

The status and distribution of the horseflies *Atylotus plebeius* and *Hybomitra lurida* on the Cheshire Plain area of North West England

Including assessments of mire habitats and accounts of other horseflies (Tabanidae)



Atylotus plebeius (Fallén) [Cheshire Horsefly]: male from Little Budworth Common 10th June 2018; female from Shemmy Moss 9th June 2018

A report to

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Based on

The results of a survey carried out during 2018

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Appendix 2 is a spreadsheet which accompanies this report
It is not paginated but effectively represents pages 56 to 82

INTRODUCTION

SUMMARY

This document is a report of the findings of a broad-ranging survey carried out by Andrew Grayson [the surveyor] during summer 2018 on numerous mire habitats and related wetlands throughout the Cheshire Plain area.

The main focus of the survey was the diminutive horsefly *Atylotus plebeius* (Fallén, 1817), which was appropriately given the vernacular name Cheshire Horsefly by Stubbs & Drake (2001 & 2014), as its British distribution seems to be restricted to Cheshire Plain mires. Its British status was given as Nationally Rare in the recent status review by Drake (2017). Its International status [designated by IUCN – International Union for Conservation of Nature www.iucnredlist.org] is considered Endangered.

The second main target of the survey was *Hybomitra lurida* (Fallén, 1817), the Broad-headed Horsefly of Stubbs & Drake (2001 & 2014). This horsefly is widely distributed in Scotland, but its English distribution is apparently restricted to the Cheshire Plain area. Its British status was given as Nationally Rare by Drake (2017). Its IUCN International status is Vulnerable.

Although not stated within the main title of this report, the surveyor's third target horsefly was *Tabanus maculicornis* Zetterstedt, 1842. This relatively small clear-winged horsefly was correctly recognised as being Nationally Scarce by Drake (2017), and was given the vernacular name Narrow-winged Horsefly by Stubbs & Drake (2001 & 2014). Its IUCN International status is Least Concern.

Prior to the survey of 2018, none of these three aforementioned horseflies had been recorded from the Cheshire Plain area since the 20th Century, so any findings during 2018 would be interesting, particularly any re-discoveries of *Atylotus plebeius*.

As the main target horseflies *Atylotus plebeius* and *Hybomitra lurida* breed on bogs, the surveyor aimed to visit as many Cheshire Plain area mires as was feasibly possible during the summer of 2018, and to target mires and other wetlands whence these national rarities had previously been recorded; and, more especially, any mires which were, at least in part, quaking bogs; regardless of whether *Atylotus plebeius* or *Hybomitra lurida* had previously been recorded there. The constraints would merely be the availability of the surveyors' time, suitably hot and sunny weather conditions, and gaining the necessary permissions from various landowners to carry out surveying.

It was inevitable that other horseflies [Tabanidae] would be encountered during the course of the survey. These would always be recorded, as this report aims to provide an assessment of the current status and distribution of all Tabanidae on Cheshire Plain area mires, based on the 2018 study.

It was also inevitable that many other invertebrates would be encountered during the course of the survey, including some which were captured by Manitoba traps which were left in situ throughout the survey period on four sites. This report includes all data from incidentally-encountered invertebrates which were captured by the surveyor for critical analysis, plus those captured by the aforementioned traps, and including all conspicuous and easily-identifiable invertebrates which were identified in the field.

The surveyor intends to forward the majority of specimens taken during the course of the survey to the World Museum, Liverpool, in order that they can be added to the collections and provide vouchers for the records within this report.

Where thought necessary, this report also aims to provide recommendations on current and future management of Cheshire Plain mire sites, and identify any significant or adverse management issues.

THE CHESHIRE PLAIN AREA MIRES

The conceptual Cheshire Plain is mainly situated in the county of Cheshire, but also extends into neighbouring counties. It is an area of relatively-flat lowland situated above a deep sedimentary basin known as the Cheshire Basin.

The mires of the Cheshire Plain, known locally as 'mosses', generally have the distinctive shallow sediment-filled water-bodies which have been termed as 'kettle-hole bogs'. Some are genuine quaking bogs [alternatively often referred to by the German term 'schwungmoor'], which is the type of bog characterised by a floating mat of *Sphagnum* and other bog plants, typically at least half a metre thick, and often covering quite deep water bodies underneath.

Pristine quaking bogs still occur in the Cheshire Plain area, but are now scarce, having formerly been a fairly common habitat until the mid 20th Century, when wholesale destruction and degradation of these habitats unfortunately occurred. Many mires were either drained and afforested [principally in Delamere Forest], hollowed out to create lakes [including in the Abbots Moss and Newchurch Common areas], or drained and subjected to extensive commercial peat-extraction [most notably on the conjoined bog complex comprising Whixall Moss, Fenn's Moss and Bettisfield Moss, which straddles the Welsh/English border].

HISTORICAL BACKGROUND TO *ATYLOTUS PLEBEIUS* IN THE CHESHIRE PLAIN AREA

Atylotus plebeius (Fallén, 1817) is a relatively-small [circa 10mm] horsefly whose British distribution is apparently restricted to a few mires in the Cheshire Plain area. Prior to the 2018 survey, it had not been recorded in Britain since the late 20th Century, and there were doubts as to whether it remained extant given that habitat losses and changes, including drainage and flooding, had occurred at many of its known sites.

Atylotus plebeius was first published as a British insect by Goffe (1931) who wrote: 'Although Verrall [Verrall (1909)] stated that this species would probably occur with us (Brit. Flies, V. p. 381) I had not seen a published report of its capture; I was, therefore, agreeably surprised to find specimens in the British Museum [now The Natural History Museum, London] collection taken by Mr. H. Womersley in Cheshire and labelled "Delamere Forest, July 15th, 1911," and "Abbott's Moss, July 22nd, 1911," respectively. The species must surely occur elsewhere in the British Isles.' We cannot be exactly sure where Womersley took these specimens as both these localities refer to broad areas which would have contained many pristine types of mire at the time.

Atylotus plebeius was subsequently found quite widely at a few Cheshire Plain area mires during the second half of the 20th Century. The records were best summarised by Stubbs & Drake (2001), which listed the following localities and dates: Delamere, 1911; Abbots Moss, between 1911 and 1941; Newchurch Common, between 1940 and 1945 (Goffe, 1944; Collin, 1945); Bettisfield, 1955; Wybunbury Moss, 1969; Whixall Moss, between 1969 and 1980; and 'a bog between Abbots Moss and Newchurch Common in the mid 1990s'. The last mentioned locality refers to Andrew Grayson's discovery of a male and female at Shemmy Moss on 21st July 1996. The record of the Shemmy Moss male was originally published in Grayson (1997) under the locality name 'a kettlehole bog near Nunsmere'. Taylor (2000) was able to add Little Budworth Common as a further British site.

The majority of British *Atylotus plebeius* records appear to be based on a few specimens collected from Abbots Moss and the adjacent Newchurch Common by H. Britten and H. L. Burrows during the 1940s, which are mainly held in The Manchester Museum. Grayson (2018) alluded to the H. L. Burrows specimens, but gave the World Museum, Liverpool, as the main depository for these, which was a text error.

H. L. Burrows was also responsible for finding *Atylotus plebeius* on at least two occasions at Wybunbury Moss (21st July 1956 and 30th June 1969) according to records held by the Soldierflies and Allies Recording Scheme. Prior to the 2018 survey, the last time *A. plebeius* was recorded in Britain was a solitary female at Shemmy Moss on 24th July 1999 by Andrew Grayson.

Atylotus plebeius is fairly distinctive among the known British *Atylotus*; however, it would be advantageous if all British specimens were re-examined in order to confirm that they do not include the very similar *Atylotus sublunaticornis* (Zetterstedt, 1842), which could potentially occur in Britain, as it occurs in similar habitats to *A. plebeius*, and shares a similar European distribution, including all the Scandinavian countries, and our near neighbours Belgium, France and Holland (Chvála *et al.*, 1972).

The most reliable character for separating these species is that both sexes of *Atylotus sublunaticornis* have a dense fringe of long black hairs on the vertex, the longest being about as long as the hairs on the thoracic dorsum, and more than twice as long as those on the frons: whereas, both sexes of *Atylotus plebeius* usually have only fine pale hairs on the vertex, and when thicker black hairs do occur; they are much shorter, intermixed with finer pale hairs, and do not form such a dense fringe. All British specimens thus re-examined by Andrew Grayson have proved to be genuine *A. plebeius*.

HISTORICAL BACKGROUND TO *HYBOMITRA LURIDA* IN THE CHESHIRE PLAIN AREA

Hybomitra lurida (Fallén, 1817) is a relatively small species for its genus [circa 13mm]. It occurs in several Scottish regions; but elsewhere in Britain, *H. lurida* is apparently restricted to the Cheshire Plain area, where it was found at a few, mainly boggy, localities during the 20th Century. As was the case with *Atylotus plebeius*, prior to the 2018 survey, there were genuine doubts as to whether or not *H. lurida* remained extant in the Cheshire Plain area, given loss of, and changes to, habitats at sites where it was formerly found.

Hybomitra lurida was recorded from Britain relatively few years after it had been described as new to science; however, some early records proved to be erroneous, and it was not recorded with certainty until 1900 according to Verrall (1909), who provided a good analysis of British records known at the time.

Hybomitra lurida was first mentioned as occurring in the Cheshire Plain area by Goffe (1937). Subsequently, Oldroyd, writing in Edwards *et al.* (1939), stated it 'has only been taken in one British locality outside Scotland; at Whixall Moss, Salop, Mr. C. H. W. Pugh took a male in June 1934, and Mr. T. Hignett took females in June and July 1936 (see Goffe, 1937, p. 189).'

Some 20th Century specialists, who had not seen authentic English *Hybomitra lurida* specimens, regarded its occurrence in England as questionable; therefore, in 1992, Andrew Grayson re-examined the five females and one male standing under *H. lurida* in The Manchester Museum collections, and was able to confirm that the females were correctly identified. These females were from: Frodsham, 1951, P. Skidmore; Pettypool, 1916, T. A. Coward; Fenn's Moss, 1939, C. H. W. Pugh; and Whixall Moss, 1936, C. H. W. Pugh, and 1939, H. Britten. The male, however, had been recorded in error for *Hybomitra bimaculata* (Macquart, 1826): it was collected at Cotterill Clough by H. Britten. Regrettably, the Frodsham site was destroyed during 1951 (The Late P. Skidmore, *pers. comm.*), and Fenn's Moss and the adjoined Whixall Moss suffered from 20th Century peat-winning operations.

Stubbs & Drake (2001 & 2014) took into account the aforementioned data, and were able to give Wybunbury Moss and Abbots Moss as additional Cheshire Plain localities for *H. lurida*. A further additional record is from Brown Moss in Shropshire, 1988; however, the recorder (N. P. Jones, *pers. comm.*) reports that the specimen was unfortunately lost due to pest damage, and now regards the record as questionable, as he was a novice dipterist at the time, and the habitat seemed inappropriate. It is fair to point out that the occurrence of *H. lurida* at Brown Moss cannot be completely discounted, as the site contains areas of *Sphagnum* bog; albeit, these are restricted to one very small area of relatively dry mire, and the extreme margins of pools.

Hybomitra lurida is superficially similar to, yet distinct from, other British *Hybomitra* species, particularly the females, which have the unique combination of a mainly bare and shining subcallus, plus mainly brown tibiae. The only other British *Hybomitra* with a bare and shining subcallus is *Hybomitra micans* (Meigen, 1804) which has entirely black legs. The remaining seven British *Hybomitra* species have partly brown, or orange-brown, legs, and the subcallus completely covered by 'dust'.

In Tabanidae, this superficial 'dust' is actually a very dense layer of very short specialist hairs which obscure the underlying surface and create a covering reminiscent of velvet. Unfortunately, from a diagnostic point of view, this covering of 'dust' is easily damaged, and it is common to find *Hybomitra* females in which large patches of 'dust' have been rubbed off the subcallus, leaving it partly, or mainly, bare. Such specimens can easily lead to erroneous records of *H. lurida*, and it is worthy of note that a female *H. bimaculata* (Macquart, 1826) taken at Brown Moss during the 2018 survey had an extensively-rubbed and bare subcallus, which would cause it to be misidentified as *H. lurida* by the inexperienced or non-specialist entomologist. It is quite possible that the aforementioned lost 1988 Brown Moss *H. lurida* specimen may have been a 'rubbed' *H. bimaculata*.

OTHER HORSEFLIES RECORDED IN THE CHESHIRE PLAIN AREA

The broad Cheshire Plain area, which is principally in Cheshire and Shropshire, has a horsefly fauna comprising twelve confirmed species. As well as the aforementioned *Atylotus plebeius*, *Hybomitra lurida* and *Tabanus maculicornis*; the following nine tabanids have also been recorded with certainty: *Chrysops caecutiens* (Linnaeus, 1758); *C. relictus* Meigen, 1820; *C. viduatus* (Fabricius, 1794); *Haematopota crassicornis* Wahlberg, 1848; *H. pluvialis* (Linnaeus, 1758); *Hybomitra bimaculata* (Macquart, 1826); *H. distinguenda* (Verrall, 1909); *H. montana* (Meigen, 1820) and *Tabanus autumnalis* Linnaeus, 1761.

Two further species have been recorded from the region; however, at least one of these, *Hybomitra muehlfeldi* (Brauer, 1880), was recorded in error, as all the purported *H. muehlfeldi* specimens were examined by Andrew Grayson during the early 1990s, and found to be *H. bimaculata*. *Chrysops sepulchralis* was recorded from Whixall Moss in 1970 by H. L. Burrows according to data supplied to the NBN Atlas by Shropshire Ecological Data Network. This record is plausibly correct, but should be regarded as questionable, unless it can be confirmed by re-examination of any extant material, or unless *C. sepulchralis* can be 'rediscovered' at Whixall Moss. It is quite possible that this record resulted from a transcription or data input error.

There are other British horseflies that could plausibly occur in the Cheshire Plain area; however, a strong case cannot be made for the likely occurrence of any of these within the region; therefore, a detailed analysis here of potential additions is considered unwarranted, and has been necessarily avoided.

METHODOLOGY FOR THE 2018 SURVEY

INTRODUCTION

Methodology was mainly determined by the requirements and aims of the 2018 survey. The principal aim was to discover if *Atylotus plebeius* remained extant in the Cheshire Plain area, and the main concept of the original project specification was targeted towards that goal, with fieldwork which was anticipated to involve only a few of the more-pristine mires, and an estimated number of up to twelve days being required for fieldwork and writing of this report.

The surveyor suggested that the project should be extended to include *Hybomitra lurida* as a target species, and that it would be ideal to survey all the mires within the region for Tabanidae interest; especially those from which *A. plebeius* and *H. lurida* had been recorded during the 20th Century. Such a broad-ranging survey would yield numerous Tabanidae records, provided all survey permissions could be obtained, and optimum hot and sunny weather conditions were present on survey days.

Although fieldwork would inevitably be greatly biased towards investigating Tabanidae, the survey requirements included the incidental recording of other assemblages; which was very appropriate, given that the Cheshire Plain region contains unusual types of mire, which collectively comprise a nationally important habitat for bog species, including some invertebrates for which the Cheshire Plain is their British stronghold, and a few which are found nowhere else in Britain. The overall fauna includes invertebrates which are internationally rare and threatened.

The planned timescale for the 2018 survey was principally the mid-summer months of June and July, but would also include the latter half of May and early August. The days chosen for fieldwork would ideally be hot and sunny; these being the optimum weather conditions for encountering female horseflies in search of a blood meal.

Given optimum weather conditions, the surveyor would plan to visit as many Cheshire Plain region mires as was feasibly possible during summer 2018, giving time-priority to those mires which had areas of genuine quaking bog, and were therefore most likely to provide habitat for *Atylotus plebeius* in particular.

The main survey effort would involve the capturing of horseflies by the surveyor using a hand-held net; but, to assist the survey effort, four Manitoba traps would be provided by the World Museum, Liverpool, and were to be erected in four separate locations. Manitoba traps capture a broad range of flying invertebrates, but were specifically designed to capture horseflies, and basically consist of a cone with a trap at the top, which is suspended above a large ball, which is itself suspended several feet above the ground in order to mimic the underbelly of a large grazing animal.

The surveyor is based in North Yorkshire, and would inevitably not be available to carry out surveying on all days when optimum weather conditions occurred in the Cheshire Plain area; however, from the outset, reasonably frequent two-day survey visits were planned; moreover, the surveyor would be an attendee of the 2018 Dipterists Forum Summer Field Meeting based at the Staffordshire University in Stoke-on-Trent between 23rd and 30th June 2018, and would therefore be in a position to easily carry out fieldwork on Cheshire Plain mires whenever optimum conditions occurred during that week.

RECONNAISSANCE

Permissions would be sought to survey a large number of mires. If permissions were all granted, it would greatly facilitate the fieldwork if the surveyor did not have to spend much time on survey days locating obscure mires, many of which were hidden down discrete tracks within the Delamere Forest and Abbots Moss area. Furthermore, as four Manitoba traps would be erected to assist the survey results, then suitable locations for these traps would ideally need to be identified in advance.

Pre-survey reconnaissance was therefore essential, and would ideally involve guiding the surveyor around as many mires as was feasible, and particularly those for which an entrance could be difficult to locate on the ground.

Katie Piercy [ex Cheshire Wildlife Trust] was familiar with the mires of the Delamere Forest and Abbots Moss areas, and kindly offered to provide a guided tour. This took place on 10th January 2018, when the surveyor and Gary Hedges [World Museum, Liverpool], were given a useful whistle-stop tour of numerous mires. These included a few mires with which Andrew Grayson was familiar, as he had carried out a small amount of fieldwork at several Cheshire Plain mires during the 1996 to 2001 period. Where appropriate, this earlier fieldwork is in part mentioned within this report, as it produced a few invertebrates of special interest, including *Atylotus plebeius*.

THE SURVEY

It was somewhat regrettable that the surveyor encountered unexpected delays when attempting to put in place the insurance requirements of the survey. This meant that surveying could not commence until 7th June, and very regrettably, the surveyor could not make use of a prolonged period of fine weather which occurred during the second half of May.

Once the survey finally commenced, it ran very smoothly with no serious issues encountered, and no substantial periods of inclement weather; indeed, an unbroken prolonged dry period of hot and sunny weather prevailed throughout the entire main Tabanidae season of early June to mid July. This was integral to the results of the survey, as such conditions are essential for encountering female horseflies in search of blood meals.

From a recording point of view, one negative aspect of the atypical unbroken period of hot sunny weather was that the Cheshire Plain area Tabanidae season ended unusually early; as, following their emergence period, all species were able to complete their annual cycle uninhibited by periods of inclement weather. This meant that horseflies became very scarce by late July, and were completely absent by the beginning of August.

Upon commencement of the survey on 7th June, the surveyor's first task was to erect the Manitoba traps. These were erected at Black Lake (SJ 5377 7089), Blakemere Moss (SJ 5468 7119), Brackenhurst Bog (SJ 5956 6985) and Shemmy Moss (SJ 5944 6884); and would remain in situ at these locations throughout the course of the survey. They were dismantled and removed from the aforementioned sites by the surveyor and Gary Hedges on 12th September. The trapping periods in between 7th June and 12th September were slightly irregular, and are tabulated in the spreadsheet which accompanies this report [Appendix 2]. The spreadsheet also contains a table showing the survey dates and weather conditions.

If easily accessible to the general public, Manitoba traps left in situ for several months are at serious risk of disturbance or damage, especially by youths; therefore, the traps were placed in such positions, that the general public would need to cross areas of bog in order to reach them. This approach was successful at preventing interference with the traps, although it did necessitate placing the Black Lake trap in the mire, rather than on an adjacent open raised area, which would have undoubtedly produced better Tabanidae results among the trap's catches.

As permissions were successfully gained to survey a large number of sites, the surveyor endeavoured to visit all sites at least once during the optimum period for Tabanidae activity. All sites were able to be visited at least once; but, in reality, the ideal objective of all visits being made during the optimum activity period and optimum weather conditions was unachievable. This was partly due to the delay in starting the survey, and partly to the horsefly season ending unusually early. Another important limiting factor was that a few sites of particular interest were planned to be the focus of time and recording effort; therefore, most small sites were inevitably afforded only brief investigations, usually lasting for between twenty minutes to half an hour.

Whilst in the field, the surveyor's principal method for capturing Tabanidae was to make himself a target for females in search of blood meals, which could then be captured via a hand-held net as they approached, or encircled, the surveyor.

LOCALITIES

Permissions were gained to visit a large number of mires and wetland habitats which were either former mires or contained areas of mire. These are illustrated by photographs over the following pages, together with some notes. Plans showing the locations of the mires etc. are on pages 48 to 55 [Appendix 1]. A full list of all Cheshire Plain area localities from where Tabanidae were recorded during 2018 is given at the head of the spreadsheet which accompanies this report [Appendix 2].

ABBOTS MOSS COMPLEX MIRES ON FOREST CAMP LAND

The land of Cheshire Scouts' Forest Camp Activity Centre contains a number of wetlands, including mires which appear likely to be of special invertebrate interest. Unfortunately, the surveyor was not permitted to visit these wetlands whilst the Forest Camp was busy, between 8th June and 6th August, which covered the main part of the horsefly season. Therefore, the Tabanidae fauna of the Forest Camp mires and other Forest Camp wetlands must largely remain something of a mystery,



Lily Pool (7th June)



Woodpile Bog (7th June)

Importantly, the Forest Camp Activity Centre land features a seemingly high quality quaking bog known as **Lily Pool** (SJ 5956 6925), which is illustrated on the previous page together with **Woodpile Bog** (SJ 5956 6934), which is a recovering mire. Cheshire Scouts' nomenclature refers to these two adjacent bogs collectively as Lily Pond.

The other Forest Camp Activity Centre wetlands visited by the surveyor during 2018 are illustrated below. **Boggy Pool** (SJ 5970 6910) is a pristine mire which is likely to be of special invertebrate interest, despite not being a genuine quaking bog. By comparison, **Centre Bog** (SJ 5968 6923) is apparently of relatively little invertebrate value, being for the most part a seasonally-wet mossy woodland floor with patches of dry *Sphagnum* at the times of the 2018 survey visits.

The main invertebrate interest at **Gull Pool** (SJ 6009 6883) lies in its boggy margins with thick *Sphagnum*; however, such areas are not extensive. Much of Gull Pool is a small lake, as too is **Wrekin Pool** (SJ 5993 6918), which is of little value for Tabanidae. It has narrow margins of marshland vegetation, and no areas of true mire habitat. Wrekin Pool is alternatively known as Round Pool by Cheshire Scouts, and otherwise as Reeking Hole, for example on Google Imagery. Lily Pool, Woodpile Bog, Boggy Pool, Centre Bog, Gull Pool and Wrekin Pool were all briefly surveyed on 7th June and 8th August. The southern margin of Gull Pool is accessible from a disused railway line known as Whitegate Way, and was also briefly visited from this access point on 5th July.



Boggy Pool (8th August)



Centre Bog (8th August)



Gull Pool (7th June)



Wrekin Pool (7th June)

ABBOTS MOSS COMPLEX MIRES ON FORESTRY COMMISSION LAND

Only three mires survive on the part of Abbots Moss owned by the Forestry Commission; nevertheless, these are high quality pristine quaking bogs, and include **Shemmy Moss** (SJ 5949 6892), which is a site of national importance for invertebrate interest. It provides habitat for such national rarities as the horsefly *Atylotus plebeius*, the crane-fly *Idioptera linnei*, and the hoverfly *Orthonevra intermedia*, all of which were found to occur here during the 2018 survey.

As Shemmy Moss was known to be a quaking bog of outstanding quality, a Manitoba trap was erected there for the duration of the 2018 survey. This was able to be erected on slightly-raised dry open ground near the head of the bog at SJ 5944 6884, which was an ideal position to attract and capture horseflies. As the Manitoba trap catches would require frequent removal, a total of twelve visits were made to Shemmy Moss during the survey: these took place on 7th, 9th, 10th, 14th, 23rd, 27th and 30th June; 5th, 14th and 25th July; 7th August and 12th September.

South Moss (SJ 5937 6863) lies adjacent to Shemmy Moss, to which it is superficially identical in type, and should have a similar invertebrate fauna; however, this remains to be proven. It was visited on 7th, 14th, 27th and 30th June; 5th and 25th July; and 7th August. **Gull Moss** (SJ 6011 6871), another fine example of quaking bog, was only visited twice, on 7th June and 5th July.



Gull Moss (5th July)



Shemmy Moss (7th June)



Manitoba trap beside Shemmy Moss (7th June)



South Moss (14th June)

BRACKENHURST BOG AND NEWCHURCH COMMON

Brackenhurst Bog (SJ 5956 6983) is situated on private land in the Abbots Moss complex district, and is an interesting mire of potential invertebrate importance. As such, it was chosen as the location for one of the Manitoba traps used during the survey. This was erected on the bog itself at SJ 5956 6985, and was emptied on each occasion that Brackenhurst Bog was visited, the dates being 7th, 9th, 10th, 14th, 23rd, 27th and 30th June; 4th, 14th and 25th July; 7th August and 12th September.

Brackenhurst Bog is reasonably expansive, and benefits from shelter provided by a complete surround of trees. It possesses a complete covering of plants typical of quaking bogs; however, nowhere is it truly quaking underfoot. There is obvious evidence of old small drains towards its margin near the entrance track. Brackenhurst Bog remains a potentially interesting site; however, the survey failed to find any significant invertebrates there.

Newchurch Common (SJ 6055 6894), investigated on 8th August 2018, was a consideration of the survey as it was an historical site for *Atylotus plebeius*. It had previously been investigated by the surveyor in 1996, when it was discovered that any former mire habitats had been replaced by two large fishing lakes, with limited marshland margins of little invertebrate interest.



Brackenhurst Bog (10th June)



Manitoba trap on Brackenhurst Bog (14th June)



Newchurch Common [southern lake] (8th August)



Newchurch Common [northern lake] (8th August)

DELAMERE FOREST MIRES

The 2018 survey investigated all larger areas of mire within Delamere Forest, plus smaller mires of potential interest. These are illustrated over the following pages, usually in alphabetical order. The main block of Delamere Forest is a gently rolling landscape which features numerous meres and mosses. With the notable exception of Black Lake (SJ 5373 7091), these were massively degraded during the mid 20th Century due to industrial scale drainage and subsequent coniferous plantation. Happily, about forty of Delamere Forest's 'lost' meres and mosses are currently being restored by the Cheshire Wildlife Trust in partnership with the Forestry Commission. Whilst restoration work has yet to bear much fruit, the process is planned to be ongoing; hence, will be greatly advantageous to Tabanidae, and all other wetland faunas which occur in Delamere Forest.

Barnsbridge Basin (SJ 5420 7190) is the most interesting of the four mires illustrated below. It is squishy underfoot rather than truly quaking, but is covered by a typical suite of bog plants. It was surveyed on 25th and 26th July. **Barns Bridge** (SJ 5411 7172) was surveyed on 4th, 5th, 25th and 26th July. **Basin Mire A01b** (SJ 5357 7211), part of the Alvanley group of mires, was surveyed on 25th and 26th July. Both these recovering mires mainly feature open peaty pools. **Barnsbridge Flushes** (SJ 5398 7182) was quite dry at the time of its investigation on 25th and 26th July. The large drains there were blocked, but none retained water.



Barns Bridge (5th July)



Barnsbridge Basin (26th July)



Barnsbridge Flushes (25th July)



Basin Mire A01b (26th July)

Basin Mire A06 (SJ 5386 7202) and **Basin Mire A07** (SJ 5375 7197) are part of the Alvanley group of mires, and are situated in the north-western quarter of Delamere Forest. Both were investigated on 25th and 26th July 2018. At the time of the survey, Basin Mire A07 was principally a large peaty pool with emergent dead trees, especially *Betula* [birches], and was relatively uninteresting as a habitat for Tabanidae. By contrast, Basin Mire A06, despite being mainly dry at the time of the survey, will be a potentially important mire, once it has fully recovered following restoration.

Basin Mire LM09 (SJ 5379 7109) and **Basin Mire LM10** (SJ 5387 7111) are part of the Little Midgel group of mires, and are situated in the south-western part of Delamere Forest. Both were investigated on 30th June and 25th July. These two mires are effectively connected, but there is a clear demarcation between their habitat types. At the time of the survey, Basin Mire LM09 was mainly dry, but did retain some areas of treacherous waterlogged ground; whereas, Basin Mire LM10 remained largely under water, and consisted of a large peaty pool with areas of rushes.

None of the four mires illustrated on this page are currently of any special importance as Tabanidae habitats; but collectively, the abundance of such mires within Delamere Forest represents a tremendous source of acidic wetland habitat.



Basin Mire A06 (25th July)



Basin Mire A07 (25th July)



Basin Mire LM09 (25th July)



Basin Mire LM10 (25th July)

Basin Mire N1 (SJ 5497 7212), **Basin Mire N2** (SJ 5502 7208) and **Basin Mire N3** (SJ 5492 7205) are all part of the Norley/Hatch Mere group of mires, and are situated in the north-eastern corner of Delamere Forest. All three of these mires were surveyed on 26th July, and Basin Mire N2 was also briefly investigated on 8th August. Unfortunately, as the Tabanidae season ended unusually early in 2018, mainly due to a prolonged period of fine weather in June, no Tabanidae were present when these mires were surveyed; however, Basin Mire N1, which is effectively a valley bottom bog with areas of *Sphagnum*, and Basin Mire N3, which is a deep flooded natural amphitheatre with a central raft of floating *Sphagnum*, are both potentially important breeding habitats for Tabanidae. Basin Mire N2 is, by contrast, currently of limited interest for horseflies, and is mainly a large peaty pool with patches of rushes.

Blain's Moss (SJ 5525 7177) is also situated in the north-eastern part of Delamere Forest. It was surveyed on 14th and 23rd June, plus 4th and 5th July. This mire is recovering, but has a long way to go before its restoration is satisfactorily complete. At the time of the survey, Blain's Moss was mainly surfaced by wet open peat; but, encouragingly, parts of its margin had become encroached by areas of bog vegetation dominated by *Sphagnum*. Given its aspect and topography, Blain's Moss will be a locality of potential importance for Delamere Forest Tabanidae once it has become fully restored to quaking bog habitat.



Basin Mire N1 (26th July)



Basin Mire N2 (8th August)



Basin Mire N3 (26th July)



Blain's Moss (5th July)

Situated in the south-western quarter of Delamere Forest, **Black Lake** (SJ 5373 7091) is currently, by a huge distance, the most important mire for invertebrate interest within the Delamere Forest landscape. It is the only Delamere Forest mire to have escaped the otherwise wholesale degradation and destruction of mire habitats carried out throughout the forest during the mid 20th Century; and it was inevitably chosen for the location of a 2018 survey Manitoba trap. Black Lake is a popular location for visitors to Delamere Forest; therefore, it would be problematic for the Manitoba trap to be placed at an easily accessible point. To avoid interference from the public, the trap was placed on the quaking bog itself at SJ 5377 7089. As expected, this less than ideal location for capturing horseflies proved unfruitful for that assemblage, but did produce other invertebrates of special interest. As the Manitoba trap would require regular emptying, and Black Lake has high quality quaking bog habitat, the site was visited ten times during 2018, on 7th, 10th, 14th, 23rd and 30th June; 4th, 14th and 25th July; 7th August and 12th September.

Blakemere Moss (SJ 5469 7120) is the largest expanse of open mire habitat within Delamere Forest, and is a site of potentially special Tabanidae interest. For these reasons it was chosen for the erection of a Manitoba trap at SJ 5468 7119. This was placed at a point which was ideal to attract female horseflies in search of a blood meal. Much of Blakemere Moss, otherwise known as Great Blakemere, is a large area of open peaty water with partly marshland surrounds. True mire should predominate once the site is fully restored. It was surveyed on 7th, 10th, 14th, 23rd and 30th June; 4th, 14th and 25th July; 7th August and 12th September.



Black Lake (7th June)



Manitoba trap on Black Lake (7th June)



Blakemere Moss (10th June)



Manitoba trap on Blakemere Moss (10th June)

Doolittle Moss is situated near the centre of Delamere Forest, and is one of the larger, and potentially better, mires within the Delamere Forest landscape. Here, the restoration work of recent years can be seen to have brought some success, despite the site being far from fully restored to a true quaking bog.

During previous nature studies, Doolittle Moss has been considered to consist of two mires, known as **Doolittle Moss (upper basin)** (SJ 5424 7155) and **Doolittle Moss (lower basin)** (SJ 5429 7142). These mire areas are connected, the former being a true deep acidic mire, and the latter being a few dry mossy-covered hollows within *Betula* [birches] scrub woodland. These two parts of Doolittle Moss were both investigated on 5th and 25th July.

The mire habitats at **Hatch Mere** (SJ 5521 7206) mainly consist of two very different parts. The eastern end of the mire is not truly quaking, but has a full covering of typical bog vegetation, and is of some potential Tabanidae interest. The western end of the Hatch Mere mire was quite dry at the time of the 2018 survey, and featured only a few seasonally-wet hollows where *Sphagnum* had gained a foothold. All parts of the Hatch Mere mire were investigated on 14th June and 5th July.



Doolittle Moss (lower basin) (5th July)



Doolittle Moss (upper basin) (25th July)



Hatch Mere [eastern end] (5th July)



Hatch Mere [western end] (14th June)

The dry mire habitat at **Great Middel** (SJ 5406 7132) is situated near the centre of Delamere Forest, on the opposite side of the central forest track to Doolittle Moss. Much drain blocking has been attempted at Great Middel; however, this had not enabled the site to retain any water at the time it was visited by the surveyor on 5th July. The drains at Great Middel are deep, and probably require to be entirely refilled with peat before any tangible restoration of the mire habitat becomes apparent.

The Ham series of mires are situated close together towards the north-eastern corner of Delamere Forest. These were investigated by the surveyor on 26th July 2018. **Ham Pool** (SJ 5459 7204) is a small peaty pool at the top of a slope and is shaded by surrounding woodland. It is unlikely to be of any significance to Tabanidae.

The other two Ham mires, **Ham (lower basin)** (SJ 5467 7205) and **Ham (upper basin)** (SJ 5467 7193), are situated either side of a forest track at the bottom of the slope which descends from Ham Pool. Ham (lower basin) was surfaced by dry peat with a mixture of plants at the time of the survey; whereas, Ham (upper basin) principally consisted of open peaty pools and bare wet peat. Once fully restored, Ham (upper basin) should be a useful breeding facility for horseflies.



Great Middel (5th July)



Ham Pool (26th July)



Ham (lower basin) (26th July)



Ham (upper basin) (26th July)

The Hart Hill part of Delamere Forest was investigated by the surveyor on 26th July. This is the far eastern part of Delamere Forest, and contains a couple of extensive mires known as Harthill Moss and Finney's Moss, which are of very different consistency from each other.

Harthill Moss (SJ 5633 7142) contains a few open peaty pools, but is in the main well vegetated with a mixture of bog and marsh plants. By contrast, at the time of the survey, **Finney's Moss** (SJ 5596 7155) was devoid of open water, and featured a mixture of bare open wet peat areas, and areas dominated by rushes.

Harthill (upper basin) (SJ 5600 7108) was also investigated on 26th July. It is situated within woodland south-westwards of Finney's Moss, and is not an extensive mire; nevertheless, Harthill (upper basin) is potentially of future Tabanidae interest if successfully fully restored to quaking or similar bog habitat.



Finney's Moss [western end] (26th July)



Finney's Moss [eastern end] (26th July)



Harthill Moss (26th July)



Harthill (upper basin) (26th July)

The south-central part of Delamere Forest contains the large mires known as Linnere Moss and Hockenhull. Linnere Moss is now bisected by an active railway line into two mires known as **Linnere Moss (north)** (SJ 5469 7070) and **Linnere Moss (south)** (SJ 5451 7054). Tabanidae investigations were carried out at Linnere Moss (north) on 10th June and 5th and 25th July; and at Linnere Moss (south) on 26th July and 8th August. Much drain blocking has been carried out to help restore the two mires of Linnere Moss, and this has provided some success in re-wetting these potentially important mires. Linnere Moss (south) currently mainly comprises peaty pools with patches of rushes; whereas, Linnere Moss (north) is less dominated by water, but does include areas that have returned to permanently wet peat carpeted by *Sphagnum*.

Much recent restoration work has been carried out at **Hockenhull** (SJ 5421 7094), including the sectioning of the mire via raised embankments of peat, and drain blocking. This work has thus far only been partially successful in aiding the mire to retain water, and return to its former habitats; however, Hockenhull is potentially of interest as a breeding site for Tabanidae. It was investigated on 30th June, and 5th and 25th July 2018.

Rush Pool (SJ 5435 7195) is very much as its name suggests, and of limited current interest for Tabanidae. It is in the northern central part of Delamere Forest, and was surveyed for horseflies on 25th and 26th July.



Hockenhull (25th July)



Rush Pool (26th July)



Linnere Moss (north) (10th June)



Linnere Moss (south) (26th July)

LITTLE BUDWORTH COMMON MIRES

Little Budworth Common is notable as being the possible current stronghold of *Atylotus plebeius* in Britain. Other Diptera of interest also occur here, including the crane-fly *Idioptera linnei*, which was found during the survey on Whitehall Moss; and the hoverfly *Microdon mutabilis*, which was taken on North Moss.

The special invertebrate interest at Little Budworth Common lies in its four separated mires. Three of these, **Central Moss** (SJ 5850 6574), **East Moss** (SJ 5859 6570) and **Whitehall Moss** (SJ 5878 6580), are outstanding and rare examples of pristine quaking bogs that fortunately avoided the serious degradation by drainage and forestry operations that affected almost all other quaking bogs throughout the Cheshire Plain region during the mid 20th Century. These three bogs were all briefly investigated for Tabanidae interest on 10th and 27th June, with *Atylotus plebeius* being found on all three bogs on both occasions. They were also investigated on 7th August, which was beyond the end of the local horsefly season in 2018.

The fourth Little Budworth Common Bog, **North Moss** (SJ 5842 6585), despite being a habitat of obvious invertebrate interest, did not possess the true quaking nature of the three aforementioned bogs, and was not found to have *Atylotus plebeius*. It was investigated on 10th and 27th June only.



North Moss (10th June)



Central Moss (10th June)



East Moss (10th June)



Whitehall Moss (10th June)

PETTY POOL AREA WETLANDS

Petty Pool was of interest to the survey, as it was from here that *Hybomitra lurida* was taken historically. This was, however, in 1916, since when, the habitats of the Petty Pool wetlands will have undoubtedly changed beyond recognition. It is likely that *Hybomitra lurida* would have been breeding at Petty Pool in 1916, but also possible that the female captured had travelled to Petty Pool from elsewhere. Given the wetland habitats currently available at Petty Pool, *Hybomitra lurida* is unlikely to still occur there.

The current wetlands at Petty Pool consist of the fishing lakes known as **Petty Pool** (SJ 6174 6999) and **New Pool** (SJ 6262 6959), which are linked by the stream called **Pettypool Brook** (SJ 6215 6966). There are no areas of true acid mire currently at Petty Pool. The margins of the two lakes have either little vegetation, or a limited range of marshland plants. The wetland vegetation adjacent to parts of Pettypool Brook has much more variety, but these streamside wet areas are of no apparent special invertebrate interest in respect of Tabanidae.

The Petty Pool area was investigated on 4th and 5th July. The lane shown below, between Petty Pool and Pettypool Brook, was the capture location for three horsefly species.



Petty Pool (5th July)



New Pool (5th July)



Lane between Petty Pool and Pettypool Brook (5th July)



Boardwalk over boggy ground by Pettypool Brook (5th July)

MISCELLANEOUS DELAMERE AREA MIRES

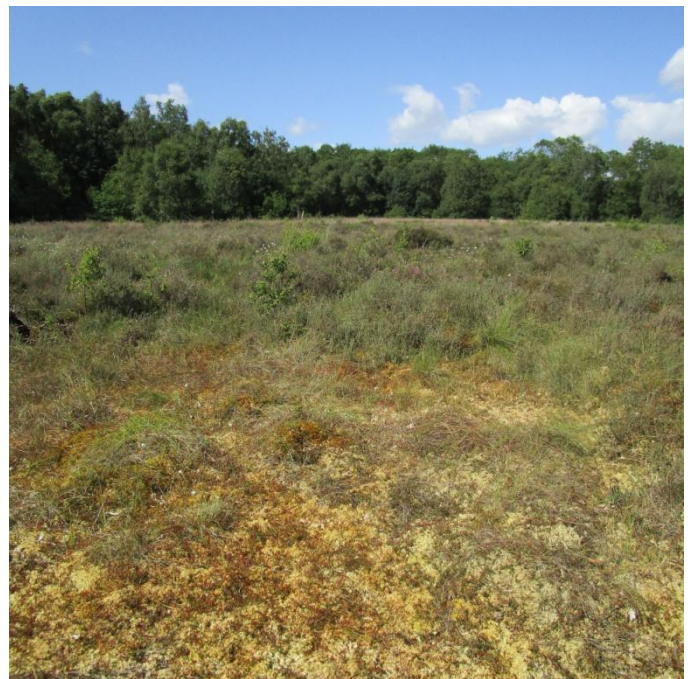
Aside from the numerous mires already illustrated and described, the Delamere area has several more outlying mires, which are generally on private land. These include the undoubtedly important **Hogshead Moss** (SJ 5842 6952) which was investigated on 9th and 10th June, and 25th July. The survey of Hogshead Moss did not produce *Atylotus plebeius*, although this quaking bog with its *Sphagnum*-dominated areas is a potential *A. plebeius* site. It did, however, produce such national rarities as the crane-fly *Idioptera linnei*, and the hoverfly *Orthonevra intermedia*.

Flaxmere Moss (SJ 5565 7229) can be considered as part of the Delamere Forest mires, but is slightly separated from the main block of Delamere Forest woodland. It was visited by the surveyor on 14th June 2018, having previously been visited by the same surveyor in 1996. Flaxmere Moss has suffered from drainage, particularly around its periphery, and is still adversely affected by drainage to the extent that it was for the most part a very dry peat-based landscape at the time of the 2018 visit, and of rather limited interest for mire invertebrates. One interesting crane-fly, *Idioptera linnei*, was found on Flaxmere Moss by the surveyor on 21st July 1996, but the site has failed to produce any Tabanidae apart from the common *Haematopota pluvialis*.

Fishpool Moss (SJ 5643 6716) has suffered massively from drainage, and is no longer recognisable as mire. It was surveyed on 30th June. **Snipe Island** (SJ 6111 6932) has a full covering of mire plants, but was dry underfoot. It was investigated on 27th June.



Fishpool Moss (30th June)



Flaxmere Moss (14th June)



Hogshead Moss (10th June)



Snipe Island (27th June)

The basin mire at **Oak Mere** (SJ 5765 6807) is a small isolated habitat situated within woodland towards the centre of the overall Oak Mere site, which is principally characterised by a restored large lake. The mire was investigated on 30th June, and found to be of quite limited Tabanidae value, as it was not a true quaking bog, and was rather dry underfoot. It did however, have a complete covering, and reasonable range, of typical bog plants.

Thieves Moss & Pool (SJ 5648 6906) was investigated on 7th and 8th August, which was beyond the end of the 2018 Tabanidae season. This is a site which includes mire that has suffered from extensive drainage work and forestry plantation. At the time of the survey, Thieves Moss was reduced at best to areas of dry *Sphagnum* and bare peat; whereas, Thieves Pool was an expanse of bland open water with little marginal vegetation, and no true acid mire vegetation. Thieves Moss & Pool may formerly have been an important local site for Tabanidae, but it is currently degraded, and of no apparent special Tabanidae interest.



Oak Mere [moss] (30th June)



Oak Mere [lake] (30th June)



Thieves Moss (8th August)



Thieves Pool (8th August)

WYBUNBURY MOSS AND CHARTLEY MOSS

These extensive and ecologically important mires are very disconnected from the main blocks of Cheshire Plain region mires which occur in the Delamere and North Shropshire areas. Both sites have areas of quaking bog with a thick floating covering of typical bog plants.

Wybunbury Moss (SJ 6965 5021) was visited on 24th and 25th June, and found to have a rich horsefly fauna, including *Atylotus plebeius* and *Tabanus maculicornis*. Wybunbury Moss has suffered from 20th Century drainage; which would have contributed to the majority of its open mire area being quite dry at the time of the visit. Nevertheless, a discrete area of genuine quaking bog still remains, and is certainly of paramount importance for the continued occurrence of *A. plebeius* at Wybunbury Moss.

The extensive mire at **Chartley Moss** (SK 0221 2825) in Staffordshire is so removed from similar habitats in the broad Cheshire Plain region that it would not usually be considered to be aligned with the main blocks of mires; however, it is a quaking bog of outstanding quality, and a potential site for *Atylotus plebeius*; hence, it was included within the surveyor's plans, and was visited on 28th June. Chartley Moss did not produce *A. plebeius*, but *Tabanus maculicornis* was found there on the day of the survey.



Wybunbury Moss [quaking bog] (25th June)



Wybunbury Moss [centre] (24th June)



Chartley Moss [quaking Bog] (28th June)



Chartley Moss [pool] (28th June)

BROWN MOSS

Brown Moss (SJ 5616 3949) in Shropshire is very much an outlying wetland site, which is notable in terms of Tabanidae as *Hybomitra lurida* has been recorded there; but, as was stated on page 3, the record may have been erroneous. The surveyor visited Brown Moss on 25th June and 8th August.

Brown Moss contains about a dozen isolated wetland habitats within a wooded landscape on raised surrounding ground. The largest wetland feature is Pool 6, which is effectively a shallow lake with seasonally-wet marginal areas. Some of the other wetlands, such as Pool 7, are in the early stages of recovery, following re-wetting and reversal of drainage.

From a Tabanidae viewpoint, the most important habitats at Brown Moss are those where *Sphagnum* dominates the surface. Most such areas are on the extreme margins of only a few pools, none being in the least bit extensive. The only area of proper mire with a complete covering of typical bog plants is Pool 9; however, this habitat was fairly dry on the dates of investigation, having been severely degraded by a large drain. The drain has been blocked, but not successfully enough to allow Pool 9 to retain a desirable level of water.



Sphagnum on the western margin of Pool 2 (25th June)



Seasonally-wet western margin of Pool 6 (25th June)



Cleared western margin of Pool 7 (25th June)



Central bog habitat of Pool 9 (8th August)

CLAREPOOL MOSS AND COLE MERE

The wetlands of **Clarepool Moss** (SJ 4356 3411) and **Cole Mere** (SJ 4284 3343) are very much towards the extreme western margin of the broad Cheshire Plain area. These wetlands, and the areas in between, were investigated by the surveyor on 26th June.

Clarepool Moss was formerly covered in mire vegetation, but was mainly flooded at the time of the survey visit, the water being of a peaty consistency. The flooding at Clarepool Moss is apparently due to a greatly increased water level caused by a blocked drain. Cole Mere is currently a large lake used for fishing and other recreational purposes. Its margins possess some marshland vegetation, but no areas of true bog vegetation.

Neither Clarepool Moss nor Cole Mere has any areas of habitat which could possibly support *Atylotus plebeius*; however, the general area is of some importance for Tabanidae, and produced several clear-winged horseflies on the day of the survey, including *Tabanus maculicornis*. Mostly, these were encountered along the lane between Clarepool Moss and Cole Mere, which is illustrated below. The margins of the pond also illustrated below are likely to provide good breeding habitat for Tabanidae.



Clarepool Moss (26th June)



Pond between Clarepool Moss and Cole Mere (26th June)



Lane between Clarepool Moss and Cole Mere (26th June)



Cole Mere (26th June)

THE FENN'S, WHIXALL, BETTISFIELD, WEM AND CADNEY MOSSES COMPLEX SSSI MIRES

The Whixall area mosses complex was a prime target for investigation during the 2018 survey, as it was from here that both *Atylotus plebeius* and *Hybomitra lurida* were recorded historically; indeed, this extensive combination of mire sites was the most likely place that *H. lurida* may have survived in the broad Cheshire Plain region. Neither of these important species was found during the survey, but they may possibly remain extant in pockets of this large mire area.

Whixall Moss (SJ 4926 3603) and **Fenn's Moss** (SJ 4848 3628) are a continuous stretch of extensive mire habitat, separable only by the fact that Whixall Moss is in England, and Fenn's Moss is in Wales. The actual border on the ground is not very apparent. Whixall Moss was investigated on 15th, 24th and 26th June; whereas, the surveyor only ventured across to Fenn's Moss on 24th June.

Both Whixall Moss and Fenn's Moss suffered drastically from 19th and 20th Century drainage and peat-winning operations, but both are recovering, remain as important wetlands regionally, and are potentially of paramount importance for Tabanidae of significant interest if *A. plebeius* and/or *H. lurida* are rediscovered in the 21st Century.



Whixall Moss [eastern end] (24th June)



Whixall Moss [central area] (24th June)



Whixall Moss [western end] (15th June)



Fenn's Moss (24th June)

Bettisfield Moss (SJ 4821 3518) is a continuation of the Whixall Moss and Fenn's Moss mire complex, and is separated from those mires merely by the Llangollen Canal which bisects the overall expanse of mire habitat. Most of Bettisfield Moss lies in Wales, but the part which was investigated by the surveyor on 24th June is on the English side of the border. Like Whixall Moss and Fenn's Moss, Bettisfield Moss is recovering following degradation due to commercial peat-winning operations. Much of Bettisfield Moss is currently an impoverished mire landscape, as is illustrated by the photograph below.

Wem Moss (SJ 4734 3431) is close to, but separated from, the main block of Whixall area mire. It has suffered badly from drainage, and contained only a few miniscule pockets of *Sphagnum*-dominated wet peat at the times it was visited on 15th and 26th June. The majority of Wem Moss was surfaced by very dry peat, and the site gave no indication that it could be of any potentially special interest for Tabanidae.

Cadney Moss (SJ 4689 3477) is another site which is separated from the main block of Whixall area mire. It is currently almost unrecognisable as a former moss, and was mainly forested when visited by the surveyor on 24th June. Although unlikely to be of any tangible special interest for Tabanidae, the visit to Cadney Moss on 24th June did at least produce *Tabanus maculicornis*.



Bettisfield Moss (24th June)



Cadney Moss (24th June)



Wem Moss [southern end] (15th June)



Wem Moss [northern end] (15th June)

POTENTIAL HOST ANIMALS FOR FEMALE TABANIDAE BLOOD MEALS

Female horseflies usually require taking blood meals from large grazing animals as part of their ecological needs for egg production. It is therefore advantageous for Tabanidae if large grazing animals are present within reasonably close proximity of their breeding grounds; indeed, rather than travel any distance whatsoever in order to gain a blood meal, many individual horseflies will remain at their breeding sites, invariably wetlands, and await the arrival of suitable hosts.

The usual blood meal hosts are horses and cattle, at least one of which was noted by the surveyor to be present in fairly close proximity to all the mire sites investigated. There is therefore no shortage of suitable blood meal hosts for female horseflies throughout the broad Cheshire Plain region. Man is also a blood meal target; however, the horsefly risks being swatted.

Pigs are also a favourite host animal for blood meals, but none were observed near any of the mire sites. Goats also offer a potential easy blood meal. Sheep, on the other hand, are subject to horsefly bites, but they are not a preferential host animal for blood meals, as Tabanidae are unable to feed easily on sheep without being brushed off by vegetation. Goats were only noted at Petty Pool. Sheep were abundant near Chartley Moss.



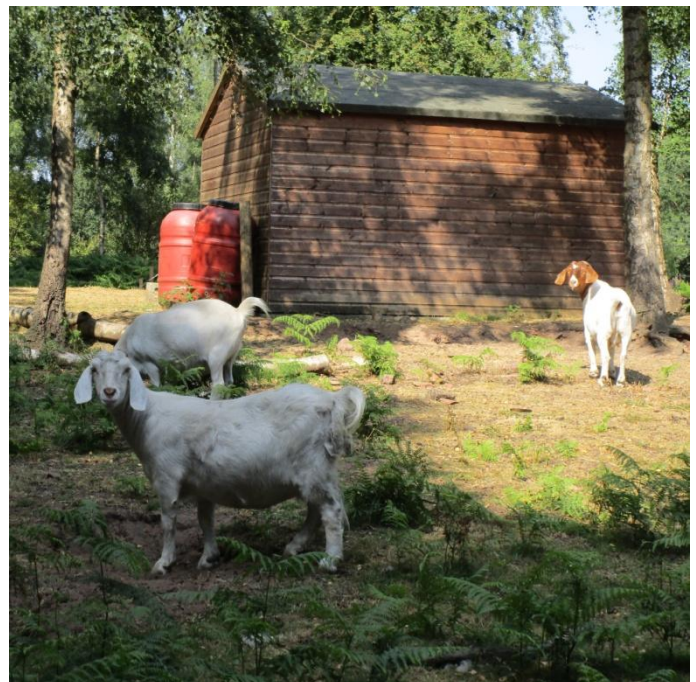
Horses near Brackenhurst Bog (10th June)



Sheep near Chartley Moss (28th June)



Cattle near Wybunbury Moss (25th June)



Goats near Petty Pool (4th July)

RESULTS

TABANIDAE

SUMMARY

The survey achieved a number of successes; most notably it provided confirmation that *Atylotus plebeius* remains extant as a British species, indeed it was found at three well-separated localities.

Tabanus maculicornis was also able to be confirmed as being present in the broad Cheshire Plain region, as it was found in four widely-separated localities, each one being in a different vice-county.

The survey produced numerous records of eleven of the twelve confirmed Cheshire Plain area horseflies mentioned on page 3. These records will inevitably include many species-additions to the lists for the localities in which they were found.

The survey was greatly aided by consistently hot and sunny weather conditions throughout the optimum months of June and July. Such conditions were perfect for encountering female horseflies in search of a blood meal, and ensured that relatively large numbers of female Tabanidae were able to be sampled.

Aided by the fine summer, the surveyor was able to carry out much more survey work than had been anticipated: this was also integral to the success of the results.

The four Manitoba traps, which were operated throughout the course of the survey, captured a few horseflies, and served to supplement the results achieved by the surveyor. Most importantly, the Manitoba traps were able to operate continuously, and stand a chance of capturing horseflies at all times.

The only recording failures of the 2018 survey were that *Hybomitra lurida* was not found, and some of the localities were inevitably visited well after the optimum Tabanidae activity period, and therefore produced few, or no, horsefly records. The surveyor has plans to rectify these deficiencies by re-visiting selected sites during 2019, and targeting *H. lurida*.

The Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses Complex SSSI is the area most likely to still have *Hybomitra lurida* as a breeding species, but its occurrence there in the 21st Century needs to be confirmed, as the site has suffered from extensive 19th and 20th Century commercial peat-winning operations.

SPECIES ACCOUNTS

Atylotus plebeius (Fallén) [Cheshire Horsefly]

The survey was able to establish that small, but viable, populations persist on three widely-separated Cheshire sites. These populations are on quaking bogs which are completely covered by a thick floating mat surface of *Sphagnum* and other plants, with *Vaccinium oxycoccos* [Bog Cranberry], *Drosera* [sundews] and *Calluna vulgaris* [Heather] as conspicuous elements. The particular bogs where *Atylotus plebeius* was rediscovered during 2018 were: Shemmy Moss (SJ 5949 6892), Wybunbury Moss (SJ 6965 5021), and the three quaking bogs on Little Budworth Common, which are known as Central Moss (SJ 5850 6574), East Moss (SJ 5859 6570) and Whitehall Moss (SJ 5878 6580). Its national status is rare, and has been discussed previously on page 1.

Atylotus plebeius was first rediscovered at Shemmy Moss on 9th June when both sexes were found by the surveyor when accompanied by Gary Hedges. The surveyor also found a male at Shemmy Moss on 10th June; but thereafter, no further sightings were made at Shemmy Moss, despite several further visits.

Atylotus plebeius appears to be well established and not uncommon on Little Budworth Common, where it was present on all three true quaking bogs [Central Moss, East Moss and Whitehall Moss] during the surveyor's brief visits on both 10th and 27th June. Approaching dusk at Whitehall Moss on 10th June, four *A. plebeius* males were apparently preparing to roost close together on a patch of *Calluna vulgaris* near the centre of the mire. One male was certainly preparing to roost, and remained motionless, perched head-downwards near the top of a *Calluna vulgaris* stem. *A. plebeius* was also swept from Whitehall Moss by John Mousley during the Dipterists Forum Summer Field Meeting on 26th June (R. Wolton, *pers. comm.*).

Atylotus plebeius was observed on two occasions at Wybunbury Moss; albeit, each time as a single female, which may have been the same individual. The first sighting was around a cow in a linear field beside the bog by the surveyor on 24th July (Grayson, 2018); and the second sighting was on vegetation near the centre of the bog by Rob Wolton, who took a photograph, on 26th July.

The surveyor has observed that both sexes of *Atylotus plebeius* have a penchant for alighting upon, and crawling over, the unopened or dead flower-heads of *Calluna vulgaris* [Heather]. When perched on the general bog vegetation, as they regularly do, it is also noticeable that males gain some camouflage advantage due to their eyes being similar in shape and colour to unripe berries of *Vaccinium oxycoccos* [Bog Cranberry].

It is likely that the British distribution of *Atylotus plebeius* is restricted to quaking bogs in the Cheshire Plain area, and it is also likely that *A. plebeius* has populations on a few additional mires to those where it was rediscovered during 2018. Probably the most likely mires which deserve future investigations for *A. plebeius* are: Barnsbridge Basin (SJ 5420 7190), Black Lake (SJ 5373 7091), Brackenhurst Bog (SJ 5956 6983), Boggy Pool (SJ 5970 6910), Gull Moss (SJ 6011 6871), Hogshead Moss (SJ 5842 6952), Lily Pool (SJ 5956 6925) and South Moss (SJ 5937 6863).

***Chrysops caecutiens* (Linnaeus) [Splayed Deerfly]**

Chrysops caecutiens was only found at four localities and on each occasion only a single female was taken. The localities and dates were: South Moss (SJ 5937 6863) on 7th June, Blain's Moss (SJ 5525 7177) on 5th July, Harthill (upper basin) (SJ 5600 7108) on 26th July, and the lane between Petty Pool and Pettypool Brook (SJ 6204 6973) on 5th July. Historically, the surveyor also found a female *C. caecutiens* in the same part of the Petty Pool estate on 21st July 1996, plus several females at Shemmy Moss (SJ 5949 6892) on the same day, and a further female at Shemmy Moss on 24th July 1999.

Chrysops caecutiens is generally distributed throughout much of Britain and occurs in a variety of wetland habitats, although it has a strong affinity for sunny sheltered areas in the close vicinity of trees, particularly sunny woodland glades. It is quite an elusive species, males being rarely found, and females being usually encountered in ones and twos. Its national status is Local.

***Chrysops relictus* Meigen [Twin-lobed Deerfly]**

Chrysops relictus was only found at Whixall Moss (SJ 4926 3603), where single females were taken on 15th and 24th June, and three females were taken on 26th June. *C. relictus* is a widespread marshland species which is typically found along the margins of ponds, lakes and ditches in lowland regions of Britain. It is nationally Local, and often locally common where it occurs. Although Whixall Moss is known as a mire site, it does have an area in the eastern part which is dominated by true marshland, and it was in this area that *C. relictus* occurred in 2018.

***Chrysops viduatus* (Fabricius) [Square-spot Deerfly]**

Chrysops viduatus is a widely distributed nationally Local bog species which is absent from most British regions, and yet is by far the most numerous *Chrysops* on some bog complexes, such as in the New Forest, and also, as proven by the 2018 survey, in the Delamere Forest, where it was found at the following locations: Barns Bridge (SJ 5411 7172), a single female on 5th July; Barnsbridge Basin (SJ 5420 7190), three females on 25th July; Barnsbridge Flushes (SJ 5398 7182), a single female on 26th July; Basin Mire A07 (SJ 5375 7197), a single female on 25th July; Basin Mire LM09 (SJ 5379 7109), two females on 30th June; Basin Mire LM10 (SJ 5387 7111), two females on 25th July; Black Lake (SJ 5373 7091), two females on 23rd June, and one female on 30th June; Blain's Moss (SJ 5525 7177), one female on 23rd June; Doolittle Moss (lower basin) (SJ 5429 7142), two females on 5th July; and Great Midgel (SJ 5406 7132), one female on 5th July.

Chrysops viduatus also proved to be well established at two large outlying mires. At Wybunbury Moss (SJ 6965 5021), the surveyor found six females on 24th June, and a further three females on 25th June. At Whixall Moss (SJ 4926 3603), two females were taken on both 15th and 24th June, and a further three were encountered on 26th June.

Chrysops viduatus was not found in the Abbots Moss Complex during the 2018 survey, which was somewhat surprising, as the surveyor had historically encountered several females at Shemmy Moss (SJ 5949 6892) on both 21st July 1996 and 24th July 1999.

***Haematopota crassicornis* Wahlberg [Black-horned Cleg]**

Haematopota crassicornis is nationally Local, being generally distributed in Britain, but more prevalent in upland regions. It occurs in a variety of wetland habitats, but most typically near small streams. As the survey did not target its more specific habitats, it was not anticipated to be found; but, nevertheless, *H. crassicornis* was found at three localities. The first finding was a male beside Shemmy Moss (SJ 5949 6892) on 10th June. Subsequent captures were all females via Manitoba traps, one being taken at Brackenhurst Bog (SJ 5956 6985) between 4th and 14th July, one at Blakemere Moss (SJ 5468 7119) between 23rd and 30th June, and a further two females being from the same trap at Blakemere Moss between 30th June and 4th July.

***Haematopota pluvialis* (Linnaeus) [Notch-horned Cleg]**

This cleg is by far the most numerous of British horseflies. It occurs in all types of wetland habitat, with females often occurring in myriads. Males are less frequently found, except for among tall grasses in damp meadows. Its national status is Common.

During the Cheshire Plain area survey, *Haematopota pluvialis* was found to be present at all sites visited throughout June and into early July, and often occurred in abundance, particularly on larger sites.

Hybomitra bimaculata (Macquart) [Hairy-legged Horsefly]

Hybomitra bimaculata is a widespread, if decidedly local, large horsefly of mires and wet heathland throughout lowland Britain, usually in wooded locations. Its national status is Local. During the survey of 2018, it was found to be widespread and not infrequent in the Cheshire Plain area, where it was found in thirteen separate localities.

It was found at two Abbots Moss mires on 10th June; four females being captured at Shemmy Moss (SJ 5949 6892), and a further female at Brackenhurst Bog (SJ 5956 6983).

In the Delamere Forest, *Hybomitra bimaculata* was found to be well established and widespread. Single females were captured at Black Lake (SJ 5373 7091) on 7th, 10th and 30th June, and at Doolittle Moss (upper basin) (SJ 5424 7155) on 5th July. Three females were taken at Linnere Moss (north) (SJ 5469 7070) on 10th June; and the Manitoba trap sited at Blakemere Moss (SJ 468 7119) captured three females during the period between 10th to 14th June, and one female during the period between 14th and 23rd June.

Elsewhere during 2018, there were three *Hybomitra bimaculata* females feeding on cattle at the outlying Cheshire mire at Wybunbury Moss (SJ 6965 5021) on 24th June, and single females at the following Shropshire localities: Brown Moss (SJ 5616 3949) on 25th June, Clarepool Moss (SJ 4356 3411) on 26th June, the lane between Clarepool Moss and Cole Mere (SJ 4296 3401) on 26th June, and at Wem Moss (SJ 4734 3431) on 15th June.

During the week of the Dipterists Forum meeting based at Staffordshire University, a single female *Hybomitra bimaculata* was found at Cannock Chase (near Penkridge Bank Road) (SK0099 1687) by the surveyor on 29th June; and single females were identified by the surveyor from a photograph taken between Mosslee Hall Farm and Coltstone (SK 00789 50701) on 24th June by Darwyn Sumner, and a specimen taken at Shavington Park (SJ 638 382) on 25th July by Chris Spilling.

Hybomitra distinguenda (Verrall) [Bright Horsefly]

Along with *Hybomitra bimaculata*, this was the other large horsefly which proved to be widely distributed and not uncommon in the Cheshire Plain area during the survey. It is overall the most widespread and common member of its genus in Britain; indeed, its national status on Recorder is listed as Common; albeit, this should be corrected to Local.

In the Delamere Forest, *Hybomitra distinguenda* was found sparingly, but widely; a male being taken at rest on top of a bridge over an active railway line near Black Lake (SJ 5381 7100) on 14th June, and single females being present at Blakemere Moss (SJ 5469 7120) on 10th June, and Finney's Moss (SJ 5596 7155) on 26th July.

Elsewhere in the Delamere area, single females were found at Hogshead Moss (SJ 5842 6952) on 9th and 10th June, Fishpool Moss (SJ 5643 6716) on 30th June, Snipe Island (SJ 6111 6932) on 27th June; and along the lane between Petty Pool and Pettypool Brook (SJ 6204 6973) on 5th July.

Further afield in the region, two *Hybomitra distinguenda* females were captured by the surveyor at Whixall Moss (SJ 4926 3603) on 24th June, plus a further female was taken in the adjoining Fenn's Moss (SJ 4848 3628) on the same day. Single females were also taken by the surveyor at Wybunbury Moss (SJ 6965 5021) on 25th June, along the lane between Clarepool Moss and Cole Mere (SJ 4296 3401) on 26th June, and at Cannock Chase (near Penkridge Bank Car Park) (SK 0008 1694) on 29th June.

Hybomitra montana (Meigen) [Slender-horned Horsefly]

Hybomitra montana is for the most part a typical species of upland bogs in northern and western Britain, but it also occurs on some lowland mire and wet heathland sites. Its distribution within the Cheshire Plain landscape is apparently far more restricted than *H. bimaculata* and *H. distinguenda*; indeed, it was really only found at two sites during the 2018 survey.

Single females were captured on 24th June at Whixall Moss (SJ 4926 3603) and the adjoining Fenn's Moss (SJ 4848 3628).

At Shemmy Moss (SJ 5944 6884), all the *Hybomitra montana* findings were via the Manitoba trap: which captured single females in the periods from 7th to 9th June and 14th to 23rd June, plus three females in the period between 5th and 14th July.

Historically, the surveyor found one female *Hybomitra montana* at Shemmy Moss on 21st July 1996, and one male and six females at Shemmy Moss on 24th July 1999. Shemmy Moss is undoubtedly a breeding site for this nationally Local horsefly.

***Tabanus autumnalis* Linnaeus [Large Marsh Horsefly]**

Tabanus autumnalis is a rather large horsefly that was historically restricted to the more southern British counties, where it occurred on marshes generally, including similar habitats such as ditches, and particularly those in coastal regions. A range expansion has been evident over recent years, and it is now well established, if decidedly local, in lowland regions with extensive marshlands as far north as Lancashire and Yorkshire. Its overall national status is Local.

Despite the Cheshire Plain area being within the current range of *Tabanus autumnalis*, its occurrence during the survey was not particularly anticipated, as the survey concentrated on mires, not marshes. Nevertheless, *T. autumnalis* was found on five occasions during 2018. Firstly a female was found at rest on the stables near Brackenhurst Bog (SJ 5940 6987) on 9th June. Subsequently, single females were captured by the Manitoba trap placed on Shemmy Moss (SJ 5944 6884) during the periods between 14th to 23rd June and 14th to 25th July. *T. autumnalis* is obviously present in the Abbots Moss Complex area, but it will not be breeding at Brackenhurst Bog or Shemmy Moss. The nearby Gull Pool (SJ 6009 6883) has marshland surrounds which are highly suitable to support *T. autumnalis*, and this would be its most likely breeding site within the Abbots Moss Complex area.

Tabanus autumnalis has also reached Delamere Forest, where a single female was captured by the Manitoba trap placed on Blakemere Moss (SJ 5468 7119) between 23rd and 30th June. Blakemere Moss currently contains some marshland type habitat, including ditches; hence, *T. autumnalis* may possibly occur there as a breeding species.

A further supplementary record of *Tabanus autumnalis* in Cheshire during 2018 was Andrew Jennings-Giles' discovery of a male at Chester Zoo Nature Reserve (SJ 40791 70697) on 29th June. This record was forwarded to the surveyor by Gary Hedges.

***Tabanus maculicornis* Zetterstedt [Narrow-winged Horsefly]**

Tabanus maculicornis usually occurs where there are seepages or streams in wet woodland overlying clay. It probably declined nationally during the second half of the 20th Century, and was categorised as Nationally Scarce in the recent review by Drake (2017). It is currently sparsely distributed in the southern half of Britain, and was historically known from the Cheshire Plain region.

The surveyor failed to find *Tabanus maculicornis* in the Delamere Forest and Abbots Moss Complex areas, but was successful in locating it in four outlying Cheshire Plain region localities, each one being in a different vice-county. Single females were taken at Wybunbury Moss (SJ 6965 5021) on 25th June, Chartley Moss (SK 0221 2825) on 28th June, Cadney Moss (SJ 4689 3477) on 24th June, and Clarepool Moss (SJ 4356 3411) on 26th June. Two females were also taken along the nearby lane between Clarepool Moss and Cole Mere (SJ 4296 3401) on 26th June.

TABLE SHOWING DISSECTION OF HORSEFLY NUMBERS

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	VC39	VC40	VC50	VC58	TOTAL
<i>Atylotus plebeius</i> (Fallén)	Cheshire Horsefly	Rare				16	16
<i>Chrysops caecutiens</i> (Linnaeus)	Splayed Deerfly	Local				4	4
<i>Chrysops relictus</i> Meigen	Twin-lobed Deerfly	Local		5			5
<i>Chrysops viduatus</i> (Fabricius)	Square-spot Deerfly	Local		7		26	33
<i>Haematopota crassicornis</i> Wahlberg	Black-horned Cleg	Local				5	5
<i>Haematopota pluvialis</i> (Linnaeus)	Notch-horned Cleg	Common	72	111	9	213	405
<i>Hybomitra bimaculata</i> (Macquart)	Hairy-legged Horsefly	Local	2	5		19	26
<i>Hybomitra distinguenda</i> (Verrall)	Bright Horsefly	Common	1	3	1	9	14
<i>Hybomitra montana</i> (Meigen)	Slender-horned Horsefly	Local		1	1	5	7
<i>Tabanus autumnalis</i> Linnaeus	Large Marsh Horsefly	Local				5	5
<i>Tabanus maculicornis</i> Zetterstedt	Narrow-winged Horsefly	Scarce	1	3	1	1	6
TOTAL			76	135	12	303	526

The table above dissects by vice-county the numbers of horseflies recorded in the broad Cheshire Plain area during the 2018 study. The majority of survey work was carried out in Cheshire [VC58], with a substantial amount of work also being carried out in Shropshire [VC40]. Relatively little time was spent in Staffordshire [VC39] and very little in Denbighshire [VC50].

Although a good range, and good numbers, of Tabanidae were recorded; three-quarters [76.9 %] of the individual horseflies found were *Haematopota pluvialis*. It is quite possible that this particular cleg, which is by far the most common and numerous British horsefly, would have been found at all the mire sites surveyed, if it had been feasibly possible to visit all the sites during its 2018 flight period.

TABLE OF HORSEFLIES RECORDED IN THE CHESHIRE PLAIN REGION DURING 2018

Details of all horsefly records are given in the spreadsheet which accompanies this report [Appendix 2].

SCIENTIFIC NAME	LOCALITIES [VC = vice-county]
<i>Atylotus plebeius</i> (Fallén)	VC58 Little Budworth Common (Central Moss), Little Budworth Common (East Moss), Little Budworth Common (Whitehall Moss), Shemmy Moss, Wybunbury Moss
<i>Chrysops caecutiens</i> (Linnaeus)	VC58 Blain's Moss, Harthill (upper basin), lane between Petty Pool and Pettypool Brook, South Moss
<i>Chrysops relictus</i> Meigen	VC40 Whixall Moss
<i>Chrysops viduatus</i> (Fabricius)	VC40 Whixall Moss VC58 Barns Bridge, Barnsbridge Basin, Barnsbridge Flushes, Basin Mire A07, Basin Mire LM09, Basin Mire LM10, Black Lake, Blain's Moss, Doolittle Moss (lower basin), Great Midge, Wybunbury Moss
<i>Haematopota crassicornis</i> Wahlberg	VC58 Blakemere Moss, Brackenhurst Bog, Shemmy Moss
<i>Haematopota pluvialis</i> (Linnaeus)	VC39 Cannock Chase (near Penkrigde Bank Car Park), Cannock Chase (near Penkrigde Bank Road), Cannock Chase (near Whitehouse Car Park), Chartley Moss, Chartley Moss area, Hawksmoor Wood, Staffordshire University Nature Reserve VC40 Bettisfield Moss, Brown Moss, lane between Clarepool Moss and Cole Mere, Cole Mere, Wem Moss, Whixall Moss, Whixall Moss (Morris Bridge Car Park) VC50 Cadney Moss, Fenn's Moss VC58 Barns Bridge, Basin Mire LM09, Basin Mire LM10, Black Lake, Blakemere Moss, Boggy Pool, Brackenhurst Bog, track to Brackenhurst Bog, Centre Bog, Doolittle Moss (upper basin), Finney's Moss, Fishpool Moss, Flaxmere Moss, Gull Moss, tracks between Gull Moss and Shemmy Moss, Gull Pool, Hogshead Moss, Lily Pool, Linnere Moss (north), Linnere Moss (south), Little Budworth Common (Central Moss), Little Budworth Common (Whitehall Moss), Oak Mere, Petty Pool, lane between Petty Pool and Pettypool Brook, Shemmy Moss, Snipe Island, South Moss, Stoneyford Lane, Thieves Moss & Pool, Vale Royal Abbey Golf Club, Woodpile Bog, Wrekin Pool, Wybunbury Moss, Wybunbury (gate near Main Road)
<i>Hybomitra bimaculata</i> (Macquart)	VC39 Cannock Chase (near Penkrigde Bank Road), between Mosslee Hall Farm and Coltstone VC40 Brown Moss, Clarepool Moss, lane between Clarepool Moss and Cole Mere, Shavington Park, Wem Moss VC58 Black Lake, Blakemere Moss, Brackenhurst Bog, Doolittle Moss (upper basin), Linnere Moss (north), Shemmy Moss, Wybunbury Moss
<i>Hybomitra distinguenda</i> (Verrall)	VC39 Cannock Chase (near Penkrigde Bank Car Park) VC40 lane between Clarepool Moss and Cole Mere, Whixall Moss VC50 Fenn's Moss VC58 bridge near Black Lake, Blakemere Moss, Finney's Moss, Fishpool Moss, Hogshead Moss, lane between Petty Pool and Pettypool Brook, Snipe Island, Wybunbury Moss
<i>Hybomitra montana</i> (Meigen)	VC40 Whixall Moss VC50 Fenn's Moss VC58 Shemmy Moss
<i>Tabanus autumnalis</i> Linnaeus	VC58 Blakemere Moss, stables near Brackenhurst Bog, Chester Zoo Nature Reserve, Shemmy Moss
<i>Tabanus maculicornis</i> Zetterstedt	VC39 Chartley Moss VC40 Clarepool Moss, lane between Clarepool Moss and Cole Mere VC50 Cadney Moss VC58 Wybunbury Moss

OTHER INVERTEBRATES

SUMMARY

The 2018 Cheshire Horsefly survey inevitably uncovered a few non-target invertebrates which are worthy of note by virtue of their technically significant current national conservation designations. This assemblage of fifteen technically significant species is enumerated below, and comprises a range of invertebrates which have varying degrees of actually national rarity, some being genuinely rare and threatened, and others being common or local, but declining in some areas of Britain.

Technically significant invertebrates comprise those which are either statutorily protected, attributed a significant national conservation status by JNCC [Joint Nature Conservation Committee], attributed a significant international conservation status by IUCN [International Union for Conservation of Nature], or are listed in the current UK BAP [United Kingdom Biodiversity Action Plan]. The latter assemblage was formerly known as UK BAP Priority Species; but, following devolution, English UK BAP Priority Species are now known as SPIE [Species of Principal Importance in England]. This name is something of a misnomer, as some SPIE, principally moths, are among the most common and widespread of British invertebrates, and were listed as SPIE for research purposes only, in order to monitor recent declines in some areas of Britain, usually southern England.

As was the case with the species accounts for Tabanidae, the 10m² National Grid references given below are central points for the sites investigated, and not necessarily the points at which notable invertebrates were recorded.

ACCOUNTS FOR SPECIES WITH SIGNIFICANT CONSERVATION STATUSES

Odonata: Libellulidae

Leucorrhinia dubia (Vander Linden) [White-faced Darter]

This very distinctive small dragonfly was present in good numbers at Chartley Moss (SK 0221 2825) on 28th June, and particularly so around the two ponds near the centre of the mire. At least twenty males and ten females were counted, but the actual number of individuals present would be far greater. *Leucorrhinia dubia* was also seen at Whixall Moss (SJ 4926 3603); but here, only a single male was noted on 15th June, and only two males were observed on 26th June. *L. dubia* was categorised as nationally Endangered by Daguet *et al.* (2008).

Orthoptera: Tettigoniidae

Metrioptera brachyptera (Linnaeus) [Bog Bush-cricket]

Orthoptera were generally ignored during the survey; however, it was appropriate to record a male nymph of *Metrioptera brachyptera* which was found at Shemmy Moss (SJ 5949 6892) on 10th June. This widespread, but at best, very local, bog cricket was designated Nationally Scarce status by Sutton (2015).

Lepidoptera: Erebidae

Tyria jacobaeae (Linnaeus) [The Cinnabar]

Tyria jacobaeae is a common British moth which was designated SPIE status in order to facilitate monitoring for research purposes following evidence of its decline in some areas of Britain. It is a very conspicuous insect, both as an adult, and larva, and was seen in three Staffordshire sites during the survey, all on 29th June. On Cannock Chase, one adult was present near Penkridge Bank Car Park (SK 0008 1694), and circa ten larvae were seen on its main foodplant *Senecio jacobaea* [Common Ragwort] near Whitehouse Car Park (SJ 9931 1621). Circa two hundred larvae were also seen on its main foodplant in the Staffordshire University Nature Reserve (SJ 8825 4529).

Lepidoptera: Nymphalidae

Boloria selene (Denis & Schiffermüller) [Small Pearl-bordered Fritillary]

Boloria selene is generally a very local species of acidic wet grasslands in valley bottoms or woodlands in northern and western Britain. It was given Near Threatened national status by Fox *et al.* (2010). It is also an SPIE. A single worn individual was seen at the base of Sherbrook Valley (SJ 9836 1884) on Cannock Chase on 29th June.

Coenonympha pamphilus (Linnaeus) [Small Heath]

Coenonympha pamphilus is a widespread and local British butterfly which was allocated Near Threatened national status in the recent review by Fox *et al.* (2010) on the basis of recent declines. It is also an SPIE on the same reasoning. It was seen in the following three areas of Cannock Chase on 29th June: one adult near Chase Road Corner Car Park (SJ 9808 1760); three adults near Penkridge Bank Car Park (SK 0008 1694); and approximately twenty adults in Sherbrook Valley (SJ 9836 1884).

Coenonympha tullia (Müller) [Large Heath]

Coenonympha tullia is very local but widespread on bogs throughout northern and western Britain. Its national status was considered to be Vulnerable by Fox *et al.* (2010). It is also an SPIE. It is well known from Whixall Moss (SJ 4926 3603), so it was unsurprising that three adults were seen there on 15th June, about twenty on 24th June, and approximately thirty on 26th June. Two adults were also seen on the adjoining Bettisfield Moss (SJ 4821 3518) on 24th July.

Hymenoptera: Crabronidae

Gorytes laticinctus (Lepeletier) [a solitary wasp]

Gorytes laticinctus was categorised with a RDB3 – Rare national conservation status by Falk (1991). Somewhat surprisingly, a female was captured by the Manitoba trap placed at Black Lake (SJ 5377 7089) during the period between 4th and 14th July.

Diptera: Limoniidae

Idioptera linnei Oosterbroek [a crane-fly]

This distinctive picture-winged crane-fly was categorised [sub nom. *Limnophila fasciata*] with RDB1 – Endangered national conservation status by Falk (1991a). During the 2018 survey, *Idioptera linnei* was found at three Cheshire mires. On 9th June, a male was found at Hogshead Moss (SJ 5842 6952), and two males and a female were found at Shemmy Moss (SJ 5949 6892). A male was also seen on 10th June on Little Budworth Common at Whitehall Moss (SJ 5878 6580). Historically, the surveyor also discovered *Idioptera linnei* at a fourth Cheshire mire, this being a male at Flaxmere Moss (SJ 5565 7229) on 21st July 1996.

Diptera: Hybotidae

Oedalea apicalis Loew [a dance fly]

This very small but quite distinctive fly was categorised with a national conservation status of Lower Risk (Nationally Scarce) by Falk & Crossley (2005). A female was captured by the Manitoba trap situated at Black Lake (SJ 5377 7089) during the period from 7th to 10th June.

Diptera: Syrphidae

Microdon mutabilis (Linnaeus) [a hoverfly]

During the 2018 survey, a male *M. mutabilis* [sensu stricto] was netted in flight as it ventured to the centre of North Moss (SJ 5842 6585) on Little Budworth Common on 10th June. *Microdon mutabilis* was listed as Data Deficient in the British hoverfly national status review by Ball & Morris (2014). It is a medium-sized and attractive hoverfly which is thought likely to be worthy of a national conservation status; however, there are uncertainties about the British records of *M. mutabilis* following the realisation that the recently described and similar *Microdon myrmicae* Schönrogge, Barr, Wardlaw, Napper, Gardner, Breen, Elmes & Thomas also occurs in Britain; and subsequently, that most British *M. mutabilis* records appear to refer to *M. myrmicae*.

Orthonevra intermedia Lundbeck [a hoverfly]

This small black hoverfly was taken at Hogshead Moss (SJ 5842 6952), a male, and Shemmy Moss (SJ 5949 6892), a female, on 10th June. Individuals were also captured in the Manitoba trap at Black Lake (SJ 5377 7089) during the periods 30th June to 4th July, a female, and 14th to 25th July, a male. Ball & Morris (2014) listed *Orthonevra intermedia* as Data Deficient, as it was only known to them as British from specimens taken in the Delamere Forest at Norley Moss and Barnsbridge Basin by Martin Drake in 2003 (Drake, 2006).

Xylota abiens Meigen [a hoverfly]

Xylota abiens was given Nationally Scarce status in the recent hoverfly review by Ball & Morris (2014). It is easily overlooked for the superficially similar and much commoner *Chalcosyrphus nemorum* (Fabricius), which is of local occurrence nationally, and was captured in all four Manitoba traps which were operated in the Delamere area during the 2018 survey. By contrast, *X. abiens* was taken only once during the survey, this being a male from Barnsbridge Flushes (SJ 5398 7182) on 25th July.

Diptera: Clusiidae

Clusiodes caledonicus (Collin) [a druid fly]

As its name suggests, *Clusiodes caledonicus* is principally a species of the Scottish Highlands, but it has also been found to occur in England on at least three previous occasions. There are published records from Wiltshire in 2008 and Nottinghamshire in 2015 [both enumerated by Chandler (2015)], plus a record from Shropshire in 1999 which is detailed on the NBN Atlas www.nbnatlas.org. During the 2018 survey, a male *C. caledonicus* was captured by the Manitoba trap at Black Lake (SJ 5377 7089) in the period between 7th August and 12th September. *C. caledonicus* was categorised with nationally Notable status by Falk (1991a).

Diptera: Scathophagidae

Cordilura rufimana Meigen [a dung fly]

Cordilura rufimana was given Notable national conservation status by Falk (1991a). It was found on three Delamere area mires during the 2018 survey. At Shemmy Moss (SJ 5949 6892), single males were taken on 9th and 10th June, and two males were taken on 14th June. Single females were found at Black Lake (SJ 5373 7091) on 4th July; and Flaxmere Moss (SJ 5565 7229) on 14th June.

Diptera: Muscidae

Phaonia falleni Michelsen [a muscid fly]

Phaonia falleni was attributed Notable national status by Falk (1991a). During the 2018 survey, a female *P. falleni* was found at Whixall Moss (SJ 4926 3603) on 15th June.

TABLE OF OTHER INVERTEBRATES RECORDED DURING THE SURVEY

For simplification and ease of reference, genera and species are arranged in alphabetical order and subgenera are omitted. Current nomenclature is accepted, except in highly problematic cases.

'JNCC' indicates a current JNCC national status classification of Notable or higher status, or the equivalent IUCN-based statuses given in more recent reviews. 'JNCC' species may also have significant IUCN statuses, or also be designated as SPIE. 'SPIE' denotes invertebrates whose only conservation status is as a **Species of Principal Importance in England** [formerly known as UK BAP Species]. 'C' or 'L' are used for all species whose national statuses are basically **Common** or **Local**, and 'n/a' is used where an identification cannot be taken down to species level; hence, a status allocation is **not applicable**.

The spreadsheet which accompanies this report [Appendix 2] gives full details for all records in the table below.

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
Class: Gastropoda	Slugs & snails etc.		
Family: Helicidae	Terrestrial snails		
<i>Cepaea nemoralis</i> (Linnaeus)	Brown-lipped Snail	C	VC58 Ham (lower basin)
<i>Cornu aspersum</i> (Müller)	Garden Snail	C	VC58 track to Brackenhurst Bog
Order: Odonata	Dragonflies & damselflies		
Suborder: Zygoptera	Damselflies		
Family: Platycnemididae	White-legged damselflies		
<i>Platycnemis pennipes</i> (Pallas)	White-legged Damselfly	L	VC40 Whixall Moss
Family: Coenagriidae	Blue damselflies etc.		
<i>Coenagrion puella</i> (Linnaeus)	Azure Damselfly	C	VC40 Clarepool Moss, Whixall Moss VC58 Centre Bog, Black Lake, tracks between Gull Moss and Shemmy Moss, Gull Pool, Lily Pool, Shemmy Moss, South Moss, Woodpile Bog, Wrekin Pool
<i>Enallagma cyathigerum</i> (Charpentier)	Common Blue Damselfly	C	VC58 Brackenhurst Bog, Shemmy Moss
<i>Ischnura elegans</i> (Vander Linden)	Blue-tailed Damselfly	C	VC58 Basin Mire LM09, Boggy Pool, Hatch Mere, Lily Pool, Wrekin Pool
<i>Pyrrhosoma nymphula</i> (Sulzer)	Large Red Damselfly	C	VC39 Chartley Moss VC40 Whixall Moss VC58 Basin Mire LM09, Black Lake, Blakemere Moss, Centre Bog, Doolittle Moss (lower basin), Hogshead Moss, Lily Pool, Linmere Moss (north), Woodpile Bog, Wrekin Pool
Family: Lestidae	Emerald damselflies		
<i>Lestes sponsa</i> (Hansemann)	Emerald Damselfly	C	VC58 Barnsbridge Basin, Ham (upper basin)
Suborder: Anisoptera	Dragonflies		
Family: Aeshnidae	Hawkers		
<i>Aeshna cyanea</i> (Müller)	Southern Hawker	C	VC58 Barnsbridge Basin
<i>Aeshna grandis</i> (Linnaeus)	Brown Hawker	C	VC39 Chartley Moss VC40 Clarepool Moss VC58 Barnsbridge Basin, Finney's Moss, Fishpool Moss Linmere Moss (north), New Pool, Oak Mere, Petty Pool, Wybunbury Moss
<i>Anax imperator</i> Leach	Emperor Dragonfly	C	VC39 Chartley Moss VC40 Brown Moss VC58 Barnsbridge Flushes, Basin Mire A06, Basin Mire N3, Black Lake, Finney's Moss, Fishpool Moss, Gull Moss, Hatch Mere, Little Budworth Common (East Moss), Little Budworth Common (north end), Little Budworth Common (Whitehall Moss)

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
Family: Libellulidae	Skimmers & darters, etc.		
<i>Leucorrhinia dubia</i> (Vander Linden)	White-faced Darter	JNCC	VC39 Chartley Moss VC40 Whixall Moss
<i>Libellula depressa</i> Linnaeus	Broad-bodied Chaser	C	VC58 Little Budworth Common (Whitehall Moss), Shemmy Moss
<i>Libellula quadrimaculata</i> Linnaeus	Four-spotted Chaser	C	VC39 Chartley Moss VC40 Bettisfield Moss, Clarepool Moss, Whixall Moss VC58 Basin Mire LM09, Black Lake, Blain's Moss, Boggy Pool, Gull Pool, Hatch Mere, Hogshead Moss, Lily Pool, Linmere Moss (north), Little Budworth Common (north end), New Pool, Oak Mere, South Moss, Woodpile Bog, Wrekin Pool, Wybunbury Moss
<i>Orthetrum cancellatum</i> (Linnaeus)	Black-tailed Skimmer	C	VC40 Brown Moss VC58 Hatch Mere
<i>Sympetrum danae</i> (Sulzer)	Black Darter	C	VC58 Barnsbridge Basin, Basin Mire LM09, Basin Mire N1, Black Lake, Great Middel, Ham (lower basin), Ham (upper basin), Hockenhull
<i>Sympetrum striolatum</i> (Charpentier)	Common Darter	C	VC40 Brown Moss VC58 Black Lake, Finney's Moss
Order: Orthoptera	Grasshoppers etc.		
Family: Tettigoniidae	Bush-cricket etc.		
<i>Metrioptera brachyptera</i> (Linnaeus)	Bog Bush-cricket	JNCC	VC58 Shemmy Moss
Order: Dermaptera	Earwigs		
Family: Forficulidae	Earwigs		
<i>Forficula auricularia</i> Linnaeus	Common Earwig	C	VC58 Blakemere Moss, Brackenhurst Bog
Order: Hemiptera	True bugs etc.		
Suborder: Heteroptera	True bugs		
Family: Acanthosomatidae	Shieldbugs		
<i>Elasmucha grisea</i> (Linnaeus)	Parent Bug	C	VC58 Brackenhurst Bog
Family: Pentatomidae	Shieldbugs		
<i>Dolycoris baccarum</i> (Linnaeus)	Hairy Shieldbug	C	VC58 Black Lake
<i>Pentatoma rufipes</i> (Linnaeus)	Red-legged Shieldbug	C	VC40 Brown Moss
Family: Rhopalidae	Plant bugs		
<i>Corizus hyoscyami</i> (Linnaeus)	a plant bug	L	VC58 Black Lake, Harthill Moss
Suborder: Auchenorrhyncha	Planthoppers etc.		
Family: Cicadellidae	Leafhoppers		
<i>Cicadella viridis</i> (Linnaeus)	Green Leafhopper	C	VC40 Brown Moss
Order: Mecoptera	Scorpion flies etc.		
Family: Panorpidae	Scorpion flies etc.		
<i>Panorpa communis</i> Linnaeus	Common Scorpion-fly	C	VC58 Brackenhurst Bog
Order: Lepidoptera	Butterflies & moths		
Suborder: Heterocera	Moths		
Family: Adelidae	Longhorn moths		
<i>Nemophora degeerella</i> (Linnaeus)	a longhorn moth	C	VC40 Wem Moss
Family: Zygaenidae	Burnet moths		
<i>Zygaena lonicerae</i> (Scheven)	Narrow-bordered Five-spot Burnet	C	VC39 Cannock Chase (near Penkridge Bank Car Park)
Family: Crambidae	Grass moths		
<i>Catoptria margaritella</i> (Denis & Schiffermüller)	a grass moth	C	VC40 Wem Moss VC58 Brackenhurst Bog
<i>Crambus pascuella</i> (Linnaeus)	a grass moth	C	VC58 Brackenhurst Bog
<i>Elophila nymphaeata</i> (Linnaeus)	Brown China-mark	C	VC58 Black Lake
Family: Geometridae	Carpet moths etc.		
<i>Hydriomena furcata</i> (Thunberg)	July Highflyer	C	VC58 Brackenhurst Bog
<i>Perconia strigillaria</i> (Hübner)	Grass Wave	L	VC40 Whixall Moss

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
<i>Rheumaptera hastata</i> (Linnaeus)	Argent and Sable	L	VC40 Whixall Moss
Family: Erebidae	Tiger moths etc.		
<i>Diacrisia sannio</i> (Linnaeus)	Clouded Buff	L	VC39 Chartley Moss VC58 Shemmy Moss
<i>Tyria jacobaeae</i> (Linnaeus)	The Cinnabar	SPIE	VC39 Cannock Chase (near Penkridge Bank Car Park), Cannock Chase (near Whitehouse Car Park), Staffordshire University Nature Reserve
Family: Noctuidae	Owlet moths		
<i>Autographa gamma</i> (Linnaeus)	Silver Y	C	VC58 Black Lake, Blakemere Moss, Brackenhurst Bog, Fishpool Moss, Hatch Mere, Shemmy Moss, South Moss
<i>Lacanobia oleracea</i> (Linnaeus)	Bright-line Brown-eye	C	VC58 Black Lake
<i>Noctua pronuba</i> (Linnaeus)	Large yellow Underwing	C	VC58 Brackenhurst Bog
Suborder: Rhopalocera	Butterflies		
Family: Hesperidae	Skippers		
<i>Ochlodes sylvanus</i> (Esper)	Large Skipper	C	VC39 Cannock Chase (Sherbrook Valley), Chartley Moss VC40 Brown Moss, Clarepool Moss, Whixall Moss VC58 Brackenhurst Bog, Fishpool Moss, Little Budworth Common (north end)
Family: Pieridae	Whites & yellows etc.		
<i>Gonepteryx rhamni</i> (Linnaeus)	Brimstone	C	VC40 Whixall Moss VC58 Petty Pool, Shemmy Moss
<i>Pieris brassicae</i> (Linnaeus)	Large White	C	VC40 Whixall Moss VC58 Brackenhurst Bog, Gull Moss, Ham (lower basin), South Moss
<i>Pieris napi</i> (Linnaeus)	Green-veined White	C	VC39 Cannock Chase (near Penkridge Bank Car Park) VC58 Barns Bridge, Barnsbridge Flushes, Basin Mire A07, Black Lake, Finney's Moss, Harthill Moss, Hockenhull, Linmere Moss (north), Linmere Moss (south), Shemmy Moss
Family: Nymphalidae	Brush-footed butterflies etc.		
<i>Aglais io</i> (Linnaeus)	Peacock	C	VC58 Basin Mire A07, Brackenhurst Bog, South Moss
<i>Aglais urticae</i> (Linnaeus)	Small Tortoiseshell	C	VC39 Cannock Chase (near Whitehouse Car Park) VC40 Whixall Moss VC58 Fishpool Moss
<i>Aphantopus hyperantus</i> (Linnaeus)	Ringlet	C	VC39 Cannock Chase (near Chase Road Corner Car Park), Cannock Chase (near Penkridge Bank Car Park), Cannock Chase (near Penkridge Bank Road), Cannock Chase (Sherbrook Valley), Cannock Chase (near Whitehouse Car Park), Chartley Moss area VC40 Clarepool Moss, Cole Mere, Wem Moss, Whixall Moss VC58 Brackenhurst Bog, Fishpool Moss, Wybunbury Moss
<i>Boloria selene</i> (Denis & Schiffermüller)	Small Pearl-bordered Fritillary	JNCC	VC39 Cannock Chase (Sherbrook Valley)
<i>Coenonympha pamphilus</i> (Linnaeus)	Small Heath	JNCC	VC39 Cannock Chase (near Chase Road Corner Car Park), Cannock Chase (near Penkridge Bank Car Park), Cannock Chase (Sherbrook Valley)
<i>Coenonympha tullia</i> (Müller)	Large Heath	JNCC	VC40 Bettisfield Moss, Whixall Moss
<i>Maniola jurtina</i> (Linnaeus)	Meadow Brown	C	VC39 Cannock Chase (near Penkridge Bank Car Park), Cannock Chase (near Penkridge Bank Road), Cannock Chase (Sherbrook Valley), Cannock Chase (near Whitehouse Car Park), Chartley Moss area VC40 Bettisfield Moss, Brown Moss, Whixall Moss VC50 Cadney Moss VC58 Brackenhurst Bog, track to Brackenhurst Bog, Fishpool Moss, New Pool, Snipe Island, Wybunbury Moss

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
<i>Pararge aegeria</i> (Linnaeus)	Speckled Wood	C	VC39 Cannock Chase (near Penkrigde Bank Car Park), Chartley Moss area VC40 Brown Moss, Whixall Moss VC58 Basin Mire A01b, Basin Mire A07, Black Lake, Brackenhurst Bog, track to Brackenhurst Bog, Finney's Moss, Flaxmere Moss, tracks between Gull Moss and Shemmy Moss, Harthill Moss, Hogshead Moss, Oak Mere, Petty Pool, Snipe Island Thieves Moss & Pool, Wrekin Pool
<i>Polygonia c-album</i> (Linnaeus)	Comma	C	VC40 Bettisfield Moss VC58 Basin Mire A07, Black Lake, Linnere Moss (north)
<i>Pyronia tithonus</i> (Linnaeus)	Gatekeeper	C	VC58 Barnsbridge Flushes, Black Lake, Brackenhurst Bog, New Pool
<i>Vanessa atalanta</i> (Linnaeus)	Red Admiral	C	VC40 Clarepool Moss, Wem Moss, Whixall Moss VC58 track to Brackenhurst Bog, Fishpool Moss, Gull Moss, Shemmy Moss
Family: Lycaenidae	Blues & hairstreaks etc.		
<i>Lycaena phlaeas</i> (Linnaeus)	Small Copper	C	VC40 Brown Moss VC58 Basin Mire N1, Brackenhurst Bog
<i>Polyommatus icarus</i> (Rottemburg)	Common Blue	C	VC39 Cannock Chase (near Chase Road Corner Car Park) VC58 tracks between Gull Moss and Shemmy Moss
Order: Coleoptera	Beetles		
Suborder: Adephaga	Ground beetles etc.		
Family: Carabidae	Ground beetles		
<i>Anisodactylus binotatus</i> (Fabricius)	a ground beetle	C	VC40 Brown Moss
<i>Cicindela campestris</i> Linnaeus	Green Tiger Beetle	L	VC58 Shemmy Moss
<i>Poecilus versicolor</i> (Sturm)	a ground beetle	C	VC40 Wem Moss
<i>Pterostichus madidus</i> (Fabricius)	a ground beetle	C	VC40 Cole Mere
Family: Staphylinidae	Rove beetles		
<i>Ocyopus olens</i> (Müller)	Devil's Coach Horse	C	VC58 Black Lake
Family: Scarabaeidae	Dung beetles etc.		
<i>Hoplia philanthis</i> Fuessly	Welsh Chafer	L	VC58 tracks between Gull Moss and Shemmy Moss
<i>Phyllopertha horticola</i> (Linnaeus)	Garden Chafer	C	VC58 Brackenhurst Bog, Hogshead Moss, Shemmy Moss
Family: Buprestidae	Jewel beetles		
<i>Agrius biguttatus</i> (Fabricius)	a jewel beetle	L	VC40 Brown Moss
Family: Elateridae	Click beetles		
<i>Denticollis linearis</i> (Linnaeus)	a click beetle	C	VC58 Hogshead Moss
Family: Cantharidae	Soldier beetles		
<i>Rhagonycha fulva</i> (Scopoli)	a soldier beetle	C	VC39 Chartley Moss VC40 Clarepool Moss VC58 Barnsbridge Basin, Finney's Moss, Petty Pool
Family: Malachiidae	Soft-wing flower beetles		
<i>Malachius bipustulatus</i> (Linnaeus)	Malachite Beetle	C	VC58 Hogshead Moss
Family: Coccinellidae	Ladybirds		
<i>Coccinella septempunctata</i> (Linnaeus)	7-spot Ladybird	C	VC 40 Brown Moss VC58 Barnsbridge Flushes, Black Lake, Brackenhurst Bog, Little Budworth Common (East Moss), Shemmy Moss, Thieves Moss & Pool
<i>Harmonia axyridis</i> (Pallas)	Harlequin Ladybird	C	VC39 Staffordshire University Nature Reserve VC40 Whixall Moss VC58 Blakemere Moss, Brackenhurst Bog, Hogshead Moss, Little Budworth Common (Whitehall Moss), Shemmy Moss, Wybunbury Moss
Family Tenebrionidae	Darkling beetles		
<i>Lagria hirta</i> (Linnaeus)	a darkling beetle	L	VC58 Brackenhurst Bog
Family: Cerambycidae	Longhorn beetles		
<i>Asemum striatum</i> (Linnaeus)	Black Spruce Borer	L	VC58 Hogshead Moss

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
<i>Clytus arietis</i> (Linnaeus)	Wasp Beetle	C	VC58 Woodpile Bog
<i>Leptura quadrifasciata</i> Linnaeus	a longhorn beetle	L	VC58 Blain's Moss, Petty Pool
Order: Hymenoptera	Sawflies, bees & ichneumons etc.		
Suborder: Apocrita	Bees, wasps & ichneumons etc.		
Superfamily: Aculeata	Bees, wasps & ants		
Family: Chrysididae	Ruby-tailed wasps		
<i>Chrysis impressa</i> Schenck	a ruby-tailed wasp	C	VC58 Black Lake
Family: Pompilidae	Spider-hunting wasps		
<i>Anoplius nigerrimus</i> (Scopoli)	a spider-hunting wasp	L	VC58 Brackenhurst Bog
Family: Eumenidae	Potter wasps		
<i>Ancistrocerus trifasciatus</i> (Müller)	a potter wasp	C	VC58 Black Lake
<i>Symmorphus bifasciatus</i> (Linnaeus)	a potter wasp	L	VC58 Black Lake
Family: Vespidae	Social wasps		
<i>Vespa crabro</i> Linnaeus	Hornet	L	VC40 Bettisfield Moss (World's End Car Park) VC58 Black Lake, Brackenhurst Bog, Delamere Office Car Park (Forestry Commission), Shemmy Moss
<i>Vespula germanica</i> (Fabricius)	German Wasp	C	VC58 Brackenhurst Bog
<i>Vespula rufa</i> (Linnaeus)	Red Wasp	C	VC58 Shemmy Moss
<i>Vespula vulgaris</i> (Linnaeus)	Common Wasp	C	VC58 Black Lake, Blakemere Moss, Shemmy Moss
Family: Crabronidae	Solitary wasps		
<i>Crabro cribrarius</i> (Linnaeus)	a solitary wasp	C	VC58 Hogshead Moss
<i>Crossocerus cetratus</i> (Shuckard)	a solitary wasp	L	VC58 Blakemere Moss
<i>Crossocerus megacephalus</i> (Rossi)	a solitary wasp	C	VC58 Black Lake
<i>Crossocerus quadrimaculatus</i> (Fabricius)	a solitary wasp	C	VC58 Hogshead Moss
<i>Ectemnius cavifrons</i> (Thomson)	a solitary wasp	C	VC58 Black Lake, Blakemere Moss, Brackenhurst Bog, Shemmy Moss
<i>Ectemnius cephalotes</i> (Olivier)	a solitary wasp	C	VC58 Brackenhurst Bog
<i>Ectemnius continuus</i> (Fabricius)	a solitary wasp	C	VC58 Blakemere Moss
<i>Gorytes laticinctus</i> (Lepeletier)	a solitary wasp	JNCC	VC58 Black Lake
<i>Mimesa equestris</i> (Fabricius)	a solitary wasp	C	VC39 Cannock Chase (Sherbrook Valley)
<i>Pemphredon lugubris</i> (Fabricius)	a solitary wasp	C	VC58 Shemmy Moss
Family: Andrenidae	Mining bees		
<i>Andrena thoracica</i> (Fabricius)	Cliff Mining Bee	L	VC58 Blakemere Moss
Family: Halictidae	Mining bees etc.		
<i>Lasioglossum fratellum</i> (Pérez)	Smooth-faced Furrow Bee	L	VC58 Blakemere Moss
Family: Megachilidae	Mason bees etc.		
<i>Coelioxys elongata</i> Lepeletier	Dull-vented Sharp-tail Bee	L	VC58 Brackenhurst Bog
<i>Megachile willughbiella</i> (Kirby)	Willughby's Leaf-cutter Bee	C	VC58 Linnere Moss (north)
Family: Apidae	Bumblebees etc.		
<i>Apis mellifera</i> Linnaeus	Honey Bee	C	VC39 Cannock Chase (near Aspen Car Park), Cannock Chase (near Chase Road Corner Car Park), Cannock Chase (near Penkridge Bank Car Park) VC40 Brown Moss VC58 Black Lake, Blain's Moss, Ham (upper basin), Shemmy Moss, South Moss

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
<i>Bombus hypnorum</i> (Linnaeus)	Tree Bumblebee	C	VC40 Brown Moss, Whixall Moss VC58 Basin Mire A07, Blain's Moss
<i>Bombus lapidarius</i> (Linnaeus)	Red-tailed Bumblebee	C	VC40 Brown Moss VC58 Fishpool Moss, Newchurch Common, New Pool, Shemmy Moss, Thieves Moss & Pool
<i>Bombus pascuorum</i> (Scopoli)	Common Carder-bee	C	VC39 Cannock Chase (near Penkridge Bank Road), Cannock Chase (near Whitehouse Car Park) VC40 Whixall Moss VC58 Basin Mire N2, Black Lake, Blakemere Moss, Brackenhurst Bog, Hatch Mere, Little Budworth Common (Central Moss), Little Budworth Common (East Moss), Little Budworth Common (Whitehall Moss), Petty Pool, Shemmy Moss, South Moss, Thieves Moss & Pool, Wybunbury Moss
<i>Bombus pratorum</i> (Linnaeus)	Early Bumblebee	C	VC40 Whixall Moss VC58 Black Lake, Little Budworth Common (Central Moss), Little Budworth Common (north end)
<i>Bombus sylvestris</i> (Lepelletier)	Forest Cuckoo-bee	C	VC58 Hogshead Moss
<i>Bombus terrestris</i> (Linnaeus)	Buff-tailed Bumblebee	C	VC40 Whixall Moss VC58 Barns Bridge, Little Budworth Common (north end), Shemmy Moss
<i>Bombus vestalis</i> (Geoffroy)	Vestal Cuckoo-bee	C	VC58 Petty Pool
Order: Diptera	True flies		
Suborder: Nematocera	Thread-horns		
Family: Tipulidae	Crane-flies		
<i>Prionocera turcica</i> (Fabricius)	a crane-fly	L	VC40 Bettisfield Moss
<i>Prionocera</i> indeterminate [<i>turcica</i> (Fabricius) or <i>pubescens</i> Loew]	a crane-fly	n/a	VC58 Hatch Mere
<i>Tipula cava</i> Riedel	a crane-fly	L	VC58 South Moss
<i>Tipula flavolineata</i> Meigen	a crane-fly	L	VC58 Brackenhurst Bog
<i>Tipula melanoceros</i> Schummel	a crane-fly	L	VC58 Black Lake
<i>Tipula oleracea</i> Linnaeus	a crane-fly	C	VC40 Brown Moss, Whixall Moss VC58 Shemmy Moss
<i>Tipula scripta</i> Meigen	a crane-fly	C	VC39 Cannock Chase (near Penkridge Bank Road) VC40 Brown Moss VC58 Black Lake
<i>Tipula variicornis</i> Schummel	a crane-fly	C	VC40 Wem Moss VC58 Black Lake
Family: Limoniidae	Crane-flies		
<i>Idioptera linnei</i> Oosterbroek	a crane-fly	JNCC	VC58 Hogshead Moss, Little Budworth Common (Whitehall Moss), Shemmy Moss
Family: Anisopodidae	Wood gnats		
<i>Sylvicola fenestralis</i> (Scopoli)	a wood gnat	C	VC58 Shemmy Moss
<i>Sylvicola punctatus</i> (Fabricius)	a wood gnat	C	VC58 Shemmy Moss
Family: Culicidae	Mosquitoes		
<i>Ochlerotatus annulipes</i> (Meigen)	a mosquito	C	VC40 Brown Moss, Wem Moss VC58 Brackenhurst Bog
Suborder: Brachycera	Short-horns		
Family: Xylophagidae	Awl-flies		
<i>Xylophagus ater</i> Meigen	Common Awl-fly	L	VC58 Woodpile Bog
Family: Rhagionidae	Snipeflies		
<i>Chrysopilus cristatus</i> (Fabricius)	Black Snipefly	C	VC39 Cannock Chase (near Penkridge Bank Road), Chartley Moss VC40 Wem Moss, Whixall Moss VC50 Cadney Moss VC58 Hockenhull, Petty Pool, Wybunbury Moss
<i>Rhagio lineola</i> Fabricius	Small Fleck-winged Snipefly	C	VC39 Cannock Chase (near Penkridge Bank Road), Cannock Chase (Sherbrook Valley) VC58 Barns Bridge, Black Lake, Blain's Moss, Brackenhurst Bog, Oak Mere, Shemmy Moss, South Moss

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
<i>Rhagio scolopaceus</i> (Linnaeus)	Down-looker Fly	C	VC40 Wem Moss, Whixall Moss VC58 Black Lake, Blakemere Moss, Brackenhurst Bog
<i>Rhagio tringarius</i> (Linnaeus)	Marsh Snipefly	C	VC40 Whixall Moss VC58 Oak Mere
Family: Xylomyidae	Wood-soldierflies		
<i>Solva marginata</i> (Meigen)	Drab Wood-soldierfly	L	VC40 Cole Mere VC58 Blakemere Moss
Family: Stratiomyidae	Soldierflies		
<i>Beris fuscipes</i> Meigen	Short-horned Black Legionnaire	L	VC40 Brown Moss, Cole Mere VC58 Wybunbury Moss
<i>Beris vallata</i> (Forster)	Common Orange Legionnaire	C	VC58 Fishpool Moss, Petty Pool, Wybunbury Moss
<i>Chloromyia formosa</i> (Scopoli)	Broad Centurion	C	VC40 Brown Moss, Whixall Moss VC58 track to Brackenhurst Bog, Fishpool Moss
<i>Microchrysa cyaneiventris</i> (Zetterstedt)	Black Gem	C	VC58 Shemmy Moss
<i>Sargus iridatus</i> (Scopoli)	Iridescent Centurion	C	VC40 Brown Moss, Whixall Moss
Family: Therevidae	Stiletto-flies		
<i>Thereva nobilitata</i> (Fabricius)	Common Stiletto-fly	C	VC58 Wybunbury Moss
Family: Asilidae	Robberflies		
<i>Dioctria baumhaueri</i> Meigen	Stripe-legged Robberfly	L	VC39 Cannock Chase (near Whitehouse Car Park) VC40 Brown Moss VC58 Hogshead Moss
<i>Dysmachus trigonus</i> (Meigen)	Fan-bristled Robberfly	L	VC58 Brackenhurst Bog, Shemmy Moss, Wybunbury Moss
<i>Leptogaster cylindrica</i> (De Geer)	Striped Slender Robberfly	C	VC39 Chartley Moss area
<i>Machimus atricapillus</i> (Fallén)	Kite-tailed Robberfly	C	VC40 Whixall Moss
<i>Neoitamus cyanurus</i> (Loew)	Common Awl Robberfly	L	VC40 Brown Moss VC58 Brackenhurst Bog, Flaxmere Moss, Petty Pool, Shemmy Moss
Family: Hybotidae	Dance flies		
<i>Oedalea apicalis</i> Loew	a dance fly	JNCC	VC58 Black Lake
<i>Hybos culiciformis</i> (Fabricius)	a dance fly	C	VC58 Black Lake, Brackenhurst Bog, Shemmy Moss
<i>Hybos femoratus</i> (Müller)	a dance fly	C	VC58 Petty Pool
<i>Ocydromia glabricula</i> (Fallén)	a dance fly	C	VC40 Wem Moss
Family: Empididae	Dance flies		
<i>Empis livida</i> Linnaeus	a dance fly	C	VC40 Wem Moss, Whixall Moss
<i>Empis praevia</i> Collin	a dance fly	L	VC58 Brackenhurst Bog
Family: Dolichopodidae	Long-legged flies		
<i>Chrysotus gramineus</i> (Fallén)	a long-legged fly	C	VC39 Cannock Chase (Sherbrook Valley), Chartley Moss VC58 Oak Mere
<i>Dolichopus atripes</i> Meigen	a long-legged fly	C	VC39 Chartley Moss
<i>Dolichopus discifer</i> Stannius	a long-legged fly	C	VC58 Blakemere Moss
<i>Dolichopus lepidus</i> Staeger	a long-legged fly	L	VC58 Blakemere Moss
<i>Medetera saxatilis</i> Collin	a long-legged fly	L	VC58 Shemmy Moss
<i>Poecilobothrus nobilitatus</i> (Linnaeus)	a long-legged fly	C	VC39 Bettisfield Moss, Staffordshire University Nature Reserve VC40 Whixall Moss VC58 Hogshead Moss
<i>Sciapus platypterus</i> (Fabricius)	a long-legged fly	C	VC58 Black Lake, Brackenhurst Bog
Family: Syrphidae	Hoverflies		
<i>Anasimyia lineata</i> (Fabricius)	a hoverfly	L	VC40 Whixall Moss VC58 Black Lake, Wybunbury Moss
<i>Chalcosyrphus nemorum</i> (Fabricius)	a hoverfly	L	VC58 Black Lake, Blakemere Moss, Brackenhurst Bog, Shemmy Moss
<i>Cheilosia bergenstammi</i> Becker	a hoverfly	L	VC58 Black Lake
<i>Cheilosia illustrata</i> (Harris)	a hoverfly	C	VC40 Wem Moss
<i>Cheilosia pagana</i> (Meigen)	a hoverfly	C	VC40 Whixall Moss
<i>Chrysogaster solstitialis</i> (Fallén)	a hoverfly	C	VC58 Black Lake, Wybunbury Moss

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
<i>Chrysogaster virescens</i> Loew	a hoverfly	L	VC39 Chartley Moss VC58 Blakemere Moss, Blain's Moss, Brackenhurst Bog, Hogshead Moss, Shemmy Moss, South Moss, Wybunbury Moss
<i>Chrysotoxum bicinctum</i> (Linnaeus)	a hoverfly	L	VC58 Rush Pool, Shemmy Moss
<i>Chrysotoxum festivum</i> (Linnaeus)	a hoverfly	L	VC58 Oak Mere
<i>Dasysyrphus albostriatus</i> (Fallén)	a hoverfly	C	VC58 Blakemere Moss
<i>Epistrophe eligans</i> (Harris)	a hoverfly	C	VC58 Boggy Pool
<i>Episyrphus balteatus</i> (De Geer)	a hoverfly	C	VC40 Whixall Moss VC58 Black Lake, Blakemere Moss, Brackenhurst Bog, Little Budworth Common (north end), Shemmy Moss, Petty Pool
<i>Eristalinus sepulchralis</i> (Linnaeus)	a hoverfly	L	VC40 Bettisfield Moss, Brown Moss VC58 Black Lake, Blakemere Moss
<i>Eristalis horticola</i> (De Geer)	a hoverfly	C	VC58 Pettypool Brook
<i>Eristalis interruptus</i> (Poda)	a hoverfly	C	VC39 Cannock Chase (near Penkridge Bank Car Park) VC58 Black Lake, Brackenhurst Bog, South Moss
<i>Eristalis intricarius</i> (Linnaeus)	a hoverfly	C	VC39 Chartley Moss VC40 Brown Moss, Clarepool Moss, Wem Moss, Whixall Moss VC58 Finney's Moss, Hatch Mere, Snipe Island
<i>Eristalis pertinax</i> (Scopoli)	a hoverfly	C	VC40 Brown Moss, Whixall Moss VC58 Black Lake, Flaxmere Moss
<i>Eristalis tenax</i> (Linnaeus)	Drone-fly	C	VC40 Wem Moss VC58 Delamere Office Car Park (Forestry Commission), Hatch Mere
<i>Eupeodes corollae</i> (Fabricius)	a hoverfly	C	VC58 Black Lake, Blakemere Moss, Brackenhurst Bog, Shemmy Moss
<i>Eupeodes latifasciatus</i> (Macquart)	a hoverfly	L	VC58 Black Lake, Shemmy Moss
<i>Eupeodes luniger</i> (Meigen)	a hoverfly	C	VC58 Basin Mire LM09, Black Lake, Shemmy Moss
<i>Ferdinanda cuprea</i> (Scopoli)	a hoverfly	L	VC58 Blakemere Moss
<i>Helophilus hybridus</i> Loew	a hoverfly	L	VC58 Barnsbridge Flushes, Black Lake, Shemmy Moss
<i>Helophilus pendulus</i> (Linnaeus)	a hoverfly	C	VC39 Chartley Moss VC58 Black Lake, Blakemere Moss, Brackenhurst Bog, Shemmy Moss, Thieves Moss & Pool, Wrekin Pool
<i>Melanostoma mellinum</i> (Linnaeus)	a hoverfly	C	VC58 Black Lake, Brackenhurst Bog, South Moss
<i>Melanostoma scalare</i> (Fabricius)	a hoverfly	C	VC58 Black Lake
<i>Merodon equestris</i> (Fabricius)	Greater Bulb Fly	C	VC40 Cole Mere VC58 Flaxmere Moss
<i>Microdon mutabilis</i> (Linnaeus) [sensu stricto]	a hoverfly	JNCC	VC58 Little Budworth Common (North Moss)
<i>Myathropa florea</i> (Linnaeus)	a hoverfly	C	VC40 Clarepool Moss VC58 Black Lake, Brackenhurst Bog, Shemmy Moss
<i>Neoascia podagrica</i> (Fabricius)	a hoverfly	C	VC40 Cole Mere VC58 Black Lake
<i>Neoascia tenur</i> (Harris)	a hoverfly	C	VC58 Black Lake
<i>Orthonevra intermedia</i> Lundbeck	a hoverfly	JNCC	VC58 Black Lake, Hogshead Moss, Shemmy Moss
<i>Parhelophilus frutetorum</i> (Fabricius)	a hoverfly	L	VC39 Staffordshire University Nature Reserve
<i>Parhelophilus versicolor</i> (Fabricius)	a hoverfly	L	VC58 Blakemere Moss, Flaxmere Moss, Wybunbury Moss
<i>Platycheirus albimanus</i> (Fabricius)	a hoverfly	C	VC58 Black Lake

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
<i>Platycheirus angustatus</i> (Zetterstedt)	a hoverfly	C	VC40 lane between Clarepool Moss and Cole Mere
<i>Platycheirus clypeatus</i> (Meigen) [sensu stricto]	a hoverfly	C	VC40 Whixall Moss
<i>Platycheirus granditarsus</i> (Forster)	a hoverfly	C	VC58 Black Lake
<i>Platycheirus peltatus</i> (Meigen) [sensu stricto]	a hoverfly	C	VC58 Black Lake
<i>Platycheirus scutatus</i> (Meigen) [sensu stricto]	a hoverfly	C	VC58 Black Lake
<i>Platycheirus</i> indeterminate [<i>scutatus</i> (Meigen) complex]	a hoverfly	n/a	VC58 Black Lake
<i>Rhingia campestris</i> Meigen	a hoverfly	C	VC40 Whixall Moss
<i>Scaeva pyrastris</i> (Linnaeus)	a hoverfly	C	VC58 Shemmy Moss
<i>Scaeva selenitica</i> (Meigen)	a hoverfly	L	VC58 Black Lake, Blakemere Moss
<i>Sericomyia lappona</i> (Linnaeus)	a hoverfly	L	VC39 Chartley Moss VC58 Black Lake, Blakemere Moss, Boggy Pool, Brackenhurst Bog, Hogshead Moss, Shemmy Moss
<i>Sericomyia silentis</i> (Harris)	a hoverfly	C	VC40 Whixall Moss VC58 Black Lake, Blakemere Moss, Boggy Pool, Brackenhurst Bog, Doolittle Moss (lower basin), Hogshead Moss, Linnere Moss (north), Little Budworth Common (East Moss), Shemmy Moss, Wybunbury Moss
<i>Sphaerophoria interrupta</i> (Fabricius)	a hoverfly	L	VC58 Black Lake
<i>Sphaerophoria philanthus</i> (Meigen)	a hoverfly	C	VC58 Brackenhurst Bog, Little Budworth Common (Whitehall Moss)
<i>Sphaerophoria scripta</i> (Linnaeus)	a hoverfly	C	VC58 Brackenhurst Bog, Hatch Mere, Thieves Moss & Pool
<i>Sphegina clunipes</i> (Fallén)	a hoverfly	L	VC58 Petty Pool
<i>Syrirta pipiens</i> (Linnaeus)	a hoverfly	C	VC40 Wem Moss, Whixall Moss VC58 Black Lake, , Great Middel, Little Budworth Common (Whitehall Moss), South Moss, Wybunbury Moss
<i>Syrphus</i> indeterminate [<i>rectus</i> Osten Sacken or <i>vitripennis</i> Meigen]	a hoverfly	n/a	VC58 Doolittle Moss (lower basin)
<i>Syrphus ribesii</i> (Linnaeus)	a hoverfly	C	VC58 Black Lake, Shemmy Moss
<i>Volucella bombylans</i> (Linnaeus)	a hoverfly	C	VC39 Cannock Chase (Sherbrook Valley) VC58 Fishpool Moss, Little Budworth Common (north end)
<i>Volucella pellucens</i> (Linnaeus)	a hoverfly	C	VC39 Cannock Chase (near Penkrige Bank Road) VC40 Wem Moss
<i>Xylota abiens</i> Meigen	a hoverfly	JNCC	VC58 Barnsbridge Flushes
<i>Xylota florum</i> (Fabricius)	a hoverfly	L	VC58 Black Lake
<i>Xylota segnis</i> (Linnaeus)	a hoverfly	C	VC58 Black Lake, Blakemere Moss, Boggy Pool, Hockenhull, Little Budworth Common (Whitehall Moss)
<i>Xylota sylvarum</i> (Linnaeus)	a hoverfly	L	VC39 Chartley Moss VC58 Black Lake, Oak Mere
Family: Conopidae	Thick-headed flies		
<i>Sicus ferrugineus</i> (Linnaeus)	a thick-headed fly	L	VC58 Brackenhurst Bog, Shemmy Moss, South Moss
Family: Tephritidae	Picture-winged flies		
<i>Terellia tussilaginis</i> (Fabricius)	a picture-winged fly	C	VC58 South Moss
Family: Sciomyzidae	Marsh flies		
<i>Tetanocera arrogans</i> Meigen	a marsh fly	L	VC40 Whixall Moss
<i>Tetanocera elata</i> (Fabricius)	a marsh fly	C	VC40 Clarepool Moss, Whixall Moss VC58 Barnsbridge Basin
Family: Sepsidae	Black scavenger flies		
<i>Sepsis cynipsea</i> (Linnaeus)	a black scavenger fly	C	VC58 Shemmy Moss, Wybunbury Moss

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
Family: Clusiidae	Druid flies		
<i>Clusiodes caledonicus</i> (Collin)	a druid fly	JNCC	VC58 Black Lake
Family: Opomyzidae	Cereal flies		
<i>Opomyza germinationis</i> (Linnaeus)	a cereal fly	C	VC39 Chartley Moss area
Family: Scathophagidae	Dung flies etc.		
<i>Cordilura ciliata</i> Meigen	a dung fly	L	VC58 Black Lake, Gull Moss, Oak Mere
<i>Cordilura rufimana</i> Meigen	a dung fly	JNCC	VC58 Black Lake, Flaxmere Moss, Shemmy Moss
<i>Scathophaga furcata</i> (Say)	a dung fly	C	VC39 Chartley Moss area
<i>Scathophaga inquinata</i> Meigen	a dung fly	C	VC40 Whixall Moss
<i>Scathophaga stercorea</i> (Linnaeus)	Yellow Dung Fly	C	VC40 Brown Moss , Clarepool Moss, Wem Moss, Whixall Moss VC58 Hogshead Moss, Little Budworth Common (East Moss), Little Budworth Common (north end), Wybunbury Moss
Family: Anthomyiidae	Root-maggot flies etc.		
<i>Eustalomyia histrio</i> (Zetterstedt)	an anthomyiid fly	L	VC40 Whixall Moss VC58 Shemmy Moss
Family: Muscidae	Housefly & sweat flies etc.		
<i>Eudasyphora cyanella</i> (Meigen)	a muscid fly	C	VC58 Wybunbury Moss
<i>Graphomya maculata</i> (Scopoli)	a muscid fly	C	VC58 Black Lake, Petty Pool, Shemmy Moss
<i>Graphomya minor</i> Robineau-Desvoidy	a muscid fly	L	VC58 Wybunbury Moss
<i>Helina impuncta</i> (Fallén)	a muscid fly	C	VC58 Brackenhurst Bog
<i>Hydrotaea irritans</i> (Fallén)	a sweat fly	C	VC40 lane between Clarepool Moss and Cole Mere, Wem Moss VC58 Black Lake, Shemmy Moss
<i>Mesembrina meridiana</i> Linnaeus	Noon Fly	C	VC40 Wem Moss VC58 track to Brackenhurst Bog
<i>Morellia simplex</i> (Loew)	a muscid fly	C	VC58 Wybunbury Moss
<i>Muscina levida</i> (Harris)	a muscid fly	C	VC58 Shemmy Moss
<i>Mydaea electa</i> (Zetterstedt)	a muscid fly	L	VC58 Brackenhurst Bog
<i>Phaonia angelicae</i> (Scopoli)	a muscid fly	C	VC58 Black Lake, Shemmy Moss
<i>Phaonia errans</i> (Meigen)	a muscid fly	C	VC40 Whixall Moss VC58 Basin Mire A06, Black Lake, Brackenhurst Bog
<i>Phaonia erronea</i> (Schnabl)	a muscid fly	L	VC58 Petty Pool
<i>Phaonia falleni</i> Michelsen	a muscid fly	JNCC	VC40 Whixall Moss
<i>Phaonia fuscata</i> (Fallén)	a muscid fly	L	VC58 Brackenhurst Bog
<i>Phaonia pallida</i> (Fabricius)	a muscid fly	C	VC58 Boggy Pool, Centre Bog, Little Budworth Common (Whitehall Moss)
<i>Phaonia serva</i> (Meigen)	a muscid fly	C	VC58 Linmere Moss (north)
<i>Phaonia valida</i> (Harris)	a muscid fly	C	VC58 Brackenhurst Bog, Shemmy Moss
<i>Polietes lardarius</i> (Fabricius)	a muscid fly	C	VC39 Chartley Moss area VC40 Bettisfield Moss VC50 Cadney Moss VC58 Blakemere Moss, Hogshead Moss, Shemmy Moss, Wybunbury Moss
Family: Calliphoridae	Bluebottles etc.		
<i>Calliphora vicina</i> Robineau-Desvoidy	Common Bluebottle	C	VC58 Hogshead Moss, Shemmy Moss
<i>Lucilia caesar</i> (Linnaeus)	Common Greenbottle	C	VC39 Cannock Chase (near Whitehouse Car Park)
<i>Pollenia angustigena</i> Wainwright	Narrow-cheeked Clusterfly	C	VC40 Wem Moss
<i>Pollenia pediculata</i> Macquart	Tufted Clusterfly	C	VC58 Black Lake
<i>Protocalliphora azurea</i> (Fallén)	Bird Blowfly	L	VC39 Chartley Moss VC58 Shemmy Moss
Family: Sarcophagidae	Flesh flies		
<i>Sarcophaga carnaria</i> (Linnaeus)	a flesh fly	C	VC58 Little Budworth Common (Whitehall Moss)

SCIENTIFIC NAME	VERNACULAR NAME	STATUS	LOCALITIES [VC = vice-county]
<i>Sarcophaga subvicina</i> Rohdendorf	a flesh fly	C	VC58 Black Lake, Blakemere Moss, Shemmy Moss
Family: Tachinidae	Parasitic flies		
<i>Eriothrix rufomaculata</i> (De Geer)	a parasitic fly	C	VC58 Brackenhurst Bog
<i>Eurithia anthophila</i> (Robineau-Desvoidy)	a parasitic fly	C	VC58 Thieves Moss & Pool
<i>Exorista rustica</i> (Fallén)	a parasitic fly	C	VC40 Brown Moss
<i>Linnaemya vulpina</i> (Fallén)	a parasitic fly	C	VC58 Shemmy Moss
<i>Phasia hemiptera</i> (Fabricius)	a parasitic fly	L	VC58 Barns Bridge
<i>Phryxe vulgaris</i> (Fallén)	a parasitic fly	C	VC58 Shemmy Moss
<i>Siphona geniculata</i> (De Geer)	a parasitic fly	C	VC58 Brackenhurst Bog
<i>Tachina fera</i> (Linnaeus)	a parasitic fly	C	VC40 Brown Moss VC58 Black Lake, Delamere Office Car Park (Forestry Commission), Little Budworth Common (north end), South Moss, Thieves Moss & Pool

RECOMMENDATIONS FOR CURRENT AND FUTURE MANAGEMENT

The surveyor's recommendations for current and future management of sites must inevitably be biased towards management which is advantageous for Tabanidae in general and *Atylotus plebeius* in particular.

Collectively, the mires of the broad Cheshire Plain area represent a habitat resource of national importance; indeed, a few Cheshire Plain mires support populations of Diptera which have not been found elsewhere in Britain, such as the horsefly *Atylotus plebeius* and the hoverfly *Orthonevra intermedia*. Both these species were found at several, rather pristine, mires during the 2018 survey.

Atylotus plebeius was only found to occur on genuine quaking bogs with a complete thick covering of *Sphagnum* and other bog plants forming a floating mat above permanent water beneath. On the Cheshire Plain mires, this floating mat is typically dominated by the plants illustrated below.



Sphagnum and *Drosera* on East Moss (10th June)



Sphagnum and *Vaccinium* on Shemmy Moss (10th June)

It is possible that *Atylotus plebeius* is a connoisseur of habitat choice which restricts itself only to genuine quaking bogs with a floating mat of bog vegetation which completely covers quite deep water beneath. It is also possible that mires with open pools, which allow larval predators such as Odonata to breed, are unsuitable habitats. As *A. plebeius* larvae are likely to be predators of crane-fly and related larvae, they may not be able to survive on well-drained mires which dry up during periods of drought.

The aforementioned paragraph is partly informed conjecture; but what is clear, is that *Atylotus plebeius* is established on quaking bog habitat at Shemmy Moss, Little Budworth Common and Wybunbury Moss, and these sites at least should be considered as being of paramount importance for the survival of *A. plebeius* in Britain. Management recommendations for Shemmy Moss and the three quaking bogs on Little Budworth Common [Central Moss, East Moss and Whitehall Moss] are quite simple – these sites are in prime condition as quaking bogs, will remain so naturally for many years to come, and do not require any management work in the foreseeable future. If there are any plans afoot to carry out work such as opening up the bog surface on any of these sites to create pools, then such plans could be catastrophic to *A. plebeius*, and should not be carried out.

Wybunbury Moss has suffered from drainage, and has only one discrete area of quaking bog. Although its drains have been blocked to a degree, Wybunbury Moss was mainly dry at the time of its 2018 survey, and would benefit from more effective drain blocking, or the complete filling in of drains.

The vast majority of Cheshire Plain area mires were drained during the mid 20th Century, some very drastically. In an attempt to aid the restoration of these important wetlands, recent attempts at drain blocking have been carried out at many sites. Most usually, drain blocking has been attempted using plastic roofing materials such as illustrated below at Wem Moss, often with some surrounding banking of earth. Some drain blocking has been attempted using bundles of short broken *Betula* [birches] branches. During a period of drought, such as occurred in the summer of 2018, it was evident, at many sites, that drain blocking had been, at best, only slightly successful at aiding mires to retain water, and was sometimes entirely ineffective. Unless drains are fully filled in, water will usually find an escape route; hence, more effective drain blocking measures need to be considered for many sites. Usually this would involve entirely filling in drains with peat and impermeable material where appropriate.



Haematopota pluvialis female at Whixall Moss (26th June)



Drain blocking at Wem Moss (15th June)

With the exception of Black Lake, the Delamere Forest mires, suffered catastrophic degradation due to mid 20th Century drainage which was necessary in order to maximise timber production within the forest. One very encouraging aspect of recent years is that much restoration work has been carried out in order to rectify the habitat destruction caused by mid 20th Century forestry policies. This restoration work has yet to fully bear fruit, but there are very encouraging signs that mires within hollows in particular are starting to have an encroachment of genuine bog plants from the margins, or are developing a floating mat of *Sphagnum*-dominated vegetation. The continuation of restoration work in Delamere Forest in particular is essential for the future health of its horsefly population. Delamere Forest may possibly have lost its population of *Atylotus plebeius*, but this species could conceivably return in the future, once suitable habitats have been fully restored, and should strays arrive in Delamere Forest from reasonably nearby sites where it still occurs [Little Budworth Common and Shemmy Moss].

Haematopota pluvialis is the most common British horsefly. It is abundant throughout the Cheshire Plain area mires, and does not require any special consideration. The female illustrated above was pictured whilst biting the surveyor. *Chrysops viduatus* would usually be a species of interest, but it is doing very well in the Delamere Forest, and as the mire habitats there are subject to ongoing restoration work, it should continue to proliferate. The important factor for all the horseflies recorded during the survey is the availability of suitable breeding habitat. This overall resource of suitable habitat is increasing due to the restoration of mire habitats throughout the Cheshire Plain area, but as previously mentioned; drainage needs to be properly arrested.

ACKNOWLEDGEMENTS

The survey would not have been possible without much preparation work by Gary Hedges [World Museum, Liverpool]. Of particular importance was that Gary gained permissions to survey a large number of Cheshire Plain area wetlands. Gary was also responsible for supplying the excellent plans in Appendix 1 which show the survey locations. Some survey work was carried out at additional outlying sites during the Dipterist Forum Summer Field Meeting based at Staffordshire University. The Dipterists Forum organisers obtained access permissions for these additional sites.

Katie Piercy [ex Cheshire Wildlife Trust] provided a very useful reconnaissance tour of mires in the Delamere area on 10th January 2018. During the survey itself, Frank von der Fecht provided an informed tour of Fishpool Moss on 30th June.

Adam Evans [Forestry Commission] provided an access key to Delamere Forest.

Rob Wolton and John Mousley provided supplementary records of *Atylotus plebeius*, which was found by them during the Dipterists Forum Summer Field Meeting. Andy Halstead, Chris Spilling and Darwyn Sumner indirectly provided records of other horseflies taken or photographed during the same meeting.

Nigel Jones verified a record of *Tabanus autumnalis*, and provided information on his record of *Hybomitra lurida* from Brown Moss in Shropshire.

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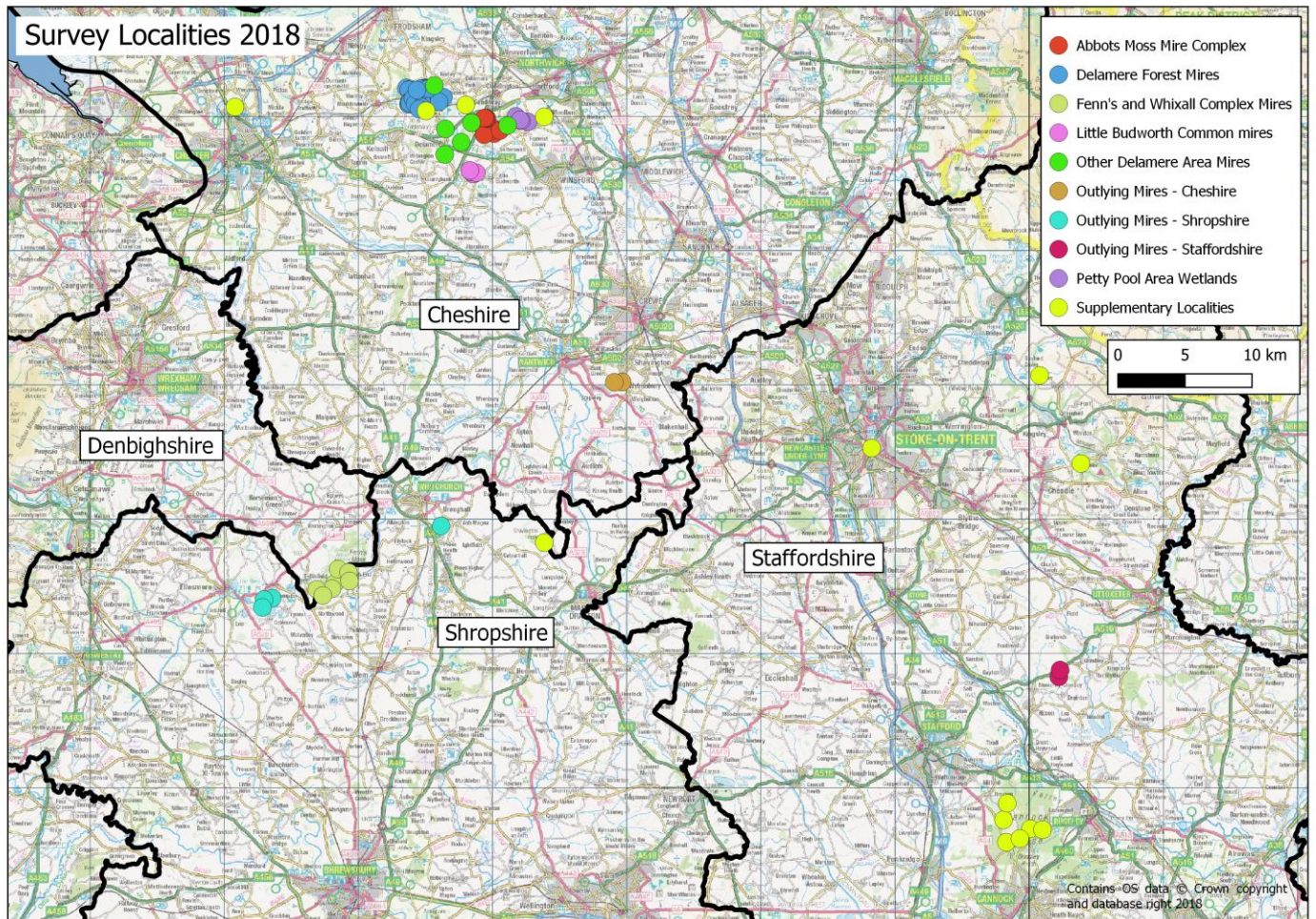
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APPENDIX 1

PLANS SHOWING THE SURVEY LOCATIONS

OVERVIEW OF ALL SURVEY LOCALITIES

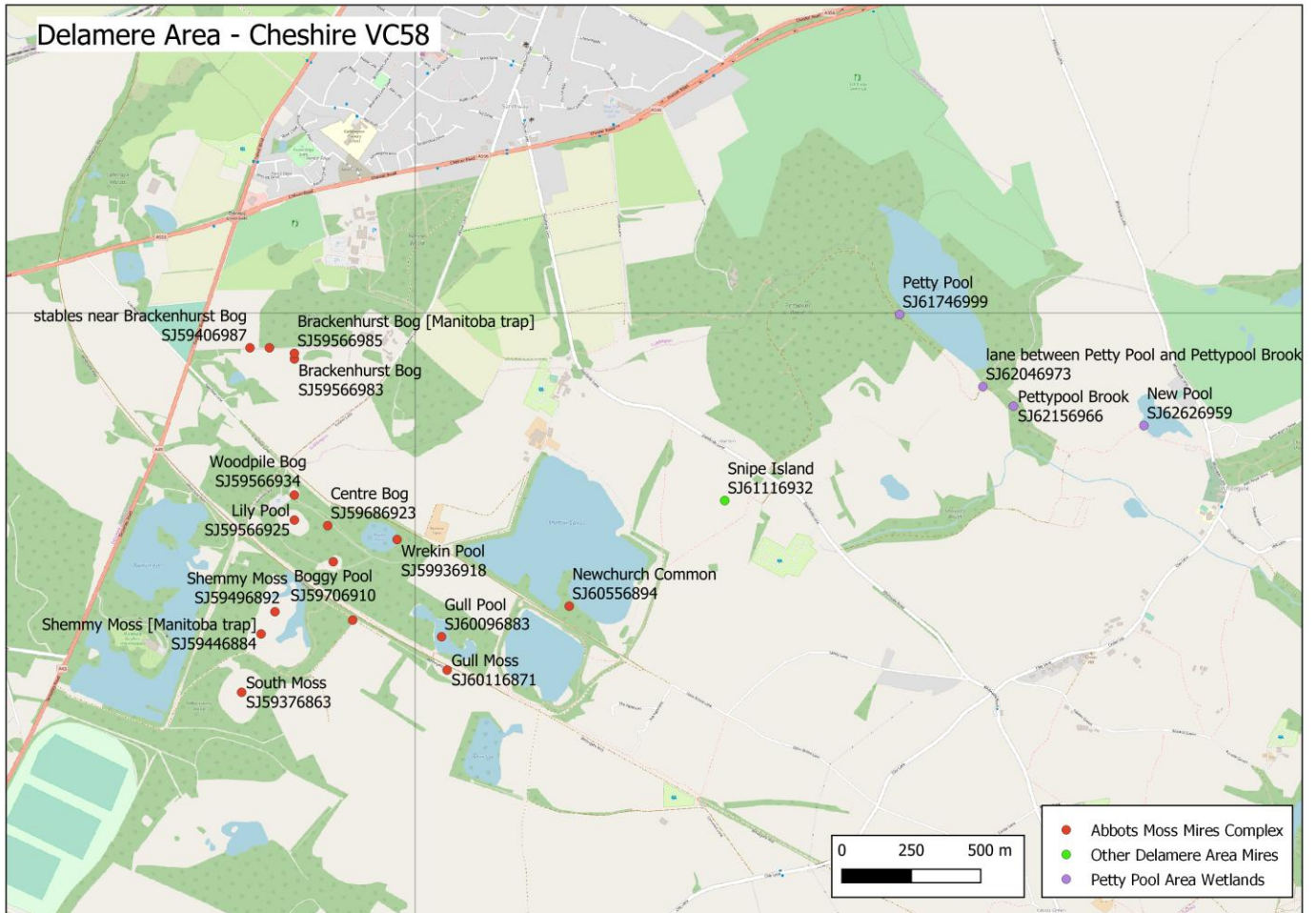


All plans in Appendix 1 were kindly supplied by Gary Hedges.

The 'Overview' plan above includes all survey localities, and the plans on pages 49 to 55 show the majority of the 2018 survey localities in more detail. Some supplementary localities, such as those in Staffordshire, are only shown on the 'Overview' plan.

The plans on pages 49 to 55 show the central points of all survey localities; but, due to space constraints, a few locations are not labelled with their locality name and central 10m² National Grid reference.

DELAMERE AREA: ABBOTS MOSS COMPLEX MIRES TO PETTY POOL AREA WETLANDS



The following supplementary localities are plotted on the plan above but not labelled:

1. 'track to Brackenhurst Bog' (SJ 5947 6987) – this is the dot situated halfway between the 'stables near Brackenhurst Bog' and the 'Brackenhurst Bog [Manitoba trap]'.
2. 'tracks between Gull Moss and Shemmy Moss' (SJ 5977 6889) – this is the dot situated halfway between 'Shemmy Moss' and 'Gull Pool'.

DELAMERE AREA: MISCELLANEOUS OAK MERE AREA MIRES



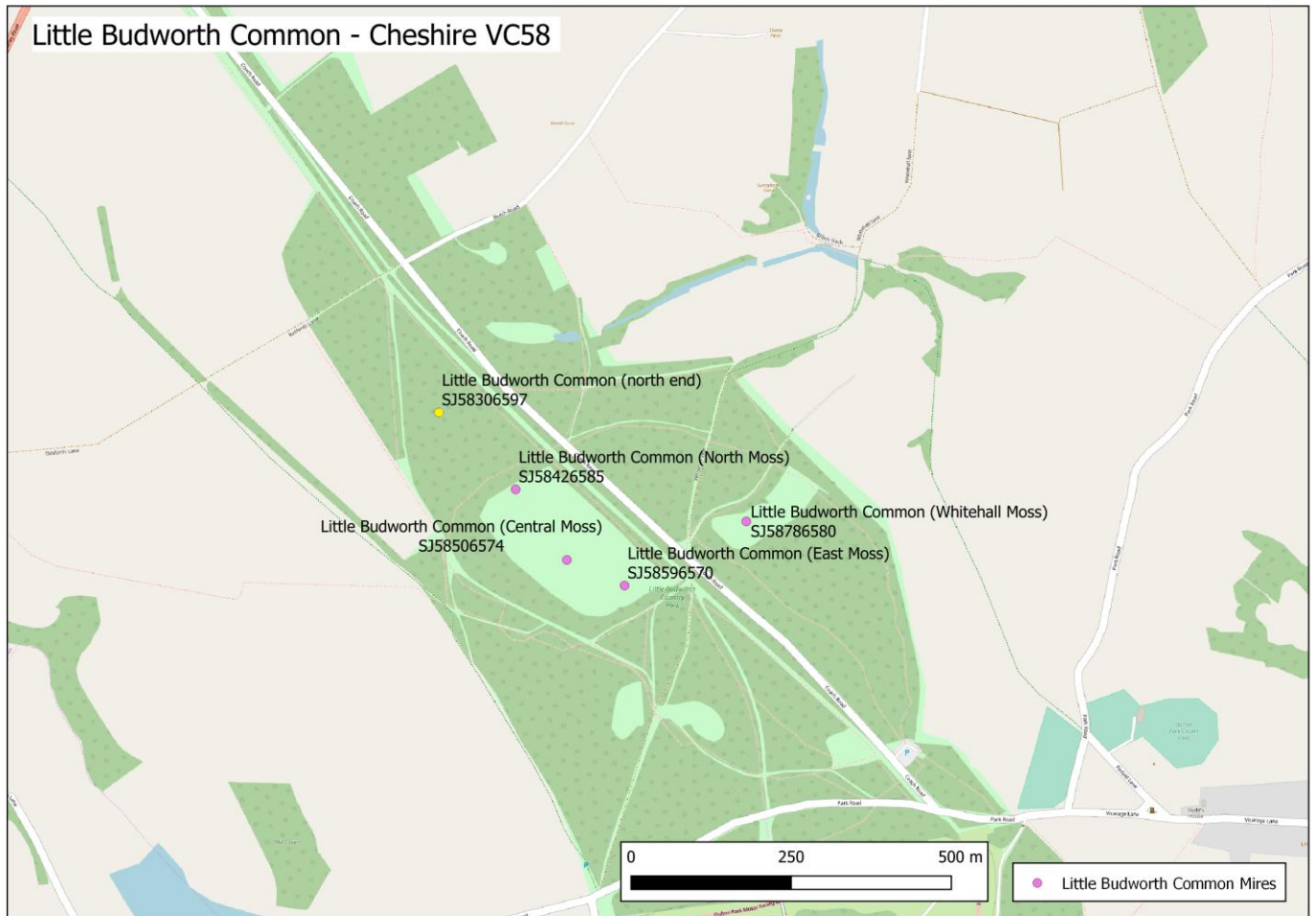
DELAMERE FOREST AREA MIRES



The following mires are plotted on the plan above but not labelled:

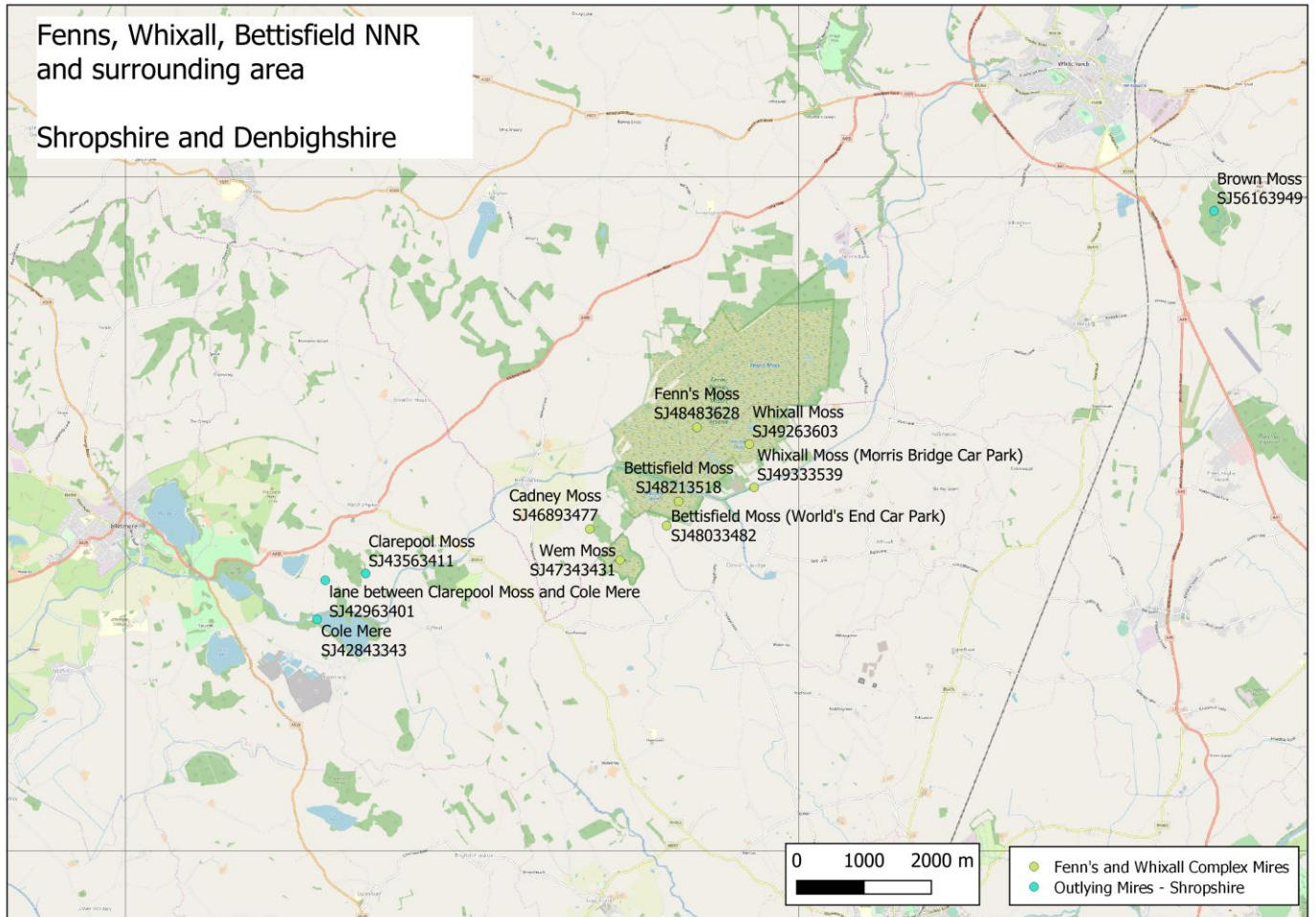
1. 'Ham (lower basin)' (SJ 5467 7205) – this is the dot situated east of 'Ham Pool' and north of 'Ham (upper basin)'.
2. 'Basin Mire N2' (SJ 5502 7208) – this is the dot situated on white background south-east of 'Basin Mire N1'.

LITTLE BUDWORTH COMMON MIRES

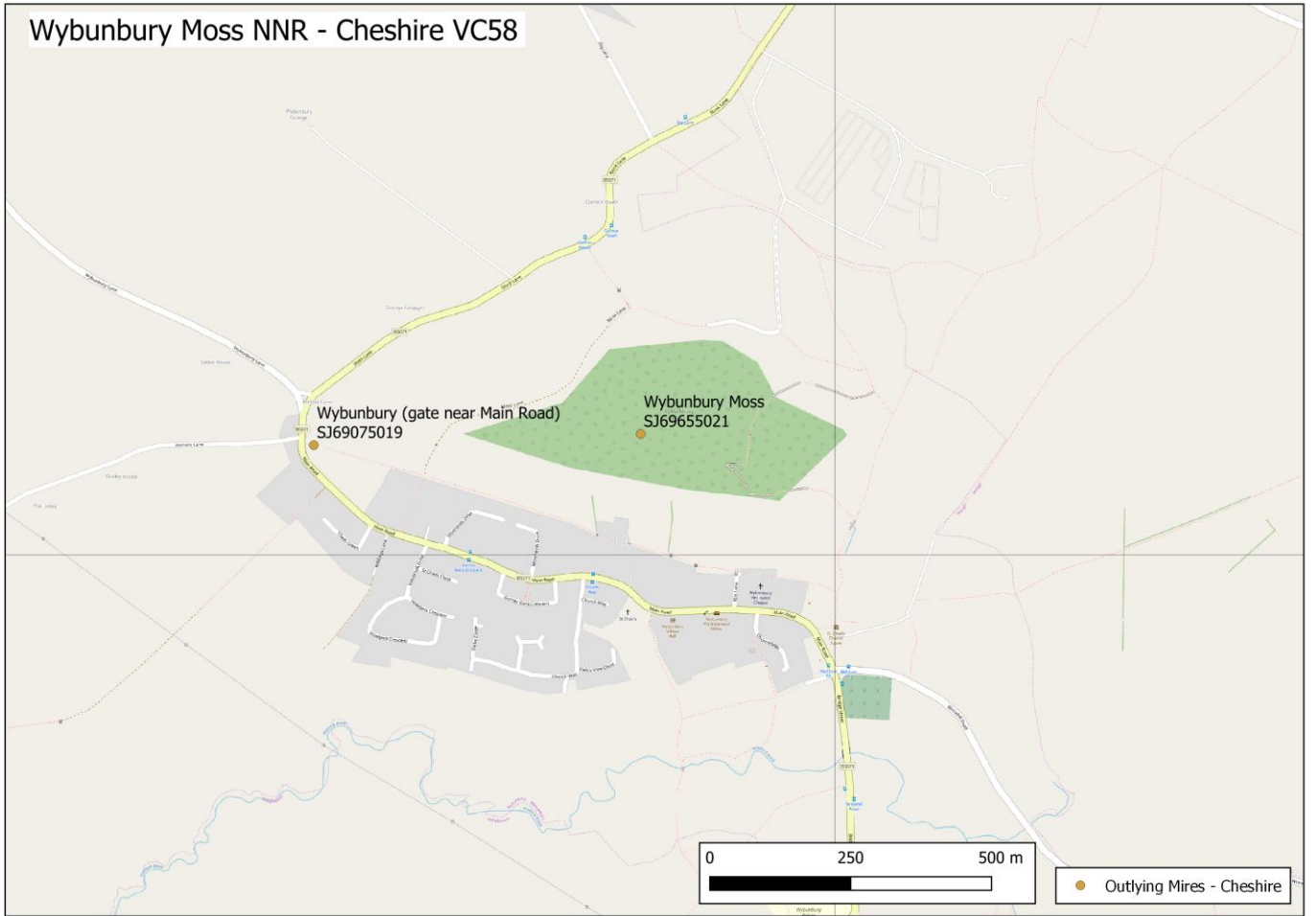


Little Budworth Common contains four mires with distinct boundaries [the 'mosses']. The above plan also marks the centre of 'Little Budworth Common (north end)' with a yellow dot: this is an open area of dry heathland.

SHROPSHIRE AND DENBIGHSHIRE MIRES AND MERES



WYBUNBURY MOSS



CHARTLEY MOSS

