

Heteroptera and Diptera surveys on the Smithills Estate

by

Phil Brighton

32, Wadeson Way, Croft, Warrington WA3 7JS

helophilus@hotmail.co.uk

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Abstract

This report provides the results of a series of heteroptera and diptera surveys carried out on the Smithills Estate, owned and managed by the Woodland Trust. Eleven visits were made between September 2015 and May 2019, resulting in 1370 individual records of the presence of a species in a 100m grid square on a specific date. This was part of a wider programme of surveys across a wide range of sites and habitats in Lancashire and Cheshire. A full list is given of the 440 species recorded and their distribution across twelve defined habitat compartments. Species recorded at this site and nowhere else during these surveys are highlighted and discussed. The species list is interpreted in terms of habitat assemblages using the PANTHEON software available on the website of the Biological Records Centre.

INTRODUCTION

This report presents the results of surveys of the Heteroptera (true bugs) and Diptera (true flies) mainly carried out over three summer seasons from 2017 to 2019 on the Woodland Trust's Smithills Estate near Bolton in Lancashire. Two preliminary visits were made in September 2015 and October 2016. These were part of a wider programme carried by the author from 2012 to 2019 over the whole extent of South Lancashire (VC59) and Cheshire (VC58) with some additional coverage of VC60 north of the Ribble (Brighton, 2020). An overall aim of these surveys has been to assess and compare the biodiversity of the insect fauna across a representative range of habitats with at least a local level of nature conservation interest.

The recording methodology (sweep-netting, with field observation for a few species) and the geographic scope of this programme are described in Brighton (2020a). The total number of records accumulated over the region now stands at 3744 for the Heteroptera and 20,249 for the Diptera. Here a record refers to the detection of the species in a 100m square (ie six-figure grid reference) on a specific day. The number of species recorded overall is 177 for the bugs and 1292 for the flies. These figures represent 34% and 39% respectively of the national numbers of species in the families covered in the surveys. For the Heteroptera these were all the terrestrial species plus the aquatic bug family Saldidae, most species of which have a terrestrial lifestyle, giving 521 species in all*. For the Diptera the range of families covered is specified in Brighton (2020a) and currently includes 3300 British species.

Brighton (2020) has analysed the whole dataset to provide various measures of the diptera diversity at 6 individual sites where most surveying has been done and across the whole region where the surveys have been less intensive. One of these is the Smithills Estate (SD61), which became the largest land-holding of the Woodland Trust when it was bought from Bolton Council in 2015. The area of 686 hectares includes large expanses of grazed grassland, deep wooded cloughs traversed by fast-flowing stony streams, heathland, and a large area of moorland on Winter Hill, scene of extensive and well-publicised fires in 2018. The latter falls within the area of the West Pennines SSSI. The estate now forms a nucleus of the Northern Forest, with extensive planting of a range of broad-leaved native trees. Figure 1 shows the division of the estate into recording compartments as defined by the Woodland Trust.

SPECIES RECORDED

Figure 2 shows the distribution of the 100m squares surveyed with the number of records in each, while Table 1 shows how the numbers of records obtained are distributed over the months of the year and the recording compartments. Given the extent of the estate, different portions were

* https://www.britishbugs.org.uk/systematic_het.html

sampled on different visits and with repeat visits to those that were most fruitful in terms of a variety of micro-habitats. Altogether 11 of the 19 defined compartments were visited. In addition the unnumbered moorland to the north-west of Compartment 9 was visited frequently. The unvisited compartments consisted mainly of enclosed farmland and pasture.

It was considered neither practicable nor necessary to follow a rigidly fixed set of sample squares, especially in the larger compartments with few landmarks. However, the red squares in Figure 2 mark particularly distinctive points, one in the main wooded clough formed by Dean Brook, and the other (at Point B) in Brownstones Quarry, a deep excavation in the sandstone with heathland and wetland habitats. At the western end of the surveyed area, the moorland includes a fen formed behind a dam just above Holden's Plantation. The spread of the visits over a number of years and different months in each year was intended to reduce the influence of seasonal and year-to-year variations associated with weather and the short flight period of many species.

Table 2 shows the overall breakdown of species by the broad groups defined in Brighton (2020a). Table 3 shows the complete species list with numbers of records. 39 species are marked with an asterisk in the latter, denoting that they have not been recorded anywhere else in the course of the present surveys. These and other features of the species list are discussed next for each group in turn.

All records from 2017 onwards are currently available on IRECORD (www.brc.ac.uk/irecord/), but have not necessarily all been verified, mainly because of a lack of verifiers for certain families.

Heteroptera

The Heteroptera includes the shield-bugs and a large range of other predatory and plant-feeding bugs. They are generally associated with warmer and drier habitats, and so it was not unexpected that very few of the scarcer species were to be found at Smithills. The only one unique to the estate in these surveys was *Phylus coryli*, a small plant bug of family Miridae with a blackish body and yellow appendages. It is partly predatory, occurring on hazel and is said to be generally common across the UK*. The NBN Atlas has a dearth of records in North-West England, while Judd (2010) and Ryan (2019) concur in showing the species as present in VC58 and VC60, but not VC59. Hence this is a first for South Lancashire (VC59), possibly the result of the recent extensive planting of trees across the Smithills Estate.

The commonest heteropteran across Smithills was *Stenodema holsata*. This is a sign of the upland and acidic character of the site, as in lowland areas only the related grass bugs *S. calcarata* and *S. laevigata* are normally found. They are elongated species with a green or light brown colour, whereas *S. holsata* is somewhat shorter. Another grass bug *Leptopterna dolabrata* was particularly abundant in the moorland area, though it is also present throughout the lowlands.

Photographs of most of the species listed in Table 3 can be found on www.britishbugs.org.uk.

Craneflies

The number of cranefly records at Smithills compares favourably with the concurrent surveys at Birkdale and Cholmondeley (see Fig. 4 of Brighton, 2020) in keeping with the extent of cool and damp habitats. Species recorded included both the largest British species, *Tipula maxima*, which has strongly marked wings, and also one of the smallest, *Tasiocera murina*, just 2mm or so in length and so much more difficult to detect.

The small to medium yellow species *Dicranomyia quadra* is a member of a complex whose taxonomy has only recently been unravelled (Starý & Stubbs, 2015), so it is of particular significance to have multiple observations at Smithills. Woodland streams are the typical habitat. *Neolimnomyia filata* is a fairly undistinctive dark grey medium-sized species, associated with wet woodland (Boardman, 2016). *Pedicia littoralis* is a member of the family of Pediciidae, which is characterised by hairy eyes. This is a fairly large

* https://www.britishbugs.org.uk/heteroptera/Miridae/phylus_coryli.html

species with yellowy-orange coloration, and particularly associated with streams (Boardman 2016), where it has been consistently found at Smithills. The final species unique to Smithills in these surveys is *Rhypholophus haemorrhoidalis* an early autumn species with well-marked hairy wings.

The most frequent crane fly recorded was *Limonia nubeculosa* very common in woods throughout the region, with spotted wings and three dark bands on the femora. The good range of *Tipula* species is noteworthy, and unusual in that numbers are not dominated by *T. oleracea* and *T. paludosa*, the daddy-long-legs responsible for leatherjackets in lawns. *T. subnodicornis* is a species of blanket bog, and also lowland mires, thought to be particularly important as a food resource for waders (Coulson, 1962; Bateson, 2019).

Hoverflies

The Syrphidae are by far the best-recorded family of Diptera, thanks to the distinctive markings of many common species and the availability of accessible identification resources. There are many species noted for visiting and pollinating flowers, but as such vegetation was not abundant in most of the habitats visited in this survey, they are not particularly well represented in Table 3.

Of the species recorded only at Smithills in these surveys, *Eristalis rupium* has a distinctly northerly distribution in Britain (Stubbs and Falk, 2003). It is distinguished from the very common *E. pertinax* and others in the genus by the pale hind metatarsus. *Melangyna cincta* is a typical black and yellow wasp mimic, commoner in woodlands in southern Britain. *Platycheirus scambus* is a typical member of this large genus, mostly dark with yellow spots on the abdomen; it is mainly found in northern Britain. *P. ramsarensis* is an upland and moorland species, only separated as a species from the common *P. clypeatus* in 1990.

The most frequent hoverflies were *Melanostoma mellinum* and *M. scalare*. These are usually swept from long grass and are also the most frequent hoverflies recorded in the full set of surveys (Brighton, 2020), just ahead of *E. pertinax*.

Empidoidea

The four families constituting this group currently contain 700 species recorded from Britain, and the site species list is correspondingly longer than for the preceding groups. They are small to medium flies, almost all predaceous on smaller insects. A The males of some species make presents of prey to the females as part of courtship – most of those in the large genus *Hilara* wrap these in silk produced by the swollen front metatarsi. Flies in the large genus *Platypalpus* (very poorly represented here) are rather small, while *Empis* and *Rhamphomyia* have many larger species. Individuals from the last two genera are equipped with a prominent proboscis, sometimes used for sucking nectar from flowers as well as the normal prey. The family Dolichopodidae are small and longer legged, often with metallic body colours: *Dolichopus* is the largest genus with many species having distinct habitat preferences.

Figure 4 of Brighton (2020) shows this group to be well represented at Smithills, though the reasons for this are not clear. The only starred species of Dolichopodid is *Dolichopus caligatus* of which a female was recorded at Brownstones Quarry, but this identification is doubtful as it is a mainly coastal species. The *Chelifera* species are delicate light-coloured flies with raptorial or mantis-like front legs for seizing prey. *Empis verralli* is an upland species first found on Snowdon in 1887 by the leading dipterist of the day, George Verrall (Collin, 1961) and named in his honour by his nephew J. E. Collin, who succeeded him as our most eminent dipterists. This species appears to be endemic to the UK*.

Although *Hilara chorica* is common generally, it seems to have a particular affinity for the moorland habitat. *H. clavipes* is distinctive because it has a very large basal tarsus on the front leg, which is also adorned with very long hairs. It is another upland species, associated with fast-running streams.

* According to https://www.gbif.org/occurrence/map?taxon_key=1583366

Rhamphomyia stigmosa was recorded in four separate compartments on the same day, 14 May 2019, an interesting example of simultaneous emergence over a fairly wide area of an otherwise scarce species, found in these surveys only at 2 other locations in Cheshire. *R. tibialis* is another mainly north-western species which appears to be generally rather scarce.

Calyptrates

This group of over 1000 British species includes the most stereotypical flies, in grey or brown colours, with many bristles over the body and legs, which are important for identification. It also includes some metallic coloured species such as blue-bottles (*Calliphora*) and green-bottles (*Lucilia*), as well as the cluster-flies (*Pollenia*) which sometimes congregate in window frames to over-winter. This was the largest group in the Smithills survey, both in terms of species and records, as it is overall. Since the group indulges in a very wide range of life-styles, as wide perhaps as the whole range of flies, it is hard to ascribe this to any particular reason.

The family Anthomyiidae, which contains 246 British species, has many ubiquitous species, which were regarded as difficult to identify until recent years with the development of a set of comprehensive keys and genitalia diagrams (Ackland *et al*, 2017). Some of the adults are frequent visitors to flowers.

The two *Botanophila* species starred in Table 3 are both known mainly from Scotland: in fact there is only one other recorded location for *sericea* in England. This large genus includes fungivorous, phytophagous and saprophagous species, but the habits of these two species appear to be unknown.

Genus *Leucophora* contains fairly large and distinctive grey species, which are all kleptoparasites on solitary bees. *Pegomya* is the largest British Anthomyiid genus, containing both leaf-miners and fungivorous species. While the mines on docks made by several species are very common, the adult flies seem generally rather elusive. This makes the large number of one of these, *P. haemorrhoum*, recorded repeatedly at Smithills in a number of compartments on different visits all the more striking. In fact South Lancashire is now the vice-county with the highest number of records of this species on the NBN Atlas! *Pegomya rugulosa* is a large robust species closely related to another dock-miner *P. bicolor*, though its own food-plant is unknown. It is classified as nationally scarce (Falk & Pont, 2017), with a mainly Scottish distribution and only one confirmed previous English record, by J. E. Collin in 1934 in Yorkshire*. Rather remarkably, this species was recorded in North Wales for the first time virtually simultaneously with the Smithills discovery (Brighton, 2019).

The only other Anthomyiid unique to Smithills in these surveys is *Zaphne inuncta* from a genus of rather large black flies, usually found in wet marshy places but their biology is otherwise unknown. It was found near one of the pools in Brownstones Quarry, and is listed as nationally scarce (Falk & Pont, 2017).

The Calliphoridae are the blowflies, mainly associated with dead vertebrate animals, but *Bellardia* and *Pollenia* larvae are parasitoids of earthworms (Falk, 2016). Some species of the lesser bluebottles of genus *Melinda* are known to parasitise snails, and the same may be true of the small black *Melanomya nana*.

The Fanniidae is the family of the lesser house-flies, *Fannia canicularis*, though this large genus of 59 British species is mainly to be found around trees (d'Assis Fonseca, 1968).

The Muscidae is the family of the common house-fly (*Musca domestica*), currently containing 293 species. It formerly included the Fanniidae. None of the species are parasitic on other insects, and the larvae are either saprophagous or carnivorous (d'Assis Fonseca, 1968). The large genus *Coenosia* consists mainly of small greyish flies mostly found in more open habitats with a short sward. *C.*

* The NBN Atlas lists two even older specimens in the Nottingham Museum, but their identity remains unconfirmed.

humilis is described as “fairly frequent” by Fonseca but although he gives Lancashire as a location for it, the NBN Atlas contains no records other than this one. *C. means* and *C. perpusilla* are strongly associated with the upland habitats of Scotland and Wales, the latter being listed as nationally scarce by Falk and Pont (2017). These appear to be first records for Lancashire, though I later found *perpusilla* on Longridge Fell (VC60).

Mydaea anicula has a more typical size for the housefly family, and is another nationally scarce species. D’Assis Fonseca (1968) and Falk and Pont (2017) describe it as a woodland species widespread in England including the Delamere Forest, but the NBN Atlas shows most records as coastal. The latter includes an unverified record from the Lancashire coast, but doubt must remain until the apparent inconsistency in habitat and distribution is resolved. *Phaonia magnicornis* is another nationally scarce species, associated with marshy areas within broad-leaved woodland according to Falk and Pont (2017), but also found at Freshfield on the Lancashire coast according to D’Assis Fonseca (1968), who used the generic name *Wahlgrenia*.

The genus *Spilogona* comprises mainly northern, upland and coastal species. *S. denigrata* with its very dark wings was the most frequently encountered Muscid at Smithills. There seem to be no other published Lancashire records apart from one in 2008 from Warton Crag. I have also found the species in the Crowden valley in the Cheshire panhandle. There is a fair sprinkling of records of *S. pacifica* across Lancashire and Cheshire: Fonseca regarded this species as common under its earlier name of *S. vana*.

Thricops is another genus characteristic of the Scottish highlands. *T. semicinereus* was described as generally distributed and very common by d’Assis Fonseca (1968). So the fact that I have found it only at Smithills could be indicative of a significant long-term change in abundance in the region.

The Sarcophagidae or flesh-flies are a mainly tropical family (Pape, 1987) so it is not surprising that they often seen basking on hot rock or even asphalt surfaces in the summer. This may also account for the appearance of only one species in this Smithills survey. Despite the family’s common name, the larval lifestyles are by no means confined to carrion. *S. aratrix* is a typical member of the largest genus, a large fly with a chequerboard pattern on the abdomen and large feet – perhaps insulated for alighting on hot surfaces? Its distribution seems to be mainly southern in the UK, with this being the first record in Lancashire and Cheshire according to the NBN Atlas.

The Scathophagidae is the family of the common yellow dung-fly *Scathophaga stercoraria*, which is the most numerous fly species in this whole set of surveys, as it is in the Smithills results. The adults take other insects including flies as prey, but have also been observed as pollinators of a wide range of flowers (Harris, 2018). Other members of the family have phytophagous larvae, *Nanna* on grasses and *Norellisoma spinimanum* on docks.

The final calyptrate family is the Tachinidae, which are parasitic on other insects. *Siphona geniculata* is the commonest overall, as at Smithills, and attacks Tipulid crane-fly larvae. It can be abundant in composite flowers using its long folding proboscis to access nectar, but most species seem to occur as isolated individuals. *Ceromya bicolor* is relatively distinctive in having a yellow abdomen attached to a grey thorax, while *Phytomyptera cingulata* is an unmemorable grey and black fly. Both attack a range of moth species (Belshaw, 1993).

Other Diptera

The families in this group have very little in common apart from being covered by relatively accessible identification resources. Only a selection of the families encountered at Smithills is discussed here.

The Bibionidae include one of the most conspicuous insects of early spring, the large black St Mark’s fly *Bibio marci* with males that hover in swarms with dangling legs around trees and bushes. They were particularly noticeable all over the Estate on 14th May 2019. The other species are similar but smaller. *B. longipes* and *B. pomonae* are species of late summer and autumn, the latter conspicuous

with its bright red legs dangling as it hovers over the heather. They have prominent spines on the front legs used for digging in soft soil, where the larvae consume vegetable matter such as plant roots. No particular reason has been identified for the relatively large range of species found at Smithills: this includes all the Bibionidae from the full set of surveys apart from *Dilophus femoratus* which seems to be common only near the coast.

The Chloropidae are a large family of small but sometimes colourful flies mostly eating live or decaying vegetable matter as larvae. As they often lurk low in the vegetation, they are not well sampled by general sweep-netting. Moreover, as comprehensive keys to the British species have yet to be developed, they have been generally omitted from this set of surveys.

The long stretch of the fast-running Dean Brook and its tributaries differentiates Smithills from the other five main sites. This shows up in the presence on the species list of three species of *Dixa*, albeit in small numbers. The Dixidae are the meniscus midges whose aquatic larvae assume a U-shaped posture at the surface of the water (Olsen *et al.*, 2001). The trickle midges *Thaumalea* of family Thaumaleidae are another sign of an unpolluted aquatic environment. These surveys have recorded only adults of such species.

The Heleomyzidae are characterised by the presence of string spines along the leading edge of the wings. The larvae of *Suillia* species live in mushrooms and bracket fungi, so the presence of several species in the Walker Fold woods (Compartments 12 and 13) may be a sign of fungal diversity or abundance. The other species have a wider range of associations with rotting matter, so the finding of three species unique to Smithills cannot be linked to any specific factor.

The Lauxaniidae are another family associated with fungi and rotting matter, with numerous rather similar smallish plump yellow or grey species. *Sapromyza albiceps* has been given the provisional designation of nationally scarce by Falk *et al.* (2016). While the status review does not mention *Poecilolygia vittata*, the NBN Atlas contains only 12 records spread along the Western fringes of England and Wales, but with a gap in the region Lancashire, making this record an apparent county first. However the local records centre holds six records across Cheshire* suggesting that this species may be relatively common in places.

The Lonchopteridae is a distinctive family of small flies with pointed wings. It has only 7 British species, all in the genus *Lonchoptera*. *L. lutea* and *L. bifurcata* are amongst the commonest of all flies to be swept from grassland over a long season, often at the same location. Curiously, males of *L. bifurcata* are very rarely found, certainly not in the present series of surveys indicating that the species is generally parthenogenetic (Smith, 1969). *L. tristis* seems to be very localised to damp woods and I have found it at only one other site in Lancashire and Cheshire.

The Opomyzidae is a small family with several species in the top 96 providing over 50% of the records in the overall dataset. The larvae feed in grass stems while the adults are yellow or brownish with spotted wings (Drake, 1993). An interesting finding from the cross-comparison of the six main sites is that *Opomyza florum* is significantly under-represented in the Smithills data (see Table 5 of Brighton, 2020). The NBN atlas also shows a dearth of records of this species in most of Northern England compared with the other two commonest species *O. germinationis* and *Geomyza tripunctata*. Drake (1993) states that the species is scarce in western pastureland, but that seems to be contradicted by the numbers found at four of the other main sites in the present surveys.

The Platypezidae are known colloquially as the flat-footed flies from the shape of their rear tarsi, and mostly with larvae developing on fungi. The adults often have distinctive patterns in black and grey or orange, but “finding them has always been a challenge” (Irwin, 2019).

The Sepsidae are small ant-like flies. The genus *Sepsis* is distinguished by the black marks towards the wing tips, which are often waved around as the flies walk over leaves. They are dung-lovers, and all of the five most frequent species nationally and regionally (Brighton 2017) have turned up in the Smithills surveys. These species seem often to peacefully co-exist.

* <http://www.record-lrc.co.uk/SpeciesSearch/Searching.aspx>

The overall site list for the soldierflies (Stratiomyidae) and allies, which include robberflies (Asilidae), stiletto flies (Therevidae) and horseflies (Tabanidae) (Stubbs and Drake, 2014), is very limited except for the snipe-flies (Rhagionidae). The scarce *Rhagio notatus* was recorded by a photographer at about the time these surveys began (Brighton 2017a), but no further specimens have turned up. That appears to be the only record for South Lancashire. A single specimen of the moorland snipefly *Symphoromyia crassicornis* was swept from upland grassland during the present surveys, apparently the first record for Lancashire and Cheshire since 1987 – it is described by Stubbs and Drake (2014) as having a classic western and northern distribution, but quite local in occurrence. It boasts impressively bulbous and hairy antennae (Figure 3).

Limited numbers of the Tephritidae were found. This is a mainly tropical family whose British representatives have attractive spotted or banded wing patterns. A preference for warmer conditions is consistent with the much better representation of this family in the Birkdale survey (Brighton 2020a). The larvae are phytophagous, many attacking composite flowers (Asteraceae), and some in fruits such as rose-hips or haws in the case of *Anomoia purmunda*.

Photographs of typical species from most of the diptera families mentioned above can be found at <https://www.naturespot.org.uk/taxonomy/term/22226>

PANTHEON analysis

In view of the complexity in interpreting the data on individual species, it has been found more informative to assess the results in terms of the ecological characteristics of groups of species using the PANTHEON software. This is based on a database relating invertebrate species to their associated feeding characteristics as larvae and adults, habitats, conservation status and other ecological associations: this was originally developed as a tool for assessing SSSI quality in the Invertebrate Species-habitat Information System (ISIS) of English Nature (Webb & Lott, 2007), but in 2018 it was made publicly available for wider use by the Biological Record Centre under the new name with a user-friendly web-based interface at www.brc.ac.uk/pantheon. Version 3.7.6 was used. PANTHEON currently contains data for about 13,000 of the 37,000 species of the macro-invertebrate fauna of England. All British heteroptera species are covered. 3597 diptera species are included, just over half the British list. The analysis for this report uses simply the species lists in Table 3: it should be noted that the numbers of records are not used in the analysis, so each species has equal weight. PANTHEON provides a variety of ways of analysing the data and presenting the results, from which a selection has been used for this report, as follows.

Figure 4 shows the breakdown of the combined species list across the sites by feeding guild*. For both larvae and adults predators are the largest category. Larvae feeding on decaying matter provide almost as large a contribution with herbivores on live plants lagging well behind. For adults nectar-feeding species contribute just under a quarter, while non-feeders, herbivores and saprophagous species are also significant proportions. The nectar-feeding adult species include Muscidae (houseflies), Syrphidae (hoverflies) and other smaller fly families, showing the importance of this resource. These charts also illustrate the point that fly species generally require different food resources as larvae and adults – this is not true of the bugs which do not undergo a complete metamorphosis.

The proportions of the slices in these pie-charts generally vary rather little from site to site, as they are mainly determined by the range of heteroptera and diptera families recorded. However, compared with the results for Birkdale (Brighton, 2020, Fig 3), the results for larvae at both Cholmondeley (Brighton 2020b) and Smithills show a larger proportion of saprophagous species compared to herbivores – presumably a reflection of the dense and lush vegetation compared to the more sparsely vegetated dunes.

Table 4 shows the results from PANTHEON for the number of species associated with each habitat represented in the data. As some species have multiple associations, the numbers add up to more

* Out of the 440 species recorded from the Smithills Estate in this survey, 363 have data entries in PANTHEON.

than the number analysed. The figure for representation is the number of species recorded as a proportion of the total number in the PANTHEON database for that habitat. The PANTHEON guidance states that 10-20% may indicate good quality, while 21% or more certainly suggests a good proportion of characteristic species. As these surveys cover species constituting only about a third of the PANTHEON data, it is considered that 7% may be taken as this threshold for a significant representation.

At Smithills, this figure is well surpassed for both wet woodland (which appears under two of the broad biotope categories) and for shaded woodland floor and is nearly reached for running water, in reasonable agreement with the general character of the site. The low representation of upland species is probably an underestimate resulting from a lack of data for the relevant species.

Each species in the PANTHEON database is assigned a species quality score (SQS) according to their conservation status. Non-designated species score 1 while the SQS increases from 4 to 32 as one progresses from the nationally scarce or notable to the rarest categories such as critically endangered. The SQI is 100 times the sum of the scores divided by the number of species, so that 100 indicates a lack of any designated species. It can be seen from Table 6 of Brighton (2020) that of the main survey sites Smithills had the lowest number of species with a conservation designation according to PANTHEON, despite being the most species-rich of the six.

DISCUSSION

Brighton (2020) discusses the proportions of the habitat associations further in a comparison with 5 other major sites. That report also includes the estimation of alpha and beta diversity measures based on the numbers of records for each Diptera species. The broad outcome of this analysis is that the Smithills Estate has the highest levels of diversity in terms of estimated numbers of species as measured by the Hill numbers (Figures 9 and 11 of Brighton, 2020) when standardised for sample size, though in most cases the error bars in the estimates overlap with some of the other sites. The range of species recorded is distinctive in terms of comparisons with the overall region and also in pairwise comparisons with the other 5 main sites, making a significant contribution to the regional diversity of diptera species. The upland or northern character of many species has been mentioned frequently in the review of species above, but does not make the site so distinctive as the coastal Birkdale site. The closest affinity is with the Delamere Forest (Brighton, 2020, Fig 11) probably reflecting the extent of woodland sampled in the surveys.

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TABLES

Table 1: numbers of records by compartment and date

Compartment	Month						Totals
	April	May	June	July	Sept	Oct	
Cpt 02		29		54			83
Cpt 03	31	54		74		27	186
Cpt 04	8	12		43		22	85
Cpt 08		12	26	25			63
Cpt 09		4			11		15
Cpt 11		36	23	27	20		106
Cpt 12	7	51	57	36	32		183
Cpt 13		113	19	43	107	10	292
Cpt 16		41		53		14	108
Cpt 18				21			21
Cpt 19		21					21
Moorland	14	21	86	80	6		207
Totals	60	394	211	456	176	73	1370

Table 2: numbers of species recorded by group and compartment

Numbers of species	Compartment											Moor-land	Whole site
	Group	02	03	04	08	09	11	12	13	16	18		
HETEROPTERA	7	9	13	4	0	6	4	13	11	3	0	11	41
CRANEFLIES	4	15	7	1	2	8	28	30	5	1	8	12	61
HOVERFLIES	10	9	7	9	0	5	2	12	3	0	0	11	37
EMPIDOIDEA	18	34	7	8	0	14	28	29	13	6	4	18	70
CALYPTRATES	16	27	18	18	8	27	31	50	26	5	7	36	129
OTHER DIPTERA	17	27	20	14	5	24	32	39	30	6	2	24	102
No of species	72	121	72	54	15	84	125	173	88	21	21	112	440
No of records	83	186	85	63	15	106	183	292	108	21	21	207	1370

Table 3: count of records for individual species by compartment. * denotes species not found at any other sites in the present series of surveys (Brighton, 2020)

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
HETEROPTERA													
PLANT BUGS & ALLIES													
<i>Anthocoris confusus</i>								1					1
<i>Anthocoris nemoralis</i>							1	1					2
<i>Anthocoris nemorum</i>	1	2				2	4	4	2	1		2	18
<i>Apolygus spinolae</i>	1								1			1	3
<i>Berytinus minor</i>			1										1
<i>Blepharidopterus angulatus</i>								1					1

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Bryocoris pteridis</i>		1						1					2
<i>Capsus ater</i>												1	1
<i>Cyrtorhinus caricis</i>									1				1
<i>Dicyphus stachydis</i>								1					1
<i>Harpocera thoracica</i>			1										1
<i>Ischnodemus sabuleti</i>												1	1
<i>Leptopterna dolabrata</i>				1		1						6	8
<i>Leptopterna ferrugata</i>				1								1	2
<i>Liocoris tripustulatus</i>									1				1
<i>Lygocoris pabulinus</i>		2					2	1	1				6
<i>Lygocoris rugicollis</i>												1	1
<i>Mecomma ambulans</i>		1		1									2
<i>Monalocoris filicis</i>			1										1
<i>Nabis flavomarginatus</i>			1										1
<i>Nabis limbatus</i>									1				1
<i>Neolygus contaminatus</i>		1	1						1				3
<i>Notostira elongata</i>			1										1
<i>Orthops campestris</i>			1										1
<i>Orthotylus ericetorum</i>									1				1
<i>Phylus coryli*</i>								1					1
<i>Phytocoris longipennis</i>								1					1
<i>Pinalitus cervinus</i>	1												1
<i>Pithanus maerkelii</i>												1	1
<i>Plagiognathus arbustorum</i>	1		1						1				3
<i>Plagiognathus chrysanthemi</i>			1										1
<i>Scolopostethus decoratus</i>						1						1	2
<i>Scolopostethus thomsoni</i>						1		1					2
<i>Stenodema calcarata</i>	1	1	2			1						2	7
<i>Stenodema holsata</i>	1	3	3	1		2	1	6	1	1		4	23
<i>Stenodema laevigata</i>		2						1					3
<i>Stenotus binotatus</i>	1		1										2
SHIELDBUGS & ALLIES													
<i>Elasmotethus interstinctus</i>								1					1
<i>Elasmucha grisea</i>			1										1
<i>Palomena prasina</i>										1			1
WATER BUGS													
<i>Saldula saltatoria</i>		2							1				3
HETEROPTERA record totals	7	15	16	4		8	8	21	12	3		21	115
CRANEFLIES													
<i>Austrolimnophila ochracea</i>		1					3	1	1			1	7
<i>Cheilotrichia cinerascens</i>						1	1	1					3
<i>Cylindrotoma distinctissima</i>								1					1

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Dicranomyia autumnalis</i>								2					2
<i>Dicranomyia fusca</i>							1						1
<i>Dicranomyia modesta</i>		3					2	3	1				9
<i>Dicranomyia morio</i>		1											1
<i>Dicranomyia quadra*</i>		2					1						3
<i>Dicranophragma nemorale</i>							2	3				1	6
<i>Dicranophragma separatum</i>		1											1
<i>Dicranota pavida</i>		1					1	1					3
<i>Dolichozepe albipes</i>							1						1
<i>Eloeophila maculata</i>												1	1
<i>Eloeophila submarmorata</i>								1					1
<i>Epiphragma ocellare</i>		1						1					2
<i>Erioconopa diuturna</i>			1										1
<i>Erioconopa trivialis</i>		1	2			2		4	1			1	11
<i>Erioptera lutea</i>			1				2	2			1	1	7
<i>Euphylidorea aperta</i>							2					2	4
<i>Helius flavus</i>												1	1
<i>Helius longirostris</i>							1						1
<i>Limonia macrostigma</i>		1						2					3
<i>Limonia nubeculosa</i>		4					1	7				1	13
<i>Limonia phragmitidis</i>								1					1
<i>Lipsothrix remota</i>								1					1
<i>Molophilus appendiculatus</i>		1											1
<i>Molophilus griseus</i>								1	3		1		5
<i>Molophilus medius</i>	1												1
<i>Molophilus pusillus</i>								1					1
<i>Molophilus serpentiger</i>		1									1		2
<i>Neolimnomyia batava</i>							1						1
<i>Neolimnomyia filata*</i>							1						1
<i>Nephrotoma flavipalpis</i>								1					1
<i>Ormosia depilata</i>							2	2					4
<i>Ormosia hederæ</i>								1					1
<i>Ormosia lineata</i>								1					1
<i>Ormosia nodulosa</i>						1	1						2
<i>Paradelphomyia senilis</i>		1						1					2
<i>Pedicia littoralis*</i>		2					1			1			4
<i>Pedicia rivosa</i>						1							1
<i>Phylidorea fulvonervosa</i>	1					1	1					3	6
<i>Ptychoptera albimana</i>			1				1						2
<i>Rhipidia maculata</i>			1				1						2
<i>Rhypholophus haemorrhoidalis*</i>							1						1
<i>Rhypholophus varius</i>		1					1	3					5
<i>Tasiocera murina</i>											1		1

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Tipula alpium</i>				1									1
<i>Tipula fascipennis</i>							1						1
<i>Tipula fulvipennis</i>							1	1			1	1	4
<i>Tipula luna</i>	1						1	2			1		5
<i>Tipula maxima</i>											1		1
<i>Tipula oleracea</i>	1					1					1		3
<i>Tipula paludosa</i>					1							1	2
<i>Tipula subnodicornis</i>					1								1
<i>Tipula unca</i>						2	1	1					4
<i>Tipula varipennis</i>								1					1
<i>Tipula vernalis</i>			1					1				2	4
<i>Tipula vittata</i>							1	1					2
<i>Trichocera saltator</i>			1										1
<i>Tricyphona immaculata</i>						1		4	1				6
<i>Ula sylvatica</i>							2						2
CRANEFLIES record totals	4	22	8	1	2	10	36	53	7	1	8	16	168
HOVERFLIES													
<i>Baccha elongata</i>									1				1
<i>Cheilosia albitarsis</i>	1	1											2
<i>Cheilosia illustrata</i>		1											1
<i>Cheilosia pagana</i>	1												1
<i>Chrysogaster solstitialis</i>			1										1
<i>Dasysyrphus tricinctus</i>			1										1
<i>Epistrophe grossulariae</i>		1											1
<i>Episyrphus balteatus</i>	1	2	1					1					5
<i>Eristalis horticola</i>	1	1	1										3
<i>Eristalis pertinax</i>								5					5
<i>Eristalis rupium*</i>						1							1
<i>Eristalis tenax</i>								1					1
<i>Eupeodes corollae</i>												1	1
<i>Eupeodes latifasciatus</i>	1												1
<i>Helophilus pendulus</i>			1					2					3
<i>Leucozona glauca</i>		2											2
<i>Melangyna cincta*</i>							1						1
<i>Melanogaster hirtella</i>	1												1
<i>Melanostoma mellinum</i>				1				1				7	9
<i>Melanostoma scalare</i>	2	1	1	1		1		4				2	12
<i>Meliscaeva auricollis</i>								1					1
<i>Meliscaeva cinctella</i>								1					1
<i>Neoascia podagrica</i>						1						1	2
<i>Neoascia tenur</i>												1	1
<i>Pipizella viduata</i>				1									1

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Platycheirus albimanus</i>		1				1		1	1			1	5
<i>Platycheirus angustatus</i>				1				1				1	3
<i>Platycheirus clypeatus</i>				1								1	2
<i>Platycheirus granditarsus</i>	2						1		1			2	6
<i>Platycheirus manicatus</i>				1									1
<i>Platycheirus ramsarensis</i>				1								3	4
<i>Platycheirus rosarum</i>	1		1										2
<i>Platycheirus scambus*</i>						1							1
<i>Sericomyia silentis</i>								2				3	5
<i>Sphaerophoria philanthus</i>				1									1
<i>Syrpitta pipiens</i>	1			1									2
<i>Syrphus ribesii</i>		1						1					2
HOVERFLIES record totals	12	11	7	9		5	2	21	3			23	93
EMPIDOIDEA													
BRACHYSTOMATIDAE													
<i>Gloma fuscipennis</i>											1	1	2
<i>Trichopeza longicornis</i>		1					2						3
DOLICHOPODIDAE													
<i>Anepsiomyia flaviventris</i>							1						1
<i>Argyra argentina</i>	1												1
<i>Argyra argyria</i>		1						2					3
<i>Argyra diaphana</i>		1									1		2
<i>Argyra leucocephala</i>		2					2	1				1	6
<i>Campsicnemus curvipes</i>	1	9	1				3	4		1			19
<i>Campsicnemus loripes</i>	1	6					3					2	12
<i>Campsicnemus scambus</i>		3				1							4
<i>Chrysotus femoratus</i>			1										1
<i>Chrysotus gramineus</i>	1	1							1				3
<i>Dolichopus caligatus*</i>									1				1
<i>Dolichopus discifer</i>	2	1		1		2	5	1				5	17
<i>Dolichopus plumipes</i>	2	2	1				4		1	1	1	2	14
<i>Dolichopus popularis</i>	2	4				1	3	1			1	2	14
<i>Dolichopus signatus</i>		1											1
<i>Dolichopus trivialis</i>	1							1				1	3
<i>Dolichopus vitripennis</i>				3								5	8
<i>Dolichopus wahlbergi</i>		1											1
<i>Hercostomus aerosus</i>	2	3	1			2	4	3		1		3	19
<i>Hercostomus cupreus</i>		2					1						3
<i>Hydrophorus balticus</i>	1												1
<i>Rhaphium appendiculatum</i>		3						1					4
<i>Rhaphium caliginosum</i>	1	2						1		1			5
<i>Rhaphium riparium</i>		1											1

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Sciapus platypterus</i>		1						1	1				3
<i>Sybistroma obscurellum</i>	1	3								1			5
<i>Sympycnus desoutteri</i>	1	1							1			1	4
<i>Syntormon pallipes</i>	1	1											2
EMPIDIDAE													
<i>Chelifera trapezina*</i>		1											1
<i>Clinocera fontinalis</i>							1			1			2
<i>Dolichocephala guttata</i>		1					1	2					4
<i>Dolichocephala oblongoguttata</i>		1					1	2					4
<i>Empis livida</i>									1				1
<i>Empis nigripes</i>	1						1	2	1			1	6
<i>Empis planetica</i>							1						1
<i>Empis praevia</i>	1	1	1					1					4
<i>Empis punctata</i>				1									1
<i>Empis stercorea</i>								1					1
<i>Empis tessellata</i>						1							1
<i>Empis trigramma</i>				1		1			1				3
<i>Empis verralli*</i>												1	1
<i>Hilara chorica</i>		2				2	1	1				6	12
<i>Hilara clavipes*</i>		1					1						2
<i>Hilara interstincta</i>												1	1
<i>Hilara litorea</i>		1						1				1	3
<i>Hilara maura</i>		1											1
<i>Hilara nigrina</i>		1											1
<i>Hilara obscura</i>		1											1
<i>Hilara rejecta</i>		2											2
<i>Phyllodromia melanocephala</i>						1	1						2
<i>Rhamphomyia albohirta</i>						1	1	2					4
<i>Rhamphomyia crassirostris</i>								1					1
<i>Rhamphomyia dentipes</i>							2	1					3
<i>Rhamphomyia erythrophthalma</i>									1				1
<i>Rhamphomyia longipes</i>								1					1
<i>Rhamphomyia nigripennis</i>									1				1
<i>Rhamphomyia pilifer</i>							1						1
<i>Rhamphomyia stigmosa</i>				1		1		1				1	4
<i>Rhamphomyia tibialis*</i>							1						1
<i>Rhamphomyia tibiella</i>								1					1
<i>Rhamphomyia umbripennis</i>							1	1					2
HYBOTIDAE													
<i>Bicellaria vana</i>				2		1	1	4	1			3	12
<i>Hybos culiciformis</i>	1		1	1			1	2	1				7
<i>Hybos femoratus</i>	1	3	2	2		2	3	1	1			4	19
<i>Ocydromia glabricula</i>							2	3					5

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Platypalpus agilis</i>						1							1
<i>Trichina clavipes</i>						1		1					2
<i>Trichinomyia flavipes</i>							2						2
EMPIDOIDEA record totals	22	66	8	12		18	51	45	13	6	4	41	286
CALYPTRATES													
ANTHOMYIIDAE													
<i>Alliopsis billbergi</i>								3					3
<i>Anthomyia liturata</i>									1			1	2
<i>Botanophila discreta</i>					1								1
<i>Botanophila fugax</i>		1		1		1	1	3				1	8
<i>Botanophila hucketti*</i>				1									1
<i>Botanophila sericea*</i>									1			2	3
<i>Chirosia betuleti</i>							1					1	2
<i>Chirosia flavipennis</i>							1						1
<i>Chirosia griseifrons</i>												1	1
<i>Chirosia grossicauda</i>			1				1					1	3
<i>Chirosia histicina</i>							1				1		2
<i>Delia florilega</i>					1							1	2
<i>Delia lophota</i>	1												1
<i>Delia platura</i>				1	1							1	3
<i>Egle ciliata</i>		1											1
<i>Egle minuta</i>							1	1					2
<i>Egle parva</i>							1						1
<i>Egle rhinotmeta</i>								1					1
<i>Emmesomyia socia</i>		1											1
<i>Hydrophoria linogrisea</i>									1				1
<i>Hydrophoria ruralis</i>		2						4					6
<i>Hylemya vagans</i>						1	1	3		1	1		7
<i>Hylemya variata</i>				1	1	1		2				3	8
<i>Hylemyza partita</i>									2				2
<i>Lasiomma latipenne</i>									1				1
<i>Lasiomma seminitidum</i>									1				1
<i>Leucophora grisella*</i>									1				1
<i>Paradelia intersecta</i>							1						1
<i>Paregle audacula</i>	1												1
<i>Pegomya bicolor</i>							1	1					2
<i>Pegomya haemorrhoum*</i>	1	3	1			2	2	5	3				17
<i>Pegomya rubivora</i>								1					1
<i>Pegomya rugulosa*</i>							1						1
<i>Pegomya solennis</i>							1	2					3
<i>Pegoplata aestiva</i>								1				1	2
<i>Pegoplata infirma</i>			1	1		2	1	6				1	12

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Phorbia fumigata</i>		1	2										3
<i>Phorbia moliniaris</i>					1								1
<i>Phorbia nuceicornis</i>						1						2	3
<i>Phorbia sepia</i>				1		2		1					4
<i>Zaphne inuncta*</i>									1				1
CALLIPHORIDAE													
<i>Bellardia viarum</i>								1					1
<i>Calliphora vomitoria</i>			1					1				1	3
<i>Lucilia caesar</i>			1			1		2					4
<i>Lucilia illustris</i>								1					1
<i>Melanomya nana</i>				1								1	2
<i>Melinda viridicyanea</i>	1					1		1	1			1	5
<i>Pollenia angustigena</i>								1	1				2
<i>Pollenia labialis</i>		1						1					2
FANNIIDAE													
<i>Fannia coracina</i>										1			1
<i>Fannia fuscula</i>						1			1				2
<i>Fannia minutipalpis</i>									1				1
<i>Fannia mollissima</i>		1					2	5					8
<i>Fannia polychaeta</i>						1							1
<i>Fannia postica</i>			1			1		1				5	8
<i>Fannia rondanii</i>				1				2					3
<i>Fannia serena</i>	2	2	2				1	1	1			1	10
MUSCIDAE													
<i>Azelia cilipes</i>			1					1	1				3
<i>Azelia triquetra</i>									1				1
<i>Azelia zetterstedtii</i>									2		1		3
<i>Brontaea humilis</i>								2					2
<i>Coenosia humilis*</i>	1												1
<i>Coenosia intermedia</i>		1				1	1						3
<i>Coenosia means*</i>												3	3
<i>Coenosia pedella</i>												1	1
<i>Coenosia perpusilla</i>												4	4
<i>Coenosia pumila</i>			2										2
<i>Coenosia tigrina</i>			1						1				2
<i>Drymeia hamata</i>												1	1
<i>Eudasyphora cyanella</i>		2						1					3
<i>Eudasyphora cyanicolor</i>						1		2					3
<i>Graphomya maculata</i>		1											1
<i>Hebecnema fumosa</i>											1		1
<i>Hebecnema nigra</i>		1					1	1				1	4
<i>Hebecnema nigricolor</i>		1											1
<i>Hebecnema umbratica</i>								1					1

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Helina depuncta</i>		1	1				1			1			4
<i>Helina eveceta</i>				1								2	3
<i>Helina impuncta</i>						1			1				2
<i>Helina lasiophthalma</i>									1				1
<i>Helina pubiseta</i>								1					1
<i>Helina reversio</i>			1									1	2
<i>Hydrotaea armipes</i>					1								1
<i>Hydrotaea dentipes</i>		1											1
<i>Hydrotaea diabolus</i>	1												1
<i>Hydrotaea irritans</i>				1			1	2		1		1	6
<i>Limnophora maculosa</i>								3					3
<i>Limnophora triangula</i>		1					1						2
<i>Lispe tentaculata</i>									1				1
<i>Lophosceles cinereiventris</i>								1					1
<i>Morellia aenescens</i>	2	1	2			1		2					8
<i>Musca autumnalis</i>	1							1					2
<i>Muscina prolapsa</i>								1					1
<i>Mydaea anicula*</i>			1										1
<i>Myospila meditabunda</i>							1						1
<i>Phaonia angelicae</i>								2					2
<i>Phaonia errans</i>				1				2					3
<i>Phaonia halterata</i>	1							2				1	4
<i>Phaonia incana</i>	1	1		1									3
<i>Phaonia magnicornis*</i>							1						1
<i>Phaonia palpata</i>		1											1
<i>Phaonia rufiventris</i>							1	2					3
<i>Phaonia serva</i>	1	1											2
<i>Phaonia subventa</i>		1											1
<i>Phaonia tuguriorum</i>						1		1					2
<i>Polietes domitor</i>									1				1
<i>Pseudocoenosia abnormis</i>												1	1
<i>Pseudocoenosia solitaria</i>						1						4	5
<i>Schoenomyza litorella</i>									1				1
<i>Spilogona denigrata</i>	1	1		1		2	3	3		1		4	16
<i>Spilogona pacifica*</i>												1	1
<i>Thricops semicinereus*</i>						1							1
SARCOPHAGIDAE													
<i>Sarcophaga aratrix*</i>								1					1
SCATHOPHAGIDAE													
<i>Nanna fasciata</i>				1			1	2					4
<i>Nanna tibiella</i>							1						1
<i>Norellisoma spinimanum</i>								1					1
<i>Scathophaga furcata</i>		2		2		3	5	3	2		1	5	23

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Scathophaga</i>						1	1						2
<i>Scathophaga stercoraria</i>	2	4	2	3	1	4	3	4	3		1	5	32
<i>Scathophaga suilla</i>		2	1	1	1	3	1	1			1	3	14
TACHINIDAE													
<i>Ceromya bicolor*</i>						1							1
<i>Lydella stabulans</i>												1	1
<i>Lypha dubia</i>		1											1
<i>Medina collaris</i>				1								1	2
<i>Phytomyptera cingulata*</i>	1												1
<i>Siphona geniculata</i>	1					2			2			1	6
<i>Siphona setosa</i>						1							1
<i>Voria ruralis</i>			1										1
CALYPTRATES record totals	19	37	23	21	8	39	41	94	34	5	7	66	394
OTHER DIPTERA													
ANISOPODIDAE													
<i>Sylvicola cinctus</i>		2	1			1		1	2				7
<i>Sylvicola punctatus</i>				1		1	2						4
BIBIONIDAE													
<i>Bibio johannis</i>								2					2
<i>Bibio lanigerus</i>					1								1
<i>Bibio longipes</i>			2					1	1				4
<i>Bibio leucopterus</i>						1	1	2	1				5
<i>Bibio marci</i>				1		1		1	3			2	8
<i>Bibio nigriventris</i>								1					1
<i>Bibio pomonae</i>					1								
<i>Dilophus febrilis</i>		1		1	1	1	1	3	3			2	13
CHLOROPIDAE													
<i>Chlorops obscurellus*</i>						1							1
<i>Elachiptera cornuta</i>									1				1
<i>Elachiptera tuberculifera</i>									1				1
<i>Thaumatomyia trifasciata*</i>												1	1
CULICIDAE													
<i>Culiseta annulata</i>							1						1
DIASTATIDAE													
<i>Diastata costata</i>						1							1
<i>Diastata fuscula</i>	1							2					3
DIXIDAE													
<i>Dixa aestivalis</i>									1				1
<i>Dixa nubilipennis*</i>		1											1
<i>Dixa puberula</i>		1											1
DROSOPHILIDAE													
<i>Scaptomyza flava</i>			1	1									2

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Scaptomyza graminum</i>	1						1	1					3
<i>Scaptomyza pallida</i>		1	1					1					3
DRYOMYZIDAE													
<i>Neuroctena anilis</i>		2						2					4
EPHYDRIDAE													
<i>Parydra coarctata</i>								1	1				2
HELEOMYZIDAE													
<i>Heteromyza oculata*</i>						1							1
<i>Scoliocentra dupliciseta*</i>							1						1
<i>Scoliocentra villosa*</i>		1											1
<i>Suillia atricornis</i>		1						1					2
<i>Suillia bicolor</i>							1						1
<i>Suillia fuscicornis</i>							1	1					2
<i>Suillia humilis</i>							1						1
<i>Suillia notata</i>												1	1
<i>Suillia pallida</i>							1	1					2
<i>Suillia variegata</i>							1						1
<i>Tephrochlamys rufiventris</i>							1						1
LAUXANIIDAE													
<i>Calliopum elisae</i>								1					1
<i>Meiosimyza decipiens</i>		1											1
<i>Meiosimyza illota</i>									1			1	2
<i>Meiosimyza platycephala</i>								1		1			2
<i>Meiosimyza rorida</i>		1				1	2	2	1				7
<i>Meiosimyza subfasciata</i>												1	1
<i>Minettia fasciata</i>			1										1
<i>Poecilolycia vittata*</i>								1					1
<i>Sapromyza albiceps</i>						1							1
<i>Sapromyza halidayi</i>									1				1
<i>Sapromyza sexpunctata</i>			1									1	2
<i>Tricholauxania praeusta</i>							1	1	1				3
LONCHOPTERIDAE													
<i>Lonchoptera bifurcata</i>		2	1				1					1	5
<i>Lonchoptera lutea</i>	1	3	2			2	3	3	2	1			17
<i>Lonchoptera tristis</i>		3											3
OPETIIDAE													
<i>Opetia nigra</i>							1		1				2
OPOMYZIDAE													
<i>Geomyza balachowskyi</i>	1		1			1			1				4
<i>Geomyza tripunctata</i>			1				2		2			2	7
<i>Opomyza florum</i>		1											1
<i>Opomyza germinationis</i>	1		1	1		1	3	2	2	1		4	16
<i>Opomyza petrei</i>	1	1	1			1		3	1			3	11

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
PALLOPTERIDAE													
<i>Paloptera trimacula</i>							1						1
PLATYPEZIDAE													
<i>Agathomyia lundbecki*</i>								1					1
PSILIDAE													
<i>Chamaepsila nigricornis</i>								1	1				2
<i>Psila fimetaria</i>							1						1
RHAGIONIDAE													
<i>Chrysopilus cristatus</i>								1				1	2
<i>Rhagio lineola</i>				1		1			1			1	4
<i>Rhagio scolopaceus</i>	1	1	1	1		1	2					2	9
<i>Symphoromyia crassicornis*</i>				1									1
SCATOPSIDAE													
<i>Thripomorpha cooki*</i>				1									1
SCIARIDAE													
<i>Schwenckfeldina carbonaria</i>						1		1	1				3
SCIOMYZIDAE													
<i>Hydromya dorsalis</i>									1			2	3
<i>Pherbellia schoenherri</i>						1							1
<i>Renocera pallida</i>	2						2						4
<i>Renocera stroblii</i>	1												1
<i>Tetanocera arrogans</i>	2												2
<i>Tetanocera elata</i>	1		1	2				1				2	7
<i>Tetanocera hyalipennis</i>	1												1
SEPSIDAE													
<i>Nemopoda nitidula</i>		1											1
<i>Sepsis cynipsea</i>		1			1	2	3	1	1			1	10
<i>Sepsis fulgens</i>		1	2	2		1		3				1	10
<i>Sepsis orthocnemis</i>		1	1	1		1	1	1	1			4	11
<i>Sepsis punctum</i>			1										1
<i>Sepsis violacea</i>	1		1						2			1	5
SPHAEROCERIDAE													
<i>Copromyza equina</i>			1					1		1	1		4
<i>Copromyza nigrina</i>	1				1		1	2		1		1	7
<i>Copromyza stercoraria</i>	1	1					2					3	7
<i>Crumomyia fimetaria</i>		2											2
<i>Crumomyia nitida</i>	1						1	1			1		4
<i>Ischiolepta crenata</i>								1					1
<i>Leptocera fontinalis</i>		1							1				2
<i>Leptocera nigra</i>		1											1
<i>Limosina silvatica</i>										1			1
<i>Lotophila atra</i>				1				1					2
<i>Opacifrons coxata</i>									1				1

Groups, families & species	02	03	04	08	09	11	12	13	16	18	19	Moor-land	Whole site
<i>Opacifrons humida</i>		1											1
<i>Spelobia clunipes</i>							1						1
STRATIOMYIDAE													
<i>Beris chalybata</i>		1		1		1		5					8
<i>Beris fuscipes</i>					1	1	2						4
<i>Microchrysa cyaneiventris</i>							1						1
TABANIDAE													
<i>Haematopota crassicornis</i>												1	1
<i>Haematopota pluvialis</i>						1						1	2
TEPHRITIDAE													
<i>Anomoia purmunda</i>	1												1
<i>Chaetostomella cylindrica</i>			1						1				2
<i>Tephritis cometa</i>		1							1				2
<i>Tephritis neesii</i>									1	1			2
THAUMALEIDAE													
<i>Thaumalea</i>							1						1
OTHER DIPTERA records totals	19	35	23	16	5	26	45	58	39	6	2	40	314

Table 4: PANTHEON habitat scores for Smithills (363 out of 439 species analysed)

Broad biotope	Habitat	No. of species	% representation	SQI	Species with conservation status
tree-associated	shaded woodland floor	160	14	110	2
open habitats	tall sward & scrub	84	3	108	1
wetland	running water	64	6	113	
wetland	peatland	54	5	130	1
tree-associated	wet woodland	47	19	106	
wetland	wet woodland	47	17	106	
wetland	marshland	34	4	109	
tree-associated	arboreal	16	1	100	
tree-associated	decaying wood	9	<1	138	1
open habitats	upland	6	4	217	1
open habitats	short sward & bare ground	5	<1	100	

FIGURES

Figure 1: Compartment map of the Smithills Estate. The dominant PANTHEON habitats sampled in the compartments visited were: in 2, 4, 8, 9, 11 & 16, tall sward and scrub; in 3, & 12, shaded woodland floor and running water; in 13, shaded wooded floor, running water and tall sward and scrub; in 18 & 19, shaded woodland floor; outside the compartments the moorland locations included marshland and peatland habitats as well as the more general upland habitat.

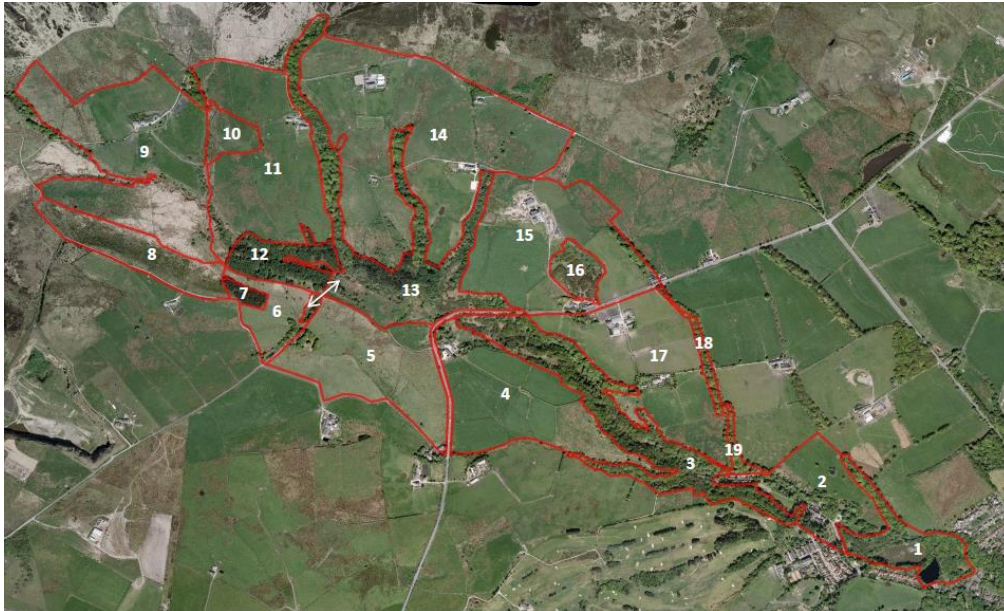


Figure 2: Map of the 100m survey squares with numbers of records in each (smaller scale than Fig 1). A marks Barrow Bridge and Compartment 2; B marks Brownstones Quarry (Compartment 16); and C marks the coniferous upper part of Walker Fold Woods (Compartment 12).

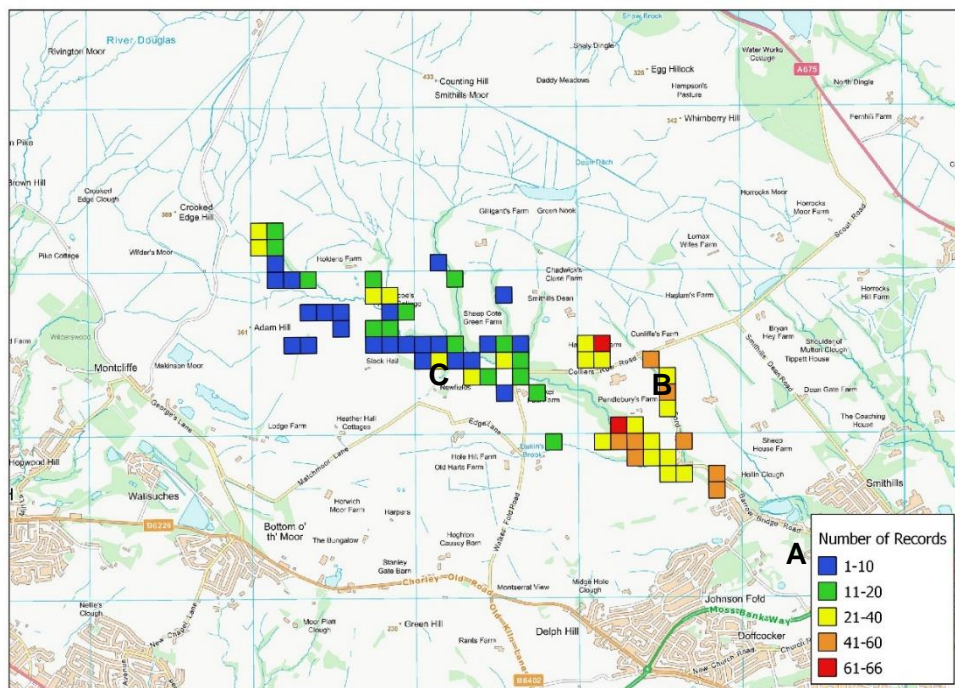


Figure 3: *Symphoromyia crassicornis* (Rhagionidae), a noteworthy species characteristic of the Smithills Estate



Figure 4: PANTHEON results for numbers of species by feeding guild (363 species analysed)

