBC). **East Kent, V.C. 15**: 1 male, Whitstable, Wraik Hill, TR087638, [grassland and scrub], 13.06.2009, L. Clemons leg. (LCC); 1 male, Cherry Down, Lenham, TQ923524, [chalk grassland], 12.06.2010, L. Clemons leg. (LCC); 1 male, near

Faversham, Oare Gunpowder Works Country Park, TR003624, [secondary broadleaved woodland and marsh], 10.07.2010, L. Clemons leg. (WML); 1 male, Cherry Down, Lenham, TQ923524, [chalk grassland], 03.08.2010, L. Clemons leg. (LCC); 1 male, Rushenden Marshes, Queenborough, TQ903711, [pulverised ash infill with brackish pools], 09.07.2012, L. Clemons leg. (LCC); 1 male, Oare, Brett's Gravel Workings, TR015625, [woodland adjacent to freshwater pond], 26.06.2013, L. Clemons leg. (LCC). **West Kent, V.C. 16**: 1 male, Cuxton, Ranscombe Farm, TQ704676, [field margin on chalk], 16.08.2016, L. Clemons leg. (LCC). **Bedfordshire, V.C. 30**: 1 male, Marston Thrift, SP97154141, 25.04.2020, S. Plummer leg. (NHMUK); 1 male, Honeydon Roadside Verge Nature Reserve, TL128586, 12.06.2020, S. Plummer leg. (SPC).

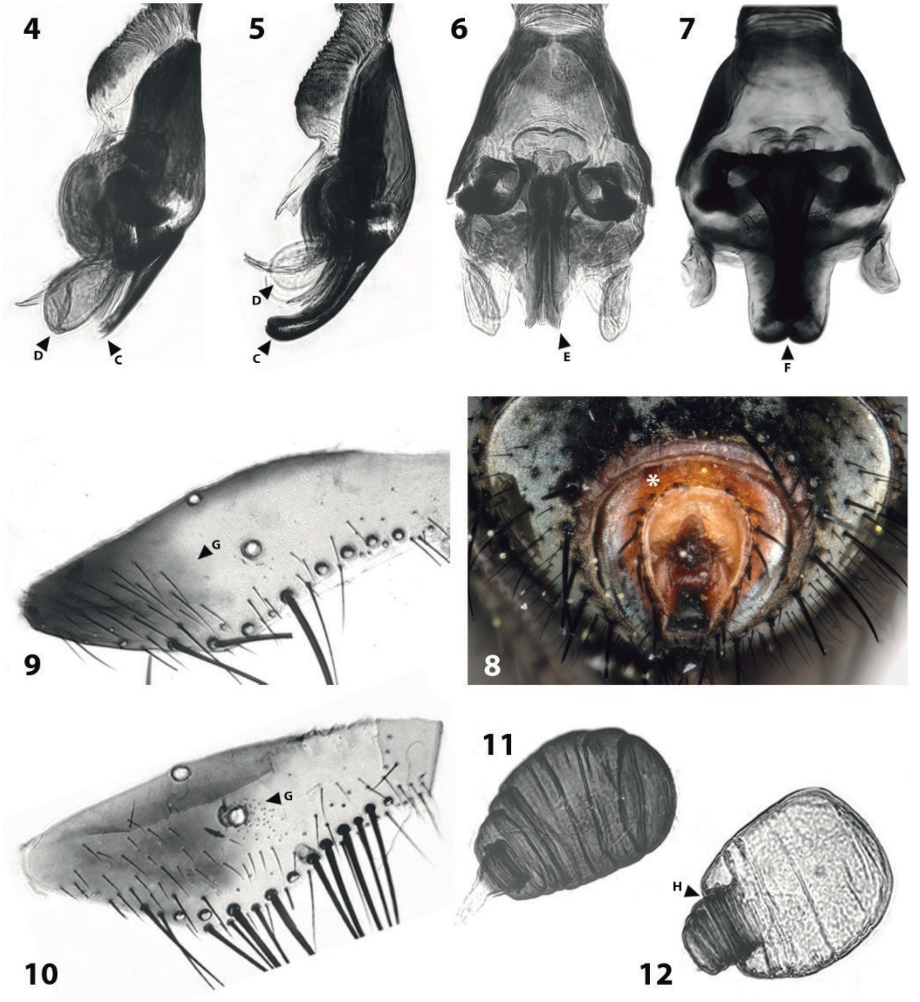
Identification

Males of *Sarcophaga* (*Heteronychia*) *bulgarica* (Figs 1, 2, 4, 6) can be distinguished from most other British and Irish *Sarcophaga* Meigen, 1826 species by the following combination of features: thorax with 3 postsutural dorsocentral setae; wing vein R_1 with numerous, closely-set setulae on dorsal surface; abdominal tergite 3 with a pair of strong median marginal setae; syntergosternite 7+8 with a large circular patch of grey pruinosity near posterior margin; epandrium red. With these features, males of *S. bulgarica* key out in couplet 54 of Whitmore *et al.* (2020a) as *S.* (*H.*) *haemorrhoa*. Specimens of *S. bulgarica* are on average slightly larger than specimens of *S. haemorrhoa* (8–12 mm vs 5–11 mm) (Whitmore 2010) and are of a lighter grey overall appearance, but the following couplet for the terminalia should be used for a certain identification:

Figs 2–3. Male terminalia: 2, *Sarcophaga* (*Heteronychia*) *bulgarica* (Enderlein, 1936) (Marston Thrift, SPC); 3, *Sarcophaga* (*Heteronychia*) *haemorrhoa* Meigen, 1826 (England, NHMUK). A = tip of cercus; B = subapical hump of cercus; C = tip of median process of juxta; D = tip of lateral process of juxta.

Tip of cercus (Fig. 2, A) gradually tapering from subapical hump of cercus (Fig. 2, B) and short; median tip of juxta (Figs 2, 4, C) short, not obviously protruding beyond spoon-like basal processes of juxta (Figs 2, 4, D); tip of juxta narrow in dorsal view, with two lateral cusps (Fig. 6, E) .... ***S. bulgarica***

\- Tip of cercus (Fig. 3, A) abruptly tapering from subapical hump of cercus (Fig. 3, B) and long; median tip of juxta (Figs 3, 5, C) long, obviously protruding beyond spoon-like basal processes of juxta (Figs 3, 5, D); tip of juxta broader in dorsal view, with a median invagination and without lateral cusps (Fig. 7, F)..................... ***S. haemorrhoa***



Figs 4–12. Male and female terminalia [modified from Richet *et al.* (2011); ©Pensoft Publishers, reproduced with permission]: 4–5, distiphallus in lateral view; 6–7, distiphallus in dorsal view; 8, last female abdominal segments in posterior view; 9–10, left half of female tergite 6; 11–12, spermathecae. 4, 6, 9, 11: *Sarcophaga* (*Heteronychia*) *bulgarica* (Enderlein, 1936) (France). 5, 7, 10, 12: *S.* (*H.*) *haemorrhoa* Meigen, 1826 (France). 8: *S.* (*H.*) *haemorrhoa* (England, NHMUK). C, E–F = tip of median process of juxta; D = tip of lateral process of juxta; G = extent of darkening on lateral portion of tergite; H = basal constriction; * = tergite 6.

Females of *S. bulgarica* would currently also key out as *S. haemorrhoa* in couplet 80 of Whitmore *et al.* (2020a). Females of these two species can be distinguished from all other British and Irish *Sarcophaga* Meigen, 1826 by having 3 postsutural dorsocentral setae, numerous closely-set setulae on the dorsal surface of wing vein R_1, having a more or less conspicuous mid femoral organ on the distal posterior surface of the mid femur and having tergite 6 undivided (without a median pleat) and of a light red/orange colour (Fig. 8). Females of *S. bulgarica* and *S. haemorrhoa* can be primarily distinguished by the extent of the lateral darkening of tergite 6 — more extensive, reaching innermost spiracle in *S. haemorrhoa* (Fig. 10); less extensive, not reaching innermost spiracle in *S. bulgarica* (Fig. 9) — and by the shape of the spermathecae — with a clear basal constriction in *S. haemorrhoa* vs. more evenly shaped in *S. bulgarica* (Figs 11–12) (see Richet *et al.* 2011). The last two characters may show intraspecific variation and their diagnostic value should be verified across a large number of specimens.

Discussion

With the discovery of *S. bulgarica*, the British and Irish sarcophagid checklist now stands at 63 published species (see Chandler 2020b). Two further species, one based on recent records and another based on a single historical record, will be added in a forthcoming paper (Whitmore and Hall, *unpublished*), bringing the total to 65. This number is comparable to other northern European faunas (e.g. Pape 1987); however, it has increased by 12% since Chandler (1998). This increase may partly be due to a renewed interest in this family in recent years, further boosted by the launch of a recording scheme (Whitmore *et al.* 2020b), although the arrival of species from continental Europe and their establishment in Britain due to favourable changes in climatic conditions is also possible, as seen with other insect families (e.g. Barclay 2004; Morris and Ball 2004; Chelmick 2012; Chmurova *et al.* 2018; Salisbury *et al.* 2018; Siljamo *et al.* 2020; Raper 2020). Some recently added species may just be very rare or localised or may have been overlooked due to close similarity with other species. One such example could be *Metopia tshernovae* Rohdendorf, 1955, recently discovered by Chandler (2020a). However, other species, such as *Macronychia striginervis* (Zetterstedt, 1838), have recently appeared in southern England and it would seem unlikely for them to have been overlooked in collections (Whitmore and Perry 2018). *Sarcophaga bulgarica* is a widespread West Palaearctic species which occurs also in Scandinavia (Pape 1987), so it may just be localised and have been previously overlooked in Britain, also due to its close resemblance to *S. haemorrhoa*, a very common and widespread species in England. On the other hand, the first British records of *S. bulgarica* presented here are all relatively recent (post 2008), and our examination of a large number of older specimens of *S. haemorrhoa* in the NHMUK and LCC collections, many of which are from SE England, didn’t reveal any misidentified *S. bulgarica*. The study of additional historical collections is needed to accurately assess whether *S. bulgarica* has recently become established or has long resided in Britain.

The biology of *Sarcophaga bulgarica* is currently unknown (see Whitmore 2010). Its larvae are likely to feed on snails like other *Heteronychia* species with a known biology, but no breeding record for this species has yet been published.

Acknowledgements

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A long-lasting swarm of *Sepsis fulgens* Meigen (Diptera, Sepsidae) – The remarkable swarming behaviour of *Sepsis fulgens* Meigen is documented thoroughly by A.C. Pont (1986. 'The mysterious swarms of sepsid flies': an enigma solved? *Journal of Natural History* **21,** 305-317) who summarised records for many swarms. Dense aggregations comprising many thousands of individuals of just this one species last from midsummer to early autumn, occupying only a small area of a few square metres of unremarkable herbaceous vegetation. A swarm may reappear in the same place in different years. Pont surmised that the function of the swarm was related to hibernation but this remains untested. The longest duration recorded was at least 90 days. I have rarely seen these swarms in the countryside but found one on a stand of *Equisetum telmateia* (great horsetail) growing on a bank by my house in East Devon (ST311060) on 18 August 2016 (Fig. 1). The swarm persisted with no apparent change in density until at least 17 October but in dwindling numbers thereafter until only a few flies were seen on 26 October, the day after the first frost (70 days after first noting the swarm), and none was found on 1 November when inclement weather set in. As noted by many recorders, the site had a strong odour that Pont described in a number of ways, mostly implying a sweet smell, but to me it was mildly unpleasant and not too dissimilar to dirty wet rags. In 2019, the swarm reappeared on 23 July and persisted with only slight diminution into October. On the day after the first heavy frost (29 October), flies were still present but I estimated only about 200 individuals, still marching about and wing-waving, as described well by Pont. Even fewer were seen on 5 November (day 105) and, although their numbers could not be described as a swarm, I could find no sepsids even a few metres away on identical vegetation. None was seen thereafter as the weather deteriorated.

Fig. 1. Part of a swarm of *Sepsis fulgens* on *Equisetum telmateia*, 18 August 2016.

A duration of 105 days appears to be a new record. In anticipation that the swarm might reappear in 2020, I kept watch and on 15 May I counted about ten flies in the area of their maximum density in previous years. A few were seen intermittently for the next four weeks. In an attempt to quantify changes in occurrence, I set out markers at 1m intervals along this 11m stretch of horsetail and counted the flies seen in 1 minute at each 1m length of vegetation, repeating this at irregular intervals between 11 July and 8 August. My expectation of another aggregation was not realised but it is interesting to note that the average number of flies was highest where the aggregation had been greatest in previous years, 2.2–6.9 flies per metre at 3m of the most 'favoured' bank, compared to 0.1–0.8 flies per metre for the remaining stretches either side of this. It strains credulity that these flies could detect the presence of the previous years' flies, after a year of Devon's heavy rainfall, and to the human eye there was not much structural difference along the stand. Rather than being a new 2020 cohort, it is more probable that these flies were long-lived remnants of the 2019 aggregation, as they became fewer and none was seen after 8 August 2020. If this is true then it supports Pont's suggestion that the swarm is related to hibernation – **C. MARTIN DRAKE**, Orchid House, Burridge, Axminster, Devon EX13 7DF; martindrake2@gmail.com

Dipterists Digest 2020 **27,** 231-236

The pNT cleptoparasite *Leucophora sericea* Robineau-Desvoidy (Diptera, Anthomyiidae) in Norfolk and an update on the aculeate hosts of British *Leucophora*

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Summary

The provisionally Near Threatened cleptoparasitic anthomyiid *Leucophora sericea* was encountered at an aggregation of the mining bee *Andrena flavipes* Panzer on the East Norfolk coast at Weybourne, V.C. 27. This is the first record of the species for Norfolk and the fifth site for East Anglia. The hosts of this fly are discussed and an updated summary of the aculeate hosts of British *Leucophora* species is presented. Three definite and nine provisional new host-parasite associations are identified.

Introduction

The satellite fly *Leucophora sericea* Robineau-Desvoidy is a seldom-recorded anthomyiid that was assigned provisionally Near Threatened (pNT) status in the most recent status review of calypterates (Falk and Pont 2015). The NBN database currently has 25 confirmed records from 19 sites of which eleven records have been added since 2000. Only five of the 19 sites are inland (three in Cambridgeshire, one in Hampshire, one in Suffolk). Thirteen sites are on or near the coasts of southern England (Devon 3 records, Dorset 3 records, Hampshire 2 records, Isle of Wight 1 record, Kent 2 records, Thames Gateway 2 records) and there is a single record from the Gower peninsula, South Wales. All records from 1987 onwards are from coastal sites. The times of year spanned by the records are 3 June – 28 August. No details of associated hosts or behaviour are given in the records.

Leucophora species of the British Isles are, characteristically, cleptoparasites of *Andrena* mining bees. In his review of the genera *Hammomyia* and *Hylephila*, both now lying under the genus *Leucophora*, Collin (1921) gave *Andrena fulva* (Müller) and *A. albicans* (= *A. haemorrhoa* (Fabricius)) as hosts of *Leucophora sericea* (*Hylephila buccata* of Collin, 1921). Both bees are univoltine with seasons March-early June (*fulva*) and March-July (*haemorrhoa*).

Occurrence

On 29.vii.2020 one of us (NWO) observed a single *Leucophora* at a nest aggregation of the mining bee *Andrena flavipes* Panzer on the beach at Weybourne, East Norfolk VC27 (TG10944367). This aggregation numbered at least 300 nests in the first brood in April 2020 and 50+ in the second brood. It is located on the landward (south) side of a man-made earth bank created in the winter of 2018/19 as a sea defence. Other *Andrena* species nesting at this site included *Andrena thoracica* (Fabricius) (80+ nests in the first brood) and *A. bicolor* Fabricius (c.30 nests in the first brood). NWO observed two spring-emerging cleptoparasitic species, *Leucophora obtusa* (Zetterstedt) and *L. personata* (Collin) shadowing and entering nests of *Andrena flavipes* at the site on several occasions in April 2020. Two other *Andrena flavipes* aggregations of 100 + nests are located within 50 metres at TG10894369 & TG10924370 (north of the new earth bank) and are the likely sources of the colonisers of the new bank.

Identification

The *Leucophora* specimen seen on 29.vii.2020, a female, was caught and retained as a voucher. At the time of capture the fly had settled on bare earth adjacent to several *A. flavipes* second brood nests. It was at first suspected that this was *Leucophora grisella* Hennig, a summer species previously observed by the authors in association with *A. argentata* Smith and *A. fuscipes* (Kirby) on Norfolk heathland in the north and west of the county (Roydon Common NNR, Kelling Heath SSSI). On closer inspection, NWO realised that the specimen was clearly different from *L. grisella*. Most apparent was the pubescent arista (plumose in *L. grisella*) with the maximum total length of hair being <0.25 the width of the post-pedicel. NWO passed the voucher specimen to MDW for identification. Using the most recent manuscript key to British Anthomyiidae (by D.M. Ackland, H. Bentley and P. Brighton, supplied at a workshop in 2017) the specimen keyed to *Leucophora sericea*. There is no true ventral seta on the mid-tibia (one ad, one pd, one p and one p/pv setae). Uniquely among British *Leucophora* species, there are numerous very long, thick setae on the hind margin of tergite 6 that extend beyond tergites 7+.

As neither of us had previous experience of this seldom-recorded species, a set of photographs taken by MDW showing the key features of the specimen was sent to Michael Ackland, who confirmed the identification as *L. sericea*. This record is the first of the species for Norfolk (V.C. 27, V.C. 28). The nearest confirmed records are from Cambridgeshire (8 records, 3 sites, 1933-1941, all by Collin) and Suffolk (1 record, 2002, by Ivan Perry).

Phenology

The discovery of *Leucophora sericea* at an *Andrena* aggregation at Weybourne provides an opportunity to investigate the phenology and host specificity of this rare fly in more detail. It remains to be confirmed whether or not *L. sericea* is exploiting the second brood of *Andrena flavipes*. If so, it is the first example of a *Leucophora* species specifically targeting the second brood of an *Andrena* species in the British Isles. The summer flying *L. grisella* seems not to target the second brood of *A. thoracica* despite parasitising two single-brooded summer nesting *Andrena* species sharing the same heathland site in Norfolk (NWO pers. obs). It might seem paradoxical for a common *Andrena* species to have a rare parasitic fly but this may be an illusion that arises from a lack of close scrutiny of nesting aggregations. A parallel case is the discovery that the pNS sarcophagid shadow fly *Miltogramma germari* Meigen is associated with the bee *Dasypoda hirtipes* Fabricius (Welch and Owens 2019); we now have evidence that this fly, previously noted only as *Miltogramma* sp, is present at many established aggregations of this widespread bee.

Andrena flavipes is a common and widespread bee of southern England and the south coast of Wales that has undergone a significant range expansion in the past 40 years, extending into Norfolk from 2002, along with its specific cleptoparasitic bee *Nomada fucata* Panzer (Owens 2017, Else and Edwards 2018). *Andrena flavipes* is bivoltine with broods in March to mid-May and mid-June to early September. The date of our *L. sericea* record places it well within the flight period of the second brood of this bee (Fig. 1). The national distributions of records of *L. sericea* and *A. flavipes* are also consistent with there being an association between them.

Collin's Cambridgeshire records of *L. sericea* (1933-1941) long precede the range expansion of *A. flavipes* in England that has occurred from the 1980s onwards. It is intriguing that Collin (1921) gives *A. fulva* as a host of *L. sericea*. This distinctive univoltine bee is an early flier (late March to mid-June) and as such would seem to be too early to be a possible host of *L. sericea*. Is it possible that this fly has been overlooked among the much more common *L. obtusa*, a known host of the bee ? Alternatively, has there been a phenological offset of the bee relative to the fly over the past 80 years ?

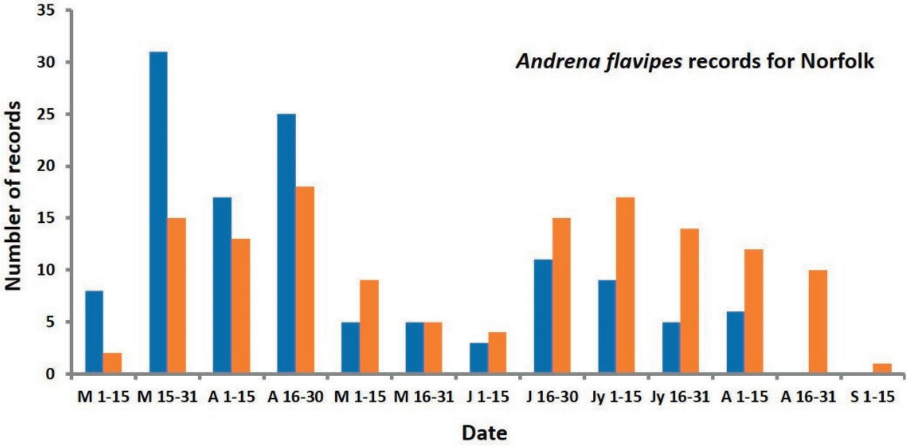

Fig. 1. ***Andrena flavipes*** **phenology in Norfolk based upon all records from the Norfolk database up to 2019: blue = males, orange = females. Note that it is common for there to be relatively fewer males in second broods of some bee species (Field 1986).**

Aculeate hosts of British *Leucophora*

We take this opportunity to include an updated summary of current knowledge of the hosts of British Isles *Leucophora* species. We have collated confirmed records of *Leucophora* species and their hosts, the published literature and from our own observations and those of dipterists and hymenopterists where the identifications have been verified, but are not yet available to the recording scheme. Phil Brighton, organiser of the Anthomyiidae recording scheme, informed us that currently there are only four records containing information about associated hosts, all from Nigel Jones who kindly sent us details. The results of our compilation are summarised in Table 1.

All four *Leucophora* species for which we have evidence of their hosts parasitise several *Andrena* species. In the case of *L. obtusa*, seven *Andrena* hosts are known or suspected. Host specificity is determined to a large extent by phenology with *L. obtusa* and *L. personata* targeting spring species and disappearing in late May, while *L. grisella* targets summer nesting species. In Norfolk, spring generation *Andrena flavipes* and *A. thoracica* are targeted by both *L. obtusa* and *L. personata*, sometimes with both *Leucophora* species present together at the same site. Their behaviour is similar but can show some differences. *Leucophora obtusa* generally waits for the host to emerge before entering (Fig. 2) while *L. personata* sometimes enters a nest while the host is still inside, though more observations are needed to establish the consistency of such patterns. The majority of British species recognised thus far as hosts of *Leucophora* nest in aggregations or share a communal nest entrance. This may simply reflect the much greater difficulty of observing *Leucophora* associated with well dispersed nests, but it is also possible that this mode of cleptoparasitic behaviour is more viable amongst aggregated nests.

We note a tantalising recent record made in May 2019 by Robert Wolton (*pers. comm.* to MDW, 28.viii.2020) who swept one male and four females of the pNT species *L. sponsa* (Meigen) near a large aggregation of *Lasioglossum punctatissimum* (Schenk) on the banks of the River Torridge in Devon. An old record cited by Collin (1921) reports *L. cinerea* Robineau-Desvoidy (possibly *L. sociata* Meigen) "ovipositing in burrows" of *Lasioglossum nitidiusculum* (Kirby) (previously *Halictus nitidiusculus*). There have been several studies reporting Nearctic and Neotropical *Leucophora* parasitising halictines, e.g. Batra (1965) and Polidori *et al*. (2015).

	grisella	*obtusa*	*personata*	*sericea*	*L. sp*
Colletes cunicularius			1 •		
Colletes halophilus	3				
Andrena argentata	2				
Andrena cineraria		3	•		
Andrena clarkella		2 •			
Andrena ferox		•			
Andrena flavipes		1 •	1	3	
Andrena fulva		•		•	
Andrena fuscipes	3				
Andrena haemorrhoa				•	
Andrena humilis					2
Andrena scotica		3			
Andrena tarsata	•				
Andrena thoracica		1	1		
Lasioglossum nitidiusculum					•
Cerceris rybyensis	3				
Cerceris arenaria	2				•
Psenulus pallipes				•	

Table 1. Recorded associations between *Leucophora* species and aculeate hosts in the British Isles. Numbers indicate levels of evidence recorded by recent observers, Ted Benton, Francis Farrow, Nigel Jones and the authors: 1 = seen shadowing, then fully entering nest burrow; 2 = seen shadowing; 3 = present at nest aggregation with or without entering nest burrow; • = published associations: Collin (1921), Huie (1916), Paxton and Pohl (1999), Falk and Lewington (2015), Else and Edwards (2018).

Collin (1921) noted that the wasp *Diodontus pallipes* (*Psenulus pallipes* (Panzer)) has been recorded as a host of *Hammomyia albescens* (*Leucophora cinerea*). In his synthesis of Nearctic Anthomyiidae, Griffiths (1993) stated that *Leucophora* parasitise sphecoid wasps of the families Astatidae and Pemphredonidae. There are indications that *L. grisella* may parasitise wasps of the genus *Cerceris* in Norfolk. On 17.vii.2020, NWO observed a *L. grisella* female on Kelling Heath closely shadowing a *Cerceris arenaria* (Linnaeus) female as she arrived in flight with weevil prey. After the wasp had landed and entered her nest, the fly remained at the perimeter of the nest entrance. At this point the fly was captured for identification. A photograph of a *L. grisella* taken at nearby Beeston Common, Norfolk, by Francis Farrow on 7.vii.2020 was described as 'hanging around *Cerceris rybyensis* nest holes and occasionally entering them'. The *Leucophora* was identified by the presence of long hairs on the arista visible in the photograph. Two *Cerceris* species are present at the *L. sericea* site, namely *C. rybyensis* (Linnaeus) and *C. quinquefasciata* (Rossi), and are possible hosts.

Fig. 2. *Leucophora obtusa* female (a) follows *Andrena thoracica* into its nest and partially enters, (b) backs out and waits just above the nest entrance on a twig for 35 minutes until the host emerges and departs, before reversing in to lay eggs, and (c) emerges from the nest 12 minutes later. Kelling Heath, Norfolk, 19.iv.2020. Photo: Nick Owens.

The possible use of wasps as hosts, as occurs in the genus *Eustalomyia* (Griffiths 1993), raises the question of the food supply of the *Leucophora* larva, which must be the animal protein stored by the wasp, such as weevils (Curculionidae), bees (Apidae) or aphids (Aphididae) in the case of the wasps listed, rather than the pollen and nectar stored by a bee.

Huie (1916) found that *L. grisella* ("*Hylemya grisea*") larvae, taken from the nests of *Andrena tarsata* Nylander ("*Andrena analis*") always fed on the pollen mass rather than on a bee larva when given the choice experimentally. A fly larva and a bee larva were never found together in the same *A. tarsata* brood cell, nor was there any sign of the remains of a partially eaten bee larva. These observations suggest that the fly larva may destroy the bee egg before eating the food store. Nevertheless, Huie described an instance of a *L. obtusa* larva 'attacking' a bee larva in an experimental box when all the pollen had been eaten. She also described and illustrated the 'well developed mouth hooks' of the *L. obtusa* larva.

Aside from Huie's studies, few if any *Leucophora* larvae seem to have been reared from the nests of British/Irish aculeates, the definitive evidence of a host-parasite relationship. Other observations can be misleading. For example, *Leucophora* females can easily be induced into orienting towards and even entering an artificial nest burrow made with a pencil amongst *Andrena* nests (NWO pers. obs.). Likewise, a *Leucophora* species seen shadowing a wasp could be a case of 'mistaken identity' with the fly responding to the yellow colour of a wasp as if it were pollen. We would welcome further records, observations or information concerning *Leucophora* hosts in the British Isles.

Acknowledgements

We thank Michael Ackland for confirming the identification of the specimen, for reading a draft of this paper and for providing much helpful information relating to this species and British *Leucophora*. Nigel Jones and Robert Wolton are thanked for providing information relating to recent British records of *Leucophora* hosts. Thanks also to Tony Irwin for assistance with identifications and to Tim Strudwick for supplying Norfolk records of *A. flavipes*

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Can the information potential of cyclorrhaphan larvae (Diptera) be unlocked?

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Summary

One of the problems identified as a barrier to studying cyclorrhaphan larvae (Diptera) is a paucity of characters due to high levels of inherent and convergent similarity. A technique for investigating this issue is reviewed. It involves combining morphological assessment with movement analysis. The results indicate that the information potential of cyclorrhaphan larvae is underestimated and that their true diversity is much higher than supposed.

Introduction

The adult is the developmental stage on which most entomological knowledge is based (van Emden 1957, Meier and Lim 2009). In terms of species and alpha taxonomy this is understandable, since taxa are defined almost exclusively on adult characters. An adult emphasis is also explained by certain difficulties of acquiring early stages, such as time-consuming field sampling and unpredictable rearing (Meier and Lim 2009), but see Rotheray (2016a). A more problematic issue raised against cyclorrhaphan larvae (Diptera) is low information potential due to inherent and convergent similarity which results in larvae that are uniform in appearance and poor in characters (Ferrar 1987). This difficulty is compounded by the lack of well-supported homologies that enable morphological components to be reliably recognised and named (Teskey 1981, Courtney *et al*. 2000). Snodgrass (1953) summarised the problem by stating that the larval head of cyclorrhaphan flies is so thoroughly modified that it is difficult to understand how it evolved from the heads of other Diptera. Teskey (1981) goes further and states that the difficulty of resolving the cyclorrhaphan larval head is because a series of connecting groups are missing.

It is unfortunate that the veracity of putative barriers such as these is little questioned because their passive acceptance undoubtedly contributes to deterring study and exacerbating neglect (Headrick and Goeden 1996, Rotheray 2016b). For instance, both Hartley (1963) and Courtney *et al*. 2000) suggest that a solution to the problem of names and homologies might be found within the lower Cyclorrhapha (= Aschiza) whose larvae were at the time poorly studied. Since then, knowledge of lower cyclorrhaphan larval stages has improved and, based on these improvements, homologies for the two most controversial and difficult cyclorrhaphan structures, the antennomaxillary organs and the mouthhook, have been found (Sinclair 1992, Rotheray and Gilbert 2008, Rotheray 2019a). The chief difficulty is apparent conflicts between morphological and developmental evidence (Courtney *et al*. 2000). Based on higher cyclorrhaphan larvae (= Schizophora), developmental studies suggest that the mouthhook is of maxillary not mandibular origin. Morphological assessment of lower cyclorrhaphans reveals that this is probably because the outgroup state of attachment between these two structures is retained. In a similar manner, the antennomaxillary organs may have been confused in developmental studies because the antenna and maxillary sense organs that are separate in outgroups and some lower Cyclorrhapha, are approximated and possibly mixed in all other cyclorrhaphans. Approximation is one of a set of distinctive cyclorrhaphan features associated with enhancements to pumping capacity, the chief means of imbibing food (Rotheray 2019a). Evidence from lower cyclorrhaphans shows that the peculiarity of the higher cyclorrhaphan larval head is more apparent than real and as found in outgroups, the same essential relationships are present between the four major components: mandible, maxilla, labium and labrum (Rotheray 2019a).

Despite lack of study, larval stages are frequently asserted to underpin Diptera biology via major roles in ecology and evolution (Hennig 1943, Rohdendorf 1974, Smith 1989, Courtney *et al*. 2000, Beutel *et al*. 2010, Wiegmann *et al*. 2011). Cyclorrhaphan ecology is, however, poorly sampled and the majority of species have not been investigated. Putative diversification mechanisms, such as the development of the cyclorrhaphan puparium, allied to morphological reduction in larvae enabling expansion of feeding niches suggested by Wiegmann *et al*. (2011), remain hypothetical. Hence, much requires to be done before the importance of the cyclorrhaphan larva can be evaluated, but a dilemma exists if studies involving morphology are difficult to impossible because of low information potential.

In this paper, I review examples of a technique that shows promise as a way out of this dilemma. The results obtained suggest that the assumption of similarity underestimates the actual diversity of the cyclorrhaphan larva. The aim here is to encourage others to try the technique and contribute to making larval assessments more complete and informative whether for taxonomic, ecological or other purposes.

Morphological methods

Traditional morphological methods are based on preserved material, dissection and microscopy, the objectives of which are description per se and recognising characters that both group and distinguish larvae across the taxonomic hierarchy. New techniques that supplement and extend traditional methods include visualisation based on 3D reconstruction, laser scanning microscopy and tomography (Meier and Lim 2009, Trautwein *et al*. 2012). These techniques hold great promise for acquiring descriptive and character data, but what all these methods do less successfully is help explain how larvae live as organisms.

There are particular reasons why knowing how cyclorrhaphan larvae live is significant for morphological analysis, i.e. how larvae feed, move, respire, etc. These life functions are carried out in diverse ways that are difficult to impossible to predict from preserved material. They involve variable sets of characters and the same characters cannot be assumed to move or function in the same way across all larvae, even congenerics or those sharing a feeding mode. Moreover, cyclorrhaphan larvae are relatively fleshy and fleshy components, either on their own or in combination with more obvious sclerotised components, are poorly observed. Movement analysis is a technique for accessing all this diversity. It is a standard investigative technique for many animal groups, but used rarely on cyclorrhaphan larvae (Roberts 1970, Green *et al*. 1983, Rotheray 2016b).

Movement analysis

Observing larval movement in real time with a binocular microscope has value, but the small size of components, their concealment and rapid motion complicates analysis (Roberts 1970, Tinkeu and Hance 1998). Videoing overcomes many of these difficulties, based on digital cameras with a macro facility or digital cameras attached to binocular microscopes (Rotheray and Lyszkowski 2015, Wilkinson and Rotheray 2017). To recognise characters and determine their movement capabilities and relationships, videos recorded at various angles relative to larvae are played back at different speeds and directions as many times as required. Freeze-framing also helps and videos provide a permanent record that is readily available for checking and reanalysis. When morphological and movement analyses inform each other a particularly viable method is created, and more so when the results are matched to variables at development sites, i.e. the places where larvae feed and grow (Rotheray 2019a).

Examples of movement analysis

1. Feeding modes

The idea that feeding modes in cyclorrhaphan larvae, saprophagy, phytophagy, zoophagy etc., are so different that each should be characterised by morphological indicators has existed for more than 100 years and, despite many proposals, no reliable indicators have been found (Ferrar 1987, Rotheray 2016b). Except for some lower cyclorrhaphans, the mandibles project from fleshy sheathes that comprise the side margins of an upside down, cup-shaped oral cavity on the underside of the head (Figs 5 and 6). Cyclorrhaphan larvae feed typically by extending the head skeleton towards food and from their sheathes, lowering a pair of mandibles on or into it. On the return stroke of the head skeleton a portion of food is pulled into the oral cavity from where it is sucked up by the pump in the head skeleton. Videoing these movements has revealed contrasts between the typical food-gathering mechanisms of the three feeding modes noted above. Saprophages feed mostly on viscous food and feeding lunges comprise head skeletons moving forwards and backwards. Their mandibles have relatively long hooks often with flattened posterior margins and they diverge on being lowered. Divergence opens the front of the oral cavity and flattening optimises the amount of food gathered. Phytophages, in contrast, feed on compact, harder food that is fragmented. This is achieved by pivoting head skeletons that draw robust, block-shaped mandibles across short lengths of food surface, often repeatedly. Fragmentation is facilitated by mandibles held in a parallel and partially lowered state or, they are fixed in position and unable to move independently. To withstand the greater physical forces involved the head skeleton is heavily sclerotised and buttressed, and the mandibles have short, broad hooks and often, accessory hooks which increase the number of cutting points. Amounts of food gathered per feeding lunge are relatively low compared to saprophages and oral cavities are smaller, but lunge rates are higher. The fundamental quality of cyclorrhaphan larval predators and some ectoparasitoids is holding and tightening the body wall of prey or hosts enough for it to be pierced usually by sharp-tipped mandible hooks, but the structures and movements involved are diverse and taxon-specific which complicates recognition of indicator morphology (Rotheray 2019a).

Although the contrasting morphologies and movements between these feeding modes appear distinctive, they are not reliable as indicators. This is because not all saprophages feed on viscous food and those feeding on firm food have some characters typical of phytophages. Also, not all phytophages feed on firm tissue and those less specialised, or feeding on softer tissue, have some saprophagous characters. There are also mixed feeding mode larvae that feed on both live and decaying plant tissue and possess features of both modes. Furthermore, saprophagous and phytophagous features can be present in zoophages depending on how easy or difficult prey or host tissues are to tear. Intermediates and exceptions such as these suggest that the biomechanical challenges of food gathering are a greater influence on trophic morphology and movement than feeding mode and the search for morphological indicators is probably fruitless. Movement analysis suggests a modified set of enquiries based on searching for correlates between morphology and movement, and particular positions along continua of food viscosity and hardness.

2. Feeding mechanisms

Movement analysis shows that food gathering is more than a function of the mandibles and the head skeleton. It involves the whole body divided into sections or modules, each with distinctive functions and not corresponding to head, thorax and abdomen (Green *et al*. 1983, Rotheray and Lyszkowski 2015). The rear module (anus up to the rear of the metathorax) grips the substrate, enabling the manoeuvrable middle one (front of the metathorax to the anterior spiracles) to reach food and the front module (front of the anterior spiracles to the mandibles) to gather it.

Movement analysis also reveals that feeding mechanisms are far from uniform, i.e. the morphology and movement involved in transferring food from an external source into the gut, and specialisations may be present. For instance, soft, saturated, white wood in fallen trees and branches is the habitat of saprophagous Clusiidae and certain Milichiidae. Morphological analysis shows that the front module of clusiids is retracted and movement analysis shows that it and the head skeleton are fixed in position, and are unusual in not extending during feeding. Instead, the apex is turned down against saturated wood and the pump spot-sucks microbial suspensions. The larva of *Neophyllomyza acyglossa* (Villeneuve, 1920) (Milichiidae) has an opposing set of features and the front module is long, thin and has relatively small mandibles. Movement analysis indicates that the larva sucks up microbial suspensions from cracks and crevices by bending the front module into them, facilitated by a uniquely flexible intermediate sclerite or middle sclerite of the head skeleton (Fig. 1). In leaf litter, microbial suspensions coat leaves and contrasting feeding mechanisms occur here. The front module of *Lonchoptera* Meigen larvae (Lonchopteridae) is an open trough and movement analysis shows that larvae lift suspensions on to it, using a forward scooping action. In contrast, *Meiosimyza* Hendel larvae (Lauxaniidae) have rows of spatulate setae traversing the front margin of the oral cavity and movement analysis shows larvae using them to brush suspensions into it (Fig. 2) (Semelbauer and Kozánek 2012, Rotheray and Lyszkowski 2015).

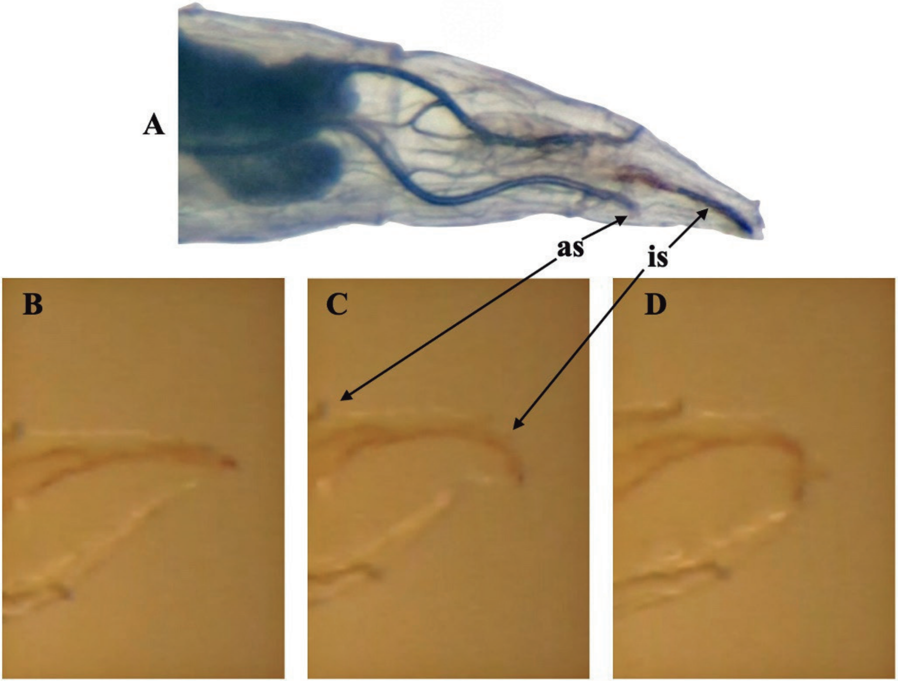

Fig. 1. *Neophyllomyza acyglossa* (Villeneuve) (Milichiidae), third stage larva: A, preserved larva, lateral view head end, length about 1.5mm; B-D, stills taken from a film of head movement, three stages in the inclination of the flexible intermediate sclerite; as = anterior spiracle; is = intermediate sclerite; film available from Rotheray and Lyszkowski (2015).

Among some larvae sharing feeding modes and styles, phytophagy and leaf-mining for instance, rather than disparate feeding mechanisms, morphological and movement analyses reveal degrees of specialisation, i.e. the extent morphology and movement is involved in feeding. Although not exclusive to this foodplant, on *Silene dioica* (Caryophyllaceae) the following leaf-mining species can be found in order of apparent specialisation: *Amauromyza flavifrons* (Meigen, 1830) (Agromyzidae); *Pegomya flavifrons* (Walker, 1849) (Anthomyiidae) and *Scaptomyza graminum* (Fallén, 1823) (Drosophilidae) (Rotheray 2019b). These leaf-miners are typical phytophages in fragmenting leaf tissue with a pivoting head skeleton and mandibles with accessory hooks, but they differ in a range of other features. Alone of the three, *A. flavifrons* has mandibles fixed in an upright position, which means the hooks point forward. Movement analysis shows that the mandibles do not lower independently and, with the rear module anchored in position by extensive coatings of micro-hooks or spicules, the mandibles and front and middle modules move as a co-ordinated unit during feeding, bending up and down and extending the head skeleton as required. These features enable a level of movement efficiency not achieved in the other two species. This is because they eliminate the need to hold the mandibles in position during feeding and enable feeding with fewer changes of position and hence, less expenditure of energy. Moreover, without the need for mandibular muscles and buttressing in the head skeleton to support them, the basal sclerite (the posterior sclerite of the head skeleton) is reduced, which cuts development costs.

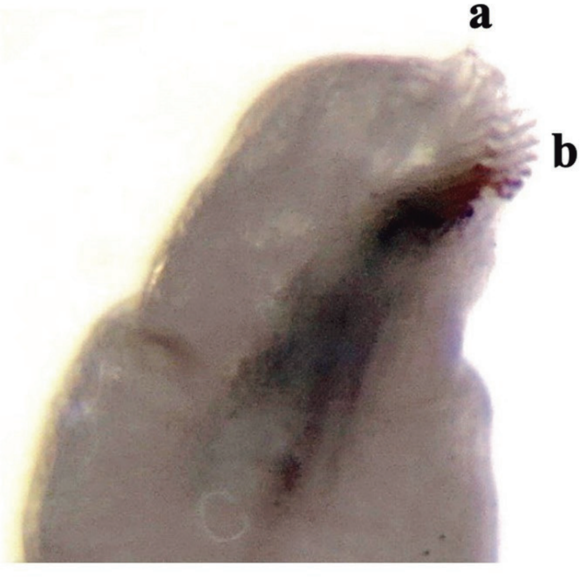

Fig. 2. *Meiosimyza* sp. (Lauxaniidae), third stage, preserved larva, head end; height about 1.5mm; a = antennomaxillary organ; b = setal brush on the dorsal lip; film available from Rotheray and Lyszkowski (2015).

The hooks of each mandible are interspersed in *A. flavifrons*, so reducing their width and facilitating fragmentation of thinly layered food. This larva also has fleshy prothoracic lobes above and below the head to contain food and to prevent the build-up of pressure during sucking, a sclerotised groove is present between the antennomaxillary organs along which air or fluids can pass. *Pegomya flavifrons* has some of these features, for instance, it has interspersed mandible hooks, and instead of a groove it has a line of pressure-relieving studs along the front margin of the head and a food bar, but only on the ventral side of the prothorax. *Scaptomyza graminum* has no apparent pressure relievers, food bars or interspersed mandible hooks and movement analysis shows that feeding rates in this larva are the slowest of the three, due in part to the mandible hooks catching on leaf tissue. The characteristics of *A. flavifrons* and *P. flavifrons* are not confined to the two species, but are features of the taxa to which they belong, albeit with variations. It is unclear if other leaf-mining *Scaptomyza* Hardy (Drosophilidae) are similar to *S. graminum*.

3. Locomotion

Absence of legs and peristaltic locomotion are groundplan features of Diptera larvae that are efficient in the dense media and confined spaces typifying development sites (Schneeberg and Beutel 2014). These states are retained in cyclorrhaphan larvae, but movement analysis shows that they possess enhanced locomotor capacity facilitated by sub-divisions in body segments that are revealed in lower cyclorrhaphans by lines impressed on the body wall, less so in higher cyclorrhaphans whose body walls are especially supple. Impressed lines and suppleness extend movement ranges by enabling the body wall to fold or crease (Rotheray 2019a).

Cyclorrhaphan larvae move backwards as well as forwards and a few can move sideways. Others move upside down or on their lateral margins and some burrow through loose material, make holes through hard material, jump, float, swim, dive, turn on a spot and a few are prehensile, i.e. their front and rear ends can curl round and grip substrates. They can travel distances of ten or more metres (Greenberg 1990), and modify their speed while others, such as parasitic and gall-forming larvae, hardly move at all. Movement analysis shows that the terms most often used to describe cyclorrhaphan larval movement, ‘creeping’ or ‘crawling’, vastly misrepresent and underestimate the elegance and sophistication of this life function which is a source of considerable amounts of information about how larvae live.

An early debate was whether the mandibles are used in locomotion and the answer from movement analysis is that they may be used, depending on taxon and circumstance (Rotheray 2016b). When they are used, they can provide a means of enabling tension energy to build up, since in gripping a substrate they hold-up a peristaltic wave, such that when the mandibles release the head springs further forward than would otherwise be the case. Apart from mandibles, attachment structures which are critical for effective locomotion include spicules, tubercles, friction mats, prolegs, suckers and head pumps, but the typical structure is an anchor pad. Anchor pads are paired, fleshy, spiculate protuberances on the underside of the metathorax and abdominal segments. They straddle adjoining segments with a greater proportion on the posterior side. Movement analysis shows that straddling segments facilitates detachment since in peristaltic waves segments fold upwards. After the wave passes, the fold opens and lowers and the anchor pad reattaches. The greater proportion on the posterior side is explained by an emphasis for forward locomotion since, in going forwards, the posterior section lowers first. Anchor pads are usually slight and proportionally small relative to the area of the underside, probably because larger sizes would complicate detachment.

Movement analysis reveals a great variety of locomotor mechanisms and some generalities. One of these exists between larvae that move through loose material versus those that move through compact or hard material. To prevent slipping during excavation of compact material a greater grasp of the substrate is required and, intuitively, anchor pads and their spicules should be more developed, but the opposite is the case. For example, the larvae of *Palloptera usta* (Meigen, 1826) (Pallopteridae) and *Suillia ustulata* (Meigen, 1830) (Heleomyzidae) move through loose material: oily decay under tree bark and spongy tissue in stems of *Sambucus nigra* (Adoxaceae) respectively. In contrast, developing in compact material, mature Asteraceae flowerheads and stem tissue in *Luzula pilosa* (Juncaceae) are, respectively, the congenerics, *Palloptera modesta* (Meigen, 1830) and *Suillia laevifrons* (Loew, 1852). Compared to the former the latter two species have, against expectation, anchor pads with relatively few or poorly sclerotised spicules (Rotheray 2016b). The explanation for these states is revealed by movement analysis, which shows that in compact material larvae enhance attachment by holding up peristaltic waves when they reach the middle module. Swollen with body fluids the middle module presses against the surrounding substrate, which enables the larva to hold itself in position and excavate. In loose media, where less opportunity exists to hold on with the body, well-developed anchor pads and spicules are more important.

Using the body to hold on is particularly well developed in tunnelling larvae, i.e. those that make permanent holes in hard material. Tunnels are usually smooth and evenly rounded, which is achieved by larvae twisting sideways and turning upside down to excavate. To protect the body and grip the tunnel, taxon-specific arrangements of spicules and sclerotised plates are often present (Rotheray 2016b). Such armature is not confined to tunnelling larvae. A remarkable locomotor mechanism through loose material, such as occurs in tree holes, margins of water bodies, etc, is found in eristaline larvae (Syrphidae). These larvae are distinguished by their heavily armoured front modules and possession of mesothoracic anchor pads or prolegs, the latter differing from the former in having muscles for extension and retraction. Movement analysis shows that, in peristaltic waves, these larvae pivot the thorax over the fulcrum of the mesothoracic attachment organs, which provides the purchase required to penetrate the medium, while the armature of hooks and spicules prevent cuts and abrasions and, catching on large particles, shift them aside (Rotheray 2019a).

Fig. 3. *Scaeva pyrastri* (Linnaeus) (Syrphidae), third stage live larva, still from a film by Geoff Wilkinson, head to the right, length about 11mm; holding on to plant stems with the anal and head ends.

Possibly due to the problems of attachment and vulnerability to desiccation, very few cyclorrhaphan larvae live externally on plants. Exceptions are found in the Chamaemyiidae and the Syrphinae (Syrphidae), predators of colonial insects on plants, such as aphids (Aphididae). Movement analysis reveals that chamaemyiid and syrphine larvae possess remarkable and exceptional levels of attachment and mobility. Chamaemyiids use sticky faeces, saliva and suction from the head pump to attach themselves to plants. Syrphines use grasping structures, head pumps and sticky saliva. Larvae within both taxa are able to move across plants by lifting the entire body with just the anal end attached and reaching out to grip a substrate with the head. With the head attached, they let go at the anal end and curl it forward to meet the head and re-attach it, and then lift the head and extend it again to repeat the sequence (Fig. 3). This style of movement is reminiscent of locomotion better known in caterpillars (Lepidoptera), notably within the family Geometridae. In chamaemyiids and syrphines such movement defines their prehensile quality (Rotheray 2019a).

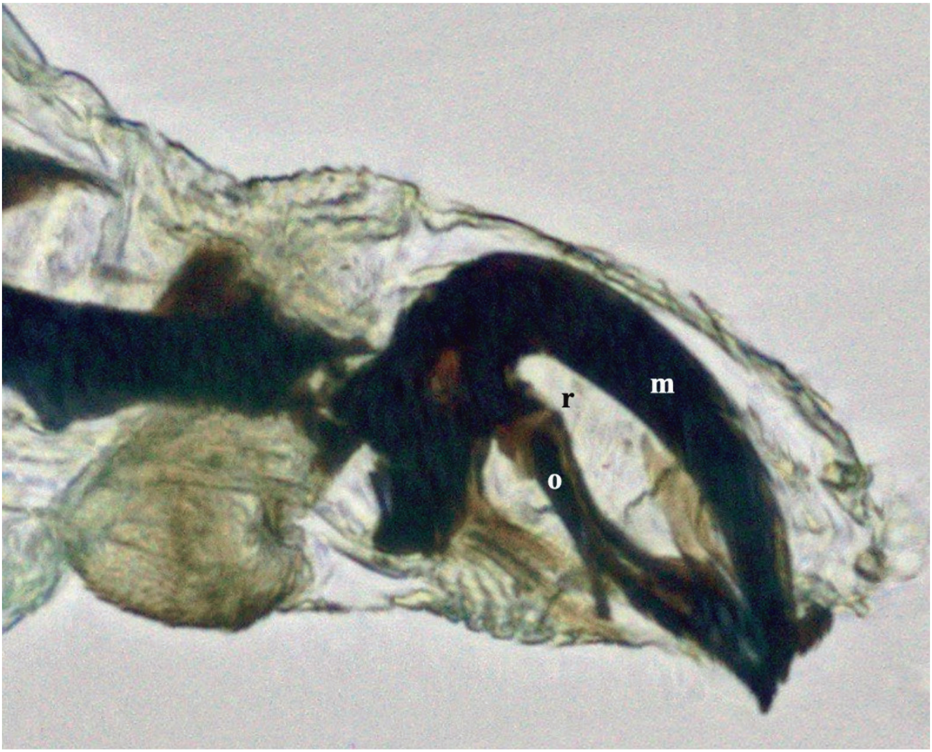

Fig. 4. *Phaonia subventa* (Harris) (Muscidae), third stage, preserved larva, lateral view of head; length of the mandible about 0.15mm; m = mandible; o = oral bars; r = ring of elastic sclerotisation; films available from Rotheray and Wilkinson (2015).

4. Character roles

An example of movement analysis resolving character roles and opening new lines of enquiry is the feeding mechanism of predatory *Phaonia* Robineau-Desvoidy larvae (Muscidae). The issue is the significance of a complex set of four or more pairs of accessory mandibular sclerites, i.e. sclerites close to or attached to the mandibles (Fig. 4). These sclerites have been discussed for over 100 years, but their role has remained elusive (Skidmore 1985). Roberts (1970) thought they helped grip prey integument, Skidmore (1973) that they enlarged wounds. Using movement analysis and larvae of *Phaonia goberti* (Mik, 1881) and *Phaonia subventa* (Harris, 1780), Rotheray and Wilkinson (2015) found that these sclerites constitute a remarkable mechanism for piercing prey. The largest pair of accessory sclerites, the oral bars, are attached to the mandibles and extend forward to just in front of them. At their base is a ring of weaker and hence, more elastic sclerotisation, and apically the oral bars have castellations. During piercing, the castellations entangle with prey integument and, as the mandibles depress, the oral bars bend at the ring which enables the mandibles to disengage and pass between them. The tips of the mandibles press against the prey and, between them and the oral bars, it tightens until the mandibles pierce it and as they do so, elasticity at the ring returns the oral bars to pre-piercing positions and the head is inside the prey ready to begin feeding. Other accessory sclerites help protect the oral cavity from abrasion and keep it open during feeding (Rotheray and Wilkinson 2015).

Comparing movement analyses of these two *Phaonia* species with other predatory larvae helps build generalisations about predation, and provides a data standard for future comparisons (Rotheray and Wilkinson 2015). Shared features include: extreme front of body flexibility which facilitates prey capture and handling; extreme head end tapering which facilitates entering prey bodies; mechanisms for holding prey prior to piercing; mechanisms preventing leakage of prey fluids during feeding and, use of paralysants for prey that characteristically respond to attacks with physical defence. Furthermore, movement analysis suggests that small differences between the size and shapes of the sclerites in the trophic apparatus of the two *Phaonia* species correlate to differences in prey ranges and habitat preferences (Rotheray and Wilkinson 2015). Continuous differences such as these are easily by-passed in taxonomic assessment and descriptive morphology. Movement analysis suggests that they can be significant and deserve better recognition and study.

5. New and poorly referenced characters

It is not unusual to encounter new or poorly referenced morphology in movement analysis. For example, in larvae that fragment food, such as the saproxylic larva of *Stegana coleoptrata* (Scopoli, 1763) (Drosophilidae), movement analysis reveals that just behind the oral cavity is a partially sclerotised, lozenge-shaped plate that moves in time with the mandibles (Rotheray and Lyszkowski 2015). Morphological analysis shows that this 'oral plate' is widespread among larvae fragmenting food, attaches to the rear margin of the oral cavity and at the other end, has muscles inserted on it (Fig. 5). During feeding these muscles protect the fleshy oral cavity by retracting it out of the way. At the end of a feeding lunge, fragments of food catch in the oral cavity when it recovers shape due to relaxation of these muscles and natural elasticity. In predatory larvae and those feeding on viscous food, oral plates have not been found and during lunging the rear end of the cavity is supported, not retracted, by a pair of dental sclerites that are embedded in it. Dental sclerites are absent or vestigial in larvae that fragment food (Rotheray 2019a). The oral plate may have originated in the relatively basal Platypezidae, as a development of the labium which in platypezid larvae forms an external rasping structure. It is similar to another feature, the ventral pharyngeal ridges that originate apparently in the basal Lonchopteridae, in that both features appear and disappear throughout the Cyclorrhapha.

The front margin of the oral cavity is a little-referenced component of trophic morphology. In the Syrphidae, Hartley (1961) referred to this region of the head which lies between the mandible hooks and the antennomaxillary organs as the 'dorsal lip'. As noted above, *Meiosimyza* larvae possess rows of setae across the dorsal lip. In Agromyzidae, Dempewolf (2001) referred to a sclerotised groove in this position. Within the dorsal lip of certain Calliphoridae, Erzinçlioğlu (1985) mentioned a spoon-shaped, oral sclerite on to which Roberts (1970) showed muscles insert. In non-frugivorous Tephritidae, Headrick and Goeden (1996) referred to a 'median oral lobe' that has muscles and projects between the mandible hooks.

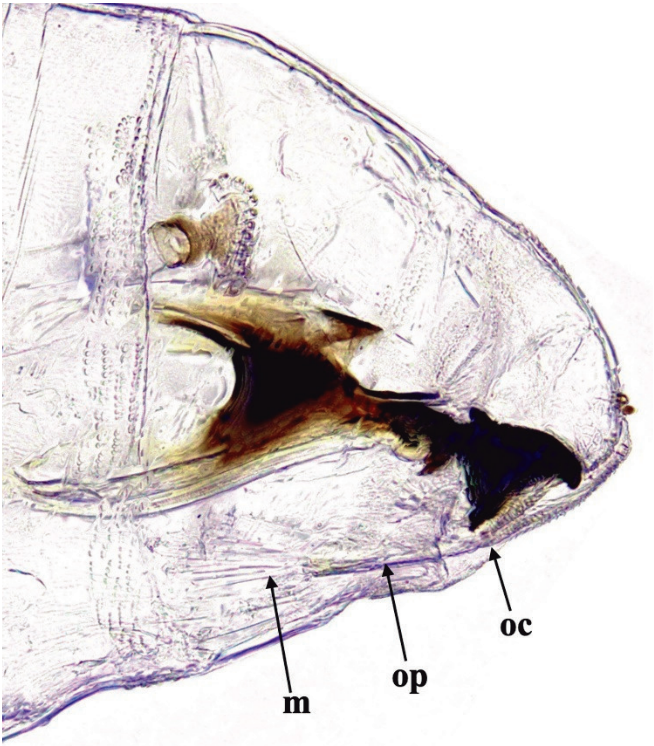

Fig. 5. ***Palloptera scutellata*** **(Macquart) (Pallopteridae), third stage preserved larva, lateral view of head; length about 1mm; oc = rear margin of the oral cavity; op = oral plate; m = muscle fibres; further data in Rotheray and Hewitt (2015).**

As noted above, the dorsal lip in *Meiosimyza* brushes food and in Agromyzidae it maintains sucking efficiency. In *Calliphora vomitoria* (Linnaeus, 1758) (Calliphoridae) movement analysis shows that when the oral sclerite retracts it raises a pair of little-referenced, sclerotised plates that lie externally on the inside margin of the oral cavity (Fig. 6). These plates not only protect the oral cavity but they also help cut through and isolate portions of food, thereby contributing to the exceptionally high lunge rates achieved by this larva (Rotheray and Lyszkowski 2015). In tephritids, Headrick and Goeden (1996) suggested that the medium oral lobe enables plant fluids to be gathered, but this needs confirmation. Movement analysis could resolve the issue.

6. Matching larval traits to development sites

Matching morphological and movement traits to variables at development sites is a significant way to progress understanding of how larvae live. For instance, most *Lonchaea* species (Lonchaeidae) are saproxylic and feed as saprophages in decaying cambial tissue under bark of fallen trees and branches (Morge 1967, MacGowan and Rotheray 2008). Under the assumption of similarity outlined in the introduction, these circumstances predict that *Lonchaea* larvae will be uniform, but matching traits to development sites shows that this is not the case.

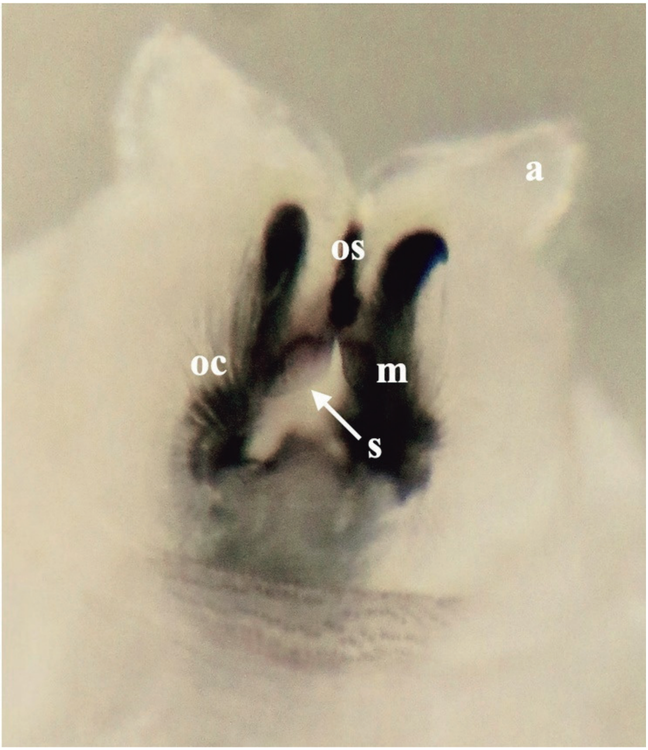

Fig. 6. ***Calliphora vomitoria*** **(Linnaeus) (Calliphoridae), third stage, preserved larva, apical view of head, width between mandibles about 0.2mm; a = antennomaxillary organs; m = mandible; oc = lateral margin of the oral cavity; os = oral sclerite embedded in the dorsal lip; s = sclerotised plate on the inner, front margin of the oral cavity; film available from Rotheray and Lyszkowski (2015).**

Morphological comparison between, for instance, *Lonchaea hackmani* Kovalev, 1981 and *L. sylvatica* Beling, 1873 (Lonchaeidae) reveals that *L. hackmani* has a longer, wider rear module, a tapered not a truncate front module, more numerous spicules per anchor pad and a smaller, less sclerotised head skeleton (Fig. 8). Such differences might be by-passed as trivial or continuous variation, but movement analysis and matching suggest otherwise. Movement analysis shows that the middle and front modules of the *L. hackmani* larva are more flexible and capable of finer-grained movement than those of *L. sylvatica*. Matching these traits, to where larvae are typically found, points to their significance. *Lonchaea hackmani* occurs in accumulations of oily decay permeating bark fibres, where its traits suit holding on and feeding (Fig. 7). In particular, the long, wide, rear module with large anchor pads and numerous spicules facilitates holding on and a narrow, manoeuvrable front module with a small head skeleton and mandibles facilitates reaching into and around fibres to suck up oily decay.

In contrast, the larval traits of *L. sylvatica* suit the places where it typically feeds, namely, narrow gaps and thinner, drier layers of decay. In this microhabitat the larva holds on with the body, which explains the relatively reduced anchor pads, and it feeds using a fragmentation feeding mechanism and, unlike *L. hackmani*, this includes an oral plate for retracting and protecting the oral cavity (Rotheray and Lyszkowski 2015). These two species are not isolated in *Lonchaea*. They are members of putative species groups defined by the same two sets of larval traits and if intermediates and additional species groups exist in this large genus defined by alternative sets of traits, this has yet to be discovered. Resource differentiation among co-occurring, closely related species occurs commonly in the Cyclorrhapha, but the extent to which it is structured by distinctive larval morphologies and movements is less well known.

Fig. 7. ***Populus tremula*** **(Salicaceae), Inverness-shire, Scotland, fallen tree, fibrous decay under bark, microhabitat of** ***Lonchaea hackmani*** **(Lonchaeidae).**

Fig. 8. Lonchaeidae larvae, third stage, preserved larvae, lateral view, head to the right, length of each larva about 7mm: upper image *Lonchaea sylvatica*; lower image *Lonchaea hackmani*.

Discussion

The movement analyses in this paper are based on videos of larval feeding and locomotion. They help unlock the information potential of cyclorrhaphan larvae by displaying characters that become apparent during movement, such as segment shape relative to holding on, body armature relative to locomotion and the mandibles, oral cavity and prothorax relative to feeding. Movement analysis also enables characters to be recognised in components that from preserved material appear to vary in trivial or continuous ways, such as variations in spicule numbers on anchor pads and variations in the size, shape and sclerotisation of the head skeleton.

Movement analysis also shows how components move together and this can lead to improved understanding of how larvae live. For instance, movement analysis shows that feeding involves the whole body divided into rear, middle and front modules with the roles of holding on, reaching food and gathering it respectively. The border between the rear and middle module is flexible and depends on a variety of factors, such as hunger and foraging speed, but the border between the middle and front modules is not as flexible. This is due to it being either side of the anterior spiracles. The anterior spiracles are fixed in the body wall and it is the complications of folding their tracheae during movement that makes this border inflexible (Rotheray 2019a).

Movement analysis reveals two general types of head skeleton movement, a forwards and backwards movement and pivoting. To an extent, these two movements correlate to saprophagous and phytophagous feeding modes respectively and, more particularly, to the viscosity and hardness of food. Movement analysis shows that head skeleton movement is associated with a range of other features, including the size, shape and movement of the mandibles and the size and shape of the head skeleton, oral cavity and prothorax. In general, the harder the food the larger and more sclerotised the head skeleton, the less the mandibles move and the shorter are feeding lunges. These features constitute a fragmentation feeding mechanism that contrasts with the opposing morphology and movements involved in the scooping mechanism typifying saprophages, but these are not absolute distinctions and intermediates are present. Supplementing head skeleton movements are specialised feeding mechanisms, such as brushing in lauxaniids, spot-sucking in clusiids, etc; the frequency of specialisations is as yet unclear. Movement analysis helps locate them and also, those that are less conspicuous but nonetheless informative, as between agromyzid, anthomyiid and drosophilid leaf-miners.

When morphological and movement analyses inform each other, considerable progress is possible, the more so when the results are matched to variables at development sites: for instance, understanding the contrasting morphologies and movements of *Lonchaea* larvae relative to food gathering opportunities under bark. Matching also provides a context for assessing newly discovered larvae, whether for characters that define and distinguish taxonomic or ecological groups. There may come a point when larvae are sufficiently well known in terms of relationships between morphology, movement and development sites that movement analysis becomes less important, i.e. ways of life will be recognised from morphology alone, but that point has yet to be reached.

This brief review of movement analysis indicates that the information potential of cyclorrhaphan larvae is unlockable and that assumptions of similarity are questionable. Similarity is frequently limited by retention of taxon-specific morphology (Rotheray 2016b). For example, characteristics of higher taxa are often modified at lower taxonomic levels, but are still recognisable in the face of functional similarities and the complication of individual characters that appear and disappear, such as the ventral pharyngeal ridges and oral plates. The prospect of species-level key works for larvae is better than supposed. These are, however, provisional results that require confirmation from a wider range of larvae. The data obtained so far suggests that this will be a rewarding and informative exercise.

Acknowledgements

The time I have spent with cyclorrhaphan larvae would not have been possible without the collaboration of fellow members of the Malloch Society: Geoff Hancock, Steve Hewitt, Dave Horsfield, Richard Lyszkowski, Iain MacGowan, Antonio Ricarte, the late David Robertson, Kenn Watt, Ashleigh Whiffin and Geoff Wilkinson. I am grateful to them all and, for this paper in particular, I am especially grateful to Richard Lyszkowski and Geoff Wilkinson for videos of larval movement and discussion of what they show.

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