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Further observations on the ecology of *Ellipteroides alboscutellatus* (von Roser) (Diptera, Limoniidae) in England and Wales

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Summary
This paper provides descriptions of nine new sites for this species in England and Wales, and updates the details of habitat, ecology and field observations within the framework of a previous paper (Heaver 2006). Details are given of conductivity and pH of the flushes. The micro-habitat remains flushed *Palustriella* moss beds on perched springline tufa flushes, the majority of which are now to be found in woodland.

Introduction

Since the first paper describing the ecology of this species was published (Heaver 2006), further observations have continued during the period 2005-2012. The same fieldwork approach was adopted as before, although adding data on flush pH and conductivity for some sites, whilst integrating all the new locations into the existing soil type and underlying geology reference tables. The pen picture descriptions for the new sites follow that of the previous ones, and should be read in conjunction to gain a full appreciation of the habitat of this species in Britain.

Ellipteroides alboscutellatus (von Roser, 1840) is a Western Palaearctic species, Oosterbroek (2013) noting its occurrence in Albania, Austria, Belgium, Bulgaria, the Czech Republic, Estonia, France, Germany, Great Britain, Hungary, Italy, Lithuania, Macedonia, Netherlands, Romania, Serbia, Slovakia, Slovenia, Spain, Switzerland, Ukraine (Carpathians), Morocco and Lebanon. As such, it is useful to consider the habitat in other countries and try to place the British fauna within a wider context, and part of this study addresses that issue.

Materials and methods

The same methodology as described by Heaver (2006) was adopted for the investigation of the new sites, although water flow was not measured, only visually estimated within simple flow speed categories. Further detail on the nature of the tufa seepages was considered important and resulted in the use of an Extech Instruments ExStik EC500 pH/Conductivity/TDS/Salinity & Temperature meter. The water temperature of springs was recorded in degrees centigrade, whilst conductivity was measured in µS. Both pH and conductivity were calibrated by the provided buffer solutions with the ExStik sample kit, but later by recourse to a Myron L Company KCI-700 µS TDS/Conductivity solution. Both the sample probe and sample containers were double washed with Aqwsafe bottled distilled water at 0 ppm dissolved solids. Temperature and conductivity were generally taken together, although in a few instances this did not happen.

The revised British distribution map (Fig. 1) was constructed using Quantum GIS (2013) version 1.7.5 Wroclaw build, with the Countries (GB) 2011 Boundaries (Generalised, Clipped) shapefile (ONS, 2011) as the outline. Grid reference data were batch processed using the online Gridreferencefinder.com tool, pasting the transformed data into Apache Open Office 4 Calc spreadsheet, which itself was saved as a CSV file. This was imported into Quantum GIS using the Add Delimited Text Layer plugin. Both the CSV file and the outline shapefile were coordinate referenced to the WGS84 projection. Production of Fig. 2, mapping sites to bedrock

geology, followed the same procedure, but using the BGS (2013) DiGMapGB-625 data 1: 625 000 ESRI® [Bedrock geology] shapefile.

Basic statistical analyses were carried out using the open source SOFA package v.1.3.4, running a Kruskal-Wallis H test since the conductivity and pH data, being founded on tufa systems, is enough skewed in its distribution away from normality.

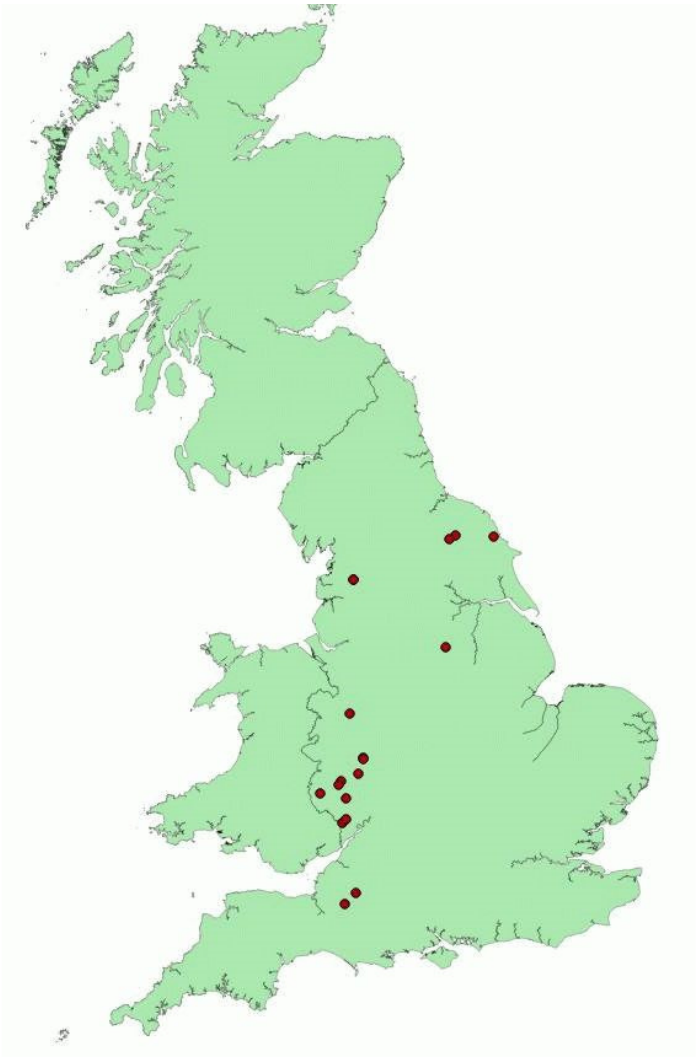

Fig. 1. Current British distribution of *Ellipteroides alboscutellatus*.

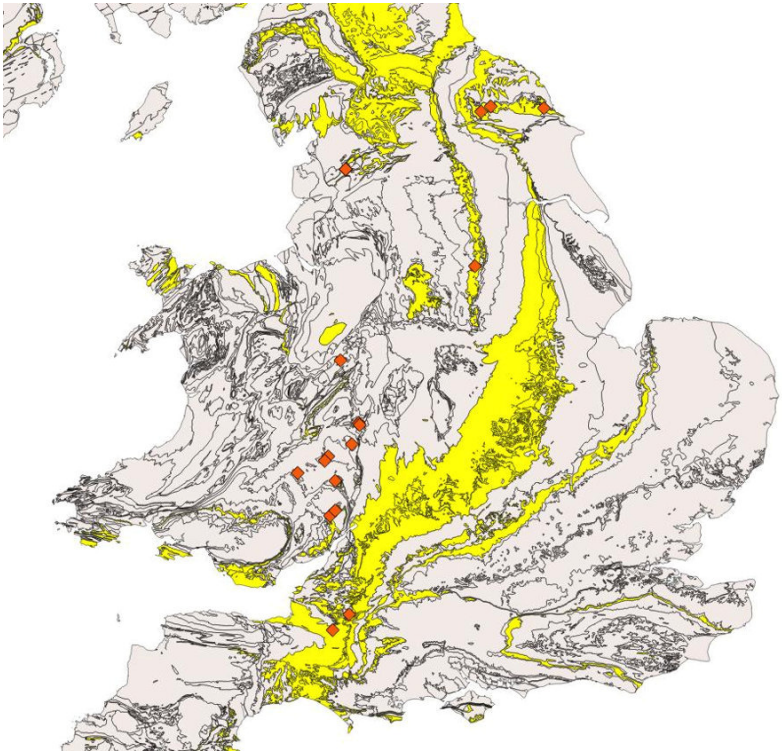

Fig. 2. Plot of *Ellipteroides alboscutellatus* sites against limestone bedrock formations.

Results

Table 1 tabulates the conductivity, pH and temperature measurements for three British sites. The fact that they are point data should be borne in mind, as fluctuations in pH and conductivity can be expected within such systems.

To place the British site data in a broader context, it was considered that there was need to review comparable data from elsewhere, something that seems, unfortunately, fairly scarce in the entomological literature, though less so in geomorphological works. Four other datasets have been accessed. These are the base data from adults caught in Malaise and targeted sweep net samples (Rádková 2011), from fen streamlets of the outer part of the West Carpathians on the Moravian-Slovak border, from other Slovakian data from a Western Carpathians study (Novikmec *et al*. 2007) which undertook larval sampling of the Hluboký potok stream spring system but set within the context of decades of other sampling regimes and techniques, and Arp *et al*. (2010) data from the Westerhofer Bach, located to the west of the Harz Mountains, c. 27 km NNE of Gottingen, Germany. In addition, Özkul *et al*. (2010) gave data on the Güney waterfall perched springline tufa deposit and associated spring waters in Turkey. It is worth noting that *Ellipteroides* is *only* recorded from the Carpathian studies, and not from either the German or Turkish site, and their inclusion within this analysis is founded entirely on demonstrating the geo-chemical parameter range within the tufa-depositing systems of types

that are used. Both look, from photographs, to have similarity with British *Ellipteroides* sites, though larger in scale.

Not enough data points were able to be collected to allow a between-site comparison of British site pairs. The conductivity ranged from 495 to 629 µS.cm-^{1} (n=8). However, combining all British data points does allow inter-country comparisons to be carried out.

Site name	Conductivity µS.cm^{-1}	pH	Temp ^{0}C
Ashberry Pastures	496	8.02	17
Ashberry Pastures	597	7.5	12.9
Blaiskey Bank	546	7.55 [a]	12
Blaiskey Bank	518	7.88	14.2
Blaiskey Bank	520	8	18.4
Blaiskey Bank	495	7.99	20.5
Pentaloe brook, mid flush	629	-	-
Pentaloe brook, upper flush	583	-	-

Table 1. pH and conductivity data from selected British *Ellipteroides* tufa flushes.

Looking at the group B sites of Rádková (2011), a group in which *Ellipteroides alboscutellatus* was an indicator taxon, a Kruskal-Wallis test shows a significant difference between conductivity levels in the Slovak autumn samples and the British sites (H=10.5, 1d.f, p=0.001), with median values = 394 µS.cm^{1} (Carpathians) and 533 µS.cm^{-1} (British sites). A similar result was found when comparing the Slovak spring sample with the British sites (Kruskal-Wallis, H=7.714, 1 d.f, p=0.005), with median values = 422 µS.cm^{-1} (Carpathians) and 533 µS.cm^{-1} (British sites).

Further analysis can be made between country pairs, and looking at the German Westerhofer Bach data and that derived from the Turkish Güney waterfall perched springline shows a significant difference in conductivity: Kruskal-Wallis H=8.25, 1 d.f, p=0.004, with median values = 994 µS.cm^{-1} (Westerhofer Bach), and 439 µS.cm^{-1} (Güney waterfall). However, this is not surprising given that the Westerhofer Bach data range, at between 903-1037 µS.cm^{-1}, is double that of some of the other site groups.

A comparative analysis of the collected pH values between the British data set and the spring measurements presented by Rádková (2011) has also been performed. Using Kruskal-Wallis (H=0.867, 1 d.f, p=0.352), this showed no significant difference between the two groups.

Table 2 extends the geological and soil type characteristics of the new British sites, and follows that in Heaver (2006), whilst Fig. 2 plots all British sites against a limestone descriptor of the GIS table. Site descriptions of the type provided by Heaver (2006) are also given in Appendix 1 for the eight new sites and briefly for a ninth.

Discussion

Eight of the new British sites fall into a similar pattern as that described by Heaver (2006), and present no great variation of type away from the perched springline seepage originally described. The ninth, the Prisk Wood site, is very atypical and is a possible exception that requires more study. The old record made by Henderson in 1926 for the only Scottish site (the Cadder Wilderness Plantation, East Dunbartonshire) as given on the NBN Gateway is deemed to be in error (Geoff Hancock *pers comm*), and was probably a case of misidentification, with the correction not being recorded in Henderson's collection in The Hunterian (Zoology Museum).

The new sites described here are plotted (Fig. 1), along with the rest of the British sites, to present an updated British distribution map. Some of the new sites bear a resemblance to those described previously (Heaver 2006): Blaiskey Bank Spring SSSI and the Pentaloe brook flush, or Whitewell Coppice and Hurdlestone Wood. The geographical proximity of some of the sites to each other is reflected in the similarity of soil types (Table 2) on which they occur, with both the Bromyard and Crwbin series being found in the Herefordshire sites. The bedrock geology provides a good match for a number of the sites (Fig. 2) when selected for limestone, an attribute layer in the mapped data table that includes limestones, mudstones, calcareous mudstones, and some siltstones. It, however, poorly matches the central Herefordshire borders group, which are better represented by the selection of Upper Devonian mudstones, sandstone and siltstones. Together both geological groups indicate areas where additional springline flushes might occur.

In an attempt to assess how typical the British sites are within the European range context, more exploration of the published data has been undertaken. However, in most reports of occurrence hardly any habitat details are given, though what little has been found is presented here. Various research groups (e.g. Bitušík *et al*. 2004) have carried out much research work in parts of the Carpathian Mountains, and the following discussion relies heavily on such work.

Rádková (2011) noted that claystone, calcareous sandstones and limestones predominate in the south-western part of the Outer Western Carpathians, the White Carpathians and their immediate surroundings. The groundwater is rich in carbonates and has a high content of carbon dioxide (CO_2), which enables the formation of springs with tufa precipitation. Their study sites showed a strong gradient from mineral-rich springs with precipitation of tufa (calcareous tufa forming fens) to extremely poor Sphagnum fens.

The "trickle flowing fen" has carbonated water that is extremely rich in minerals, the average conductivity values of around 422 $\mu S.cm^{-1}$ and the average pH value of around 7.9. The spring water has a high content of calcium ions and CO_2, high pH, and with the typical ground water to precipitation of tufa ($CaCO_3$) pathway (Rádková 2011). The habitat described is quite recognisable as a typical British *E. alboscutellatus* site.

Bulánková (2007) had similar findings on the Stupavský potok brook in the Carpathian mountains, and demonstrated that the species occurred in five out of her seven substrate classes, though it showed a preference for sand substrates. This was closely followed by her "macro" and "microlithic" sediment classes. There is no definition of the sediment classes used, but given that these would be tufa-forming systems, one can see some analogy to the equally-undefined "tufaceous silts and gravels" used as descriptors in this work.

The main direction of variation in the community biplot holding *E. alboscutellatus* also reflected changes in the nature of the substrate, with the trickle groups A and B within which *E. alboscutellatus* occurs (although weakly in A), having a coarse, inorganic substrate in the form of sand, gravel and stones. They were also notable for having a lower organic content than

found in other samples (Rádková 2011).

Rádková (2011) performed a Principal Component Analysis on the macro-invertebrate assemblages of fen streamlets in the outer part of the Western Carpathians. This gave a distinctive group on the biplot composed of *E. alboscutellatus* larvae, the larvae of the stratiomyid *Oxycera pygmaea* (Fallén), and the widespread seepage caddis *Beraea maurus* (Curtis). Whilst *O. pygmaea* has not been encountered on the British sites, *O. pardalina* Meigen is a common associate species in this habitat (Heaver 2006). It is possible that undertaking co-incident mapping of these other species, in conjunction with the bedrock geology map may well point to new flush areas, many of which remain largely ignored and uncommented on within the woodlands in which they typically occur. This is, in part, because they have a low floral diversity and so do not merit attention from non-entomologists, much in the same way as exposed riverine sediments have been overlooked in the past.

Rádková (2011) further recorded that *E. alboscutellatus* was one of several taxa in her study, where the number of individuals within the communities reached abundances greater than 1% of the total number of individuals (742 adults taken, representing 5% of fauna). She utilised the EUNIS habitat classification, and placed the species in the C2.21 epirithral stream section (European Environment Agency 2014), where the streamlets fan out below the main springhead. This is a typical British situation, and would well describe Whitwell Coppice, for example. Novikmec *et al*. (2007), working on Carpathian stream systems, similarly noted *E. alboscutellatus* as being the dominant species (20-100% of the sampled fauna) in the Hluboký potok Hlu2 sampling site, and sub-dominant (10-20%) in both Hlu3 and Stu1samples, with the two Hlu sites being closer than Stu1 under a complete linkage cluster analysis. This numerical dominance is consistent with the field observations in British sites where, at the time of emergence, it seems by far the commonest insect on the wing.

The Hluboký potok Hlu2 sampling site spring is described as having "a lot of cascades, a high slope and a lot of moss-covered rocks" (Novikmec *et al*. 2007), and might be considered something like the Hackfall wood site. The habitat surrounding Hluboký potok Hlu2 is further described as "young beech stands with mixture of maple (5%), with 80% of shading. *Asperula odorata, Dentaria bulbifera, Dryopteris filix-mas, Petasites albus, Rubus idaeus* and *Senecio nemorensis* are presented in undergrowth", a description, albeit with different species, that could be applied to many British *E. alboscutellatus* sites in terms of having a drier vegetation stand around the seepage areas and having a degree of tree shading but not complete cover.

The differences noted here between conductivity levels between country sites say more about the variability in geo-chemistry between calcareous aquifers than they do about micro-habitat choice by *E. alboscutellatus*, though it is useful to understand the physio-chemical ranges found in habitats that could support it. Through all these investigations it is now possible to state that *Ellipteroides alboscutellatus* can be found within conductivity range between 161-629 $\mu S.cm^{-1}$.

As noted earlier, it is unknown if *Ellipteroides alboscutellatus* occurs in the Westerhofer Bach site or at the Güney waterfall, and so whether it can tolerate the more elevated conductivity levels found there remains unclear. Whether the faunal dominance of *E. alboscutellatus* at both the Hlu2 sampling site (which has a mean conductivity of 181.4 $\mu S.cm^{-1}$, Novikmec *et al*. 2007) and at Blaiskey Bank SSSI (anecdotally now the strongest British population, with the highest conductivity sample at 546 $\mu S.cm^{-1}$), actually indicates a more optimal conductivity range is as yet unclear.

Table 2. Location and Characteristics of *Ellipteroides alboscutellatus* sites in Britain.

The pH values measured in both the Carpathians and the British sites showed no significant differences, and are comparable and typical of the pH values (pH 7.7-8.2) given by, for example, Heery (2007) in a study of tufa vegetation communities in Ireland. Bulánková (2007) recorded the highest pH value (pH 8.44) on the Stupavský potok brook in June, whilst Rádková's (2011) Group B sites had an average pH of 7.58 ± 0.89. As such, and combining all data it is now possible to state that the pH tolerance of *E. alboscutellatus* lies at least in the range 7.5-8.44.

Flight period.
The new sites have provided more flight data periods, and in Britain this ranges from 8 July to 15 August (n=11), but combining it with the previous flight data shows a flight period still ranging from 10 June (exceptionally early it seems) to 28 August. This fits in with the scant European flight data, with records ranging from 25 June 2008 (Starý 2009, Bohemian site), 5 July 2000 (Pârvu 2004, Romanian site), 2 July and 8 August 2005 (Podėnas and Podėnienė 2008, Italian site).

APPENDIX 1: Catalogue of site descriptions.

Blaiskey Bank Spring SSSI (SE625886)
This is a large, open flush system on a hillside, backed by acidic *Betula* woodland with *Vaccinium*, though the lower section below the fence is heavily grazed out. A secondary flush system, not entered, lies just along the same hill-slope within the garden of a farmhouse, and looks of similar quality as the main SSSI flush, though its lower sections are truncated by the farmhouse access track.

The main tufa seepage arises sharply from a linear spring-line at the woodland edge, and has 5 or 6 runnels fanning out to form a deltaic structure, with strong to medium water flow. The flushes run, albeit in deep channels at the lower reaches, to the bottom of the site where the whole hydrological system appears to sump into a ditch. It is likely that the farm track that runs along there truncated the original seepage somewhat. Most of the flush has 0% canopy cover, with only 50% at the woodland edge at the springhead. The flushed areas are open, with sedges and *Deschampsia*, with *Eriophorum vaginatum*, harebell *Campanula rotundifolia*, and butterwort *Pinguicula vulgaris* being occasional to locally frequent. Marsh helleborine *Epipactis palustris* was occasional. The springhead line has 70% *Palustriella communis* cover, with 20% open and tufaceous gravels and silts, with 10% *Carex* and *Juncus* cover.

Most runnels were active, though those on the furthest eastern reaches were dry at the time of the visit. Large *Palustriella* sheets were on the main bank by the wood, with no surface water flow, though they probably sit on a tufa bench with flow from beneath. *Ellipteroides* was abundant on this site, with 14 being easily captured in one net sweep, and this being repeatable across the site. The large numbers that were *in copula* suggests a strong and recent emergence on this site. At least one cranefly had fallen to the sticky trapping leaves of the common butterwort. Site visited on 10.vii.2009.

Park Wood SSSI B, Herefordshire (SO588177)
Recent forestry operations within this woodland had removed a large area of thick and scrubby coppice growth further along from the Park Wood site previously recorded, revealing a secondary and previously hidden flush. Park Wood B is a broad seepage c. 150m in length, with a variable slope. At its widest, the flushed area is some 11m wide, running down to smaller runnels only 2m wide. The seepage zones are split by drier baulks with woodland

vegetation, such as abundant dog's mercury *Mercuralis perennis* and enchanter's nightshade *Circaea lutetiana*, and bramble *Rubus* species. The flushes have relatively small amounts of *Palustriella*, and more open tufaceous gravel deposits, with a good amount of petrifying dead wood across the system. Canopy cover was 70%, with ash *Fraxinus excelsior* dominant, with oak *Quercus* and low hazel *Corylus avellana* scrub. Water levels were low, with only slight water flow perceptible and, unlike the original Park Wood site, this had far fewer tufa dams. Hart's tongue fern *Asplenium scolopendrium* was frequent, with *Dryopteris* ferns occasional, and hemp agrimony *Eupatorium cannabinum* frequent. Water mint *Mentha aquatica,* was abundant in places, with brooklime *Veronica beccabunga*, yellow pimpernel *Lysimachia nemorum*, meadowsweet *Filipendula ulmaria* and marsh valerian *Valeriana dioica* being rare.

This system has no clear and defined springhead, just a broad and gently sloping muddy pool with rocks and bryophytes. The flush length is c. 30m. The lower parts of the flush system are fed water through tufaceous gravels, with only dry tufa gravels above this; there was little visible water flow in these sections. The bottom part of the flush sumps (1.2m wide) below the riverside track, and does not obviously express itself on the River Wye riverbank. There are heavy tufa gravel deposits around this sump area, with a low pool and waterfall arrangement, having good water flow. The gravels are mostly bare on this lower reach, probably because of previous shading. Around 10 *Ellipteroides w*ere seen on the system, and there is undoubtedly exchange of adults between the two parts of the Park Wood tufa system. Site visited on 26.vii.2008.

Moccas Park NNR, West 6 (SO334428)

This site was found by Andy Godfrey in 2001, as part of a larger entomological survey of the Lower Park invertebrates, commissioned by English Nature. The discovery of *E. alboscutellatus* here was rather eclipsed by the finding of the hoverfly *Myolepta potens* (Harris) (Syrphidae).

The seepage is a linear system only about 1.5m wide and about 26m long, which runs down parallel to the Park boundary fence, and on the edge of one of the more wooded sections of the Upper Park. There is less than 10% canopy cover from the oak-ash woodland here, with the under-storey heavily bracken dominated.

The flush itself has soft rush *Juncus effusus* as the dominant species, with abundant water mint and the blue-green *Carex* species as frequent. *Palustriella* cover is good and it was scored as abundant. *Briza* was present but rare, on the drier banks. Water flow was moderate over silty tufaceous gravels. The resident deer herd obviously make some passage through the flush area, helping keep it open though not greatly impacting upon it. Only 1 *Ellipteroides* was found but then the visit was at the extreme end of the flight period. Site visited on 15.viii.2008.

Whitwell Coppice SSSI (SJ621186)

This site is an 18m wide braided stream system, flowing through very open and heavily deer-grazed deciduous woodland. It flows through a small alder-dominated valley not far from the upper edge of the wood, with sycamore frequent on the drier ground. The main flush occurs under 85% canopy cover, with some denser areas locally, though generally the alder trees are tall and thin and so allow light to the flush floor. Ash-hazel woodland surrounds the small valley. This is one of Britain's most important geological localities, internationally recognised as the standard reference section for the base of the Homerian Stage, the upper half of the Wenlock Series of the Silurian System (Natural England 2013).

Palustriella is present only in the canopy gaps over tufaceous gravels and lateral seeps, and in the more slack waters in the otherwise very strong water flow. There are some drier

baulks present, though recent "flood-defence" excavations, probably connected with the nearby property, have damaged some of these. A footpath and board walk conveniently cross the system. The flush system extends for around 100m, and has dominant *Carex pendula* stands, with occasional *Ribes*. Below this main zone is a lateral wash zone where the topography allows the stream to braid on ground that otherwise enforces it to stay in channel, and here occasional hemp agrimony is found.

The stream has built a complex braided channel with much channel cross-over, with areas of flushed tufaceous gravel both with and without *Palustriella*, though the moss patches are nowhere extensive. A series of small tufa rills are present as the valley descends through the wood, and these have much woody debris. Dog's mercury is dominant in the drier woodland, with occasional enchanter's nightshade and ivy *Hedera helix*. Below the boardwalk, the main channel flow is augmented by 2 smaller streams joining it, though the impression was gained that these are not as base-rich, as tufa deposition below is reduced, presumably a consequence of the dilution and changes in the system pH. *Ellipteroides* was present in both flushed areas, although more numerous in the upper main one. Pete Boardman visited this site a few days later on 12 July, and also noted large numbers to be present (Boardman 2013). Site visited on 8.vii.2012.

The Dropping Wells, The Biblins (SO551144)

This site is well known as a geological feature and as the backdrop to the Biblins campsite by the River Wye. It is a large limestone cliff, with an extensive tufa seepage on its face, this pooling to an impacted seepage system at its base. Heavy visitor pressure and fencing have resulted in a combination of excessive erosion and lack of grazing in this basal area. The expected *Palustriella* sequence one might expect from such an arrangement is thus greatly truncated.

The vertical face of the cliff has some *Palustriella* bathed in the dropping water seeps, giving a complex of wet faces and drier buttresses. The bottom 100m or so is at a slope of c. 35°, but is badly trampled. The south-facing cliff face is fronted by light ash-hazel woodland, though the basal tufa gravels are 90% bare and trampled. Pendulous sedge *Carex pendula* occurs in the runnels at the cliff base, with *Equisetum* and hemp agrimony being rare. Behind the fenced section, the cliff face water effectively sumps. *Palustriella* occurs along a small part of the cliff bottom, in a narrow band and at about 3m up from the base. The vertical flush community is a mix of *Deschampsia*, hemp agrimony, *Mentha*, *Tussilago*, and algal and bryophyte mats. Only one *Ellipteroides* was swept from this area.

A discussion with the campsite staff revealed an easy way to the cliff top, and this was duly explored. Here, extending back c. 30m from the cliff edge is a fine tufa seepage stream system, though dry weather at the time of recording had reduced its extent a little. The main tufa stream is c. 1m wide with bare tufaceous gravels, with occasional *Palustriella,* and frequent *Juncus*, this grading into a perched and flushed *Phragmites* reedbed closer to the cliff edge and some 40m along. *Carex* is rare here, and hemp agrimony is occasional in the stands. The flushed areas had a 40% canopy cover of low birch, alder *Alnus*, oak and rare alder buckthorn *Frangula alnus*. Small runnels join the stream from the slope behind, through pond sedge beds. The overall impression is a complex of habitats, queuing up to the cliff edge. Safety consideration precluded exploring too far into the system, and *Palustriella* may be more abundant in less visible parts of the seepage complex.

The drier woodland areas at the back of the flush and between the several flush areas along the cliff edge have much bramble, with hemp agrimony and pendulous sedge in the wetter interface. The hydrology has been, in part, impacted by water collection from one of the

springheads, a large water tank having been driven into the system, though there remains enough water to keep it dynamic, and *Ellipteroides* has not been greatly affected. A return visit in 2012 showed that the system still looked in good condition. Site originally visited on 11.vii.2005.

Prisk Wood SSSI (SO532090)

This, the only Welsh site, is woodland with a small stream that has a pebbly bed, and a surrounding ground flora of hart's tongue fern, *Dryopteris*, and mossy boulders, but no *Palustriella.* The 95% canopy cover is from small-leaved lime, sycamore, field maple, and canopy-layered ivy. Peter Kirby originally identified this site in 2004 (Gwent Wildlife Trust 2004). A single *Ellipteroides* was swept from here in 2005, though the specimen has been subsequently lost, and it is unclear if the main population centre lies nearby and has yet to be discovered. Further confirmation that this indeed supports a population of *E. alboscutellatus* is needed as the watercourse is a very atypical habitat. It actually looks to be a more typical habitat of the closely related *E. limbatus* (Blythe 2010). Site visited on 11.vii.2005.

Hill Hole Dingle SSSI (SO538542)

This NCR site is a wooded stream valley with a range of tufa seepages along its length, issuing from the banks into the main channel.

The largest seepage has the springhead on the dingle edge, just below the break of slope, where it then forms a wide braid down to the stream channel. The springhead has strong flow, and the flushed areas have much dead wood. It lies under a 70% canopy of dominant ash, with some hazel, over patchy *Palustriella* beds with large extents of intervening bare tufaceous gravels. Herb robert *Geranium robertianum* is occasional as is figwort *Scrophularia*, with poor bramble bushes being frequent, with some stands of opposite-leaved golden saxifrage *Saxifraga oppositifolia*, frequent meadowsweet and dominant wood millet *Milium effusum* in some parts. There is a strong water flow throughout. The more open areas have *Palustriella* hummocks with flushed tufaceous gravels, all having extensive terracing with complex braided flow patterns. Adjacent to this area is a less active *Palustriella*-dominated area leading onto the stream below. There is much damp tufa deposition here, but it is only building at the main seepage, so it is likely that the flow has been shifted by decades of deposition. Other sections are under 90% canopy cover, again of ash-hazel woodland, with the same flow as the adjacent area but covering only 15% of the ground, and covered in much fallen timber. The main flush is some 18m wide, with the adjacent flushes being perhaps another 9m.

Further downstream, and on both banks are a range of other, although smaller, tufa seepages. A steep 50º slope down to the stream is a solid *Palustriella* bed, flanked by tufaceous gravels, the seepage into the stream seemingly through the bare tufa, although it will all be flushed. This seepage stands at some 5m long by 4m wide, and is best described as *Palustriella* hummocks, shaded by light hazel and rare wych elm *Ulmus glabra*. Opposite-leaved golden saxifrage is frequent here, with occasional herb robert and nettle *Urtica dioica*, rare enchanter's nightshade and hard fern *Blechnum spicant*. Lateral but basal water flow is good here, and is more obvious in the side gravels. The whole riverbank is extremely friable and slumping, exacerbated by extensive deer passage. There is no clear springhead here.

Another nearby flush some 7m upstream of this occurs on a shallower (35°) slope, with the bottom of the seepage entering into the stream, although covered at the time by a large log jam. Two large trees lie across this seepage. There are stronger water flows here, but less *Palustriella* cover, with many patches of flushed tufaceous gravel. The flora is similar to the

nearby flush, though this was sunnier, albeit under an 80% canopy of ash. The top of the riverbank here has a massive sedimentary rock slab face, with seepages arising in a broad zone of wetness, under 80% canopy shade from the woodland trees, and again much opposite-leaved golden saxifrage. The ground to the side of this was boggy, with strong water flows in this area, and many deer tracks.

Just about all of the seepage areas held *Ellipteroides*, and there is probably some interchange of adults between the sub-sites. A large storm event a few years later had the stream torrent carve much of the lower bank away, truncating the seepages at their base, though leaving the upper areas and the springheads untouched. Both *Stratiomys potamida* Meigen and *Oxycera terminata* Meigen (Stratiomyidae) were swept from the lower seepage areas by the stream when it was first discovered. Site visited on 13.vii.2006.

Hackfall Wood (SE236771)

As noted before (Heaver 2006) this site had not been visited by the author at the time, but now has been and is described here. This is possibly one of the better sites for *Ellipteroides*, having not only a fine waterfall but also an extensive streamside series of seepages down its length. The sides of the waterfall have extensive and steep *Palustriella* beds, assisted by some recent tree clearance around the falls that must have greatly improved the amount of light getting through. At the time there was only about 15% canopy cover over the two main water channels down the falls. Much dead wood lay in the cascade, with tufaceous silts in the pebbly channel, and a lateral side flow channel coming out from the still shady side margin woodland of hazel coppice. There were many *Palustriella* cushions here, surrounded by a typical ground flora of *Dryopteris* ferns, hard fern, dog's mercury, opposite-leaved golden saxifrage, with rare pendulous sedge. Though the side stream area had good flow, it nowhere matched the falls, though there were more gravels than silts in the former. Canopy cover away from the falls rose to 95% dense hazel coppice over the side flush, with a similar ground flora.

Near to this complex is an area with much tufaceous gravel in a 1m wide channel, with the first of the lateral stream seeps arising from another 0.5m wide channel out of hazel coppice, with a wide fan of wet quaking woodland soil. The lower parts of this seep were augmented by the stream itself, and had an *Equisetum telmateia* stand under 75% hazel canopy, with tufaceous gravel and silts in channel.

This whole complex itself then joins the main stream, which flows down the valley into the main river. Though not fully explored, it seems to have an 80% ash-hazel canopy over-topping it, with areas of the same ground flora type. Two *Ellipteroides* were taken at the base of the falls.

Some 200m downstream of this section are a set of tufaceous gravel seeps into the main stream channel, arising from out of the adjacent hazel coppice. There is much terracing here, with petrifying dead wood, and *Palustriella* cushions flushed with base rich water.

The full extent of the seepage system down the valley was not assessed, as the weather started to turn to heavy rain, but it looked to be extensive. Site visited on 13.vii.2007.

Hawks Wood, Thorpe Salvin, South Yorkshire (SK525817)

As with the Hackfall Wood site (Heaver 2006), this is a known site for the species but has not yet been visited. The record derives from Bill Ely's observation dated 28 July 1999, as recorded on the NBN (National Biodiversity Network). The mapped soil type is described as a shallow, locally brashy, well-drained calcareous fine loamy soil, of the Aberford 511a series. It appears from aerial photography to be a lateral seepage system into the Chesterfield Canal, in an area formerly worked for lime-kilns.

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