

Dipterists Digest



1994

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DIPTERISTS DIGEST

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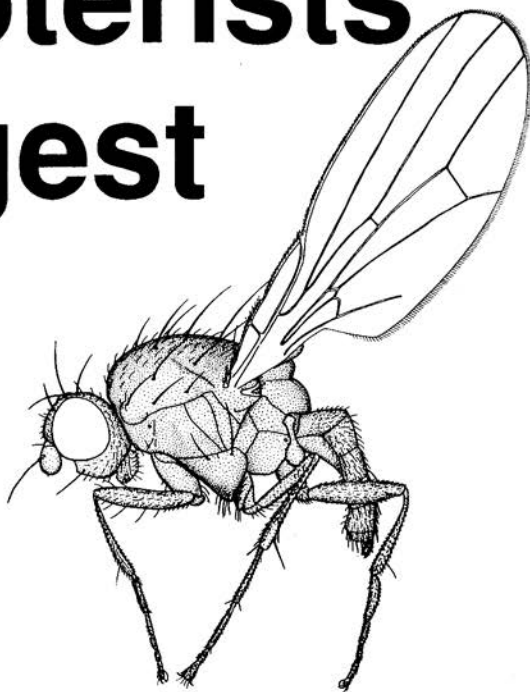
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- the behaviour, ecology and natural history of flies
- new and improved techniques (e.g. collecting, rearing etc)
- the conservation of flies
- provisional and interim reports from the Diptera Recording Schemes, including preliminary maps
- records and assessments of rare and scarce species including those new to regions, countries, districts etc
- local faunal accounts, field meeting results and "holiday lists" if accompanied with good ecological/natural history data
- descriptions of species new to science
- notes on identification including deletions, amendments to standard key works and checklists

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Enquiries and papers for publication should be sent to the Editor, Dr Graham E Rotheray, Royal Museum of Scotland, Chambers Street, Edinburgh EH1 1JF.

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**PETER CROW'S MERIONETH SYRPHIDS
(DIPTERA, SYRPHIDAE)**

**JOAN MORGAN, School of Animal Biology, University College of North Wales,
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For nearly 20 years Peter Crow lived in a small house, Dolafon, in the grounds of Plas Tan y Bwlch near Maentwrog, Merioneth, Wales. In his younger days he had collected butterflies and the larger moths extensively, in Berkshire and southern England, and this collection is now in Glasgow Museum. His interest in syrphids began before he moved to Wales, enthused by the hoverfly fauna of Windsor Forest and also his success there of seeing the therevid *Psilocephala melaleuca* Loew which had never been seen as an adult in Britain before. He ran a mercury vapour trap at Dolafon and acquired a considerable knowledge of the local lepidoptera. At the same time he became increasingly interested in the aculeate hymenoptera but more especially in the hoverflies. This was before the days of *British Hoverflies* (Stubbs & Falk, 1983), most of his specimens being acquired in the 1970's. A particular highlight was his discovery of *Eriozonea syrphoides* (Fallén) in August, 1968, a species then new to Britain. For years afterwards he was full of this great find - his friends used to say that he "crowed" about it! In recent years *E. syrphoides* has proved to be quite widely distributed, even up to N.W. Scotland. He delighted in finding new localities for the species and his collection contained a long series from different places in Merioneth. He bred out numerous Lepidoptera and a few hoverflies. He was pleased with his success in breeding *Cheilosia semifasciata* Becker from *Umbilicus rupestris* (Salisbury) Dandy in the grounds of Plas Tan y Bwlch.

Unfortunately, apart from his notes of the discovery of *E. syrphoides* (Crow, 1969) and a few short notes in the *Entomologist's monthly Magazine*, he published almost nothing on the insect fauna of Merioneth, a county which has always had a great shortage of resident entomologists. He exhibited at meetings of the Lancashire and Cheshire Entomological Society and the South London (now British) Entomological and Natural History Society. These specimens are referred to in the relevant Annual Reports and Proceedings, but include a very small number of species.

After his death in 1987 the cabinet containing his collection of diptera and hymenoptera was acquired by Liverpool Museum. But there was also a vast number of store boxes containing material which was either unidentified or awaiting incorporation into his cabinets. These were rescued from certain destruction and came to me and have since occupied many hours of sorting and identifying. This is now complete apart from some of the hymenoptera. I was fortunate in obtaining from a relative two diaries which contain Peter's collecting notes. The earliest is for 1968 before he lived permanently in Maentwrog but made a number of visits during the year. Unfortunately the diaries for 1969-1972 are lost. The next starts on 23.i.73 and continues in one volume, the last entry being 15.x.87.

By working through these diaries, and in some cases matching up specimens and references, as well as assembling a complete list of all the specimens which came into my possession,

I have been able to produce a final list of all the syrphid species he recorded in Merioneth. There is a small number of records from other Welsh counties made on casual visits, but I have not included these. The bulk of this collection is in Liverpool Museum. A few have been sent to the National Museum of Wales, Cardiff; these either being from South Wales or species of which there were a large number of Welsh specimens. I have retained a few at Bangor to fill gaps in the insect collection in the School of Animal Biology. I am grateful to Mr Tom Mawdsley who sent me a complete list of all the hoverfly species in the P.N. Crow cabinet in the Liverpool collection. This included eight species on which I had no information, as well as further details of many others. I have incorporated these in producing this list of all Peter Crow's Merioneth hoverfly records.

The species are listed below following the checklist of Stubbs & Falk (1983). Many of them were recorded from Dolafon and the Plas Tan y Bwlch estate, neighbouring farmlands and woods, as well as a section of the nearby Festiniog railway track. They are all in the grid square SH 6540 and no other locality is given below but details are available on file. He had several favourite collecting spots in the Harlech area and "Harlech" on data labels probably refers to one of these, and not the town itself. All other Merioneth localities are named here. Most records are for ones and twos; higher numbers are quoted where appropriate.

Apart from the Liverpool material I have checked the identification of all specimens already named and identified many others. Alan Stubbs identified a number of problem species and I am grateful for his help. In cases where no voucher specimens are available, but species are recorded in the diary, I have included these in the list below, marked "?" and with the proviso that they are "diary records only". Following the list published in *Hoverfly Newsletter* 14 in 1992, I have indicated which species are considered nationally scarce (N) or Red Data Book categories (RDB 1,2 or 3).

- Baccha elongata* (Fab.): SH 6540 and Talsarnau; 1973 and 1974.
Melanostoma mellinum (L.): SH 6540, Nantmor and Talsarnau; 1974-1983.
M. scalare (Fab.): SH 6540, Hafod Fawr, Talsarnau and Trawsfynydd; 1969-1983.
Platycheirus albimanus (Fab.): SH 6540, Ceinws near Corris, Hafod Fawr, Harlech Forest, Talsarnau; 1969-1984 (numerous specimens).
P. clypeatus (Meig.): SH 6540, Talsarnau and Trawsfynydd; 1972 and 1977.
P. manicatus (Meig.): SH 6540; 1973 and 1978.
P. peltatus (Meig.): SH 6540, Abergeirw, Hafod Fawr Forest, Talsarnau; 1977-1983 (numerous).
P. scutatus (Meig.): SH 6540; 1983.
Pyrophaena granditarsa (Forst.): Bronaber Marsh, Gellilydan, Llandecwyn, Trawsfynydd; 1973-1979.
P. rosarum (Fab.): SH 6540, Bronaber and Hafod Fawr; 1969-1979.
Xanthandrus comtus (Harris): SH 6540; 1983-1985, 6 specimens. N.
Paragus haemorrhous Meig.: Talsarnau, 1975.
Chrysotoxum arcuatum (L.): SH 6540 and Coed y Brenin; 1974-1979.
C. bicinctum (L.): SH 6540, Aberdovey, Abergeirw and Hafod Fawr Forest; 1972-1979.
C. festivum (L.): Morfa Harlech, Aberdovey and Talsarnau; 1974-1979.
?C. vernalis Loew: Ceinws, 20.v.79. RDB 1. Diary record only.
Dasyrphus albostrigatus (Fall.): Morfa Harlech; 1973.
D. lunulatus (Meig.): SH 6540 and Morfa Harlech; 1974, 1976, 1978.
D. tricornatus (Fall.): SH 6540, Bronaber, Morfa Harlech, Trawsfynydd; 1973-1979.

- D. venustus* (Meig.): SH 6540, Talsarnau and Trawsfynydd; 1972-1976.
- ?*Didia alneti* (Fall.): Abergeirw, 1979. RDB 1. 3 specimens, diary record only. (Alan Stubbs suggests that this is more likely to be *D. intermedia*).
- D. fasciata* Macq.: SH 6540 and 9 other localities in Merioneth, in some numbers, 1969-1983; (a few seen by M.J.M). N. Diary note for Abergeirw, 26.vii.81: "lots".
- ?*Epistrophe diaphana* (Zett.): Hafod Fawr and Coed y Brenin; 1977 and 1982. Diary records only.
- E. eligans* (Harris): SH 6540, Harlech, Talsarnau and Trawsfynydd, 1969-1977.
- E. grossularia* (Meig.): SH 6540, Bronaber, Coed y Brenin, Gellilydan, Hafod Fawr and Llyn Mair; 1974-1983.
- Epsyrphus balteatus* (Deg.): SH 6540, Hafod Fawr, Harlech, Talsarnau; 1968-1984.
- Eriozone syrphoides* (Fall.): First record for Britain 28.viii.68, Llan Ffestiniog. Taken regularly at Merioneth localities from 1968-1984: Abergeirw, Bronaber, Coed y Brenin, Dolgellau, Ffestiniog, Hafod Fawr, Morfa Harlech, Pont-y-gain, Talsarnau, Tomen y mur, and Trawsfynydd.
- Leucozona glauca* (L.): SH 6540 and Hafod Fawr; 1968-1976.
- L. lateraria* (Muell.): SH 6540; 1968.
- L. lucorum* (L.): SH 6540 Hafod Fawr, Talsarnau ("female egg-laying on red campion covered with aphids"); 1972-1977; Talsarnau, 1985 - "flying freely".
- Megasyrphus annulipes* (Zett.): SH 6540, Abergeirw, Coed y Brenin, Deudraeth Forest, Ffestiniog, Hafod Fawr, Trawsfynydd; 1969-1984. N
- Melangyna cincta* (Fall.): SH 6540; 1973 and 1983.
- M. lasiophthalma* (Zett.): SH 6540, Corris, Talsarnau; 1972-1983.
- Meliscaeva auricollis* (Meig.): SH 6540, Harlech and Pont-y-gain, 1964, 1975-1982.
- M. cinctella* (Zett.): SH 6540, Ffestiniog, Hafod Fawr, Morfa Harlech, Talsarnau, Trawsfynydd; 1969-1983.
- Metasyrphus corollae* (Fab.): SH 6540, Bronaber, Hafod Fawr, Morfa Harlech; 1974-1985.
- ?*M. lapponicus* (Zett.): Hafod Fawr, 26.vii.75. N. Det. P.N.C. (diary record). This is probably the specimen recently identified by Darwin Summer as species A.
- M. latifasciatus* (Macq.): SH 6540, Hafod Fawr, Harlech; 1973-1975.
- M. luniger* (Meig.): SH 6540, Aberdovey, Deudraeth Forest, Morfa Harlech, Talsarnau, Trawsfynydd; 1968-1983.
- Parasyrphus lineolus* (Zett.): Harlech Forest, 1979.
- P. malinellus* (Collin): Hafod Fawr; 1969 and 1983; a scarce species with few Welsh records.
- P. punctulatus* (Verrall): SH 6540, Morfa Harlech and Talsarnau; 1972-1983.
- Scaeva pyrastris* (L.): SH 6540, Aberdovey, Harlech ("very common in 1979"), Talsarnau; 1967-1979.
- S. selenitica* (Meig.): SH 6540, Abergeirw, Bronaber marsh, Penrhyndeudraeth, Trawsfynydd; 1977 and 1979.
- Sphaerophoria*: female specimens from several localities were not determined; male genitalia were dissected out (M.J.) from the following:
- S. batava* G. de Te.: Hafod Fawr, 1969.
- S. philanthus* (Meig.): Plas Tan y Bwlch, 1977.
- S. scripta* (L.): Morfa Harlech, 1968 and 1973.
- Syrphus ribesii* (L.): SH 6540, Hafod Fawr, Morfa Harlech; 1968-1983.
- S. torvus* Osten-Sacken: SH 6540, Hafod Fawr, Morfa Harlech; 1968-1978.
- S. vitripennis* Meig.: Plas Tan y Bwlch and Bont Newydd; 1968-1983.
- Xanthogramma citrofasciatum* (Deg.): Morfa Harlech, Dyffryn Ardudwy and Talsarnau; 1975 and 1976.
- X. pedissequum* (Harris): Morfa Harlech and Dyffryn Ardudwy; 1973-1975.
- Callicera aenea* Fab.: SH 6540 and Bronaber Marsh; 1977. RDB 3. 2 specimens of this very rare species det. M.J.M and retained in Bangor collection.

- Cheilosia albipila* Meig.: SH 6540, Hafod Fawr and Harlech; 1972-1977.
C. albitarsis Meig.: SH 6540, Bronaber, Coed y Brenin, Harlech and Talsarnau; 1969-1983.
C. antiqua Meig.: Harlech and Pont-y-gain; 1977 and 1983.
?C. barbata Loew: SH 6540, 1983. Diary record only.
C. bergenstammii Beck.: SH 6540, Bronaber, Deudraeth Forest, Morfa Harlech and Talsarnau; 1969-1984.
C. chrysocoma (Meig.): Harlech, 1977-1979. RDB 3.
C. fraterna Loew: SH 6540, Arenig, Bronaber, Corris, Hafod Fawr, Harlech, Maentwrog Power Station waterfall, Talsarnau, Trawsfynydd; 1975-1983.
C. grossa (Fall.): SH 6540, Morfa Harlech; 1977 and 1978.
C. honesta Rondani: Morfa Harlech, Harlech Forest; 1975 and 1977.
C. illustrata (Harris): Hafod Fawr and Morfa Harlech; 1971-1977.
?C. intonsa Loew: Talsarnau, 1975; det. Dr. J. Lucas.
?C. longula (Zett.): Pont-y-gain, 1979; det. Dr. J. Lucas.
C. nasutula Beck.: SH 6540 and Talsarnau; 1975-1983.
C. nebulosa Verrall: SH 6540, Arthog, Harlech; 1973-1978. 18 specimens of this very scarce species were taken at Morfa Harlech and Harlech Forest during this period. RDB 3.
C. pagana (Meig.): SH 6540 and Talsarnau; 1977-1983.
C. proxima (Zett.): SH 6540, Bronaber, Bryn Mawr moor, Hafod Fawr, Harlech, Talsarnau, Gellilydan, Trawsfynydd; 1968-1983.
C. scutellata (Fall.): SH 6540; 1977-1982.
C. semifasciata Beck.: SH 6540 and Talsarnau; 1973-1984. About 80 specimens, some taken as adults, others bred from larvae on *Umbilicus rupestris*. RDB 3.
C. variabilis (Panz.): SH 6540 and Talsarnau; 1972-1984.
C. vernalis (Fall.): SH 6540 and Harlech Forest; 1979-1983.
Ferdinandea cuprea (Scop.): SH 6540, Morfa Harlech and Talsarnau; 1969-1982.
Portevinia maculata (Fall.): Harlech, Maes-y-neuadd and Talsarnau; 1974-1976; "flying freely" Talsarnau, 1985.
Rhingia campestris Meig.: SH 6540, Deudraeth Forest, Hafod Fawr, Bronaber, Morfa Harlech and Talsarnau; 1968-1983.
Brachyopa scutellaris (R.-D.): SH 6540 and Talsarnau; 1973 and 1977.
Chrysogaster hirtella Loew: SH 6540 and Harlech; 1969, 1972 and 1977.
Lejogaster metallina (Fab.): Bronaber, Coed y Brenin; 1979 and 1983.
Neosascia podagrica (Fab.): Talsarnau; 1977.
Sphegina clunipes (Fall.): Harlech area and Talsarnau; 1968 and 1983.
Anasimyia lineata (Fab.): SH 6540 and Hafod Fawr; 1976, a total of 12 specimens.
Eristalinus sepulchralis (L.): Hafod Fawr and Talsarnau; 1974, 1975 and 1983.
Eristalis abusivus Collin: Aberdovey, Bronaber, Morfa Harlech and Trawsfynydd; 1977-1980.
E. arbustorum (L.): SH 6540, Aberdovey, Bronaber, Blaenau Ffestiniog, Dyffryn Ardudwy, Hafod Fawr, Morfa Harlech, Penrhyndeudraeth and Talsarnau; 1968-1973. Considerable numbers in the collection.
E. horticola (Deg.): SH 6540, Aberdovey, Bronaber, Harlech, Talsarnau, Trawsfynydd, 1975-1979.
?E. intricarius (L.): SH 6540, Bronaber marsh, Corris, Hafod Fawr, Llandecwyn, Morfa Harlech; 1968-1977. Diary records only.
E. nemorum (L.): SH 6540, Aberdovey, Bronaber, Dyffryn Ardudwy, Morfa Harlech, Nantmor, Pont-y-gain, Talsarnau; 1968, 1979 and 1983.
E. pertinax (Scop.): SH 6540 ("lots"), Bronaber, Corris, Dyffryn Ardudwy, Hafod Fawr, Morfa Harlech, Nantmor, Talsarnau; 1968-1984.
E. rupium Fab.: SH 6540, Abergeirw, Bronaber marsh, Corris, Hafod Fawr, Pont-y-gain, Talsarnau, Trawsfynydd; 1974-1983.
E. tenax (L.): SH 6540, Corris, Hafod Fawr; 1973-1976.
Helophilus hybridus (L.): Aberdovey, Bronaber, Blaenau Ffestiniog; 1977 and 1979; 14 specimens.
H. pendulus (L.): SH 6540, Aberdovey, Blaenau Ffestiniog, Bronaber, Deudraeth Forest, Dyffryn Ardudwy,

- Hafod Fawr, Talsarnau, Trawsfynydd; numerous records, 1968-1979.
- H. trivittatus* (Fab.): SH 6540 and Aberdovey; two specimens of this scarce species, 1975 and 1979.
- Myathropa florea* (L.): SH 6450 and Pont-y-gain; 1972-1983.
- Eumerus tuberculatus* Rond.: SH 6540, Dyffryn Ardudwy and Talsarnau; 1977-1983.
- Merodon equestris* (Fab.): SH 6540 (including *f. narcissi* and *f. validus*), Deudraeth Forest, Morfa Harlech and Talsarnau; 1969-1982.
- Pipiza austriaca* Meig.: SH 6540; 1977 and 1978.
- P. bimaculata* Meig.: Dyffryn Ardudwy, 1982. Det. Dr. J. Lucas.
- P. fenestrata* Meig.: Harlech Forest; 1979. Det. Darwin Summer.
- P. luteitarsis* (Zett.): Morfa Harlech and Talsarnau; 1977 and 1983; 3 specimens of this uncommon species.
- P. noctiluca* (L.): SH 6540, Coed y Brenin, Morfa Harlech, Talsarnau; 1976-1984 (det. A. E. Stubbs).
- Arctophila fulva* (Harris): SH 6540, Bronaber, Gellilydan, Hafod Fawr, Harlech area, Trawsfynydd; 1968-1977; 22 specimens of this very local species.
- Sericomyia lappona* (L.): Hafod Fawr, Bronaber, Pont-y-gain, Talsarnau; 1974-1982.
- S. silentis* (Harris): SH 6540, Arthog, Hafod Fawr, Harlech area, Trawsfynydd; 1968-1977.
- Volucella bombylans* (L.): SH 6540, Bronaber marsh, Corris, Hafod Fawr, Pont-y-gain, Talsarnau; 1969-1983.
- V. pellucens* (L.): SH 6540, Corris and Harlech; 1968, 1972 and 1975.
- Brachypalpus lenta* (Meig.): SH 6540 and Talsarnau; 1972-1976; 5 specimens of this uncommon species.
- Chalcosyrphus nemorum* (Fab.): SH 6540 and Hafod Fawr; 1975-1977.
- Criorhina berberina* (Fab.): SH 6540, Talsarnau and Trawsfynydd; 1969-1977.
- C. floccosa* (Meig.): SH 6540 and Talsarnau; 1973-1983; 7 specimens.
- C. ranunculi* (Panz.): Harlech and Talsarnau; 1976; 6 specimens exhibited as new to Wales at meetings of the Lancs. and Cheshire Ent. Soc. and B.E.N.H.S. Also found in subsequent years at SH 6540, Pont-y-gain and Talsarnau; 1977-1982. N.
- Syrpitta pipiens* (L.): SH 6540, Aberdovey, Bronaber and Coed y Brenin; 1973-1983.
- Tropidia scita* (Harris): Harlech and Talsarnau; 1969 and 1977.
- Xylota coeruliventris* Zett.: Ffestiniog, Hafod Fawr and Morfa Harlech; 1968-1984; one at *Rubus* blossom. N.
- X. florum* (Fab.): SH 6540 and Hafod Fawr; 1981 and 1976; 2 specimens only. N.
- X. segnis* (L.): Harlech, 1968, and 2 specimens labelled Gallt y Pandy (1969), a ?Merioneth locality which I have not been able to trace.
- X. sylvarum* (L.): SH 6540 and Hafod Fawr; 1969, 1972 and 1977.

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A POSSIBLE EMPID-CERCOPID INTERACTION

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While collecting in Forest Ganol, Glamorgan (ST 1080) on 9.6.89, I observed an empid sitting on "cuckoo-spit", the larval pabulum of Cercopidae (Hemiptera). It was on an horizontally lying stem about 0.5m above ground level.

The fly was seen to turn the distal half of its abdomen down through almost ninety degrees, and to dip its genitalia into the fluid. It stayed in this position for an estimated 15-20 seconds before resuming its normal stance. The fly remained stationary for a rather longer period before repeating the dipping action. This activity was observed in the same individual 3 times in 3-4 minutes, after which it was tubed.

The fly proved to be a male of *Rhamphomyia (Holoclera) nigripennis* (Fabricius). The identity of neither the cercopid nor its host plant was established.

The weather was sunny and warm, with high insect activity. These observations were made in an exposed situation bordering a track, at about 10.30am. The fly was not apparently trapped in the cuckoo spit; its legs were on the surface, and its body clear of the fluid. It was not struggling, and did not appear distressed. If this trivial explanation is set aside, the question arises as to whether the observed behaviour was specific to cuckoo-spit, or whether other material (e.g. a water droplet) might elicit the same response.

The composition of cuckoo-spit is reported by Wilson & Dorsey (1958) to be as of plant sap, but with a lower amino-acid and sugar content. It does not appear to possess significant antimicrobial properties, but provides a favourable medium for microbial growth. Gram-negative motile rods may be present in numbers large enough to affect the physical properties of the medium. It does, however, contain a strong surface tension depressant (wetting agent). This presumably helps confer great stability on the bubbles in cuckoo-spit. Cuckoo-spit provides both protection from predators and a favourable microhabitat for cercopid larval development, factors which have been quantified by Whittaker (1970).

Published observations on interactions of diptera with cuckoo-spit are restricted to Drosophilidae. Their larval association with the medium was first proposed by Myers (1930). Odhiambo (1958) records *Leucophenga nr. sema* Burla as parasites in spittle. He also reports of *Ptyelusimyia decaryi* Ségué and *Clastopteromyia inversa* (Walker) larvae from the medium. The association of *Cladochaeta* spp. with cercopid spittle has also been investigated by V. Thompson in the United States (A.J.A. Stewart, pers. comm.). Pipunculidae are not known to parasitise larval Cercopidae in spittle, although *Verrallia* parasitises adults (Whittaker, 1969).

It is hoped that this note will encourage others to make further observations of this behaviour in *R. nigripennis* and related species. These are needed before this apparently bizarre

activity can be explained.

My thanks to Adrian Plant for identifying the empid and to Alan Stewart for providing information on Cercopidae and cuckoo-spit.

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MUSCIDAE (DIPTERA) AS FLOWER-VISITORS AND POLLEN-FEEDERS

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Muscidae are generalist flower-visitors and primitive pollinators (Faegri & van der Pijl, 1979; Kevan & Baker, 1983). They have a short lapping or suctorial proboscis, and this restricts their visits largely to open blossoms. Whilst it is well-known that one of the reasons for anthophily is to feed on nectar, it is not always appreciated that certain flies may also be feeding on pollen. Indeed, the relationship between blossoms and flies is often a very intricate one.

Flies and flowers

In the temperate life-zones, many flowers are dependent on flies for pollination and out-crossing. The floral characteristics that influence the kinds of fly visitors are nectar quantity and quality, pollen quantity and quality, flower size, flower shape and flower colour. Interactions between flies and blossoms involve rewards of many kinds, which in certain climatic conditions are of vital importance for the flies. Some species feed on pollen, which is highly nutritious and is rich in protein (up to 45%), carbohydrates, lipids, vitamins and minerals. This is often the principal source for many flies of the protein that is required during yolk formation in developing eggs. Nectar, composed of the sugars sucrose, fructose and glucose is the reward most commonly sought by flies (Faegri & van der Pijl, *op. cit.*), and is the fuel that is required for activities such as swarming, searching for mates and searching for oviposition sites. Furthermore, blossoms have their own microclimate, utilising different strategies for heat entrapment (Kevan, 1975); the temperature within the bloom may be 4-10°C higher than the ambient, and whilst this clearly speeds up the flower's maturation process it also attracts flies to bask in the warmth. Blossoms may also be shelters from high winds, sites for copulation, sites where predators hunt for prey, sites where flies find haven from predators, and even brood-places.

Many bare lists of flower visitors have been published, but in themselves these are not very useful. It may be argued that they indicate the flower-form or flower-colour that particular groups of flies prefer, but this is not necessarily so. A fly's perception of colour is very different from our own, and it is not the physical colour *per se* but the ultraviolet reflection by flowers that is most important for insect vision and perceptions (Kevan, 1972). Moreover, colour is only one of the factors that attract flies to flowers; others include shape of flower and its physical situation, scent, stage of anthesis, and nutritional quality of nectar and pollen. A simple list says nothing about what the fly actually does: it may be feeding, but either on nectar or pollen or both; or it may be resting, basking, sheltering, hiding, marking its territory, searching for a mate or prey.

Observations

Observations on flower-visiting behaviour by Muscidae and other flies in North Sweden (Abisko National Park), supplemented by a few observations in this country, have revealed some unique and highly specialised modes of pollen feeding amongst species of the muscid

genera *Thricops* Rondani and *Phaonia* Robineau-Desvoidy, which appear not to have been noticed before. These flies feed on both nectar and pollen, but whereas the proboscis is used to lap up liquid nectar the fore tarsi play a leading role in the process of gathering pollen grains prior to their ingestion through the proboscis. Two different procedures are involved. After much trampling over the blossom probing for pollen and/or nectar, the fly may stop and rub its fore tarsi together as if grooming, simultaneously extending the proboscis and ingesting the pollen grains that are gathered and concentrated at the base of the basal tarsomeres by this grooming procedure. The actual site of lapping seems to be at the base of the first tarsomere and the tip of the tibia. It is a rapid process, with the proboscis moving and probing as the tarsi are rubbed together. This is the method adopted by species of *Thricops*, and it is taken a stage further by species of *Phaonia*. Whereas *Thricops* species also obtain pollen with the proboscis directly from the anthers, species of *Phaonia* appear not to feed directly on the pollen at all. Instead, they rake the anthers by dragging their fore tarsi over them; the proboscis remains extended, and as each leg is drawn back through the anthers towards the body the proboscis laps at the loosened pollen grains. This is done in very rapid, flickering movements, and the sequence is concluded by rubbing the tarsi together to clean them and then feeding on the pollen accumulated thereby, as described for *Thricops*.

Flies that trample over blossoms inevitably collect pollen grains that become trapped amongst the hairs and bristles on the head, body and legs. Regular grooming and cleaning involves a different procedure, which can be observed in these or other flies. The fore tarsi are rubbed together to dislodge fragments of solid materials, and the proboscis is cleaned by being drawn back through the fore tarsi, or by the tarsi being drawn down over the proboscis itself (e.g. Dethier, 1976). These are quite separate processes and are distinct from the rapid lapping movements made when feeding off the tarsi. That the behaviour just described is indeed a specialised form of pollen-gathering and feeding can be confirmed when a fly is seen to feed on a blossom with conspicuous, brightly-coloured pollen grains (e.g. *Saxifraga azoides*), when the transfer of the grains from flower to tarsus to proboscis can be clearly observed.

The modes of feeding among Muscidae and certain other flies can be arranged in the following sequence, moving from the most simple to the most specialised:

- (1) Seeking nectar alone, avoiding contact with anthers and, on dish blooms, creeping below anthers from the side to feed at base of stamens or petals.
Empididae
Anthomyiidae: *Chiastocheta* Pokorny, *Paregle* Schnabl, *Zaphne* Robineau-Desvoidy
Muscidae: *Spilogona pseudodispar* Frey, *Spilogona triangulifera* Zetterstedt, *Limnophora nigripes* Robineau-Desvoidy, *Limnophora triangula* Fallén, *Coenosia* species
- (2) Seeking nectar alone, but not avoiding contact with anthers; trampling over anthers and plunging down through anthers, stamens, stigmas, to feed on nectar.
Empididae
Anthomyiidae: *Botanophila* Lioy, *Delia* Robineau-Desvoidy, *Pegomya* Robineau-Desvoidy

Muscidae: *Spilogona alpica* Zetterstedt, *Spilogona brunneisquama* Zetterstedt, *Spilogona dorsata* Zetterstedt, *Spilogona megastoma* Boheman, *Spilogona ?nitidicauda* Schnabl, *Spilogona tundrae* Schnabl

- (3) Seeking pollen, trampling over anthers and feeding on pollen or on both pollen and nectar.
Syrphidae
Fanniidae: *Fannia mollissima* Haliday
- (4) Activity as 2 or 3, followed by cleaning of fore tarsi (rubbing them together to remove loose pollen grains); sometimes the head, proboscis and/or abdomen also groomed.
This is regular grooming behaviour of nectar-feeders and of many of the non-Muscidae. It was not observed in pollen feeders, which progress from mode 2 or 3 to mode 5.
- (5) Activity as 3, or sometimes individual stamens held steady between fore tarsi; followed by rubbing fore tarsi together and feeding from the tibial-tarsal internode on the pollen grains concentrated or accumulated during the process.
Fanniidae: *Fannia mollissima* (rarely)
Muscidae: *Thricops aculeipes* Zetterstedt, *Thricops cunctans* Meigen, *Thricops hirtulus* Zetterstedt, *Thricops innocuus* Zetterstedt, *Thricops longipes* Zetterstedt, *Thricops nigritellus* Zetterstedt, *Thricops separ* Zetterstedt
- (6) Rapid, energetic raking of the anthers by fore tarsi, whilst the proboscis is extended and laps up the pollen grains loosened by this process, the proboscis flickering from leg to leg as each fore tarsus rakes; followed by rubbing fore tarsi together and feeding on the pollen grains as described under (5).
Muscidae: *Thricops longipes* (rarely), *Phaonia alpicola* Zetterstedt, *Phaonia angelicae* Scopoli, *Phaonia hybrida* Schnabl, *Phaonia incana* Wiedemann, *Phaonia lugubris* Meigen, *Phaonia pallidisquama* Zetterstedt, *Phaonia serva* Meigen, *Phaonia subfuscineris* Zetterstedt.
- (7) Rarely, and only with small gullet or tube flowers, the tarsi inserted into the flower one at a time and evidently rubbed over the anthers; then withdrawn, the tarsi rubbed together and the pollen removed from the tarsi by the proboscis as described under (5).
Muscidae: *Phaonia alpicola*, *Phaonia* sp. indet.

It is interesting to note that species which otherwise feed as predators on other insects (genera *Spilogona* Schnabl, *Limnophora* Robineau-Desvoidy, *Coenosia* Meigen) are exclusively nectarivorous on flowers, whereas species of *Thricops* and *Phaonia* evidently obtain all their protein requirements from pollen.

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Note added in proof: a detailed account of this topic has been published by the author in 1993. Observations on anthophilous Muscidae and other Diptera (Insecta) in Abisko National Park, Sweden. *Journal of Natural History* **27**: 631-643.

OBSERVATIONS ON SWARMING BEHAVIOUR OF THREE SPECIES OF *Aedes* MOSQUITOES IN BRITAIN

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In the course of a study of the mating behaviour of several mosquito species, swarming was observed in a field population of the British *Aedes* mosquitoes. Such observations may result in a better understanding of the rôle of swarming in mosquito mating behaviour and the means by which sexual isolation is maintained between species in the field.

The study area and the species present

Observations were made on fine evenings in the summer of 1983, at Ham Common, Richmond, Surrey, an area of dense broad-leaved woodland overlying a levelled Victorian rubbish dump. A number of paths penetrated deep into the wood, which was otherwise carpeted by a layer of brambles, nettles and bracken. Flooded bomb craters and depressions resulting from poor land levelling provided temporary mosquito aquatic sites.

Swarming mosquitoes were captured using a large black butterfly net fitted with a 3 metre long handle. Three *Aedes* species were identified using the morphological keys devised by Marhsall (1938); *A. cantans* (Meigen), *A. punctor* (Kirby) and *A. rusticus* (Rossi).

The swarming sites

The swarms of all three species appeared to be associated with areas of clear ground; over trodden paths in the undergrowth or where there was a glade in the wood. It is possible that this site preference was apparent rather than real, since dense vegetation precluded a thorough examination of unpathed areas of the wood.

All the swarms observed consisted of males of a single species. Each species appeared to favour particular swarming sites, reappearing day after day at the same spot. It was impossible to determine what particular characteristic of a site made it favourable to one species and not to another. Swarms did not appear to be associated with any obvious markers. On one occasion a swarm of *A. punctor* was observed above a fallen branch of silver birch. It was presumed that the white bark contrasting with the grass acted as a marker, yet when the branch was dragged a distance of about 2 metres from its original site, the swarm immediately dispersed and reformed at its *original* position, suggesting that the branch did not, therefore, appear to be acting as a marker.

On one evening the extremities of swarms of *A. cantans* and *A. rusticus* were seen to overlap. This occurrence seemed to have no effect on the members of the two swarms; individuals continued on their original flight paths, apparently oblivious to the presence of the other species. A similar observation was made by Downes (1958) on *A. hexadontus* Dyar and *A. flavescens* (Müller). He found swarms of these two species at different heights above a single marker, and collected conspecific mating pairs of both species. On one

occasion, however, the two swarms overlapped for an instant, and several interspecific mating pairs were collected. Whether the overlap observed in the present study could have resulted in heterospecific matings could not be tested because of the apparent absence of matings.

Timing and duration of swarming behaviour

The timing of swarming activity was similar in *A. cantans* and *A. rusticus*. Both species were first seen swarming 4 hours prior to sunset (-7.45 crep: see Appendix). On other occasions, when initiation was not witnessed, swarming was found to be well established 2 hours prior to sunset (-3.70 crep), and continued until shortly after sunset (+0.37 crep). *A. punctator* began swarming only about 30 minutes prior to sunset (-0.88 crep), and continued for almost an hour, until the end of twilight (+1.0 crep), long after the other two species had ceased.

Size and shape of swarms

The swarming behaviour of each species was quite distinct, and it was possible to identify species by this means alone. When first observed the swarms consisted of only a few insects, but as time progressed the number of participants increased until, in some cases, swarms were composed of hundreds of individuals.

Aedes cantans: The swarms were roughly spherical and very compact, rarely exceeding more than 1.5 metres in diameter. The centre of the swarm was normally about 2 metres above ground. Each individual was observed to perform a roughly circular or figure-of-eight flight path with only a very small vertical component. The flight paths of the individuals were frequently interrupted by bouts of stationary hovering flight. The swarms were often very dense, comprising many hundreds of individuals.

Aedes rusticus: The swarms were in the form of a horizontally elongate spheroid measuring about 3 metres by 1 metre, at a height of about 1.5-2 metres above ground. Each individual traced a long sweeping circuit with an abrupt turn about, again with a minimal vertical component. On the return flight each individual flew along the same flight path as on the outward flight. The flight paths of all the participants were parallel to one another. Nielsen & Nielsen (1963) observed a similar swarming behaviour in Danish populations of this species, although they found this species also swarms in a manner similar to that described for *A. cantans* above; this was not observed in the present study.

Aedes punctator: Swarms were very different from those of the other two species, in that they formed at a height of around 3 metres. This made observation more difficult, but it appeared that they were of a generally spherical form, usually not much larger than 1 or 2 metres in diameter. The flight path of each individual appeared erratic with as large a vertical as horizontal component. The swarms also differed from those of the other species in that at around -0.25 crep they gradually ascended, one swarm eventually attaining an estimated height of 10 metres, at which point both civil twilight (see Appendix) and the swarming came to an end. On several evenings one of the swarms was seen to divide, with one part

continuing to ascend whilst the other maintained its position. Individuals appeared to move freely between the two swarms, although the lower swarm eventually dispersed or its members joined the upper swarm. Nielsen & Nielsen (*op. cit.*) observed a similar phenomenon in an *A. punctor* swarm, although the ascension of their swarm from an initial height of about 2 metres started much later at +0.15 crep. Nielsen & Greve (1950) noted that swarms of *A. cantans* ascended to form "top swarms" though how rapidly this proceeded was not made clear.

No matings were observed in any swarm, despite the large numbers of individuals and the many hours spent observing. Fallis & Snow (1984) also failed to observe matings in *A. cantans* swarms in Epping Forest.

Discussion

It is perhaps surprising that, despite many hours of observation, no matings were observed. However, the observations were made several weeks after all the available breeding sites had dried out, and it is hence unlikely that virgin females would have been available. It is possible that females may mate several times in their lives, i.e. after egg-laying, and if so, selection would favour males which continued swarming throughout the season.

Failure to observe matings in swarms has, in the past, led to controversy over their function (Haddow & Corbet, 1961; Nielsen & Greve, 1950). Nielsen and his co-workers were of the opinion that the majority of females are mated early in their lives, during casual flights in the emergence area, and that the swarming is a behavioural ritual of unknown significance and of no real importance in mating behaviour (Nielsen & Greve, *op. cit.*; Nielsen & Haeger, 1960). It is difficult to believe that swarming is a mere functionless ritual, considering its cost in terms of energy and exposure to predators. Swarms are exploited by predators such as bats, birds (Banks, 1919; Rao & Russell, 1938; Howard *et al.*, 1917) and dragonflies (Corbet, 1962). The selective advantages associated with swarming activity must, on average, exceed these costs.

Charlwood & Jones (1980), Quraishi (1965) and Downes (1969) have shown that the rate of mating in the swarm, though apparently low, is sufficient to account fully for the mating of the entire population.

The timing of swarming activity of the three *Aedes* species, while not identical, overlap to a considerable degree. Similar overlap has been found among a number of sympatric species (Downes, 1955, 1958; Haddow & Corbet, 1961; Chiang, 1963; Charlwood & Jones, 1979; Marchand, 1984). It is unlikely that such slight temporal differences in swarming activity could ensure the specificity of matings. Other factors such as the orientation to species specific markers may, in some cases, rule out the need for the sophisticated contact discriminatory mechanisms possessed by the day-flying *Stegomyia* group of mosquitoes (Nijhout & Craig, 1971).

The absence of obvious markers at the swarming sites does not necessarily imply that the swarms were not making use of such a marker. Aerial or vertical markers such as branches

and tree trunks may serve for this purpose. It has been suggested that the position of a potential marker is important in determining whether it attracts swarming individuals. Possibly factors such as the contour of the horizon with the position of other prominent objects serve to define a suitable swarming "arena" (Bässler, 1958; Charlwood & Jones, 1980).

There is no obvious explanation for the ascent of the *A. punctor* swarms. It is possible that this ascension is a response to perceived or probabilistic changes in the availability of females at various heights. Yet this argument, if correct, begs another question: what causes females to alter their flight altitude?

The different flight patterns of the three species may be interpreted as species specific adaptations for mating efficiency. The flight pattern followed by each male no doubt optimises the chance of intercepting females as they fly through the swarm. Thus, where females tend to fly at a range of heights, one might expect the individual swarming males to include a vertical component in their flights, as in *A. cantans* and especially *A. punctor*, whereas the long horizontal flight paths of *A. rusticus* might suggest that females of this species tend to fly at a predictable height, possibly along routes perpendicular to the flight paths of the males. The tendency of swarms to form near to the paths in the undergrowth on Ham Common may have been due to the males exploiting the females tendency to use such paths as convenient unobstructed flight paths.

These male "patrolling" flights would only be competitively advantageous if male flight speed was greater than that of the females, and if males could only detect females over a short distance. Studies have found that female flight speed is indeed less than that of males in a number of swarming species, including *Culex quinquefasciatus* Say (Gibson, 1945), *Anarete pritchardi* Kim (Chiang *et al.*, 1980) and *Chrionomus pseudothummi* Strenzke (Syrjämäki, 1966). Furthermore, males of *Anopheles gambiae* Giles appear to be able to detect the presence of females, by their flight tone, over the distance of only 5cm or so (Charlwood & Jones, 1979).

It seems probable that females are attracted to swarms or swarm markers, and are not merely intercepted by chance. It does appear indeed that the female responds to the marker in a way that is closely related to that of the male, and it is the behaviour of the female that ensures contact with males of her own species. This concept is supported in the literature: Wesenberg-Lund (1921) claimed that females of *Anopheles claviger* (Meigen) direct their flight toward the male swarm from a distance, and Syrjämäki (1965) in his studies on Chironomidae noted that females resting near to the swarm made short "offering flights" in the swarm and if not immediately intercepted would perform a somewhat reduced swarming flight. In the light of this, another interpretation of the characteristic male flight patterns within the swarms is that they might act as a component of a species-specific mate recognition system enabling approaching females to identify conspecific swarms.

Once the female enters a swarm (whether by chance or design) she probably only plays a minor rôle in determining which male mates with her. If female discrimination between males were to occur it would have to rely on phenotypic characters indicative of genetic

quality; for a female to make a "choice" she would first have to survey some or all of the available males. Given the problems which would face the female trying to assess the relatively quality of each male, it seems probable that she relies upon male competition to provide the "best" suitor. Field studies have shown that when a female enters a swarm, a fast and convoluted chase involving a number of males ensues, one of which is eventually successful in copulating with her (Marchand, *op. cit.*). Successful males would tend to be those proficient in intercepting females as a result of their fast and agile flight. If, as seems likely, such attributes have some genetic basis, females would gain an advantage by mating with fast, agile, rather than slow, clumsy, males. Female "choice" may play a minor rôle as virgin females will often resist the attentions of prospective mates by kicking them off (Charlwood, 1976), hence prolonging the chase. Clearly, females should favour large swarms where male competition would be intense.

As the number of participants in a swarm increases, the level of competition for mates also increases. Unless large swarm size acts as a super-stimulus to females resulting in large swarms gaining a proportionally larger quota of females than a smaller swarm, it would pay males to leave a large swarm and form, or join, another smaller competing swarm. Hence arises a conflict of interests between the sexes. Studies have shown that the constitution of swarms changes continually as males enter and leave (Nielsen & Greve, *op. cit.*; Syrjämäki, 1964, McAlpine & Munroe, 1968). This phenomenon was observed in the high and low swarms of *A. punctator* in the present study. Sullivan (1980) has suggested that this flight between swarms may be due to the males searching for their best mating chance and evaluating various swarms with regard to the rate of female arrival and degree of male competition.

Appendix: Twilight and the crep unit

The swarming activity of mosquitoes is correlated with the rate of change of illumination (Nielsen 1963). This rate of change varies considerably with season and latitude. This is apparent in the duration of civil twilight, the period when the altitude of the sun's centre is between -0.50° and -6.00° . At the equator twilight lasts 22-23 minutes throughout the year; its duration increases as one approaches the poles. At latitudes above 67° at midsummer there is no twilight as the sun never sets.

Nielsen suggested that, in order to allow comparisons to be made at different latitudes and seasons, behaviour should be related to the duration of twilight, by means of "crep" values.

Hours and minutes are changed into crep values using the following expressions:

$$\frac{(\text{time of day} - \text{time of sunset})}{\text{duration of twilight}}$$

and

$$\frac{(\text{time of sunrise} - \text{time of day})}{\text{duration of twilight}}$$

Thus if sunset is at 21:30 hours and twilight lasts 32 minutes, the hour 23:00 will be +2.8 crep, and 20:30 will be -1.9 crep. Crep values are positive when they refer to the period during which the sun is below the horizon. Sunset and sunrise have a crep value of zero, while the beginning of dawn and the end of twilight after sunset have a crep value of +1.0.

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**SYRPHID LARVAE (DIPTERA: SYRPHIDAE) MINING THE ROOTS OF
ARTICHOKE (*CYNARA SCOLYMUS* L.) IN BRITTANY**

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In the coastal zone of N. Brittany, cultivation of artichokes occupies more than 11,000 hectares, mostly in the Département of Finistère. In 1987, growers in the commune of Guimaec experienced a significant decrease in artichoke production and discovered large numbers of larvae among the roots of their plants. By rearing these larvae, it proved possible to obtain the adult fly and establish its identity: *Cheilosia vulpina* Meigen (Brunel *et. al.*, 1989). The final instar larva and puparium of *C. vulpina* were subsequently described from this material (Brunel and Cadou, 1990).

This appeared to be the first time that a syrphid was reported using artichoke as a larval host plant in Europe. However, in the course of culturing plants attacked by *C. vulpina*, larvae of three other syrphid species were also encountered.

***Syritta pipiens* (L.)**

One larva of this species was found on a root attacked by *C. vulpina*. From what is known of the larval development of *S. pipiens*, it can be presumed that this individual was using the rotting plant debris at the stem base as a food source. The larva of *S. pipiens* was described by Hartley (1961), following Lundbeck (1916) and Hodson (1931).

***Ferdinandea cuprea* (Scopoli)**

Larvae of this species were found frequently in the artichoke roots, always in the company of *C. vulpina*, one to three *F. cuprea* larvae being found per plant. From 80 plants collected in September/October 1988, 862 larvae of *C. vulpina* and 20 larvae of *F. cuprea* were obtained. The general appearance of the larvae of these two species, and their behaviour, was similar. Most of the individuals of *F. cuprea* were not recognised until they had formed puparia: the anterior respiratory processes, which take the form of short horns, are brick red in *C. vulpina* and black in *F. cuprea*. Some features of the puparium of *F. cuprea* were described by Hartley (1961), who reported that the larva of this species inhabits sap runs on trees, especially trees infested by *Cossus cossus* larvae. According to this report, *Ferdinandea* larvae may be distinguished from those of *Cheilosia* by their lack of buccal armature. Discovery of *F. cuprea* larvae in artichokes, together with capture of adults of this species in Malaise trap samples from a wide range of biotopes, including treeless or nearly treeless sites, suggests that the larvae can develop in diverse situations, and demonstrates that they are certainly not confined to sap run habitats. Production of the blackish exudates caused by the attacks of *C. vulpina* upon the artichoke could provide the stimulus for *F.*

cuprea to oviposit there, as do the sap runs elicited by *C. cossus* activity in tree trunks. However, do the larvae depend solely upon such exudates to provide their food supply throughout their development?

Examination of the larval mouthparts remaining within the puparia reveals that *F. cuprea* does possess a buccal armature resembling that of *Cheilosia*, contrary to the findings of Hartley (*loc. cit.*), whose account was based on an incomplete specimen. Taken together with the similar behaviour of *F. cuprea* and *C. vulpina* larvae in artichoke roots, this fact argues that it is necessary to regard *F. cuprea* as a species with plant-feeding larvae.

***Eumerus strigatus* Fallén**

Larvae of this species were numerous in the artichoke roots examined during the course of the work on *C. vulpina*. In first year plants, larvae were found in abundance in October, always in the company of *C. vulpina*. Their numbers varied from 1-6 per plant. Approximately 20% of the plants attacked by *C. vulpina* also contained *E. strigatus*. In second year plants, larvae of *E. strigatus* occurred in the heart of the roots, although larvae of *C. vulpina* were searched for in vain. The larval galleries were concentrated in a layer of necrotic tissue at the base of the last year's flower stem. In one bed, from which 100 plants were examined, 10 plants contained larvae, at a density of 1-10 per plant.

Until recently, three closely related *Eumerus* species have been confused. These three species, *strigatus*, *tuberculatus* Rond. and *sogdianus* Stack., have been referred to under the general name of the "lesser bulb fly" as distinct from "the bulb fly", *Merodon equestris* (Fab.). In the Nearctic a fourth species belonging to this group is recognised, *E. narcissi* Smith. It is possible that, in the Palaearctic, additional species of this group await recognition. For instance, at Carquefou (Loire-Atlantique) a male resembling *E. strigatus* but with genitalia differing from those of the three known European species of this group has been collected by Malaise trap and is now under study. *E. strigatus*, *tuberculatus* and *sogdianus* are also present at Carquefou. That these species may frequently occur together does not facilitate their study. Neither does it help that the larvae of *E. strigatus* and *tuberculatus* are difficult to separate (Hodson, 1932), or that the larva of *E. sogdianus* remains undescribed.

To judge from our experiences and those literature sources which can be taken to have reliably referred to a single species (Hodson, 1927, 1931, 1932), only *E. tuberculatus* is exclusively associated with bulbs: its larvae never seem to have been found other than with the bulbs of flowering plants (narcissus, hyacinth etc), onions and shallots. The larvae of *E. sogdianus* have been found in association with rotting tubers of potato and with carrots, both wild and cultivated. The larvae of *E. strigatus* have been found in association with the plants used by both of these *Eumerus* species and also with other plants like the artichoke, but as a secondary infestation following attack by some other agent, such as fungus, bacterium or a different insect. Thus the three *Eumerus* species have different requirements which can all be satisfied by a single vegetable-growing establishment, given the diversity of plants normally cultivated. This explains why it is not unusual to find these three species together. In Brittany this is the case in numerous sites we have visited: at Carquefou (Loire-

Atlantique), Le Rheu (Ile et Vilaine), Daoulas, Guimaec and Saint Pol de Leon (Finistère).

These three species all have similar flight periods, from April to October, with a peak in August in Brittany. There appear to be a number of overlapping generations succeeding each other during the course of a year. All three overwinter as full-grown final instar larvae.

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**EPIGAMIC SWARMING BEHAVIOUR OF RHAMPHOMYIA (MEGACYTTARUS)
CRASSIROSTRIS, HILARA LUNDBECKI AND EMPIS (XANTHEMPIS)
SCUTELLATA (EMPIDIDAE)**

ADRIAN PLANT, 30 Dorset Street, Blandford Forum, Dorset DT11 7RF

In many Empididae of the subfamily Empidinae, feeding and swarming habits have become specialised and adapted in distinctive ways to become a fully integrated part of the mating habit. Thus, in many species of *Hilara* Meigen, *Rhamphomyia* s. lat. and *Empis* s. lat., predatory activity is confined to the male, and a prey item is presented to the female in flight at the moment of contact of the sexes during highly ritualised swarming activity (Downes, 1969). The female feeds on the prey throughout copulation and it is speculated that, with some exceptions (Hamm, 1933), this nuptial gift may be the only food taken during the adult life of the female. Prey transfer may be further ritualised by the secretion of a silken web around the prey (Kessel & Karabinos, 1947; Kessel, 1959) or the transfer of a silk-wrapped inanimate object such as a flower petal or seed, while males of *Hilara sartor* Becker merely proffer an empty silken sac to the female (Chvála, 1976).

Probably the commonest pattern of epigamic behaviour amongst swarm-mating Empidinae is one in which males gather in swarms after having captured prey (Alcock, 1973; Chvála *op. cit.*; Tuomikoski, 1939). Females then visit the swarm and mate-selection is considered to be predominantly the prerogative of the female. More rarely, sex-role reversal occurs in which the females form swarms to which the males come for mating. Such a mating strategy is best known from *Hilara clavipes* Harris, *H. morata* Collin and *H. nigrina* Fallén; (Chvála *op. cit.*), *Rhamphomyia geniculata* Meigen, *R. vesiculosa* Fallén, *R. spinipes* Fallén (Gruhl, 1963), *Empis livida* L. (Hamm, 1908) and in *Empis borealis* (L.) which has been extensively studied by Svensson *et. al.*, (1989, 1990) and Svensson & Peterson (1987, 1988).

Although much is known of the mating and feeding habits of Empidinae, there remain large gaps in our knowledge. Such behaviour is of ecological relevance and phylogenetic importance (Chvála *op. cit.*), while the case of sex-role reversed behaviour represents an important evolutionary phenomenon. In this study I report observations of epigamic flight behaviour of *Rhamphomyia* (*Megacyttarus*) *crassirostris* Fallén, a species well known for its habit of forming large mating swarms and also report for the first time on the swarming behaviour of *Empis* (*Xanthempis*) *scutellata* Curtis and *Hilara lundbecki* Frey.

***Rhamphomyia* (*Megacyttarus*) *crassirostris* Fallén**

Observations totalling about 15 hours were made at the following localities and supported by incidental observations from elsewhere: Magor Swamp, Monmouthshire (v.c. 35), ST 1182, 11.v.1991 and 24.v.1991; Llwynioli near Craigiau, Glamorgan (v.c. 41), ST 085796, 6.v.1991; Coed y Bedw near Tongwynlais, Glamorgan (v.c. 41), ST 1182, 7.v.1990 and at Stoborough Heath, Dorset (v.c. 9), SY 9385, 6.v.1992.

Females formed conspicuous swarms of between 10 and several hundred individuals at

2.5 m above the ground and orientated about a swarm marker which was frequently a longitudinal topographical feature such as a stream or ditch, a pathway through *Phragmites*, an elongated clearing or field boundary at the edge of woodland. The flight pattern consisted of a rapid horizontal, linear flight of 3-8 m. along the longitudinal axis of the swarm marker followed by an abrupt reversal of direction and the assumption of a slower and rather fluttering return flight, usually at a slightly lower level. Males carrying prey entered the swarm from below during the slow-flight phase (point A in Fig. 1) and flew closely alongside the female (point B). If the approach of the male was successful, prey was apparently transferred to the female and the pair dropped rapidly (point C) 1-1.5 m. below the swarm and commenced mating immediately, before flying away together (in fact, it appears that the male provides the means of flight, the female remaining rather passive and presumably preoccupied with the nuptial gift). The mating flight was sustained and the pair did not rapidly descend to the ground as does *Rhamphomyia sulcata* (Meigen) (Laurence, 1955) and I was able to follow mated pairs for about a minute during which they showed little inclination to come to the ground.

I examined the prey held by 16 mating pairs captured immediately as they left the swarm. All prey items were Diptera of the following families: Mycetophilidae (7), Sciaridae (1), Culicidae (5), Tipulidae (1), Phoridae (1) and Empididae (1).

Males of *R. (M.) crassirostris* also form swarms of which two forms were clearly discernible. The first form was probably associated with predatory activity and typically took place over the surface of water, although it was sometimes seen well away from water in gaps between bushes or along the line of a path in woodland. Species of the subgenus *Megacyrtarus* Bigot are specialised for collecting prey from the surface of water (Chvála *op. cit.*) and this they do by flying close over the surface with their hind legs extended vertically down below the thorax, apparently in readiness for grasping prey.

The flight of such predatory swarms appeared to have no ordered structure and such "swarms" may have been no more than fortuitous aggregations of males about a good source of prey. If there were no other insects swarming over the water, the swarms usually skimmed over the surface. However, predatory swarms seem to be displaced upwards if other species start swarming in large numbers. For example, I have seen male swarms displaced in this way by the onset of swarming of *Hilara maura* (Fabricius) over a woodland stream at Coed y Bedw and by *Hilara fulvibarba* Strobl over a peaty pool at Stoborough Heath. Under such circumstances, these *Hilara* spp. were found as prey of *R. (M.) crassirostris* captured nearby and so the upward displacement should be viewed as a behavioural adaptation conferring a predatory advantage.

The second form of male swarm involved loose aggregations of individuals, usually, but not exclusively, flying in proximity to female swarms. The males concerned were swarming at a lower level and were often laterally displaced from the female swarm, flying rapidly in a pattern resembling a figure of eight or other complex patterns derived from it. The males adopted a characteristic posture with the front legs outstretched almost vertically above the thorax such that when viewed from in front the fly appeared as a V-shape. The hind legs trailed rather loosely behind and below the body except when holding prey. On two

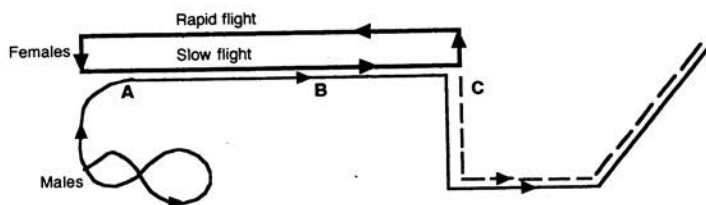


Fig 1. Mating swarm behaviour of *Rhamphomyia (M.) crassirostris*, see text for explanation

occasions I witnessed males fly upwards and enter female swarms to fly closely alongside as detailed above, so there would seem to be little doubt that this form of male swarm is an epigamic behavioural character.

Male swarms have also been noted for sex-role reversed *E. borealis* (Tuomikoski, *op. cit.*). Chvála (*op. cit.*) interpreted female swarms of normal sex-role empids as "offering" swarms, which form when females predominate numerically over males. Such behaviour might not be as organised as primary swarms but the behaviour of *R. (M.) crassirostris*, particularly with regard to the distinctive posture adopted by males, suggest that offering swarms might be more structured than has been supposed.

***Hilara lundbecki* Frey**

Observations of this species were made over a four hour period at the Kenfig rivermouth, Glamorgan (v.c. 41), SS 7883 on the afternoon of 26.v.1991. This species, which is well known as a salt marsh dweller (Meyer & Heydemann, 1990), is abundant at Kenfig and I have reared it without difficulty from turf sods dug from the drier areas of salt marsh which have become inundated by wind blown sand.

Both sexes were found sitting at a density of 5-15 insects/m² on the stems of grasses and flower heads of thrift (*Armeria maritima*) throughout the salt marsh area. (*H. lundbecki* will enter the flowers of thrift to feed on pollen or nectar, the thorax becoming densely covered

with pollen. This species must be an important pollinator of this plant). Long periods of inactivity were punctuated by short bouts of frenzied activity during which 2-5 individuals of mixed sex were involved in a short flight about 10cm above the ground. The insects flew rapidly in tight circles, clearly involved in a chase, and although it was impossible to determine the exact sequence of events, mating contact evidently took place during flight and mated pairs would fly together to a nearby grass stem. More often than not, pairs did not form and the flies would resume sitting on vegetation. If a pair did form, the female held onto the substrate, the male holding on to her dorsum, and with the swollen basal metatarsal segment of his front legs placed immediately in front of her eyes. Despite close observation I was unable to note transfer of prey or any silken structure from the male to the female.

Epigamic aggregations of *Hilara* spp. typically involve conspicuous swarming behaviour over a protracted period, sometimes at considerable elevation above the substrate. On a windswept saltmarsh, such behaviour would be impossible on a relatively large number of occasions, compared with a less exposed and more typical habitat for the genus. The adoption of a short, low elevation swarming habit by *H. lundbecki* may be an adaptation to facilitate mating in an exposed situation.

***Empis (Xanthempis) scutellata* Curtis**

Observations were made on the Gwent Levels at Peterstone Wentlooge, Monmouthshire (v.c. 35), ST 276803 on the evening of 4.vi.1991. Both sexes of this species engaged in swarming, activity commencing about an hour before sunset and continuing with increased fervour until darkness. Male swarms consisted of up to 30 individuals flying with a rather lazy swaying flight at 1-5m. above the ground and positioned in the lee of hedges at the margins of fields, over *Phragmites* growing in reens or over the head of the observer. Occasionally, individuals would show a sudden burst of speed, flying 20-50cm. to one side before returning along the same track, and there was some "bickering" between males. The hind legs were held outstretched, pointing backwards and slightly above the abdomen while the mid legs were held rigidly pointing backwards below the abdomen.

Mating took place after a female entered the swarm from the side, coming alongside the male; the pair made a few erratic movements together, and then at the moment of contact, ceased flying and fell rapidly to the ground. I did not observe any transfer of a "nuptial" gift in this species. Sexual contact did not occur until the pair had been settled on the ground for several minutes. The female held on to the substrate while the male held on to her with his posterior legs crossed beneath her abdomen and mid legs beneath her thorax, just in front of the wings; the front legs were held reflexed upwards, and bent forward in such a way that the terminal tarsi are presented in front of the females' eyes.

Female swarms were rather larger, numbering up to 150 individuals, perhaps positioned in somewhat more open situations than those formed by the males. The swarms were more structured, consisting of swaying columns 1-6m. high, each individual performing slow and regular lateral oscillations which were less erratic than those seen in the male swarms. The anterior pair of legs were held raised and in front of the body while the posterior pair were held extended downwards and trailing behind. One female was captured carrying a

chironomid midge as prey. These aggregations of females can be interpreted as offering swarm behaviour induced (Chvála, *op. cit.*) by the relative abundance of females (female swarms were larger and more frequent than male swarms).

The observation that *E. (X.) scutellata* forms swarms is interesting, as Chvála (*op. cit.*) has asserted that members of the subgenus *Xanthempis* Bezzi are the only members of the genus *Empis* which do not swarm in the air, having transferred mating activity to the ground. *E. (X.) scutellata* is a rather structurally anomalous example of *Xanthempis*, possibly forming a link between *Xanthempis* and *Argyrandus* Bezzi (Collin, 1961), a contention which is supported by these behavioural observations. In general, swarm-forming species of *Empis* have males with holoptic eyes and more or less enlarged upper ommatidia while the females are dichoptic with all facets of equal size (Chvála *op. cit.*). Typical examples of *Xanthempis* have the eyes widely separated in both sexes and it is relevant that *E. (X.) scutellata* has greatly enlarged eyes which are only narrowly separated on the frons and thus approach the holoptic condition found in swarm-forming *Argyrandus*.

Discussion

This study has demonstrated typical epigamic flight behaviour for the first time in a species of the subgenus *Xanthempis* and added further to our knowledge of the sex-role reversed mating behaviour of *R. (M.) crassirostris*. All three British species of *Megacyttarus* exhibit pronounced sexual dimorphism with regard to wing venation or pigmentation, and the suggestion of Gruhl (*op. cit.*) and Svensson & Petersson (1987) that there is a correlation between sexual differences of wing area and female swarming activity warrants further investigation; certainly, sex-role reversed behaviour is shown by *R. (Pararhamphomyia) marginata* (Fabricius) (*unpublished observations*) in which the female has remarkably enlarged, pigmented wings; by *R. vesiculosa*, *R. spinipes* (Gruhl, *op. cit.*), the females of which have large pigmented wings, and by *E. borealis* where the incidence of successful mating is higher for larger, low wing-wear females (Svensson & Petersson, *op. cit.*, Svensson *et al.* 1989). However, female swarming is known from many species such as *Hilara morata* with no obvious wing dimorphism (Chvála, *op. cit.*). Many species of *Empis* and *Rhamphomyia* have females with dark-pigmented wings and it is possible that further observations will reveal that sex-role reversed behaviour is widespread in these genera. It is clear that despite a considerable knowledge of empidid swarms, the area remains a fertile field for future behavioural investigation and that much can be learnt by close observation of even common species.

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**TEPHRITIDAE (DIPTERA) - FOUR SPECIES UNDER-RECORDED IN THE
BRITISH ISLES AND NEW FOODPLANT RECORDS**

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***Urophora stylata* (Fabricius, 1775)**

The distribution of this species given by White (1988) is "England, as far north as Yorkshire". It is, however, quite widespread in Scotland as the following records and captures show: (a) Grimshaw (1901) refers to a capture of this species by A.A. Dalglish; the specimen is in the National Museums of Scotland collections and is labelled, Scotland 1900.99.10 and was collected in July 1899 at Barr, Ayrshire (VC 75); (b) two imagines emerged between 11-18.ii.1986 from flowerheads of *Cirsium vulgare* (Savi) Ten. collected near Newbattle Abbey (Grid Ref. NT 3366), Midlothian (VC 83) on 29.ii.1985; the early emergence was presumably due to the thistle heads being stored indoors (Rotheray, 1986a & b); (c) a specimen was seen at rest on *C. vulgare* at Loch Tummel (Grid Ref. NN 7559), Perthshire (VC 88) on 17.vi.1988; (d) dead galled flowerheads of *C. vulgare* collected on the Isle of Danna (Grid Ref. NR 6979), Argyllshire (VC 101) on 12.viii.1989 produced two imagines of *U. stylata* on 1.vii.1990 along with a single *Eucosma cana* (Haw.) (Lepidoptera: Tortricidae). Another collection of flowerheads of *C. vulgare* from Loch Coille-Bharr (Grid Ref. NR 7890), Argyllshire (VC 101) on 15.viii.1989 also produced these species (*U. stylata* emerged 2.vii.1990; *E. cana* emerged 8-14.vii.1990).

***Paroxyna absinthii* (Fabricius, 1805)**

According to White (*op. cit.*), the distribution of this species is poorly known with old records from scattered English localities as far north as Yorkshire with recent records only from Kent, Norfolk, Surrey and Sussex. Falk (1991), however, considers it widespread but local in the midlands of England and there is a long history of this species in Scotland: Walker (1853) states that it is found in Scotland; Hardy (1872a,b) recorded it from Pease Bridge, Berwickshire; Grimshaw (1916) refers to a capture of this species by C. G. Lamb in 1914 from the Isle of Lewis; Evans (1920) took it in Fife on 16.vii.1904 and more recently Waterston (1981) recorded it from South Uist.

To these records we add the following: Pettycur (Grid Ref. NT 2686), Fife (VC 85) 6 flies emerged 24-27.vi.1986 from flowers of *Artemisia vulgaris* L. collected on 19.ix.1985.

***Paroxyna plantaginis* (Haliday, 1833)**

White (*op. cit.*) states that this species is distributed along the coast of England, except the north-west. It is also found in southern Scotland as the following record and captures show: (a) Nelson (1980) recorded it from Caerlaverock NNR; (b) flowerheads of *Aster tripolium* L. collected at Aberlady (Grid Ref. NT 4780), East Lothian (VC 82) on 13.x.1984 produced

3 flies of *P. plantaginis* between 10-25.vii.1985; similar old flowerheads collected from the same place on 13.x.1991 contained larvae and puparia; (c) a collection of *A. tripolium* seedheads from Kincardine Bridge (Grid Ref. NS 9296), Stirlingshire (VC 86) on 6.x.1991 were found to contain tephritid larvae and puparia of this species.

***Platyparea discoidea* (Fabricius, 1787)**

According to White (*op. cit.*), this species is known only from a few sites in Yorkshire. A single male was, however, captured while it rested on a sunlit leaf in a garden at Newbattle Abbey (see above). On 22.viii.1991, a larva was found in the stem of *Campanula latifolia* L. growing in woods nearby. It pupated on 4.ix.1991 and on 13.vi.1992, a male *P. discoidea* emerged. This rearing record confirms that *C. latifolia* is a foodplant of this species. White (*op. cit.*) records this as a foodplant requiring confirmation. This may indicate that the species is established in the area. It may thus be worthwhile looking for *P. discoidea* in other parts of southern Scotland, such as Raehills in Dumfriesshire (VC 72) where it was recorded by Rev. W. Little in 1842 (Dale, 1904). The specimen on which this record is based is still extant in the C.W. Dale collection in the Hope Entomological Collection, Oxford University (G. MacGavin, *pers. comm.*). On a recent visit to Raehills we found *C. latifolia* growing there, but none of the several plants investigated showed signs of infestation.

***Terellia serratulae* (Linnaeus, 1758)**

White (*op. cit.*) states that this species is very rare in northern Britain. In Scotland Rotheray (1986b) recorded the species from Newbattle, Midlothian (VC 83) and referred to an older capture from Forres, Morayshire (VC 95) by J.J.F.X. King. It is also present at Kingsbarn (Grid Ref. NO 6012), Fife (VC 85) where from old flowerheads of *Cirsium vulgare* collected on 20.i.1990, two *T. serratulae* emerged on 23.vii and 3.viii.1990 respectively.

***Trypeta immaculata* Macquart, 1835**

White (*op. cit.*) gives *Taraxacum* sp. as the only confirmed foodplants for this species in the British Isles, but various other Compositae (Asteraceae) including *Crepis* sp. have been reported in Europe. In East Perthshire (VC 89), *T. immaculata* frequents deep, shady river gorges where its foodplant is *Crepis paludosa* (L.) Moench. This conclusion is based on three rearings of the species from such habitats: (a) leafmines in *C. paludosa* collected on 15.ix.1990 in Craighall Gorge (Grid Ref. NO 1748), Blairgowrie, Perthshire yielded this fly on 9.vi.1991; (b) leafmines in *C. paludosa* collected on 22.ix.1990 in Romadie Wood (Grid Ref. NO 1452), Bridge of Cally, Perthshire, produced a single fly on 9.vi.1991; (c) leafmines in *C. paludosa* collected on 22.ix.1990 in Den of Riechip (Grid Ref. NO 0647), Butterstone, Perthshire, also produced this species (date of emergence not recorded).

Close inspection of other Compositae, including *Taraxacum* sp. in these localities did not reveal the characteristic mines of this species. A single vacated mine of similar general form

was found in *Taraxacum* at Romadie Wood, but the mine was much darker, narrower and more typical of an agromyzid.

***Trypeta zoe* Meigen, 1826**

The usual foodplants of *T. zoe* are various species of Compositae (White, *op. cit.*) so it was somewhat surprising to rear a long series of the species from a labiate, namely *Ajuga reptans* L. Three leaves containing multiple mines were selected from several infested plants growing at the waters edge of a stream in a shady gorge at Avenel Hill (Grid Ref. NT 5239), Roxburghshire (VC 80) on 13.vii.1991. All the mines seen were in extra-large vegetative leaves growing on the stable shingle at the burnside. Flies duly emerged between 7-12.viii.1991.

Acknowledgements

We are grateful to Dr. Roselind A.H. Smith of SNH for verifying the identification of *Crepis paludosa* and to Dr George MacGavin of the Hope Entomological Collections, for looking up *P. discoidea* in the C.W. Dale collection. The Scottish Insect Records Index in the Royal Museum of Scotland was used to locate some of the records.

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AGROMYZIDAE (DIPTERA) NEW TO SCOTLAND

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During a reappraisal of the Agromyzidae occurring in Scotland, it was discovered that there were no previous published Scottish records for some 20 species. These species (*), along with a few others deserving comment are given below. Unless otherwise stated the records are those of the author.

**Ophiomyia labiatarum* Hering

This species was formerly recorded from Scotland (Spencer, 1956; Griffiths, 1962) but these records were found to be in error (Spencer, 1971). It has now been reared from stem-mines in *Stachys sylvatica* L. collected at the Falls of Fender (NN 8766), East Perthshire (v.c. 89) on 30.viii.1990 (emerged 16.v.1991). Similar mines in *S. sylvatica* were also observed at Keltneyburn (NN 7650), West Perthshire (v.c. 88) on 8.ix.1990.

**Agromyza albitarsis* Meigen

Reared from leaf-mines in *Populus tremula* L. collected at Ross Point (NS 3795), Loch Lomond, Stirlingshire (v.c. 86) on 28.vi.1983 (emerged 20.vii.1983).

Agromyza ambigua Fallén (= *niveipennis* Zetterstedt)

The distribution of this species is recorded as "Kent: Thames Marshes. Local in Spencer (1972) even though specimens, verified by Spencer, are present in the Royal Museum of Scotland collections labelled "Aberdour 1904 71.134" (v.c. 85, collected 7 July 1904 by P. Grimshaw according to the accession data); and "Bonhill 1907 J.R. Malloch" (v.c. 99). These records are reported in Spencer (1956).

Agromyza nigrociliata Hendel

This species has been recorded from Scotland (Spencer, 1956; Griffiths, *op. cit.*) but these records were later erroneously claimed to be a mistake (Spencer, 1971). Specimens, verified by Spencer, are present in the Royal Museum of Scotland collections labelled "Morningside 30.v.93" (v.c. 83); "Aberdour 6.vii.93" (v.c. 85); "Aberlady 96.105.382 (v.c. 82, collected 4 June 1896 by P. Grimshaw according to the accession data); "Bonhill, J.R. Malloch" (v.c. 99) and "Braid Burn 27.v.1918 P. Grimshaw" (v.c. 83).

**Agromyza phragmitidis* Hendel

Reared from leafmines in *Phragmites communis* Trin. collected at Ardblair Moss (NO 1644), East Perthshire (v.c. 89) on 10.ix.1981 (emerged 20.iv.1982) and collected at Luffness (NT 4780), East Lothian (v.c. 82) on 16.viii.1987 (emerged 6-10.vi.1988) and 24.viii.1991 (emerged 3-5.vi.1992).

****Phytobia betulae* (Kangas)**

A single female was reared from a pale straw-coloured puparium collected on 22.iii.1992 from under moss on the base of a birch tree at Craigdilly (NT 1820), Peeblesshire (v.c. 78). Fly emerged 19.v.1992. Posterior spiracles of puparium compare favourably with the illustration in Spencer (1976). An identical emerged puparium was found in a similar situation at the same locality on 13.ii.1993.

****Liriomyza amoena* (Meigen)**

Reared from leafmines in *Sambucus nigra* L. collected at Duddingstone Loch (NT 2872), Midlothian (v.c. 83) on 3.ix.1990. Also known from other localities in v.c. 82, 83, 85 and 89.

****Liriomyza congesta* (Becker)**

Reared from leafmines in *Lathyrus montanus* Bernh. collected at Glen Fender Meadows (NN 8967), East Perthshire (v.c. 89) on 31.viii.1990 (emerged 4-17.v.1991).

****Liriomyza infuscata* Hering (= *portentosa* Spencer)**

Specimens verified by Spencer are present in the Royal Museum of Scotland collections labelled "Bonhill J.R. Malloch" (v.c. 99).

****Liriomyza valerianae* Hendel**

Reared from leafmines in *Valeriana officinalis* L. collected at Drumchastle (NN 6858), West Perthshire (v.c. 88) on 14.vii.1990 (emerged 7.viii.1990) and at Rossie Muir (NO 6453), Angus (v.c. 90) on 4.viii.1991 (emerged 13-14.v.1992).

****Paraphytomyza fulvicornis* (Hendel) (= *langei* (Hering))**

Vacated leafmines in *Salix aurita* L. apparently referable to this species were found on Arthur's Seat (NT 2773), Midlothian (v.c. 83) on 4.x.1989.

****Paraphytomyza tridentata* (Loew)**

Vacated leafmines in *Salix viminalis* L. apparently referable to this species were found on Blackford Hill (NT 2570), Midlothian (v.c. 83) on 24.vii.1983, at Whitehouse Point (NT 1479), West Lothian (v.c. 84) on 5.ix.1987 and near Duddingstone Loch (NT 2872), Midlothian (v.c. 83) on 3.ix.1990.

****Phytomyza artemisivora* Spencer**

Reared from leafmines in *Artemisia vulgaris* L. collected at Bawsinch (NT 2872), Midlothian (v.c. 83) on 27.viii.1977 (emerged 22.ix.1977), at Pettycur (NT 2686), Fife (v.c. 85) on

229.ix.1985 (emerged x-xi.1985) and at West Wemyss (NT 3294), Fife (v.c. 85) on 3.xi.1990 (emerged 19.iv.1991). The first of these records was originally misidentified and recorded as *Paraphytomyza discrepans* (Wulp) from a new host plant by Bland (1983). This record must now therefore be deleted.

****Phytomyza asteris* Hendel**

Reared from leafmines in *Aster tripolium* L. collected near Higginsneuk (NS 9286), Stirlingshire (v.c. 86) on 8.x.1988 (emerged 15.i.1989) and at Oban Trumisgarry (NF 8774), North Uist (v.c. 110) on 18.vii.1992 (emerged 31.vii.1992).

****Phytomyza brunnipes* Brischke**

Vacated leafmines in *Sanicula europaea* L. were observed at Den of Riechip (NO 0647), East Perthshire (v.c. 89) on 22.ix.1990. A further visit to the same site on 7.ix.1991 yielded occupied mines which produced flies of this species on 20.iv.1992. Vacated leafmines in the same plant were also seen at Falls of Moness (NN 8547), West Perthshire (v.c. 88) on 30.vii.1992.

****Phytomyza campanulae* Hendel**

This is a widespread upland species known from v.c. 78, 86, 88, 90, 92 and 96.

****Phytomyza nigripennis* Fallén**

A specimen, verified by K.A. Spencer, is present in the Royal Museum of Scotland collection, labelled: "Braidwood, 13.v., J.J.F.X. King" (v.c. 77).

****Phytomyza origani* Hering**

Reared from leafmines in *Origanum vulgare* L. collected on Kinnoull Hill (NO 1322), East Perthshire (v.c. 89) on 22.vi.1989 (emerged spring 1990). Also known from vacated mines from Aberdour (NT 1985), Fife (v.c. 85).

****Phytomyza pauliloewi* Hendel**

This species was recorded as possibly British by Spencer (1972) on the basis of a leafmine from Yorkshire. Its British status was later confirmed (Spencer, 1976). It is now recorded from Scotland - reared from leafmines in *Pimpinella saxifraga* L. collected at St. Abbs (NT 9167), Berwickshire (v.c. 81) on 17.vi.1990 (emerged 23.vii-25.viii.1990 and 29.iv.1991).

****Phytomyza ranunculivora* Hering**

Reared from leafmines in *Ranunculus repens* L. collected at Balrobbie Farm (NN 9062), Mid Perthshire (v.c. 88) on 7.x.1990 (emerged 21.v.1991).

****Phytomyza symphyti* Hendel**

Reared from leafmines in *Symphytum officinale* L. collected at Longniddry (NT 4477), East Lothian (v.c. 82) on 24.viii.1991 (emerged 17.ix.1991).

****Phytomyza tetrasticha* Hendel**

Reared from leafmines in *Mentha* sp. collected by Duddingstone Loch (NT 2872), Midlothian (v.c. 83) on 3.ix.1991 (emerged 5.vi.1992).

Acknowledgement

I am grateful to the Royal Museum of Scotland, Edinburgh for allowing me to quote material in their collections and for access to the Scottish Insect Records Index.

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A NOTE ON THE REARING OF *SOLVA MACULATA* (MEIGEN) (XYLOMYIIDAE)

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On 26.iii.1991 I visited the New Forest to search for diptera larvae. In a large fallen beech I located a substantial water-filled cavity containing some Eristaline hoverfly larvae. Approximately a litre of "slurry" from the bottom of the cavity was transferred to a plastic ice cream container. This I took home and kept in an unheated wooden garden shed.

Two species of Syrphidae, *Myathropa florea* (L) and *Mallota cimbiciformis* (Fallén) were duly reared, but it was not long before it became apparent that these were not the only inhabitants. On 24.v.1991 I found a larva, which I recognised as a "*Solva*" type, crawling around on the lid of the container. As it appeared to be looking for somewhere to pupate, I transferred it to a container of damp soil, where it buried itself. A male *Solva maculata* emerged on 20.vi.1991.

Stimulated by this bonus, I made a careful search of the remaining "slurry" and found two smaller larvae under a decaying beech leaf on the surface. These I continued to check on throughout the summer. Occasionally they would "disappear" for weeks at a time, presumably down into the "slurry" (which by then had the consistency of runny porridge) only to reappear and move around on the surface. In November they left the "slurry" and I transferred them to a container of damp soil where they buried themselves. Both emerged the following summer, a male on 27.v.1992 and a larger female on 31.v.1992. All specimens are deposited in the collections of Hampshire County Museum Service.

It is worth noting that all three adult *S. maculata* must have emerged at night or very early in the morning, as they were not out at 1800/1900 hours the previous evening, but were fully inflated and active by 0900 hours.

Previous authors (Parmenter 1950, 1951; Brindle 1961; Falk 1991) have given decaying beech wood and rot holes as the substrate for the larvae of *S. maculata*, but I have found no other reference to them living a semi-aquatic existence in water-filled rot holes. My experience may at least partly explain an observation by Stubbs (pers. comm.) who found empty skins of puparia floating in several water-filled cavities in a gale-felled beech. In addition, it also confirms that *S. maculata* may take up to two years, if not more, to become adult.

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***EOSERISTALIS CRYPTARUM* (DIPTERA, SYRPHIDAE) - ON DARTMOOR**

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In August 1993 Roger Morris and Stuart Ball wrote to us of their exciting re-discovery of *Eoseristalis cryptarum* on Dartmoor. Previously, we had searched unsuccessfully at several old localities for this species which was last recorded in Britain in 1978.

On 21 August 1993, we visited an isolated marshy bog in an open flat area of heathland on Dartmoor. An adjacent stream supplies the site with water and a clump of trees gives shelter. The site is about 300 by 150m and has an altitude of 341m. Here we were delighted to find *E. cryptarum*. At first we saw only females but over the next 2-3 weeks we found both sexes.

In the field, *E. cryptarum* appears as a rather small, stout and conspicuously dark *Eoseristalis* with a shining thorax and striking white bands at the posterior edges of the tergites. The fulvous wing patches add to its dark appearance. The orange side patches on tergite 2 are stronger in the male than the female.

We saw females feeding at the flowers of sedges and rushes. Other females seen were sunning themselves at ground level on dry sphagnum moss. On 4 September 1993 which was a warm sunny day with a light breeze, we saw over twenty males hovering and chasing over the wetter areas of the bog. They were rarely seen more than two feet above ground and they often flew much lower. They alighted on the ground and on grass stems or heather. The male flies with an audible hum, similar to that of *Helophilus pendulus*. None of these males were seen to feed. Although other eristalines were present, *E. cryptarum* tended to be the only species occupying the wetter parts of the bog.

To judge from our observations, *E. cryptarum* seems to be a species of wet, boggy heathland. Many such sites exist on Dartmoor but the species is very scarce (RBD 2) so other factors are obviously involved. The precise location is not being made available until its status is re-assessed now that the habitat of the species is better known.

**BRITISH DIPTERA FAUNA - REVISIONS TO THE CHECKLISTS FROM THE
CATALOGUE OF PALAEARCTIC DIPTERA (EDIT. SOÓS, A. & PAPP, L.)
VOLUMES 3-12**

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Kolenohelea De Meillon & Wirth, 1981. New genus, including *calcarata* (Goetghebeur, 1920) = *sharpi* (Edwards, 1929) (syn. by Rieb, J.-P. & Delécolle, J.-C. 1979. *Bull. Soc. ent. Fr.* 84: 240-247) transferred from *Stilobezzia*. *Ann. Natal Mus.* 24: 513 (Ceratopogonidae).

Bezzia fascispinosa Clastrier, 1962. New to Britain. Wirth, Palchick & Forster, 1984. *Proc. Entomol. Soc. Wash.* 86: 155-175. [= sp. indet. of Edwards, 1929] (Ceratopogonidae).

The following nine changes in Ceratopogonidae are due to Szadziewski, R., 1986. *Polskie Pismo Ent.* 56: 3-163.

Forcipomyia costata Zetterstedt, 1838 = *picea* (Winnertz, 1852).

Atrichopogon (S. **Psammopogon** Remm, 1979) **flavolineatus** (Strobl, 1880) = *trifasciatus* Kieffer, 1918.

Dasyhelea (sensu stricto) **saxicola** (Edwards, 1929) = *lithotelmatica* Strenzke, 1950 (not 1951).

Dasyhelea (S. **Sebessia**) **acuminata** Kieffer, 1919 = *polita* Edwards, 1921.

Dasyhelea (S. **Dicryptoscena**) **modesta** (Winnertz, 1852) = *holosericea* s. *aestiva* (Winnertz, 1842) sensu Edwards, 1929.

Culicoides (S. **Monoculicoides**) **algecirensis** (Strobl, 1900) = *puncticollis* (Becker, 1903).

Bezzia coracina (Zetterstedt, 1850) = *albipes* (Winnertz, 1852).

Bezzia leucogaster (Zetterstedt, 1850) = *xanthocephala* Goetghebuer, 1911.

Palpomyia distincta (Haliday, 1833) = *ephippium* (Zetterstedt, 1855).

The following seven further changes in Ceratopogonidae may also be deduced from Remm, H., 1988. Ceratopogonidae. In *Catalogue of Palaearctic Diptera* 3: 11-110.

Alluaudomyia splendida (Winnertz, 1852). New to Britain. Only generic name cited in British Check List.

Brachypogon Kieffer, 1899 and **B. vitiosus** (Winnertz, 1852). New to Britain. (The genus is included in the key to British genera of Ceratopogonidae by Boorman, J. & Rowland, C., 1988. *Ent. Gaz.* **39**: 65-73, without further comment).

Culicoides delta Edwards, 1939 = *lupicaris* Downes & Kettle, 1952.

Culicoides newsteadi Austen, 1921 = *halophilus* Kieffer, 1924.

Culicoides alazanicus Dzhafarov, 1961 = *musilator* Kremer & Callot, 1961.

Culicoides festivipennis Kieffer, 1914 = *odibilis* Austen, 1921.

Culicoides cameroni Campbell & Pelham Clinton, *C. reconditus* Campbell & Pelham Clinton, *C. segnis* Campbell & Pelham Clinton and *C. dendriticus* Boorman are referred to *S. Oecacta* Poey. There are also subgeneric changes in *Atrichopogon*, *Forcipomyia* and recognition of subgenera in *Dasyhelea*.

The following four changes in *Serromyia* Meigen, 1818 (Ceratopogonidae) are due to Borkent, A. & Bissett, B., 1990. *Syst. Ent.* **15**: 153-217.

Serromyia atra (Meigen, 1818) = *nitens* Goetghebuer, 1920.

Serromyia ledicola Kieffer, 1925. New to Britain.

Serromyia rufitarsis (Meigen, 1818). New to Britain.

Serromyia subinermis Kieffer, 1919. New to Britain.

Zabrachia tenella (Jaenicke, 1866) = *minutissima* auctt. nec (Zetterstedt, [1838]). Correction made by Beuk, P. L. Th., 1990. *Ent. Ber.*, Amsterdam **50**: 101-106. (Stratiomyidae).

Palloptera modesta (Meigen, 1830) = *parallela* Loew, 1858. Synonymy by Morge, G., 1967. *Naturk. Jb. Stadt Linz* **13**: 141-212 (Pallopteridae).

Palloptera marginata (Meigen, 1826) = *costalis* Loew, 1873. Synonymy by Morge, G., 1981. *Beitr. Ent.*, Berlin **31**: 305-306. (Pallopteridae).

Neossos Malloch, 1927 = *Ornitholeria* Frey, 1930 (transferred from Heleomyzidae to family Chiropteromyzidae). One species, *Neossos nidicola* (Frey, 1930). Changes according to Hackman, W., 1980. *Notulae Ent.* **60**: 117-162.

Liriomyza huidobrensis Blanchard, 1926. New to British Isles from Ireland (introduced species). Hume, T., Dunne, R. & O'Connor, J.P., 1990. *Ir. Nat. J.* **23**: 325-326.

The following four additions to the Agromyzidae are due to Robbins, J. 1989. *Dipterist's Digest* 2: 17-30.

Amauromyza lamii (Kaltenbach, 1858). New to Britain.

Chromatomyia fuscata (Zetterstedt, 1838). New to Britain.

Phytomyza erigerophila Hering, 1927. New to Britain.

Phytomyza pauliloewi Hendel, 1920. Confirmed as British.

Chamaemyia triorbiseta Beschovski & Tanassijtchuk, 1990. New species. *Reichenbachia* 28: 79-87. (Chamaemyiidae).

[*Chamaemyia nigripalpis* Collin, 1966 is synonymised with both *juncorum* (Fallén, 1823) and *geniculata* (Zetterstedt, 1838) by Beschovski & Tanassijtchuk, 1990; both species were present in the type series and no lectotype was designated so the synonymy has not been validated].

Meoneura prima (Barnes, 1903) = *seducta* Collin, 1937. Synonymy by Papp, L., 1977. *Acta Zool. Hung.* 23: 171-181. (Carnidae).

The following seven changes in *Hydrellia* Robineau-Desvoidy, 1830 (Ephydriidae) are due to Zatwarnicki, T., 1988. *Polskie Pismo Ent.* 58: 587-634.

Hydrellia meigeni Zatwarnicki, 1988 = *albiceps* (Meigen, 1830) nec *albiceps* (Meigen, 1824).

Hydrellia ishiaca Loew, 1862 = *appendiculata* Collin, 1966.

Hydrellia griseola (Fallén, 1813) = *chrysostoma* (Meigen, 1830) (supporting this synonymy established by Collin, J.E., 1966. *Boll. Mus. Civ. St. Nat. Venezia* 16: 7-18, 20 pls.)

Hydrellia laticeps Stenhammar, 1844 = *flaviceps* sensu Collin, 1966 nec (Meigen, 1830).

Hydrellia maura Meigen, 1838 = *modesta* Collin, 1928.

Hydrellia flaviceps (Meigen, 1830) = *transsylvana* Becker, 1896 = *discors* Collin, 1966. (Zatwarnicki, T., 1986. *Polskie Pismo Ent.* 56: 133-141 had already synonymised *discors* with *transsylvana*).

Ditrichophora collini (Canzoneri & Meneghini, 1977). New species, described in *Discocerina* S. *Ditrichophora*). *Soc. Sci. Ven. Nat.* 2: 22-29. [Transferred to *Ditrichophora* S. *Gymnoclasiopa* Hendel, 1930 by Zatwarnicki, T., 1991. *Dtsch. ent. Zeit.* N.F. 38: 295-333]

The following additional changes in Ephydriidae may be deduced from Cogan, B.H., 1984. Ephydriidae. In *Catalogue of Palaearctic Diptera* 10: 1-402.

S. Parathyroglossa Hendel, 1931. for *Athyroglossa ordinata* Becker, 1896.

Schema Becker, 1907 = *Pelignus* Cresson, 1926 (not Loew, 1864).

Schema acrosticalis (Becker, 1903). New to Britain.

Discocerina obscurella (Fallén, 1813) = *palliditarsis* (Becker, 1896) (the synonym transferred from Ditrichophora).

Ditrichophora plumosa (Fallén, 1823) = *longula* (Stenhammar, 1844).

Notiphila stagnicola (Robineau-Desvoidy, 1830). New to Britain.

Dichaeta Meigen, 1830. Reduced to subgenus of *Notiphila* Fallén.

Philygria maculipennis (Robineau-Desvoidy, 1830) = *sexmaculata* Becker, 1896.

Hydrellia falvicornis (Fallén, 1823) = *nigripes* Zetterstedt, 1838 (transferred from synonymy of *cochleariae* (Haliday)).

Delete brackets from *Hydrellia porphyrops* Haliday, 1939, *H. ranunculi* Haliday, 1939 and *H. thoracica* Haliday, 1839.

Pelina aenea (Fallén, 1813) = *aenescens* (Stenhammar, 1844).

Parydra hecate (haliday, 1833). Not *hecata*.

S. Chaetoapnaea Hendel, 1930 for *Parydra pusilla* (Meigen, 1830) (other species of *Parydra* sensu stricto).

Limnellia quadrata (Fallén, 1813) = *graminum* (Haliday, 1833) (not a nomen dubium).

Delete *Halmopota* Haliday, 1856 and its species ?? *salinarum* (Bouché, 1834).

S. Neoscatella Malkloch, 1933 for *Scatella silacea* Loew, 1860 and *S. subguttata* (Meigen, 1830) (other species in *Scatella* sensu stricto).

Teichomyza Macquart, 1835. Reduced to subgenus of *Scatella* Robineau-Desvoidy, 1830.

Incertella Sabrosky, 1980 = *Tropidoscinis*: auctt., nec Enderlein, 1911. New genus including British species previously referred to *Tropidoscinis* except *nigriformis* (Duba, 1933) which is transferred to *Conioscinella*. *Proc. ent. Soc. Lond.* 82: 412-429. (Chlorophidae).

Chlorops Meigen, 1803 = *Anthracophaga* Loew, 1866. Synonymy by Beschovski, V.L., 1979. *Reichenbachia* 17: 219-223. (Chlorophidae). [*Chlorops* is masculine and all specific names ending in *a* should be corrected to *us* except for *hypostigma* which is a noun ending in apposition]

Pollenia *viatica* Robineau-Desvoidy, 1830 = *pallida* Rohdendorf, 1926 = *carinata* Wainwright, 1940. Synonymy by Rognes, K., 1991. *Syst. Ent.* 16: 439-488. (Calliphoridae)

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