



The Diversity of Hemiptera and Diptera on Burnt Edge, Smithills Estate

by

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Cover photos

Hemiptera (top, from left to right):

- Cercopis vulnerata* (Cercopidae)
- Ditropis pteridis* (Delphacidae)
- Neophilaenus lineatus* (Aphrophoridae)
- Ulopa reticulata* (Cicadellidae)
- Pithanus maerkelii* (Miridae)
- Orthops campestris* (Miridae)

Photos courtesy of www.britishbugs.org.uk

Diptera (bottom, from left to right):

- Bibio lanigerus* (Bibionidae)
- Sicus ferrugineus* (Conopidae)
- Morellia aenescens* (Muscidae)
- Neuroctena anilis* (Dryomyzidae)
- Polietes hirticrus* (Muscidae)
- Beris vallata* (Stratiomyiidae)
- Scathophaga stercoraria* (Scathophagidae)

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Abstract

This report presents the results of a further series of Hemiptera (true bug) and Diptera (true fly) surveys carried out on the Smithills Estate, owned and managed by the Woodland Trust. Thirteen visits were made at roughly fortnightly intervals between April and September 2022, resulting in 3944 individual records of the presence of a species in a 100m grid square on a specific date. A full list is given of the 601 species recorded and their distribution across 12 survey locations along a 1.5km transect in the valley upstream of Walker Fold. The species list is interpreted in terms of feeding guilds and habitat assemblages using the PANTHEON database, which also identifies species with a national conservation designation. Overall numerical measures of Diptera diversity are compared with earlier results from the Smithills Estate and from other locations in Lancashire and Cheshire.

Introduction

The promotion of biodiversity has become one of the key aims of landscape and habitat management in Britain. There are many ways of looking at this concept, but the number of wild species occupying a site or broader habitat is a basic element. By this measure, invertebrates and plants provide a much bigger contribution than the vertebrate fauna which attracts most attention from wildlife recorders. This report is part of wider project looking at the diversity of two insect orders, Hemiptera (true bugs) and Diptera (true flies), across a range of wildlife sites across Lancashire and Cheshire.

An earlier report (Brighton 2021) gives details of surveys of these insects carried out across the whole expanse of the Smithills Estate just after it was first acquired by the Woodland Trust. The results of these were compared with five other large sites in a further report using various measures of biodiversity (Brighton 2020).

These surveys were rather irregular in the coverage of the different months and of the habitats within each site, as well as varying in the total effort deployed. While these factors could be addressed to some extent by various statistical methods, it was considered desirable to investigate the replicability and completeness of the sweep-net collecting method. In 2020 with the lockdown and travel restrictions imposed by the COVID epidemic, weekly surveys were carried out at 6 locations at Houghton Green Pool (HGP), a 10-hectare site of recently developed willow-scrub (Brighton 2022) adjacent to the M6/M62 intersection. This study showed that, while the relative abundance of common species was reliably recorded with this intensity of survey, it was still impossible to arrive at a firm estimate of the total number of species present or passing through. Many species were encountered only

once. Nevertheless it was concluded that a reliable measure of Diptera diversity could be made using Fisher's α (alpha) index (Magurran 2004).

The HGP study was also notable for the large differences between the recorded abundances of species and those which would be expected from the regional distribution. In particular one fly species found in considerable numbers, *Botanophila biciliaris* (family Anthomyiidae), had previously been recorded only at six or so other locations throughout Britain. This shows the value of quite small areas of new semi-natural habitat developing in a farmed landscape affected by modern infrastructure.

In the two following years, I have extended these surveys to further sites featuring the development of new habitat within a landscape relatively lacking in wildlife interest. With the recent establishment of new tree plantations, the Smithills estate offered the opportunity to carry out baseline surveys in the early stages of development of the Northern Forest. The study includes areas of the moorland fringe outside the new plantations: though wilder in character, these are normally regarded as limited in the invertebrate fauna compared with more botanically diverse lowland areas.

The taxonomic scope is as described in Brighton (2020) with the addition of the Auchenorrhynca, the division of the true bugs (Hemiptera) including frog-hoppers, leaf-hoppers and plant-hoppers (see www.britishbugs.org.uk). The comprehensive identification keys by Le Quesne (1960, 1965, 1969) and Le Quesne & Payne (1981) were used, supplemented by the more recent guide of Biedermann and Niedringhaus (2009).

Brighton (2020) also listed major Diptera families excluded from the surveys because of the difficulty of identification. These included the

large fungus gnat family Mycetophilidae. It has been found feasible to bring part of this family into the scope of the surveys along with the related families Bolitophilidae, Diadocidiidae, Ditomyiidae and Keroplatidae – adding 232 species to the 909 “other Diptera” in Table 1 of Brighton (2020). These are covered by Hutson *et al* (1980). (A recently published handbook (Chandler 2022) deals with the remaining 334 species of fungus gnat in the subfamily Mycetophilinae).

Although the Sciaridae remain a largely intractable group of small gnats, a few distinctive species common have also been recorded using the key by Freeman (1983). Likewise, a few Phorid flies have been recorded using Disney’s (1983) keys.

Survey Locations

Sweep-net surveying was carried out as described by Brighton (2020, 2022) at twelve locations as follows (see Figures 1 and 2):

- **Location 1** (SD676120): area at south end of car park with a presumably sown wild-flower rich area but also extensive *Juncus*.
- **Location 2** (SD675122): in the fenced plantation extending up the hill from the car park. Mainly birch saplings in the area sampled. Includes a seepage with rush *Juncus* and lady-fern *Athyrium*. Extensive grass area with few herbs apart from patches with *Angelica*.
- **Location 3** (SD673123): in the fenced plantation extending up the hill from the car park. Similar to Location 2 but damper with a seepage running from the path all the way down to the boundary fence. Saplings mainly alder. Taller vegetation in the late summer with *Angelica* and Himalayan balsam *Impatiens* prominent (see Fig 2a).
- **Location 4** (SD671123): the area at the top of the slope just beyond the fenced plantation and adjacent to Newfields Farm, with abundant hogweed *Heracleum* and nettles. A trickle emerges from a small rocky dell which then flows into the small wooded New Field Clough.
- **Location 5** (SD669124): a strong seepage runs down a steep slope forming a rushy corridor in an area of acid grassland with tormentil. There are two isolated sallows (see Fig. 2b).
- **Location 6** (SD668126): a damp flat area with a group of half-a-dozen or so mature sallows amongst the very ruined remains of a small colliery, including a mound with abundant mouse-ear hawkweed (*Pilosella*) (see Fig. 2c).
- **Location 7** (SD666126): this flat area was centred on a large area of bracken *Pteridium* in an expanse of purple moor-grass *Molinia* with occasional heather *Calluna* and bilberry *Vaccinium*.
- **Location 8** (SD664126): this is an area of dense heather and bilberry on the steeper slope of Burnt Edge. Cow-wheat *Melampyrum* was frequent. There appear to be no seepages in this area (fig. 2d).
- **Location 9** (SD662127): this consists an area of acid grassland with herbs including pig-nut *Conopodium* and occasional marsh thistle *Cirsium* adjacent to a stream-course with extensive rush.
- **Location 10** (SD661130): a distinct area of rush with abundant fox-glove within an old field boundary with possible industrial remains and a clump of scrub including elder *Sambucus* and snowberry *Symphoricarpos* (see Fig. 2e).
- **Location 11** (SD660131): an acid fen formed by the historic damming of the main watercourse of Dean Brook at the top of Holden’s Plantation. There is a mature willow and patches of bog-moss *Sphagnum* amongst the abundant rush *Juncus* with thistles *Cirsium* and lady-fern *Athyrium* (see Fig. 2f).
- **Location 12** (SD661132): just above Location 11, this is fenced area which has been recently planted with a variety of trees. It is on the edge of the open moorland and parts were burnt during the wild-fire outbreak of 2018. There is some regeneration of heather but there is also plenty of lush grassland but few if any herbs.

Each sample was timed to 15 minutes including both sweeping and frequent examination to remove specimens of interest with the aspirator, while trying to avoid gathering multiple specimens of a single species. A few additional records were gathered of specimens found basking on fences or logs or feeding on flowerheads. These were either caught using a 50ml pot or identified in the field.

Results

The Appendix gives the full list of species listed by group and family with the numbers of records at each location, and also totals along the whole transect. There were 13 fortnightly surveys so this is the maximum number possible at any one location.

The overall number of records was 3944 covering 601 species. The breakdown across the two groups of Hemiptera and five groups of Diptera

within the scope of the study is given in the following table:

Group	No. of records	No. of species	National representation
Auchenorrhynca	358	49	11.8%
Heteroptera	400	40	6.5%
Craneflies	266	68	19.2%
Hoverflies	208	38	13.3%
Empidoidea	581	85	12.1%
Calyptrates	1125	174	16.7%
Other Diptera	1006	146	[15.5%]

The national representation is the number of species recorded as a proportion of the number on the respective checklists for Great Britain. For the Hemiptera the national numbers were 415 and 617 at the end of 2021 according to the British Bugs website (www.britishbugs.org.uk). For the Diptera the national numbers are taken from Table 1b of Brighton (2023) based on the 2020 checklist. The representation for other Diptera is based on only those species from the families included in the “Miscellaneous” category of Brighton (2023): there were 92 of these in the survey.

The next Table shows the proportions of the species numbers in the Diptera groups compared with my previous surveys (Brighton 2022):

Group	Burnt Edge	Houghton Green Pool	Brighton (2020)
Craneflies	13.3%	8.1%	13.6%
Hoverflies	7.4%	6.0%	9.3%
Empidoidea	16.6%	18.4%	19.7%
Calyptrates	34.1%	34.6%	28.5%
Other Diptera	28.6%	32.8%	28.9%
TOTALS	511	381	1292

Figure 3 shows the variation through the season of the numbers of records in the successive fortnightly surveys for the main Hemiptera and Diptera groups and also for some individual Diptera families of particular interest. There was an abrupt increase in Hemiptera numbers in late July as many species reached the adult stage when identification becomes feasible. Cranefly numbers were greatest in late May and June, while hoverflies had a fairly constant presence from early May to late August. The Empidoidea build to broad peak in June and then decline steadily for the rest of the summer. The patterns for the three constituent families in Fig. 3c show marked differences with Empididae decreasing strongly after the sharp peak in May while the

Dolichopodidae are building to a sharp peak in June. The Hybotidae have a much broader peak through to mid-September. This is similar to the pattern found at HGP in 2020, possibly reflecting general differences in the ecology of these three families of mainly predatory flies.

The Calyptrates rise fairly steadily to a peak in July and are the most numerous before the subsequent decline when they are overtaken by a strong peak in the very varied group of other Diptera. Fig. 3d shows that the Anthomyiidae are noticeably in advance of the Muscidae, the other dominant family in the Calyptrates. In April numbers of the other Diptera, from otherwise rather unproductive visits, were boosted mainly by lesser dung-flies Sphaeroceridae and several species in the fungus gnat genus *Boletina* which are particularly noted for their ability to thrive in open moorland (Hutson *et al.* 1980).

The maximum possible incidence for any species in this survey is $12 \times 13 = 156$. The highest observed incidence was 91 for the common yellow dung-fly *Scathophaga stercoraria* present in well over half of the samples. The next two places were taken by the grass-feeding Acalyptrate fly *Opomyza petrei* (66) and the small predatory Hybotid *Bicellaria vana* (64).

Diversity Measures

While there were several other species which appeared for prolonged periods at multiple locations, the Diptera list is dominated by singletons and doubletons, as seen in the Table overleaf: this includes results for the previous Smithills surveys in 2015-19, both for the overall estate and for the Walker Fold (BioBlitz Compartments 8-13) and moorland areas only. The derivation and significance of Fisher’s diversity parameter α is discussed by Brighton (2022). The most important point is that it is insensitive to the sample size. It is at first sight surprising that it should be larger for the eastern section of the transect than for the complete transect, but this is because it takes account of the evenness of the distribution of the species numbers. Similarly one might have expected the diversity to be higher for the earlier surveys of the Walker Fold and moorland areas as this included the wooded areas before the recent clearance. There is however a clear contrast

	Diversity statistics for Diptera				2015-2019 (All areas)
	All locations	Locations 1-6	Locations 7-12	2015-2019 (Cpts 8-13 & moorland)	
Number of records	3186	1817	1369	801	1255
Number of species	512	423	316	297	398
Fisher's α	172.5	173.3	128.8	170.8	201.0
Number of singletons	165	165	134	150	182
Number of doubletons	90	74	46	50	70
Chao1 estimate	663.3	607.0	511.2	522.0	634.4

between the eastern and western sections of the transect, as there is also between the present surveys and the full results of the 2015-19 including the downstream areas.

Brighton (2022) also discussed the derivation of the Chao1 estimate of the total species richness. It is subject to high uncertainty. As in the HGP survey, the present results show that more intensive surveying tends to increase the Chao1 estimates.

These numbers take no account of the species composition of the different samples. Again following Brighton (2022), the differences between one area and another or between one year and another can be gauged using a measure of β -diversity known as the Morisita-Horn index. Like Fisher's α this is weighted towards the commoner species in each sample and is insensitive to differences in sample size. Various comparisons have been made: between the eastern and western sections of the 2022 transect; between the overall 2022 survey and the 2015-19 results for the upper valley; between the 2022 results and the reference study at HGP; and finally between the 2022 Burnt Edge results and the regional dataset across Lancashire and Cheshire reported by Brighton 2020. These pairwise comparisons are shown diagrammatically in Fig 5. They show the eastern and western sections to be more similar in species composition than the overall Burnt Edge results are to those from the upper valley up to 2019. The results are rather closer to the wider results across the whole of Lancashire and Cheshire than were those from Houghton Green Pool (Brighton 2022).

Surprisingly, the difference between the eastern and western sections of Burnt Edge are also

smaller than that between the wet and dry locations at Houghton Green Pool (0.70). This is attributed to there being a greater proportion of very common species being found all along the transect. The species contributing most to the difference between the Burnt Edge sections have been identified using the χ^2 statistic with one degree of freedom, with the results in the following Table.

Species Family	Locs 1-6	Locs 7-12	χ^2
<i>Coenosia femoralis</i> Muscidae	5	25	19.9
<i>Dolichopus vitripennis</i> Dolichopodidae	2	17	16.8
<i>Bicellaria vana</i> Hybotidae	52	12	15.3
<i>Phorbia moliniaris</i> Anthomyiidae	0	9	11.9
<i>Chirosia grossicauda</i> Anthomyiidae	0	8	10.6
<i>Coenosia means</i> Muscidae	1	10	10.3
<i>Dolichopus discifer</i> Dolichopodidae	7	19	9.6
<i>Coenosia perpusilla</i> Muscidae	2	11	9.2
<i>Morellia aenescens</i> Muscidae	12	0	9.0
<i>Platypalpus notatus</i> Hybotidae	1	9	9.0
<i>Spilogona pacifica</i> Muscidae	5	15	8.4
<i>Tephritis neesii</i> Tephritidae	8	19	8.3
<i>Spilogona denigrata</i> Muscidae	3	11	7.2
<i>Hylemya variata</i> Anthomyiidae	15	26	7.0
<i>Sepsis cynipsea</i> Sepsidae	16	27	6.9
<i>Opetia nigra</i> Opetiidae	9	0	6.8
<i>Botanophila latifrons</i> Anthomyiidae	1	7	6.5

<i>Phorbia nuceicornis</i> Anthomyiidae	1	7	6.5
<i>Bibio lanigerus</i> Bibionidae	1	7	6.5
<i>Melanostoma mellinum</i> Syrphidae	17	27	6.1
<i>Limonia nubeculosa</i> Limoniidae	8	0	6.0
<i>Minettia fasciata</i> Lauxaniidae	11	1	5.9
<i>Platycheirus ramsarensis</i> Syrphidae	2	8	5.6
<i>Rhamphomyia variabilis</i> Empididae	2	8	5.6
<i>Ceromya bicolor</i> Tachinidae	0	4	5.3
<i>Boletina gripha</i> Mycetophilidae	0	4	5.3
<i>Tipula fulvipennis</i> Tipulidae	7	0	5.3
<i>Tipula oleracea</i> Tipulidae	7	0	5.3
<i>Botanophila discreta</i> Anthomyiidae	7	0	5.3
<i>Hylemya vagans</i> Anthomyiidae	7	0	5.3
<i>Coremacera marginata</i> Sciomyzidae	7	0	5.3
<i>Tricholauxania praeusta</i> Lauxaniidae	7	0	5.3
<i>Sympycnus desoutteri</i> Dolichopodidae	10	1	5.2
<i>Calliopum elisae</i> Lauxaniidae	10	1	5.2

The yellow highlighting indicates species for which the difference in occurrence between the two sections was statistically significant at the 99% level and the grey identifies additional species with a significant difference at the 95% significance level. Consideration of individual species reveals that there are various factors at play.

Species in the Muscid genus *Coenosia* are small grey flies which are predatory both as larvae and adults. Generally, I find them more frequently in shorter vegetation. *C. perpusilla* is a nationally scarce species mainly associated with upland habitats above the tree-line according to Falk and Pont (2017). *C. means* is one of the larger species, with a national distribution almost exclusively in Wales, Northern England and Scotland. The Muscid *Morellia aenescens* was one of the commonest species seen feeding on umbellifers, explaining its restriction to Locations

2-6. The genus *Spilogona* species has many northern species, but the greyish *pacifica* and the black dark-winged *denigrata* are also found regionally in the lowlands though Smithills has been noted previously as a hotspot for the latter (Brighton 2020a).

Of the two *Dolichopus* species showing a strong bias towards the western section, *D. vitripennis* is known to be characteristic of acid conditions. However, *D. discifer* is usually associated with wet woodland (Vincent 2013). What may be happening here is that the flies are dispersing from the wooded clough near the moorland transect.

Bicellaria vana is a small predatory fly hunting as an adult on vegetation. It was the most frequent species of all at HGP, present throughout the sample area throughout the season from early May onwards. That pattern is seen in the eastern section at Burnt Edge where it was recorded on 10 of the 13 visits at each of the Locations 1, 2 and 3. Its appearance was much more sporadic in the western section, suggesting less favourable conditions. Another Hybotid *Platypalpus notatus* was strongly associated with the willow at Location 11.

The Anthomyiidae are closely related to the Muscidae, but unlike them the family contains numerous herbivorous species. The genus *Chirosia* all feed on ferns as larvae, and was well represented in the survey with 7 out of the 12 British species being found during the Burnt Edge survey. In addition the nationally scarce *C. griseifrons* which is believed to develop in lady-fern was found at Location 11 in the 2015-19 surveys (Brighton 2021). It is not surprising that *C. grossicauda* one of the commonest species, which forms galls on bracken, was confined to Locations 7 and 8.

The Anthomyiid genus *Phorbia* has grass-feeding larvae. The females are equipped with blade-like ovipositors for inserting eggs in the stems. As its name suggests, *Phorbia molinaris* was found almost exclusively in the area dominated by *Molinia* moor-grass, together with *P. nuceicornis*. Another Anthomyiid favouring the western section, *Botanophila latifrons*, has a somewhat similar ovipositor but its larvae feed on *Epichloë* fungi which grow on grass stems (Leuchtman & Michelsen 2016).

Tephritidae are a family of herbivorous flies, usually with intricate dark patterns on the wings (Brighton 2021a). *Tephritis neesii* attacks ox-eye daisies so it was not surprising to find it in the wild-flower area of Location 1, but in the latter half of the season it was abundant in the bracken areas of Locations 7 and 8 as well as further afield in the western section which was devoid of the food-plant. This indicates strong dispersive behaviour and possibly gathering to over-winter. Two other *Tephritis* species, *cometa* (food-plant thistles) and *formosa* (sow-thistles), were found to follow a similar pattern.

The rest of the list of species with a statistically significant difference in numbers between the eastern and western sections come from a wide variety of families and the factors affecting their distribution are no doubt equally varied. There are many generally common species: the crane fly *Limonia nubeculosa* is ubiquitous in damp woodlands as is the yellow Lauxaniid *Tricholoauxania praeusta*. *Opetia nigra* is a small but distinctive black fly whose habits are rather mysterious as only males are normally found by sweep-netting. The larvae have been associated with rotting birch and spruce but adults have also been found emerging from the ground away from trees (Ståhls & Kahanpää 2006).

The small hoverfly *Platycheirus ramsarensis* is an upland species (Stubbs and Falk 2002) though only recognised as separate from more wide-ranging *P. clypeatus* in 1990. The latter was also found in the Burnt Edge surveys well spread over the whole transect.

I have often found the predaceous fly *Rhampomyia variabilis* around heather during its flowering period, whether here at Burnt Edge, on the lowland mosses or on the coast. However, the PANTHEON database has it down as a denizen of the shaded woodland floor.

PANTHEON Analysis

As explained in the report of the earlier Smithills surveys (Brighton 2021), the PANTHEON database produces data on the overall ecological characteristics of a species list, including feeding guilds and habitat associations. In Figures 6 and 7 these are compared for the two sections of the transect, the previous survey of Smithills as a whole (not just the upper valley), and overall

results for 1292 Diptera species I recorded across Lancashire and Cheshire up to the end of 2019 (Brighton 2020).

Figure 6 shows the proportions of species occupying the various feeding guilds. The results for the Diptera larvae show a smaller proportion of saprophagous species in the western section of the transect than in the eastern section or the earlier Smithills surveys. This perhaps reflecting a smaller diversity of plant species and therefore of decaying matter. The western section shows greater proportion of parasitoids than the eastern part of the transect. Both have higher proportions than the earlier Smithills survey, but are similar to the Lancashire and Cheshire data. The PANTHON database has as yet very few entries for the Tachinid flies which attack other insects, so these results refer mainly to Calliphoridae and Polleniidae which attack earthworms and the snail-killing flies of family Sciomyzidae. This suggests that the open areas are more productive of these hosts.

Coprophagous larvae were also most prevalent in the western section of Burnt Edge, particularly compared to the regional survey. This may reflect a relative dearth of other resources in the open moorland environment.

Turning to the adults in Fig 6b, the most noticeable difference is the low number of non-feeding species in the western moorland section of Burnt Edge. These are mainly the crane flies, which are regarded as good indicators of ecological conditions (Stubbs 2021). The western section also has proportionately more saprophagous and phytosaprophagous adults feeding on decaying matter. Species feeding on nectar are a fairly constant proportion across all the surveys. This seems somewhat surprising as regards the moorland section of Burnt edge, but various Asteraceae (composites) were certainly in evidence at some of the locations.

Figure 7 presents a selection of the habitat analyses from PANTHEON. At the coarsest level of broad biotopes (Fig. 7a), the Diptera species show a clear increase in the proportion of open habitat species progressing from the overall Smithills results to the eastern Burnt Edge transect and then the Western section. However, tree-associated species remain a major proportion throughout. In contrast the

Hemiptera show a large majority of open habitat species in the Burnt Edge surveys. This reflects the dependence of most of the bug species on their specific food plants and their relative immobility. The large numbers of woodland species in the moorland environment suggests the much greater importance of dispersal for Diptera in seeking resources for feeding, mating and egg-laying.

The PANTHEON database also pinpoints species with a national rarity or scarcity designation, and the list from the Burnt Edge survey appears in the adjacent column. The current version of PANTHEON has not incorporated the status designations for the Calyptrate families reviewed by Falk and Pont (2017) so species have been added from this source as indicated by asterisks. A further addition is *Meiosimyza mihalyii* as a recent addition to the British list – see further below.

It was particularly significant to find a single male of *Botanophila biciliaris* at Location 2 on 3 July as this species was a notable feature of my previous surveys at HGP and CZNR. Though previously known from only half-a-dozen scattered locations across England and Scotland, it is now apparently well-established in the local region. Similar comments apply to the Calliphorid *Angioneura acerba* whose national distribution was the subject of a recent paper (Andrews & Sivell 2019). This was found several times in the CZNR survey, but only a single female was found at Location 7 on Burnt Edge on 11th September. This species is believed to be a parasitoid of snails.

The Anthomyiidae are closely related to the house-fly family Muscidae and different genera have a wide variety of life-styles. *Egle parvaeformis* is one of 12 British species that mostly have close association with willows with the adults feeding on the flowers in early spring before the new generation develops in the developing seeds. Numerous species often co-exist in the same tree, as has been seen several times in Britain (Jones 2018).

The record of *Paregle atrisquama* is only the second in England, the first being in 2012 from Dunford Bridge just over the Pennines from us. There is no information on the larval habits of this genus, but the adults have the elongated

Nationally rare or scarce species in Burnt Edge survey	
Anthomyiidae	<i>Botanophila biciliaris</i> *
	<i>Egle parvaeformis</i> *
	<i>Paregle atrisquama</i> *
	<i>Pegomya rugulosa</i> *
	<i>Zaphne inuncta</i> *
Calliphoridae	<i>Angioneura acerba</i>
Lauxaniidae	<i>Homoneura interstincta</i>
	<i>Meiosimyza mihalyii</i> *
	<i>Sapromyza opaca</i>
	<i>Sapromyza quadricincta</i>
Limoniidae	<i>Idioptera pulchella</i>
	<i>Scleroprocta sororcula</i>
Muscidae	<i>Coenosia perpusilla</i>
Sciomyzidae	<i>Ectinocera borealis</i>
	<i>Tetanocera punctifrons</i>
Sepsidae	<i>Themira gracilis</i>
Tachinidae	<i>Meigenia majuscula</i>
Aphrophoridae	<i>Aphrophora major</i>
Cicadellidae	<i>Anoscopus ?albiger</i>
*Species not assessed in PANTHEON	

mouthparts of several nectar feeders. The species has been recorded twice in North Wales and repeatedly high in the Cairngorms.

Pegomya rugulosa was found once in the earlier Smithills surveys on 3 May 2018 in the Walker Fold conifer woodland, one of very few English records (Brighton 2021). So it was pleasing to find a further single specimen of this nationally scarce species on 7 May 2022 at Location 5. While the larval requirements seem to be unknown, it is a very widespread northern species listed by Griffiths (1997) as belonging to a Circumpolar High Boreal/Low Arctic group.

Zaphne inuncta is another nationally scarce fly found once in the earlier survey at the Brownstones quarry on 25 July 2018. In 2022, I found it next to the stream at Location 11. This genus of robust black flies is associated with wet and marshy places. Adults of this genus are recognised as predators, some including blood-sucking blackflies (family Simuliidae) in their diet (Werner & Pont 2006).

The Lauxaniidae is a family of smallish flies often plump and orange-coloured, and regarded as

saprophagous or phytosaprophagous both as larvae and adults (Marshall 2012). 20 of the 56 British species were found in the Burnt Edge survey. *Homoneura interstincta* is particularly small and so perhaps much less likely to be found by sweep-net, which may account for its apparent rarity (Gibbs 2004). *Meiosimyza mihalyii* was also added to the British list fairly recently (Cole and Godfrey 2004) with records from six locations in Northern Britain. It is very similar to *M. illota* which was the fourth most frequently recorded fly species in the Burnt Edge survey with 55 records distributed fairly evenly over the whole transect. In the earlier Smithills surveys, *M. illota* was found just twice. *Sapromyza opaca* was one of numerous Lauxaniid species reared in the laboratory on decaying deciduous tree leaves by Semelbauer and Kozánek (2014), as were other species found in this survey.

The small crane fly *Idioptera pulchella* is a nationally scarce species with attractive banded wings. Stubbs (2021) states that it occurs on boggy ground in acid areas but is very localised. I found it at Location 9 in the extensive rush by the small stream there. The other scarce species found was *Scleroprocta sororcula* from the seepage on the steep slope at Location 5, again consistent with the expected habitat.

The upland Muscid *Coenosia perpusilla* has already been mentioned above.

The Sciomyzid fly *Ectinocera borealis* was classed by Falk (1991) as nationally rare, with a distinctly northern distribution and regarded as a boreo-montane species in Europe. This is the only record from Lancashire and Cheshire, though there have been a few from Yorkshire. It is not known whether this species is a parasitoid of slugs or snails like most other members of this family. Many records have been from coniferous woodland, but my female specimen was found at Location 8 on 19 May.

The Sciomyzid *Tetanocera punctifrons* was found on two occasions, at Location 2 on 14 July and at Location 1 on 29 July. Although classed as nationally scarce by Falk (1991) it has since been found much more widely than this designation would suggest.

The Sepsidae are a small family of dung-loving flies with an ant-like body form. An extensive survey of this family over 42 sites in the North of England by Randall *et al* (1981) found the predominant species in upland sites to be *Sepsis cynipsea*, *S. orthocnemis* and *S. neocynipsea*. In the present surveys 5 species of *Sepsis* were encountered but not *neocynipsea*. *Themira* species are generally much scarcer. The record of *T. gracilis* in the fen at Location 11 is only the second in Lancashire and Cheshire. This is a Northern species in Britain, thought by Pont (1986) to originate from Mongolia.

Tachinid flies of the genus *Meigenia* are parasitoids of Chrysomelid leaf-beetles (Belshaw 1993).

Finally two Hemiptera species were flagged up as of conservation concern by PANTHEON. *Aphrophora major* is a larger version of the common European alder spittle bug *A. alni*. *A. major* has a very patchy distribution in England and Wales according to the NBN Atlas, and has only recently been recorded in Lancashire and Cheshire (Hedges & Hunter 2020). The Burnt Edge record is from Location 11 with its large willow at the upper end of the wooded clough of Holden's Plantation (see Fig. 2f). In 2020 the species was also recorded at two locations near Bury, so has apparently spread widely in the region over the last few years.

Finally it must be admitted that the identification of another nationally notable Auchenorrhynca species, *Anoscopus albiger*, is uncertain (le Quesne 1965) as only a single female was found, at Location 9 on 29 July, but the grassland and marshy habitats there are appropriate and the national distribution includes records in neighbouring counties.

Other Points of Interest

Two specimens of *Molophilus ater* were caught. This is a tiny black crane fly with atrophied wings so that it is flightless. Its ecology and biology in high altitude Pennine bogs were studied by Hadley (1969, 1971). As males and females are short-lived and mainly lurk deep in the vegetation it is rarely caught by sweep-netting (Stubbs 2021). The Burnt Edge specimens were a female at Location 3 on 19 May and a male at Location 7

on 2 June, not particularly like the wet peat bog conditions normally associated with the species.

The finding of the hoverfly *Leucozona glauca* several times is not remarkable in itself, but perhaps noteworthy as a recent national study of the distribution of this species (Ball and Morris 2022) has found a north-western shift in its national distribution, probably associated with more frequent hot and dry conditions in the South-East. The well-publicised drought conditions of 2022 seemed to have had little effect on Burnt Edge, where the seepages kept flowing on every visit.

Drosophila suzukii is the spotted-wing vinegar or fruit fly, recorded at Locations 6 and 11 on 23 September, swept from the willows. This is a south-east Asian species first recorded in Britain in 2012 and is a pest of top and soft fruit (Harris & Shaw 2014). Its presence at Burnt edge shows its strong dispersal capabilities after adults emerge from the affected crops. They can be swept from leafy vegetation over the winter.

Another unexpected find was the curious Hippoboscid fly *Ornithomya chloropus* at Location 9 on 29 July. Its flattened body shape reflects its lifestyle as a blood-sucking parasite on birds, but the adults do fly unlike some other members of the family (Hutson 1980). A single larva develops in each female and pupates very shortly after it is born. This species is particularly associated with upland areas in Britain. These flies are normally found by bird-ringers.

A disappointment of this survey was the failure to re-find the Moorland Snipefly *Symphoromyia crassicornis* (family Rhagionidae), a highlight of the previous surveys which I rashly described as characteristic of the Smithills Estate (Brighton 2021a). Stubbs and Drake (2014) say it is quite local in occurrence, but ideal habitat comprises boggy patches and marshy spots by streams on moorland, though not the most acid boggy places. As a compensation I did get three records of the tiny Liverwort Snipefly *Spania nigra*, an easily overlooked species according to Stubbs and Drake. These were at Locations 5 and 11 which are likely spots to harbour liverworts.

Finally it is noted that various members of the family Pipunculidae were frequently encountered, with 46 records comprising

perhaps 10 or so species. These are close relatives of the hoverflies, and are also skilful hoverers but their most striking feature on close examination is the large almost spherical head almost entirely occupied by the compound eyes. The females are equipped with piercing ovipositors with which the eggs are injected into larval or adult Auchenorrhynca where they develop as parasitoids. Because of difficulties with identification of most of them, these records have been omitted from this report but specimens have sent to a national expert. The one species which was definitely identified was *Verrallia aucta* with 8 records between mid-June and mid-July well spread over Locations 1 to 9. This species is known as a parasitoid of the froghoppers *Philaenus spumarius* and *Neophilaenus lineatus* (Whittkaer 1971) which were very common all along the transect.

Discussion

The topic of biodiversity is multifaceted, even when attention is restricted to a specific group of organisms. Nevertheless the large number of species within the Hemiptera and Diptera and the extensive range of ecological niches they occupy should make surveys of this kind a good indicator of wider diversity. We can make some interesting comparisons with other data from earlier surveys.

First, the overall diversity measured by Fisher's α is markedly larger than found at Houghton Green Pool or Chester Zoo Nature reserve. This may simply reflect the larger extent of the area sampled, as the vegetation on Burnt Edge does not seem particularly more or less favourable.

Surprisingly, the result for Burnt Edge is slightly larger than for the whole of the upper valley in the earlier surveys which included the Walker Fold areas before the recent extensive felling. The same degree of diversity is seen in the results for locations 1 to 6 with its more diverse and lush plant cover, but there is a significant drop-off in the more open and exposed expanse of Locations 7-12. However in terms of composition of commoner species the β - diversity measure shows quite a high degree of similarity between the eastern and western sections of the transect. The two parts of the transect are more similar to one another, than is the whole assemblage

compared to the earlier upper valley results. This change over the intervening period of 3 years could reflect fluctuations in the populations of individual species, or to species arriving into the area and displacing earlier residents. Nevertheless, Diptera species associated with wooded environments remain an important component of the fauna even in the western transect. This may simply result from the proximity of the transect to the main watercourse which is still wooded for most of its length despite the felling.

These results mainly reflect the commoner species which occur at numerous locations over extended periods rather than species which appear only for a few days in a limited location and so register less strongly in the survey if indeed they are detected at all. There are, as always in these surveys, a large number of singletons, which may be dispersing individuals of fairly common species away from their customary haunts or species which are never present or detectable in large numbers, even in their preferred habitats.

The report of my earlier Smithills survey (Brighton 2021) commented on the presence of numerous species with a northern or upland distribution, but these did not have a dominant influence on the diversity results. We do not actually have an established index to measure “northernness” but the degree of similarity between the eastern and western transects reinforces this conclusion.

That the western transect was not fully representative of the upland habitats is borne out by comparison with earlier studies. In her surveys of craneflies around ditches on the West Pennine moors to the north of Winter Hill, Bateson (2019) found the dominant species to be *Tricyphona immaculata*, *Tipula subnodicornis*, *Idioptera pulchella* and *Ormosia pseudosimilis*. While the first of these was the most frequent cranefly in the present survey, and found along the whole transect, the second and third were each found only once and the fourth not at all. The absence of *Sepsis neocynipsea* as a decidedly upland species has already been noted above.

Other studies of variation of the insect fauna with altitude in Northern England (Lawton *et al* 1987) and more generally (Hodkinson 2005) indicate

that the rather modest altitudes in the present survey, roughly 250m-350m, would not in any case be expected to have a large effect.

The habitat associations of the Hemiptera have not been considered in detail in this report, but results from a large-scale survey of the Auchenorrhynna in grasslands in Northern England are given by Eyre (2005).

Conclusion

This survey has demonstrated the importance of the semi-naturalised habitats on Burnt Edge for insect biodiversity, even though outside the wooded cloughs designated as local Sites of Biological Importance. Given the multiplicity of ecological niches and habitat affinities of the large number of species recorded, there are few clear implications for habitat management, apart from highlighting the importance of inconspicuous features such as the seepage flows on the steep slopes, and other damper areas. It is hoped that this survey will provide a baseline for future surveys as the Walker Fold plantation matures.

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Fig 1a: sampling locations – eastern section of transect. Note that this shows Walker Fold Woods before extensive removal of larch



Fig 1b: sampling locations – western section of transect.

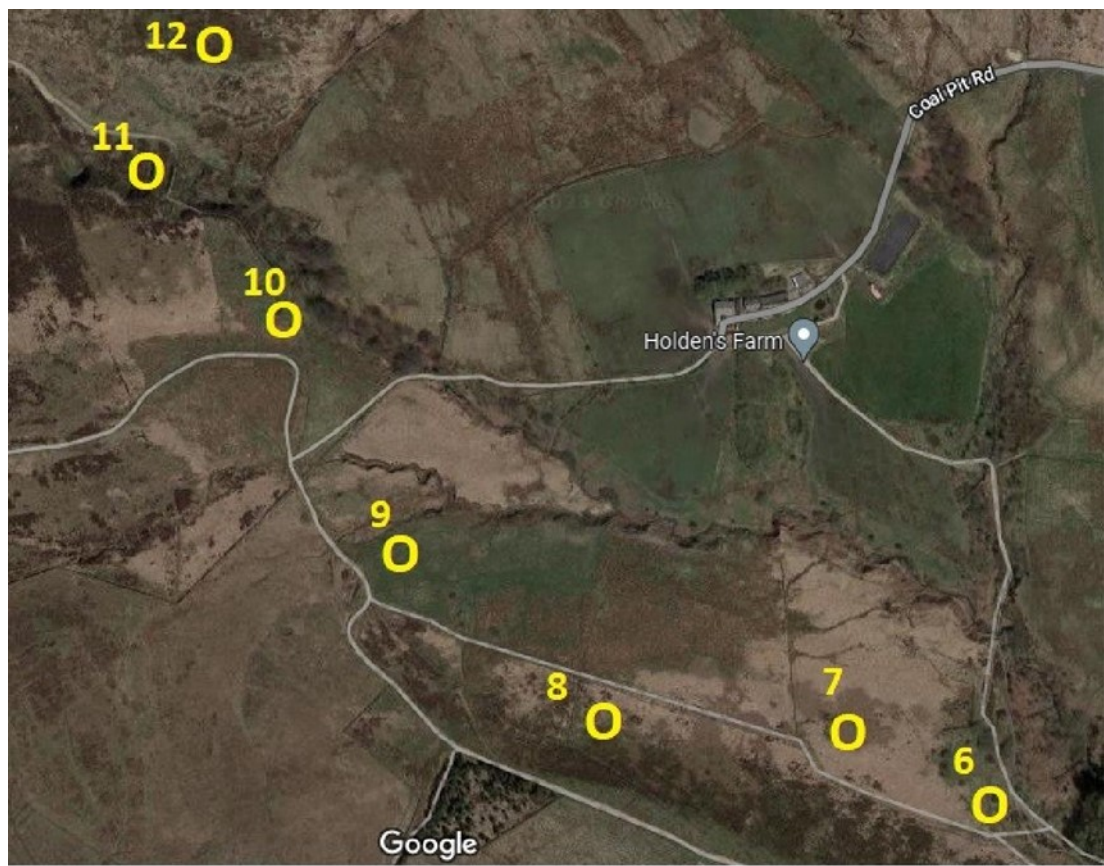


Fig 2a: Angelica at Location 3 on 8 August



Fig 2b: Location 5 – seepage runs down towards the large willow



Fig 2c: remains of mine building at Location 6



Fig 2d: view from Location 8 towards Location 9



Fig 2e: Location 10 on 8th August



Fig 2f: Location 11



The Diversity of Hemiptera and Diptera on Burnt Edge, Smithills Estate

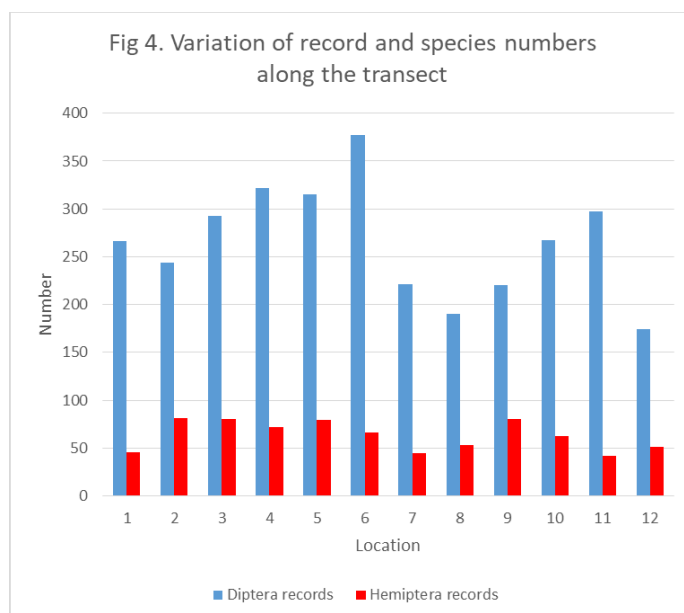
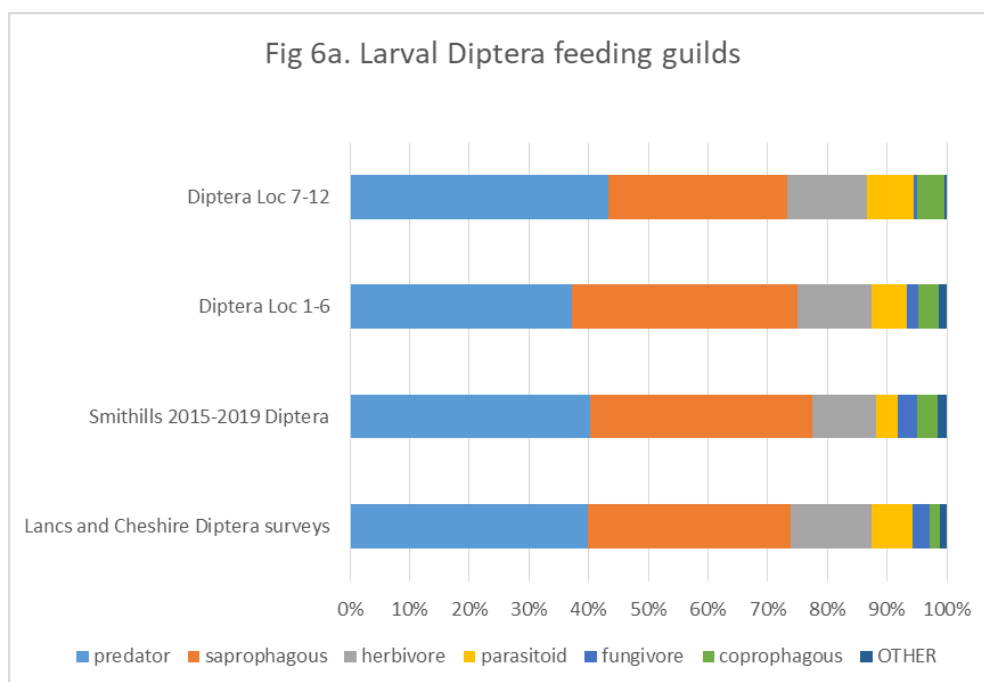
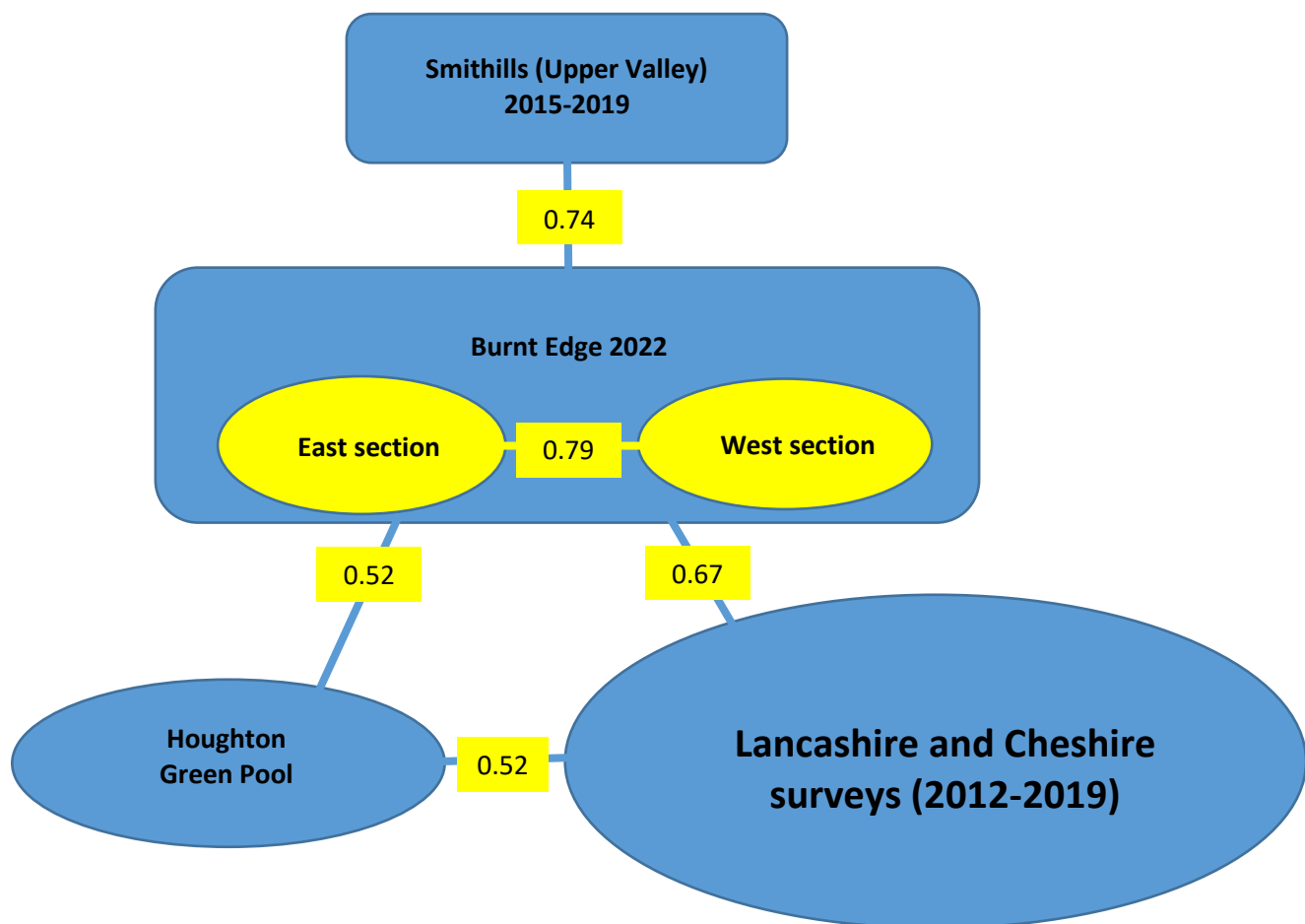
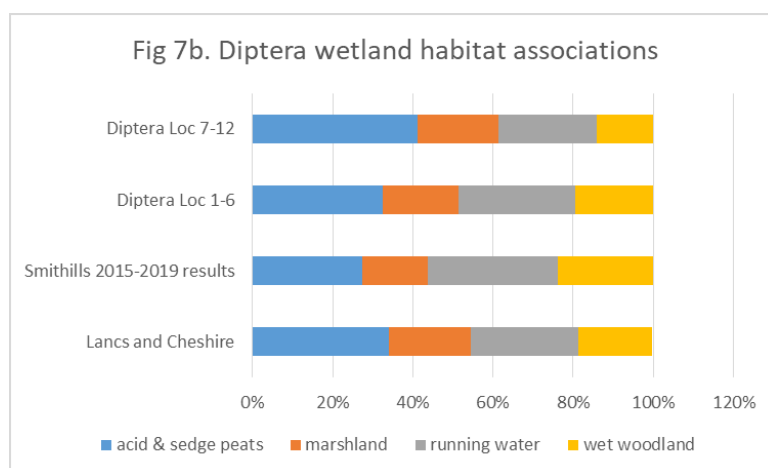
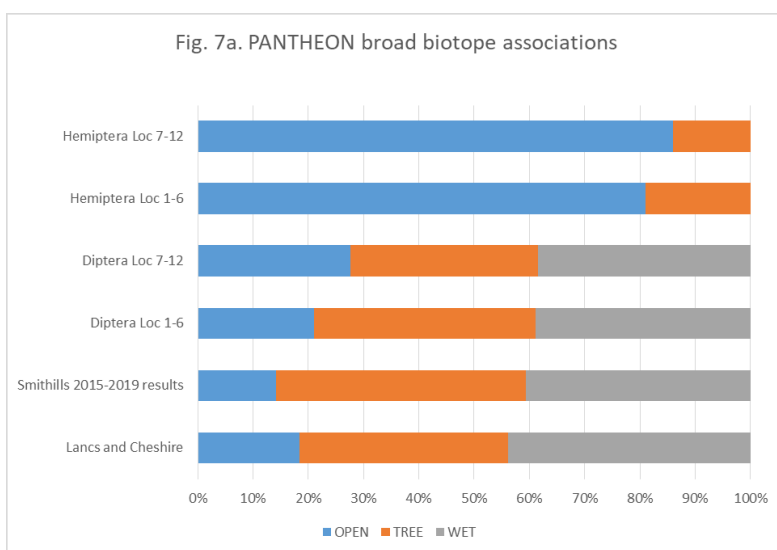
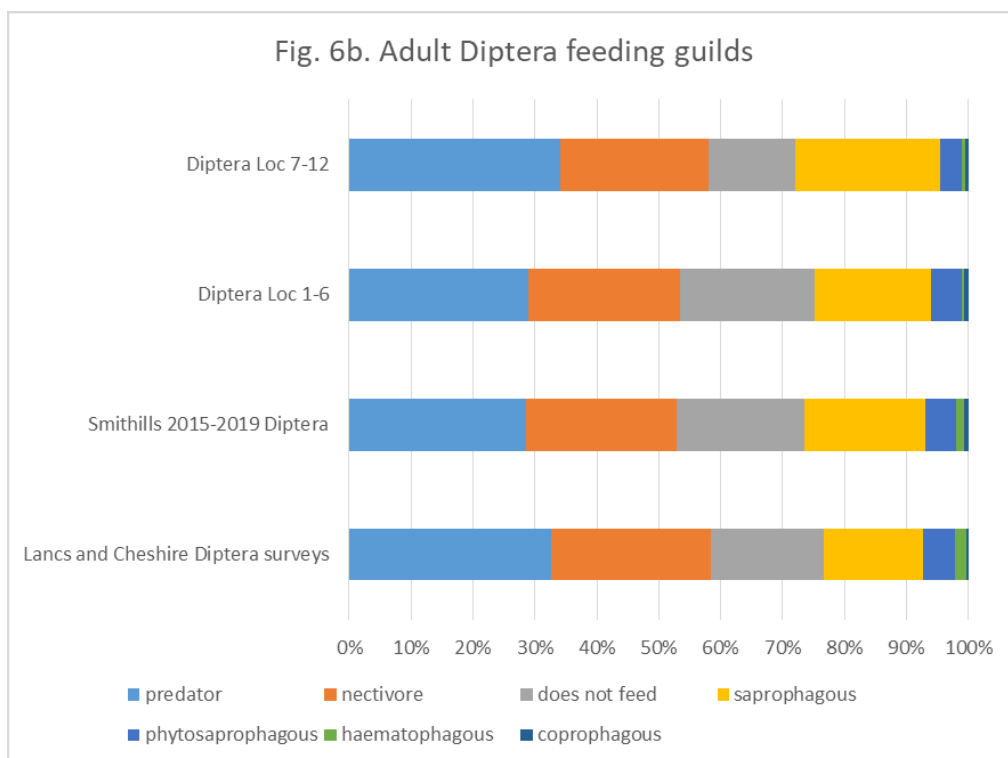


Fig 5. Pairwise comparisons with the Morisita-Horn Index





APPENDIX

Full list of species recorded with incidence at each location (maximum possible 13)

Group/Family/Species	Locations												Totals
	1	2	3	4	5	6	7	8	9	10	11	12	
1. LEAFHOPPERS													
CERCOPIDAE													
<i>Aphrophora alni</i>						1							1
<i>Aphrophora major</i>											1		1
<i>Cercopis vulnerata</i>		2	2	1	2	1							8
<i>Neophilaenus lineatus</i>		5	2	3	4	4	3	5	6	4	4	5	45
<i>Philaenus spumarius</i>	5	5	6	7	7	2	5	7	4	2	4		54
CICADELLIDAE													
<i>Alebra wahlbergi</i>			1										1
<i>Aphrodes albiger</i>									1				1
<i>Aphrodes makarovi</i>	1		2	1					1		1		6
<i>Arthaldeus pascuellus</i>				1				1	2				4
<i>Balclutha punctata</i>						1							1
<i>Cicadella viridis</i>		2	5	1	3	3	1	1	3	2	2	1	24
<i>Cicadula aurantipes</i>	1				1								2
<i>Cicadula persimilis</i>	2	5	4	1	5	2			4	4	5		32
<i>Cicadula quadrinotata</i>	1										1		2
<i>Conomelus anceps</i>	3	1	1		3	5			4	5	3	2	27
<i>Conosanus obsoletus</i>	1	2			1	1			4	4	2		15
<i>Deltocephalus pulicaris</i>						1							1
<i>Elymana sulphurella</i>		1		2		1			2			1	7
<i>Empoasca vitis</i>		1									1		2
<i>Eupteryx aurata</i>			2	3	2		1						8
<i>Eupteryx cyclops</i>			1			1							2
<i>Eupteryx filicum</i>						1							1
<i>Euscelis incisus</i>	1				1					1		1	4
<i>Idiocerus lituratus</i>											1		1
<i>Jassargus pseudocellaris</i>						1						2	3
<i>Kybos butleri</i>					2	1							3
<i>Macrosteles laevis</i>			2	1					4	1			8
<i>Macrosteles sexnotatus</i>					1								1
<i>Macrosteles viridigriseus</i>						1			1				2
<i>Macustus grisescens</i>		2	1							2			5
<i>Oncopsis flavicollis</i>		1	1										2
<i>Paluda flaveola</i>		2	1	1					2				6
<i>Populicerus confusus</i>											1		1
<i>Psammotettix confinis</i>						1			1			1	3
<i>Speudotettix subfuscus</i>					1	1							2
<i>Streptanus aemulans</i>		1											1
<i>Streptanus marginatus</i>		1										1	2
<i>Thamnotettix confinis</i>		1	1		2	2							6
<i>Ulopa reticulata</i>						1							1
CIXIIDAE													
<i>Cixius cunicularius</i>						1	1	1					3
<i>Cixius nervosus</i>	2	3	4	1	1			1		2			14
<i>Tachycixius pilosus</i>			1	1	1		1			1	1	1	7

Dolycoris baccarum	2					3					5		
Palomena prasina				1	1			1			3		
Picromerus bidens						1					1		
RHOPALIDAE													
Corizus hyoscyami					1						1		
3. CRANEFLIES													
CYLINDROTOMIDAE													
Cylindrotoma distinctissima					1						1		
LIMONIIDAE													
Austrolimnophila ochracea						2					2		
Cheilotrichia cinerascens					2	1					3		
Dicranomyia autumnalis			1						1		2		
Dicranomyia chorea					1	2					3		
Dicranomyia modesta			1	1							2		
Dicranomyia morio			1								1		
Dicranomyia quadra					2						2		
Dicranophragma adjunctum	1		1								2		
Dicranophragma nemorale	2	2	1		3				1		9		
Eloeophila submarmorata					3				1		4		
Erioconopa diuturna	1										1		
Erioconopa trivialis	1	5	4		1	3		1	2	2	2	1	22
Erioptera fuscipennis					3						3		
Erioptera lutea		1	2		1			1		2	7		
Euphylidorea lineola						1					1		
Euphylidorea meigenii						1		1			2		
Gonomyia dentata					2						2		
Gonomyia simplex		1									1		
Helius flavus		1									1		
Helius longirostris			1	1							2		
Idioptera pulchella									1		1		
Limonia flavipes						1					1		
Limonia nubeculosa				4	1	3					8		
Limonia phragmitidis				1							1		
Molophilus appendiculatus		1		1		3					5		
Molophilus ater			1					1			2		
Molophilus flavus		2	1		3				1		7		
Molophilus griseus				1	1	2			1		5		
Molophilus obscurus	1	2	3		1				2		9		
Molophilus pusillus									1		1		
Neolimnomyia filata				1							1		
Ormosia albitibia		1									1		
Ormosia hederæ	3	1	1								5		
Ormosia nodulosa	1				1	2					4		
Paradelphomyia senilis					1						1		
Phylidorea fulvonervosa			1		1	1			5		8		
Rhipidia maculata			1		2						3		
Rhypholophus varius						1					1		
Scleroprocta sororcula					1						1		
Symplecta hybrida						1		1	1		1	4	
Symplecta stictica			1								1		

PEDICIIDAE

Dicranota claripennis										2			2
Dicranota exclusa				1									1
Dicranota subtilis					2								2
Pedicia littoralis				2									2
Pedicia rivosa				1									1
Tricyphona immaculata	4	2	6	2	5	1		1	4		5		30

TIPULIDAE

Dolichopeza albipes				1	1								2
Nephrotoma flavipalpis				1									1
Nephrotoma quadrifaria				1									1
Tipula confusa	1	1	1				2			1		3	9
Tipula fascipennis	1	1		1						1			4
Tipula fulvipennis	1	1	2	2	1								7
Tipula lateralis											1		1
Tipula luna					2						1		3
Tipula oleracea			1	1	3	1	1						7
Tipula pagana					1			1					2
Tipula paludosa	3	4	2	2	1	1	1		2		1	3	20
Tipula rufina	1			1									2
Tipula scripta						2	1						3
Tipula submarmorata						1							1
Tipula subnodicornis									1				1
Tipula unca					1	1							2
Tipula varipennis			1	1		1				1			4
Tipula vernalis				1					1			2	4
Tipula vittata			1								1		2

TRICHO CERIDAE

Trichocera regelationis		1	1		1	1	1		1	1	2		9
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4. HOVERFLIES

SYRPHIDAE

Cheilosia albitarsis	2												2
Cheilosia illustrata				4		1							5
Cheilosia pagana					2								2
Cheilosia vernalis	2												2
Chrysogaster solstitialis				1									1
Chrysotoxum bicinctum				1		1							2
Episyrphus balteatus					1		1			1			3
Eristalis pertinax			1	1	2								4
Eristalis tenax	1	1	1	1									4
Eupeodes corollae									1				1
Eupeodes latifasciatus	1		1										2
Eupeodes luniger		1								1			2
Helophilus pendulus	1												1
Leucozona glaucia			1	1	1		1						4
Leucozona laternaria							1						1
Melanogaster hirtella				2							1		3
Melanostoma mellinum	5	1	3	2	1	5	2	4	6	6	1	8	44
Melanostoma scalare	1	1		4	2	2	1	1		2	1		15
Neoascia meticulosa											1		1

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<i>Neoascia podagrica</i>	1		1						1			3
<i>Neoascia tenur</i>									1	2		3
<i>Pipizella virens</i>						1	1	1				3
<i>Platycheirus albimanus</i>	4	1	2	1	2	4	2	3		1	1	21
<i>Platycheirus angustatus</i>	1	5		2	1	2		1	3	2	3	20
<i>Platycheirus clypeatus</i>	1	1		1	1	1	1		3	2	5	16
<i>Platycheirus granditarsus</i>	3		2									5
<i>Platycheirus manicatus</i>	1		1						1		1	4
<i>Platycheirus peltatus</i>					1	1	1			1		4
<i>Platycheirus ramsarensis</i>				1		1		2	3		3	10
<i>Platycheirus rosarum</i>	1											1
<i>Rhingia campestris</i>	1											1
<i>Sericomyia silentis</i>		1										1
<i>Sphaerophoria fatarum</i>											1	1
<i>Sphaerophoria interrupta</i>	3		1			1				1	1	7
<i>Sphaerophoria scripta</i>	1											1
<i>Syrirta pipiens</i>	5										1	6
<i>Syrphus ribesii</i>			1									1
<i>Xylota jakutorum</i>				1								1

5. EMPIDOIDEA

DOLICHOPODIDAE

<i>Argyra leucocephala</i>	1											1	
<i>Argyra perplexa</i>			1	1								2	
<i>Campsicnemus curvipes</i>				1						1		2	
<i>Campsicnemus loripes</i>	1		3	1	1	2			1	3		12	
<i>Campsicnemus scambus</i>			1									1	
<i>Chrysotus cilipes</i>	1											1	
<i>Chrysotus gramineus</i>		2	2		1	1	3	2				11	
<i>Dolichopus atratus</i>											1	1	
<i>Dolichopus atripes</i>			3								4	7	
<i>Dolichopus brevipennis</i>			2									2	
<i>Dolichopus discifer</i>			1	2		4	1	3	5	4	4	2	26
<i>Dolichopus griseipennis</i>	1		1								1	3	
<i>Dolichopus lepidus</i>						1		1	1			3	
<i>Dolichopus plumipes</i>	3	4	5	4	4	1	1		2	3	5	32	
<i>Dolichopus popularis</i>		3	1		1	1						6	
<i>Dolichopus trivialis</i>	1	2		1	2	1	1					8	
<i>Dolichopus vitripennis</i>						2		1	4	3	5	4	19
<i>Hercostomus aerosus</i>				4		6	2	1		2	5	1	21
<i>Hercostomus cupreus</i>			1	3	1	3		1			3	2	14
<i>Rhaphium appendiculatum</i>				1	2								3
<i>Rhaphium caliginosum</i>			1										1
<i>Sybistroma obscurellum</i>				2									2
<i>Sympycnus desoutterii</i>	4		4	2						1			11
<i>Syntormon denticulatum</i>			1										1
<i>Syntormon pallipes</i>			3										3
<i>Syntormon submonilis</i>			1										1
<i>Syntormon sulcipes</i>		1			1								2
<i>Syntormon tarsatus</i>											2		2

EMPIDIDAE

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Platypalpus longiseta		1	1	1		1	1						5
Platypalpus minutus	1		1		1		1			2			6
Platypalpus nigratarsis											3		3
Platypalpus notatus						1			1	8			10
Platypalpus pallidiventris	1	1	1		1	1	2	1	1	1			10
Platypalpus verralli				1		1				2			4
Trichina clavipes						1	1		2	1			5
Trichinomyia flavipes					1								1

6. CALYPTRATES

ANTHOMYIIDAE

Adia cinerella					1								1
Anthomyia liturata	3		1			1			1	1			7
Anthomyia mimetica										1			1
Botanophila biciliaris		1											1
Botanophila brunneilinea	1												1
Botanophila discreta	5		2										7
Botanophila fugax	4	1		5	4	4	3	1	1	1	1	2	27
Botanophila hucketti					1		4	1					6
Botanophila latifrons						1	1	2	1	1		2	8
Botanophila profuga								1					1
Botanophila seneciella	1	1		1									3
Botanophila sericea		4	1	1	1		1		1	1	1		11
Botanophila striolata	2												2
Chirosia betuleti											1		1
Chirosia cinerosa					1	1							2
Chirosia crassiseta							1						1
Chirosia flavipennis				1			4						5
Chirosia grossicauda							5	3					8
Chirosia histicina				2									2
Chirosia nigripes							1						1
Delia criniventris						1							1
Delia florilega	3		3	3		1		1	1	1		1	14
Delia platyura	1	1	2	2			1	1	2	1	1		12
Egle ciliata						1							1
Egle lyneborgi						1							1
Egle minuta					1	1							2
Egle parvaeformis						1							1
Heterostylodes nominabilis						1							1
Heterostylodes pratensis						2							2
Hydrophoria silvicola											1		1
Hylemya urbica	3	1	1	2	2	3						3	15
Hylemya vagans	1		1	1		4							7
Hylemya variata	5	3	4	1	1	1	2	3	8	6	1	6	41
Hylemyza partita				1									1
Lasiomma picipes						2	1	1		2			6
Lasiomma seminitidum		1		1	2	3						1	8
Lasiomma strigilatum										1			1
Paradelia intersecta			1	2		2				1			6
Paregle atrisquama								1					1
Paregle audacula										1		1	2

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<i>Pegomya bicolor</i>				1	1						1		3
<i>Pegomya haemorrhoum</i>		1	2	3	3	3	2	1			1		16
<i>Pegomya rugulosa</i>					1								1
<i>Pegomya solennis</i>			1							1		1	3
<i>Pegoplata aestiva</i>	3	2	1	2	3	5	2	1	4	3	2	3	31
<i>Pegoplata infirma</i>	3	2	4	7	5	7	3	4	4	2	5	2	48
<i>Pegoplata nigroscutellata</i>				1						1			2
<i>Phorbia bartaki</i>		1											1
<i>Phorbia fumigata</i>		4	3	1	2		1			4		1	16
<i>Phorbia moliniaris</i>							3	3	1			2	9
<i>Phorbia nuceicornis</i>						1	2	2		1		2	8
<i>Phorbia sepia</i>		2		2		1				2			7
<i>Subhylemyia longula</i>												1	1
<i>Zaphne caudata</i>											3		3
<i>Zaphne inuncta</i>											1		1
CALLIPHORIDAE													
<i>Angioneura acerba</i>							1						1
<i>Bellardia pandia</i>	2		1									1	4
<i>Bellardia viarum</i>												1	1
<i>Bellardia vulgaris</i>	1		2	1	2								6
<i>Calliphora vicina</i>	1												1
<i>Calliphora vomitoria</i>				1									1
<i>Lucilia ampullacea</i>					1								1
<i>Lucilia caesar</i>				2		2					1		5
<i>Lucilia illustris</i>					1								1
<i>Melanomyia nana</i>	1	1	1	1	2	1			1	3			11
<i>Melinda viridicyanea</i>	2			1			1	1			1		6
<i>Pollenia amentaria</i>							1						1
<i>Pollenia angustigena</i>	1	1					1	1		1			5
<i>Pollenia labialis</i>	2		1		1	1	3	1		1	1	1	12
<i>Pollenia pediculata</i>	4	1	1	1			1	3		2		1	14
<i>Pollenia rudis</i>	5	1	1	3	2	1	1	2	1	1	2		20
FANNIIDAE													
<i>Fannia armata</i>		1	2	1						1			5
<i>Fannia fuscua</i>										1			1
<i>Fannia genualis</i>												1	1
<i>Fannia minutipalpis</i>					1			1					2
<i>Fannia mollissima</i>			1		1	1							3
<i>Fannia monilis</i>				1		1							2
<i>Fannia pallitibia</i>				1									1
<i>Fannia polychaeta</i>		1						1		2	1		5
<i>Fannia postica</i>		4	4	4	6	6	1	4	3	6	5		43
<i>Fannia rondanii</i>				2	1	1	2	1			1		8
<i>Fannia serena</i>	2	3	5	5	6	6	1	1	1	5	2		37
<i>Fannia similis</i>				1							1		2
<i>Fannia sociella</i>	1	2		1	1	1					1		7
<i>Fannia subsimilis</i>				1		2							3
HIPPOBOSCIDAE													
<i>Ornithomya chloropus</i>										1			1
MUSCIDAE													

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<i>Azelia cilipes</i>			1		2	1	2	2		1		1		10
<i>Azelia nebulosa</i>						1				1				2
<i>Azelia triquetra</i>				1		1								2
<i>Azelia zetterstedtii</i>		1										1		2
<i>Brontaea humilis</i>	1							1						2
<i>Coenosia femoralis</i>					5	5	5		3	3	9			30
<i>Coenosia humilis</i>										1				1
<i>Coenosia intermedia</i>					2				2	2				6
<i>Coenosia means</i>					1				4		3	3		11
<i>Coenosia pedella</i>					1									1
<i>Coenosia perpusilla</i>					2	1	2	4	1		3			13
<i>Coenosia pumila</i>	6	1							2	1		1		11
<i>Coenosia tigrina</i>	1			2				1	2					6
<i>Drymeia hamata</i>	2	2		1		1				1				7
<i>Eudasyphora cyanella</i>				1										1
<i>Eudasyphora cyanicolor</i>										2				2
<i>Haematobosca stimulans</i>									1					1
<i>Hebecnema nigra</i>				1			1							2
<i>Hebecnema umbratica</i>			1	2		2	3	1	1	2	2			14
<i>Hebecnema vespertina</i>			3		2									5
<i>Helina depuncta</i>				1										1
<i>Helina evecta</i>		1		1	2	3			1	3				11
<i>Helina impuncta</i>		1				1				2				4
<i>Helina lasiophthalma</i>											1			1
<i>Helina pubiseta</i>					1									1
<i>Helina reversio</i>	5	2	1	3	1		1	1	1	1	2	6		24
<i>Helina setiventris</i>		4		1										5
<i>Hydrotaea armipes</i>			1											1
<i>Hydrotaea floccosa</i>									1					1
<i>Hydrotaea irritans</i>	1		1	1	1	1	2	2		2				11
<i>Limnophora maculosa</i>						1					1			2
<i>Limnophora olympiae</i>											1			1
<i>Limnophora triangula</i>			1											1
<i>Lophosceles cinereiventris</i>				1	1	1								3
<i>Lophosceles mutatus</i>										1				1
<i>Morellia aenescens</i>		2	5	1	2	2								12
<i>Morellia simplex</i>							1							1
<i>Musca autumnalis</i>									1	1				2
<i>Mydaea anicula</i>										1				1
<i>Mydaea orthonevra</i>										1				1
<i>Myospila meditabunda</i>			1		1			1						3
<i>Neomyia cornicina</i>			1					2	1					4
<i>Phaonia angelicae</i>				2	1	2				1				6
<i>Phaonia errans</i>						1				4	1			6
<i>Phaonia halterata</i>			1	1	1						1			4
<i>Phaonia incana</i>	2		2		1					1				6
<i>Phaonia pallida</i>						2								2
<i>Phaonia rufiventris</i>				1		1								2
<i>Phaonia serva</i>				1										1
<i>Phaonia subventa</i>						1								1

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<i>Phaonia tuguriorum</i>	2	1			1	1		3	1	1		10
<i>Polietes domitor</i>					1							1
<i>Polietes hirticus</i>				1	1				1			3
<i>Pseudocoenosia abnormis</i>									2			2
<i>Pseudocoenosia solitaria</i>	2	2	4		2	1		5		5		21
<i>Schoenomyza litorella</i>								2				2
<i>Spilogona denigrata</i>					1	2		1	1	6	3	14
<i>Spilogona pacifica</i>		3	1		1	4		1	4	4	2	20
<i>Thricops semicinereus</i>				1	2							3
SARCOPHAGIDAE												
<i>Metopia argyrocephala</i>										1		1
<i>Sarcophaga haemorrhhoa</i>	1											1
SCATHOPHAGIDAE												
<i>Nanna fasciata</i>		1	3	2	3	1		1	1			12
<i>Nanna inermis</i>		1			2				2		2	7
<i>Norellisoma lituratum</i>					1			1				2
<i>Scathophaga furcata</i>	1		3	3	4	7	2	2	2	3	7	34
<i>Scathophaga inquinata</i>		1			1	2		1	1			6
<i>Scathophaga stercoraria</i>	9	8	5	8	9	10	6	6	8	8	7	91
<i>Scathophaga suilla</i>				1		5	2		2	2	3	15
TACHINIDAE												
<i>Appendicia truncata</i>											1	1
<i>Blepharomyia pagana</i>								2				2
<i>Campylocheta inepta</i>					1					1		2
<i>Ceromya bicolor</i>							1			3		4
<i>Dufouria nigrita</i>		1	1									2
<i>Epicampocera succincta</i>		1										1
<i>Exorista larvarum</i>			1					1				2
<i>Gymnocheta viridis</i>				1								1
<i>Lydella stabulans</i>		1										1
<i>Lydina aenea</i>											2	2
<i>Medina collaris</i>								1		1		2
<i>Meigenia majuscula</i>			1							1		2
<i>Pales pavidata</i>	1											1
<i>Pelatachina tibialis</i>				1								1
<i>Phasia obesa</i>		1										1
<i>Phryxe vulgaris</i>	2	1	1						1		1	6
<i>Ramonda spathulata</i>				1	1							2
<i>Siphona geniculata</i>	3		5	1	2	1				1	2	15
<i>Siphona maculata</i>					1							1
<i>Siphona setosa</i>								1				1
7. OTHER DIPTERA												
ANISOPODIDAE												
<i>Sylvicola cinctus</i>			1	1	4	2				2		10
<i>Sylvicola punctatus</i>	1	1				1		2		1		6
<i>Sylvicola zetterstedti</i>			4		1							5
BIBIONIDAE												
<i>Bibio johannis</i>						1		1				2
<i>Bibio lanigerus</i>						1	1	1	2	1	2	8
<i>Bibio leucopterus</i>	1	1		1			1					4

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Bibio longipes		1	1	1		1				1		1	6
Bibio marci	1	1									1		3
Bibio nigriventris		1	1		1								3
Bibio pomonae										1			1
Dilophus febrilis	5	2	6	2	2	2	3	2	4	3	3	4	38
Dilophus femoratus		2	1	3					1				7
BOLITOPHILIDAE													
Bolitophila pseudohybrida				1									1
CONOPIIDAE													
Sicus ferrugineus						1							1
DIASTATIDAE													
Diastata costata									1		1		2
DIXIDAE													
Dixa aestivalis				1						1			2
Dixa dilatata					1								1
Dixa nubilipennis				1									1
Dixa puberula				1									1
DROSOPHILIDAE													
Drosophila subobscura						2	1						3
Drosophila suzukii						1					1		2
Drosophila transversa							1						1
Lordiphosa andalusiaca				1									1
Scaptomyza flava			1	1		4							6
Scaptomyza graminum				1		2							3
Scaptomyza pallida				1		1				1			3
DRYOMYZIDAE													
Neuroctena anilis			5			1							6
HELEOMYZIDAE													
Gymnomus amplicornis	1			1									2
Heteromyza commixta										1		1	2
Morpholeria ruficornis											1		1
Suillia fuscicornis						1							1
Suillia laevifrons						2				1			3
Suillia notata						1							1
KEROPLATIDAE													
Isonneuromyia semirufa										1			1
Macrocera stigma						1	1						2
Macrocera stigmoides							1					2	3
Macrocera vittata	1			1	1	3	2			1	2		11
Platyura marginata		1			1		1						3
LAUXANIIDAE													
Calliopum elisae	5	1	1		3						1		11
Calliopum simillimum				1		2							3
Homoneura interstincta										1			1
Lauxania cylindricornis									1				1
Meiosimyza affinis				1									1
Meiosimyza illota	6	4	8	2	8	5	4	5		6	7		55
Meiosimyza mihalyii		1		1	1	1				1			5
Meiosimyza platycephala				1									1
Meiosimyza rorida				2		1							3

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Meiosimyza subfasciata		2	4		2	4	3			1		16	
Minettia fasciata	5	3			1	2			1			12	
Minettia inusta				1	2	1						4	
Minettia longipennis						1						1	
Poecilolycia vittata					1	1						2	
Pseudolyciella pallidiventris										1		1	
Sapromyza halidayi		1										1	
Sapromyza opaca	1				1				2			4	
Sapromyza quadricincta				1								1	
Sapromyza sexpunctata		1		2			2					5	
Tricholauxania praeusta				4	1	2						7	
Species X					1							1	
LONCHOPTERIDAE													
Lonchoptera bifurcata	1		1	1	1	2			3			9	
Lonchoptera lutea	1	2	5	7	4	9	2	2	4	3	3	5	47
MYCETOPHILIDAE													
Acnemia nitidicollis							1	2				3	
Boletina dubia		1							1	1		3	
Boletina gripha							1	2	1			4	
Boletina pallidula						1						1	
Boletina plana							1			1		2	
Boletina sciarina								1				1	
Boletina trispinosa					1							1	
Boletina trivittata			1	1	2	1	1		2	1	4	13	
Mycomya annulata						1						1	
Neuratelia nemoralis								1		1		2	
OPETIIDAE													
Opetia nigra	1	2	2	2	1	1						9	
OPOMYZIDAE													
Geomyza balachowskyi		3	2	1	2	1			2	2	1	14	
Geomyza tripunctata	2	1	2	3	2	1			2	1	1	15	
Opomyza florum				1	2		4				1	8	
Opomyza germinationis	1	4	2	4	1	6	3	2	4	5	3	2	37
Opomyza petrei	6	8	6	6	7	9	3	4	6	7	1	3	66
PALLOPTERIDAE													
Palloptera saltuum				1								1	
Palloptera scutellata		1	1			1						3	
PHORIDAE													
Anevrina thoracica						1						1	
Anevrina urbana		1										1	
Phora speighti				1								1	
Triphleba papillata	1											1	
PSILIDAE													
Chamaepsila obscuritarsis		1										1	
Chamaepsila rosae		1			1			1			2	5	
Psilosoma lefebvrei					1						1	2	
RHAGIONIDAE													
Chrysopilus cristatus	1	2	4		2						1	10	
Rhagio lineola		1			3	2	4			4		14	
Rhagio scolopaceus	3		2	3	3	1	2	3	1	2	1	2	23

The Diversity of Hemiptera and Diptera on Burnt Edge, Smithills Estate

<i>Rhagio tringarius</i>	3	1	3		1		1	2				11	
<i>Spania nigra</i>					2					1		3	
SCIARIDAE													
<i>Austrosciara hyalipennis</i>					1		1	1		1	1	6	
<i>Cratyna nobilis</i>	1											1	
<i>Schwenckfeldina carbonaria</i>	4	3	1	2	3	1	1	1	3	2	3	1	25
<i>Sciara hemerobioides</i>		2	1		2	3	2	2	3	2	1		18
SCIOMYZIDAE													
<i>Coremacera marginata</i>		6	1										7
<i>Ectinocera borealis</i>								1					1
<i>Hydromya dorsalis</i>			3				1				4		8
<i>Limnia paludicola</i>					1		1	3					5
<i>Pherbellia cinerella</i>				4									4
<i>Pherbellia ventralis</i>					2						1		3
<i>Renocera pallida</i>											2		2
<i>Tetanocera arrogans</i>											1		1
<i>Tetanocera elata</i>			1		1				1				3
<i>Tetanocera ferruginea</i>	3	1	3		1	2			1	1	3	1	16
<i>Tetanocera hyalipennis</i>		1	2	1							4		8
<i>Tetanocera punctifrons</i>	1	1											2
SEPSIDAE													
<i>Nemopoda nitidula</i>						1							1
<i>Sepsis cynipsea</i>	3	2	1	4	2	4	6	7	5	2	4	3	43
<i>Sepsis flavimana</i>						2	1	2	4				9
<i>Sepsis fulgens</i>	1	3	4	2	4	4	7	3	4	4	4	2	42
<i>Sepsis orthocnemis</i>	1	1	2	1	5	3	3	5	1	4	1	4	31
<i>Sepsis violacea</i>			1				1	1		1	1		5
<i>Themira annulipes</i>	1												1
<i>Themira gracilis</i>											1		1
<i>Themira pusilla</i>										1	2		3
SPHAEROCERIDAE													
<i>Borborillus vitripennis</i>								1					1
<i>Coproica vagans</i>												1	1
<i>Copromyza equina</i>										1		1	2
<i>Copromyza nigra</i>		3			2	1		1			1		8
<i>Copromyza stercoraria</i>	1		2	5	4	4	1	4	4	3	1	3	32
<i>Crumomyia nitida</i>					1						1		2
<i>Leptocera fontinalis</i>						2							2
<i>Leptocera nigra</i>									1				1
<i>Limosina silvatica</i>				1	1								2
<i>Lotophila atra</i>		1		1	1	2	2		4	1		1	13
<i>Opacifrons humida</i>			2										2
<i>Rachispoda limosa</i>									2				2
<i>Spelobia clunipes</i>		1		1		1							3
<i>Sphaerocera curvipes</i>									1				1
STRATIOMYIDAE													
<i>Beris chalybata</i>			2	2	1								5
<i>Beris fuscipes</i>				1	1	2							4
<i>Beris geniculata</i>				1	1								2
<i>Beris vallata</i>	1		1	1		1				2			6

