# A PRELIMINARY ASSESSMENT OF THE DISTRIBUTION AND STATUS OF MONTANE BRACHYCERA AND CYCLORRHAPHA (DIPTERA) IN SCOTLAND


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**Summary**

This study greatly increases the knowledge of the ecology, distribution and status of montane Diptera in Scotland. The results of our own collecting are presented and previous records from the literature, museum collections and other unpublished records are reviewed.

Adult Diptera were collected by water-traps, pitfalls and casually from upland habitats at 176 localities on 38 hill ranges widely spread through the Scottish uplands.

From the collated records 24 species, mainly or only caught above the potential climatic tree line, were identified as comprising the montane Brachycera and Cyclorrhapha of Scotland. 21 of these species were caught in this study.

Of these 24 montane species 22 are assigned to a rarity category by Falk (1991), fifteen as Red Data Book (RDB) species and seven as Notable species. The data we have gathered (422 records from this study and 135 previous records) has allowed us to re-evaluate the status of many of these species and our suggestions are included in the text.

The montane species fall into three general geographical patterns of distribution in Great Britain. These are :

- Widespread
- Highland
- Grampian

The distribution of the species groups shows some degree of correlation with low mean maximum summer isotherms and these are suggested as a factor limiting the range of species.

## Introduction

Montane Diptera are defined in this report as those species that have been captured mainly above the potential natural tree-line. In Scotland the climatic limit of forest has been estimated to range from 610-690m in the Grampians (Pears 1968), descending to about 300m in the cooler and more exposed north-west Highlands and to near sea-level in the Northern Isles (Ratcliffe & Thompson 1988). The habitats found within this montane zone consist of vegetation characterised by tall shrubs such as juniper and willow, natural heaths of heather and bearberry, grasslands, moss-heaths, late snow-bed vegetation, flushes and springs, rock and freshwater habitats.

About 2.5% of Britain's land surface lies above an altitude of 610m (2000ft), while 0.2% lies above 914m (3000ft). Scotland holds the largest area of high ground in the British Isles, with 89% (5039 $km^2$) of the total of 5665 $km^2$ above 610m, and 98% (394 $km^2$) of the 404 $km^2$ above 914m (Ratcliffe & Thompson 1988). Despite covering a large area, the remoteness and relative inaccessibility of montane areas in Scotland has resulted in there being few records of montane Diptera. Most previous records are from the Cairngorms in the eastern Highlands and the Breadalbane range in the southern Highlands between Beinn Laoigh and Ben Lawers. Many of these earlier records are scattered in the literature or are represented by specimens in museum collections. More systematic work on the montane flies of part of the Breadalbane range near Killin in Perthshire was carried out by Edwards (1933a, b) and Collin (1933) who found many species new to Britain. More than 60 years after these ground-breaking studies a review is timely.

Over a period of 10 years we have collected Diptera from a wide range of high altitude locations throughout the Highlands and the Southern Uplands of Scotland, especially in areas outside those frequented by earlier workers. Water traps, pitfall traps and hand-collecting were used to collect large numbers of specimens. This work has produced a large number of additional records, which are collated together with earlier records. Twenty-four species are provisionally designated as montane Diptera and their distributions patterns and conservation status are assessed. The data are discussed in relation to the wider distribution of the species in Britain and Europe.

## Methods

Trapping was the main method used to collect adult Diptera. Three main types of trap were employed:

(1) white (occasionally yellow or orange) water-trap bowls (dia. 14-23cm), generally placed among boulders or on cliffs to protect against disturbance by deer or sheep;

(2) yellow water-trap bowls (dia. 15cm) sunk flush with the ground surface, which meant that they also acted as pitfall traps;

(3) white pitfall traps (plastic beakers dia. 6.5cm) sunk flush with the ground surface.

All types of trap were filled to within 3-5cm of the rim with 2-4% formalin with a few drops of detergent added to reduce the surface tension and thus facilitate capture of specimens. The long-lasting preservative powers of the formalin ensured that the catch remained fresh for up to a month between collections. The collected material was stored in 70% alcohol until identification.

Most of the trapping took place between mid May and mid July, although in Lurcher's Gully (Cairngorms) it was between late May and late August and on Creag Meagaidh it extended between mid May and early October.

At seven sites (An Teallach, Beinn Dearg, Bidean nam Bian, Creag Meagaidh, Fannich Hills, Lurcher's Gully and Tweedsmuir Hills) two or more sets of traps were in operation both in open ground within the upper levels of the potential forest zone, or in birch woods, and in montane habitats. This allowed distinctions to be made between species which were truly restricted to the montane zone and those which also occur at lower altitudes. Also, a Malaise trap was operated in a native pine wood at 300m.

Specimens were also caught by direct tubing and occasionally by sweep-netting. The altitude of capture of the specimens and the vegetation in which they were caught were noted.

Bowls and pitfalls were operated on 16 hill ranges or other areas across the Highlands and on one hill range in the Southern Uplands. Specimens were also taken casually (by tubing and sweep-netting) on these hills and on a further 21 hill ranges or other areas. Collecting was carried out at more than one locality on most hills giving a total of 176 locality records from the 38 areas or hill ranges. Specimens were captured from a total of fifty-five 10 km squares

To obtain previous records of Diptera at high altitude we carried out a search of the literature, consulted Nature Conservancy Council (NCC) record cards compiled by Steven Falk, obtained records from museum collections (British Museum of Natural History (BMNH), Hope Department at Oxford, Cambridge and Doncaster Museums and the Royal Museum of Scotland (RMS) and made our own examination of the RMS collection. Other entomologists also kindly provided us with records.

Nomenclature follows Kloet & Hincks (1976) for Empididae and Dolichopodidae, Dely-Draskovits (1993) for Anthomyiidae, Gorodkov (1984) for Heleomyzidae, Gorodkov (1986) for Scathophagidae, Pont (1986) for Muscidae, Peck (1988) for Syrphidae and Rognes (1991) for Calliphoridae.

**Results**

From the collated records of Brachycera and Cyclorrhapha 24 species were provisionally considered to meet the definition of a montane species in Scotland:

| | |
|---|---|
| **Brachycera** | |
| Empididae | *Rhamphomyia hirtula* Zett. |
| | *Rhamphomyia morio* Zett. |
| | *Clinocera nivalis* (Zett.) |
| | *Wiedemannia impudica* Mik |
| Dolichopodidae | *Dolichopus maculipennis* Zett. |
| | *Hydrophorus rufibarbis* Gerstaeker |
| **Cyclorrhapha** | |
| Syrphidae | *Platycheirus melanopsis* Loew |
| | *Cheilosia sahlbergi* Becker |
| Heleomyzidae | *Scoliocentra scutellaris* (Zett.) |
| Calliphoridae | *Calliphora stelviana* (Braur & Bergenstamm) |
| Scathophagidae | *Gonatherus planiceps* (Fall.) |
| Anthomyiidae | *Alliopsis albipennis* (Ringdahl) |
| | *Alliopsis atronitens* (Strobl) |
| | *Botanophila moriens* (Zett.) |
| | *Zaphne spiniclunis* (Pandelle) |
| | *Delia caledonica* Assis Fonseca |
| | *Delia pilifemur* (Ringdahl) |
| | *Delia piliventris* Pokorny |
| Muscidae | *Thricops aculeipes* (Zett.) |
| | *Thricops hirtula* (Zett.) |
| | *Phaonia meigeni* Pont |
| | *Phaonia subfuscinervis* Zett. |
| | *Spilogona alpica* Zett. |
| | *Spilogona triangulifera* (Zett.) |

These include three species not taken in the present study. ( *W. impudica, A. albipennis* and *D. pilifemur).*

**Geographical distribution**

The known geographical distribution patterns of the 24 montane Diptera are tentatively identified as belonging to three groups.

The **Widespread** group includes ten species which are to be found widely in the Highlands and further south either in the Southern Uplands of Scotland or in the uplands of England and Wales. *R. morio* and *P. melanopsis* are also recorded from some of the Scottish islands. *A. atronitens* is the only species which apparently reaches the southern limit of its distribution in the Southern Uplands

This group includes :

*Rhamphomyia morio, Platycheirus melanopsis, Scoliocentra scutellaris, Calliphora stelviana, Gonatherus planiceps, Alliopsis atronitens, Thricops aculeipes, Thricops hirtulus*, *Phaonia meigeni* and *Phaonia subfuscinervis.*

The **Highland** group of eight species is found on high ground throughout the Scottish Highlands. *Delia caledonica* is exceptional within the group in that it has a western and northern, oceanic distribution and descends to lower altitudes in the far north. *D. caledonica* and *Spilogonia alpica* are exceptional for the group in being found on islands.

The species are:

*Clinocera nivalis, Dolichopus maculipennis, Hydrophorus rufibarbis, Botanophila moriens, Delia caledonica, Delia piliventris, Spilogona alpica* and *Spilogona triangulifera.*

The **Grampian** group contains six species which are apparently confined to the high mountains of the Central Highlands from Ben Nevis in the west to the Cairngorms and Glas Maol in the east.

The species are :

*Rhamphomyia hirtula, Wiedemannia impudica, Cheilosia sahlbergi, Alliopsis albipennis, Zaphne spiniclunis* and *Delia pilifemur.*

**Species Accounts** follow for all the montane species incorporating information from our own survey work, museum collections, published work (including our own), Nature Conservancy Council record cards and other records. Some earlier records lacking grid references have been assigned 10 km square grid references encompassing the locality of the record. Where the earlier record is sufficiently precise an estimate of the altitude of the record is also given.

The Red Data Book (RDB) and Notable status of species are taken from Falk (1991) where full definitions and criteria are given for the different categories. RDB species are those estimated to exist in 15 or fewer 10 km squares at the present time and are graded RDB 1, 2, 3 and K;

respectively endangered, vulnerable, rare and insufficiently known. Notable species exist in 16-100 10 km squares. The status categories of Falk (1991) are reassessed in the light of the additional data presented on distribution and abundance. The European distribution of the species is also given.

## SPECIES ACCOUNTS

### RHAMPHOMYIA HIRTULA

**FAMILY Empididae**

***Rhamphomyia hirtula* Zett.**

**Distribution:** Grampian group.

The present records show the distribution of this species to be highly disjunct. There are records from the Cairngorm and Caenlochan-Glen Clova ranges in the eastern Highlands and a more isolated record for Bidean nam Bian in Glencoe.

The species was previously known from the eastern Grampians (Cairngorms and Glen Clova). Our records confirm its continuing presence there and extend the known range westward to Glencoe.

**Previous records:** Collin (1961) records the species from Glen Clova, Angus, taken in 1895 and 1896, and in some numbers near the summit of the Lairig Ghru (Aviemore-Braemar pass, Cairngorms, NH 9700, about 820m) on 22 June 1933. A specimen was taken in 1962 at about 1100m on the south flank of Cairn Gorm (NH 997023), captor unknown (NCC record cards); while in June 1984 J. Cole (NCC record cards) also took a specimen on Cairn Gorm.

**Habitat:** The species is only known from high altitudes (800-1100 m). Our records are from a range of montane vegetation including *Racomitrium lanuginosum* moss-heaths, *Racomitrium-Empetrum* heaths, *Deschampsia cespitosa* and *Nardus stricta* grasslands and tall-herb ledges.

**Status:** This species is only known from twenty-nine specimens and from six 10 km squares. At present this species is classified as RDB 3 but with such a small number of sites and few specimens taken we would consider **RDB 2** to be more appropriate.

**European distribution :** Engel & Frey (1938-56) give Britain, Iceland and Greenland. Therefore, outwith Britain, this species has an arctic-subarctic distribution.

**RHAMPHOMYIA MORIO**

**FAMILY Empididae**

***Rhamphomyia morio* Zett.**

**Distribution:** Widespread group

This species is widely spread throughout the Highlands with additional records from the islands of Rum, Jura, Lewis, St. Kilda and Orkney. It is also present in the Southern Uplands and on the Grampian coast (Kincardine).

Our records fill in the previously known widely scattered distribution in the western and southern Highlands and extend it to the Cairngorms, Ebudes and Southern Uplands.

**Previous records:** There are montane records from "Grey Fell" Rannoch (?Garbh Mheall, NN55) and on "high ground" on Meall Ghaordaidh and Beinn Heasgarnich in the Killin district of Perthshire (Edwards 1933b, Collin 1961). L. Davies took specimens on Foinaven (427m) in West Sutherland in 1970 (RMS). A.R. Plant has taken the species in Coire an Laoigh on Beinn Eighe (NG 9759, West Ross) between 12-20 June 1989 (pers. comm.).

There are coastal records from Muchalls (Kincardine - a record requiring confirmation), St Kilda and Isle of Lewis (Collin 1961) and from exposed shores on Orkney (Laurence 1988).

*R. morio* is also known from northern England (Nelson 1971) and Wales (Collin 1961, Goodier 1965).

**Published records from this study:** Horsfield (1988a) gives records from An Teallach, Wester Ross.

**Habitat:** Our records are from a wide range of montane vegetation types including grasslands, ericaceous dwarf-shrub heaths, *Racomitrium lanuginosum* moss-heaths, tall-herb ledges, wet flushes and springs.

**Status:** This species is one of the more frequently taken species and is known from twenty-five 10 km squares in Scotland. Taking English and Welsh records into account the present **Notable** status is satisfactory.

**European distribution :** Ringdahl (1951) gives the distribution as "arctic-subarctic". Engel & Frey (1938-56) give Britain and northern Scandinavia.

## CLINOCERA NIVALIS

**FAMILY Empididae**

***Clinocera nivalis* (Zett.)**

**Distribution:** Highland group.

This species is known from the eastern, southern, central and north-western Highlands. The records are scattered with the main concentration in the Breadalbane range, Perthshire.

Our records extend the previously known range in the eastern and southern Highlands into the central and north-western Highlands.

**Previous records:** Edwards (1933a) caught this species near the summit of Ben Nevis (about 1300m) and on the Perthshire hills of Ben More, Beinn nan Eachan, Ben Lawers, Beinn Heasgarnich and Beinn a' Chreachain (Edwards 1933b). Edwards (1933a, b) found most of his specimens on wet stony and mossy slopes, especially below melting snow patches, always above 850m.

Collin (1961) records this species from near the summit of the Lairig Ghru (830m). J.M. Nelson (pers. comm.) found it in an *Anthelia julacea* spring in Coire Raibert near the summit of Cairn Gorm at around 1000m (NJ 0003) in the 1960's while a single male was taken by I. Perry (pers. comm.) at 1000m on Cairn Gorm on 15 June 1990.

**Published records from this study:** Horsfield (1984) gives a record from the Fannich Hills in Wester Ross.

**Habitat:** This species has been hand-caught by us and others on bryophyte springs which is probably one of its main habitats. We have also taken it in traps set in *Racomitrium* moss-heath near to wet grassy flushes and in a moss-dominated snow-bed community, also with flushes.

**Status:** This species is only known from a small number of specimens from eleven 10 km squares . Although the species is probably restricted to bryophyte springs and flushes these are widespread in the Highlands within the known altitudinal range. The trapping methods we employed are possibly not the best for detecting this species which probably does not fly a great deal, and it is likely to prove more widespread than our records indicate. At present **RDB 3** status seems appropriate.

**European distribution :** Ringdahl (1951) gives the distribution as "arctic". Engel & Frey (1938-56) record this species from northern Europe and Siberia (Lapland).

## WIEDEMANNIA IMPUDICA

**FAMILY Empididae**

***Wiedemannia impudica* Mik**

**Distribution:** Grampian group.

This species is only known from Loch Avon in the Cairngorms (Banff). No specimens were taken during the present survey.

**Previous records:** This species was taken by the rocky shores of Loch Avon, Cairngorms (730m) by R.L. Coe on 7 August 1937 (Collin 1961). A further specimen was taken by J.M. Nelson in the same place on 18 August 1984 (RMS).

**Habitat:** The adults have presumably been taken from shingle or emergent boulders around the loch edge, a habitat characteristically occupied by other species in the family. The larva may live in moss on emergent boulders.

**Status:** Since the species is only known at present from a single locality, **RDB 1** status is appropriate.

**European distribution :** Engel & Frey (1938-56) give Norway, Faeroes and central European mountains, which equates to a boreo-alpine distribution.

## DOLICHOPUS MACULIPENNIS

**FAMILY Dolichopodidae**

***Dolichopus maculipennis* Zett.**

**Distribution:** Highland group.

This species is mainly known from the southern Highlands west of Killin and from the western and north-western Highlands.

Earlier records were from Perthshire. Our records extend the known range of this species into the western and north-western Highlands and to Glas Maol in the east.

**Previous records:** The earliest records of this species are from the Perthshire hills of the Ben Lawers group including Stuchd an Lochain, Creag na Caillich, Meall Ghaordaidh and Ben Challum (Edwards 1933b). There are later records from Ben Lawers itself in the 1970's by J. Cole and P. Skidmore and from the neighbouring Beinn Heasgarnich by Nelson (1984).

**Published records from this study:** MacGowan (1987) and Horsfield (1988b) give details of all British records up to and including 1985.

**Habitat:** This species has been taken by us in a range of mainly wet habitats on or by small permanent pools, in bryophyte flushes, flushed grasslands and wet mire. All the records are from the more calcareous mountains of the Highlands.

At our Beinn Dearg trap site (on Am Faochagach) the majority of specimens were captured near a cluster of small pools at 780m. Similarly, Edwards (1933b) recorded it from the wet, black mud of partly dried pools, at about 610m.

**Status:** This species is known from 23 records from eleven 10km squares. This species probably has a specialised habitat, with a preference for more base-rich hills. Apparently suitable habitat is widespread on the hills from which it has been taken within the known altitudinal range. We consider that the rarity category **RDB 3** fits the definitions and criteria better than the current RDB 2 .

**European distribution :** Ringdahl (1951) gives the distribution as "arctic-highboreal". Stackleberg (1933) calls it "a boreal moorland species" and gives the Soviet Union, Finland, Sweden, Norway and Denmark. According to Dahl (1968) it occurs at sea-level in bog-meadow biotopes within the Arctic Circle in Norway, while Ringdahl (1928) states that it is common in bogs in central and northern Sweden.

## HYDROPHORUS RUFIBARBIS

**FAMILY Dolichopodidae**

***Hydrophorus rufibarbis* Gerstaeker**

**Distribution:** Figure 6. Highland group.

This species is widely distributed throughout much of the Scottish Highlands. There are two main concentrations of records in the eastern Highlands on the Cairngorms and surrounding hills, and in the north-west and northern Highlands in West Ross and East Ross. Our records extend the previously known range in the eastern and southern Highlands to the central, western, north-western and northern Highlands.

**Previous records:** This species was taken in Glen Callater near Braemar in July 1873 (Verrall 1904-5), on Meall Ghaordie in Perths (Edwards 1933b), on the Pools of Dee in the Cairngorms by J.E. Collin in 1934 (Assis Fonseca 1978), on Cairn Gorm by W.H. Tans in 1934 (BMNH), on Beinn Heasgarnich in Perths (Nelson 1984) and near Tomintoul north of the Cairngorms in July 1988 (I. Perry, pers. comm.).

**Published records from this study:** Horsfield (1984) gives a record for the Fannich Hills, while MacGowan (1987) gives a summary of all records to date.

**Habitat:** Our records are from a wide variety of wet habitats most frequently the surface of small peaty pools but also grassy flushes, bryophyte springs and once from a dubh lochan. The pools were located in a wide range of vegetation on peaty soils, most commonly *Nardus stricta* snow-bed grassland but also *Calluna-Scirpus* heath, *Calluna* heath and *Calluna-Eriophorum* blanket bog. Records from other habitats where specimens were caught in traps were possibly of stray individuals.

Our records show that there is a tendency for this species to be found at lower altitudes in the northern Highlands. At high altitudes it was unaccompanied by other members of the genus but in the lower part of its altitudinal range it was sometimes found on pools with *Hydrophorus albiceps* Frey. *H. albiceps* appears to replace *H. rufibarbis* at lower altitudes and occurs especially on pools on the deep peat of blanket bog. Two females found under flat stones on a well-drained slope at 820m in September 1990 on Mullach Coire Mhic Fhearchair suggest that this species may over-winter as adult. The altitudinal range of our records is from 518m to 1020m. The species has been recorded at 400m and 500m by I. Perry and G.H. Verrall in the eastern Highlands.

**Status:** There are 60 records for this species and it is known from 20 hill ranges and thirty-three 10 km squares, higher than any other species partly due to the large number of captures by hand-collecting. **Notable** status seems appropriate at present.

**European distribution :** Ringdahl (1928) lists this species as "boreal" and states that it had been found in Lapland. Stackleberg (1933) gives the distribution as "Central Europe" while Jonassen (1988) records this species from Norway. Its distribution therefore appears to be boreo-alpine.

## PLATYCHEIRUS MELANOPSIS

**FAMILY Syrphidae**

***Platycheirus melanopsis* Loew**

**Distribution:** Widespread group.

This species is mainly known from the Grampians ranging from the Cairngorms and Glas Maol in the east to Meall nan Gabhar near Ben Laoigh and Ben Nevis in the west. There are a few more isolated records in the northern and north-west Highlands as far north as Loch Assynt and the species also occurs on Rum.

Our records have helped to fill in the widely scattered previous records of this species with records from the southern, central, eastern, western and northern Highlands.

**Previous records:** There are records from Braemar and Rannoch (Verrall 1901); from Loch Assynt (Yerbury 1912); from Schiehallion (Speight 1966); from Fionchra, Rum (Ravenscroft et al 1991); and Meall nan Gabhar, Succoth, Dalmally (Christie 1990).

The species is also known from Helvellyn in the English Lake District (Verrall 1901).

**Habitat:** This species was taken by us in a wide range of montane and sub-montane vegetation. The majority of our records are from ericaceous dwarf-shrub-dominated heaths or from vegetation where dwarf-shrubs are co-dominant with sedges such as blanket mire or wet heath. Some records are from moss-dominated summit heaths and grasslands. Specimens were also taken from *Caltha palustris* flowers in wet flushes.

On an altitudinal transect of traps on Creag Meagaidh the largest numbers were caught in tall *Calluna vulgaris* and *Vaccinium myrtillus* heaths between 510-760m though it also ranged above and below that. We have had a single capture in a pine-wood at 300m (Coille Coire Chuilc, Tyndrum, NN 3227) which is our only record from woodland.

**Status:** There are 37 records of this species which has been taken from fourteen hill ranges and seventeen 10 km squares in Scotland . There is one English record. The species exceeds the threshold of 15 km squares for an RDB species and with a widespread habitat seemingly available, is not considered to be under threat. **Notable** status rather than RDB3 would be a better indicator of it's current status.

**European distribution :** Peck (1988) gives Sweden, Poland, Czechoslovakia, France, Switzerland, Austria, Italy, Romania, Bulgaria and the USSR. Assuming this mainly central European species occurs in the mountains or at high altitudes in the more southerly parts of its range its distribution would be lowboreal-montane (or -alpine).

## CHEILOSIA SAHLBERGI

**FAMILY Syrphidae**

***Cheilosia sahlbergi* Becker**

**Distribution:** Grampian group.

This species is only known from the Grampians though it ranges across from the Cairngorms and Glas Maol in the east to Ben Nevis and Bidean nam Bian in the west. Our records extend the known range from the Cairngorms and Breadalbanes westwards to Ben Nevis and Glencoe, and into the central Grampians.

**Previous records:** This species was originally found in Britain on the Cairngorms (Glen Feshie and Braeriach) by C.H. Andrewes during the 1950's (NCC record cards, specimens in BMNH).

Other records are from Beinn a' Chuallaich (Speight 1966, 1974), Ben Lawers (Stubbs & Falk 1983) and Loch na Lairige (P. Skidmore, specimens in Doncaster Museum), all in Perthshire; and from Carn Liath (NO 1697), Aberdeenshire (E.C. Pelham-Clinton). Details of the last two records are from NCC record cards.

**Habitat:** Our records are from a wide range of montane vegetation types though the largest number of specimens were taken by traps which were situated in flushed *Deschampsia cespitosa* grasslands or dripping wet crags with *Cochlearia, Sedum rosea* and other herbs. Two specimens were taken by hand from flowers of *Caltha palustris* in wet flushes and the species was taken throughout Lurcher's Gully where there is widespread flushing. Other records are from *Nardus stricta* grassland, ericaceous dwarf-shrub heaths, flush mires and bryophyte springs.

Speight (1974) records the species on *Potentilla erecta* flowers in a somewhat boggy area near a stream on open montane heathland at an altitude of 763m. Stubbs & Falk (1983) state that it has been taken on mountains with local base-rich soils. They note that a specimen was found on *Saxifraga* flowers by boggy flushes. Our records are mainly from mountains with locally base-rich rocks including schist and igneous rock, but also from Braeriach and Lurcher's Gully in the Cairngorms where the rocks are wholly acidic granite. However, both these sites of capture on the Cairngorms are subject to localised flushing resulting in floristic enrichment.

**Status:** There are 23 records of this species from eight hill ranges and thirteen 10 km squares . Some 244 specimens were caught during our survey which further suggests that the species should be regarded as **RDB 3** rather than RDB 2.

**European distribution :** According to Speight (1974) this is a montane species in Europe occurring in Finland, Germany, Poland and Switzerland. Peck (1988) records this species from Scandinavia, Czechoslovakia, Switzerland, Romania, Bulgaria and the USSR. This distribution is possibly boreo-alpine.

| SCOLIOCENTRA SCUTELLARIS | RDB 3<br>FAMILY Heleomyzidae |
|---|---|

***Scoliocentra scutellaris* (Zett.)**

**Distribution:** Figure 9. Widespread montane group.

This species is mainly known from the western end of the Grampians. There are more isolated records from Glas Maol in the eastern Highlands, from Bonhill near Loch Lomond and from the Tweedsmuir Hills in the Southern Uplands.

Our records extend the known range of this species from the southern Highlands and Midland Valley to the eastern, western and central Highlands and Southern Uplands.

**Previous records:** Collin (1943) states that this species has only been found "on and near the Scottish Grampians". There are specimens in the BMNH from Meall nan Tarmachan (near Killin, Perths, 763-1037m) and from nearby Beinn Heasgarnich, taken in June 1932 (NCC record cards) and there are specimens in the RMS taken by A.J. Malloch at Bonhill, Dunbartonshire in 1906 and 1907.

The species has also been taken by Nelson (1971) on the Moor House NNR in northern England.

**Habitat:** Our records are from a wide range of montane vegetation types including ericaceous dwarf-shrub heaths, grassland, moss-heath and tall-herbs. On Bidean nam Bian it was taken within the upper limit of a birch wood (450m) and on the Tweedsmuir Hills at 550m on an open herb-rich slope within the potential upper altitudinal range of woodland.

**Status:** There are 15 records of this species from eight hill ranges and only eight 10 km squares in Scotland. There is one English record. This and the fact that we only caught thirty-one specimens would lead us to suggest that **RDB 2** would be a more appropriate status rather than RDB 3.

**European distribution :** Ringdahl (1951) gives the distribution as "arctic- high-boreal". Gorodkov (1984) gives Sweden, Finland, Switzerland, Czechoslovakia and USSR. Its distribution therefore seems to be boreo-alpine.

## CALLIPHORA STELVIANA

**FAMILY Calliphoridae**

***Calliphora stelviana* (Brauer & Bergenstamm)**

**Distribution:** Widespread group.

This species has a wide distribution in Scotland occurring across the Grampians from the Cairngorms in the east to Ben Nevis and Ben Heasgarnich in the west. There is a isolated record from the Tweedsmuir Hills in the Southern Uplands.

Our records extend the known range from the Cairngorms to the central, western and north-west Highlands and the Southern Uplands.

**Previous records:** Emden (1954) gives Glenmore (Cairngorms). There is a specimen in the RMS from Braeriach (1220m), also on the Cairngorms, collected by E.C. Pelham-Clinton on 12 July 1955.

This species has been taken in northern England by Fordham (1945), Nelson (1971) and in bait traps in Cumbria and Durham (Dear 1981, Davies 1980) and the central Pennines in Yorkshire (Davies & Laurence 1992).

Davies & Laurence (1992) give a map of the British distribution which incorporates our Scottish records to 1989 inclusive.

**Published records from this study:** Horsfield (1984, 1988a) gives records for Fannich Hills and An Teallach, both in Ross-shire.

**Habitat:** This species was caught by us in a variety of montane vegetation types ranging from tall *Calluna vulgaris* heath to *Racomitrium lanuginosum* moss-heath.

**Status:** There are 17 records of this species from nine hill ranges and eleven 10 km squares in Scotland. There are also eight 10 km square records in England. This species has exceeded the threshold of fifteen 10 km squares for an RDB species , occurs in a wide range of habitat types, and we consider should be regarded as **Notable** rather than RDB 3.

**European distribution :** Ringdahl (1951) gives the distribution as "boreo-alpine". Schumann (1986) gives Norway, Sweden, Finland, Austria, Poland and USSR. Further details are given by Rognes (1991).

## GONATHERUS PLANICEPS

**FAMILY Scathophagidae**

***Gonatherus planiceps* (Fallen)**

**Distribution:** Widespread group

This species is known from the Grampians ranging from the Cairngorms in the east to Ben Nevis in the west and the Ben Lawers group of hills in the south. There are two more isolated and widely separated records for the northern Highlands.

Our records extend the known range of this species from the southern and eastern Highlands to the western, central and northern Highlands.

**Previous records:** Collin (1933) gives Ben Lawers, Stuchd an Lochain and Meall Ghaordie (Perths). There is a specimen in the RMS taken by E.C. Pelham-Clinton on Geal-charn (Cairngorms, NH 8801, 760-915m) on 17 June 1967. Collin (1958) found specimens near the summit of the Lairig Ghru in 1934.

Nelson (1971) took several specimens on the Moor House NNR in northern England.

**Habitat:** This species was taken by us in a range of montane vegetation types including grasslands, ericaceous dwarf-shrub heaths, *Racomitrium lanuginosum* summit moss-heaths and wet heath.

**Status:** There are eighteen records of this species from eight hill ranges and eight 10 km squares in Scotland . There is one record from England. With only 48 specimens captured in this survey we consider the present **RDB 3** status to be appropriate.

**European distr.:** Ringdahl (1951) gives the distribution as "?boreo-alpine". Gorodkov (1986) gives Sweden, Finland, USSR and Germany.

## ALLIOPSIS ALBIPENNIS

**FAMILY Anthomyiidae**

***Alliopsis albipennis* (Ringdahl)**

**Distribution:** Grampian group.

This species is apparently confined to the Cairngorms and was not taken in our surveys.

**Previous records:** This species has only been taken twice in Britain on Ben MacDui (NH 90, 1309m) in the Cairngorms on 5 July 1951 by R.L. Coe (D.M. Ackland, pers. comm.) and on Cairn Gorm itself (?NJ 00) in July 1984 (Pont *in press*).

**Habitat:** This species is only known from very high altitude in Britain where the vegetation is *Juncus trifidus* rush-heath, *Nardus stricta* snow-bed grassland, moss- or sedge-dominated late snow-bed vegetation, springs and flushes.

**Status:** There are only two records of this species from two 10 km squares from two parts of the Cairngorms massif. Possibly our highest trapping site in the Cairngorms at around 1000m altitude in a corrie on the south side of Braeriach and in Lurcher's Gully was not high enough to catch this species. Along with *Delia pilifemur* this appears to be one of Britain's rarest montane flies. Until further ecological data or records are available there is a case for retaining the present **RDB K** (insufficiently known) category for this species.

**European distribution :** Ringdahl (1951) gives the distribution as "arctic" and gives the European records as from Lapland and Jamtland. Dely-Draskovits (1993) gives Norway, Sweden and Finland.

## ALLIOPSIS ATRONITENS

**FAMILY Anthomyiidae**

***Alliopsis atronitens* (Strobl)**

**Distribution:** Widespread group.

This species is widely distributed in the Highlands. It occurs across the Grampians from the Cairngorms and Glas Maol in the east to Ben Nevis in the west and Ben Lomond in the south. North of the Great Glen the species is known from as far north as Ben Armine (East Sutherland). The species also occurs on the Tweedsmuir Hills and Moffat Hills in the Southern Uplands.

**Previous records:** Collin (1933) gives a record for the summit of "Grey Fell" (Rannoch) in June 1898, and records it as common above 760m on mountains in the Killin District (Perths) but gives no further details.

J.M. Nelson (pers. comm.) caught a male and saw many others at flowers of *Saxifraga oppositifolia* on Ben Lawers on 25 May 1974. There are also specimens in the RMS collected by E.C. Pelham-Clinton from the Cairngorms on 15 June 1967 (610-760m), from Carn Liath near Braemar on 7 June 1964 (NO 1697, 760-850m) and from Meall Corranaich (Ben Lawers range, NN 6141, 975m) on 18 June 1955.

**Published records from this study:** Horsfield (1984) gives records for the Fannich Hills.

**Habitat:** This species was taken by us most frequently in *Racomitrium lanuginosum* moss-heath and in *Nardus stricta* snow-bed grassland or in mosaics of the two on summit plateaux. Also, it was taken in prostrate *Calluna vulgaris* heath, *Vaccinium-Empetrum* and *Vaccinium* heaths and *Deschampsia cespitosa* grassland. We have also observed it feeding on flowers of *Loiseleuria procumbens* both in summit dwarf-shrub heath and in *Racomitrium lanuginosum* moss-heaths.

On Creag Meagaidh, Beinn Dearg and in Lurcher's Gully most specimens were taken from 850m to around 1000m, with only a few individuals taken from as low as 575m. In the far north on Ben Armine many individuals were seen on the summit ridge at around 680m.

**Status:** There are at least 47 records of this species from fifteen hill ranges and nineteen 10 km squares. This was the most abundantly taken species during our survey (2296 specimens), though it is not the most widely distributed montane species. This species was not assigned a status by Falk (1991). The number of 10 km squares falls within the 16-100 range for a **Notable** species and we would recommend this status.

**European distribution :** Ringdahl (1951) gives the distribution as "boreo-alpine". Hennig (1966-76) gives the Alps, north- and mid-Sweden and north-Finland. Hackman (1980) also records it for Finland. Dely-Draskovits (1993) gives Austria, France, Great Britain, Italy, Sweden and Finland.

## BOTANOPHILA MORIENS

**FAMILY Anthomyiidae**

***Botanophila moriens* (Zett.)**

**Distribution:** Highland group.

This species is only known from three widely separated high-altitude massifs: the Cairngorms in the eastern Highlands, Creag Meagaidh in the central Highlands and Beinn Dearg in the northern Highlands.

This species was previously thought to be restricted to the Cairngorms. Our records have extended the known range to the central and northern Highlands.

**Previous records:** Earlier records are both from the Cairngorms. These are Ben MacDhui (NN 9999, 1310m) on 5 July 1951 (col. R.L. Coe) and Geal-charn (NH 8801, 915m) on 17 June 1967 (col. D.M. Ackland and E.C.M. Assis Fonseca) (Ackland 1989; D.M. Ackland, pers. comm.). Hennig (1966-76) refers to the Geal-charn record.

**Published records from this study:** Horsfield (1991a) gives records for Beinn Dearg, Creag Meagaidh and the Cairngorms.

**Habitat:** This species was taken by us in a bryophyte spring in *Nardus stricta* snow-bed grassland, in *Racomitrium lanuginosum* moss-heath, *Vaccinium-Empetrum* heath, *Vaccinium myrtillus* heath, *Deschampsia cespitosa* grassland and on a flower of *Caltha palustris* in a spring.

The species has only been taken at high altitude (760-1310m ).

**Status:** There are eight records of this species from three hill ranges and six 10 km squares. Only six specimens were taken during this study, one specimen for each record. This species is presently categorised as RDB K (Insufficiently Known) but based on these numbers of specimens and the limited distribution we consider **RDB 2** status to be appropriate.

**European distribution :** Ringdahl (1951) gives the distribution as "arctic". Hennig (1966-76) gives Sweden, Norway and Scotland. Dely-Draskovits (1993) gives Sweden, Norway and Great Britain.

## ZAPHNE SPINICLUNIS

**FAMILY Anthomyiidae**

***Zaphne spiniclunis* (Pandelle)**

**Distribution:** Grampian group.

This species is only known from the Cairngorms and Glas Maol in the eastern Highlands and from Creag Meagaidh in the central Highlands. The species is widely distributed within the Cairngorms.

This is another species previously thought to be restricted to the Cairngorms. Our records have extended the known range to the central Highlands and in the south east to Glas Maol.

**Previous records:** Females of this species were recorded by Collin (1953) as not uncommon in early June 1934 on mountains in the Cairngorm district, especially near melting snow-drifts. Collin also notes that the only British male that he had seen was taken in the Aviemore-Braemar Pass (Lairig Ghru, Cairngorms) on 10 August 1935 by C.J. Wainwright. There is also a record by J.E. Collin from the Pools of Dee (Lairig Ghru) on 2 June 1934 (D.M. Ackland, pers. comm.). Nelson (1980) reports both males and females near the summit of Cairn Gorm on stones in seepages at 1100m (NJ 0003) on 15 August 1973.

Other records from the Cairngorms are by F.W. Edwards from the top of Cairn Toul in 1931; W.H. Tams and C.J. Wainwright from Cairngorm (sic) in 1934; and P. Skidmore from Beinn a' Bhuird (1190m) in 1966 (NCC record cards). Pont *(in press*) gives a record from Coire an t-Sneachda on the northern flank of the Cairngorms in 1987.

Ashmole (1983) records a male of the species feeding on invertebrates trapped on a snow-bed to the north-east of Ben MacDui in the Cairngorms on 19 July 1982 (NN9999, 1150m).

**Habitat:** This species was taken by us in a range of montane vegetation types. Most captures were in grasslands, especially *Nardus stricta* snow-bed, and also in ericaceous dwarf-shrub heaths, moss-heaths and bryophyte springs. Specimens taken by hand were chiefly taken on moss near melting snow, or in *Nardus* snow-bed grassland and at spring-heads within the latter.

Most specimens have been taken above 800m with only a single specimen taken below 610m.

**Status:** There are 31 records of this species from only three hill ranges but from twelve 10 km squares. In our trapping and hand searching we found the species to be frequent on the Cairngorms and a moderately high number (118) of specimens were taken. This species is presently categorised as RDB K (insufficiently known) but based on this data we would consider **RDB 3** status to be appropriate.

**European distribution :** Hennig (1966-76) gives the distribution as the Alps, Pyrenees and Scotland. Dely-Draskovits (1993) gives Austria, Germany, Switzerland, France and Great Britain. This appears to be an "alpine" distribution.

## DELIA CALEDONICA

**FAMILY Anthomyiidae**

***Delia caledonica* Assis Fonseca**

**Distribution:** Highland group

This species is only known from the western and northern Highlands from Ben Nevis, just south of the Great Glen, to Ben Hope in West Sutherland and from Orkney. This is the only species with a western and northern, oceanic distribution.

Our records have extended the known range in Scotland from Orkney to the western and northern Highlands.

**Previous records:** This is from Burwick, Orkney (holotype male) (Assis Fonseca 1965).

There is also one other record from the British Isles. This is from Puffin Island, Republic of Ireland (D.M. Ackland, pers. comm.).

**Published records from this study:** Horsfield (1984, 1987, 1988a) gives records for the Fannich Hills, Ben Hope and An Teallach.

**Habitat:** This species was taken by us mostly in montane grasslands of *Nardus stricta* and *Deschampsia cespitosa*, and also in *Racomitrium lanuginosum* moss-heath and blanket bog adjacent to prostrate *Calluna* heath. A capture was made at an altitude as low as 560m on Ben Hope in the far north, while all the other captures were above 700m.

Like *Rhamphomyia morio* and *Phaonia meigeni* this species occurs close to sea-level in the far north (and far west in Ireland).

**Status:** There are 12 Scottish records of this species from six hill ranges or other areas and six 10 km squares . Only 35 specimens were taken during this survey. This species is presently categorised as RDB K (Insufficiently Known) but there is, in our view, sufficient information to suggest that it be regarded as **RDB 2.**

**European distribution :** Sierra Nevada, Spain, 2000-2500m (Hennig 1966-76). Dely-Draskovits (1993) gives Spain and Great Britain.

## DELIA PILIFEMUR

**FAMILY Anthomyiidae**

***Delia pilifemur* (Ringdahl)**

**Distribution:** Grampian group.

This species is only known from the Cairngorms.

**Previous records :** This species has only been taken once in Britain from the Lairig Ghru in the Cairngorms on 4 June 1965 by E.A. Fonseca (D.M. Ackland, pers. comm.).

**Habitat :** The vegetation in the Lairig Ghru is mainly montane ericaceous dwarf-shrub heaths, *Nardus stricta* snow-bed grassland, bryophyte springs and pools are also present.

**Status :** There is only one British record of this species. Until further records are available the species should remain as **RDB K** (insufficiently known).

**European distribution :** Ringdahl (1951) gives the distribution as "arctic-highboreal". According to Hennig (1966-76) the species is only known from Sweden (Lapland, Jamtland). Dely-Draskovits (1993) gives Norway, Poland, Sweden, Finland and USSR.

## DELIA PILIVENTRIS

**FAMILY Anthomyiidae**

***Delia piliventris* Pokorny**

**Distribution**. Highland group.

This species has a scattered distribution in the Highlands. Records range from the Cairngorms and Glen Doll in the eastern Highlands to Ben Lawers and Meall nan Tarmachan in the south, Bidean nam Bian and Ben Nevis in the west and a small group of sites in the north-west and northern Highlands.

Our records extend the known range from the southern Highlands to the western, north-western and northern Highlands and to the eastern Highlands.

**Previous records:** Collin (1933) recorded three males and a possible female from different localities between 610 and 915m near Killin (Perths).

Recently Bland (1994) found larva feeding on plants of moss campion *Silene acaulis* and reared them through to adult. The larva were taken in Glen Doll (Angus, NO2474) on 2 August 1993 at an altitude of 500m and on Meall nan Tarmachan (Mid Perth, NN5940) on 16 August 1992 at an altitude of 600m.

**Published records from this study:** Horsfield (1984, 1988a) gives records for the Fannich Hills and An Teallach.

**Habitat:** Our records are from a range of montane vegetation, most frequently *Racomitrium lanuginosum* moss-heath, grasslands and tall-herb community.

The host plant of this species *S. acaulis* (Bland 1994) is an arctic-alpine species that occurs widely in the Highlands, on Scottish islands from Mull northwards and in the Lake District and North Wales (Perring & Walters 1962). *S. acaulis* has been recorded by us during botanical surveys from all the sites from which *D. piliventris* has been taken. The plant occurs in *R. lanuginosum* moss-heath, in grassland on base-rich rock and on rock outcrops and ledges among tall-herbs.

**Status:** There are at least 19 records of this species from nine hill ranges and nine 10 km squares. 73 specimens were taken during this survey. This species was not given a status by Falk (1991). The wide distribution of the host plant suggests further collecting may produce further records. We would suggest that **RDB 3** category is appropriate at present.

**European distribution :** Hennig (1966-76) gives various localities in the Alps, Apennines, Sweden and the Faeroes. Dely-Draskovits (1993) gives Austria, Switzerland, Germany, France, Great Britain, Italy and Sweden. Therefore its distribution is "boreo-alpine".

## THRICOPS ACULEIPES

**FAMILY Muscidae**

***Thricops aculeipes* (Zett.)**

**Distribution:** Widespread montane group.

This species occurs across the Grampians from Beinn a' Ghlo in the east to the Monadhliaths in the north and Ben Laoigh in the south-west. There is an isolated record in the Midland Valley on the edge of the Campsie Fells and the species is also known from the Southern Uplands.

Our records fill in the range of this species and extend its known distribution to the eastern Highlands.

**Previous records:** Grimshaw (1900, 1904) gives Strathblane on the edge of the Campsie Fells (Stirlingshire) and Heriot on the fringes of the Moorfoot Hills (Midlothian). Assis Fonseca (1968) gives records from the Upper Findhorn (Morays) and Lochan na Lairige (Perths) both for June 1963, where both sexes were found resting on ferns growing on the banks of mountain streamlets. In the RMS collection there is a male from Corrour (?W. Inverness-shire, ?NN 36, July 1914).

Skidmore (1979) collected 30 specimens from Ben Laoigh (Main Argyll) mainly on calcareous crags and slopes with grassland between about 450 and 800m altitude and also in a conifer plantation at an altitude of 275m on 5 July 1979. He also collected 17 specimens from calcareous crags by Lochan na Lairige (Ben Lawers) at an altitude of 600m on 3 July 1979.

The species is also known from Durham, Westmoreland, Yorkshire and Nottinghamshire in England (Assis Fonseca 1968, Pont *in press*).

**Habitat:** This species was taken by us mainly in montane grasslands, ericaceous dwarf-shrub heaths and tall-herb community. Specimens were also taken in a herb-rich birch wood at 400m asl. Generally we caught it in herb-rich vegetation, or in proximity to herb-rich grassland. On an altitudinal transect of traps on Creag Meagaidh the largest numbers were taken in *Deschampsia cespitosa* grassland at 790m. The species has only been taken by us on base-rich soils, mainly on schists. The collections made by Skidmore (1979) were all on grasslands or crags underlain by or made up of calcareous schist.

**Status:** In Scotland there are 23 records of this species from twelve hill ranges and thirteen 10 km squares. Including English records the threshold of 15 km squares for an RDB species is exceeded. The present **Notable** status is considered appropriate.

**European distribution :** Ringdahl (1951) gives the distribution as "boreo-alpine". Pont (1986) gives Austria, Belgium, Switzerland, Czechoslovakia, Germany, France, Italy, Norway, Roumania, Sweden and Finland.

## THRICOPS HIRTULUS

**FAMILY Muscidae**

***Thricops hirtulus* (Zett.)**

**Distribution:** Widespread group.

This species is widely distributed in the Highlands and there is also an isolated record from the Tweedsmuir Hills in the Southern Uplands.

Our records fill in the range of this species and extend the known distribution to the Southern Uplands.

**Previous records:** Assis Fonseca (1968) gives various localities in the Highlands. These are Ullapool (West Ross), Loch Einich and Aviemore (Easterness), Braemar (South Aberdeen) and Killin (Mid Perth).

Skidmore (1979) records a single male taken on calcareous crags on Ben Laoigh (NN2627) on 5 July 1979 between 480-800m.

There is only a single specimen in the RMS taken by E.C. Pelham-Clinton on Meall nan Tarmachan (Ben Lawers range, Perths) on 16 July 1961 at 976m.

The species is also known from Cumberland and Westmoreland in England (Assis Fonseca 1968).

**Published records from this study:** Horsfield (1984) gives a record for the Fannich Hills.

**Habitat:** This species was taken by us in a wide range of montane vegetation. On an altitudinal transect of traps on Creag Meagaidh no specimens were caught below 375m and high numbers only from 760m to the highest trap site at 1000m. On Bidean nam Bian only a single specimen was taken in water-trap bowls at 450m while sixteen were taken in water-trap bowls at 800m.

**Status:** This species is known in Scotland from 56 records from eighteen hill ranges and from twenty-three 10 km squares. This is the second-most abundantly taken montane species in our study . The present **Notable** status is appropriate.

**European distribution :** Ringdahl (1951) gives the distribution as "arctic-subarctic". Pont (1986) gives Norway, Sweden, Finland and northerly parts of USSR.

## PHAONIA MEIGENI

**FAMILY Muscidae**

***Phaonia meigeni* Pont** [1]

**Distribution:** Widespread group.

This species is widely distributed across the Grampians from Glen Doll and the Cairngorms in the east to Ben Nevis and Bidean nam Bian in the west. There are more isolated records from the north-west Highlands and Lewis in the Outer Hebrides. Our records extend the known range of this species to the western and north-western Highlands.

**Previous records:** Assis Fonseca (1968) gives Braemar and Ballochbuie (South Aberdeen) and Dalnaspidal (East Perth). Pont (*in press*) gives three additional Scottish records for Loch Tummel in 1967 (Mid Perth), Glen Doll in 1977 (Forfar) and Stornoway Castle (Isle of Lewis, Outer Hebrides).

There are two specimens in the RMS collection, both collected by E.C. Pelham-Clinton. One is from Carn Liath (NO 1697, 763-854m) near Braemar, and was taken on 7 June 1964; and the other is from Sgoran Dubh (NH 9000, 1068m) near Glen Feshie, and was taken on 17 June 1967.

Pont (*in press*) also records the species from England, from Blelham Beck and Low Wray in Lancashire, both 1936; and Hawes Water in Westmoreland, also in 1936.

**Published records from this study:** Horsfield (1988a) gives records for An Teallach.

**Habitat:** On an altitudinal transect of traps on Creag Meagaidh this species was taken mainly in ericaceous dwarf-shrub heaths between 510m and 760m, and in *Deschampsia cespitosa* grassland at 790m, with only small numbers being caught on the high plateau at 885-1000m. It was also taken in large numbers in *D. cespitosa* grassland on Aonach Beag (Ben Nevis range, 800m) and among tall herbs on Bidean nam Bian (800m). In general, it appears to be a species of high grassy slopes, although, like *Rhamphomyia morio*, it descends to sea-level in the far north.

**Status:** This species is known in Scotland from 39 records from sixteen hill ranges or sites and from seventeen 10 km squares . Including records from England the present **Notable** status is therefore appropriate.

**European distribution :** Pont (1986) gives various countries in northern and central Europe, and these, together with the more detailed localities in Hennig (1955-64), suggest a broad "boreo-alpine" distribution.

## PHAONIA SUBFUSCINERVIS

[1]Note on nomenclature: P. meigeni Pont is the new name for P. lugubris (Meigen) given by Adrian Pont (pers. comm.) in an unpublished checklist of British Muscidae. P. lugubris is given by him as the correct name for the common northern species Phaonia morio (Zett.).

***Phaonia subfuscinervis* Zett.**

**Distribution:** Widespread group.

This species has a scattered distribution taking in the eastern, western, north-western and northern Highlands.

Our records extend the previously known range of this species on the Cairngorms and south-west Highlands northwards to the northern Highlands and to Glas Maol in the east.

**Previous records:** Collin (1933) gives Beinn Heasgarnich (Mid Perth) between 895 and 1065m on 11 June 1932. Assis Fonseca (1968) also records a male and a female from 915m on Geal-charn (NH 8801) on 17 June 1967 and J. Cole also took it on the Cairngorms in June 1984 (NCC record cards).

Nelson (1980) records it from the Moor House NNR (Westmoreland) in northern England.

**Published records from this study:** Horsfield (1984) gives records from the Fannich Hills.

**Habitat:** Our records are from a range of montane vegetation, most frequently grasslands and *Racomitrium lanuginosum* moss-heath. Also, small numbers of specimens were taken in *Vaccinium-Empetrum* heath and *Scirpus cespitosus-Calluna vulgaris* wet heath. Most of the specimens were taken above 800m.

**Status:** There are 21 Scottish records of this species from nine hill ranges and ten 10 km squares. Even with the single English record this species would qualify as **RDB 3** rather than the Notable category to which it is assigned by Falk (1991).

**European distribution :** Ringdahl (1951) gives the distribution as "arctic-subarctic". Pont (1986) gives Norway, Sweden, Finland and USSR.

## SPILOGONA ALPICA

**FAMILY Muscidae**

***Spilogona alpica* Zett.**

**Distribution:** Highland group.

This species has a scattered distribution with records from the Cairngorms in the eastern Highlands, Ben Lawers in the southern Highlands, Ben Nevis (Aonach Beag) in the west, the Cuillins on Skye and Beinn Eighe in the north-west Highlands.

Our records extend the known range of this species from Ben Lawers to the eastern and western Grampians, north-west Highlands and Skye.

**Previous records:** There are two previous records, both from Ben Lawers (Andrewes 1958, Nelson 1980) at an altitudinal range of about 1040-1214m.

**Published records from this study:** Horsfield (1988c, 1991b) gives records for Skye, Beinn Eighe and Aonach Beag (Ben Nevis range).

**Habitat:** Our records of this species are from *Deschampsia cespitosa* grassland (Coire Brochain, Braeriach), *Nardus stricta* snow-bed grassland (Aonach Beag), rocky ground with scattered vegetation (Garbh Beinn, Cuillins, Skye) and *Calluna vulgaris* heath at the edge of a Scots pine wood (Beinn Eighe).

**Status:** This species is only known from six records from five hill ranges and five 10 km squares. Only four specimens were taken during this study. This species must be regarded as one of the rarer montane species. Possibly sufficient information is now available for it to be designated as **RDB 2** rather than RDB K (insufficiently known).

**European distribution :** Ringdahl (1951) gives the distribution as "boreo-alpine". Pont (1986) gives Iceland, Norway, Sweden, Finland, France, Germany, Switzerland, Austria and Italy.

## SPILOGONA TRIANGULIFERA

**FAMILY Muscidae**

***Spilogona triangulifera* (Zett.)**

**Distribution:** Highland group.

This species occurs across the Grampians from the Cairngorms and Glas Maol in the east to Ben Nevis and Ben Laoigh in the west and also occurs in the northern Highlands.

Our records extend the known range of this species northwards from the Grampians to the northern Highlands.

**Previous records:** Edwards (1933a) gives records of this species from patches of snow near the summit of Ben Nevis while Collin (1933) gives records for Beinn a' Chreachain, Meall Ghaordie and Ben Vorlich (Perths). Skidmore (1979, 1981) found 13 males on the summit of Ben Lawers on 2 July 1979 at around 1150-1214m altitude and a single male in a conifer plantation at an altitude of 275m at the foot of Ben Laoigh. The latter specimen was presumed by Skidmore to have been blown down from the summit of Ben Laoigh.

According to NCC record cards there are many records from the Cairngorms (P. Skidmore 1962, C.H. Andrewes 1964, D.M. Ackland 1967, P.J. Chandler, J. Cole 1984 and I. McLean 1984). The list of sites includes Coire Raibert, Beinn a' Bhuird, Geal-charn (NH 8801), the Lairig Ghru and in the Northern Corries at 900m.

In the RMS there is a male collected by E.C. Pelham-Clinton from Meall Corranaich (NN 6141, Ben Lawers, Perths) on 18 June 1955 at 976m. Nelson (1980) took the species by the gravely shores of Loch Avon at 710m in the Cairngorms. Ashmole (1983) and Ashmole et al (1983) describe six females of the species feeding or handling prey trapped in the snow on a snowfield on Ben MacDui (1150m) in the Cairngorms on 19 July 1982.

**Published records from this study:** Horsfield (1984) gives records from the Fannich Hills.

**Habitat:** Our records are mainly from montane snow-bed grasslands and *Racomitrium lanuginosum* moss-heath, and also in a range of montane ericaceous dwarf-shrub heaths. Previous records show an association with snow-beds. Individuals are often found sunning themselves on rocks.

The altitudinal range of records is mainly from 710m to about 1200m.

**Status:** This species is known from 37 records from foutreen hill ranges and twenty-one 10 km squares. The current **Notable** status considered appropriate.

**European distribution :** Ringdahl (1951) gives the distribution as "arctic-subarctic". Pont (1986) gives Norway, Sweden, Finland, USSR and Austria. This distribution is "boreo-alpine".

## Discussion

### 1. Other candidate species

In this report we have identifies the 24 British species of Brachycera and Cyllorhapha which we consider represent the British montane fauna. Four other species were considered as candidates for the list of montane Diptera but were left out for the following reasons.

*Phaonia colbrani* Collin (Muscidae) is only known from the holotype male collected in Choir Odhar near Grantown on Spey by Mr. Colbran J. Wainwright on 30th June 1942 (Collin 1953). Choir Odhar is a corrie which lies at the relatively low altitudinal range of c.400-500m, though the exact altitude at which the species was taken is not known. Until more specimens are taken this can at best be regarded as only a possible montane species.

The hoverfly *Melanostoma dubium* (Zett.) is generally regarded as being a high-altitude species (Stubbs & Falk 1983). Analysis of morphological data from large numbers of specimens caught in our traps suggests that *M. dubium* is only a montane form of the common and widely distributed *Melanostoma mellinum* (Linnaeus) (MacGowan *in press*).

Another species which may be montane in Britain is *Botanophila apiciseta* (Ringdahl). There are only two records of this species in Britain: a male collected at Aviemore on 30 May 1959 by J.E. Collin and a female caught on Beinn Ghlas (Ben Lawers range) by E.A. Fonseca on 8 July 1965 (Ackland 1989). Ringdahl (1951) gives the distribution as "arctic-highboreal" and Hennig (1955-64) notes it from Sweden and Finland. Until further British specimens and ecological information is available we have not included it in our list.

The Tachinid *Ramonda prunaria* (Rondani) has only been taken in Britain at 670m on the Cairngorms (Emden 1954). According to Robert Belshaw (pers. comm.) however, it is definitely not montane.

### 2. Threats

There are several threats to the montane insect fauna :

**Global warming** as a threat to British wildlife is considered by Barkham (1995) who gives the most recent assessment of global warming to the year 2050 as in the range 0.5 to 2.0 $^{0}$C. Assuming *R. hirtula* is temperature dependent and given a lapse rate of around 0.7 $^{0}$C for every 100m increase in altitude then at the highest prediction the potential range of this species would decrease from a lowest altitude of 800m to 1086m. However, there are too many uncertainties for such accurate figures to be assigned at present, though global warming must be a regarded as a threat to the range of many montane species.

**Acid deposition** is equally difficult to assess. Some species such as *Delia piliventris* whose host plants have a preference for base-rich substrates may be reduced in abundance if their host plants are lost from less well-buffered sites by acidification of upland soils.

Continued **heavy grazing** may erode the fragile vegetation and soils on the high tops and summit

plateau. This could even threaten the habitat of the abundantly caught *A. atronitens* or *T.hirtulus* that were among the commonest of the montane species. However, even on heavily grazed hills larva may be able to develop in rocky ground that is protected from grazing, so the species as a whole may not threatened. More work needs to be done on the larval habitat of these and most other montane species so threats can be more adequately assessed.

### 3. Distribution patterns

All the montane Diptera which we have designated are to a greater or lesser degree relict species with disjunct populations on widely separated mountain ranges. These species would have been more widespread in lowland Britain and Europe during and shortly after the last Ice Age. As temperatures rose they would have retreated to the cooler mountain areas of Scotland, Scandinavia or the Alps and other European mountains. The European distributions most of the British montane Diptera broadly conform to three main geographical patterns: boreal (northern or arctic), boreo-alpine and alpine. These distributions are similar to those found in other insect groups such as Coleoptera (e.g. Holdhaus & Lindroth 1939, Lindroth 1935).

Two species do not fall easily into these three main patterns of distribution. *Platycheirus melanopsis* has been recorded from many sites in central Europe but only from southern Sweden and Great Britain in the north and may be regarded as lowboreal-montane (or -alpine) in distribution. *Delia caledonica* has an apparently highly disjunct Atlantic distribution; outside the British Isles it has only been recorded from the Sierra Nevada mountains in Spain (Hennig 1966-76).

### 4. Links to minimum temperatures

The review of the distribution of the British arctic-montane flora by Conolly & Dahl (1970) showed that the distribution of many montane plant species could be linked to the low average annual summer maximum temperatures experienced in montane areas. Applying their map of mean annual maximum summer isotherms to the distribution of the British montane Diptera also shows strong correlations. In general the species of the Widespread group have the highest limiting maximum summer isotherms of mostly 23-24 $^{o}$C in Scotland and mainly 25 $^{o}$C in England . Both the Highland and Grampian groups are similar, and mostly the species have highest limiting maximum summer isotherms in the range 21-22 $^{o}$C. The low maximum temperatures experienced on Scottish mountains may be a factor which limits many species to the Highlands and accounts for their apparent absence from the warmer mountains of northern England and Wales. Correlations are not necessarily evidence of causal connections and until more is known about the ecology of the species the actual factors limiting the species' distributions must remain unknown. For example competitive exclusion by other species favoured by warmer temperatures may be actually limiting the range of montane species.

All species found south of Scotland occur within higher limiting isotherms in the southern parts of their range than they do in the north. This phenomenon was also noted by Conolly & Dahl (1970) for montane plant species. Possible explanations are that in more southerly locations species have become adapted to the higher temperature regimes since the last ice age or alternatively that species survive in small local pockets of lower temperatures. Within the

limiting isotherms there will be local areas of lower temperatures created by aspect, exposure and summits above the general level of the surrounding uplands. For example within the area enclosed by the 25 $^{o}$C isotherm in the northern Pennines there is a spot temperature of 23.2 $^{o}$C presumably on the summit of Cross Fell. These locally low temperatures may be just sufficient to provide suitable conditions for the survival of small populations.

## 5. Importance of the fauna

Although the 24 species identified as being montane in Scotland represent only a very small proportion of British Diptera they are of considerable importance for several reasons. Firstly as relict populations they give an insight into the insect fauna which existed in Britain in the period just after the last glaciation and which retreated to higher ground as temperatures rose and more competitive species supplanted them in lowland areas. Secondly, insects are good indicators of changes in climate as the majority have annual life cycles and may respond quickly to change. Many may also have the ability to move and disperse rapidly in response to changes in climate. Monitoring of distribution and population sizes of montane Diptera by quantitative trapping would be one effective way to biologically monitor changes in climate. Acidic deposition is high in montane areas and monitoring of montane Diptera may give insights into the effects of air-borne pollutants. There is also potential for montane Diptera to be monitored to measure the effect of recreational disturbance on montane habitats.

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