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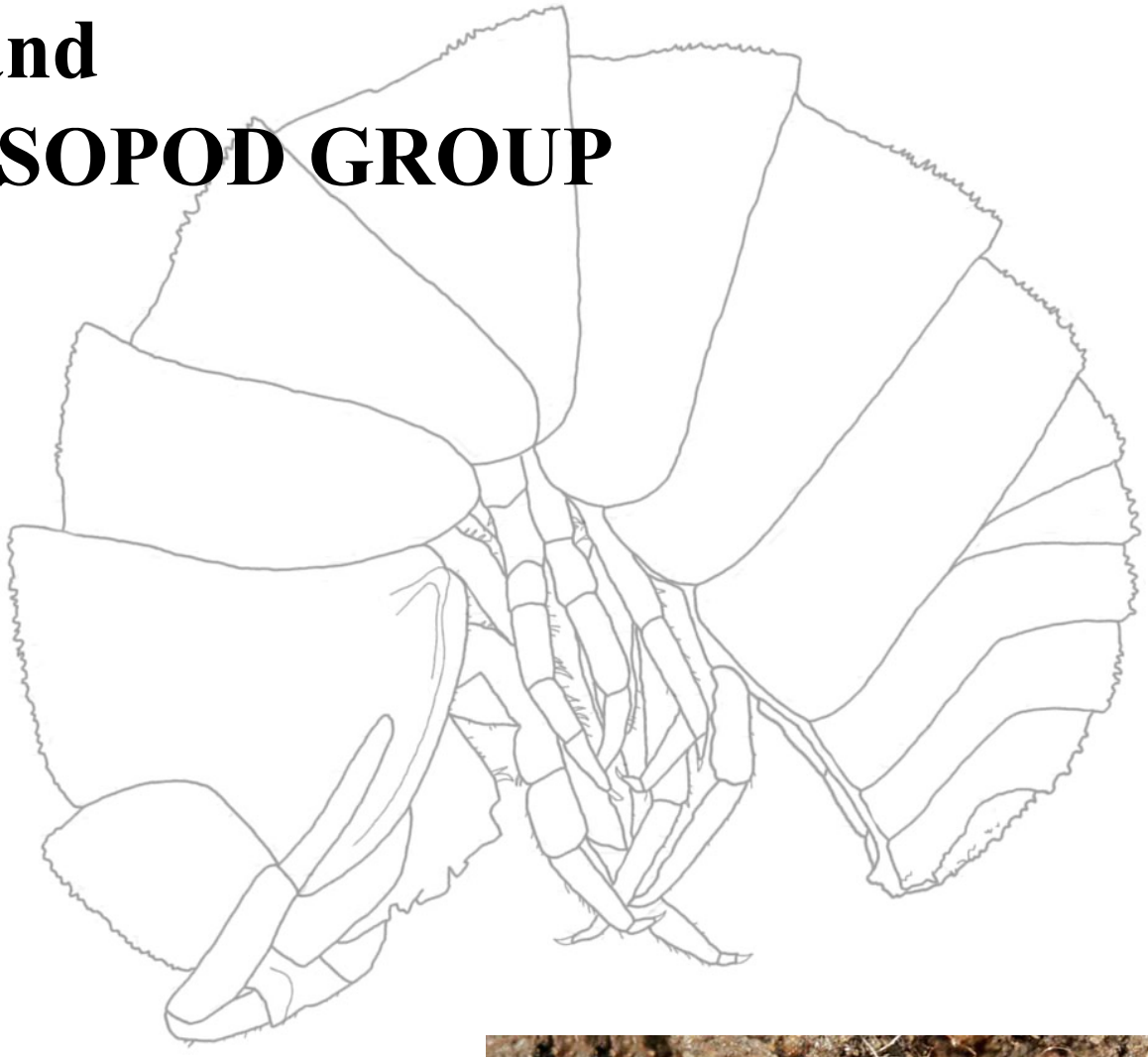
Bulletin of the BRITISH MYRIAPOD and ISOPOD GROUP



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Contents

Cover illustration: *Alloschizidium pruvoti* (Racovitza), habitus © Thomas D. Hughes
Cover photograph: *Lithobius curtipes* C.L.Koch male © Paul Richards

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Editorial

I'm writing this in what feels like strange circumstances as Europe is gradually shutting down due to the COVID-19 virus and we have had to take the difficult decision to cancel our annual field meeting. Not attending a meeting the weekend after Easter meeting will feel very peculiar. Over the years, while the actual weekend of the meeting has occasionally varied, and was once (2001) postponed to the autumn due to an outbreak of Foot and Mouth, not since before 1982 have we missed one completely. For me the meeting is an annual boost, an opportunity to feel that you are not working alone, a bit of encouragement to get on with those neglected projects and an opportunity to have conversations that only people with shared interests can have.

For me at least I did have an extra boost last year in the form of the International congress in Hungary, a great opportunity to catch up with old friends and to make new ones. Our host and congress organiser, Zoltán Korsós, is well known to some of the British myriapod community as he organised a week of collecting in Hungary for BMIG in 1994 which was memorable for the colourful millipedes, the giant chunks of meat cooked over an outdoor fire and some hilarious video footage of some strange Brits behaving very peculiarly in the Hungarian countryside!

Sadly however, the British contingent to the International Congress was very poor. While the majority of the attendees are professionals working in Universities and museums it is a very friendly group and there is plenty to be gained by those of us who work on these groups in a less professional way. The next congress is in Colombia in August 2021, the first time in South America, before it returns to Europe two years on from that.

Exotic species continue to be discovered in the UK, as this Bulletin can testify, some bringing new species of fungi with them! While many are being discovered in glass houses (as reviewed by Steve Gregory and Keith Lugg), others are being found outside and the distributions of less well known species are expanding, coupled with the discovery of more cryptic species like *Philoscia affinis* the British list continues to grow each year.

While confined to barracks this winter Tony has made good progress on the centipede atlas with help and support from BRC and we look forward to seeing the fruits of their labour. Staff from BRC have also been hugely supportive in helping BMIG change the way the mailing list is handled and the newsletters sent out. Now using Mail Chimp it is hoped to be able to send out communications more frequently than the previous twice yearly formal newsletters. You should have received one announcing the publication of this Bulletin for example. If you are not on our mailing list do consider signing up, which you can do from the web pages (www.bmig.org).

Let us hope that the period of confinement that many of us are experiencing at the moment encourages some productivity, in sorting out, identifying and writing up projects. The Bulletin would be pleased to hear from you if this is the case!

I hope that all our readers keep safe in these uncertain times and look forward to flurries of activity on social media to keep our spirits up.

Helen Read

Further observations of *Philoscia affinis* Verhoeff, 1908 (Isopoda, Oniscidea, Philosciidae) in Britain and Ireland: Distribution, Habitat and Identification

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Abstract

Philoscia affinis Verhoeff was first reported in Britain in 2017. Subsequently, records from 52 localities, within 40 hectads, have been submitted to the BMIG Non-marine Isopod Recording Scheme. These are mostly the result of targeted field work undertaken since 2018, but examination of reference collections of *Philoscia muscorum* (Scopoli) has revealed three additional sites recorded between 2004 and 2007. A provisional distribution map indicates that most records are from western Britain, suggesting an Atlantic distribution. *P. affinis* favours open woodland and coastal habitats and at some sites has been found to co-exist with *P. muscorum*. It is considered that previously *P. affinis* has been overlooked in Britain and Ireland due to its close resemblance its common congener *P. muscorum*. An illustrated guide to the identification of *P. affinis* and *P. muscorum* is given.

Key words: Isopoda, Oniscidea, *Philoscia affinis*, Britain, Ireland, distribution, habitat, identification.

Introduction

The Striped Woodlouse *Philoscia muscorum* (Scopoli) is ubiquitous in southern England (Gregory, 2009), where it rarely gets a second glance from most active woodlouse recorders. However, a second species, *Philoscia affinis* Verhoeff, 1908 is known to occur just across the Channel in northern France and Belgium (Séchet & Noël, 2015; Boeraeve, De Smedt, Arijs & Segers, 2017). In July 2017 *P. affinis* was confirmed as occurring in the UK (Segers, Boeraeve & De Smedt, 2018) with the collection of specimens from woodland in Arundel, West Sussex during a SPINICORNIS (www.spinicornis.be/) field excursion to south-east England. This is the first native or naturalised woodlouse (Isopoda: Oniscidea) to be recorded from Britain or Ireland since *Trichoniscoides helveticus* (Carl) was added by Steve Hopkin in 1990 (Gregory, 2009).

Following the recommendation of Segers, *et al*. (2018), the author examined his personal voucher collection of *P. muscorum*, which comprised fourteen tubes (mostly from Oxfordshire) and BMIG's basic and research collections (Harper, 2007) of nine tubes, mostly from south Wales and south-east England. In addition the author put out a plea in the BMIG Newsletter (Gregory, 2017) to encourage recorders to look out for this species. As a result a number additional UK records have come to light from various sources which are collated and discussed below.

Observations of *Philoscia affinis*

Since its discovery in 2017 *Philoscia affinis* has been recorded from 52 localities falling within 40 hectads in Britain and Ireland. Summary details of the records are listed in Appendix I.

In addition to the two sites given by Segers, *et al*. (2018), Hughes (2019) reports three sites in Caernarvonshire, north Wales and Anderson (2019) three sites in Co. Down and Co. Antrim, Northern Ireland. Examination of reference collections of *Philoscia muscorum* has revealed three additional sites for *P. affinis*. Two from south Wales (collected in 2004) were discovered following the examination of specimens held in the BMIG Collection and one from western Scotland (near Oban, in 2007) that is held in the author's reference collection. Records for an additional 41 localities have been submitted to the BMIG Non-marine Isopod Recording Scheme (www.bmig.org.uk/page/woodlice-waterlice-recording-

scheme) either submitted directly to the Recording Scheme organiser (the author); submitted via Biological Record Centre's iRecord website (www.brc.ac.uk/irecord/) and verified by the author; or data extracted by the author from BMIG's *Isopods and Myriapods of Britain and Ireland* group (https://www.facebook.com/groups/407075766387553/). A few additional, but poor, images of possible *P. affinis* have been posted online (e.g. from Essex, Yorkshire and southern Ireland), but in the absence of a specimen these have not been accepted by the Recording Scheme.

Distribution

A provisional distribution map for *Philoscia affinis*, based on the accepted records (Appendix I), is shown in Fig. 1. For comparison the map includes verified records (c. 700) for *Philoscia muscorum* submitted to the Recording Scheme from July 2017 to end December 2019. Although the first British records of *P. affinis* were from south-east England (South Essex and West Sussex) (Segers *et al*., 2018), the majority of subsequent records have been made from western Britain, from south Devon, through Wales and Lancashire into western Scotland as far north as the North Ebudes. There is a scattering of records across Northern Ireland (Counties Antrim, Down and Tyrone) and an outlying population on the Burren (County Clare). A large proportion of the records are from coastal areas, but it is clearly able to penetrate far inland. Records range from sea level to 240m asl at Cwn Bychan, North Wales and up to 370m asl at McArt's Fort in Northern Ireland. It is of note that the UK supports, by far, the most northerly known populations of *P. affinis*. The record from Raasay, North Ebudes (northern-most red dot in Fig. 1) is some 700km further north than previously known observations in Belgium (Boeraeve, *et al*., 2017).

Although the distribution map reflects areas where a few recorders have actively searched for this species, the general western trend appears to be genuine. Experienced recorders have not recorded *P. affinis* from eastern parts of Britain, including the Lothians of south-east Scotland where it has been specifically searched for (W. Maguire, pers. comm.) and parts of East Anglia (pers. obsv.; T. Hughes, pers. comm.), nor in central southern England (pers. obsv.; K. Lugg, pers. comm.). Thus, *P. affinis* seems to exhibit a typical western 'Atlantic' distribution in the British Isles and additional field work may prove it to be more widespread across Ireland. This contrasts with the more south-eastern 'Continental' bias noted for the distribution of *P. muscorum* (Gregory, 2009). Interestingly, one recent record is from the Weald in south-east England (Ashdown Forest), an area that is known to experience a relatively mild 'Atlantic' climate compared to other parts of the typically more 'Continental' south-eastern England (Chater, 1984). For example, this area is known to support inland populations of the strictly Atlantic woodlouse *Porcellionides cingendus* (Kinahan).

It is of note that during BMIG's spring 2019 field meeting to the Galloway coast, south west Scotland, *P. affinis* was collected from six rural sites (marked * in Appendix I) in both coastal habitats and inland woodland, but the only confirmed record for *P. muscorum* (i.e. male specimen examined) was from an ornamental garden (Cally Gardens); very much a synanthropic site. Subsequently, *P. affinis* has been recorded further north from the islands of Lismore and Raasay, with possible females from Arran (specimens examined by author) and Skye. These are important observations because during BMIG's previous field meetings in western Scotland (which predate the discovery of *P. affinis* in Britain), *P. muscorum* had been widely recorded from Kirkcudbrightshire (Gregory, 1997), Ayrshire (Collis, 2007), Argyllshire (Collis, 2008) and Kintyre (Gregory, 2016). One of these records (Oban 'wooded slopes', see Appendix I) has subsequently been shown by examination of voucher material to be *P. affinis*. Unfortunately, no additional voucher material of *Philoscia* collected during these meetings is available to check species identification.

Thus, it seems quite probable that some (possibly many) populations of *P. muscorum* reported from western Britain (and are mapped in Gregory, 2009) will be found to include, or to be entirely composed

of *P. affinis*. In Wales and western northern England both *P. affinis* and *P. muscorum* are known to coexist at the same site (see *Habitats, microsites and associated species* below). However, current evidence (albeit limited) suggests that *P. affinis* may partially (or even completely) replace *P. muscorum* in rural sites in western Scotland. This could be true also in Ireland, where, based on the few available records, *P. affinis* seems to be the predominant species found in rural habitats (Roy Anderson; Warren Maguire, pers. comms.). The conclusion is that many of the records for *P. muscorum* from the west coast of Scotland and across Ireland shown in Gregory (2009) could be erroneous and actually refer to *P. affinis*.

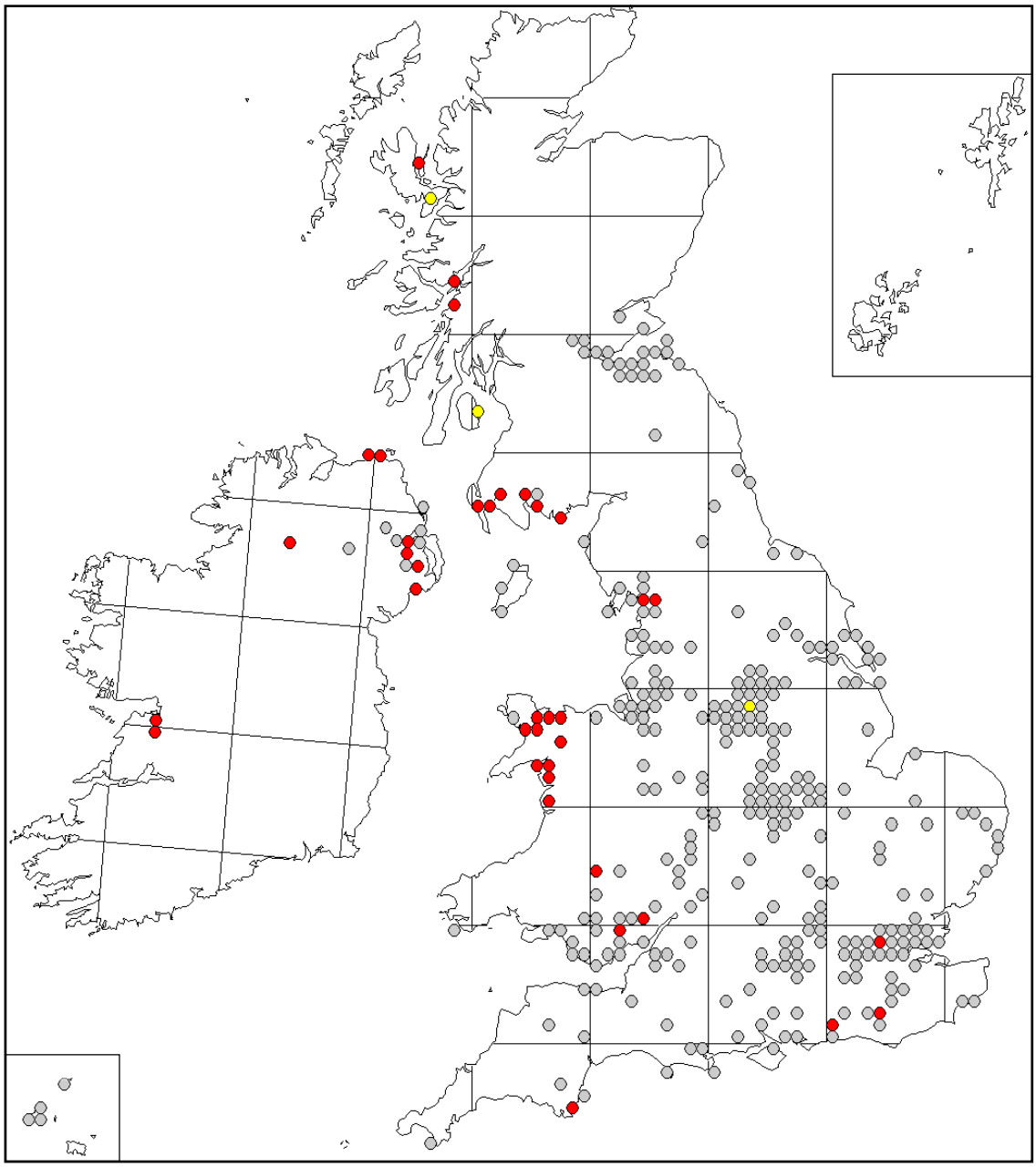

Figure 1: Provisional distribution of *Philoscia* species in Britain and Ireland.
***Philoscia affinis*:** ● Confirmed male specimens; ● Possible female specimens (data from App. I).
***Philoscia muscorum*:** ○ Verified records submitted to iRecord, July 2017 to end December 2019.
Where both species are present *P.affinis* takes precedence. Plotted at 10km (hectad) resolution.

Habitat, micro-sites and associated species

The majority of known British sites for *P. affinis* are open deciduous woodland, often oak *Quercus* sp., but also other deciduous trees, including alder *Alnus glutinosa* carr. The northern-most record from Raasay, North Ebudes was made from Hazel *Corylus avenula* and Downy Birch *Betula pubescens* 'Celtic Rainforest'. It appears to avoid deep shade, such as found beneath a closed canopy. It is typically found under stones and dead wood; from among accumulations of leaf litter, such as found at the base of trees and rocks; or among carpets of moss. On one occasion it was collected using a suction sampler (R. Gallon, pers. comm.). In woodlands it is typically associated with the ubiquitous *Oniscus asellus* Linnaeus, *Porcellio scaber* Latreille, *Trichoniscus pusillus* agg. and, on several occasions, *P. muscorum*.

However, *P. affinis* is by no means confined to woodland and also has been collected from coastal habitats. In south Devon it was collected from rank wet coastal grassland (K. Lugg, pers. comm.). In North Wales Hughes (2019) reports its occurrence (associated with *P. muscorum* and *Porcellionides cingendus*, T. Hughes, pers. comm.) from among shingle where leaf-litter derived from adjacent woodland had accumulated (Fig. 2B). In south-west Scotland it has been collected from among thick carpets of moss, beneath dead wood on rank fescue *Festuca* sp. grassland (at one site associated with *Armadillidium pulchellum* (Zencker)) or beneath drift wood along the strandline. In Northern Ireland, Anderson (2019) reports *P. affinis* from calcareous valley fen (among the roots of vegetation and moss) and from upland peaty heath (370m asl). On the Burren in Ireland it has been recorded from unimproved grassland (including pitfall traps) and on limestone pavement (R. Anderson, pers. comm.).

The distribution of *P. affinis* is not restricted by underlying geology and it occurs on both acidic substrates (Hughes, 2019; Fig. 2A) and on calcareous substrates (N. Garnham, pers. comm; Figs. 3A-B). The majority of records are from ground level, but above ground observations include on a dry stone wall (N. Garnham, pers. comm.), in a Malaise trap (R. Anderson, pers. comm.) and a female knocked from dead wood on a tree at 2m height (S. Gibson, pers. comm.). The key requirement seems to be for a stable habitat that provides relatively high levels of humidity. Such conditions are typically found in woodland, but also occur in open habitats in western coastal areas (as noted for terrestrial Molluscs by Kerney, 1999). In addition, minimum winter temperatures on the western coast are ameliorated by the relatively warm North Atlantic drift, such that 'tender' exotic plants such as *Fuchsia* sp. are able to survive outdoors even in western Scotland (pers. obsv.). Thus, it is perhaps not unexpected that the 'southern European' *P. affinis* is able to survive in these areas.

Many recorders have reported that both *P. affinis* and *P. muscorum* may be found at the same site (e.g. N. Garnham; T. Hughes, pers. comms.), occasionally beneath the same log or stone. Another example of the co-existence of these two species is illustrated by the BMIG reference collection sample from Aberedw Woods, south Wales (Appendix I), which was found to contain six male specimens of *P. affinis* and six of *P. muscorum* (with about 50 unidentified females). Interestingly, although *P. affinis* was readily found at six rural sites during BMIG's spring 2019 field meeting in south western Scotland (Appendix I), *P. muscorum* was not found at the same sites, but was only recorded from a synanthropic ornamental garden in the same general area.

The fact that *P. affinis* is characteristically found in rural semi-natural habitats suggests that it is most likely an over-looked native species. However, there remain very few confirmed observations in Britain and Ireland and additional observations will help clarify the situation. Certainly, in northern France and Belgium, where woodlouse recorders have been more active in recent years, *P. affinis* is thought to have been long present, but under-recorded (Séchet & Noël, 2015; Boeraeve, *et al*., 2017). This may also be true in Britain and Ireland. It is perhaps unfortunate that its congener *P. muscorum* has long been considered to be an 'easy' species that can be readily identified in the field (the author included). Few active recorders (again author included) have ever kept voucher specimens of *Philoscia* making it difficult to verify old records.

Figure 2: Habitat views of sites where *Philoscia affinis* has been recorded (Caernarvonshire). A) Acidic woodland at Roman Camp, Bangor; B) Coastal shingle adjacent to woodland at Spinnies, Aberogwen (images © Thomas Hughes).

Figure 3: Habitat views of sites where *Philoscia affinis* has been recorded (West Lancashire). Open woodland on limestone: A) Warton Crag LNR; B) Trowbarrow LNR (images © Nicola Garnham).

Pitfalls of Identification

Both *Philoscia affinis* and *P. muscorum* are similar in general appearance and body size (up to 11mm in length), hence the past confusion. Segers, *et al*. (2018) and Hughes (2019) provide basic information and figures for distinguishing *P. affinis* from its considerably more widespread congener *P. muscorum*. Male specimens, if viewed correctly, should not present problems with identification. However, several active recorders have noted areas of potential confusion in distinguishing the two species (as highlighted by Anderson, 2019). Firstly, both species may co-exist; secondly, both species exhibit numerous (and similar) colour varieties; and thirdly, males of both species bear a toothed spur (albeit of different orientation) on the merus of pereiopod 7. These potential pitfalls in identification are discussed below.

Head and body pigmentation

A useful (but un-reliable) field assessment can be made from head pigmentation of adults and larger specimens. In *P. affinis* the head typically is brown speckled with paler yellowish mottling (never uniformly pigmented) and usually of a similar colour to, or slightly darker than, the body (Figs. 4B, 5A-B & 6A-D). Sometimes there is an indistinct yellow mark at the back of the head. In *P. muscorum* the head is typically uniformly pigmented, often black (but may be brown, red or other colours). However, typically it is noticeably darker than the body (Fig. 4A). Characteristically, there is a contrasting bright yellow spot at the rear of the head, but this may be feebly developed or sometimes entirely absent. In immature specimens of *P. muscorum* the head may be speckled with paler mottling as seen in typical *P.affinis*. Head pigmentation characters may not be apparent in pale colour forms of either species.

There are also consistent differences in body pigmentation. As a rule, *P. affinis* lacks the white and orange/brown stripe along the edge of the epimera (which is typical for *P. muscorum*). Instead it has a clear white oval spot towards the front of each epimeron (compare Figs. 4A & 4B; also see Segers, *et al*., 2018, fig. 2). However, a large variety of colour forms occur in both species (Figs. 5 & 6) and exceptions to the typical pigmentation patterns are frequently encountered. Some examples of the wide range of colour variation seen in *P. muscorum* can be seen on the BMIG website (BMIG, 2019) and for *P. affinis* (in France) at Galerie du Monde des Insectes (2019).

Figure 4: Female *Philoscia* species showing typical habitus. A) *Philoscia muscorum*; B) *Philoscia* cf *affinis* (images from BMIG website © Paul Richards). Also see Segers, *et al.* (2018, fig. 2).

Figure 5: Some colour forms of female *Philoscia affinis*
A) Live specimen, Lancashire (image © Nicola Garnham); B) Specimens freshly preserved in 70% IDA, Ringdoo Point, Wigtownshire (image by author).

Figure 6: Some colour forms of male *Philoscia affinis*.
Live specimens from A) South Wales (image © Christian Owen); B) Northern Ireland (image © Roy Anderson); C) & D) South-west Scotland (images © Warren Maguire).

Male secondary sexual characters

Reliable identification can only be undertaken by examination of a male specimen. Examination of male pleopods 1 and 2 is not helpful in the separation of these two species (Vandel, 1962; Gruner, 1966). However, the two species can be readily separated by examination of male pereiopod 7 which bears a triangular projection at the base of the merus in both species (Fig. 7A-D). The direction of viewing is critical and both Boeraeve, *et al*. (2017) and Anderson (2019) highlight the potential confusion caused by viewing male pereiopod 7 from an inconsistent angle. Pereiopod 7 must be observed in lateral view, most easily achieved by removing it from the specimen and allowing it to lie flat (as in Figs. 7C-D). In this position (lateral view) the projection is clearly visible in *P. affinis* as a ventrally projecting 'tooth' (Fig. 7D; also see Segers, *et al*. 2018, fig. 3A; Hughes, 2019, fig.4; Gruner, 1966, fig. 172).

In *P. muscorum*, with pereiopod 7 in the same orientation, the projection curves around the merus towards the mid-line of the animal and, because it is partially obscured, appears as a low rounded bump the meral base (Figs. 7B-C; also see Segers, *et al*. 2018, fig. 3B; Gruner, 1966, fig. 170). Unfortunately, this 'bump' is barely discernible in Oliver & Meecham's (1993) fig. 27B. However, if pereiopod 7 is rotated through 90° (to give ventral view) this curved spur may become conspicuous (as in Fig. 7A), especially in smaller individuals where it seems to be more prominent, resulting in possible mis-identification as *P. affinis*. The figures in Vandel (1962; figs. 250, 253, 254) are misleading.

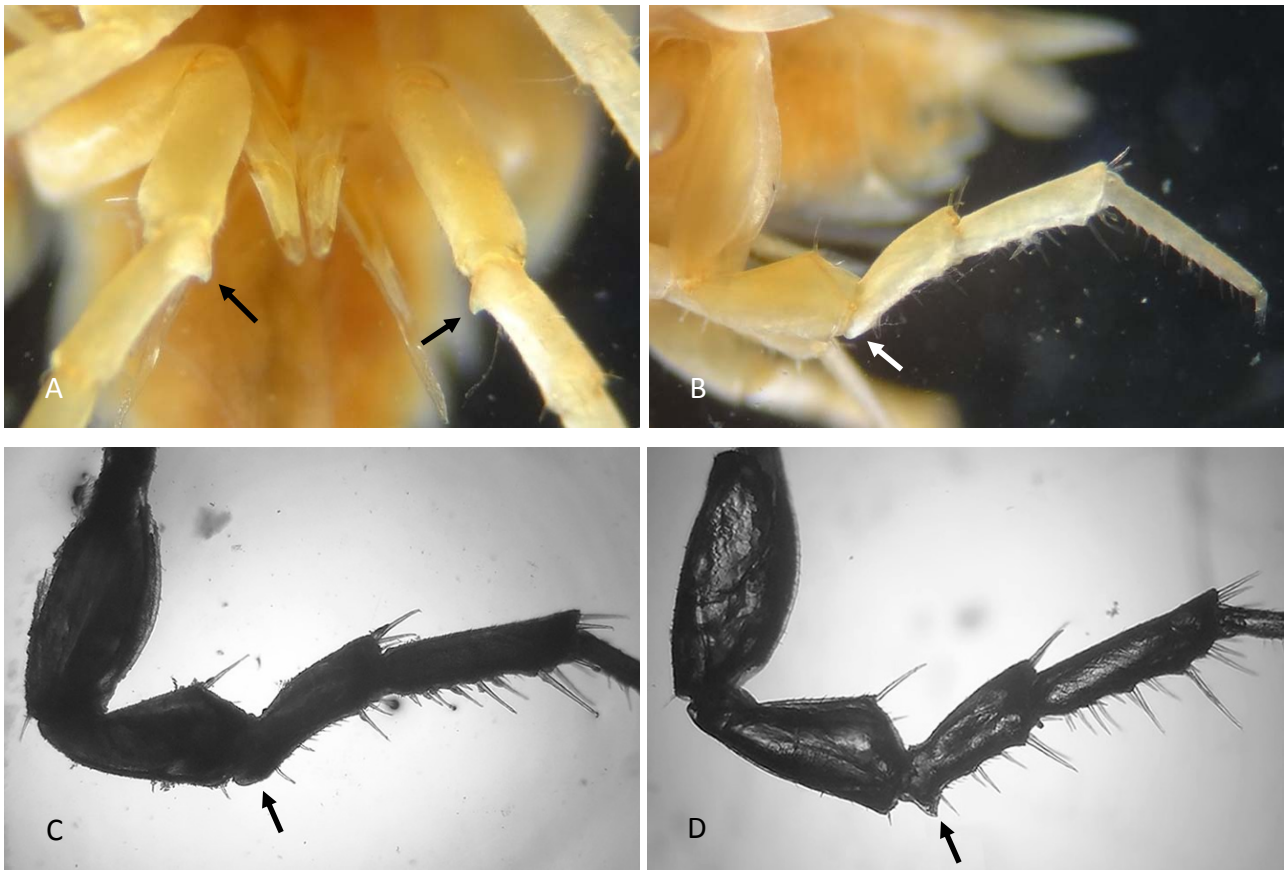

Figure 7: Male *Philoscia* species, pereiopod 7.

***Philoscia muscorum*:** A) Pereiopod 7, ventral view, showing triangular projections at base of merus (arrowed) (tips of male endopods 1 & 2 are visible at centre of image); B) & C) Same specimen as above, but pereiopod 7 rotated through 90° to give lateral view and the triangular projection is now obscured from view (arrowed).

***Philoscia affinis*:** D) Pereiopod 7, lateral view, indicating diagnostic ventrally directed triangular projection at base of merus (arrowed).

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Roy Anderson, Nicola Garnham, Tom Hughes, Warren Maguire, Christian Owen and Paul Richards provided much discussion and kindly allowed the use of their images in this paper.

I'm grateful to Frank Noël and Pallieter De Smedt for promptly answering my many queries regarding *Philoscia affinis*.

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Appendix I: Records of *Philoscia affinis* submitted to the British & Irish (BMIG) Woodlouse Recording Scheme to end December 2019.
Records based on male specimens, except where noted '♀ only'. * indicates records from BMIG's 2019 spring field meeting to south west Scotland.

Locality	Grid Ref	VC	VC Name	Broad Habitat	Date	Source/Recorder
Published records						
Wanstead	TQ423869	18	South Essex	Allotments	01.x.1985	Segers *et al*. (2018)
Houghton (Arundel)	TQ001110	13	West Sussex	Deciduous woodland	15.vii.2017	Segers *et al*. (2018)
McArt's Fort	J324795	H39	County Antrim	Peaty upland heath (at 70m asl)	23.xi.2018	Anderson (2019)
Corbally Ponds Fen	J451386	H38	County Down	Calcareous valley Fen	17.x.2018 11.xii.2018	Anderson (2019)
Turmennan Fen	J485500	H38	County Down	Deciduous woodland	12.ix.2018 29.x.2018	Anderson (2019)
Roman Camp, Bangor	SH580727	49	Caernarvonshire	Acidic deciduous woodland	24.xi.2018	Hughes (2019)
Bangor Mountain	SH583719	49	Caernarvonshire	Acidic deciduous woodland	07.ii.2019	Hughes (2019)
Spinnies, Aberogwen	SH617724	49	Caernarvonshire	Vegetated coastal shingle	09.ii.2019	Hughes (2019)
Records derived by examination of reference collections						
Aberedw Woods	SO083471	43	Radnorshire	Mixed woodland; 6m (and 6m P.muscorum) [c. 50ff]	08.viii.2004	BMIG Coll., tube AL
Croes-Robert Wood	SO478058	35	Monmouthshire	Mixed woodland; 4m 2f	21.viii.2004	BMIG Coll., tube GI
Oban, 'wooded slopes'	NM86-29-	98	Argyllshire	Habitat not recorded; 1m 5f	05.x.2007	Author's Collection
Recent additional field observations, in chronological order						
Dolgoch Falls	SH652043	48	Merionethshire	Deciduous woodland	26.xi.2017	S.J. Gregory
Slapton Ley	SX829444	3	South Devon	Rank grassland above shore	10.xii.2017	K. Lugg
Ecclesall wood (♀ only)	SK318823	63	S.W. Yorkshire	Ancient deciduous woodland	16.ii.2018	P. Richards
Newborough Warren	SH432627	52	Anglesey	Grassland above shore	05.iii.2018	J.H. Bratton
Warton Crag LNR	SD496725	60	West Lancashire	Calcareous deciduous woodland	05.iv.2018 25.xi.2018	N. Garnham
Slievecarran NR, Burren	M3--0-- various	H9	County Clare	Limestone pavement, grassland, scrub, etc	07.vii.2018 08.ix.2018	R. Anderson
Ballyogan Loughs	R377908	H9	County Clare	Limestone pavement	11.viii.2018	R. Anderson
Near Risca	ST266907	35	Monmouthshire	Alder *Alnus* carr woodland	15.ix.2018	C. Owen
Moelyci	SH597670	49	Caernarvonshire	Not recorded	01.xi.2018	J.H. Bratton
Trowbarrow LNR	SD480756 SD481755	60	West Lancashire	Calcareous deciduous woodland	07.xi.2018 15.x.2019	N. Garnham

Minnowburn Beeches	J323684	H38	County Down	Fen carr woodland	01.i.2019	R. Anderson
Coed Gorswen NNR	SH755710	49	Caernarvonshire	Acidic deciduous woodland	05.i.2019	R. Gallon
Sir Thomas & Lady Dixon Park	J303673	H39	County Antrim	Leaf litter in parks dump	08.i.2019	R. Anderson
Belfast Castle Estate	J325794	H39	County Antrim	Deciduous woodland	30.i.2019	R. Anderson
Lords Lot, Capernwray	SD543712	60	West Lancashire	Deciduous woodland	10.ii.2019 08.xi.2019	N. Garnham
Rathmullan Point, Tyrella	J484358	H38	County Down	Coastal grassland	10.iv.2019	R. Anderson
Port Moon, Benbane head	C978451	H39	County Antrim	Coastal grassland	21.vi.2019	R. Anderson
Ringdoo Point*	NX170551	74	Wigtownshire	Rank Fescue grassland above shore	26.iv.2019	S.J. Gregory, K. Lugg & W. Maguire
Mullock Bay*	NX708437	73	Kirkcudbrightshire	Rank Fescue grassland above shore	27.iv.2019	S.J. Gregory, K. Lugg & W. Maguire
Ravenshall Wood*	NX525522	73	Kirkcudbrightshire	Deciduous woodland	27.iv.2019	S.J. Gregory
Kirroughtree Forest*	NX456646	73	Kirkcudbrightshire	Deciduous woodland	28.iv.2019	S.J. Gregory
Black Loch, Gargre Moor*	NX27-65-	74	Wigtownshire	Under stones on heather moor	28.iv.2019	H.J. Read
Craigoch Park Moor*	NX00-53-	74	Wigtownshire	Rank Fescue grassland above shore	29.iv.2019	K.N.A. Alexander
Ashdown Forest, Chestnut Gill	TQ449275	13	West Sussex	Deciduous woodland	29.iv.2019	M. Funnel
Plas y Brenin	SH716578	49	Caernarvonshire	Oak & mixed woodland (200m asl)	May 2019	T. Hughes & R. Gallon
Coed Crafnant NR	SH617286	48	Merionethshire	Acidic deciduous woodland	31.v.2019	R. Gallon
White Park Bay	D018438	H39	County Antrim	Grey dunes on coast	08.vii.2019	R. Anderson
Weir's Snout, Giant's Causeway	C943441	H39	County Antrim	*Phragmites* swamp above shore	23.vii.2019	R. Anderson
Achueran House, Lismore	NM889452	98	Argyllshire	Not recorded	28.vii.2019	D. Whiteley
Camas Mhic Lairtidh, Lismore	NM872454	98	Argyllshire	Not recorded	29.vii.2019	D. Whiteley
Lamlash, Arran (♀ only)	NS042325	100	Clyde Islands	Deciduous woodland corridor	03.viii.2019	G. Maguire
Holy Island, Arran (♀ only)	NS05-30-	100	Clyde Islands	Heather moorland	07.viii.2019	G. Maguire
Rakeeranbeg, Dromore,	H389611	I 36	County Tyrone	Acidic deciduous woodland on peat	07.viii.2019	W. Maguire
Tokavaig, Skye (♀ only)	NG60-11-	104	North Ebudes	Deciduous woodland	22.viii.2019	S. Gibson
Cwm Bychan	SH648309	48	Merionethshire	Acidic decid. woodland (240m asl)	08.ix.2019	S.J. Gregory
North east of Harlech	SH589314	48	Merionethshire	Acidic deciduous woodland edge	12.ix.2019	S.J. Gregory
Wern Y Wylan Wood	SH555798	52	Anglesey	Deciduous woodland, Oak Litter	19.ix.2019	P. Richards
Leighton Moss NR	SD487758	60	West Lancashire	Deciduous Woodland	19.x.2019	N. Garnham
Eaves Wood	SD470761	60	West Lancashire	Deciduous Woodland	20.x.2019	N. Garnham
Loch Eadar dà Bhaile, Raasay	NG55-40-	104	North Ebudes	Celtic Rainforest (Hazel, Birch)	27.xi.2019	S. Gibson
Hyning Scout	SD502737	60	West Lancashire	Deciduous Woodland	28.xi.2019	N. Garnham

Upland centipedes in North Wales with a review of the Welsh Chilopoda

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Abstract

Since Eason's (1957) paper on centipedes from Carnarvonshire there has been an accumulation of centipede records from various parts of Wales but relatively few are from upland areas. Recent records from Snowdonia included several species, including *Lithobius* (*Monotarsobius*) *curtipes*, from locations up to around 1,000m. We present a review of centipedes recorded from the 13 Welsh vice-counties which includes 41 species, 4 of which are from buildings or heated greenhouses, 4 apparently obligate halophiles from coastal sites and one doubtful. Wales has a variety of types of habitat including both lowland and montane rural areas and urban/industrial/post-industrial locations which no doubt contributes to the diversity of its chilopod fauna.

Introduction

The centipede *Lithobius curtipes* is not known in Britain from large numbers of past records, indeed in his *Cotteswold* paper of 1953, E.H. Eason (Eason, 1953) had referred to his record from Kildanes Scrubs, Gloucestershire in 1952 as only the third British record. The finding of it by RG at around 1,000m in Snowdonia, along with *Lithobius variegatus* and *Strigamia acuminata* at similar heights, prompted us to look at the occurrence of upland centipedes in North Wales and in Wales in general and to review the species recorded from the principality.

The highest point in the North Wales area, indeed in the whole of Wales, is Snowdon (Yr Wyddfa) at 1,085m (3,560ft) whilst the principality as a whole contains 188 locations in excess of 610m (2,000ft), Pen-y-Fan in the Brecon Beacons at 886m being the highest outside Snowdonia. By comparison, the highest point in England is Scafell Pike in Cumbria at 978m with Cheviot at 815m and Cross Fell in the Pennines 893m. The highest point in southern England is High Willhays on Dartmoor (621m). Scottish upland areas reach greater altitudes with Ben Nevis at 1,345m and 282 "Munros" (over 3,000ft = 914m) on the Scottish Mountaineering Club list. Whilst these altitudes are relatively low compared with many areas of Europe, Britain and Ireland are off the western (Atlantic) edge of the continent with a corresponding moister oceanic climate of warmer winters and cooler summers.

Records from North Wales

E.H. Eason (1957) published an account of the Chilopoda and Diplopoda of Caernarvonshire in which, as well as listing species, he quoted the highest altitude for species that were found above 180m. He used records collected by himself, by J.G. Blower, P.M. Butler and O. Gilbert with the highest altitude recorded being 460m at Clogwyn Mawr (PMB) for *Lithobius variegatus*, *Lithobius borealis* (recorded as *L. lapidicola*), *Geophilus carpophagus* and *Geophilus truncorum* (as *Brachygeophilus truncorum*).

Since the publication of this paper there has been an accumulation of centipede records from various parts of Wales which are now held by the Centipede Recording Scheme / Biological Records Centre, but, apart from some from South Wales and the Brecon Beacons and a handful from Montgomery and Radnor, relatively few are from upland areas.

In this account detail is included for species that have been recorded from higher altitudes but, to put this in context, we also include all centipede species for which we appear to have Welsh records together with comments on their occurrence. Records from the Eason paper are indicated (E), from RG collections (RG), from Welsh Peatland Invertebrate Survey (WPIS), and from other sources e.g. Centipede Recording Scheme data (O). Reference is made to Watsonian vice-counties 35 (Monmouthshire), 41 (Glamorgan), 42 (Breconshire), 43 (Radnorshire), 44 (Carmarthenshire), 45 (Pembrokeshire), 46 (Cardiganshire), 47 (Montgomeryshire), 48 (Merionethshire), 49 (Caernarvonshire), 50 (Denbighshire), 51 (Flintshire) and 52 (Anglesey). We use here the term "North Wales" to refer to vice-counties 48-52. The number of records from the latter is given as an approximate figure because of overlap of sites, duplication by different recorders or use of different names for the same site. Highest recorded altitudes for Britain and Ireland are those from Centipede Recording Scheme/BRC and are those current for records up to the end of 2018 unless indicated otherwise. See Table 1 for list of vice county records for Welsh centipedes.

Order Geophilomorpha

***Haplophilus subterraneus* Shaw, 1794**

Eason (1957) did not find this in Snowdonia although it was present on the Creuddyn. It is a species very widespread in Britain with many lowland Welsh records, but with no British/Irish locations known for it from above 366m. Records (O) are scattered across North Wales from all vice-counties (48-52) with the highest recorded altitude being only 140m at Beddgelert (1984). In the rest of Wales, it is recorded from all vice-counties (35, 41-47) and at an altitude up to 350m at Dol-y-Gaer (1989). It is often associated with human activity and can be found in soil in gardens and allotments.

***Hydroschendyla submarina* (Grube, 1869)**

This is an exclusively littoral species typically found in rock crevices at or below high water mark and has been recorded three times from the coast of Pembrokeshire (VC45): Westdale Bay and Watwick Areas (both 1957) and Ramsey Island (1999). It is not often recorded, probably because of its habits, but has been found in south-west England, Yorkshire, Ireland and Jersey.

***Schendyla dentata* (Brolemann & Ribaut, 1911)**

This small (12mm), soil dwelling parthenogenetic species was not identified from Britain until the 1960s since when it has been recorded on a number of occasions, always in more or less synanthropic sites such as parks, churchyards and waste ground and mostly in an area south of Norfolk to Shropshire, but also from Edinburgh and from Ireland. The only Welsh record is from the south, Bynea, Llanelli (VC44, 2008) where it was found by John Harper. It could probably turn up in other areas of Wales in appropriate habitats. The highest recorded altitude for Britain and Ireland is 180m.

***Schendyla nemorensis* (C.L. Koch, 1837)**

Described (E) as fairly common in Snowdonia and recorded from litter at Blaen Nanmor at 210m, also at Beddgelert and Nantmor, this species is widespread in Wales and in the British Isles generally, but rarer in the north and there are no British/Irish records from above 500m. It is a small species (up to 20mm) and easily missed. There are records from all Welsh vice counties 41-52 and 35 although not much more than 20 in total from our northern ones (E, O). The highest recorded location for it in North Wales is at Chirk Castle at 100m (VC50, 1996), whilst for the remainder of Wales it is Craig Cerrig-gleisiad, 400m (VC42, 2011). The highest recorded altitude for Britain and Ireland is 490m.

***Schendyla peyerimhoffi* Brolemann & Ribaut, 1911**

This is a species somewhat similar to the last but, in Britain and Ireland, at least, it appears to be exclusively littoral. There are North Wales records from Malltraeth (VC52, 1983, 1985) and from Foryd

Table 1: Welsh Centipedes: Vice County Records

X = Recorded; (X) Recorded inside Building/ Heated Greenhouse; ? = Doubtful Record

Vice-county:	35	41	42	43	44	45	46	47	48	49	50	51	52	Notes
Haplophilus subterraneus	X	X	X	X	X	X	X	X	X	X	X	X	X	
Hydroschenyla submarina						X								Littoral
Schendyla dentata					X									
Schendyla nemorensis	X	X	X	X	X	X	X	X	X	X	X	X	X	
Schendyla peyerimhoffi		X								X			X	Littoral
Henia brevis	X	X	X											
Henia vesuviana		X			X							X		
Strigamia acuminata	X	X	X	X	X	X	X	X	X	X	X	X	X	
Strigamia crassipes	X	X	X	X	X		X			X				
Strigamia maritima	X	X			X	X	X		X	X	X	X	X	Littoral
Geophilus alpinus	X	X	X	X	X		X	X		X	X	X	X	
Geophilus carpophagus s.l.		X	X	X	X	X	X	X	X	X	X		X	
Geophilus carpophagus s.s.	X	X			X					X				
Geophilus easoni	X	X	X	X	X	X	X	X	X	X	X	X		
Geophilus electricus	X	X	X	X			X		X	X	X	X	X	
Geophilus flavus	X	X	X	X	X	X	X			X	X	X	X	
Geophilus osquidatum	X	X	X	X	X		X				X	X		
Geophilus seurati		X			X					X				Littoral
Geophilus truncorum	X	X	X	X	X	X	X	X	X	X	X	X	X	
Cryptops anomalans	X	X		X							X			
Cryptops hortensis	X	X	X	X	X	X	X	X	X	X	X	X	X	
Cryptops parisi	X	X	X		X		X							
Cryptops cf *hispanus*		(X)												
Lithobius borealis	X	X	X	X	X	X	X	X	X	X	X		X	
Lithobius calcaratus		X	X	X	X	X	X	X	X	X	X	X	X	
Lithobius erythrocephalus							?							
Lithobius forficatus	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lithobius lapidicola										(X)				
Lithobius macilentus			X	X	X			X		X				Also 48/50
Lithobius melanops	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lithobius muticus	X	X												
Lithobius piceus	X	X												
Lithobius pilicornis	X	X			X	X							X	
Lithobius tenebrosus							X							
Lithobius tricuspis	X	X												
Lithobius variegatus	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lithobius crassipes	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lithobius curtipes		X	X	X	X			X	X	X	X		X	
Lithobius microps	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lamyctes caeculus					(X)									
Lamyctes fulvicornis	X	X	X	X	X	X	X	X	X	X	X		X	
Scutigera coleoptrata	(X)													

Bay (VC49, 1996). The only other Welsh records seem to be from several sites on Gower (1973-1987) and from Nash Point (1979) (both VC41).

***Henia brevis* (Silvestri, 1896)**

Quite different in appearance to the next species, this is a relatively small, but elongate (19mm) synanthropic species, often found in habitats superficially similar to those of *Schendyla dentata*. It has been found as far north as Shropshire, but it is much more obviously synanthropic than *Henia vesuviana*. There are no records from North Wales, but in the south it has been found at Caerleon (VC35, 1984), Brecon Market and Lower Chapel (both VC42, 1988), Limeslade Bay, Mumbles (VC41, 2008), nr Llandegfedd Reservoir (Rangers Office, VC35, 2010) and St. Fagans (VC41, 2017). Highest recorded altitude for Britain and Ireland is 150m.

***Henia vesuviana* (Newport, 1844)**

As its name would suggest, this distinctive species is essentially a southern European species and most records are from synanthropic sites, mostly from southern Britain especially the south coast, but it has also been found in Yorkshire, Leicestershire and at Heysham, Lancs (where it occurred repeatedly inside a house). There is a single record from North Wales, Afon Dyfrdwy SSSI (VC51, 2004) (Cofnod) and three South Wales locations; Bewic, Llanelli (VC44, 2008), Anstee Court, Cardiff (VC41, 2015) and North Cornelly (VC41, 2017) (O), but given our present knowledge of its habits, we could predict that more Welsh records may well be made. The highest recorded altitude for Britain and Ireland is 250m.

***Strigamia acuminata* (Leach, 1814)**

There are records of this species from all Welsh vice-counties. It was listed (E) (as *Scolioplanes acuminatus*) from Beddgelert, Betws-y-coed (about 60m) and Capel Curig. The latter is without an altitude given although the area is at around 200m. It is also known from: VC48: Islaw Dref (120m, 1969), Coeddydd Maentwrog (1985); VC49: Deganwy (1956), Coedydd Afon Menai, (1985), Clogwyn Du'r Arddu (850m, 2016); VC50: Marford Sand Pit (2018); VC52: Newborough Forest (2015).

There are several records from Montgomeryshire (VC47) including Trannon Moor at 440m (1998) and from, amongst other South Wales locations, Chwarel-y-Fan (VC42, 650m, 1989) and Craig Cerrig-gleisiag (VC42, 400m, 2011) (O). We now add to these, recent records from Caernarvonshire (VC49, RG), Carnedd Dafydd, 1,013m, under *Rhacomitrium* fringed felsenmeer rocks (06.05.2019), Clogwyn du'r Arddu, 850m (12.05.2016) and Leadbrook Wood, 70m (12.05.2018) (all RG). The Carnedd Dafydd record (1,013m) is the highest recorded for the species in Britain.

English highest records where altitude has been recorded are from mid-west and north-west Yorkshire; 457m at Hell Gill (1980), 290m from Deer Park Wood, Marske (1981) and at 381m from South House Pavement near Horton in Ribblesdale (1984). Although there are more than 600 British records of *S. acuminata*, no very clear pattern of its ecology seems to have emerged other than a southern tendency and generally more or less rural locations. It has not been recorded from Scotland and there is a single record from Ireland with some doubt attached to it (Cawley, 2010).

***Strigamia crassipes* (C.L. Koch, 1835)**

This, a similar species to the preceding, seems not to have been reported from North Wales apart from a single record by Debbie Evans and Julian Thompson from Treborth Botanic Gardens in Cofnod files (VC49, 2010) although there are a number of records from the south (VCs 35, 41, 42, 43, 44, 46) with a record from 310m at Capel-y-ffin (VC42, 1987). In Britain, it does not seem to have been recorded from above this altitude.

***Strigamia maritima* (Leach, 1817)**

This common littoral species, found all round Britain and Ireland, is recorded from all the coastal Welsh vice-counties (VCs 35, 41, 44, 45, 46, 48, 49, 50, 51, 52).

***Geophilus alpinus* Meinert, 1870**

Formerly known as *Geophilus insculptus*, this was recorded (E) from Botwnnog, a lowland location on the Lleyn peninsula rather than in central Snowdonia. *Geophilus alpinus* is widespread and is often common in northern and eastern Britain, but there are no British/Irish records from over 500m.

Subsequent records from North Wales include: VC49: Nant Porth (1985), nr Betws-y-coed (1985), Rhydlanfair (1985), Sychant Pass (1988), Puffin Island (1988), Bardsey Island, including Cristin area (2012, 2013); VC50: Bettisfield Moss (1993); VC51: Y Ddol Uchaf (2010), Moel Hiriddig Dyserth (2010) and Cwm Churchyard, Dyserth (2010, 150m); VC52: Llangefni (2010) (O).

For the rest of Wales, there are records from vice-counties 35, 41, 42, 43, 44, 46 and 47 with an altitude record of 340m for Cray Reservoir (VC42, 1989). A very high proportion of these records are from vice-counties 35 and 41 which include the main urbanised areas of the south.

The highest recorded altitude for the species in Britain and Ireland is at 480m.

***Geophilus carpophagus* Leach, 1817**

Now split into two species, *Geophilus carpophagus s.s*. which is mostly associated with buildings, trees and sea shore and *G. easoni* Arthur *et al*., 2001, which is the typical reddish-brown "*carpophagus*" of rural sites such as woodland and moorland, found in leaf litter and under stones and seemingly distributed widely across Britain and Ireland. Eason described *Geophilus carpophagus* as the commonest centipede throughout Snowdonia with a number of localities including, as noted above, Clogwyn Mawr at 460m. With our present knowledge of the two species, it would be reasonable to suggest that this and almost certainly most, if not all, of the older *G. carpophagus* records or subsequent ones when the two species have not been distinguished probably refer to *Geophilus easoni*. These include records from all of the Welsh vice-counties with the exception of 35 (Monmouthshire) or 51 (Flint).

The greatest altitudes *for G. carpophagus s.l.* recorded in North Wales seems to be that above along with Drum Dhu at 500m (VC47, WPIS, 1989) and the Radnor Hills at 450m (VC43, 1987) being the highest in Wales. Records of 390m from the Pentland Hills (VC83) and 457m at Henhole in Cheviot all suggest the ability to survive in upland sites. These are all much exceeded by a 1983 record from Cumbria, Hobcarton Crag of 2,500 feet (762m), the highest recorded altitude for Britain and Ireland; almost certainly all these refer to *Geophilus easoni*.

Geophilus carpophagus* Leach, 1817 *sensu stricto

There are records from Gwylan Fach island off Aberdaron (1988), Llandudno (2011) and Bardsey Island (2012, 2013) (all VC49). Other Welsh records are from Llanarth (VC35, 2002), Gower (VC41, 1985), Flat Holm (VC41, 2017), Bynea (VC44, 1987, 2009), Cardiff Gate Services Area, M5 (VC41, 2014) and Porthcawl (VC41, 2014) (all O). The Cardiff Gate location was at about 70m.

It has been found at 150m in Sussex and Warwickshire which are the highest recorded altitude for Britain and Ireland: 150m.

***Geophilus easoni* Arthur *et al.*, 2001**

As explained, this species has only been recognised since its description in 2001 and, as such, apart from older records where there is sufficient information to distinguish them from the preceding with reasonable confidence, only clearly identified post-2001 records are included. There are more than a

dozen records from vice-counties 48, 49, 50 and 51 with an altitude near Beddgelert of 300m. Also from Penryn Quarry (VC49) at 330m and Cadair Idris (VC48) at 600m (RG).

For the rest of Wales there are at least one record from each of vice-counties 35 and 41-47 with an altitude recorded at Caernfell Valley (1989) of 350m (O). Just outside Wales, highest records include one from the Long Mynd, Shropshire at 500m. The species is clearly widespread in Wales. Highest recorded altitude for it for Britain and Ireland is 600m.

***Geophilus electricus* (Linnaeus, 1758)**

Generally regarded as a species of mostly synanthropic habitats, this character can mean that it might be found further north (and possibly at a higher altitude) in such situations. We have records from Llanrwst (VC50, 1966), Pont Buarth-glas (VC48, 1983), Penmon, Flagstaff Quarry (VC52, 1985), Nant Porth, Coed Afon Menai (VC49, 1985), nr Dinas Bach (VC49, 1996), Porth Dillaen (VC49, 2002), Marford Sandpit (VC50, 2010), Erddig NT (VC50, 2010) and Ffith Bay, Prestatyn (VC51, 2010). The Pont Buarth-glas location was at 152m.

In South Wales there are records from vice-counties 35, 41, 42, 43 and 46 with the highest recorded altitude of 280m at Gwar-henalt near Buith Wells (1988) (All O). The highest recorded altitude for Britain and Ireland is 350m.

***Geophilus flavus* (Leach, 1814)**

Described (E) (as *Necrophloeophagus longicornis*) from under stones on a mountainside at Pen-y-Gwryd at 260m and at Llyn Geirionydd as well as from a shore locality. We have records from all Welsh vice-counties except, it seems, Montgomeryshire (VC47) and Merioneth (VC48) with more than twenty-five from North Wales (VCs 49-52). The highest North Wales record with altitude data seems to be Eason's Pen-y-Gwryd one with the highest in Wales (and, it appears, Britain) being Foel Fawr (520m, VC44, 1988) (O). This is a widespread and often common species in Britain and, although with a seeming eastern bias; it is also widespread in Ireland.

***Geophilus fucorum seurati* Brolemann, 1924 (*Geophilus gracilis* Meinert, 1870)**

The species *Geophilus fucorum* was recorded by R.S. Bagnall from the South Devon Coast. *Geophilus fucorum seurati* was reported by J.G. Blower (1961) from Llandudno (VC49) as having been collected by P.M. Butler in 1952 and from the Isle of Man. It is another of our littoral geophilomorphs with South Wales records from VC41 (Horton, Port Eynon, Cardiff and Crofty) and VC44 (Penrhyngwyn).

***Geophilus osquidatum* Brolemann, 1909**

This is a species with a distinct south-western tendency in Britain. Recorded from south-west of a line from Flintshire to Kent, it was first listed as British by J.G. Blower (1961) from Worcestershire (1952), from Caswell Bay (VC41, 1959) and Somerset. The only records from North Wales were made in 2010 and are from Erddig (outdoors and in greenhouse, VC50, 2010, 70m) and the Hawarden area (VC51, 2010).

For the rest of Wales there are only about a dozen records of the species, nearly half of which are from VC41 (Glamorgan, including The Gower). Recorded from vice-counties 35, 41, 42, 43, 44 and 46 with a recorded altitude of 80m at Hay on Wye (1987) (all O). The highest recorded altitude for Britain and Ireland is 280m.

***Geophilus truncorum* (Bergsoë & Meinert, 1886)**

Described as a common species in Caernarvonshire both in the mountains and in woodlands, with a number of localities named including Clogwyn Mawr (460m) (E). A small animal (commonly only 12-14mm) and easily missed, this is very widespread in Britain and Ireland, almost always in rural areas and is a characteristic animal of moorland as well as in litter and under bark of dead wood in woodland.

It is recorded from all Welsh vice-counties with more than 40 records from North Wales from where the highest altitude record seems to be the Clogwyn Mawr one. For Wales as a whole, the highest recorded altitude is at Chwarel-y-Fan (VC42) at 650m whilst the highest recorded altitude for Britain and Ireland overall is at 770m.

Order Scolopendromorpha

Cryptops anomalans Newport, 1844

Considered to most likely be an introduction e.g. from southern Europe and very much an animal of synanthropic sites including towns and cities, this is our largest species of *Cryptops* at up to 50mm. Fairly widespread in south-east and south-west England, it has been found as far north as Sheffield and the highest altitude from which it has been recorded seems to be in Buckinghamshire at 250m.

From North Wales we have just one record, from Marford Sandpit, Denbighshire (VC50) recorded as at 50m (2010). There are only six locations for the remainder of Wales, from VC35 (Abergavenny, 1988 and Risca, 2014, 2015), VC41 (Swansea, 2008, Cardiff, 1984, 2015, Llanmaes, 2003) and VC43 (Llandrindod Wells, 1988). The highest recorded altitude for Britain and Ireland is 250m.

Cryptops hortensis (Donovan, 1810)

Described (E) as a common species in the oak and birch woods of Snowdonia, Eason reports it from Beddgelert, Blaen Nanmor and Nantmor. These would all appear to be "lowland" sites for this species which is often, but not exclusively, associated with human activity in Britain and relatively rare in much of Scotland. There are a number of records from across North Wales, including records from all vice-counties (VCs 48-52), but the highest recorded altitude was only 190m at Rhyd-Ddu, Merioneth. Correspondingly, there were also records from all of the other Welsh vice-counties (35, 41-47) with the highest altitude at Bwlch-y-Rhiw, Carmarthen at about 250m (O). The highest recorded altitude for Britain and Ireland for the species is 400m.

Cryptops parisi Brolemann, 1920

More likely to be a "native" species, at least in south-west England than *C. anomalans*, this is widespread in Britain with odd records as far north as Aberdeen. It seems to be widespread, especially in disturbed sites and especially in vice-counties 41 (Glamorgan) and 35 (Monmouth), less so perhaps, in VC44 (Carmarthen). From VCs 42 and 46 there are only one or two records each and none at all so far from VCs 43, 45 and 47 or from any North Wales locations. The highest altitude recorded was 280m at Groes-faen Quarry (VC35) which is the highest recorded altitude for this species in Britain and Ireland.

Cryptops cf *hispanus* Brolemann, 1920

In 2007, Ian Morgan collected some specimens of *Cryptops* from a heated greenhouse at Singleton Park, Swansea (VC41). These included *C. hortensis*, *C. parisi* and a specimen which John Lewis (Lewis, 2011) identified as closely related to *Cryptops hispanus*, originally described from Spain, and may have been that species. No subsequent collecting in the relevant greenhouse seems to have taken place.

Order Lithobiomorpha

Lithobius (*Lithobius*) *borealis Meinert,* 1868

Recorded (E) as *Lithobius lapidicola* and referred to as the commonest of the smaller lithobiids in Snowdonia with several records including Clogwyn Mawr (460m). There are about 20 further records for the four vice counties 48, 49, 50 and 52 (O), but the highest altitude given was only 300m apart from a relatively more recent record (RG, 01.05.2011) from Cwm Cneifio (VC49) at 640m.

Elsewhere in Wales there is at least one record from each of the vice-counties 41-47 and 35 and there are many records from across Britain (up to Shetland) at altitudes up to 770m in Cumbria and also in Ireland (up to 850m on Slieve Donard). It is in some areas the common upland *Lithobius* (e.g. Shetland, Hoy) whilst in others (e.g. Cheviot, Orkney Mainland) this seems to be *Lithobius crassipes* both of which can occur at more than 700m. The highest recorded altitude for Britain and Ireland is 850m

***Lithobius* (*Lithobius*) *calcaratus* C.L. Koch, 1844**

This species was not recorded in the Caernarvonshire paper (E), but there were a series of records of it between 1949 and 2002 with at least one from each of the vice-counties 48-52 (O) including some from the peatland survey (WPIS), but none were reported from altitudes above 200m. However, there is a recent record from Minera Quarry at 325m (VC50, 2018) (RG). There are also records from Montgomery (VC47) at 350m (Roundton Hill) and 440m (Trannon Moor) altitude and records from all of vice counties 41-46, but not, it seems, from 35 (Monmouthshire) (O).

Said to be often associated with dry situations and sometimes found on moorland as well as elsewhere, this is recorded up to 600m in Britain, but is apparently absent from Ireland.

***Lithobius erythrocephalus* C.L. Koch, 1847**

There are old records of this, fairly widespread European species, from Northumberland, Midlothian and Cardiganshire (VC46) and Eason (1964) comments that "although British records are so few there is no reason to doubt their authenticity, and this species may well be indigenous". The Cardiganshire record is by M. Thompson (1924) from pasture land in the Aberystwyth area in 1920-21 where he reports a single example from soil 3-9 inches (7.6-22.9cm) deep. The only other centipedes he lists are *Geophilus flavus* (as *Geophilus longicornis*), *Geophilus truncorum* (as *Brachygeophilus truncorum*) and *Lithobius forficatus*. It is surprising that no other small/medium sized lithobiid was recorded from the survey. There have been no records made within the last 90 years of *L. erythrocephalus* from anywhere in Britain or Ireland.

***Lithobius* (*Lithobius*) *forficatus* (Linnaeus, 1758)**

Described (E) as a common species throughout the county of Caernarvonshire, this could also be said of its occurrence throughout most of Britain and Ireland. Recorded from under stones on mountainside at Pen-y-Gwryd at 260m as well as elsewhere. It has been found at more than 700m, but is far less common in such areas than *Lithobius variegatus* and is often associated with present or past human activity. The highest recorded locations in Britain (O) appear to be from Cumbria: Great Gable, 899m (1992), 792m (1980); Hobcarton, 762m (1980) and Kirk Fell, 747m (1980). In North Wales it has been recorded at 600m at Clogwyn Du'r Arddu, Snowdon (1995), in South Wales at 616m, Black Mountain (1993) and in Yorkshire at 617m at Fountains Fell (1982).

Being a relatively large and very common species, it is frequently recorded and the Centipede Recording Scheme has more than ten thousand records, the highest of any species, and, of these, more than 4,000 are with altitude data. In recent years North Wales records include Penrhyn Quarry (2015) at 362m and Cwmorthin (2016) at 346m (RG), but most are from much lower altitudes. It is recorded from all Welsh vice counties.

***Lithobius* (*Lithobius*) *lapidicola* Meinert, 1872**

The first British record of this was from a greenhouse at the Royal Botanic Gardens Edinburgh in 1986 (coll: C. Rawcliffe, det: E.H. Eason) and there was a subsequent greenhouse record from Abbotsbury, Dorset in 1996. In 1988 it was found outdoors above the beach at Sandwich Bay in Kent and subsequently from the Suffolk (1994) and Essex (2004) coasts. There have been other greenhouse records. In 2010 it was identified (conf. M. Zapparoli) from a small heated botanical greenhouse at Treborth, Bangor (VC49, 2010).

Note: this is not the *Lithobius lapidicola* of E.H. Eason's *Centipedes of the British Isles* (1964) and earlier British workers which is now known as *Lithobius borealis*.

***Lithobius* (*Lithobius*) *macilentus* L. Koch, 1862**

Recorded (E) as *Lithobius aulacopus* from Betws-y-coed and from the banks of the River Conway. Subsequently reported (O) from Cwm Idwal (VC49, 1985) and near Cerrigydrudion (VC48/50, 1985). In South Wales there are records from Lower Chapel (VC42, 1963, 1971), Old Radnor Wood (VC43, 1971), Carreg Cennen (VC44, 1985, 1987, 1997) and Llanfair Caereinion (VC47, 1983). The Carreg Cennen site was at 250m.

There are records of this, apparently parthenogenetic (in Britain) species, scattered across England, Wales and Scotland. The highest recorded altitude for it for Britain is 480m.

***Lithobius* (*Lithobius*) *melanops* Newport, 1845**

This is a species often associated with human activity that may often be found in parks, domestic gardens, urban waste ground, industrial sites, quarries, etc, and also on the coast. Records from inside unheated greenhouses or even inside houses are also known. It can sometimes be found in rural or upland areas where there are remains of old industrial or extractive industry. Because of its habits it is likely to be easily transported by human activity and this is the likely reason for it being recorded from the Falkland Islands, for instance.

It is recorded from all Welsh vice-counties with around thirty reports from North Wales, the highest recorded one being 442m at Tan-y-Pistyll (VC50, 1983). Elsewhere in Wales it was found at Trannon Moor (VC47, 1997) at 440m and Brecha Forest (VC44, 2014) at 340m. Highest recorded altitude for Britain and Ireland is 600m.

***Lithobius* (*Lithobius*) *muticus* C.L. Koch, 1847**

This was for a number of years, following its rediscovery in Britain in the 1950s in the Oxford area, Hampshire and West Sussex and subsequently in other counties, thought to be confined more or less to south-east England (S.G. Brade-Birks had a record in his notebook of finding it in Kent in 1920). It is almost always found in rural or semi-rural locations, typically deciduous woodland.

However, there have been a number of subsequent scattered reports from various parts of England (Cheshire, Lancashire, Staffordshire, South-west Yorkshire, Nottinghamshire, Worcestershire, Northumberland) and in 2004 John Harper recorded it in South Wales from near Cwmbran (VC35) and there are now also records from the Bridgend area (VC41, 2017/18) by Chris Owen and others.

The highest recorded altitude for it in Britain and Ireland is 240m.

***Lithobius* (*Lithobius*) *piceus* L. Koch, 1862**

Until comparatively recently this species was thought to be more or less confined to an area of Hampshire, Sussex and Surrey in south-east England although there had been old records, in 1913, and of questionable status, from Northumberland and Durham by R.S. Bagnall. However, in 2001 John Harper recorded it from near Pontypool (VC35) at 200m and it has subsequently been found at other sites in South Wales (VCs 35 and 41) by Christian Owen and subsequently by Steve Gregory (VC35) and Derek Whiteley (VC35).

The highest recorded altitude for Britain is 320m from Maerdy Colliery spoil heaps (VC41, 2016) (it has not been recorded from Ireland).

***Lithobius* (*Lithobius*) *pilicornis* Newport, 1844**

In parts of south-west England, notably some sites in West Cornwall, this species occurs in typically "wild" sites such as woodland, but as a synanthropic animal there are scattered records from urban or

similar areas as far north as Edinburgh. It probably out-competes *Lithobius forficatus* in suitable sites being a somewhat larger animal.

There is a single record from North Wales, Amlwch Port (VC52, 20m, 2010) which probably fits into this latter category. In South Wales, it may be "native" in areas in the west such as Pembrokeshire (VC45); it is also recorded from Monmouthshire (VC45), Glamorgan (VC41) and Carmarthen (VC44), a total of nearly 20 records, more than half of which are from VC41, which includes Maerdy Colliery spoil heaps at 320m (VC41, 2016). The Big Pit Museum (Coity Tip) at 400m (VC35, 2018) is the highest recorded altitude for Britain and Ireland.

***Lithobius* (*Lithobius*) *tenebrosus* Meinert, 1872**

There are old records of this from Durham and Cornwall whose status is unclear. In 1988 a single 9.5mm male was collected by Andy Keay from Aberystwyth in 1988 (VC46). There have been no other modern British records.

***Lithobius (Lithobius) tricuspis* Meinert, 1872**

This species was first published as British following its discovery at Drewsteignton, Devon in 1964 and it was thought for many years that VC3 (South Devon) was its only British location with a number of records from there, all from more or less rural sites. There was an unconfirmed cave record from Somerset in 1975 and query Dorset and Isle of Wight records. It was discovered in Wales at Groesfaen (VC41) in 2010 by Christian Owen and there appears to be a well-established population in the area with further records from various sites in vice-counties 35 and 41. The highest recorded altitude for Britain is 320m from Maerdy Colliery spoil heaps (VC41, 2016).

***Lithobius* (*Lithobius*) *variegatus* Leach, 1813**

In Britain this distinctive species shows a marked western and rural tendency; there are areas of eastern England and of Scotland where it appears to be largely or entirely absent even though a total of more than 7,000 records have been made across Britain and Ireland. It was once thought to be endemic to Britain and Ireland, but it is now known to be widespread in the Channel Islands (Guernsey, Jersey, Alderney, Sark, Herm) and has been recorded from Brittany as well as Iberia. Eason describes it in Caernarvonshire as far commoner than *L. forficatus* and found frequently at all altitudes. Amongst a number of locations he gives Clogwyn Mawr (460m), southern slopes of Snowdon Range (460m) and Llyn Llydaw (430m). It is, in fact, a common animal in rural Wales with a large number of records from all vice counties.

The Centipede Recording Scheme holds more than 3,000 records of this species of which there is altitude data and more than 70 which are from 500m or more. It would not be appropriate to list all these, but from North Wales (VCs 48, Merioneth and 49, Caernarvon) we have Elidir Fach (700m, 2003, JB), Cwm Cwnion (650m, 2001, JB), Llyn y Caseg-fraith (650m, 2001, JB), Llwytmor Bach (670m, 2000, JB), Cwmglas Bach (690m, 2002, JB), Cwm Cneifon (650m, 2003, JB), (all from VC49; those marked JB were recorded by J.H. Bratton) and Coed y Brenin (VC48, 600m, 1991). There are also upland records from Radnor (540m), Brecon (650m) and Carmarthen (616m) and in England, Shropshire (500m), Mid-west and North-west Yorkshire (617m and 530m) and South Northumberland (549m). Cumbria, including the Lake District, has the highest records with 820m from Moor House (VC69) and Helvellyn and Fairfield (VC70) at 800m as well as several more at more than 700m.

Further upland records (RG) we now add are: VC48: Aran Fawddwy (884m, 10.05.2019); VC49: Cadair Idris (605m, 29.06.2017), Y Aryg (880m, 22.04.2019), Pen yr Helgi Du (880m, 27.12.2018), Glyder Fawr (987m, 09.09.2018; 931m, 02.09.2018), Glyder Fach (905m,02.09.2018), Mynydd Perfedd (810m, 26.05.2018), Foel-goch (830m, 26.05.2018) and Y Garn (923m, 09.09.2018; 930m, 26.05.2018).

The highest recorded altitude for Britain and Ireland is the Glyder Fawr one (987m).

***Lithobius* (*Monotarsobius*) *crassipes* L. Koch, 1862**

In England this is probably more common in the east and north, largely, but not entirely eastern in Scotland and seemingly virtually confined to the northern half of Ireland. Eason (1957) reported it as "notably absent from Snowdonia", but recorded it from the Great Orme. For North Wales, there are about 25 records including reports from all vice-counties 48-52. The highest location recorded for the species is at Tan-y-Pistyll (VC48, 442m, 1983) (O).

Records from the rest of Wales are from all vice-counties, 35 and 41-47, the highest recorded altitude being 650m at Chwarel-y-Fan (VC42, 1989). The highest British records for the species were at 779m at Grizedale Pike summit and 770m at Hopegill Head summit (Cumbria) by S.P.Hopkin in 1986. Upland records also include 762m at Hobcarton Crag in Northumberland (1983) (O). It was found to be extremely widespread in the upland area of the Cheviot, up to at 720m at Auchope Cairn on the England/Scotland border (Barber, 1984). It is possible that some of the earlier Welsh records might have been specimens of the extremely similar *Lithobius curtipes* before it was recognised how widespread the latter was in the principality.

***Lithobius* (*Monotarsobius*) *curtipes* C.L. Koch, 1847**

This species was first recorded from Cambridgeshire, very distinctly not an upland county, by Brade-Birks (1934) as cited in Blower (1955) who reported it also from Yorkshire (VC62) and noted Eason (1951) who had found it in Warwickshire in 1950. The species was recorded from Hampshire, from East Sussex and from Oxfordshire in the 1950s. Eason (1957) had recorded it from Betws-y-Coed, Trefriw and Botwnnog, all more-or-less "lowland" locations for specimens collected in 1954 and 1956. The first from South Wales were from VC42 (Brecon area) in 1963. None of these have an altitude given

There are now scattered records, often from woodland, right across England and Wales although only a small number of records exist from south-west England with none, so far, from Cornwall. In the north of England it seems very limited, being recorded only from southern Westmorland (2 locations) and north-east Yorkshire. From Scotland there are two records only from the south-east, from near Dunbar and from Selkirk. No records exist for Ireland.

Over the years of the Centipede Recording Scheme more records of the species continued to come in but, even so, the total now included, with those listed here, remains at much less than 200 for the whole of Great Britain with less than two thirds having altitude data. This compares with more than two and a half thousand records for the somewhat similar looking *Lithobius crassipes*. Superficially the records seemed to give a general impression that *L. curtipes* was something of a "lowland" species found in woodland, etc and, maybe, even favouring ancient woodland. However, in 1987, one of the present authors (ADB) was much surprised to find the species under stones at 616m on Black Mountain, South Wales (VC44). Discussion with one or two colleagues indicated that this was not an isolated occurrence and other collections show that the species seems to be found in a variety of rural habitats, both lowland and upland. The highest record prior to the last ten years was this one, although Ian Morgan had recorded it from Mynydd Du (VC44) in 1987 at 600m and, from North Wales, Adrian Fowles (WPIS) had collected it from 250m at Merddwr (VC50) in 1988 and there was also an older (1971) record from Glan Fedwen (VC47) at 396m. The lowest altitude we have recorded was at Oxwich at 15m (VC41, 1982).

In 2016 collections made by RG led to *L. curtipes* being identified from Clogwyn Coch at 700m and 720m (29.09.2016) and at Y Gribin, Glyders at 700m (12.05.2016), both in the Snowdon Range and recent studies reveal it as being characteristically present in upland sites in scree and felsenmeer in Snowdonia up to more than 1,000m. See Figs 1-4. These include: VC48: Aran Fawddwy (under *Rhacomitrium* fringed rocks, 884m, 10.05.2019); VC49: Carnedd Dafydd (under small stones on felsenmeer, 1,024m, 06.05.2019), Carnedd Llewelyn (950m, 04.06.2012), Y Garn (felsenmeer, 923m,

09.09.2018), Glyder Fawr (felsenmeer, 950m, 09.09.2018; 987m, 02.09.2018), Y Gribin, Glyders (slate scree, 790m, 29.09.2016), Foel-goch (felsenmeer, 720m, 26.05.2018) and Clogwyn Coch (under rocks, 720m, 20.05.2017; 12.05.2016). Carnedd Dafydd (1,024m) is the highest recorded altitude for Britain for this species.

Figure 1: Y Gribin, Glyders (and Nant Ffrancon behind), 29.09.2016, 790m.

Figure 2: Y Gribin, Glyders, 29.09.2016, 790m, showing *Lithobius curtipes* habitat within slate scree.

Figure 3: Y Gribin, Glyders, 29.09.2016, 790m, showing *Lithobius curtipes* habitat within slate scree, and the high Carneddau mountains in the background**.**

Figure 4: Y Garn, 09.09.2018. Site where two specimens of *Lithobius curtipes* were found in felsenmeer at 923m.

Other North Wales records include: Trawsfynydd (VC48, 200m, WPIS, 1988), Merddwr (VC50, 250m, WPIS, 1988), Cors Erddrieniog (VC52, 60m, WPIS, 1988) and Fairy Glen near Betws-y-coed (VC49, 1985) (O). Records from the remainder of Wales include: Mynydd Du (VC44, 450m, 500m, 600m, 1987), Near Colbrem (VC42, 200m, 1989), Dyffrynoedd Nedd a Melite (VC42, 200m, 1990), Gors Coch (VC43, 450m, 500m, 600m 1989) and Glan Fedwen (O).

English locations at 150m or more (O) include: Cumbria: Burns Beck Moss (180m, 2001), Hutton Roof Crag (150m, 2001); Shropshire: Poles Coppice, 200m (1998), Ercall Quarry, 225m (1999); Southern England: Hilcot Wood, Glos, 200m (1999), Asham Woods, Somerset, 150m (1986), Lydeard Hill, Somerset, 320m (1988), Powerstock Common, Dorset, 150m (2000), Wychwood Forest, Oxon, 160m (1989), Cowleaze Wood, Oxon, 250m (1992) and Wytham Wood, Berks, 150m (1982).

Scottish locations are near Wester Kershope, Selkirk at 300m (1987) and Woodhall Dene, East Lothian at 125m (1990) (O).

In other parts of Europe such as France, Belgium and the Netherlands, its distribution seems fairly limited or it is described as rare. It is also known from Austria, Czech Republic, Germany, Hungary, Lithuania, Poland, Romania, Slovakia, Switzerland, Ukraine and Northern Russia. Its occurrence in the far north of Europe is notable with the species being found right up to the northern coastline of Norway (Finnmark), although largely absent from western Norway and eastern areas of Denmark (Andersson *et al*., 2005; Bergersen *et al*.; 2006, Palmen, 1949). The only other European centipedes extending regularly this far north are *Geophilus proximus* and *Pachymerium ferrugineum*. These same three species extend across the Kola Peninsula and around the White Sea Area (Palmen, 1949; A. Przhiboro, *pers. comm.*, I. Zenkova, *pers. comm.*). Zenkova (2016) describes *L. curtipes* as a "polyzonal eurytopic" species on the Kola Peninsula and Korobushkin *et al.* (2016), citing Zalesskaja (1978), describe it as the most common and abundant species in the European part of Russia.

***Lithobius* (*Sigibius*) *microps* Meinert, 1868**

Eason (E) described a form of this species, (then known as *Lithobius duboscqui)*, as var. *caernensis* from Betws-y-Coed, but the only specimens of the typical form he reported were from the Little Orme (i.e. outside Snowdonia). *L. microps* is widespread across Britain and Ireland, but the only Scottish records seem to be from the south-east and east. It is a small (9.5mm) species commonly associated with human activity. As a species*, L. microps* is frequently found in domestic gardens and other synanthropic sites, but sometimes in more "wild" ones notably in south-east England and can be abundant.

It is recorded from all Welsh vice-counties with about 50 records from the northern ones and significantly more in the south, reflecting possibly the degree of settlement as well as collecting activity and, maybe, a lesser degree of abundance for climatic or other reasons. As far as altitude is concerned, the highest record from North Wales, from Carrog (VC48, 2011), was only 150m, although that for the rest of Wales it was Tarren yr Esgob (2005) in vice-county 42 at around 500m and probably the highest recorded altitude for Britain & Ireland.

There have been a number of subsequent records of *caernensis* including recent ones from the Isle of Wight by S.J. Gregory although no more have been noted from Wales.

***Lamyctes emarginatus* Newport, 1844**

This is a rather seasonal species (late summer, autumn, winter), and is often considered to be associated with damper habitats (including, in Wales, river shingle), but also with moorland and cultivation, waste areas and derelict industrial sites. There are a considerable number of records across both North and South Wales (all vice counties, except VC51) with recorded altitude from 10 m or less up to 650m (Snowdon, 1989, VC49; Chwarel-y-Fan, 1989, VC42). Many of the records were contributed by the

peatland survey (WPIS). It is clearly a species that can occur at moderate altitudes as well as lowland ones where suitable habitats exist. The highest recorded altitude for Britain and Ireland is 727m.

It is possible that some of our records may, in fact, be of the very similar species *Lamyctes africanus* (Porat, 1871), specimens of which have been found in outdoor localities in Denmark and Germany in recent years. In 1986, specimens were collected from heated greenhouses at the Royal Botanic Garden, Edinburgh by Charles Rawcliffe and identified by E.H. Eason. There are also greenhouse records from other European countries.

***Lamyctes caeculus* Brolemann, 1899**,

A small (5mm), blind species, this has been found in greenhouses in Northern Europe has been recorded from the large glasshouse at the National Botanic Garden of Wales (VC44, 2004). It is also known from the Eden Project in Cornwall, Cambridge Botanic Gardens, Whipsnade Zoo (Butterfly House) and from Glasgow.

Order Scutigeromorpha

***Scutigera coleoptrata* (Linnaeus, 1758)**

Unlike any of our other species in appearance, this, the so-called "house centipede", is periodically reported from inside buildings in Britain including homes, offices, factories, a golf-club clubhouse and even a hospital. There seem to have been increasing numbers of records in recent years, but whether this is due to increased frequency of occurrence or of easier recognition and reporting is not clear. The only Welsh record we can find is from Newport Docks Office (VC35) in June 2013. In Jersey and Guernsey it may be found outdoors as well as indoors and there is a recent English record of it being seen on the outside wall of a bungalow at night.

Discussion

There are obviously a variety of factors which affect the distribution of animals and plants and clearly centipedes are no exception. Probably some of the main ones are the tolerance or otherwise of human activity/urbanization on their environment; climate in its various aspects, both macroclimatic effects such as temperature and microclimates such as microsite humidity; food availability for these generalist carnivores; presence or absence of free-water (osmotic effect); freezing and other factors. Much time has been taken up in informal discussions on centipede distribution patterns at field meetings and elsewhere, but there still remain puzzles. One of us (Barber, 1985, 1992) described some of the patterns as then seen in our chilopod fauna and presented some climatic maps of Britain in an attempt to possibly understand some of these patterns.

Altitude

As far as the upland Snowdonia pattern is concerned, we have, in recent recording and with the limited data, found an apparent pattern of *Lithobius variegatus* & *Lithobius curtipes* at altitudes up to around 1,000 metres along with a record of *Strigamia acuminata*. This seems to be reflected, at least to some extent in upland South Wales. Obviously, even if we do not clearly understand the reasons for the individual species distribution, these animals must be able to tolerate the conditions of temperature, exposure, etc. at such altitudes. According to Chandler & Gregory, in 1976, (cited in Barber, 1985), a 1,000m increase in altitude led to a temperature drop of the order of 6^{o}C and with greater precipitation and humidity compared with surrounding lowland and freezing temperatures on most winter nights above 600m.

L. variegatus is a species which seems to be confined to Britain & Ireland (including the Channel Islands), part of Western France and to Iberia, and which, in Britain, shows a very distinct western

tendency. It is in Scotland, apart from some isolated records, to a large extent mostly confined to the western coastal areas which would seem to fit with the south-north January isotherms. However, in Cumbria it certainly occurred up to 820m where one would expect a significant temperature drop compared with the lowlands and in Cheviot it is extremely patchy in occurrence without any obvious reasons, but was recorded at 400m at Coquet Dale (Barber, 1984 and other data). As can be seen above, it is widespread and common in Wales.

L. curtipes is a somewhat enigmatic species. It occurs across England, rather unpredictably patchy in location (with current knowledge), seemingly getting scarcer further north, with two reports from southern Cumbria and similarly from south-east Scotland. However, there are no records from the rest of Scotland. As noted, nevertheless it does occur in mainland Europe right up to the White Sea where it must be subject to far more extreme low temperatures

Hence, we have in Wales an upland region where both species exist, presumably occupying different niches. North of this *L. curtipes* occurrence peters out; to the south and east we have more lowland areas.

Strigamia acuminata, where altitude has been recorded, has been found at between 1 and 1,013m, the latter being recently established, but occurrence at 200 – 400 m is noted in a number of cases, up to 650m in South Wales. Interestingly, in the analysis of "horizon" data in the Provisional Atlas (Barber & Keay, 1988; Barber, 1992) this species, along with the two other darker species (i.e. reddish brown rather than yellow or white), *Strigamia crassipes* and *Geophilus carpophagus* s.l. (along with the frequently subcortical *Geophilus truncorum*) were less common than the paler ones in deeper soil horizons. Whether this is, in any way related to their habits is not easy to say but, although the highest record for *S. crassipes* is only 310m, that for *G. carpophagus* s.l. (i.e. almost probably *G. easoni*) is 762m and for definite *G. easoni* 600m. With *G. truncorum* (recorded up to 770m), *G. easoni* is a frequent centipede in moorland areas.

Two species of *Lithobius,* of roughly the same size as *L. curtipes* (11mm), also stand out as occurring in upland areas, *L. borealis* (12.5mm) (recorded up to 850m) and *L. crassipes* (13.5mm) (up to 791m). Although *L. crassipes* tends to be possibly more eastern and *L. borealis* maybe more western, it is not, at present, too obvious why areas have one rather than the other, or why *L. curtipes* is so much the small/medium "upland" *Lithobius* in montane Wales rather than one of these, which are both also recorded there. We have limited information about our upland areas which are more difficult to access and can be more difficult to collect from and more of such records will clearly be very welcome. It might also be worthwhile to look further at the occurrence, upland and lowland, of *L. crassipes* and *L. borealis* (and *L. curtipes*) in Britain and Ireland.

Synanthropy

Synanthropy refers to living in proximity to and benefiting from human activity and relates to both vertebrates and invertebrates and also plants and to communities as a whole. This has been explored in the context of two indicators of synanthropy for bird species by Guetté *et al*. (2017). The first of these differentiated species along a continuum from urban "avoiders" to urban "dwellers", the second, in relation to building density between "losers" and "winners" at increasing density. While it would not be easy to apply these, especially the second, to centipedes without clear numerical data, certainly the concepts can inform our thinking if we consider "urbanization" in broad terms and are also aware of the potential impact of previous human activity such as at upland former mine sites. The synanthropic habitat potentially offers both benefits and risks and clearly different species of centipede, for reasons, mostly not understood, occupy different positions along the spectrum of avoiders to dwellers.

We also need to recognize that species may have different degrees of "synanthropy" depending on location where in one part of Britain the species occurs in the "wild" whilst in another it is highly

dependent on human activity as in *Lithobius lapidicola*, found occasionally in heated greenhouses, but also above the shore, in the "wild" on the coasts of Kent, Suffolk and Essex. We may also wish to distinguish somewhat between species that are solely synanthropic in a particular area (obligate synanthropes) and those that seem to occur in rural sites as well. For instance, *Cryptops anomalans* seems to be an obligate synanthrope throughout Britain (and almost certainly an introduction) whereas *Schendyla nemorensis* seems to occur in both urban and rural sites whilst the similar sized *Geophilus truncorum* is very largely an "avoider".

As far back as 1973, Henrik Enghoff (Enghoff, 1973), writing about myriapods from suburban localities around Copenhagen, concluded that the myriapod fauna of these areas was dominated by probably introduced species and noted that the chilopod and diplopod fauna of Denmark reached the peak of its diversity in the types of biotope covered by his investigation (heavily man-influenced). "Thus, the changing of the environment by man is not always detrimental to the diversity of the fauna."

Blackburn *et al.* (2002), in their study of an area of north-west England, commented that there was a pronounced synanthropic trend in geophilomorphs, absent in lithobiomorphs. The species they had recorded were *Haplophilus subterraneus, Schendyla nemorensis*, *Geophilus electricus*, *Geophilus flavus* ("intermediate": 10-50 individuals, 4-12 sites), *Geophilus alpinus* and *Geophilus truncorum* ("common", 100+, 20+ sites). (There was also a single individual of *Strigamia acuminata*.) They concluded that it might be premature to consider these as introductions and that it was difficult to distinguish natural range expansion from the effects of human activity, but that northward migrating propagules could survive near or in heat islands. Also, clearly, synanthropes are much more likely to be accidentally transferred by human activity.

Of the species we have noted as occurring in Wales, it will be noted that most geophilomorphs would seem to fit in the category of having distinct synanthropic tendencies. The most obviously less so are *G. truncorum* with its strongly negative association with pH and *Geophilus easoni*, not recorded in the Blackburn *et al.* study. The two terrestrial species of *Strigamia*, as commented above, do not seem to fit any obvious pattern of distribution other than absence from the northern part of Britain.

Although Blackburn *et al*. refer to a pronounced synanthropic trend as absent in lithobiomorphs, *Lithobius forficatus*, *L. melanops* and *L. microps* are known to commonly occur in synanthropic sites (as does *L. pilicornis* where it occurs in Wales). Scolopendromorphs were not included in the study, but experience of our three "outdoor" *Cryptops* species indicates that we could place them in order where *C. anomalans* seems to be exclusively synanthropic in Britain, *C. parisi* appearing less so and possibly "native" in south-west England and *C. hortensis* clearly native in at least parts of southern Britain where it can be found in woodland etc. (it has also been recorded from limestone pavement). Wesener *et al.* (2016) suggest that, in Germany, *C. anomalans* as "most likely introduced from the Mediterranean" whereas *C. hortensis* and *C. parisi* are referred to as "naturally occurring".

Wales is a country where there is a sharp contrast between areas where heavy industry and extensive settlement have taken place, with the former leaving a legacy of abandoned derelict buildings, spoil tips, waste at least in some parts and rural areas where agriculture and low levels of settlement are characteristic with tourism and informal recreation. The uplands, especially, have large areas of land where low-intensity sheep farming is characteristic and montane locations with little human activity other than walking and climbing. The two inland national parks are typical of this latter. With this diversity comes a wide variety of niches for centipedes to occur in. It would be simplistic to say that developed areas of, say, Monmouthshire and Glamorgan would, for instance, favour *Cryptops* species, *Lithobius pilicornis*, *Lithobius forficatus*, *Geophilus electricus*, *Lithobius melanops*, etc., whilst Snowdonia (away from extractive industry, etc.) favours *Lithobius variegatus*, *L. crassipes*, *L. curtipes, L. borealis*, *Geophilus easoni* and *G. truncorum*, but patterns like this certainly occur.

Heated greenhouse species

These are clearly living in a highly artificial environment and are not necessarily related at all to the local "outdoor" fauna, having been brought in at some time with plants or compost or similar. Correspondingly they can, potentially, be transferred with plants, compost, etc. to other greenhouses. In this category, in Wales, we list *Cryptops* cf *hispanus*, *Lamyctes caeculus* and *Lithobius lapidicola* (in this part of its range, apparently). The Eden Project in Cornwall, as well as *L. caeculus,* records *Cryptops doriae*, *Mecistocephalus guildingii* Newport, 1843 and *Tygarrup javanicus* Attems, 1929. The latter is relatively small (20mm) and apparently parthenogenetic and, presumably, can be spread easily and is known from Kew Gardens and other sites. Possibly these, or other species, could turn up in Wales.

Survivors?

It is interesting that, in addition to the anticipated species in parts of South Wales, we have now found others that seem away from other known colonies of the species. These include *Lithobius piceus* (south-east England), *Lithobius tricuspis* (South Devon) and *Lithobius muticus*, all three of which seem to be on the "avoiders" end of the synanthropy spectrum and which are widespread in Europe. Two potential reasons for their occurrence as these apparently isolated populations are either that they are introductions brought in at some time and have succeeded in establishing themselves or that they are, in fact, vestiges of a one time much more widely distributed population across (southern) Britain. The fact that they are "rural" species maybe tends to give credence to the latter.

Halophiles

As noted, there are four halophilic geophilomorphs (from three different families) known from the Welsh coast. The seashore is a rich and continuously refreshed habitat providing a food web in which centipedes, invading it from above the beach, can participate, assuming they can cope with the saline environment, waves and tides. Colonisation of the sea-shore by centipedes has happened a number of times at different places around the world (Barber, 2011).

Other possible species

The "British List" (Barber, 2009) includes a number of species not referred to above, most of these seem to be restricted to a fairly limited area, but past experience indicates that this is not necessarily a reason why they might not be found in Wales in the future. Some, maybe all, are likely "introductions", but may be well established, including in rural areas. These include *Haplophilus souletinus* (Brolemann, 1907) (Falmouth area), *Eurygeophilus pinguis* (Brolemann, 1898) (North Devon and West Cornwall) and *Lithobius lucifugus* L. Koch, 1862 (identified from several synanthropic sites across southern Scotland). Two small (12-13mm) geophilids are known only from a few sites in the south of England, *Arenophilus peregrinus* Jones, 1989 (Scilly, West Cornwall) and *Nothogeophilus turki* Lewis, Jones & Keay, 1988 (Scilly and Isle of Wight). *Geophilus pusillifrater* Verhoeff, 1898, possibly halophilic, another small (13mm) species is known from Scilly, Cornwall, Sussex and the Channel Islands.

Pachymerium ferrugineum (C.L. Koch, 1835), a rather large (50mm) and distinctive species, widespread in Europe, turns up from time to time in shingle on the south-eastern coasts of England and has now been recorded from Guernsey (Barber, Gregory & Marquis, 2020). *Stenotaenia linearis* C.L. Koch, 1835 is a relatively large geophilid (55mm) recorded from synanthropic sites (and occasionally greenhouses) and is widespread in the London area as well as occurring elsewhere and could well be found in such habitats in Wales. *Lithobius peregrinus* Latzel, 1880, a vagrant species of similar superficial appearance to *Lithobius forficatus*, has been recorded from two ports, Sheerness (probably now extinct) and Harwich.

Dicellophilus carniolensis (C.L. Koch, 1847), a central European species was recorded in the early years of the 20th century from greenhouses, but has never become established in Britain. *Schendyla monoeci* (Brolemann, 1904) was recorded from a greenhouse in Cornwall in 1944. Examination of a surviving slide of a specimen has indicated that it was definitely not this species, but most likely an immature *Geophilus* (L. Bonato, *pers. comm*.). The existence of *Lithobius agilis* C.L. Koch, 1847 recorded from Armagh and Donegal and subsequently in Cornwall more than 70 years ago remains questionable as a British or Irish species.

Conclusions

Wales has been shown to contain a large proportion of the British species of centipede in a diversity of habitats. Factors likely to affecting their occurrence in different areas include, almost certainly, climatic ones and the existence of particular species at higher altitudes say, 600m to 1,000m or more probably reflects their tolerance of the more extreme local climate. However, the precise way in which distribution of species such as *Lithobius variegatus* and *Lithobius curtipes* is determined and reasons for the existence of *Lithobius curtipes*, *Lithobius borealis* or *Lithobius crassipes* in particular upland/moorland locations in the British Isles remains unclear. The Welsh upland species seem to represent a near unique situation in the island of Britain where an overlap of the areas of occurrence of *L. variegatus* and *L. curtipes* occurs in upland habitats.

With the history of past heavy industry and mining in various parts of the country as well as urbanization, synanthropy, the ability to thrive in or at least tolerate heavily human influenced habitats is clearly another factor causing the diversity of species in Wales and the length of its species list.

There is clearly a need for more upland records to explore these, generally, relatively poorly worked and difficult of access habitats, not only in Wales, but in northern England and Scotland. It would also be interesting to know how far other groups of invertebrates parallel the situation in the centipedes of Snowdonia.

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Some recent observations of woodlice (Isopoda: Oniscidea), millipedes (Diplopoda) and centipedes (Chilopoda) from artificially heated glasshouses

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Abstract

Heated glasshouses provide stable environmental conditions that allow introduced non-native species to exist well beyond their natural (outdoor) range. The woodlice, millipedes and centipedes of heated glasshouses are relatively well known in Britain with many species discovered in recent decades. Here we collate our recent observations, including six species of woodlice, four of millipede and two of centipede, that are characteristic inhabitants of heated glasshouses, including the first Welsh and Scottish records for the millipede *Poratia digitata*. Further surveys may reveal additional species.

Introduction

Heated glasshouses, such as those of botanic gardens and butterfly houses, provide stable environmental conditions, characterised by artificially maintained temperatures and irrigation, which typically provide relatively higher temperatures and higher humidity than observed in semi-natural or synanthropic habitats that occur outside in Britain. Woodlice (Isopoda: Oniscidea), millipedes (Diplopoda) and centipedes (Chilopoda), either as eggs, juveniles or adults, can be readily and unintentionally introduced along with soil and other substrates associated with imported plant material (Cochard, *et al.*, 2010; Stoev, *et al.*, 2010). Thus, introduced non-native ('exotic') species are able to thrive within heated glasshouses well beyond their natural (outdoor) range; species which otherwise would be unable to survive outdoors in our mild British climate.

The woodlice, millipedes and centipedes of heated glasshouses have been relatively well studied in Britain since at least the start of the 20th Century (Gregory, 2009; Lee, 2006; Barber, 2009). In recent decades collecting from heated glasshouses has become more popular, and several woodlice, millipedes and centipedes have been discovered new for Britain (e.g. Read, *et al.*, 2002; Lewis, 2007; Read, 2008; Gregory, 2014; Telfer & Gregory, 2018). Currently, eighteen species of woodlouse, eleven of millipede and seven of centipede have been recorded in Britain only from artificially maintained climates such as those found inside heated glasshouses (Lee, 2015; Telfer & Gregory, 2018). Many of these species are typically known from very few sites.

This paper collates recent observations made by the authors during a series of visits targeting a number of heated glasshouses across Britain between 2015 and 2017.

Localities surveyed

A total of seven sites were visited by the authors between 2015 and 2017 (Table 1). One site, Royal Botanic Gardens Edinburgh (RBGE), Midlothian, is in Scotland and was visited during the BMIG spring field meeting to Linlithgow. One site is in Wales: National Botanic Garden of Wales (NBGW), Carmarthenshire. The remaining five sites are in southern England: Living Rainforest (LRF), Berkshire; Cambridge Botanic Garden (CBG), Cambridgeshire; Birmingham Botanical Gardens (BBG), Warwickshire; Whipsnade Zoo (WZ), Bedfordshire; and Stratford Butterfly Farm (SBF), Warwickshire.

Where possible live specimens were collected and photographed by KL (e.g. see Figs. 1 and 2) and uploaded to the relevant species accounts on the BMIG website (www.bmig.org.uk).

Table 1: List of sites visited and glasshouses surveyed

Locality (Site)	Glasshouse	Code	Date	Grid Ref.	VC	Recorders
Royal Botanic Garden Edinburgh ~ RBGE	Arid House Fern House House 19 Tropical Orchids Montane Tropics Orchid & Cycad Temperate House Tropical Palm Wet Tropics	1a 1b 1c 1d 1e 1f 1g 1h 1i	10.iv.2015	NT 247 755	83	S.J. Gregory & K. Lugg NB: other BMIG members are also present, but their records are not available to the authors.
Living Rainforest ~ LR	Lowland Amazonica	2a 2b	12.i.2017	SU 537 764	22	S.J. Gregory & K. Lugg
Cambridge Botanic Garden ~ CBG	Tropical Forest Continents Apart Mountains	3a 3b 3c	19.i.2017	TL 454 572	29	S.J. Gregory & K. Lugg
Birmingham Botanical Gardens ~ BBG	Tropical House Subtropical House Mediterranean Arid House	4a 4b 4c 4d	24.i.2017	SP 048 854	38	S.J. Gregory & K. Lugg
Whipsnade Zoo ~ WZ	Butterfly House Discovery Centre	5a 5b	07.ii.2017	c. TL 00 17	30	S.J. Gregory, K. Lugg, A.R. Outen & M.G. Telfer
National Botanic Garden of Wales	Tropical Dome	6a 6b	06.vi.2016 27.ii.2017	SN 522 181 SN 522 181	46	S.J. Gregory K. Lugg
Stratford Butterfly Farm ~ SBF	Flight Area Insect City	7a 7b	10.xi.2017	SP 206 546	38	S.J. Gregory & K. Lugg

Table 2: Species of Woodlice recorded, and the glasshouses in which they were found.
For key to localities (maximum 7) and glasshouses (maximum 23) see Table 1. * = non-native species characteristic of heated glasshouses.

Locality & Glasshouse:	RBGE			LR	CBG			BBG				WZ		NB GW	SBF		No. locali-	No. glass-
Woodlice	**1d**	**1e**	**1f**	**2b**	**3a**	**3b**	**3c**	**4a**	**4b**	**4c**	**4d**	**5a**	**5b**	**6b**	**7a**	**7b**	**ties**	**houses**
Androniscus dentiger	#									#			#				**3**	**3**
Haplophthalmus danicus													#				**1**	**1**
*Styloniscid female indet.				#													**1**	**1**
**Styloniscus mauritiensis*[1]		#		#				#						#			**4**	**4**
**Anchiphiloscia pilosa*[2]												#					**1**	**1**
Philoscia muscorum							#										**1**	**1**
Oniscus aesllus asellus							#	#	#						#	#	**3**	**5**
**Trichorhina tomentosa*				#	#										#		**3**	**3**
Porcellio dilatatus											#			#	#		**3**	**3**
Porcellio scaber			#	#		#			#	#		#					**5**	**6**
Porcellionides pruinosus								#									**1**	**1**
**Nagurus cristatus*								#									**1**	**1**
Armadillidium nasatum				#	#		#								#		**3**	**4**
Armadillidium vulgare						#	#								#	#	**2**	**4**
**Reductoniscus costulatus*				#	#								#				**3**	**3**

[1]Previously reported by Gregory & Lugg (2018); [2]Previously reported by Telfer & Gregory (2018).

Woodlice Recorded

Fifteen species of woodlouse (Isopoda: Oniscidea) are recorded (Table 2), including six non-native species only found inside heated glasshouses in Britain: *Styloniscus mauritiensis* (Barnard) (Styloniscidae), an unidentified Styonliscid, *Trichorhina tomentosa* (Budde-Lund) (Platyarthridae), *Anchiphiloscia pilosa* (Budde-Lund) (Philosciidae), *Nagurus cristatus* (Dollfus) (Trachelipodidae) and *Reductoniscus costulatus* Kesselyák (Armadillidae). These six represent a third (33%) of Britain's 18 species of non-native woodlice characteristic of heated glasshouses (Lee, 2015; Telfer & Gregory, 2018) and are discussed below. Of the remaining 12 species that are not recorded by this survey, these have either not been seen in Britain since their initial discovery in the early- to mid-20th Century (Gregory, 2009) or are recent additions to the British list discovered at the Eden Project (Gregory, 2014).

Styloniscus mauritiensis (Fig. 1A) was previously only known from RBG Edinburgh where it was discovered in the mid-1980s. It was found to be still present in 2015, and three additional localities are added by this survey (as previously reported by Gregory & Lugg, 2018): the Living Rainforest, where it was found among rotting wood, the tropical glasshouse at Birmingham Botanical Gardens and the National Botanic Garden of Wales.

Females of an unidentified small (3mm in length) well pigmented styloniscid (Fig. 1B) were found at the Living Rainforest under leaf sheaths at the base of a banana plant (associated with *R. costulatus*). It is hoped to make a return trip to collect male specimens for positive identification.

Trichorhina tomentosa (Fig. 1C) is a well-known inhabitant of heated 'glasshouses' with six post 1980 localities given in Gregory (2009), varying from a confines of a heated cockroach cage to the vast expanse of the Eden Project Tropical Biome. Here we add three additional localities. At the Living Rainforest it was found within a rotting palm stump; at Cambridge Botanic Garden among chipped bark and under logs (associated with *R. costulatus*) in the tropical forest glasshouse and at Strafford Butterfly Farm it was collected from beneath low growing sprawling vegetation.

Anchiphiloscia pilosa (Fig. 1D) was first collected new for Britain by Mark Telfer from Whipsnade Zoo Butterfly House (Telfer & Gregory, 2018), where subsequent visits have found it to be well established among leaf-litter.

The only modern record for *Nagurus cristatus* (Fig. 1E) is from the Eden Project where it was collected between 2004 to 2010 (Gregory, 2014). Here we add an observation from the tropical glasshouse at Birmingham Botanical Gardens where it was collected from among accumulated leaf-litter at the base of a shallow depression.

Reductoniscus costulatus (Fig. 1F) is well known at Kew Gardens, where it has been recorded on several occasions (Gregory, 2009) and it has been recently recorded from Eden Project (Gregory, 2014). Here we report three additional locations. At the Living Rainforest it was found under a leaf sheath at the base of banana plant and among peaty 'soil' nearby. At Cambridge Botanic Garden it was found (associated with *T. tomentosa*) among chipped bark and under logs in the tropical forest glasshouse. It was also found, among detritus, at the (now closed) Whipsnade Zoo Discovery Centre.

Five additional woodlouse species, *Androniscus dentiger* Verhoeff (3 localities), *Haplophthalmus danicus* Budde-Lund (1 locality), *Armadillidium nasatum* Budde-Lund (3 localities), *Porcellio dilatatus* Brandt (3 localities) and *Porcellionides pruinosus* (Brandt) (1 locality) are frequently reported from inside glasshouses, although by no means confined to them (Gregory, 2009). The remaining four species, *Philoscia muscorum* (Scopoli) (1 locality), *Oniscus asellus* Linnaeus (3 localities), *Porcellio scaber* Latreille (5 localities) and *Armadillidium vulgare* (Latreille) (2 localities), are common and ubiquitous across much of Britain (Gregory, 2009). However, it is of note that these 'common' species were recorded in just a few of the surveyed sites, and typically in low numbers.

Figure 1: Some characteristic woodlice of heated glasshouses recorded during this survey. A) *Styloniscus mauritiensis* (from BBG); B) Unidentified Styloniscid female (LRF); C) *Trichorhina tomentosa* (SBF); D) *Anchiphiloscia pilosa*, (WBH); E) *Nagurus cristatus* (BBG); F) *Reductoniscus costulata* (LRF). For key to localities see Table 1 (images © Keith Lugg).

Millipedes Recorded

Eleven species of millipede (Diplopoda) are recorded (Table 3) of which four non-native species are found only inside heated glasshouses in Britain: *Oxidus gracilis* (C.L.Koch) (Paradoxosomatidae), *Cylindrodesmus hirsutus* Pocock (Haplodesmidae), *Poratia digitata* Porat (Pyrgodesmidae) and *Cylindroiulus salicivorus* Verhoeff (Julidae). These four represent about a third (36%) of Britain's eleven species of non-native millipede characteristic of heated glasshouses (Lee, 2015) and are discussed below. Of the additional seven heated glasshouse species that are not recorded by this survey *Prosopodesmus panporus* Blower & Rundle was recorded from Kew Gardens in 1975, and the remainder are recent discoveries in the UK, mainly from the Eden Project (Lee, 2015).

Oxidus gracilis is a well-known inhabitant of plant nurseries and botanic gardens across Britain (Lee, 2006). Thus, it is no surprise that this millipede was recorded from 13 glasshouses (of a total of 23; 56%) at all seven of the localities surveyed, often in good numbers.

Currently, *Cylindrodesmus hirsutus* (Fig. 2A) is known from 'tropical' glasshouses at Kew Gardens, Wisley Gardens and Eden Project (Lee, 2006; Lee, Barber & Gregory, 2019). Here we add Whipsnade Zoo, where it was recorded from both the Butterfly House and the (now closed) Discovery Centre.

Poratia digitata (Fig. 2B) has been reported from four localities in England, including repeated observations at Kew Gardens (Lee, 2006). Here we report the first Welsh and Scottish records from NBG of Wales and the Tropical Palm House at RBG Edinburgh, respectively.

Cylindroiulus salicivorus (Fig. 2C) was first reported from RBG Edinburgh in 1987 (Read, *et al*. 2002), who also note a second Scottish site, St Andrews Botanic Gardens. Here we confirm it continued occurrence at RBG Edinburgh in the Montane Tropics and Temperate glasshouses.

Choneiulus palmatus (Němec) (recorded from 12 glasshouses at 6 localities) and *Cylindroiulus truncorum* (Silvestri) (Fig. 2D) (from 5 glasshouses at 4 localities) are heavily synanthropic in the UK and are often found inside glasshouses (Lee, 2006).

Of the remaining five millipedes, *Polydesmus coriaceus* Porat*, Blaniulus guttulatus* (Fabricius) and *Cylindroiulus britannicus* (Verhoeff) (Fig. 2D) are common and widespread species occurring in a wide variety of habitats in Britain and Ireland (Lee, 2006). *Allaiulus nitidus* (Verhoeff) and *Cylindroiulus londinensis* (Leach) are widespread but uncommon in Britain. Although the former is known to have synanthropic tendencies, the latter (recorded from the RBGE Temperate House) favours woodland and is rare in Scotland (Lee, 2006).

Centipedes Recorded

Nine species of centipede (Chilopoda) are recorded (Table 4), of which two non-native species only occur inside heated glasshouses in Britain: *Tygarrup javanicus* (Attems) (Mecistocephalidae) and *Lamyctes caeculus* (Brolemann) (Henicopidae). These two represent a third (33%) of Britain's six non-native centipedes characteristic of heated glasshouses (Lee, 2015). Of the additional four heated glasshouse species not recorded by this survey *Dicellophilus carniolensis* has not been reported since early in the 20th Century and the remainder are relatively recent discoveries in the UK (Lee, 2015).

Tygarrup javanicus is currently known from four localities, including tropical glasshouses at Kew Gardens, Wisley Gardens and Eden Project (Barber, 2009; Lee, Barber & Gregory, 2019). Here we add an additional locality; the Living Rainforest (Lowland glasshouse) in Berkshire, where it was found among sparse leaf-litter.

Barber (2009) reports *Lamyctes caeculus* (Fig. 2E) from two sites (Eden Project and NBG of Wales). Here we add two additional localities; Cambridge Botanical Gardens and Whipsnade Butterfly House, where it was recorded among sparse leaf-litter.

Table 3: Species of Millipede recorded, and the glasshouses from which they were found.

For key to localities (maximum 7) and glasshouses (maximum 23) see Table 1. * = non-native species characteristic of heated glasshouses.

Locality & Glasshouse: / Millipedes	RBGE									LR		CBG		BBG			WZ		NBGW		SBF		No. localities	No. glasshouses
	1a	1b	1c	1d	1e	1f	1g	1h	1i	2a	2b	3a	3c	4a	4b	4c	5a	5b	6a	6b	7a	7b		
Blaniulus guttulatus						#	#	#	#														**1**	**4**
Choneiulus palmatus	#	#	#		#							#	#	#	#	#	#		#		#		**6**	**12**
Allaiulus nitidus			#																				**1**	**1**
Cylindroiulus britannicus	#	#					#			#	#	#			#				#			#	**6**	**9**
Cylindroiulus londinensis							#																**1**	**1**
**Cylindroiulus salicivorus*					#		#																**1**	**2**
Cylindroiulus truncorum										#	#	#			#		#						**4**	**5**
**Cylindrodesmus hirsutus*																	#	#					**1**	**2**
**Oxidus gracilis*	#	#		#					#	#	#	#		#	#		#	#	#		#	#	**7**	**14**
**Poratia digitata*								#												#			**2**	**2**
Polydesmus coriaceus						#	#					#					#						**3**	**4**

Table 4: Species of Centipede recorded, and the glasshouses from which they were found.

For key to localities (maximum 7) and glasshouses (maximum 23) see Table 1. * = non-native species characteristic of heated glasshouses.

Locality & Glasshouse: / Centipedes	RBGE							LR		CBG			BBG				WZ	NBGW		SBF		No. localities	No. glasshouses
	1a	1b	1c	1d	1f	1g	1i	2a	2b	3a	3b	3c	4a	4b	4c	4d	5a	6a	6b	7a	7b		
**Tygarrup javanicus*								#														**1**	**1**
Haplophilus subterraneus					#	#															#	**2**	**3**
Stenotaenia lineata						#																**1**	**1**
Cryptops hortensis			#	#			#					#	#		#			#		#		**5**	**8**
**Lamyctes caeculus*											#						#					**2**	**2**
Lithobius forficatus		#	#					#	#	#										#		**4**	**6**
Lithobius lapidicola	#	#												#			#					**3**	**4**
Lithobius melanops											#	#			#	#						**2**	**4**
Lithobius pilicornis																			#			**1**	**1**

Figure 2: Some characteristic millipedes and centipedes of heated glasshouses recorded. A) *Cylindrodesmus hirsutus* (WBH); B) *Poratia digitata* (RBGE); C) *Cylindroiulus salicivorus* (RBGE); D) *Cylindroiulus truncorum* (darker specimen) and *C. britannicus* (paler specimen) (LR); E) *Lithobius lapidicola* (note last pair of legs missing) (BBG); E) *Lamyctes caeculus* (WZ). For key to localities see Table 1 (images © Keith Lugg, except D, by Steve Gregory).

Lithobius lapidicola Meinert (Lithobiiidae) (Fig. 2D) has an interesting distribution in Britain. It is recorded from a handful of outdoor coastal sites in Kent and Suffolk, but also reported from glasshouses at RBG Edinburgh and in Dorset (Barber, 2009). Here we confirm its continued occurrence at RBG Edinburgh and report the collection of specimens from two additional sites; Birmingham Botanical Gardens and Whipsnade Butterfly House.

Stenotaenia lineata (C.L.Koch) is mainly known from a few outdoor synanthropic sites in south-east England (Barber, 2009), but has been recorded elsewhere. This includes RBG Edinburgh (A.D. Barber, pers. comm. to SJG) where we also found the species in 2015. *Lithobius pilicornis* Newport can be locally frequent in south-west England and south Wales. Here we record it from the NBG of Wales. The remaining four centipedes, *Cryptops hortensis* (Donovan) (recorded from 5 localities), *Haplophilus subterraneus* (2 localities), *Lithobius forficatus* Linnaeus (4 localities) and *L. melanops* Newport (2 localities), are common and widespread species occurring in a wide variety of habitats in Britain and Ireland (Barber, 2009).

Discussion

The distribution of species associated with heated glasshouses is not restricted by outdoor climatic factors, such as temperature or rainfall (as with native and naturalised species), but by their ability to disperse through human activity to new sites (i.e. as accidental imports). Thus, species associated with heated glasshouses may be recorded anywhere within Britain and Ireland, wherever appropriately heated and irrigated glasshouses, and opportunities for accidental introduction, exist.

During this survey about a third of the non-native 'exotic' woodlice, millipedes and centipedes that are found only inside heated glasshouses in Britain were recorded; i.e. six of 18 woodlouse species, four of 11 millipedes and two of six centipedes. A relatively large proportion of those species that were not recorded by this survey have either not been seen in Britain since their initial discovery in the early- to mid-20th Century (Lee, 2015) or are recent additions to the British list, such as those discovered at the Eden Project (Lewis, 2007; Read, 2008; Gregory, 2014).

A few of the non-native species characteristic of heated glasshouses, notably the millipede *Oxidus gracilis,* but also the woodlouse *Trichorhina tomentosa*, are widely recorded and are well documented within such artificially maintained envirnments (Lee, 2006; Gregory, 2009). However, many of these characteristic heated glasshouse species are typically known from very few sites and seem to be sporadically encountered, perhaps being less readily dispersed by human activity. Other species seem to have been under-recorded in the past, with a relatively high proportion of records made during these recent targeted surveys. This includes the woodlice *Styloniscus mauritiensis* and *Reductoniscus costulatus*: the millipedes *Cylindrodesmus hirsutus* and *Poratia digitata*; and the centipedes *Tygarrup javanicus* and *Lamyctes caeculus*. However, this may be a reflection of recent renewed interest in the fauna of heated glasshouses. Some species recorded appear (at the moment) to be one-off introductions, such as Mark Telfer's discovery of *Anchiphiloscia pilosa* at Whipsnade Zoo (Telfer & Gregory, 2018). Of course, it is possible that in time this, and other species, may be unintentionally spread to other sites in Britain.

Surveys of other heated glasshouses (botanic gardens, butterfly houses, etc.) throughout the British Isles are likely to prove interesting. Indeed, one is never sure which species may be found inside a given glasshouse, and additional species of woodlouse, millipede and centipede new for Britain undoubtedly await discovery. We hope that this article will encourage others to have a closer look at the Isopod and Myriapod fauna of heated glasshouses.

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Duncan Sivell organised the BMIG meeting to Linlithgow and arranged access to Edinburgh RBG.

We thank the staff at RBG Edinburgh, Living Rainforest (Simon Pratley), Cambridge Botanic Garden, Birmingham Botanical Gardens (Wayne Williams), Whipsnade Zoo (Tyrone Capel), National Botanic Garden of Wales (Laura Jones) and Stratford Butterfly Farm for allowing access to collect specimens.

We are very grateful to Mark Telfer for alerting us to his discovery of *Anchiphiloscia pilosa* at Whipsnade Butterfly House, and for his company, with Alan Outen, during our subsequent the visit to that site.

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Troglomyces rossii Santamaría, Enghoff & Reboleira, 2014 (Laboulbeniales) new to Britain and Ireland on *Ophyiulus germanicus* (Verhoeff) (Diplopoda: Julida: Julidae)

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The Laboulbeniales are an Order of fungi which grow on the bodies of insects and other invertebrates, including millipedes. Hitherto, only one species has been known from millipedes in Britain: *Rickia laboulbenioides* De Kesel. It has been recorded from a few host species in genus *Cylindroiulus* (Diplopoda: Julida: Julidae): *C. punctatus* (Leach), *C. britannicus* (Verhoeff), *C. latestriatus* (Curtis), *C. pyrenaicus* (Brölemann) and *C. sagittarius* (Brölemann) (Gregory *et al.*, 2018; Gregory & Owen, 2019; Storey, 2019; Gregory, in prep.).

On 17 September 2019, Roy Anderson collected several *Ophyiulus germanicus* from his garden in Belfast (J349695, Co. Down VC H38), Northern Ireland, and gave them alive to the author when we met up in a restaurant that evening. Later examination of the millipedes revealed that most were heavily colonised by Laboulbeniales (Fig. 1). These were provisionally identified as *Troglomyces rossii* Santamaría, Enghoff & Reboleira, 2014 by reference to Santamaría *et al.* (2014, 2018). Specimens were sent to Prof. Sergi Santamaría who kindly confirmed their identity.

Figure 1: *Troglomyces rossii* on the legs of *Ophyiulus germanicus*.

Laboulbeniales are easily overlooked and so specimens of *O. germanicus* in the author's collection from the original British locality at Trap Grounds, Oxford (SP502081, Oxfordshire VC 23; 18 April 2016) (Gregory, 2018) and a second British locality at Ventnor Botanic Gardens (SZ5476, Isle of Wight VC 10; 12 February 2019) were carefully examined. There were no Laboulbeniales on the Trap Grounds

specimens but Laboulbeniales were present on most of the Ventnor Botanic Gardens specimens. These were identified as *T. rossii* and confirmed by Prof. Sergi Santamaría.

Although there were no Laboulbeniales fungi on the Trap Grounds specimens, there were some other fungi growing singly on the tibia or tarsus of the legs. These fungi are much smaller than *T. rossii*, and lie appressed to the leg making them difficult to spot; the black point of attachment is more conspicuous than the thallus (Figs. 2, 3). They very much resemble (Henrik Enghoff, *in litt.*) the unidentified 'enigmatic fungi' found on *Xestoiulus laeticollis* (Porat) and *O. pilosus* (Newport) (Diplopoda: Julida: Julidae) in Denmark and illustrated in Figures 2 and 3 of Enghoff & Reboleira (2017).

Figure 2: Leg of *O. germanicus* with one 'enigmatic fungus' on the tarsus, showing the black point of attachment (arrowed).

Some ecological and life-history information may be inferred from the occurrence of Laboulbeniales. Laboulbeniales are thought to be transmitted between individuals by direct contact, when spores from an infected millipede attach to another. In some Laboulbeniales on millipedes, it is clear that they are primarily sexually transmitted, with the fungi concentrated around the gonopods of males and the gonopore surroundings of females, though this concentration is less clear with *T. rossii* on *O. germanicus*. It is presumably essential for the persistence of the fungus that infected millipedes mate, or otherwise come into close contact with, individuals of the younger generation. The occurrence of 'enigmatic fungi' on the distal segments of the leg suggests their spores are contracted by walking over substrate. If this is the case, they may not be specific to millipedes but are more likely to be detected on millipedes than other invertebrates by virtue of their pale legs and considerably greater footfall.

Acknowledgements

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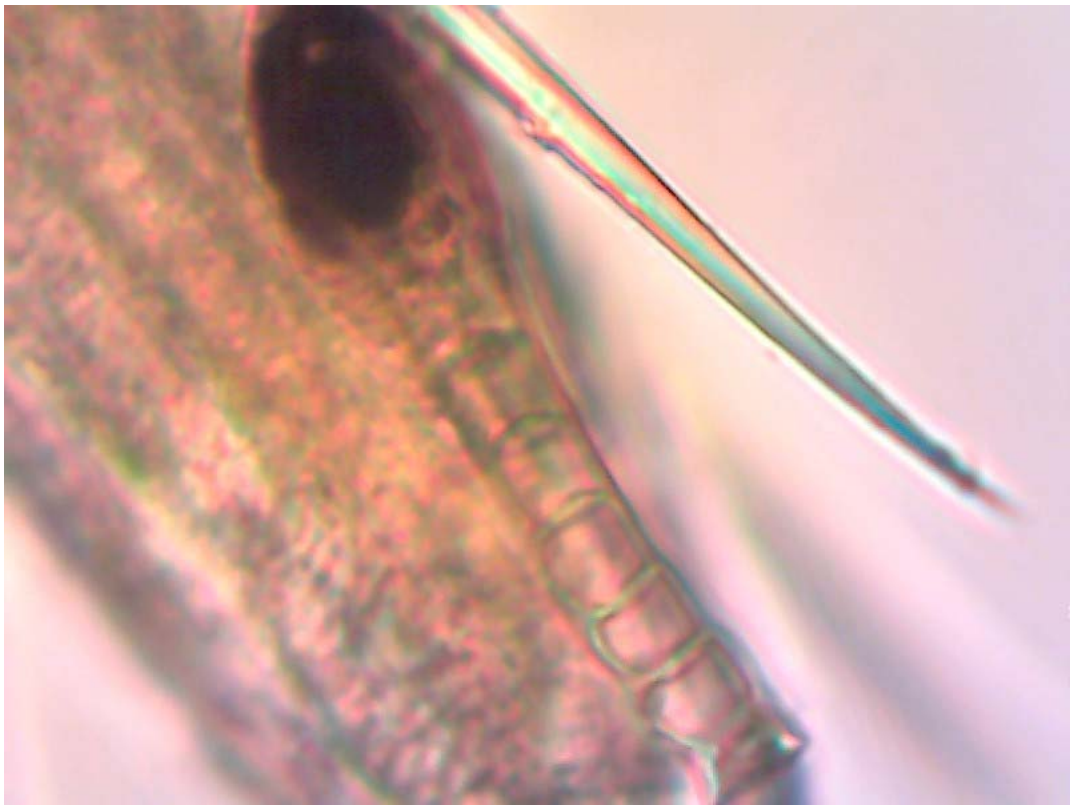

Figure 3: The 'enigmatic fungus' from Fig. 2, viewed through a compound microscope.

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Melogona voigtii (Verhoeff, 1899): a millipede new for England (Chordeumatida, Chordeumatidae)

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Abstract

The Nationally Rare millipede *Melogona voigtii* (Verhoeff, 1899) is reported from its first English site; a woodland in West Lancashire. A brief description with illustrations is provided, and comparison is made with the widespread *M. gallica* Latzel. The ancient woodland habitat and associated species is in keeping with the idea that it may be an overlooked native species. Additional sites may be found in England. However, its status remains Data Deficient pending additional observations.

Introduction

Melogona voigtii (Verhoeff, 1899) was recognised as a British species on the basis of specimens collected from three sites in the Lothians, Scotland, in 1988 and 1995 (Corbet, 1996). Subsequently, specimens were collected from Glasgow Necropolis (cemetery) by Davidson (2013). In light if the paucity of records, Lee (2015) designates *M. voigtii* as Nationally Rare and, solely within Britain, Data Deficient pending additional information. *M. voigtii* bears a strong resemblance to the widespread *M. gallica* Latzel and it is only possible to separate the two species by microscopic examination of mature male or female specimens (Corbet, 1996; Enghoff, 2016). Thus, it is quite probable that *M. voigtii* has been under recorded as a result of past taxonomic confusion. There is also uncertainty as to whether it is a native or introduced species (Lee, 2015).

Here we report the discovery of *M. voigtii* from an ancient woodland site in West Lancashire (VC60) in northern England.

First English observations

In January 2019 NG collected three samples of *Melogona* specimens from West Lancashire (VC60) and Westmorland (VC69) from leaf-litter while searching for hoverfly (Syrphidae) larvae. This entailed filling a 'bag for life' type shopping bag (of approximately 22L in volume) with leaf-litter collected from the top layers of leaf-litter from a contiguous sampling area. Back home this was shaken through a sieve, through which most millipedes readily passed into a collecting tray below. Leaves and other coarse material held back by the sieve were then hand sorted to reveal additional specimens. The *Melogona* specimens thus obtained were sent SJG for identification.

The three samples (Table 1) comprised entirely of female specimens so determinations were undertaken from female bursal sclerites (the fused vulval bursae) as recently described and figured by Enghoff (2016). These are located between second and third pair of legs and were dissected from the specimens and mounted on temporary slides, in clove oil, for drawing. However, it is possible to view these in situ, without dissection, if the legs are gently teased out of the way (Enghoff, 2016).

A female specimen with 28 body rings collected from Yew Tree Tarn (NY321003, VC69, 26.i.2019) has a bursal sclerite that is much broader than long and has a convex distal margin (Fig. 1A). This is a good match with *M. scutellaris* as figured in Enghoff (2016, Fig. 3); a species widely distributed across Britain and Ireland (Lee, 2006).

Table 1: First English records of *Melogona voigtii* and other material of *Melogona* examined.
N. Garnham, leg.; S.J. Gregory, det.

Locality	Grid Ref	VC	Number specimens	Date of Collection	Habitat
Melogona voigtii					
Dalton Crags	SD546761	60	1♀	27.i.2019	Deciduous woodland at edge of limestone pavement.
Dalton Crags	SD546763	60	1♂ 1♀	05.xi.2019	Mixed woodland; from Beech & Larch litter.
Melogona gallica					
Rabbit Lane, Arkholme	SD572707	60	2♀	22.i.2019	Mixed woodland: Beech, Larch, Pine, Hazel & Birch litter.
Lord's Lot, Capernwray	SD547707	60	1♂ 5♀	8.xi.2019	Mixed woodland: from Sycamore litter (near conifers).
Melogona scutellaris					
Yew Tree Tarn	NY321003	69	1♀	26.i.2019	Mixed deciduous and coniferous woodland.
Trowbarrow LNR	SD480756	60	1♂	26.x.2019	Mixed deciduous and coniferous woodland.
Middle Barrow	SD466770	69	6♂ 4♀	02.xi.2019	Mixed woodland; from Beech, Ash, Sycamore & Larch litter.
Dalton Crags	SD547761	60	1♂ 1♀	05.xi.2019	Mixed woodland; from Beech & Larch litter.

Two female specimens with 30 body rings from Rabbit Lane, Arkholme (SD572707, VC60, 22.i.2019) have a bursal sclerite broader than long with straight lateral edges and broadest distally with a concave distal margin (Fig. 1B). This is interpreted as a female *M. gallica* (using Enghoff, 2016, Fig. 1), a species well known across much of western Britain (Lee, 2006).

A final female, also with 30 body rings, from Dalton Crags (SD546761, VC60, 27.i.2019) (live specimen shown in Fig. 2A) has a bursal sclerite slightly longer than broad and with a convex distal margin (Fig. 1C). This is a reasonable match with *M. voigtii* as figured in Enghoff (2016, Fig. 2), but given its restricted Scottish distribution was only tentatively ascribed to this species (Gregory, 2019).

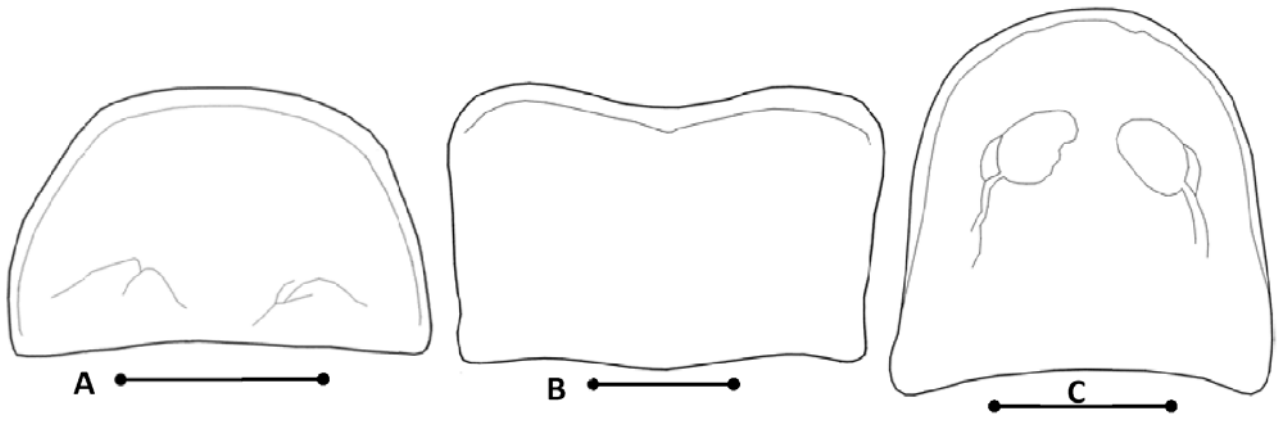

Figure 1) Bursal sclerites of female *Melogona*. A) *M. scutellaris* (Yew Tree Tarn); B) *M. gallica* (Rabbit Lane, Arkholme); C) *M. voigtii* (Dalton Crags). Scale bars = 0.1mm.

In November 2019 NG returned to Dalton Crags to collect additional litter samples, primarily to target *Melogona* millipedes. Here, the full depth of leaf litter was collected, including that from cavities within bedrock, such as limestone pavement grikes, and from around the base of trees and dead wood. One of the samples (Table 1) contained a male and female specimen with 30 body rings. In side view the male (Fig. 3A) lacked the prominent three-lobed paragonopod that typically is quite apparent in *M. gallica* (Fig. 3B). The specimens were, in life, more heavily pigmented and were noticeably larger than specimens of *M. scutellaris* when placed side by side (Fig. 2B). The specimens were forwarded to SJG for examination. The male (and female) specimen proved to be *M. voigtii*, thus confirming the occurrence of this species in England, some 200km south of previous Scottish observations (Fig. 6). The specimens are stored in 75% ethanol and are currently retained in the personal collection of SJG.

Figure 2) *Melogona* females from Dalton Crags. A) Live specimen of *M. voigtii* collected 27.i.2019; B) Preserved specimen of *M. voigtii* (top) and *M. scutellaris* (bottom), collected 05.xi.2019 (images © Nicola Garnham).

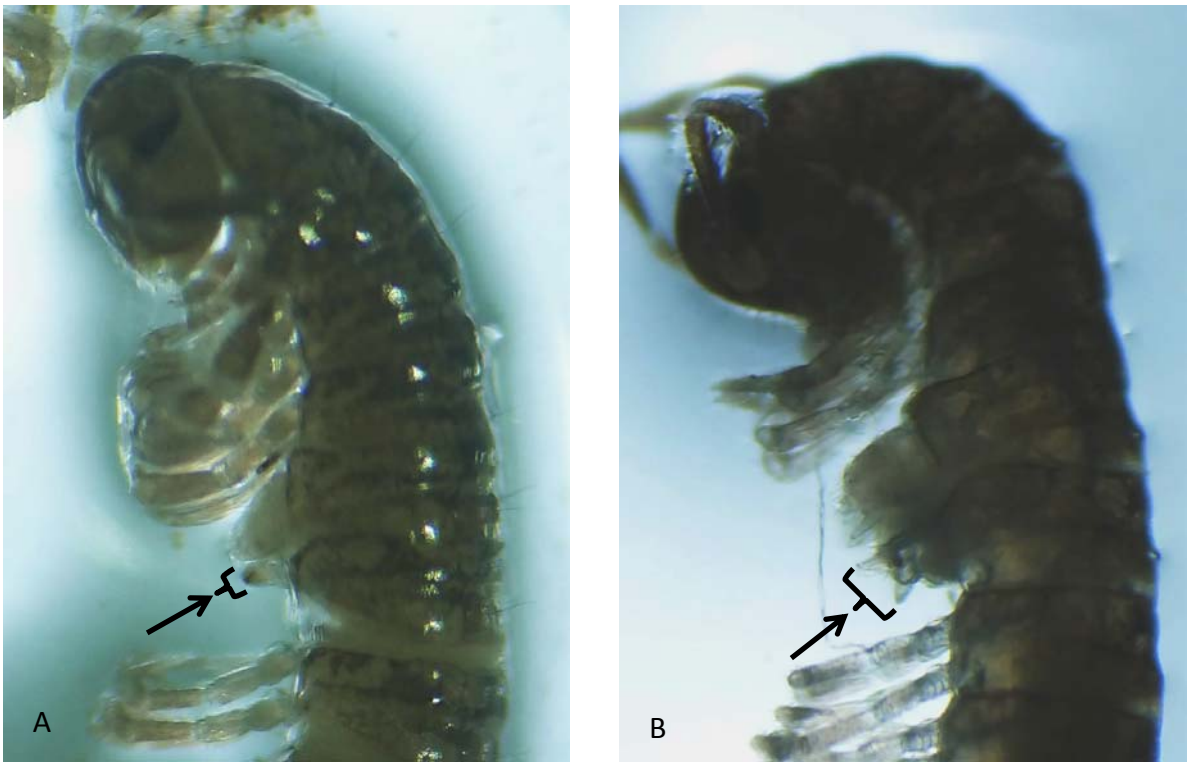

Figure 3) *Melogona* males showing gonopods, lateral view (posterior paragonopods, modified leg pair 11, arrowed). A) *Melogona voigtii*, from Dalton Crags. B) *Melogona gallica*, from Lord's Lot, Capernwray (images © Nicola Garnham).

Identification of *Melogona voigtii*

M. voigtii bears a superficial resemblance to *M. gallica* (and will key to that species in Blower, 1985). It can only be identified by examination of adult male or female specimens (Corbet, 1996; Enghoff, 2016). Corbet (1996) provides a brief description with figures of male *Melogona voigtii* collected from the Lothians, Scotland. A more detailed description (as *Microchordeuma voigti*) is provided by Brolemann (1935, pp 349-351). Both publications highlight the structure of the modified leg pair 11 (posterior paragonopods) and leg pair 12 (7th visible pair) as key features in separating *M. voigtii* from *M. gallica* (and also from *M. scutellaris*). These, and other, characters are briefly described and figured.

Body size

The sizes of the specimens examined by Corbet (1996) or Davidson (2013) are not given. Of the three specimens collected from Dalton Crags in 2019, the male is 7.5mm in length by 0.7mm diameter (maximum ring height) and the two females 9.0mm and 9.5mm in length; both 0.8mm in diameter. Thus, these specimens are similar in size to *M. gallica* (as given by Blower, 1985) and noticeably larger than *M. scutellaris* (Blower, 1985; also see Fig. 2B above).

Male: leg pairs 1-6

In the male, leg pairs 1 and 2 are slightly reduced in size (as in *M. scutellaris*), with leg pairs 3-6 much more robust.

Male: leg pair 7 (anterior paragonopods)

Family Chordeumatidae is unique among other British millipedes of order Chordeumatida in that leg pair 7 is reduced in size and highly modified (Blower, 1985). Those of *M. voigtii* (Fig. 4A) are not

figured by Corbet (1996), but differ subtly in shape from those of *M. gallica* (Blower, 1985, Fig. 28B) and also *M. scutellaris* (Blower, 1985, Fig. 29B).

Male: leg pair 8 (peltogonopods)

These are figured in Corbet (1996, Fig. 3 & 4) and are not figured herein.

Male: leg pair 9 (gonopods)

These are figured in Corbet (1996, Fig. 2) and are not figured herein.

Male: leg pair 10

These are highly reduced in family Chordeumatidae (Blower, 1985; Brolemann, 1935) and considered to be of little taxonomic value.

Male: leg pair 11 (posterior paragonopods)

In *M. voigtii* these are weakly bilobed distally in anterior and posterior view (Fig. 4B; Corbet, 1996, Fig. 1), this being not obvious in lateral view (Fig. 3A). This contrasts with *M. gallica* where the posterior paragonopods are strongly tri-lobed in both anterior and posterior view and also in lateral view (Fig. 3B; Blower, 1985, Fig. 28E).

Male: leg pair 12

In *M. voigtii* the coxae of leg pair 12 (visible leg pair 7) bear a prominent projection that is much larger than that on the trochanter (Fig. 4C). The reverse is seen in *M. gallica* where the projection on the trochanter is much larger than that on the coxa (Fig. 4D). In contrast *M. scutellaris* lacks projections on both the coxa and trochanter of leg pair 12.

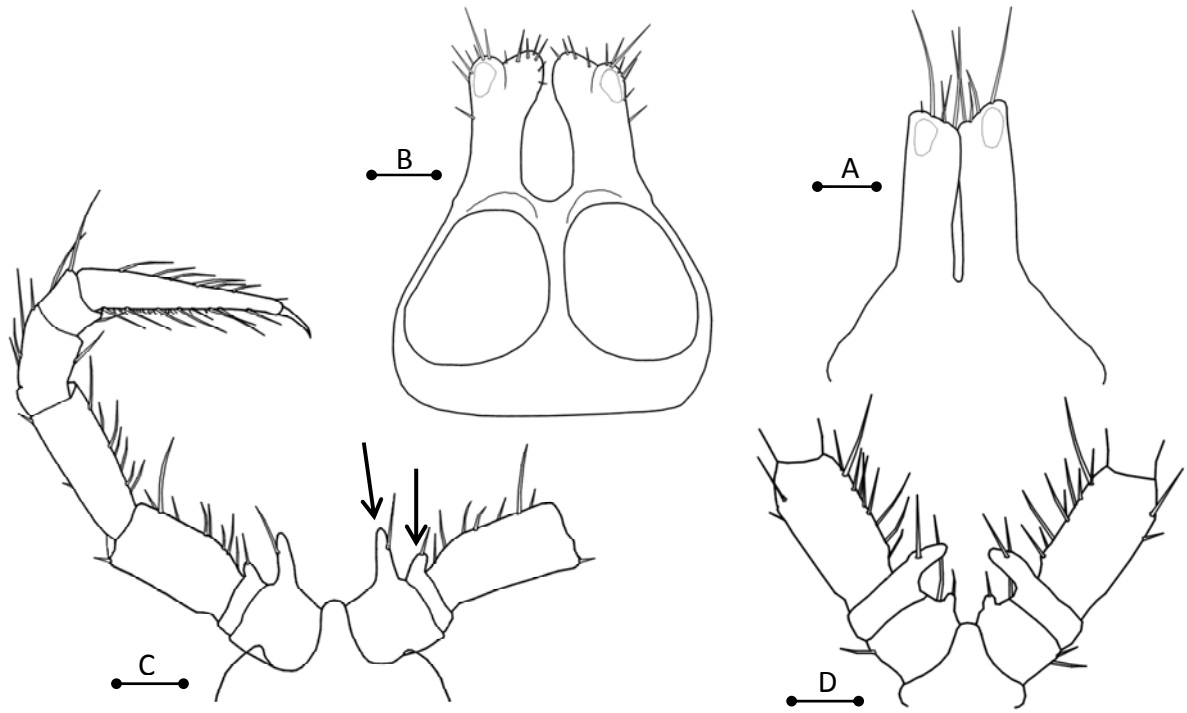

Figure 4) ***Melogona voigtii*** **male, Dalton Crags** (specimen shown in Fig. 3A**).** A) Modified leg pair 7 (anterior paragonopods); B) Modified leg pair 11 (posterior paragonopods); C) Leg pair 12, showing projection on coxa much larger than that on trochanter (arrows).
Melogona gallica **male, Lord's Lot, Capernwray** (specimen shown in Fig. 3B). D) Leg pair 12, showing projection on coxa much smaller than that on trochanter. All scale bars = 0.1mm.

Female: bursal sclerite

Female specimens of *M. voigtii* are readily identifiable by the shape of the bursal sclerite (Enghoff, 2016), which is slightly longer than broad and with a convex distal margin (Fig. 1C).

Female bursal sclerites, as figured in Enghoff (2016), have proved to be a relatively quick and easy method for determination of British *Melogona* species, since it is possible to view these in situ, without dissection, if the legs are gently teased out of the way.

Habitat and associated species

Dalton Crags is a rural site, about 120ha in extent, lying on Carboniferous Limestone and comprises a mixture of limestone pavement, ancient deciduous woodland and recently planted beech *Fagus sylvaticus* L. and larch *Larix* sp. plantation (Forestry England, 2019). It lies on a gentle south west facing slope below the much larger Hutton Roof massif (which includes areas designated as SSSI, NNR and SAC).

The specimens were collected from an area of mixed deciduous woodland lying on a south facing slope, including beech, ash *Fraxinus excelsior* L., sycamore *Acer pseudoplatanus* L. and birch *Betula* sp. (Fig. 5). The area is intermittently grazed by a small number of cattle and there is very little understorey. There are scattered limestone rocks and rotting dead wood. The ground is quite rocky with little soil, mainly accumulated between rocks, dead wood and around standing trees, etc.

Figure 5: Dalton Crags, area of mixed deciduous woodland from which *Melogona voigtii* was recorded (image © Nicola Garnham).

Associated millipedes recorded in the samples from Dalton Crags are *Glomeris marginata* (Villers), *Nanogona polydesmoides* (Leach), *Chordeuma proximum* Ribaut, *Melogona scutellaris* (Ribaut), *Brachydesmus superus* Latzel, *Polydesmus angustus* Latzel, *Proteroiulus fuscus* (Am Stein), *Julus scandinavius* Latzel and *Tachypodoiulus niger* (Leach). Centipedes recorded are *Haplophilus*

subterraneus (Shaw), *Strigamia acuminata* (Leach), *Geophilus insculptus* Attems, *Lithobius variegatus* Leach, *L. microps* Meinert and the Nationally Scarce *L. muticus* C.L. Koch. This latter species, a characteristic animal of deciduous woodland, represents an isolated population beyond its typical south-eastern English range (A.D. Barber, pers. comm.).

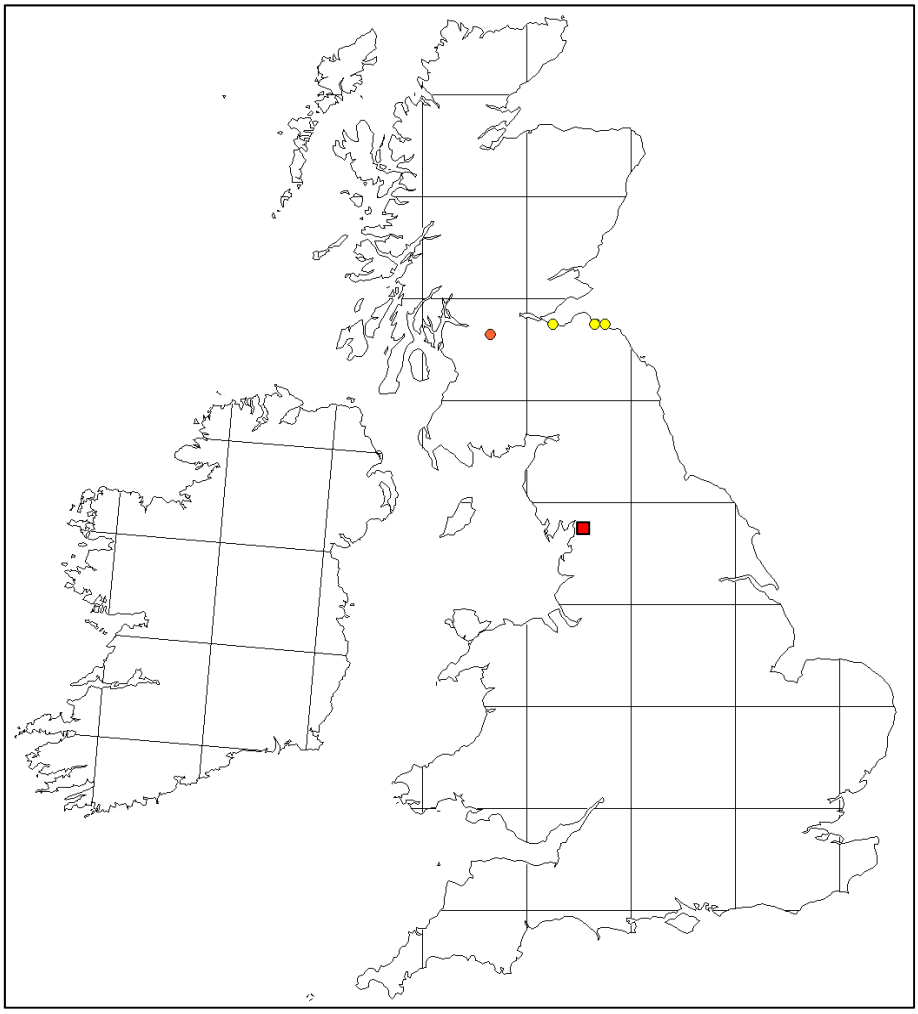

Figure 6: Known British and Irish distribution of *Melogona voigtii* plotted at 10km resolution
○ Corbet, 1996 (plotted in Lee, 2006); ● Davidson, 2013; ■ First English record reported herein.

Discussion

Lee (2015) highlights the uncertainty regarding the native status of *M. voigtii* in the UK. On the European continent the distribution of *M. voigtii* lies mainly to the north and east of *M. gallica*, but their ranges do overlap in the Low Countries (Kime, 1990; 2004). In the Netherlands *M. voigtii* is considered synanthropic (Jeekel, 2001). The three Lothian records were from either synanthropic sites (private gardens) or from semi-natural woodland (albeit with evidence of human disturbance) and both Corbet (1996) and Jeekel (2001) suggest that *M. voigtii* may have been introduced by human activity via trade from the continent. In keeping with this idea, the Glasgow site (Davidson, 2013) is also strongly synanthropic, being a large graveyard established in a disused quarry near the city centre. In Germany (and elsewhere in Europe) *M. voigtii* is an inhabitant of woodland (Spelda, 1999; Kime, 1990) and Kime (2001) considers its presence in Scotland to be a natural extension of its European range and that further populations may be discovered in eastern England.

There is little in the way of recent human disturbance at Dalton Crags other than public access and recent forestry plantings, although a few disused lime kilns are present nearby. In addition, the associated species recorded during the surveys include several species typical of undisturbed woodland, such as the centipede *Lithobius muticus*. However, it is not possible to rule out the introduction through human activity of *M. voigtii* (or even *L. muticus*) to this site. Indeed, the introduced terrestrial flatworm *Marionfyfea adventor* Jones, 2016 has been recorded nearby, but does seem to be generally widespread in this area (NG, pers. obsv.). The discovery of a population of *M. voigtii* at Dalton Crags would seem to support Kime's (2001) idea that this may be an overlooked native species in the UK. None-the-less, this isolated record does not alter this species' IUCN classification of Data Deficient in Britain (Lee, 2015) and additional information on its habitat preferences (whether it favours synanthropic or semi-natural sites) would help clarify the status of this rare millipede in the UK.

It can no longer be assumed that *M. voigtii* is restricted to Scotland and it may have been overlooked (as *M. gallica*) at other sites in northern England. Reliable determination of these two species should be based on examination of adult male or female specimens as detailed in this paper.

Acknowledgements

We thank Paul Lee for his helpful comments about the identification and status of *M. voigtii*.

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The occurrence of *Metatrichoniscoides leydigii* (Weber, 1880) (Isopoda: Oniscidea) on the Ribble Estuary, Lancashire

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Summary

Metatrichoniscoides leydigii (Weber, 1880) is recorded at its fourth site for the British Isles along the Ribble estuary, Preston, Lancashire. This is the second British record for this species within a semi-natural environment, and the first record for the western coastline of England.

Discovery

In December 2018 the author visited the northern bank of the Ribble estuary (SD 5003 2926), due west of Preston Dockland, Ashton in an attempt to locate coastal Trichoniscids; particularly *Miktoniscus patiencei* Vandel and *Trichoniscoides saeroeensis* Lohmander. On 19.xii.2019, 13 small (c. 3mm), off-white woodlice were located under firmly embedded rocks along the high tide mark above a dense layer of storm debris. Sampling showed pockets of suitable habitat, particularly below trees and vegetation where the substrate graded from sandy silt into a rich humus. Later examination of these woodlice revealed an absence of ommatidia and a coarsely tuberculated body suggesting a *Metatrichoniscoides* sp. Vandel. A few individuals of *Trichoniscus pygmaeus* Sars also turned up in this sample. Unfortunately, all the *Metatrichoniscoides* sp. were female; the absence of a male specimen for dissection meant that identifying to species was not possible.

A return to the original site on 22.xii.2019 turned up a further 8 females. On 5.i.2019 an attempt to locate this species on the southern bank slightly further downstream (SD 4877 2881) turned up a further 6 females as well as 5 *T. saeroeensis* (determined through dissection by Steve Gregory). Finally, during a revisit to the original site on 29.iv.2019, 2 male specimens were located alongside 2 females.

Dissection of one of these males (Fig. 1A) revealed sexual characteristics identical to *M. leydigii* (Weber, 1880) and matched figures described by Hopkin (1991). Pleopod 1 exopodite (Fig. 1B), clearly showed the twin tailed distal process, kinked at a 90 degree angle against the vertex. The pleopod 2 endopodite (Fig. 1C) also displayed the diagnostic spade shaped distal process.

Discussion

M. leydigii has been recorded three times previously within the British Isles. The initial discovery by Gregory in 1989 (Hopkin, 1990) was from a long-standing garden centre in Oxford (now demolished), implying that this species had likely arrived through horticultural means. This mode of introduction was also supported by the most recent record from Wentworth Castle Gardens in Stainborough by Richards (2016), where it was found within the nursery area of the walled garden. In contrast, Gregory (2012) discovered a single male specimen from the bank of the River Medway in Kent; unlike the other two (clearly introduced) records, this was a semi-natural location and had habitat characteristics similar to its known natural range in the Netherlands and Belgium (Berg *et al.*, 2008; De Smedt *et al.*, 2016). This observation raised speculation around the native status of this species within the British Isles. However, due to the extensive industrial history of the River Medway a synanthropic origin could not be completely ruled out. As a result *M. leydigii* still resides on the Non-native Species Register (http://www.nonnativespecies.org/factsheet /factsheet.cfm?speciesId=2218).

The Ribble Estuary also reflects a similar industrial past to the River Medway. The sampling location is in close proximity to Preston Dockland (previously, one of the largest single docks in Europe). The construction of the docks required a major remodelling and diversion of the river channel, with many of the riverbanks being artificially laid with stone. Following its completion in 1892, the docks had a 90-year industrial lifespan, being heavily involved in the importation of cotton, coal, timber, wood pulp, china clay, fruits, oil etc. from all over the world (Davies, 2019). The available literature failed to make any clear links with countries within the range of *M. leydigii*, but the likelihood of vessels moving between these countries and Preston Docks is still exceptionally high. This evidence greatly diminishes the probability of this being a native population of *M. leydigii*, but it does suggest a much broader distribution for them around the British coastline, especially along semi-natural and industrially-disturbed estuarine habitats.

Figure 1: Male *Metatrichoniscoides leydigii* from the Ribble Estuary, Preston Docks, Ashton, Lancashire. A) Habitus, dorsal view; B) Pleopod 1; C) Distal process of the Endopodite 2

Despite this, the number of individuals sampled along the Ribble Estuary is noteworthy. The surveys of the location suggest a sizeable and stable population, with a total of 29 females and 2 males recorded (see overview of records). Therefore, the longevity of *M. leydigii* at this location is positive due to its close proximity to the Ribble Estuary SSSI which protects an extensive area of estuarine habitat (stretching from Blackpool to Southport, encompassing the mouth of the River Ribble). An additional attempt to sample a similar but less disturbed habitat due north along the River Lune estuary produced no examples of *M. leydigii*.

Overview of Records

Metatrichoniscoides leydigii: Ribble Estuary, Preston Dockland, Ashton, Lancashire, England. SD 5003 2926, 19.xii.2018, T. D. Hughes leg/det. 13♀

Metatrichoniscoides leydigii: Ribble Estuary, Preston Dockland, Ashton, Lancashire, England. SD 5003 2926, 22.xii.2018, T. D. Hughes leg/det. 8♀

Metatrichoniscoides leydigii: Ribble Estuary, Preston Dockland, Ashton, Lancashire, England. SD 4877 2881, 5.i.2019, T. D. Hughes leg/det. 6♀

Metatrichoniscoides leydigii: Ribble Estuary, Preston Dockland, Ashton, Lancashire, England. SD 5003 2926, 29.iv.2019, T. D. Hughes leg/det. 2♂, 2♀

Trichoniscoides saeroeensis: Ribble Estuary, Preston Dockland, Ashton, Lancashire, England. SD 4877 2881, 5.i.2019, T. D. Hughes leg. S. J. Gregory det. 1♂, 4♀

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The distribution of *Oritoniscus flavus* (Budde-lund, 1906) in VC83 Midlothian (Isopoda: Oniscidea: Trichoniscidae)

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INTRODUCTION

The woodlouse *Oritoniscus flavus* (Budde-Lund, 1906) is rare in Britain (though widespread in southern Ireland, as described in Gregory, 2009), having first been recorded in 1994 in a location in south Wales (Morgan, 1994). In September 2010, the species was also, surprisingly, found by the River North Esk at Melville Castle in Midlothian (VC83), Scotland, making this the northernmost occurrence of *O. flavus* in the world by some 200km (Sivell & Gregory, 2015). Fieldwork in 2011 recorded the species at two further sites along the North Esk and River Esk (as it is named after the confluence of the North and South Esk rivers), at Dalkeith Country Park and near Whitecraig, with additional records gathered at Dalkeith CP during the BMIG annual fieldtrip in April 2015 (*ibid.*). The bedrock in the region belongs to the Clackmannan Group, a mixture of sandstone, mudstone, siltstone and limestone with Coal Measures overlying parts of it (see https://mapapps.bgs.ac.uk/geologyofbritain/home.html), meaning that the area is relatively base rich, though local conditions can produce more acidic habitats. The presence of *O. flavus* here has been hypothesised to stem from accidental introduction, perhaps via long-standing plant nurseries in the area.

On 30.vii.2017, I had my first encounter with this species, a single individual found under a fallen wall stone at Inveresk, about 150m east of the River Esk, also in Midlothian. My initial assumption that it was a small, dark *Philoscia muscorum* (Scopoli, 1763) proved incorrect on closer examination, which revealed it to be *O. flavus*. This was about 0.5km downstream from the nearest previous record. This find raised the question of the distribution of *O. flavus* along the Esk river systems, and targeted fieldwork (mostly in 2018 and 2019) was carried out by the author in order to determine the limits of the species' geographical distribution in the area. Fieldwork consisted of searching suitable habitat (usually woodland) within a short distance of the river system. The dark colour and characteristic behaviour of *O. flavus* (in the author's experience scattering rapidly like small ball-bearings in all directions on disturbance) mean that it is a conspicuous species where it is present. However, the speed at which the species scatters makes collection of samples and photography difficult, though occasional individuals may act indecisively or even freeze, at least for a few seconds, and in frosty conditions it is more sluggish (Figs. 1-2). It is typically found, often in good numbers, in leaf litter and under deadwood, sawn logs, stones and other debris, and it is usually quickly evident if it is present at a location. The species was found in mixed woodland, usually within a short distance of the river, and although it evidently prefers somewhat damp conditions, it can also be found in relatively dry microhabitats and appears to be less common in wet and waterlogged places. *O. flavus* was rarely found under birch or conifers, suggesting that it disprefers acidic microhabitats. The results of this fieldwork are summarised in Table 1.

Distribution of *Oritoniscus flavus* along the Esk river system

O. flavus was found to be common, indeed abundant, along both banks of the North Esk at Dalkeith CP (especially between NT333677 and NT332680) and along the east bank of the River Esk at Inveresk between NT346709 and NT347717. Several individuals have also been found about 250m west of the river (though near a tributary burn) under the railway bridge at Monktonhall (NT342711). Further

Table 1: Fieldwork along the Esk river system.

Date	Location	Grid Ref	Notes
30.vii.17	Inveresk	NT345712	Single individual seen under a fallen wall stone 150m from the river.
17.ix.17	Dalkeith CP	NT332680 to NT332677	*O. flavus* abundant under cut wood and in leaf litter on the west bank of the North Esk.
17.ix.17	Dalkeith CP	NT333678	*O. flavus* common under stones on the east bank of the North Esk.
25.iii.18	Inveresk	NT345713	About a dozen under sawn logs near the river.
25.iii.18	Roslin Glen	NT273628 to NT275629	No *O. flavus* found.
11.xi.18	Bilston Wood near Polton	NT287648	Up to 20 individuals found under an old pallet and fence posts in dry woodland above the river.
11.xi.18	The Maiden Castle	NT285644	One individual found under deadwood by the river.
03.i.19	Roslin Glen	NT266620 to NT268626	No *O. flavus* found.
03.ii.19	Monktonhall	NT342711	Several seen under bricks below the railway bridge, 250m west of the river.
03.ii.19	Inveresk	NT346709 to NT347717	*O. flavus* abundant under deadwood, sawn logs and stone along the course of the river, uncharacteristically sluggish because of the hard frost. See Figures 1 and 2.
23.iii.19	Inveresk	NT346708	Several collected for Joerg Spelda's isopod DNA barcoding project.
27.vii.19	Lady Lothian's Plantation (South Esk)	NT327650 to NT328655	No *O. flavus* found, even though other woodland species were plentiful.
17.viii.19	Lord Ancrum's Wood (South Esk)	NT331657 to NT336666	No *O. flavus* found, even though other woodland species were plentiful.
31.viii.19	Mouth of the Esk, west bank	NT344730	No *O. flavus* found in open parkland with few trees, so habitat not really suitable.
31.viii.19	Young amenity woodland at the west end of Levenhall Links Leisure Park	NT346735	No *O. flavus* found in young dry woodland.
31.viii.19	Station Road, Musselburgh	NT338721	Two individuals found under deadwood.
31.viii.19	Musselburgh	NT338716	Three *O. flavus* under a log.
12.x.19	Bilston Wood	NT281646	Two individuals found under loose stones on a lime-mortared wall (with *Porcellio spinicornis*) about 400m from the river, 150m from the small Bilston Burn tributary.
12.x.19	Between the Maiden Castle and Hawthornden Castle	NT284642	Several individuals under deadwood by the river.
12.x.19	Between the Maiden Castle and Hawthornden Castle	NT285639	Several individuals under deadwood by the river.
12.x.19	Opposite Hawthornden Castle	NT285636	Over 20 found under campfire stones in the high, dry forest on the west bank of the North Esk.
09.xi.19	Dalkeith CP	NT339676 to NT339691	None found along this stretch of the South Esk, much of it dominated by mature oak woodland.
09.xi.19	Dalkeith CP	NT339691 to NT333684	No *O. flavus* detected along the east bank of the final stretches of the North Esk, an area dominated by mature oak woodland.
09.xi.19	Dalkeith CP	NT333683	Several *O. flavus* immediately apparent in mixed woodland on the east bank of the North Esk.
17.xi.19	Roslin Glen to Hawthornden Castle	NT273628 to NT284636	No *O. flavus* found along the west bank of the river or in the dry woodland above it.

fieldwork sought to determine the upstream and downstream limits of the species. A visit to Bilston Woods, near Polton, on 11.xi.2018 revealed the species to be present in good numbers under an old pallet and fence posts in the high, dry woodland above the North Esk at NT287648, whilst a single individual was found even further upstream at The Maiden Castle (NT285644). This was about 4km upstream from the previous Melville Castle records. Additional exploration of this area on 12.x.2019 revealed *O. flavus* to be present further upstream again, with the species recorded on the west bank of the North Esk at NT284642 and NT285639, and opposite Hawthornden Castle at NT285636. This last record, 5km upstream from Melville Castle, consisted of over 20 individuals found under the stones of an old campfire in dry woodland high above the river, which at this point passes through a deep canyon.

A further two individuals were found next to Bilston Wood under loose stones on a lime-mortared wall (with *Porcellio spinicornis* Say, 1818) at NT281646, about 400m from the river (though only about 150m from the small Bilston Burn tributary), giving an indication of how far the species can spread away from running water.

The Musselburgh area was visited on 31.viii.2019 in order to determine the downstream limits of the species. No sign of *O. flavus* was detected in the open parkland on the west bank of the River Esk near its mouth (NT344730) nor in the young amenity woodland at the west end of Levenhall Links Leisure Park (NT346735). Between the mouth of the river and the A6095, there is no obvious suitable habitat for the species, with the riverbanks, which consist of grass lawn and aisles of single trees with no rank vegetation, substantial leaf litter or fallen wood, surrounded by buildings. South of the A6095 bridge, there is a stretch of accessible woodland on the east bank of the river. Searches revealed three *O. flavus* individuals under a sawn log at NT339716, and two individuals under deadwood at NT338722, these latter being the furthest downstream occurrences of the species so far recorded. It thus appears that *O. flavus* is found down the River Esk towards the sea as far as the habitat remains suitable.

No evidence has yet been found of *O. flavus* along the North Esk upstream of Hawthornden Castle. Repeated searches in 2018 and 2019 at Roslin Glen (NT2762) failed to find any evidence of the species. On 17.xi.2019, the west bank of the North Esk between Roslin Glen carpark (NT273628) and Hawthornden was surveyed, with no sign of the species detected. Thus the record of *O. flavus* opposite Hawthornden Castle (NT285636) on 12.x.2019 remains the known upstream limit of the species. The North Esk passes through a deep canyon between Hawthornden and Roslin, which may have discouraged spread upstream. But given that the species appears to be common in higher, dry woodland well away from the river in locations further downstream, there is no reason why this should be a particular impediment to further extension of its range in the direction of Roslin as this canyon is surrounded by similar woodland. It seems likely that the species has just not yet spread any further upstream.

Three visits to the South Esk have also failed to produce any evidence of *O. flavus*, suggesting that the species has not (yet) spread up the southern branch of the river. Surveys were conducted on 27.vii.2019 between NT327650 and NT328655 (Lady Lothian's Plantation), on 17.viii.2019 between NT331657 and NT336666 (Lord Ancrum's Wood), and on 09.xi.2019 between NT339676 and NT339691 (Dalkeith CP). This last stretch reaches to the confluence of the North and South Esk, an area dominated by mature open oak woodland (both *Quercus robur* L. and *Q. petraea* (Matt.) Liebl.). It is notable that no *O. flavus* were detected along the east bank of the initial stretch of the North Esk either, from NT339691 to NT333684, an area which is similarly dominated by oak, even though the species was found immediately upstream at NT333683 in mixed woodland (as well as further downstream along the River Esk). Might it be possible that *O. flavus* disprefers woodland of this type, and that this has so far stopped it spreading up the South Esk? Why this might be so is uncertain, as this woodland is no drier/damper or darker/lighter than other woodlands the species was found in. The acidity of oak wood may perhaps be a factor, given that *O. flavus* also appears to be absent under conifers and birch.

Figure 1: *Oritoniscus flavus* at Inveresk, 03.ii.2019 (image © Warren Maguire).

Figure 2: A group of *Oritoniscus flavus* with *Collembola* at Inveresk, uncharacteristically sluggish due to a hard frost, 03.ii.2019 (image © Warren Maguire).

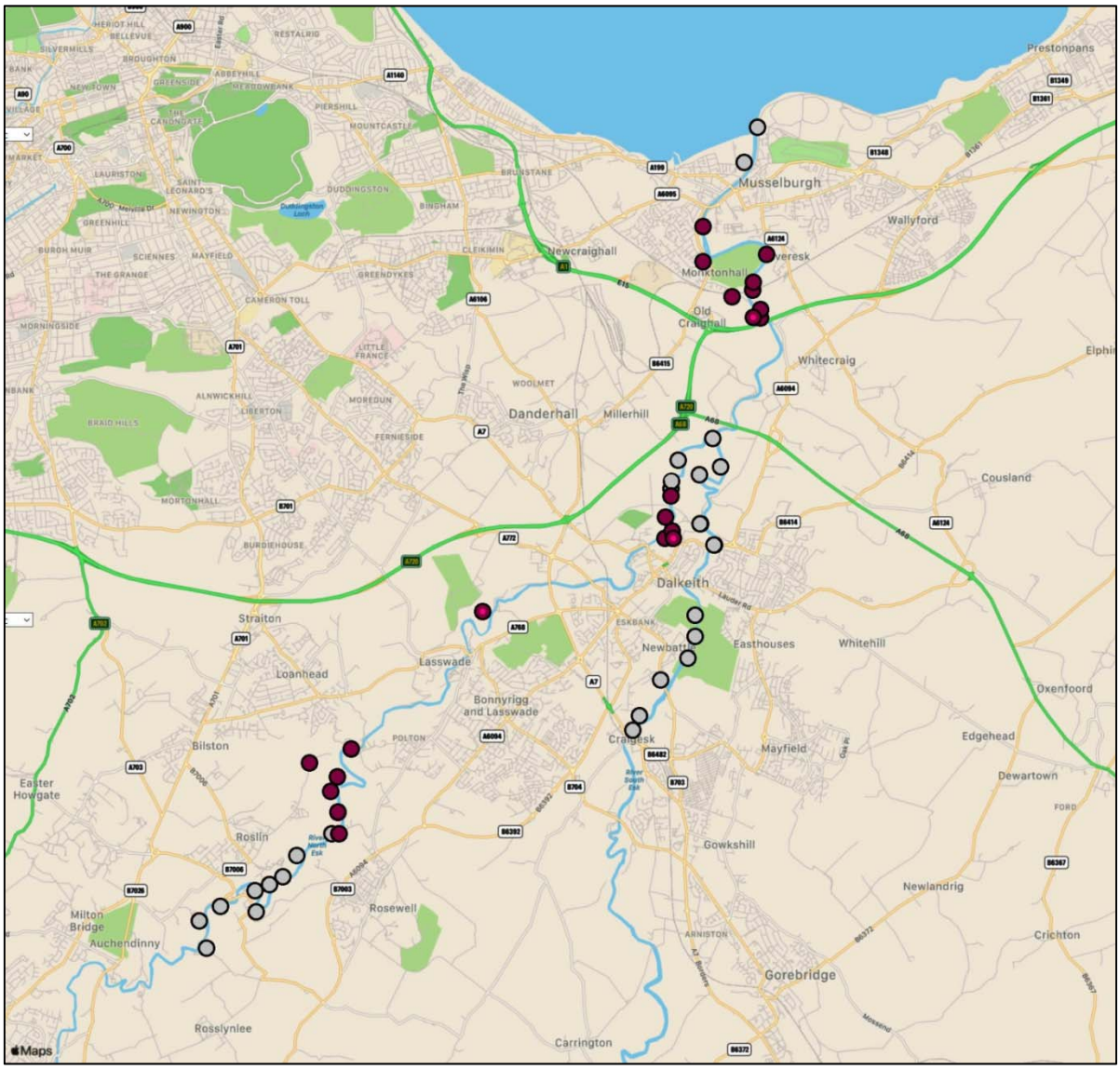

Figure 3: The distribution of *Oritoniscus flavus* in Midlothian (VC83).
● *O. flavus* recorded 2017-2019;
● Indicates the three original 2010-2011 sites reported in Sivell & Gregory (2015);
○ Site surveyed, but *O. flavus* not recorded.
Map compiled using https://gridreferencefinder.com, which uses Apple Maps.

Conclusions

The recorded distribution of *O. flavus* along the River (North) Esk is shown in Fig. 3. The species is found along a 14km stretch of territory, covering at least 16 monads over three hectads, between about 120m asl and 10m asl. The most inland record, at Hawthornden, is 10.25km from the coast at Joppa. Melville Castle lies at the centre of this area, so the hypothesis put forward in Sivell & Gregory (2015) that the population derives from accidental introduction via plant nurseries in this location is still consistent with the distribution of the species. However, the range has proved to be wider than that indicated by Sivell & Gregory's fieldwork, perhaps as a result of geographical expansion if not an artefact of wider survey coverage (but Sivell & Gregory 2015: p47 note that fieldwork between 2011 and 2013 failed to find evidence of the species at Polton or Musselburgh). Whether the species spreads further up the North Esk to Roslin or up the South Esk to Lord Ancrum's Wood and beyond remains to

be seen. The species has not (yet) been recorded along other watercourses in the Lothians, and given its conspicuous nature this would suggest that it is not present elsewhere in the region. Nevertheless, further survey work along the River Almond, the Union Canal, the Water of Leith, the Braid Burn (including Duddingston Loch and Bawsinch Nature Reserve), and Brunstane/Niddrie Burn is required to confirm this.

Acknowledgements

I would like to thank Steve Gregory for encouraging me to take on this project, for advice on writing this paper, and for compiling the map in Figure 3.

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The discovery of *Haplophthalmus montivagus* Verhoeff, 1941 (Isopoda: Oniscidea) at Treborth Botanic Garden, North Wales

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Introduction

On 19.x.2019, a woodlouse identification course organized by Cofnod, North Wales Environmental Information Service and conducted by Steve Gregory at Treborth Botanic Garden (TBG) (Bangor, Gywnedd, North Wales) resulted in the discovery of three county first records (for VC49 Caernarvonshire). These included: *Porcellionides pruinosus* (Brandt), which was found in large numbers in the compost heap at TBG (SH 5510 7102); a population of *Porcellio dilatatus* Brandt which was discovered by Susan Andrew in an abandoned cowshed in Bangor (SH 5685 7213) and most surprisingly, a male specimen of *Haplophthalmus montivagus* Verhoeff, identified by David Hill (DGH) from the limestone rockery at TBG (SH 5502 7107).

The discovery of *H. montivagus* is discussed hitherto due to the isolated nature of this record, 168km directly west from the nearest observation at Haddon Hall, Bakewell (Harper, 2004). The inclusion of these three records brings the number of 'outdoor' terrestrial isopod species in North Wales to 25, representing c. 60% of the total UK diversity (Gregory, 2009; Hughes, 2019).

Identification

The genus *Haplophthalmus* is represented by three species in the UK; *H. danicus* (Budde-Lund), *H. mengii* (Zaddach) and *H. montivagus* Verhoeff (Gregory, 2009).

H. montivagus is easily separated from *H. danicus* by the presence of a distinct median bi-lobe present on the dorsal surface of the third pleonite (Fig. 1B & 2A); a characteristic also present in *H. mengii*. Separation from *H. mengii* is only possible through the dissection of male specimens. The carpus of pereiopod 7 of *H. montivagus* has several prominent spines with a 'needle-like' tip (Fig. 1A & 2B), whilst in *H. mengii* this feature is much shorter, thicker and blunt (Hopkin, 1991).

Discovery and Origin

Examples of *H. montivagus* were collected from a humus rich soil within a 40cm deep gryke in a limestone rockery sat on a matrix of limestone gravel and topsoil, by DGH on 19.x.2019 (Fig. 1). Accompanying vegetation included *Asplenium scolopendrium, A. trichomanes, Polypodium cambricum 'Richard Kayse', Iris foetidissima, Dryopteris filix-mas* and *Juniperus communis*. To support this identification and to confirm the extensiveness of the population a further study of the rockery was undertaken by Thomas Hughes (TDH) on 1.xi.2019. A further five male specimens were examined which showed characteristics consistent with *H. montivagus* (Fig. 2).

H. montivagus is considered rare in the UK and has been recorded sporadically in ancient woodland on limestone or chalk, typically in southern England and Wales (Gregory, 2009). Due to *H. montivagus* also being regarded as a synanthropic species, especially with respect to movement by horticultural practices (Harper, 2004), it is fair to assume a similar origin of the TBG population. To rule out a native population within the surrounding woodland at TBG random sampling was conducted by TDH in November 2019 - no specimens were recorded with the exception of its widespread congeners

H. danicus and *H. mengii*. During a discussion with the TBG curator (Natalie Chivers) about this observation, she kindly offered to locate the source of the limestone used in constructing the rockery in hopes it could represent a point of origin. Her correspondence with the former TBG curator (Nigel Brown) revealed "the rocks came from a medium sized working quarry in East Anglesey - Aber Quarry between Moelfre and Traeth Lligwy at SH 5025 8660". During December 2019, TDH visited several woodlands within close proximity of Aber Quarry on Anglesey in hopes of finding specimens. Despite consistent efforts, no *H. montivagus* examples were located suggesting the population at TBG arrived through soil and plants used during the original planting of the rockery. Therefore, we can be certain of an anthropogenic origin for this outlying population.

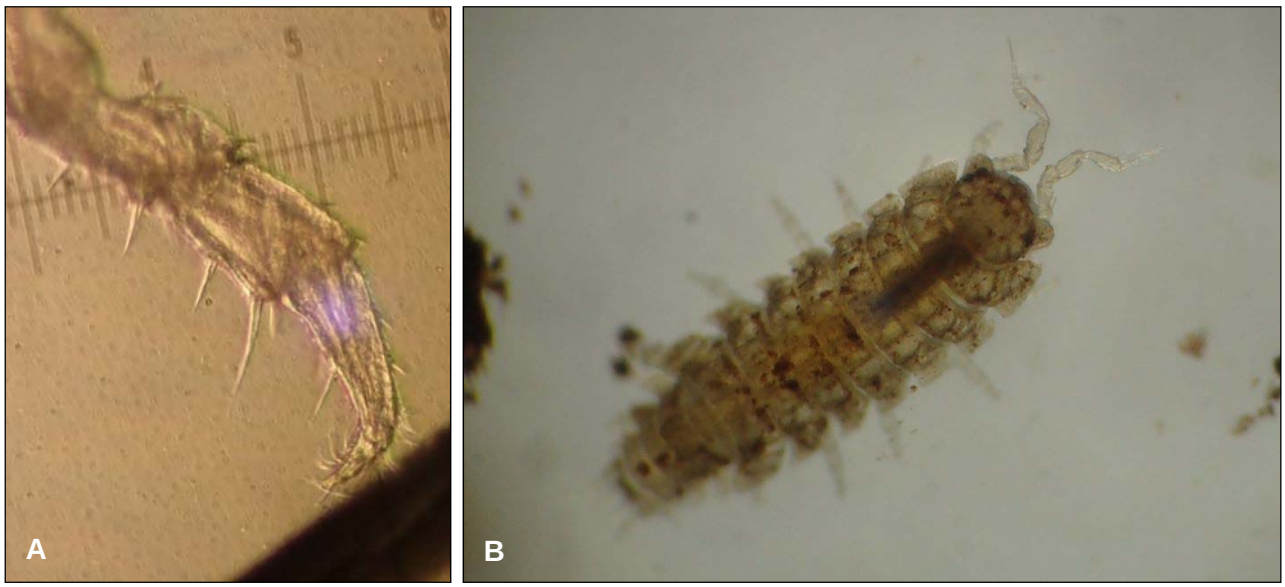

Figure 1: *Haplophthalmus montivagus*, male, from Treborth Botanic Garden
A) Pereiopod vii; B) Habitus. (Coll. 19.x.2019 D. Hill).

Figure 2: *Haplophthalmus montivagus* from Treborth Botanic Garden.
A) In-situ Treborth Botanic Garden; B) Pereiopod vii of male (Coll. 1.xi.2019 T. Hughes).

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A new location for the rare French endemic woodlouse *Alloschizidium pruvoti* (Racovitza, 1907) (Oniscidea: Armadillidiidae)

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Introduction

Whilst sampling for woodlice for a dissertation project in south eastern France in June 2019, three poorly pigmented, enrolling woodlice were found on 5.vi.2019 under deeply embedded andesitic rocks near a grotto entrance (known locally as 'La Grotte Mystérieuse') in a ravine due west of Villeneuve-Loubet, Alpes-Maritime (43.650169, 7.122942) (Fig. 1A). The specimens were initially assumed to belong to the genus *Paraschizidium* Verhoeff due to their small size c. 3mm, ovoid body shape when enrolled and the presence of a distinct schisma on the posterior corner of the first pereonite (Vandel, 1962; Taiti & Ferrara, 1996).

A re-visit to the site on 10.vi.2019 turned up several more individuals, of which two specimens were documented at a length of c. 7mm - putting the original consideration of *Paraschizidium* into question as their size was considerably greater than any known member of this genus in France (Vandel, 1962; Juchault & Legrand, 1962). Examination of photographs taken in-situ on the same date (Fig. 1B), revealed characteristics more akin to *Alloschizidium* Verhoeff - notably the presence of a well-developed and distinct postscutellar line (Vandel, 1962; Taiti & Ferrara, 1996). Of the five known *Alloschizidium* in France, only *A. pruvoti* (Racovitza) and *A. racovitzai* (Vandel) are recorded from the mainland, with the remaining species being endemic to Corsica and Sardinia (Séchet & Noël, 2015). The specimens collected here were provisionally attributed in the field to *A. pruvoti* due to the lack of ommatidia and the trapezoidal telson, easily distinguishing it from *A. racovitzai* which has three ommatidia and a triangular telson (Racovitza, 1907; Vandel, 1954, 1962).

Figure 1: A) Cave entrance, Villeneuve-Loubet; B) *A. pruvoti* in-situ.

A. pruvoti is believed to be endemic to the Alpes-Maritime department (Fig. 3). The type locality was a small cave in the gardens of a presbytery in Le Colombier (Roquefort-les-Pins), which was sadly destroyed during the development of a chapel (Racovitza, 1907; Jeannel & Racovitza, 1907; Vandel, 1954, 1962; Juchault & Legrand, 1962). A single gravid female was later collected on the Île Saint-Honorat (Cannes) and reared in captivity until a male specimen became available for identification (Juchault & Legrand, 1962); however, no further individuals were ever found at this location. In August 2012, after a 50 years hiatus, it was rediscovered whilst trialing Owen-Lopes-Oromi pitfall traps in a private garden in Contes by J.M. Lemaire (Noël, 2012). Further use of these traps by the Association Troglorites recovered *A. pruvoti* in 3 public gardens in Monaco in 2016 (Lemaire & Raffaldi, 2016).

Therefore, due to the limited number of modern records a further study of the grotto entrance was undertaken on 13.vi.2019 to fully document the habitat type and locate more individuals.

On return from the field, dissection of 1♂ collected on 5.vi.2019 later validated the identification as *A. pruvoti*. As a result, a description with illustrations is provided here, revealing *A. pruvoti* at its fifth location and its third extant site for the Alpes-Maritime department.

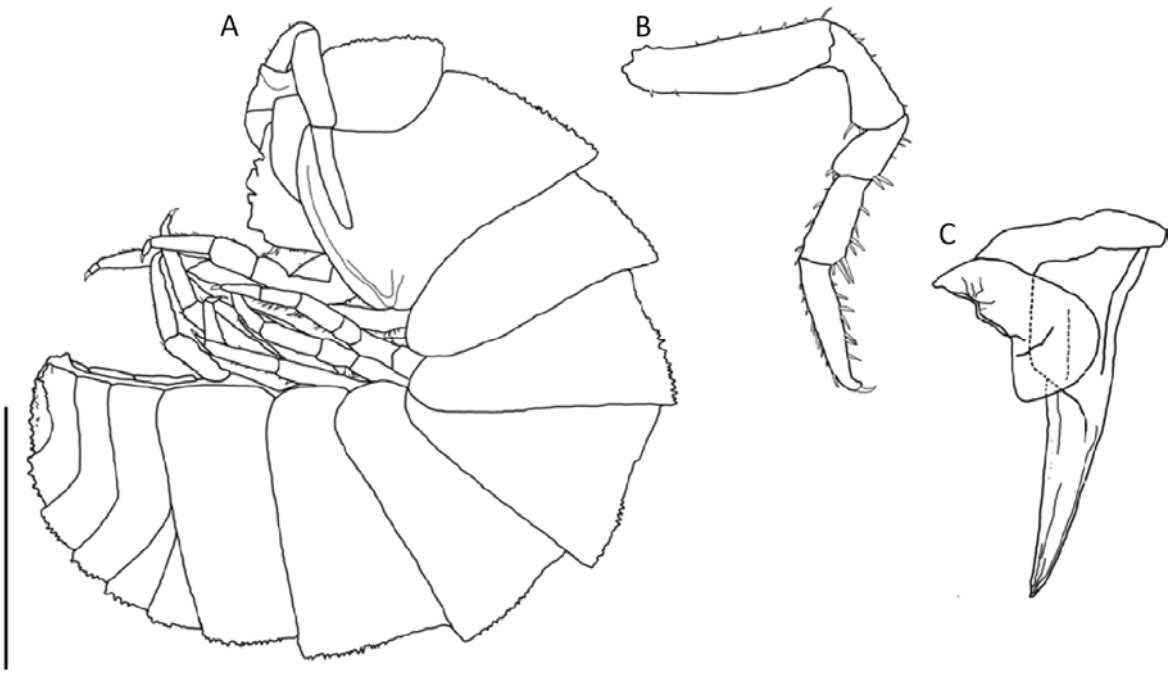

Figure 2: *Alloschizidium pruvoti* male
A) Adult specimen, lateral view, scale bar 1mm; B) Pereiopod 7; C) Pleopod 1

Description

Family Armadillidiidae

***Alloschizidium pruvoti* (Racovitza, 1907)**

Syn. *Armadillidium pruvoti* Racovitza, 1907

Specimens examined — 2♂, 1♀, Villeneuve-Loubet, Provence-Alpes-Côte d'Azur, 43.650169, 7.122942, under deeply embedded andesitic rocks near 'La Grotte Mystérieuse' entrance, leg/det. T. Hughes, 5.vi.2019. (Specimens retained in the author's collection)

Appearance

Although Vandel (1962) suggests a complete lack of pigmentation, all individuals sampled here showed clear evidence of longitudinal orange subcuticular regions along the dorsal surface (Fig. 1B). This pigmentation rapidly faded in alcohol and likely represented dietary rather than cuticular pigmentation. The surface is visually smooth and covered in obtusely angled triangular scale-setae (Racovitza, 1907; Vandel, 1962). It is able to roll into a perfect, ovoid ball. The eyes are clearly absent, and the cephalon has semi-circular post-scutellar lines. Pereonite 1 has a clear schisma present just shy of the posterio-lateral corner (Fig. 2A) and the telson is a trapezoidal shape.

Male Sexual Characteristics

Pereiopod 7 (Fig. 2B) with no discernible sexual modifications. Pleopod 1 exopod with a rounded posterior point and the endopod weakly angled medially with a pointed distal process (Fig. 2C).

Habitat

A. pruvoti was harvested from mixed semi-deciduous woodland of Holm Oak (*Quercus ilex*), Glutinous Alder (*Alnus glutinosa*), Field Elm (*Ulmus minor*) and several other hardwood tree species, creating a strongly enclosed canopy. The associated woodlouse community included; *Agabiformius lentus* (Budde-Lund), *Chateophiloscia* sp., *Cylisticus esterelanus* Verhoeff, *Haplophthalmus* sp., *Helleria brevicornis* von Ebner and *Trichoniscus biformatus* Racovitza, under large andesitic boulders typically resting at a depth of c. 30cm within a 20m radius of the grotto entrance. *Armadillidium sordidum* Dollfus, *A. vulgare* (Latrielle) and *Philoscia affinis* Verhoeff were also recorded in leaf litter at the same site. Measurements taken mid-afternoon on the 13.vi.2019 recorded an ambient surface temperature of 24.3°C, contrasting with a below-rock temperature of 21.0°C. The soil was very compacted, slightly moist and full of voids. The grotto entrance was north easterly facing and within 25m of a slow-running stream, creating a humid environment. No further individuals of *A. pruvoti* were sampled further up this ravine, suggesting a potentially strong association with a specific microhabitat around the grotto entrance.

La Grotte Mystérieuse itself is likely of artificial origin; containing a Madonna and alter at its rear and being used as a refuge for locals during the bombardments of the second world war (City of Villeneuve-Loubet, n.d.). However, due to its 'mysterious' history it is still unknown whether it was man-made.

Discussion

Racovitza (1907) originally suggested *A. provoti* was an endogenous (subterranean) species, but Vandel (1962) later considered it to be cavernicolous and stated that the only endogenous *Alloschizidium* local to the region of Grasse was *A. racovitzai*. However, based on current observations Racovitza is likely correct. The examples collected in Contes and Monaco represented an entirely subterranean existence, whilst those represented here, although associated with a grotto entrance did not exhibit a cavernicolous lifestyle (i.e. living within the grotto itself).

The distribution of *A. pruvoti*, is likely due to the presence of a specific subterranean domain referred to as the Milieu Souterrain Superficiel or Mesovoid Shallow Substratum (MSS) (Juberthie *et al.*, 1980). The MSS is a void rich contact zone between the soil base and the bedrock and is a habitat commonly found in southern France (F. Noël, pers. comm.). As *A. pruvoti* has mainly been harvested within different types of MSS it is likely it occupies a particular niche within it (F. Noël, pers. comm.). In fact, the observations made here at Villeneuve-Loubet were made under large Andesitic boulders which likely acted as a sampling interface with the subterranean alluvial MSS along the stream bank (Ortuño *et al.*, 2013).

Although sporadic, the present *A. pruvoti* distribution (Fig. 3) appears to mirror the extent of the Var as it looked during the Early Miocene (c. 5.33-2.58mya) when it was flooded by a ria during the expansion of the Ligurian Sea (Clauzon, 1978). This distribution is very uncharacteristic compared to other Alpes-Maritime endemics. For instance, observations by Vandel (1962) found woodlice such as *Cylisticus esterelanus, Helleria brevicornis and Trichoniscus biformatus* abundant west of the Var, but were not recorded eastwards of it, implying the Var and its ancient ria has been a significant factor in their biogeography. Therefore, the present and unusual distribution of *A. pruvoti* may suggest it evolved within the MSS prior to or during the formation of this Miocene ria, although further observations would be needed to fully support this pattern.

Fig. 3. - *Alloschizidium pruvoti* Distribution map, Alpes-Maritime Depar*tment, France.*

Conclusions

This new location for *A. pruvoti* has a good representative woodlouse community of the area, including species of potential scientific interest such as *A. sordidum* which is recorded here outside of its known range on mainland France. *A. pruvoti*, although rare, may be abundant within its range and is very likely under-recorded due to its subterranean lifestyle and small size.

Acknowledgments

I am very grateful to Frank Noël for his help with identifications as well as pointing me towards key literature. My gratitude also extends to Annie Northfield, Pauline Hughes and Max Callens for their assistance with fieldwork and collection of valuable habitat data.

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Long form of *Pachymerium ferrugineum* (C.L. Koch, 1835) recorded from the Channel Islands (Geophilomorpha: Geophilidae)

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Abstract

The long form of the centipede *Pachymerium ferrugineum* C.L. Koch is reported from the Channel Islands, the first record for the British Isles. Information about microsites inhabited and associated species is given. A female specimen with 57 leg bearing segments is briefly described and figured, with a revision of current identification works (Barber, 2008; 2009). We present a review of the 'long' and 'short' forms of this species occurring in neighbouring France and throughout its wide global range. We conclude that further study, including genetic and biochemical studies, would be useful to ascertain whether the two forms are cryptic subspecies or species.

Introduction

One of us (AM) collected a large centipede, 60mm in length, with 57 leg bearing segments (LBS) from a beach on Guernsey, Channel Islands, which did not readily key out using Barber (2009). The specimen (Fig. 1) was collected from beneath a stone at the top of a shingle and pebble beach just below some low mud cliffs (<1m high) at La Croix Bay, Vale (49.50098N -2.50446W; WV360834) (Figs. 5A, B) on 24th March 2019. Images of the specimen, including close ups of key features required for determination (Figs. 2A-D), were posted on BMIG's *Isopods and Myriapods of Britain and Ireland* group (Marquis, 2019a) where it was provisionally identified as *Pachymerium ferrugineum* (C.L. Koch, 1835) by SJG (and others). However, specimens collected previously in Britain have had just 43 or 45 LBS and were typically 30-35mm (exceptionally to 50mm) in length (Eason, 1964; Barber, 2009). Thus, it was forwarded to SJG for examination, who confirmed the identification as a female *P. ferrugineum.*

On 7th April AM collected a second female from the same site, 43mm in length and also with 57 LBS. Images of this were also posted online (Marquis, 2019b). Associated species included the Scaly Cricket *Pseudomogoplistes vicentae* Gorochov (Orthoptera) and the woodlice (Isopoda: Oniscidea) *Ligia oceanica* (Linnaeus), *Halophiloscia couchii* (Kinahan), *Philoscia muscorum* (Scopoli), *Porcellio scaber* Latreille, *Porcellionides cingendus* (Kinahan), *Armadillidium vulgare* (Latreille) and a male specimen of *Chaetophiloscia cellaria* (Dolfuss), a woodlouse new to the British Isles (Gregory & Marquis, 2019).

The Channel Islands are an archipelago of relatively small islands located about 30km west of Normandy, France (Fig. 3) with Guernsey some 65km² in area. They were, however, linked by land to the French mainland to a much later date than Great Britain. Guernsey, with Alderney, Herm and Sark, had separated from the mainland by about 7,000BC (Johnston, 1981). The Islands have several plant and animal species such as the Jersey orchid (*Anacamptis laxiflora*) and the wall and green lizards (*Podarcis muralis, Lacerta viridis*) which do not occur as natives in mainland Britain. The islands are British Crown Dependencies and, traditionally, are included within many biological recording schemes and, therefore, many published distribution atlases for the British Isles, including that for Centipedes (Barber & Keay, 1988).

Figure 1: *Pachymerium ferrugineum* female. Live specimen c. 60 mm in length with 57 LBS (image © Andy Marquis).

Figure 2: *Pachymerium ferrugineum* female. Live specimen with 57 LBS, from Guernsey. A) Head and forcipular tergite, dorsal view; B) Forcipules, ventral view; C) Dorsal coxal pores; D) Ventral coxal pores (images © Andy Marquis).

These are the first recorded occurrences of *Pachymerium ferrugineum* from the Channel Islands, where it was not recorded by Barber (2006) in his account of myriapoda of the archipelago. Verhoeff (1902) had distinguished a subspecies *P. ferrugineum insulanum* from the eastern Mediterranean, which was larger than the typical *P. ferrugineum ferrugineum* and had more LBS (49-61). The discovery of a "long form" (as we will term it for the present) of *P. ferrugineum* with 57 LBS from Guernsey prompted us to review the occurrence of the forms of this species occurring in neighbouring France and throughout its global range.

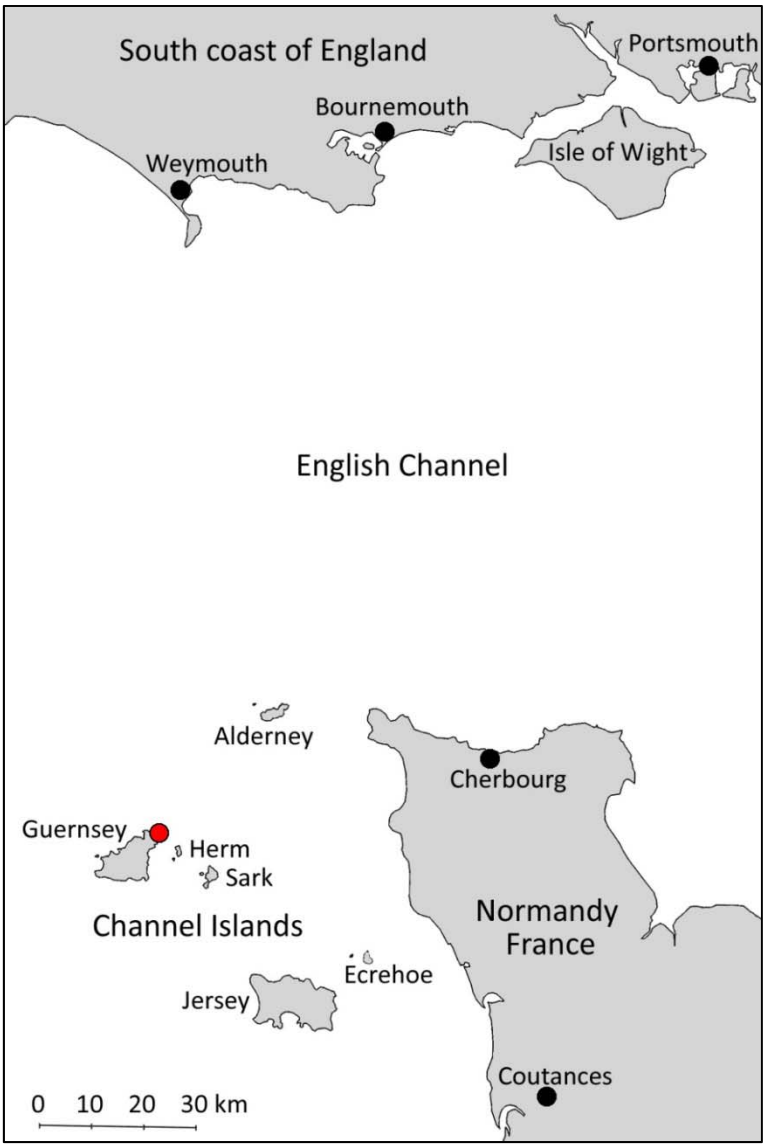

Figure 3: Location of the Channel Islands in relation to France and England
● Indicates *Pachymerium ferrugineum* record reported herein.

Identification

The first specimen, a female with 57 LBS and 60mm in length, was examined by SJG. It matches the description of *Pachymerium ferrugineum* given in Barber (2009, pp 110-111), with the exception of the number of LBS (57 vs 43-45) and body length (60mm vs exceptionally to 50mm).

The clypeus and labrum were examined by removing the forcipules and maxillae and cleared in situ on a temporary mount using clove oil (Figs. 4A, B). The labral mid-piece bears six blunt-tipped tubercles,

but lacks the c. three lateral fimbriae figured in Eason (1964, fig. 140, p. 103). Each side-piece bears about five prominent fimbriae, with a small number of less prominent ones that are curved and obscured from view. Overall, the structure of the labrum (Fig. 4B) does not comply with that figured in Eason (1964), but is very similar to that figured by Brolemann (1932, fig. 186, p. 136) of a female of the "long form" (with 55 LBS) from the Alpes Maritimes, France. The labrum of form *insulanum* ("long form") figured by Kaczmarek (1969, fig. 1E, p. 264) appears somewhat intermediate between the two.

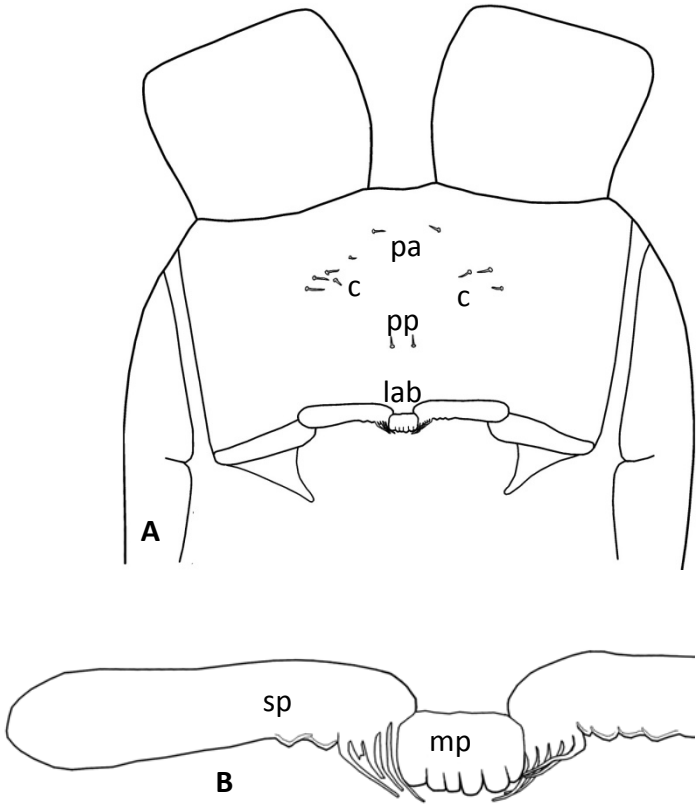

Figure 4: *Pachymerium ferrugineum*, female with 57 LBS collected from Guernsey. A) Cephalic shield, ventral view, showing clypeus with clypeal setae (c), post-antennary pair of setae (pa), posterior pair of setae (pp) and labrum (lab); B) Labrum, showing mid-piece (mp) and side-piece (sp).

Using the dichotomous key in the Linnean Society Synopsis (Barber, 2009, p. 20), which is essentially the same in the AIDGAP key (Barber, 2008), both the "short form" and "long form" will readily key to *P. ferrugineum*. The insertion of an additional couplet (5A below) will readily separate the two forms:

Couplet 1 → Couplet 2 (coxal pores over entire surface of coxae of last legs)

Couplet 2 → Couplet 3 (coxal pores small and very numerous, distributed over both dorsal and ventral surfaces of coxae)

Couplet 3 → Couplet 5 (head longer than broad, fewer than 73 pairs of legs) (*Pachymerium ferrugineum* is a "rare inhabitant of coastal shingle")

Couplet 5 → First option (claw on last legs, posterior end of forcipular tergite about the same breadth as the head and ¾ breadth of next tergite: fig. 22 in Synopsis) ……..…….*Pachymerium ferrugineum*: 5A

Couplet 5A 41-47 leg pairs……...…….....*Pachymerium ferrugineum* "short form"

or 55-59 or more leg pairs..……..…*Pachymerium ferrugineum* "long form"

Using the tabular key in the Linnean Society Synopsis (Barber, 2009, pp.34-35), essentially the same in the AIDGAP key (Barber, 2008), the two forms can be inserted separately into their respective places in the key as there is no overlap in LBS. See table below.

Species	LBS	Coxal pores		Claw on last leg	Basal node, poison claw	Carpo-phagus structure	Sternal pore groups	Other features	Max. length
		No.	Position						
P. f. "long form"	55-59	∞	Dorsal / ventral	✓	✓	no	✓	Coastal, rare	70mm
P. f. "short form"	41-47	∞	Dorsal / ventral	✓	✓	no	✓	Coastal, rare	50mm

Note: Specimens with much more than 59 leg pairs are known from some Mediterranean locations e.g. Greece (S. Simaiakis, pers. comm.)

There may be other details separating the two forms.

Occurrence: Short form, south & east coasts of England; Long form: Channel Islands.

Discussion

A global species

Pachymerium ferrugineum, first described from Germany, is probably one of the most widely distributed centipedes in Europe and occurs as an introduction across much of the globe. Indeed, Nefediev, *et al.* (2017) describe it as "a trans Palaearctic polyzonal species". It has been found across Eurasia from Macaronesia to Central Asia and Siberia as well as in the Russian Far East, Taiwan and Japan. It is also found across North America as far as Alaska and the Pribilof Islands and from Mexico, Chile, Juan Fernandez, Hawai'i and Easter Island. It is also known from Asia Minor, Caucasus, North Africa, The Azores, Canary Islands and Madeira.

In northern and western Europe its distribution is interesting. It is known from Norway, Sweden, Finland and Denmark, and from the White Sea coast as well as inland in north-east Europe. In Eastern Fennoscandia records include from under stones, in decaying *Fucus* and other debris on seashores as well as from dry terrestrial sites (Palmen, 1949). Meidell (1979) drew attention to the fact that this species and *Strigamia maritima* (Leach) form an "east-west pair of species" with *S. maritima* occurring along the western coast and *P. ferrugineum* along the eastern coast of southern Norway and a zone of overlap in both the north and south (see also Simaiakis *et al*., 2010). All records from the Netherlands and Belgium appear to be from inland sites (Berg *et al.*, 2008; Lock, 2000, 2009). It has described as widely distributed in France and Corsica and favouring the seashore "without being strictly halobiontic or highly halophilous" (Geoffroy & Iorio, 2009). From France there are records from about 30 départements, both inland and coastal including Finistère, Loire-Atlantique, Morbihan and Vendée. It is often thought of as an exclusively coastal species but this is certainly not necessarily the case - it has a wide ecological range and has been found up to 2,800m in the Hoggar Mountains in the Sahara (Palmen & Rantala, 1954).

Means of dispersal

Geophilomorph centipedes, both terrestrial and littoral have been shown to be tolerant of immersion (more so than lithobiomorphs) (Hennings, 1903; Plateau, 1890). Schubart (1929) found that submerged specimens of *P. ferrugineum* from Germany survived 7-68 days at room temperature (16-18°C) whilst Suomalainen (1939) reported 24-95 days at 19-27°C and 68-178 days at 6-12°C for Finnish animals. Given this characteristic it is possible to speculate that, amongst possible modes of accidental dispersal,

Figure 5: La Croix Bay, Guernsey. A) View of bay. Specimens of *P. ferrugineum* were collected from among shingle at top of beach near top-centre of image; B) Close up of shingle and low mud cliff behind (images © Andy Marquis).

that by rafting, such as on plant debris (hydrochory), is a likely dispersal mechanism for animals. Littoral species are in an optimum situation or this, both in terms of being accidentally carried away and of establishing themselves when they arrive at a suitable destination. Suomalainen had, indeed, reported *P. ferrugineum* floating on sea water for as long as 31 days before sinking and long survival when submerged in such water (Barber, 2011). The varied nature of coasts would be likely to break up species into isolated local populations which could favour genetic divergence and dispersal across oceans and to islands would accentuate this effect. This may be reflected in variations in characters between populations at different sites, for instance variation of numbers of leg-bearing segments.

Occurrence in Britain

Despite the wide distribution of *P. ferrugineum* and its apparent potential distribution by rafting, in the UK it is known from just five coastal shingle sites in southern and eastern England (Sussex, Suffolk, Isle of Wight, Dorset & Essex) (Lewis, 1960; Barber, 2009) and is designated Nationally Rare (Lee, 2015).

The first records were of ten specimens found by John Lewis between August 1957 and May 1958 at Cuckmere Haven (Lewis, 1960) during the course of sampling for *Strigamia maritima* (Leach) when some 1,500 specimens of the latter were taken between autumn 1956 and summer 1959 (Lewis, 1961). Subsequent records were "one-offs", except those from Essex, which were a series of reports from March 2012 to June 2015 by Keith Lugg from Colne Point (pers. comm.) and there was some evidence of a possibly well-established colony there. Clearly *P. ferrugineum* is very much on the edge of its range on the British coast and it is difficult to be certain whether the species is well-established (but either difficult to find or genuinely rare) or whether these records derive from animals that are recent colonists and may, perhaps, have only a transitory existence here.

Variation in LBS and ecology

The numbers of leg bearing segments (LBS) in each sex, as in all but one family of geophilomorphs, are variable. In Palmen's (1949) study in Eastern Fennoscandia they ranged between 41-45 in males and 43-47 in females and in a more recent study by Simaiakis *et al*. (2010) modal values for Scandinavia (Sweden & Finland) were 41/43 LBS in males and 45 in females. The latter also demonstrated a north-south temperature cline in segment numbers. If one looks through the literature, numbers like 41-55/41-57 (France; Brolemann, 1932, copied by Demange, 1981), 41-55/43-57 (Scandinavia: Andersen *et al.*, 2005), 41-55/43-57 (Austria; Koren, 1986), 41-57 (Central Europe, Schubart, 1964), 41-55/43-57 (Netherlands: Berg & Evenhuis, 2001), 43-57 (Cyprus: Simaiakis *et al.*, 2013) so clearly there is a wide range.

Verhoeff (1902) had distinguished a subspecies *P. ferrugineum insulanum* from the Greek islands of Syros, Aegina and Naxos and also from Herzegovina, Dalmatia, Tunisia and Cilicia (Turkey) which was larger than the typical *P. ferrugineum ferrugineum* and had more LBS (49-61). Details for this form were also given by Kaczmarek (1969) who reported *insulanum* from Bulgaria, from the Black Sea coast, whereas the typical form was found in the central part of the country. She had actually looked at only 28 specimens from 5 locations and she gave LBS numbers as 57-59. A number of other characters, mostly head features, were given by both authors and Verhoeff mentioned a colour difference, *heller gelb* ('lighter yellow'), compared with the *mehr orangegelb* ('more orange-yellow') of *P. ferrugineum ferrugineum.*

English specimens that had been found had 43 or 45 LBS and were typically 30-35mm (exceptionally 50mm) in length (Eason, 1964; Barber, 2009). In the five Cuckmere Haven specimens examined (Lewis, 1960) the number of clypeal hairs corresponded fairly closely with Verhoeff's description of *P. ferrugineum ferrugineum*, but the number of labral teeth varied over the range given for both types (5 to 7+1 transitional) and in the adolescens was even lower (3) than that given for either. It was also noted

by Lewis that Ribaut (1915) had described a specimen from Algeria which, whilst otherwise having the characters of *insulanum* had only 5 labral teeth.

On the island of Crete Simaiakis & Mylonas (2003) reported the occurrence of two distinct forms of *P. ferrugineum*: a "short form" with 41-47 LBS, which occurs on the main island (except on the coast), and a "long form" with 55-59 LBS (which they called *P. ferrugineum f. insularum*), which occurred mainly on small satellite islands and on the coast. There is no overlap in the range of LBS. In a subsequent paper Simaiakis *et al.* (2004) revealed some interesting ecological information about the two forms:

> *P. ferrugineum ferrugineum* was very common from western to eastern Crete, up to 2,000 m asl but mainly between 1,000 and 2,000m. Females occurred from late autumn to early spring whilst males were found in late autumn and early winter. It was said to be quite common in habitats modified by man, in *Pinus brutia* forests, in phryganic and maquis ecosystems with *Coridothymus capitatus, Sarcopterium spinosum, Pistacia lentiscus* and *Nerium oleander* as well as in mountainous areas dominated by *Quercus coccifera*, in subalpine and alpine phrygana.
>
> *P. ferrugineum insularum* was very common in the southernmost areas of Crete (altitudinal range effectively around 0m). It was found on the small satellite islands and on almost every coastal area around Crete. Adults occurred in the spring as well as late autumn and early winter. It preferred coastal phryganic areas and sand dunes. It was also collected on a plateau dominated by *Berberis cretica, Genista acanthoclada, Sarcopoterium spinosum, Phlomis sp.,* and some *Quercus coccifera* and *Acer sempervirens.*

In Greece, LBS numbers vary from 41/43 up to 63/65 with, apparently, not continuous variation, but a clear geographical separation of the "short" and "long forms" (S. Simaiakis, pers. comm.).

In France *P. ferrugineum* does favour the seashore, being widespread along the Mediterranean and Atlantic coasts, but is not considered to be strictly halobiontic or highly halophilous (Geoffroy & Iorio, 2009). There are also records from western and southern Brittany and scattered records inland (Iorio, 2014). Interestingly, an apparently similar condition to the Cretan one appeared to occur in an area of north west France where Iorio & Tiberghien (2007) report 43 and 45 LBS for two females collected inland on the mainland (at Saint-Rémy- la-Varenne and Brézé) and 53, 55 and 57 LBS for three females collected from a small off-shore island (Île de Groix). However, Blower (1987) found 3 large females with 55 LBS at Pointe de Benodet and an immature with 51 LBS at Beg Miel in south Finistère whilst Iorio (2014) reports on the species (without detail of LBS) at Penmarc'h. All these latter three sites were on the mainland of the département.

Clearly the pattern of occurrence of the two forms in France is especially of interest in relation to the Channel Islands. Etienne Iorio (pers. comm.) has kindly made available some of his data and offered comments about the French situation where there is both a "short form" with 41-49 LBS and a "long form" with 51-57. Although these seem to form a continuum, apparently specimens of both forms with 49 LBS and 51 LBS are rare (as are the "long form" ones with 59) and there appears to be no difficulty in separating the two forms. Ecologically the two forms are distinct with the "long form" being exclusively a species of sea-beaches (Mediterranean and Atlantic) as a halobiont, found up to 10m above the strandline (lower than this in Greece), and records of the "short form" include habitats described as river banks, alder wood, salt marsh, alluvial wood, humid wood and mixed wood on river bank. It seems that "island" vs "mainland" is less determining than habitat with mainland beaches having the "long form". One location, the beach of an island, was seemingly unusual in having single animals with 45 and 55 LBS. Salt marshes, such as those of Hérault, an "intermediate habitat", tend to have the "short form".

Conclusion

In addition to different maximum body lengths and non-overlapping distributions of LBS, the ecological information regarding the two forms in both Crete and France does certainly suggest that we might be looking at distinct or incipiently distinct subspecies or species. Apart from obviously much needed laboratory studies on the two forms from recognisably distinct "form" populations and more data both in general about the variation within *P. ferrugineum* populations in Europe, microscopical examination of the features used by Verhoeff and Kaczmarek to separate *P. ferrugineum ferrugineum* from *P. ferrugineum insulanum* in specimens from different "forms" and locations as well as genetic and biochemical studies are desirable. Unfortunately, the British Isles are probably not the best place to do this latter!

Acknowledgements

Stelios Simaiakis for confirming the sex of the Guernsey specimens and for many valuable comments and information relating to the species, Etienne Iorio for most useful information about the habits and occurrence of the two "forms" of *Pachymerium ferrugineum* in France and Antoine Racine for his data & comments.

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The first record of *Eurygeophilus multistiliger* (Verhoeff, 1899) (Chilopoda: Geophilomorpha: Geophilidae) in the north west of the Iberian Peninsula: an ecological approach

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Abstract

The first record of *Eurygeophilus multistiliger* (Verhoeff, 1899) in the north-west of the Iberian Peninsula is presented, thus expanding its known distribution in Spain and confirming its ability of living in temperate climates. A review of the known distribution of *E. multistiliger* is given. Ecological remarks and an identification key for the genus *Eurygeophilus* Verhoeff, 1899 are given.

Key Words: Cascadas de Oneta, Villayón, Asturias, oak, distribution.

Resumen

Se presenta la primera cita de *Eurygeophilus multistiliger* (Verhoeff, 1899) en el noroeste de la península ibérica, ampliando su distribución conocida en España y confirmando su capacidad para desarrollarse en climas templados. Se realiza una revisión sobre la distribución conocida de *E. multistiliger,* se comentan algunas observaciones ecológicas y se proporciona una clave de identificación para el género *Eurygeophilus* Verhoeff, 1899.

Palabras Clave: Cascadas de Oneta, Villayón, Asturias, robledal, distribución.

Introduction

Eurygeophilus Verhoeff, 1899 is a genus of chilopod of the order Geophilomorpha, family Geophilidae. Only two species are known in this genus: *Eurygeophilus pinguis* Brölemann, 1898 and *Eurygeophilus multistiliger* Verhoeff, 1899 (Bonato *et al.,* 2006). *E. pinguis* has been recorded from temperate areas of Spain (Barace & Herrera, 1980; Salinas, 1990; Bonato *et al*., 2006), the French Pyrenees and Corsica (Geoffroy & Iorio, 2009; Zapparoli & Iorio, 2012), Great Britain (Barber, 2009; Barber *et al.*, 2010; BMIG Centipede Recording Scheme, unpub. data), the Austrian, Italian and Swiss Alps (Bonato *et al*., 2006, 2016) and Slovenia (Vode & Kos, 2014) (Fig. 1A). *E. pinguis* has been rarely reported in Spain, with records from the Cantabrian municipality of Vega de Liébana in the eastern Picos de Europa mountain range (Bonato *et al.*, 2006), from the Quinto Real mountain range and the Irabia reservoir in the Navarre Pyrenees (Barace & Herrera, 1980; Salinas, 1990) and also from the Natural Park of Urbasa-Andía in the north-west of Navarre (S. Gregory, pers. comm.) (Fig. 1B). The species has been found in temperate deciduous forests (Barber, 2009; Bonato & Minelli, 2009), montane and sub-montane woodlands and mixed broadleaved forests, beechwoods and *Larix decidua* Mill. forests (Minelli & Iovane, 1987). On the other hand, *E. multistiliger* is present in Mediterranean countries of southern Europe and it has been recorded from Portugal (Verhoeff, 1988; Attems, 1952), Spain (Machado, 1952; Serra & Ascaso, 1990; Bonato *et al.,* 2006; Vadell & Pons, 2008), the French Pyrenees (Brölemann, 1926; Iorio, 2016), Sardinia (Italy) (Bonato *et al.*, 2006; Zapparoli, 2011) and Greece (Simaiakis *et al*., 2016) (Fig. 1A). Reports of *E. multistiliger* in Spain are also scarce, with records from the Montseny mountain range in Barcelona (Serra & Ascaso, 1990) and Vidrá in Gerona (Machado,

1952). In addition, *E. multistiliger* has been reported from insular Spain in the Balearic Islands, namely in the Tramuntana mountain range of Mallorca (Vadell & Pons, 2008) (Fig. 1B). This species is only known to inhabit sub-Mediterranean woodlands (Bonato & Minelli, 2009), mountain pastures (Simiakis *et al.,* 2016) and cave systems (Vadell & Pons, 2008). In essence, distribution patterns and the environmental ecology of the *Eurygeophilus* species are poorly known. Hence, the main aim of this work is to enhance our knowledge of the distribution of *E. multistiliger* both in Europe in general and in the Iberian Peninsula and to provide ecological data and identification keys.

Material and Methods

Study area

The specimen was found near Cascadas de Oneta in the municipality of Villayón, located in northwestern Asturias (NW Iberian Peninsula) (Figs. 1B-C). Although a Mediterranean macrobioclimate is the norm for most of the Iberian Peninsula, more Atlantic macrobioclimates are present in several northern areas (Rivas-Martínez *et al.,* 2017). This is particularly the case for the study area which has a meso-temperate climate with annual temperature variation of between 10 and 14ºC and abundant rainfall throughout the year (900-1400mm) (Díaz-González, 2015). Soil substrates are mainly composed of sedimentary and metamorphic rocks. The Oneta river gives rise to hygrophilic wooded areas which are dominated by a mixed forest of common oaks (*Quercus robur* L.) and chestnut trees (*Castanea sativa* L.). Other typical trees near the riverside are hazel (*Corylus avellana* L.), bay (*Laurus nobilis* L.) and ash (*Fraxinus excelsior* L.). Also, grassland and agricultural fields can be found near the village.

Methodology

The specimen was hand collected and then fixed and preserved in 70% ethanol. A binocular stereomicroscope model NOVEX AP-2 (10-60x) was used for identification. Identification keys and works on the morphology of the *Eurygeophilus* species were consulted in determining the identity of the specimen (Verhoeff, 1899; Brölemann, 1926; Machado 1952, 1953; Bonato *et al*., 2006, 2014; Vadell & Pons, 2008; Simaiakis *et al*., 2016). *Habitus in vivo* was photographed with a Panasonic Lumix DMC-FZ200 camera equipped with a Raynox DCR-250 macro lens. Maps were generated with QGIS Desktop 3.4.9-Madeira.

Results

Eurygeophilus multistiliger (Verhoeff, 1899)

Material examined

1♀, Spain: Cascadas de Oneta, [Parish of] Oneta, [Municipality of] Villayón – [Principality of] Asturias – 29T 688084 4814623 – 08/12/2019, 271m., D. Cabanillas leg. & det. 2019.

Short description

Antennae, head and ultimate leg bearing segment are orange, with a brownish orange trunk but dark grey in the posterior part (*in vivo*) (Fig. 1D). 53 leg pairs. Forcipular tergite short and narrowing anteriorly. Forcipular targunsula slender and flattened, showing a sting-like appearance. Forcipular coxosternite with diverging coxopleural sutures and no visible chitin lines. Short, stout and spine-like setae on the central part of the anterior metasternites (less apparent in the posterior region of the trunk). A transverse band of pores in the posterior part of the metasternites, in both the anterior and the posterior part of the trunk. Central sub-circular depressions close to the anterior edge of metasternites. Ultimate pleuropretergite not divided by sutural sulci. Ultimate leg bearing metasternite sub-rectangular

and 7/8 pores close to the internal margin of the coxopleura. 3/4 coxal pores are visible in dorsal view, close to the anterior margin of the metatergite.

Ecological remarks

The specimen was found under a stone in the boundaries of an oak and chestnut mixed forest located between arable fields and the Oneta river.

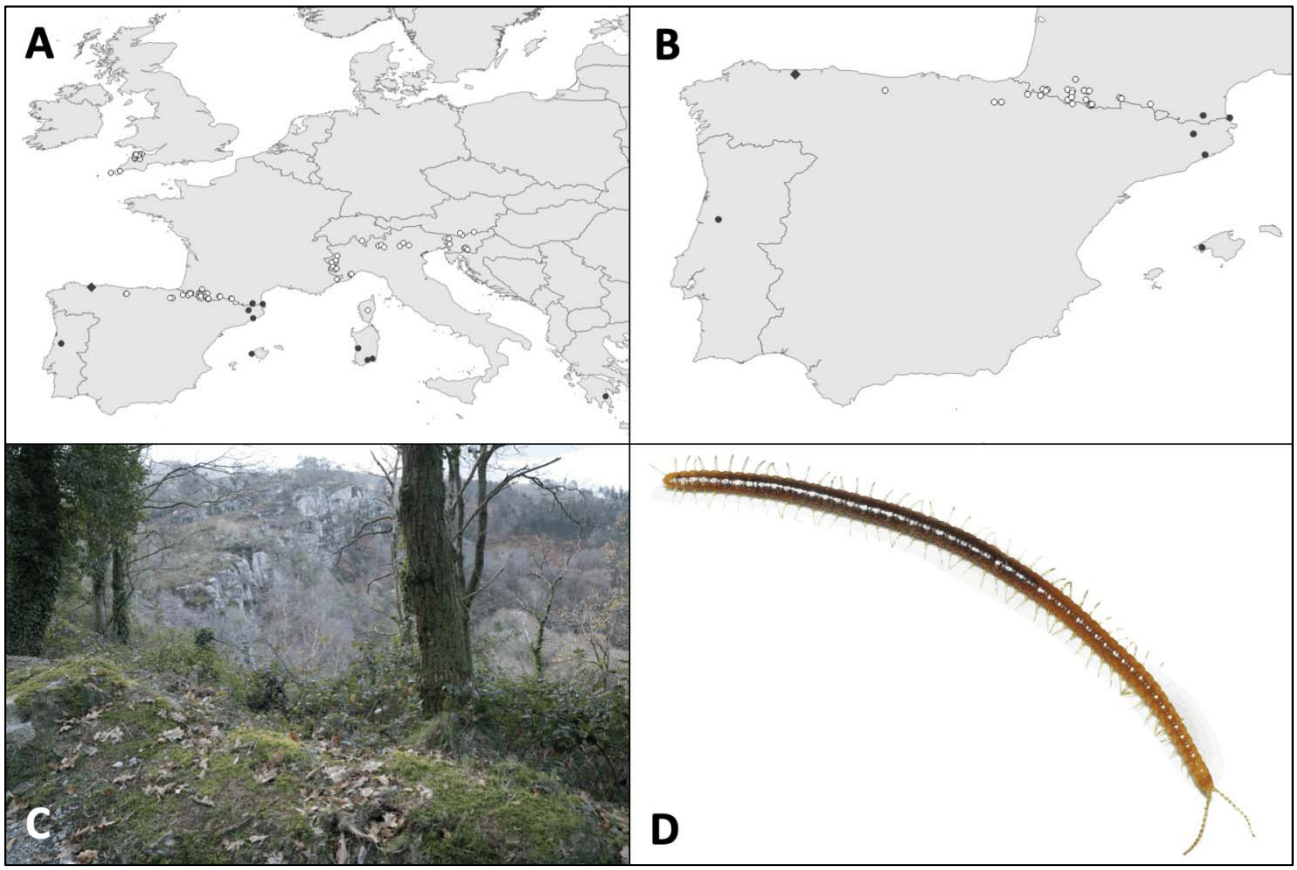

Figure 1: The genus *Eurygeophilus* in Europe. A) European records of *Eurygeophilus pinguis* (white circles) and *Eurygeophilus multistiliger* (grey circles); B) Ibero-Balearic records of *Eurygeophilus pinguis* (white circles) and *Eurygeophilus multistiliger* (grey circles, the grey diamond indicates the new record); C) Study area in Cascadas de Oneta (Villayón, Asturias); D) *Habitus in vivo* of *E. multistiliger* (female).

Identification key

Eurygeophilus is readily distinguished from other Spanish geophilomorph genera by having narrowed, slender and sting-like forcipular tarsungula (see Simaiakis *et al*., 2016). *E. multistiliger* is primarily differentiated from *E. pinguis* by having short and well-marked setae on the metasternites (Bonato *et al*., 2006). Other criteria useful to determine the species are the pattern of coxal pores, shape of the ultimate leg bearing metasternites and the number of leg pairs (Bonato *et al*., 2006, 2014). In order to help when determining specimens of the genus *Eurygeophilus*, a simplified dichotomous key is presented (see Appendix 1 for key in Spanish). More detailed data and figures of the morphology are available in Bonato *et al*. (2006), Vadell & Pons (2008) and Simaiakis *et al*. (2016).

33-47 leg pairs. Without short and stout spine-like setae on anterior metasternites, at most several long setae. Ultimate metasternite trapezoidal, with lateral sides sub-parallel. Ultimate coxopleura with scattered ventral pores…….....……..……..... *Eurygeophilus pinguis* (Brölemann, 1898)

49-57 leg pairs. Short and stout spine-like setae on the central part of anterior metasternites. Ultimate metasternite sub-rectangular, with lateral sides converging posteriorly. Ultimate coxopleura with ventral pores close to the lateral margin of the metasternite……..... *Eurygeophilus multistiliger* (Verhoeff, 1899)

Discussion

Eurygeophilus is one of the least studied genera due to difficulties in getting significant samples to assess population dynamics or environmental preferences. It has been suggested that *Eurygeophilus* species show low collection rates because they seem to be rare and scarce in biological communities or maybe exhibit unusual habits which still remain unknown to researchers (Bonato *et al*., 2006). However, the morphology of *Eurygeophilus* species has been studied in depth (Bonato *et al*., 2006; Vadell & Pons, 2008; Simaiakis *et al*., 2016), although intraspecific variations studies amongst the European populations are being developed. The female of *E. multistiliger* collected in Asturias agreed with previous descriptions and provided a new datum in regard to the number of leg pairs of a Spanish population (53 LP), which is within the normal range for the species (49-57 LP) (Bonato *et al*., 2014).

The ecology of *E. multistiliger* is poorly known due to lack of representative data throughout its distribution area, which is currently unclear. The species was known to occur from the western Iberian Peninsula, Pyrenees, Balearic Islands, Sardinia and Greece, all of them classified as Mediterranean regions, although climatological conditions may vary at a smaller scale. This is particularly the case of the Iberian Peninsula and nearby areas. The Portuguese and both the Pyrenean and the pre-Pyrenean records were reported near the ecotone that exists between the Mediterranean and more Atlantic bioclimates. The Asturian record made it possible to confirm the capacity of *E. multistiliger* to survive in a truly temperate region of southwestern Europe. Hence, the Spanish records suggest that the species could occur in temperate regions further north or ecotone areas of southern Europe, so further studies should consider this possibility. It is particularly worth noting that localities where it has been recorded are peripheral areas, often coastal areas or near mountainous systems (Verhoeff, 1899; Brölemann, 1926; Machado, 1952; Bonato *et al*., 2006; Iorio, 2016; Simiakis *et al*., 2016). Several ecological factors modified by the nearby sea or mountains, such as moderated temperatures and high moisture levels, may be conditioning the presence of *E. multistiliger* and shedding light on the distribution pattern of this species in Europe. It is difficult to assess whether these environmental conditions are playing a significant role because temperature ranges or precipitation rates are usually not reported when describing the study areas. Nevertheless, environmental conditions of collection areas were checked in order to look for similarities in regard to temperature values and precipitation rates (Source: https://es.climate-data.org/). Although these data are not completely accurate and hence only a guide, the annual mean temperature values seem to coincide with *ca.* 16 ºC in strictly Mediterranean areas and *ca.* 11 ºC in temperate or mountainous areas, apparently not exceeding 25ºC in the warmer season. The precipitation range in these areas was between 420-920mm although habitat and microenvironmental conditions could be of utmost importance. In this sense, little is known about the habitat preferences of *E. multistiliger* because records are scarce and niche segregation is actually not apparent. However, the species is expected to be found in humid locations, thus agreeing with the Spanish records in woods, mountainous systems and caves (Machado, 1952; Serra & Ascaso, 1990; Vadell & Pons, 2008). The possibility exists that *E. multistiliger* could live in deeper layers of the soil as Zapparoli (2011) reported, or maybe reach strictly subterranean environments and exhibit an eutroglophilous role, thus hindering its detection in epigean environments. However, only one specimen has been found in a cave (Vadell & Pons, 2008), so the relation between such environments and the presence of *E. multistiliger* needs clarification.

In summary, the Asturian record of *E. multistiliger* provides new geographical and ecological data and confirmed that this species is able to survive under temperate climatic conditions. Further studies are needed to improve our knowledge of the environmental factors that condition the presence of *E. multistiliger* in southern Europe.

Acknowledgements

We would like to thank Lucio Bonato, Tony Barber and Peter Smithers for clarifying the location data for *Eurygeophilus pinguis* in Cantabria and also Steve Gregory and the BMIG Centipede Recording Scheme for providing unpublished data of *Eurygeophilus pinguis* in Spain and Great Britain. We would like to heartily thank Nacho Noval, Marián Álvarez Fidalgo and Piluca Álvarez Fidalgo for helping us sample the study area. We would like to express our gratitude to Víctor González García for providing valuable bibliographic references on bioclimatology. We would also like to thank André Burgers and the BMIG editors for reviewing the English text. Finally, we would like to express our gratitude to Consejería de Infraestructuras, Ordenación del Territorio y Medio Ambiente (Principado de Asturias) for granting the permits for the collection of specimens.

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Appendix 1: Identification key in Spanish.

33-47 pares de patas. Sin sedas cortas y gruesas con forma de espina en los metaesternitos anteriores, a lo sumo algunas sedas largas. Último metaesternito trapezoidal, con los laterales subparalelos. Coxopleuras terminales con poros ventrales de forma dispersa…...……. ……...… *Eurygeophilus pinguis* (Brölemann, 1898)

49-57 pares de patas. Sedas cortas y gruesas con forma de espina en la parte central de los metaesternitos anteriores. Último metaesternito subrectangular, con los laterales convergentes posteriormente. Coxopleuras terminales con poros ventrales cerca del margen lateral del metaesternito... ..…… *Eurygeophilus multistiliger* (Verhoeff, 1899)

Report on the 18th International Congress of Myriapodology

25-31 August 2019

Budapest Hungary

The 18th Congress was hosted by Zoltán Korsós at the relatively new Hungarian Natural History museum close to the centre of Budapest. It followed the usual format of four days of presentations and a full day excursion in the middle. On two evenings there were poster sessions with a large number on display.

With nearly 100 delegates from over 30 countries it was a large and truly international gathering. Every continent except Antarctica was represented including of course plenty from Europe. Sadly, like the last congress, the UK was poorly represented, with just Greg Edgecombe and myself. It was sad that no one else made the trip, they missed out on a great opportunity to meet other like-minded people. As Henrik Enghoff remarked when accepting his honorary membership of CIM it is a very friendly community; and others also commented that people are very willing to share ideas and data and be supportive of others, clearly unlike some other similar societies.

I was able to catch up with several people well known to the British myriapod community, including Thomas Wesener who attended our field meeting in 2018 and Karin Voigtländer, Hans Reip, Norman Lindner and Per Djursvoll who travelled with us to collect in northern Spain in 2009.

The scientific sessions included many papers presenting genetic analyses which contributed to the taxonomy of various groups, including a phylogenetic analysis of the pill millipedes by Jan Philip Oeyen which included *Adenomeris* collected for him by BMIG members a few years ago.

Each day started with a longer, keynote lecture, where we learnt about the diverse millipedes of the Eastern Arc Mountains of Tanzania (Henrik Enghoff) and China (Sergei Golovatch) while Greg Edgecombe spoke about the timing of myriapod terrestrialization including a discussion about the fossils from Scotland.

Fossil myriapods were well represented and Thomas Wesener showed some stunning pictures of a small group of millipedes from a single piece of Burmese amber that showed all the characteristics of the order Cowiedesmida only previously known from fossils and therefore considered extinct. Micro computer tomography enabled incredibly clear views of one specimen, including its gonoods.

There were several presentations on cave myriapods including the especially rich Balkan area. Varpu Vahtera gave a fascinating insight into the Movile Cave in Romania, completely isolated from the outside environment and an ecosystem dependent on methane and sulphur oxidising bacteria. Three species of myriapods were found, *Archoboreoiulus*, *Symphynella* and a species of *Cryptops*. Her presentation concerned the *Cryptops* which looks morphologically like *C. anomalans* but molecular study indicates that it is a separate species.

Faunistic papers included a review of the Hungarian millipede fauna (Zoltán Korsós) and Aegean centipedes (Stylianos Simaiakis who attended the BMIG field meeting some years ago) as well as Tasmania (Bob Mesibov who attended the BMIG meeting in Scotland in 1994).

As in the last Congress, ecological presentations were in a minority. Jean-Francois David presented results of a study comparing the fauna of different forest stand types from Finland to Italy, finding the species richness did not differ significantly between coniferous and deciduous stands and reached its greatest where there was a mix of both tree types (in Romania and Poland). Other ecological presentations included impacts of nitrogen deposition on millipedes in soil microbial food webs. Millipedes significantly altered the microbial communities in soil/leaf litter.

Irina Semenyuk looked at trophic niches in tropical millipedes of Vietnam where she found that a species found year-round switched from being a leaf litter feeder to a diet containing more algae during the time of the year when a different seasonal species became abundant.

Julian Bueno-Villegas showed photographs and SEM of Siphoniulids found recently, 125 years after the original discovery of a female (Sumatra in 1894). It was discovered in Mexico a couple of years ago in soil samples but only known from dead specimens until recently. Extensive searching eventually proved fruitful so the male is now known and there is video footage of the live animals.

Bojan Ilić spoke about the defensive secretion of *Megaphyllum unilineatum*, a relatively common European species, on zebra fish embryos. Even at relatively low concentrations it was toxic to the fish and caused malformed development and Bojan entreated us to wear gloves when collecting.

Manoela Karam-Gemael had carried out a desk-based review of Red Data Book myriapods worldwide, including a comparison of country based lists and global lists. 11 countries responded to her plea for information about red listing (including the UK). None of the national/regional lists are in the IUCN database and some countries use different criteria which is unhelpful. Manoela concluded that only 50% of all myriapod species known have actually been assessed for their status. She made a plea for the setting up of an IUCN specialist group on myriapoda as there is not one currently. An interesting discussion followed with examples given of where listing has helped get money for the conservation of species, such as the giant pill millipedes from Madagascar which Thomas Wesener spoke about at our field meeting last year.

Peter Decker spoke about EDAPHOKEYS, a web-based portal to help recording millipedes, centipedes and woodlice. Interactive keys on line will allow the quick identification through the narrowing down of options using characters that are easily seen and distinguished rather than a conventional dichotomous type key. Peter gave an example that typically using these keys you can identify a specimen after 4-5 questions rather than the 20 or so more usual in a dichotomous key. The project was aimed largely at citizen science and intended to stimulate future scientists by being beginner friendly with lots of images. The website will initially be in German but it is intended to translate it to English, it covers a range of European countries, not just Germany. The project also includes the setting up of a verifier system and a link to a database.

There was a prize for the best poster, a competition that must have been difficult to judge due to the number and quality. The prize was won by Leif Moritz, one of Thomas Wesener's students for a poster showing micro CT scans of the gonopods of fossil Chordeumatids from amber.

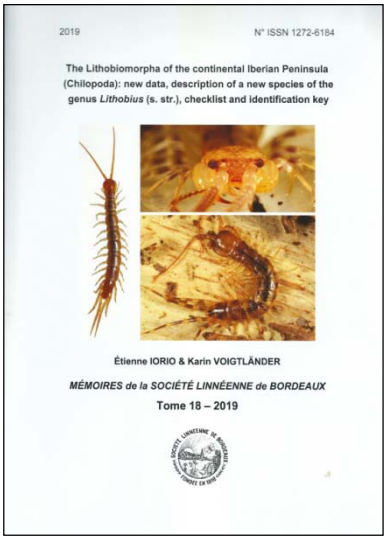
Sadly, there was not an Onychophora session at the congress. Traditionally Onychophora have been treated as honorary myriapods but it seems there were no offers of papers this time. Although we have no Onychophora in the UK it is usually a fascinating session and an opportunity to learn more about a 'classic' biological study organism.

It is planned that the proceedings will be published, probably split into two special volumes, one of Zootaxa and one of Crepuscula Biologica which is published by the Hungarian Natural History Museum.

Helen Read

Book Review

The Lithoiomorpha of the continental Iberian Peninsula (Chilopoda): new data, description of a new species of the genus *Lithobius* (s.str.), checklist and identification key



By Étienne Iorio & Karin Voigtländer

Memoires de la Societété Linnéenne de Bordeuax **18**: 1-98 (2019)

Iberia, along with Morocco forms the Baetic-Rifan complex, one of the ten hotspots for plant biodiversity in the Mediterranean area and one of the two main centres of biodiversity of the Mediterranean as well as the Iberian Peninsula being a hotspot for both vertebrates and invertebrates according to the two authors and this includes the subterranean fauna. Such a high level of diversity (and endemism) may well be due to the area remaining ice-free during glacial periods and providing refugia for northern and central European species.

In relation to the lithobiid centipedes, some 37 taxa are reported from Spain and a new troglobitic species is described. Such high levels of biodiversity raise two key issues, the importance of recording such diversity and the potential difficulties in separating and clarifying the characteristics of the species and of, as the authors have done, providing an identification key. Everyone who has looked at lithobiomorphs, even the small number of species recorded in Britain and Ireland, must be aware of the sometimes apparently subtle characters that need to be looked at and, of course, unlike the situation in most insects, millipedes and woodlice, reference to the 'gonopods, whether male or female, is of very limited value in many, if not most cases.

After an introduction which includes reference to earlier studies, notes are given for each of the species, synonyms, locations found, type location and, as appropriate, other comments. Of the 53 species/subspecies of the subgenus *Lithobius* included in the checklist, those familiar to British students of centipedes are *Lithobius borealis*, *L. calcaratus*, *L. forficatus*, *L. lapidicola*, *L. macilentus*, *L. melanops*, *L. muticus*, *L. piceus piceus*, *L. pilicornis*, *L. tricuspis* and *L. variegatus variegatus*. The last of these is distinguished from *L. variegatus rubiceps*, is illusrated, and also features on the front cover of the volume. Two of the listed species are marked as only likely to occur in the area, including *L. peregrinus*. In addition there are five species of subgenus *Monotarsobius* (including *L. crassipes* – although these might refer to *L. crassipesoides*) and two of *Sigibius* (including *L. microps*). Of the genus *Eupolybothrus* with its numerous and irregularly arranged coxal pores, the only species, rare and based on old records from two southern provinces, is *E. nudicornis*. Two henicopids, *Lamyctes africanus* (not yet known in Iberia) and *L. emarginatus* are also included in the key.

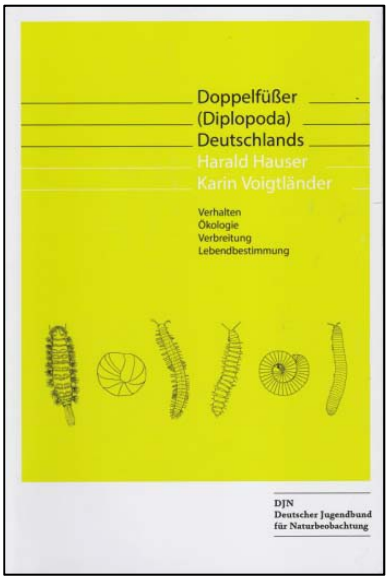
The key following the notes is of the familiar pattern but, as with some other works by the first author, includes colour photographs of characteristic features making it, at least potentially, much more user-friendly than many of the keys we have all used at various times. There are also illustrations in the introductory remarks showing the arrangement of tergites, a nice picture, appropriately annotated, of the ventral spinulation of *Lithobius validus* (which should be useful to anyone who struggles to sort out what we mean by VpF, VmF and VaF and suchlike) and the posterior end of *L. pilicornis* showing 15VaC.

Written, in English, by authors from France and Germany, about species from Spain and Portugal, congratulations are due for this most useful contribution to our knowledge of the European chilopod fauna.

Tony Barber

Book Review

Doppelfüßer (Diplopoda) Deutschlands [Millipedes of Germany]



By Harald Hauser and Karin Voigtländer

2019 published by Deutschere Jugenbund für Naturbeobachtung.

The book costs 15 Euros; available from www.naturbeobachtung.de.

This, apparently small, book is packed with information about millipedes. While the main focus is on keys and distribution maps there is plenty more information in addition and it includes many colour photographs.

The main sections include an introduction and short description of what millipedes are. This is followed by a description of each order with photographs and diagrams and a section with information about mating, moulting, growth and development. This is followed by chapters on ecology and biogeography, a short section on collecting methods and then the identification section including keys. The appendices include distribution maps and information about which species are found where in Germany. This section has both lists per region and per species. Finally, there are several appendices including a glossary and a tabular identification key with figures of gonopods.

The ecological information includes some interesting background information, such as temperature ranges at which different species are active and details of humidity preferences. The tables of course include non UK species but there are also plenty of familiar ones. It is interesting to note for example that *Tachypodoiulus niger* is listed as having temperature range of 18-26^{o} whereas for *Polydesmus angustus* it is 4-10^{o}. There is a diagram and additional information about degree of synanthropism where it is interesting to see that *Cylindroiulus britannicus* and *C. parisiorum* are both listed as very synanthropic species something we wouldn't perhaps expect in the UK. Another species listed in this category is *Ophiodesmus albonanus* which we would. *Glomeris marginata* is listed as predominantly in natural biotopes whereas we might find it in synanthropic conditions too. One point to bear in mind is that some of these figures may be based on very low numbers of specimens where the species are rare in Germany.

The ecological information continues with a kite diagram showing changes in abundances in the species found in biotopes of a specific valley/valley sides and details of biotope preferences for some species. Finally there is a section on microhabitats including information for four woodland species on whether they are found more in the leaf litter (*Allajulus nitidus*), at the base of trees (*Tachypodoius niger*), in tree stumps (*Polydesmus angustus*) or found roughly equally in all three (*Glomeris marginata* - least at the base of trees). It might be interesting to repeat this study in an English woodland where I would suspect different results.

There are notes on phenology and activity over the year with graphs illustrating different patterns for various species. For example *Ommatoiulus sabulosus* is summer active, *Melogona voigtii* and *Craspedosoma rawlinsii* are active in spring and autumn and *Leptoiulus belgicus* in winter.

There is a section on faunogenesis with a case study presenting the origin of some species found in Germany. This shows many species found in the UK as reaching Germany from the west but the country also has both an alpine suite of species and an eastern suite. Most of these last two groups are not part of the British fauna except for a few rarer species.

The section on study methods is quite short but includes illustrations of include a home made spi-pot, similar to that used by arachnologists for studying live specimens, as well as a pooter and sieves etc.

The section on identification starts with a table showing characteristics of each order, largely using diagrams to show the important features of how these vary. Each order is treated separately with the identification method varying. For example for *Glomeris* species there are photographs and drawings of colour patterns; for Polydesmids there is a table and text using size, number of rings and comments on distribution to help separate the species; Chordeumatids have a similar table and text. For Blaniulids there is a table incorporating drawings of the male heads showing cheek plate shape and eye colour and pattern. Julids have two tables, one featuring photographs of habitus and the other drawings of telson and anal valve shape. The final part of this section is a dichotomous key to all species.

The appendices make up a fair section of the book and are largely focussed on distribution in Germany. These start with introductory tables including one listing all the Red Data Book species and includes for example *Brachycheateuma bagnali* and *Cylindroiulus parisorum* (see also the maps in the appendix). Then follow the distribution maps for each species. A couple of introductory maps show the German Federal states and some physical features that might be important for distributions such as the Rhine valley. The species maps have an interesting addition which is that they incorporate information on which other countries the species has been found in by listing them to the relevant cardinal point (Sweden to the north, Belgium to the west and Ukraine to the east for example). Different species are shown with different coloured dots, the significance of which I was unable to determine – probably due to my poor language skills.

In appendix 2 each species is listed with were they are found in Germany and the type of place where they were found such as beech forests, botanic gardens, caves etc. and there is a wealth of information here.

Finally there is a tabular key to all species and this includes illustrations of the gonopods of everything other than Glomerids.

In summary the book will be useful for identification and includes a variety of different methods, both dichotomous and tabular (although they are in different places in the book). For a small book it is packed with information and the ecological details are presented in a variety of visual formats which makes them both interesting and accessible. In addition there are the distribution maps for each species. This booklet will be of use for British workers as there are many species found in both countries, as well as some more eastern and alpine species that are not recorded from the British Isles. For someone with better German language skills there is even more information to be gleaned from it but the fact that it is well illustrated with nice photographs and drawings means there is still much of interest for someone with very limited German. Although seemingly small it is packed with useful information.

Helen Read

Miscellanea

Myriapod Trivia

Over the years with an interest in the more formal study of myriapods, especially centipedes, I have also accumulated a few items of what we might call "trivia" - prints, pictures etc. The two items here come into that category and I know there are many more like them around and they are offered as light relief for Bulletin readers. I know little about The Penny Magazine but it clearly represents a cheap, presumably weekly, publication dedicated to that great Victorian aim of "self improvement". This issue comprises eight pages with items as varied as "Essays on the lives of Remarkable Painters No.XXXI: Andrea del Sarto", "The English and Irish Ordnance Surveys" and "The Hareem of Ibrahim Pasha". I have abridged the item on Centipedes and Millipedes from the original three pages. "The Rabbit and the Centipede" comes from a children's book of 1907. I am not sure that it sheds any particular new light on myriapod locomotory mechanisms.

Tony Barber

Curiosities of British Natural History: Centipedes and Millipedes

The group at the head of the present article presents us with an association of creeping things, from which many turn with indifference, but which are nevertheless far from being destitute of interest. It must be confessed indeed that they are neither striking in their appearance nor obtrusive in their habits; they are creatures of darkness and conceal themselves from observation. It is during the gloom and silence of the night –

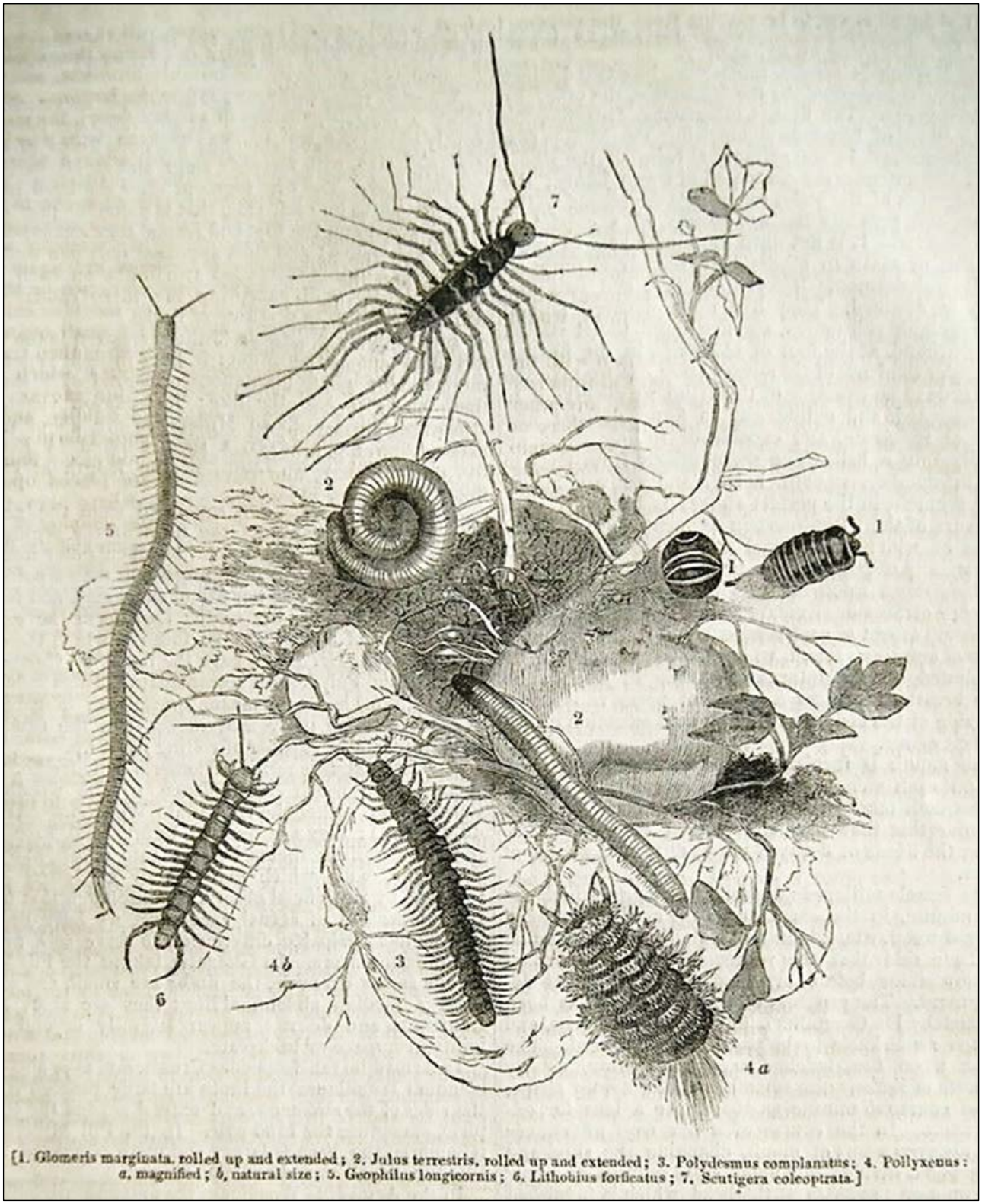
"When the dew is on the grass,

And the wisp on the morass"

that they come forth from their lurking places and wander abroad in search of food; but with the dawn of day they seek the obscurity of their retreats. These creatures constitute a group termed by naturalists Myriapoda, the first order of insects according to M. Latreille, but really forming a distinct section or class, of the subkingdom articulate, and displaying affinities to the crustacea, scorpions, and insects, yet distinguished by characters of their own. They are composed of a series of distinct segments, and to every segment is appropriated one pair of limbs; sometimes indeed two pairs.

The head is furnished with jaws, antennae which are regarded as feelers, and eyes either simple or compound. Respiration is effected through spiracles, as in insects, whence air-tubes ramify over the internal viscera. Like insects they undergo a metamorphosis, or rather several changes before acquiring their perfect form; and the sexes are distinct.

Their movements are winding and serpentine; some are slow, gliding gently along; others on the contrary are active and rapid in the extreme. They feed on decayed vegetable and animal substances, on fruits, roots, &c, and many on living prey…….



[1. Glomeris marginata, rolled up and extended; 2. Julus terrestris, rolled up and extended; 3. Polydesmus complanatus; 4. Pollyxenus: *a*, magnified; *b*, natural size; 5. Geophilus longicornis; 6. Lithobius forficatus; 7. Scutigera coleoptrata.]

From THE PENNY MAGAZINE, October 5, 1844, No.803 pp.385-387

1. *Glomeris marginata*, rolled up and extended; 2. *Julus terrestris* [*Tachypodoiulus niger*] rolled up and extended; 3. *Polydesmus complanatus* [*Polydesmus angustus*]; 4. *Pollyxenus* [*Polyxenus lagurus*] a. magnified; b. natural size; 5. *Geophilus longicornis* [*Geophilus flavus*]; 6. *Lithobius forficatus*; 7. *Scutigera coleoptrata*

The Rabbit & the Centipede

By G.D. Lynch.

1
The Rabbit and the Centipede went out to have a walk,
The day was very hot and so beneath a cabbage-stalk
They rested for a little while and had a pleasant talk.

2
"I wonder," said the Rabbit, "if it is not indiscreet,
Why you don't sometimes give a rest to some of your poor feet
Instead of making all of them walk up and down the street."

3
Your policy appears to me, devoid of common sense
Because it puts you every day to such a great expense,
The wear and tear of boots and shoes alone must be immense.

4
Now if instead of all your feet, you walked upon a score,
With practise and good management you ought not to use more,
The saving would be very great, of that I feel quite sure."

5
The Centipede replied, "There is much truth in what you say;
But you have two eyes and two ears which you use every day
If one would do why use the two, come tell me that, I pray?

6
Now I have many servants who are working under me,
And don't intend that any one of them should idle be."
The Rabbit had to own it was a question of degree.

J.K.S.

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Contents

Cover illustration: *Alloschizidium pruvoti* (Racovitza), habitus © Thomas D. Hughes
Cover photograph: *Lithobius curtipes* C.L.Koch male © Paul Richards

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