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Editorial for Bulletin 33 (2021)

The Bulletin this year includes another bumper crop of new species for the UK and our various individual countries. Remarkably this includes what appears to be three new millipedes to science to add to the fauna of south Wales. We hope all will be eventually be formally described elsewhere, but the article here by Christian Owen and Steve Gregory should enable them to be recognised should they be found in the meantime. Trapping in a public garden in Scotland has also added two new species to the UK, the Chordeumatid *Orthochordeumella pallida* and another *Cylindroiulus* originating from the Iberian peninsula, *C. dahli*, described here by Mike Davidson. 'In exchange' we can also report news that the familiar British woodlouse species, *Philoscia muscorum*, has been found in Iberia. To complete the suite in terms of new millipedes is *Brachyiulus lusitanus* from the Eden project, which was first recorded from a single specimen some years ago but has been re-found several times since, both outside and in the Mediterranean biome, so worth checking *Brachyiulus* in the future. The Eden project is also the location for a new woodlouse to the British fauna, *Porcellionides sexfasciatus*.

The last couple of years may not have added any centipedes to the British list but Tony Barber may feel grateful for that as he continues to make good progress on the atlas and we look forward to the completed publication soon.

There has quite a tranche of BMIG news to celebrate this year too, despite the cancellation of our annual field meeting in the spring due to the COVID situation and postponement of the AGM until November. The AGM was carried out online but we were still able to celebrate over 50 years of work on centipedes by John Lewis, although perhaps not quite in the way we had anticipated. John was presented (virtually!) with a BMIG 'life-time achievement' award in appreciation of many years dedicated to centipedes, especially the Scolopendromorpha. In a British context John, along with Gordon Blower and Colin Fairhurst, was one of the initiators of the, then, British Myriapod Group and chose the location for the Group's first ever field meeting (BMG Bulletin 1:1 (1972)). John's important work has been well recognised worldwide by those working on centipedes who regularly seek him out to discuss aspects of taxonomy and ecology. We feel privileged to have had his attendance at field meetings as his company always lifts the mood in the room as well as being enlightening scientifically.

A new venture for BMIG, formally adopted at the AGM, is the inclusion of the Intertidal Isopod Recording Scheme to our fold. Despite the initial intention to include this group many years ago this never became a reality. We are pleased that Warren Maguire approached us with a request to re-establish the group under the BMIG umbrella and this has now been formally adopted. Those of us with more terrestrial interests look forward to learning more about this group in the future. Warren is also helping expand the BMIG reach on social media via Twitter.

Finally, at the AGM we also gave thanks to our long-standing Chairman and millipede scheme organiser, Paul Lee, who stood down from both roles. Paul took over running the Millipede Scheme in 1998 being just the 4th organiser, his predecessors being Colin Fairhurst, Doug Richardson and Dick Jones. His work on the scheme culminated with the publication of the atlas in 2006, which was one of the first to include colour pictures of each species. Paul was elected as Chairman of BMIG in April 2010, following on from Eric Philp, and has steered BMIG through various changes over the years. We wish Paul well, thank him for many years of service to our organisation, and hope that he will remain as involved in BMIG and the recording schemes as his health allows.

Looking forward, we have already made the decision not to hold a field meeting in spring 2021 but are intending to have a day of talks online instead. On the positive side this means that those who might not normally be able to attend will be able to do so. By the time you are reading this we may already have had our planned day of talks on line.

John Lewis, a celebration of fifty years of centipede studies

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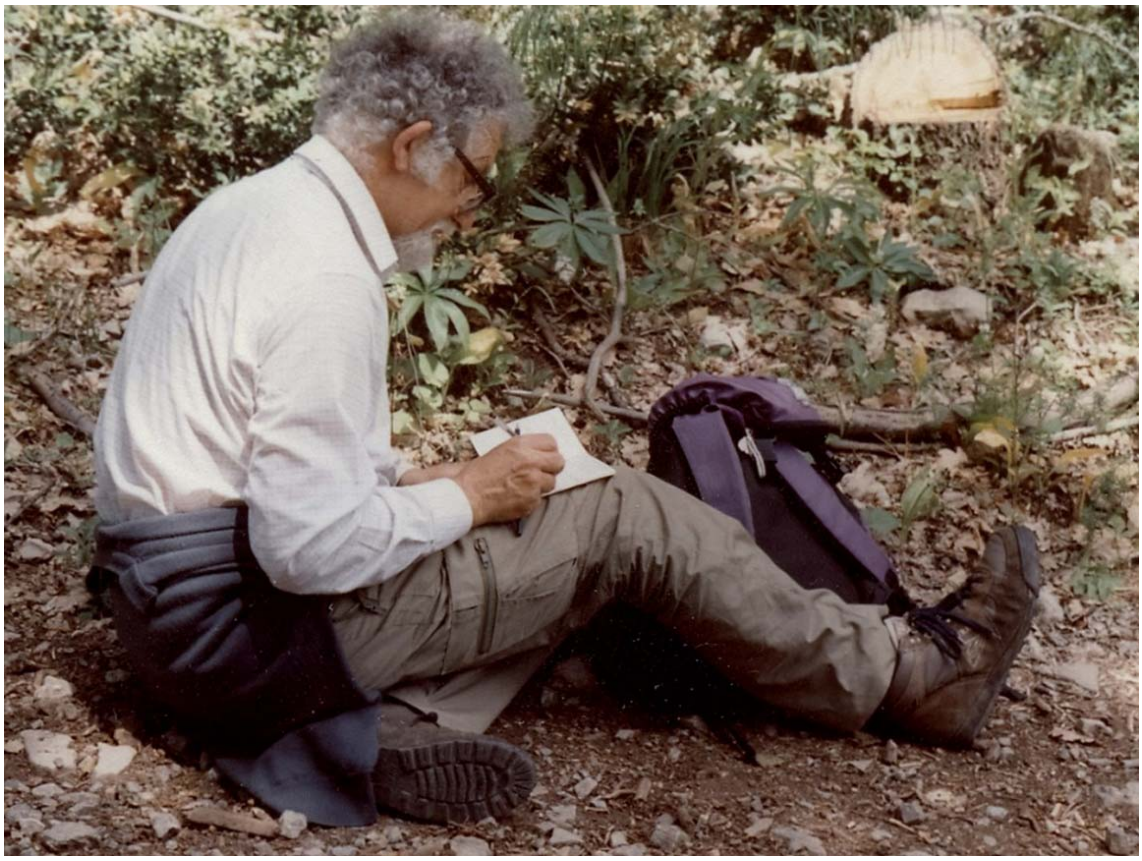
In December 2020, at a virtual BMIG Annual General Meeting, John was presented with a framed print of centipedes by artist Richard Lewington from his book *Garden Wildlife*. We had hoped to do this at the 2020 AGM at the planned meeting in Somerset but other things intervened.

Always something of a larger-than-life character, enthusiastic, knowledgeable and ever helpful, John, who is a great raconteur with a real sense of humour, also seems to have just that tiny bit of a public-school master about him, a role he actually had during part of his career. He could be very funny and Helen Read tells of him running at great speed to try to catch a *Scutigera* in Galicia. At the same time, the volume of his publications about centipedes and, sometimes other groups, is striking testimony both to his industry and to his scholarship.

Postgraduate studies on *Strigamia maritima* on the Sussex coast, revealed three centipede species new to Britain. *Pachymerium ferrugineum* (1960), *Schendyla peyerimhoffi* & *Geophilus pusillifrater* (1961). *Pachymerium*, despite being very widely distributed elsewhere in the world, remains a species rarely recorded here and only, it seems, from our east & south coasts. *G. pusillifrater* is an inconspicuous animal, rarely recorded whose status is elusive. *S. peyerimhoffi*, on the other hand is quite widely distributed on the south and west coasts of Britain & Ireland with more than fifty records. His classic studies on the life history and ecology of *S. maritima* were reported in 1961 in *Proc.Zool.Soc.* and he followed up his studies on littoral centipedes with an account of the species found on the shore in the Plymouth area (1962) which included discussion of *Geophilus seurati* as we now know it and on physiological adaptations (with John Binyon, 1963), and spiracular structure (1963) and his first paper on a non-British species, *Clinopodes poseidonis* (now *Tuoba poseidonis*) from the Red Sea (1963). It is interesting to note that *S. maritima* has become a "model centipede" in more recent times including studies on populations, embryology and development and genetics - it is a centipede which can be found in very large numbers for such work.

After his postgraduate studies at Queen Mary College, John worked at Bradford Institute of Technology. Some results of this were his studies on life cycles of *Lithobius variegatus* and *Lithobius forficatus* (1965) and their protozoan parasites (1966). He subsequently took university posts in Africa, first at Khartoum (Sudan) and then at Zaria (Nigeria) so by 1966 we have an account of *Scolopendra amazonica* and of the scolopendromorph centipedes of the Sudan (1967a, 67b). This was the beginning of his work on African centipedes and of his interest in the Scolopendromorpha which extended over many years and to the knowledge of which he has made significant contributions. Apparently, he found himself, despite a first interest in ecology, spending much time doing taxonomic work just to know what centipedes he was actually finding.

John attended the first international myriapod congress in Paris in 1968 which saw the setting up of the Centre International de Myriapodologie, C.I.M. (International Society for Myriapodology) and attended most of its subsequent congresses. He is now an honorary member. His interests were wide, also including such topics as segmentation and nomenclature of centipede body parts as well as life history and taxonomy. In 1981 he published *The Biology of Centipedes*, now a standard reference work. His name is attached to papers, as either the sole or joint author, on centipedes from various parts of the world; Ascension, Chagos Is, Christmas Island, Eritrea, Iraq, Mauritius & Rodrigues, Nepal & Kashmir, Oman, Saudi Arabia, Sarawak, Seychelles, Spain, Tunisia, UAE, US Virgin Is., Yemen, as well as Sudan and Nigeria.



John Lewis compiling field notes during British Myriapod Group's excursion to Hungary in 1994. Image by Liz Hornung.

When the then British Myriapod Group met for the first time in 1970 in North Devon, John (now back from Africa) with Gordon Blower and Colin Fairhurst were the main instigators and he was, for many years, a regular attender (with Sheila) at the group's annual meetings in Britain and elsewhere and a consistent contributor to the Bulletin. He felt strongly that observations about myriapods (behaviour, abnormalities, ecology, and so on) should not be limited to conversations in the bar at meetings but should be recorded somewhere rather than becoming just hearsay or lost altogether and he made efforts to do this himself by regular contributions to the Newsletter and Bulletin.

As well as the three British species already referred to, John's name is linked, often with other British workers, in recording *Tygarrup javanicus*, *Cryptops doriae* and *Cryptops* cf *hispanus* and the description of *Nothogeophilus turki.* In 1985 we find him describing *Geophilus carpophagus* in houses, later reporting on the two forms (as they were then referred to) in Somerset and his name is listed amongst the authors of the 2001 separation of *G. carpophagus* sensu stricto and *Geophilus easoni*.

And…… just in case one should think of John as a "one class" specialist… we have discovered that he once wrote papers on beetles (1964) and a spider (1965) – African - and several accounts of millipedes (Nigeria, Sarawak) and his name is actually attached to a chapter on Woodlice and Myriapoda in J.L. Cloudsley-Thompson's *Sahara Desert* (1984).

Of the nearly 120 publications, both singly and jointly to which John's name is attached, just over forty had a British interest and these varied from short notes in the *Bulletin* to full length papers of importance in British/Irish myriapod studies (see list below).

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John Lewis (left) during British Myriapod Group's excursion to Hungary in 1994; with Zoltan Korsos (centre) and Desmond Kime (far right). Image by Liz Hornung.

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A new BMIG Intertidal Marine Isopod Recording Scheme

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When the Isopod Recording Scheme was set up by the British Isopod Study Group in 1968, it initially included marine as well as freshwater and terrestrial isopods (Gregory, 2009: 7-8). In 1970, the Marine Recording Scheme (as detailed in Holdich & Lincoln, 1974) separated from the Non-marine Isopod Recording Scheme and operated for a number of years under the direction of David Holdich and Roger Lincoln. However, due to a lack of records and difficulty verifying the records of other observers, the scheme petered out and has not been revived since, though David Holdich and others have continued to gather records for marine species and many of these have fed into the National Biodiversity Network (NBN) database (*nbn.org.uk*).

The discontinuation of the Marine Recording Scheme is regrettable. The marine isopods constitute an important group of organisms that are extremely under-recorded (as revealed, for example, by the sparsity of dots on the NBN maps for British and Irish species). Fieldwork by the author in south-east Scotland, for instance, has shown that a good range of species is present, but there are few if any records for most of them in the area. Their study has much to tell us about the health and diversity of marine environments and the effects of human disturbance and climate change. Whilst study of the sub-littoral species necessarily remains a specialist pursuit, around 70 intertidal species may be encountered by field-recorders, and their identification is greatly aided by the publication of *British Marine Isopods* (Naylor, 1972) and especially its updated edition *Intertidal Marine Isopods* (Naylor & Brandt, 2015). Identification of the intertidal isopods is of a difficulty similar to that of woodlice, centipedes and millipedes, and most species can be readily identified by a suitably informed field-worker, though some require examination under higher magnification. Good quality photographs/micrographs of the whole animal and of key characteristics are in most cases sufficient to confirm identification, and this is one advantage that we have today over the original Marine Isopod Recording Scheme, where verification of records proved troublesome.

There is every reason, therefore, why the time is ripe for a new intertidal marine isopod recording scheme. The technology available to us today, in terms of digital photography, online communication and electronic submission of records, means that many of the difficulties encountered by the original Marine Recording Scheme can be overcome. For example, the Biological Records Centre's iRecord website (*www.brc.ac.uk/irecord*) is ideally suited for gathering intertidal isopod records (and indeed many such records have already been added to it), as it allows recorders to submit not only find details but also photographs to help with verification. Once verified, these records can feed into national recordings schemes and databases such as the National Biodiversity Network, enabling us to assemble a detailed picture of the distributions and environmental preferences of these poorly understood organisms.

Given that it already oversees recording schemes for freshwater and terrestrial isopods, as well as for centipedes and millipedes, the BMIG is ideally suited to overseeing a new intertidal marine isopod recording scheme. This is a natural extension of its remit, especially since the Non-marine Isopod Recording Scheme already includes aquatic species outside of Oniscidea (the Asellids). The recent exclusion of *Ligia oceanica* from Oniscidea on genetic grounds and its placement closer to the sub-orders Valvifera and Sphaeromatidae (Dimitriou, Taiti & Sfenthourakis, 2019) further blurs the boundaries. The difficulties in recording sub-littoral species and the artificial separation of these from

the intertidal species remain, but in practical terms the intertidal species are a fairly well defined group whereas the sub-littoral species remain beyond the reach of most observers (as indicated by the restriction of coverage in Naylor and Brandt 2015 to intertidal species).

In order to support a new intertidal marine isopod recording scheme, a list of intertidal marine isopods with details on identification and distribution has been added to the BMIG website, using the model provided by the woodlice, centipede and millipede pages (*www.bmig.org.uk/checklist/marine-isopods-checklist*). In addition, verification of marine isopods records on iRecord has begun. The new BMIG-led intertidal marine isopod recording scheme launched at the end of 2020, with iRecord being used as the primary means for gathering records, though of course more traditional avenues are also available. Fieldworkers are encouraged to submit marine isopod records to iRecord, including as much information as possible along with photographs of the whole animal and key ID characteristics. For further information on the scheme and how to submit records, visit *www.bmig.org.uk/page/marine-isopod-recording-scheme*.

Eurydice pulchra Leach: a common intertidal isopod found on sandy shores around the coasts of Britain and Ireland (image © Warren Maguire).

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Three apparently un-described silk millipedes (Diplopoda: Chordeumatida) recorded from south Wales

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Abstract

We report the discovery of three species of millipede, *Psichrosoma cf breuili* (Vandeleumatidae), *Turdulisoma cf helenreadae* and *Turdulisoma cf turdulorum* (Haplobainosomatidae), from south Wales. These appear to be new to science and are awaiting formal description, but in the mean-time we provide a brief description of each to facilitate their identification within the British Isles.

Introduction

Recent fieldwork indicates that The Valleys of south Wales support a remarkable diversity of potentially non-native millipedes. Since 2015 nine species of millipede new to Britain have been discovered here. Six of these, the chordeumatidans *Ceratosphys amoena* form *confusa* Ribaut, *Hylebainosoma nontronensis* Mauriès & Kime and *Cranogona dalensi* Mauriès, and the julids *Cylindroiulus pyrenaicus* (Brölemann), *Cylindroiulus sagittarius* (Brölemann) and *Ommatoiulus moreleti* (Lucas), have been formally reported elsewhere (Telfer *et al.*, 2015; Gregory *et al.,* 2018a; 2018b; Gregory and Owen, 2019).

However, the remaining three species, *Psichrosoma cf breuili* (Vandeleumatidae), *Turdulisoma cf helenreadae* and *Turdulisoma cf turdulorum* (Haplobainosomatidae) appear to be new to science (Jörg Spelda, pers. comm.) and are awaiting formal description. Consequently, although briefly mentioned in the informal BMIG Newsletter (Gregory, 2016; 2017; 2018), the occurrence of these three species has not been formally published in the scientific literature.

Here we formally report the discovery of these three millipedes from south Wales and provide a brief description of each with just sufficient information to separate these species from other known British millipedes. We are not proposing formal names nor providing detailed descriptions, which will be published elsewhere.

Psichrosoma cf breuili, (Chordeumatida: Vandeleumatidae)

Taxonomic note

Psichrosoma breuili (Mauriès, 1971) was originally attributed to the genus *Psychrosoma*, but later (due to preoccupation) Mauriès (2013) proposed *Psichrosoma*. Subsequently, Gilgado, Enghoff & Ortuño (2015) noted that Mauriès (1982) had previously proposed a new subgenus, *Typhlopsychrosoma* for a species of '*Psychrosoma*', which under the rules of the International Code of Zoological Nomenclature took priority. Hence, the Welsh specimens were initially attributed to the genus *Typhlopsychrosoma.* However, Serra & Mauriès (2015) considered that external morphological characters, male gonopods and female vulvae were sufficiently distinct to warrant two distinct genera *Typhlopsychrosoma* and *Psichrosoma* (which includes *P. breuili*). We have followed this revision and the genus *Psichrosoma* is used herein.

Figure 1: Three new species of millipede recorded in south Wales.
A) *Psichrosoma cf breuili,* habitus, live animal *in situ* (image © Christian Owen); B) *P. cf breuili*, head showing ommatidia (image © Christian Owen); C) *Turdulisoma cf helenreadae*, habitus, live animal (image © Keith Lugg); D) *T. cf turdulorum*, head showing ommatidia (image © Steve Gregory). Note both *T. cf helenreadae* and *T. cf turdulorum* are identical in general appearance.

Discovery

On 8th October 2015 CO undertook a casual survey of the invertebrates occurring at a site at Newbridge (ST201966, VC35); a disused railway embankment, strewn with much dumped ash and slag, above a small stream. Here a number of small pallid Chordeumatidan millipedes were encountered under large stones, reminiscent of *Brachychaeteuma melanops* Brade-Birks & Brade-Birks, but with noticeably stout macrochaetae (Fig. 1A). Microscopic examination by CO of male gonopods (Fig. 2A-B), and other characters, clearly indicated that these were not *B. melanops,* but a species new to Britain. A male specimen was sent to SJG who confirmed this conclusion (but was unable to provide a determination).

A return visit by CO on 15th October found this species to be numerous and additional specimens were collected. Some were forwarded to Jörg Spelda at The Bavarian State Collection of Zoology (ZMS) for identification and genetic barcoding who attributed male specimens to the genus *Typhlopsychrosoma* Mauriès, 1982 (Vandeleumatidae); a genus (as then defined) with four known species distributed across the Iberian Peninsula. The specimens are closely allied to *T. breuili* (Mauriès, 1971), but differ on a sufficient number of characters to be considered a new species (Jörg Spelda, pers. comm.).

This genus is now split and *T. breuili* has been transferred to *Psichrosoma* Mauriès, 2013 (see *Taxonomic note* above).

Identification

Psichrosoma cf breuili is a small off-white millipede, up to 10 mm in length, with the body bearing well-developed paranota each bearing three pairs of long stout curved macrochaetae (Fig. 1A) and eye comprising about seven variably pigmented ommatidia arranged an ill-defined triangular patch (Fig. 1B). Mature male specimens may be readily identified by the distinctive shape of the male gonopods, especially in lateral view which resembles an inverted ‘comma’ (Fig. 2A-B).

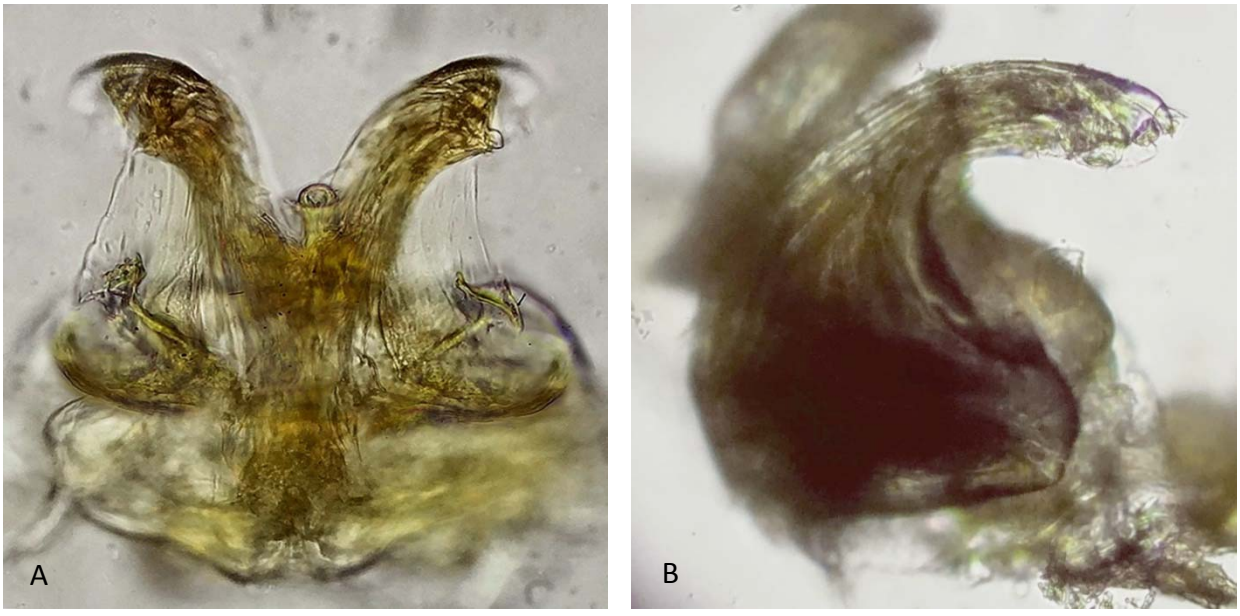

Figure 2: *Psichrosoma cf breuili* male gonopods.
A) Male gonopod, posterior view; B) Male gonopod, lateral view (cleared in euparal).

Using Blower (1985), *P. cf breuili* will key to *Brachychaeteuma melanops*, due to its small size, absence of pigmentation and relatively well pigmented ommatidia. However, it differs in the triangular arrangement of the ommatidia, slightly longer body length and prominent macrochaetae. It is more

similar in appearance to *Cranogona dalensi* Mauriès, another species discovered in south Wales by CO in 2016 (Gregory *et al.,* 2018a), but at 6 mm in length the latter is noticeably smaller.

Images of live specimens can be seen at *www.bmig.org.uk/species/Psichrosoma-cf-breuili.*

Distribution, habitats and associated species

Psichrosoma cf breuili is currently known from three locations (Table 1). The first two sites lie in close proximity, possibly representing a single metapopulation. The initial Newbridge site (discovered in October 2015) lies along a 0.75 km stretch of disused railway embankment that runs parallel to the A472 road. The embankment, now colonised by secondary woodland, is strewn with much dumped ash and slag, presumably discarded from the steam locomotives that once used the now abandoned railway line. A stream runs along its base. The Pentwyn-Mawr site (discovered in June 2016) is located about 250 m to the north and also comprises secondary woodland growing along a second disused railway line. Both disused railway lines meet about 250 m further west. A third site at Merthyr Tydfil, some 18 km to the west, was discovered in August 2018. The habitat here is very similar to the Newbridge site, comprising disturbed ground made up of dumped ash and slag and located close to a stream.

Table 1: Records of *Psichrosoma cf breuili*

Verified records submitted to BMIG Millipede Recording Scheme. Recorders: CO - Christian Owen; SJG - Steve Gregory; KL - Keith Lugg; MGT - Mark Telfer; LO - Liam Olds.

Locality	Grid Ref.	VC	Date	Recorders
Newbridge	ST201966	35	08.x.2015	CO
			15.x.2015	CO
			12.xi.2015	CO, SJG, KL
			25.i.2016	CO
			01.iii.2016	CO, SJG, KL, MGT
			13.xi.2016	CO
	ST202966	35	17.x.2015	CO
	ST204966			
	ST206966			
	ST199963	35	14.v.2016	CO
Pentwyn-Mawr	ST197967	35	21.vi.2016	CO
	ST199968	35	26.vi.2016 01.vii.2016	CO
Merthyr Tydfil	SO042054	41	15.viii.2018	CO, LO

At all three sites *P. cf breuili* has been found beneath stones and dead wood, but also collected from leaf litter. On occasions it has proved to be numerous in favoured spots and/or in favourable weather conditions. The four known described species of '*Typhlopsychrosoma'* (in the former sense) have been found in subterranean habitats, such as caves and Mesovoid Shallow Substratum (MSS) (Gilgado *et al*., 2015). *P. cf breuili* also displays typical troglobiomorphic traits, notably body depigmentation and reduction of ommatidia, and it may be that the made up ground (e.g. railway embankments) at its three known sites provide conditions analogous to MSS.

At Newbridge, which has been surveyed on several occasions, *P. cf breuili* is most frequently found associated with the millipedes *Brachydesmus superus* Latzel, *Leptoiulus belgicus* (Latzel) and *Ophyiulus pilosus* (Newport). Other millipedes recorded at this site include *Glomeris marginata* (Villers), *Nanogona polydesmoides* (Leach), *Ceratosphys amoena confusa* Ribaut (which since its discovery in 2014 has proved to be widespread in south Wales; CO pers. obsv.), *Chordeuma proximum* Ribaut, *Melogona scutellaris* (Ribaut), *Cylindroiulus punctatus* (Leach) and *Tachypodoiulus niger* (Leach). Centipedes recorded include *Geophilus alpinus* Meinert, *Cryptops parisi* Brölemann and *Lithobius piceus* L. Koch (at one of its few known sites in south Wales). This site also supports populations of the non-native Ghost Slug *Selenochlamys ysbryda* Rowson & Symondson and the terrestrial flatworm *Kontikia andersoni* Jones.

The described *Psichrosoma breuili* Mauries, 1971 is confined to a single cave system at the type locality in the Cantabrian Mountains in northern Spain (Atapuerca Caves, Ibeas de Juarros, Burgos province) (Gilgado *et al*., 2015).

Turdulisoma cf helenreadae (Chordeumatida: Haplobainosomatidae)

Discovery

During an informal 'bio-blitz' held on 5th December 2016 at the former colliery site near Maerdy (SS970992, VC41) (see Owen, 2017 for details) CO found specimens of a Chordeumatidan millipede that in the field looked superficially akin to *Ceratosphys amonea confusa* Ribaut (a species recently discovered in south Wales; Telfer *et al*., 2015), but were noticeably more darkly and uniformly pigmented. Six specimens were collected. Microscopic examination by CO of male gonopods (Fig. 3A-B), and other characters, indicated that these were not examples of *C. amonea confusa*, but a species unknown in Britain. A male specimen was sent to SJG who confirmed this observation. In addition CO sent two males and three females directly to Jörg Spelda at The Bavarian State Collection of Zoology (ZMS) for examination and genetic bar-coding.

On the basis of male morphology Jörg Spelda has attributed these to the genus *Turdulisoma* Mauriès, 1964 (Haplobainosomatidae) and closely allied to *T. helenreadae* Mauriès, 2014, but differs in a sufficient number of characters to be considered a new species (Jörg Spelda, pers. comm.).

Currently, this genus has three known species distributed across the Iberian Peninsula (Mauriès, 2014).

Identification

Turdulisoma cf helenreadae is a well pigmented brown millipede, about 12 mm in length, with the body bearing distinct but bluntly rounded paranota (Fig. 1C) and the eye comprising about 25 ommatidia arranged in an equilateral triangle (as in Fig. 1D). On the basis of external morphology this species is identical to *T. cf turdulorum* (see species account below), but mature males of the two species are readily separated by the distinctive shape of the telopodites of the gonopods in anterior view (Fig. 3A-B vs Fig. 3C-D).

Using Blower (1985), *T. cf helenreadae* will key to *Craspedosoma rawlinsii* Leach due to rounded paranota and dark pigmentation. However, it differs primarily in size, being somewhat smaller than *C. rawlinsii* (which reaches 15-16 mm in length; Blower, 1985).

Images of live specimens can be seen at *www.bmig.org.uk/species/Turdulisoma-cf-helenreadae*.

Distribution, habitats and associated species

To date *T. cf helenreadae* has been recorded only from the spoil heaps of Maerdy Colliery located near the village of Maerdy in the Rhondda Valley (Table 2). The site has been allowed to naturally re-vegetate following closure of the colliery in 1990, and now covered with scattered heath and scrub.

The first specimens were found under an old railway sleeper, with additional specimens encountered beneath stones on sparsely vegetated banks of colliery spoil in association with *Leptoiulus belgicus* (Latzel) and *Polydesmus sp.* immatures. The millipedes *Glomeris marginata* (Villers)*, Melogona scutellaris* (Ribaut)*, Chordeuma proximum* Ribaut and *Cylindroiulus britannicus* (Verhoeff), and the centipedes *Lithobius piceus* L. Koch (at one of its few sites in south Wales)*, L. pilicornis* Newport*, L. tricuspis* Meinert (at one of its few sites in south Wales) and *Lithobius variegatus* Leach, were also recorded on that date (05.xii.2016). During the 2017 survey adult *Polydesmus angustus* Latzel were recorded and additionally *Brachydesmus superus* Latzel and *Ophyiulus pilosus* (Newport).

Table 2: Records of *Turdulisoma cf helenreadae*

Verified records submitted to BMIG Millipede Recording Scheme. Recorders: CO – Christian Owen; SJG – Steve Gregory; KL – Keith Lugg.

Locality	Grid Ref.	VC	Date	Recorders
Maerdy Colliery Tips	SS96-99-	41	05.xii.2016	CO
	SS967994		08.xii.2016	CO
	SS968992		25.ii.2017	CO, SJG, KL

The described *Turdulisoma helenreadae* Mauriès, 2014 is known from a handful of sites in Galicia, north-west Spain (Provinces of Pontevedra and Ourense) and northern Portugal (District Viana do Castelo) where it was collected during BMIG's 2004 field meeting.

Turdulisoma cf turdulorum (Chordeumatida: Haplobainosomatidae)

Discovery

On 17th April 2017 CO visited Craig yr Aber (SS855850, VC 41) to search for male specimens of an unidentified 'large black millipede with pink legs' that had been collected there by Emma Williams a few days earlier (these proved to be *Ommatoiulus moreleti* (Lucas) found associated with *Cylindroiulus pyrenaicus* (Brölemann), both species new to the UK; Gregory *et al*., 2018b). On this occasion CO also picked up specimens of a brown Chordeumatidan millipede that on external morphology appeared to be identical to *T. cf helenreadae* (see species account above). However, microscopic examination by CO of male gonopods (Fig. 3C-D) indicated that these were a different species also unknown in Britain (an observation confirmed by SJG). On 4th November 2017 CO re-visited Craig yr Aber and collected additional material. Images of a dissected male and preserved male specimens were sent to Jörg Spelda at The Bavarian State Collection of Zoology (ZMS) who has attributed these to the genus *Turdulisoma* Mauriès, 1964 (Haplobainosomatidae), closely allied to *T. turdulorum* Mauriès, 1964, but differing in a sufficient number of characters to be considered a new species (Jörg Spelda, pers. comm.).

The three known species in this genus are distributed across the Iberian Peninsula (Mauriès, 2014).

Identification

Turdulisoma cf turdulorum is morphologically identical in appearance to *T.cf helenreadae.* It is a well pigmented chocolate brown millipede, about 12 mm in length, with the body bearing distinct but bluntly rounded paranota (as in Fig. 1C) and the eye comprising about 25 ommatidia arranged in an equilateral triangle (Fig. 1D). Mature males of the two species are readily separated by the distinctive shape of the telopodites of the gonopods in anterior view (Fig. 3C-D vs Fig. 3A-B).

Using Blower (1985), *T. cf turdulorum* will key to *Craspedosoma rawlinsii* Leach due to rounded paranota and dark pigmentation. However, it differs primarily in size, being somewhat smaller than

C. rawlinsii (which when adult is 15-16 mm in length; Blower, 1985).

Images of live specimens can be seen at *www.bmig.org.uk/species/Turdulisoma-cf-turdulorum*.

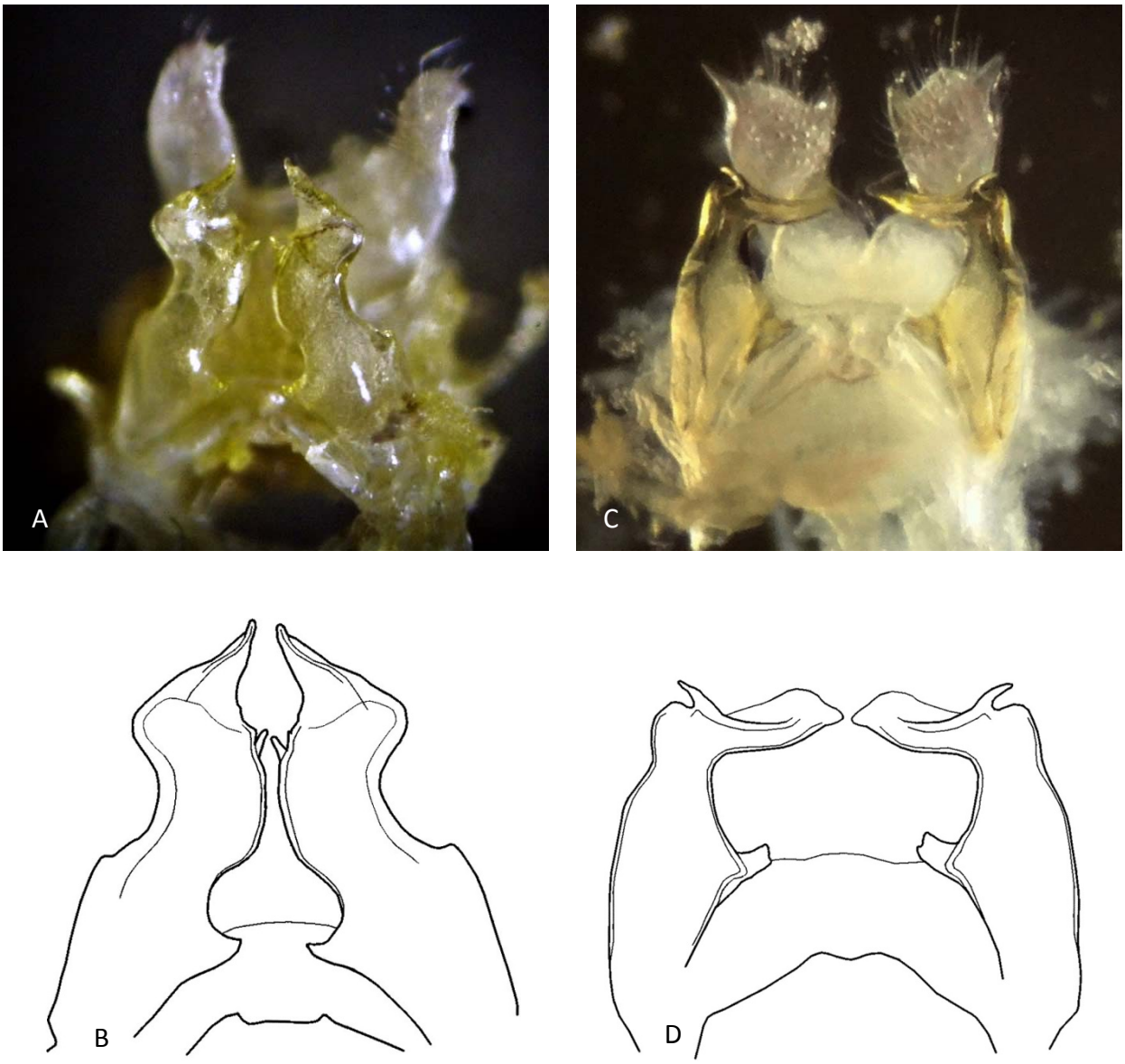

Figure 3: Male gonopods of *Turdulisoma* species recorded from south Wales.
A-B) *Turdulisoma cf helenreadae*. A) Male gonopods (with paragonopods behind), anterior view (image © Christian Owen); B) Drawing of telopodites of gonopods, anterior view.
C-D) *Turdulisoma cf turdulorum*. C) Male gonopods (with paragonopods behind), anterior view (image © Steve Gregory); D) Drawing of telopodites of gonopods, anterior view.

Distribution, habitats and associated species

To date *T. cf turdulorum* has been recorded from five sites, each in a different valley, along a 20 km stretch across Neath Port Talbot and Bridgend (Table 3). If this species is introduced, it seems to be well-established. Typically specimens have been recorded from shaded woodland growing on, or in close proximity to, former colliery workings. However, at Darren Fawr Tip specimens were found in open grassland growing on reclaimed colliery spoil tip (see paragraph below).

At Craig yr Aber, Bridgend, a large area of former open-cast coal mine lies to the south. At this site specimens have been found beneath decaying logs in mixed deciduous and coniferous woodland, including an area of mature Beech *Fagus sylvaticus* L. Additional specimens were not found by sieving leaf-litter. At Cwmafan, Port Talbot (SS791929, VC41) this species was found in young broadleaf woodland on colliery spoil. Subsequently, four additional sites have been found by Liam Olds (Colliery Spoil Biodiversity Initiative). At Craig Gwladys Country Park (SS765995, VC41) a male and two females were found while undertaking a Halloween mini-beast hunt. In August 2020 numerous adults of both sexes were found at Ogmore Washery (SS937887, VC41), under stones and dead wood in mixed deciduous and coniferous woodland along the route of a former aerial ropeway associated with the now disused colliery/washery. Atypically, at Darren Fawr Tip (SS892926, VC41) specimens were found beneath dead conifer logs in dry open grassland (well away from mature trees) growing on reclaimed colliery spoil tip situated on an exposed hilltop at over 340 m asl (Liam Olds, pers. comm.). This contrasts with other known sites which are sheltered woodland growing on valley sides at lower elevation. It is possible that this species may have moved onto the exposed tip following the clear-felling of an adjacent conifer plantation between 2010 and 2013 (Liam Olds, pers. comm.).

Table 3: Records of *Turdulisoma cf turdulorum*

Verified records submitted to BMIG Millipede Recording Scheme. Recorders: CO – Christian Owen; LO – Liam Olds; SJG – Steve Gregory; KL – Keith Lugg; MGT – Mark Telfer.

Locality	Grid Ref.	VC	Date	Recorders
Craig yr Aber, Bridgend	SS855850	41	17.iv.2017 04.xi.2017 30.xi.2017	CO CO CO, SJG, KL, MGT, LO
Cwmafan, Port Talbot	SS791929	41	29.viii.2018	LO (CO det.)
Craig Gwladys Country Park	SS765995	41	30.x.2018	LO (CO det.)
Ogmore Washery	SS937887	41	19.ix.2020	LO (CO det.)
Darren Fawr Tip	SS892924 SS892927	41	18.ix.2020 06.xi.2020	LO (female only) LO

Craig yr Aber is the most extensively surveyed site for this species and has proved to be a very species diverse. Millipedes found associated with *T. cf turdulorum* include *Ceratosphys amoena confusa* Ribaut, *Hylebainosoma nontronensis* Mauriès & Kime (these two species proving to be widespread in the south Wales; CO pers. obsv.), *Polydesmus angustus* Latzel, *Cylindroiulus punctatus* (Leach), *C. pyrenaicus* (Brölemann) and *Ommatoiulus moreleti* (Lucas) (the latter two reported new to Britain here in 2017; Gregory *et al*., 2018b). Associated centipedes include *Haplophilus subterraneus* (Shaw), *Strigamia crassipes* (C. L. Koch), *Geophilus truncorum* (Bergsoë & Meinert), *Lithobius borealis* Meinert, *L. muticus* C. L. Koch (at one of its few south Wales localities), *L. piceus* L. Koch (at one of its few south Wales localities), *L. pilicornis* Newport and *L. variegatus* Leach. It is also of note that the pseudoscorpion *Neobisium simile* L. Koch was recorded here new to Britain during the survey of 30th November 2017 (Telfer, Cuff, Spelda & Owen, 2020).

The described *Turdulisoma turdulorum* Mauriès, 1964 is only known from a single male collected from northern Portugal (province of Douro Litoral). No additional specimens or localities are known (Mauriès, 2014).

Discussion

All three species considered in this paper have been recorded from a relatively small area of south

Wales. Currently, *Psichrosoma cf breuili* is known from three sites (two in close proximity), *Turdulisoma cf helenreadae* from a single site and *Turdulisoma cf turdulorum*, the most widespread, from six localities. Their congeners are only known from a handful of sites on the Iberian Peninsula (Gilgado *et al*., 2015; Mauriès, 2014). We consider that it is quite likely that *P. cf breuili*, *T. cf helenreadae* and *T. cf turdulorum* are non-native unintentional introductions into south Wales.

Many of the known sites for these three millipedes are known to support populations of other species thought to be introduced non-natives. For example, at Newbridge, the original site for *P. cf breuili*, the millipede *Ceratosphys amoena confusa* Ribaut (native to south-west France; Telfer *et al*., 2015), the Ghost Slug *Selenochlamys ysbryda* Rowson & Symondson (related species occur in The Crimea; Rowson & Symondson, 2008) and the terrestrial flatworm *Kontikia andersoni* Jones (native to Australia/New Zealand; Boag, 2012) have been recorded. At Craig yr Aber, where *T. cf turdulorum* was first discovered, *Cylindroiulus pyrenaicus* (Brölemann) (native to the French and Spanish Pyrenees and the French Massif Central) and the expansive millipede *Ommatoiulus moreleti* (Lucas) (native to Portugal and southern Spain) were also discovered new to Britain (Gregory *et al*., 2018b). In addition *C. amoena confusa* and *H. nontronensis* and the recently discovered pseudoscorpion *Neobisium simile* L. Koch (Telfer *et al*., 2020) were also recorded here.

One hypothesis proposed is that these species may have been introduced with importations (including from the Spanish Basque Country) of iron ore or other industrial raw materials imported into south Wales following widespread industrialisation in the 19th century following the discovery of coal in The Valleys the previous century (Gregory *et al.*, 2018b). For example, the Orconero Iron Ore Company in northern Spain had been a subsidiary of the Dowlais Iron Company in south Wales since 1873 (Heath, 2017) and a few years later several hundred workers (and their families) were brought over from northern Spain to work in south Wales. Thus, it is also possible that some species may have been transported with the Spanish miners and their equipment.

It will be interesting to see if any of these three species are recorded elsewhere in Britain.

Acknowledgements

We thank Jörg Spelda (Zoologische Staatssammlung München, The Bavarian State Collection of Zoology) for undertaking the identification of specimens and for providing relevant literature. We also thank Liam Olds (Colliery Spoil Biodiversity Initiative) for much useful discussion and for making his records available for inclusion in this paper. We are grateful to Emma Williams who indirectly contributed to the discovery of *Turdulisoma cf helenreadae* (as organiser of the informal 'bio-blitz' at Meardy Colliery) and of *Turdulisoma cf turdulorum* (through her discovery of *Ommatoiulus moreleti* at Craig yr Aber). Keith Lugg kindly allowed the use of his image of *Turdulisoma cf helenreadae.*

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Cylindroiulus dahli Demange, 1970 (Julidae) and *Orthochordeumella pallida* (Rothenbühler 1899) (Chordeumatidae): two millipedes new to Britain and *Propolydesmus testaceus* (C. L. Koch, 1847) (Polydesmidae) a millipede new to Scotland.

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Abstract

Two species of European millipede, *Orthochordeumella pallida* (Rothenbühler 1899) and *Cylindroiulus dahli* Demange, 1970, are reported as new to Britain, along with *Propolydesmus testaceus* (C. L. Koch, 1847) which is recorded from Scotland for the first time. All three species were found in the same public garden in Glasgow (Scotland).

Brief descriptions with illustrations are provided for *O. pallida* & *C. dahli* along with information on their European distributions and habitat preferences. A list of millipedes found in the garden is given and the possible origin of the new species is discussed in relation to the development of the garden on a post-industrial site.

Introduction

The Hidden Gardens is a public garden/urban green-space run by a Charity. It is located near the centre of Glasgow (NGR: NS581631), Scotland, just south of the formerly heavily industrialised River Clyde. The Gardens were established around 2003 on a former tram works and depot which operated from c.1894 to the 1960s. However it is believed that the area was used as a tree/shrub nursery in the early 19th C. to supply plants to the large domestic gardens and estates in the area (*thehiddengardens.org.uk*).

This survey evolved from RBW's involvement in public bioblitz events at the Gardens. With the assistance of Gardens volunteers, a series of pitfall traps was deployed from 1st March until 8th May 2017 in a variety of habitats, ranging from annual and perennial flower beds to recently established woodland. The catch was sorted by RBW and the millipedes were identified (with some expert assistance) by MBD in 2020. Further pitfall material was collected, over at least a year, and will become available for identification in due course.

Results

The survey produced the ten species of millipede listed in Table 1 and these are shown in order of abundance in Fig. 1. By far the most frequent millipede species in this pitfall trap survey were *Ophyiulus pilosus*, *Polydesmus angustus* (both common species) and, perhaps surprisingly, *Propolydesmus testaceus*, previously unrecorded in Scotland, followed by *Orthochordeumella pallida*, a species previously unknown in Britain.

Propolydesmus testaceus was easily identified from descriptions in Blower (1985) and verified by Paul Lee. However, two other species did not appear to be identifiable using the current British identification keys and literature. The abundant chordeumatid initially appeared likely to be one of the two known British *Chordeuma* species (both of which occur in Scotland; Gregory, 2016). However the gonopod was not consistent with either species. Reference to Schubart (1934) and Demange (1981) indicated that it was most likely to be *Orthochordeumella pallida*, later confirmed by Henrik Enghoff. A single male

specimen of a *Cylindroiulus* was referred to Helen Read who recognised it as *Cylindroiulus dahli*, an Iberian species new to Britain.

Brief descriptions of *C. dahli* and *O. pallida* are given, based on this Scottish material, to assist with identification of specimens when they are inevitably found elsewhere in Britain.

Table 1: Species collected from the Hidden Gardens, Glasgow in 2017
GB IUCN Status: LC = least concern; NT = near threatened; DD = data deficient.
GB Rarity Status: NS = nationally scarce; NR = nationally rare.
Habitat: A = annual flower bed; P = perennial flower bed; W = woodland.

Species	**Authority**	**Habitat in Gardens**	**Status/Comments**
Allajulus nitidus	(Verhoeff, 1891)	P	LC/NS
Cylindroiulus britannicus	(Verhoeff, 1891)	P/A/W	LC
Cylindroiulus dahli	Demange, 1970	A	1st British Record
Cylindroiulus punctatus	(Leach, 1815)	P/W	LC
Ophyiulus pilosus	(Newport, 1842)	P/A/W	LC
Tachypodoiulus niger	(Leach, 1814)	P/A/W	LC
Polydesmus angustus	Latzel, 1884	P/A/W	LC
Propolydesmus testaceus	(C. L. Koch, 1847)	P/A	NT/NR; 1st Scottish Record
Melogona voigtii	(Verhoeff, 1899)	W	DD/NR
Orthochordeumella pallida	(Rothenbühler, 1899)	P/A/W	1st British Record

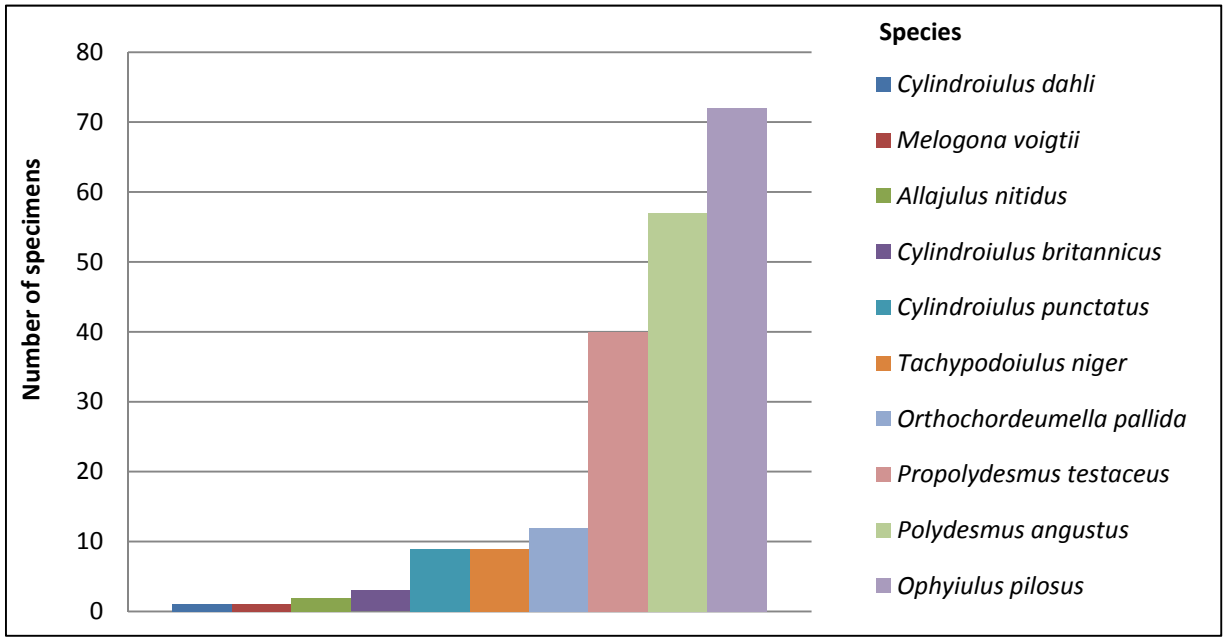

Figure 1: Species abundance

Description of *Cylindroiulus dahli* Demange, 1970

Cylindroiulus dahli is described (sp. nov.) by Demange (1970) from the Azores, while Read (2007) includes it in her key to the known *Cylindroiulus* species of north-west Spain.

Only a single adult male specimen of *C. dahli* was found in the pitfall material from this survey. No female or juvenile specimens were found. Attempts to identify it with existing British literature failed, ending up with *C. britannicus/latestriatus* as similar species.

However, it was noted that there were more than the required three setae on each anal valve. On dissection it was clear that the gonopod was different from other species on the British list, including recent finds from South Wales (e.g. Gregory & Owen, 2019). From photographs of the gonopod (Figs. 4 & 5), an identification as *Cylindroiulus dahli* was provided by Helen Read and confirmed by Henrik Enghoff.

Read describes *C. dahli* as being dark brown to black. The bleached colour of the preserved male pitfall trap specimen (Fig. 2) is unlikely to be representative of its live state and Demange describes it as grey, with darker head and pygidium (pre-anal ring) when preserved in alcohol. The single adult male collected in this survey measured as follows: length approx. 18 mm, diameter 1.4 mm. Demange gave the size of his holotype male as approximately 15 mm long.

The pointed telson extends a little over the valves - as described by Demange. In her key to the known *Cylindroiulus* of north-west Iberia, Read (2007) differentiates between *C. britannicus/latestriatus* (common British species and *C. dahli* with the former having 3 setae on each anal valve. Demange gives *C. dahli* 4 setae on each valve, while in the specimen from this study there appear to be 5 setae (one broken off) on the right valve and 4 on the left (Fig. 3).

In Fig. 4 note the hooked tip (a) to the promerite, forming an "eye" with the tip of the mesomerite (b). In the gonopod (Fig. 5) note the angular shape of the bachit (a), the backward pointing tip of the solenomerite (b), the angular phylacum (c) with a large lower tooth and the rounded coxit (d).

All photographs ©Mike Davidson

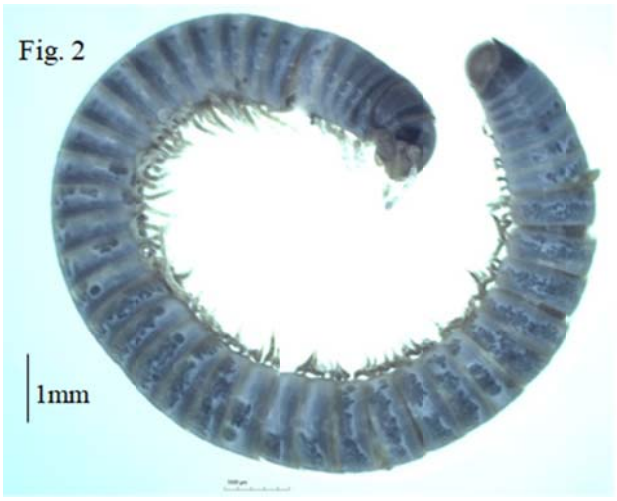

Figure 2: *C. dahli* ♂.

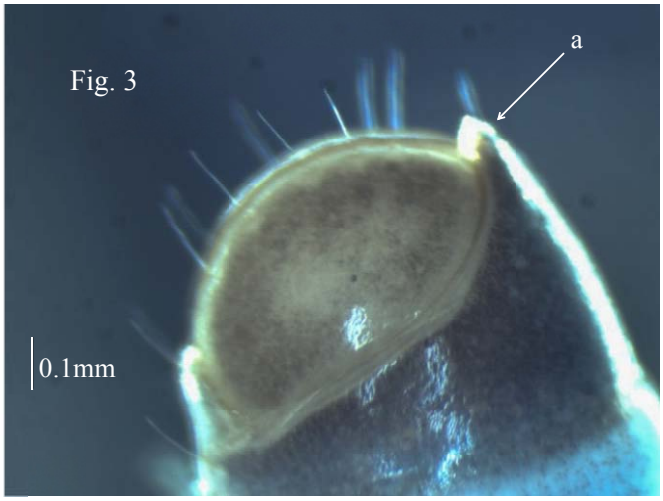

Figure 3: *C. dahli* 4+5 setae on anal valves and a) pointed telson extending over the valves.

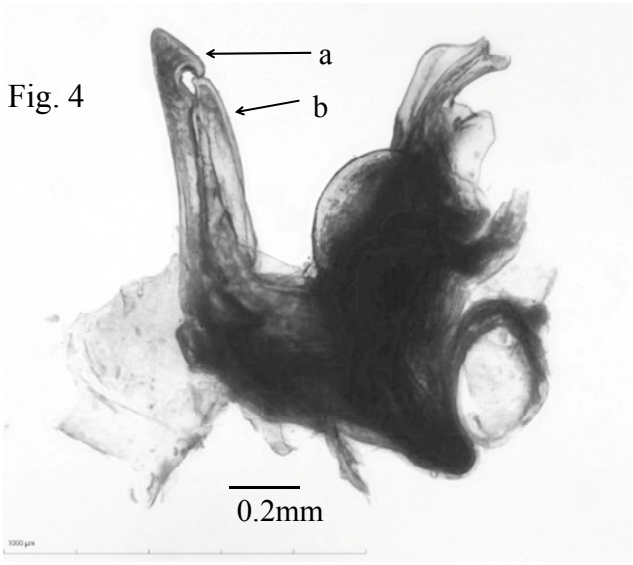

Figure 4: *C. dahli* gonopod internal view a) promerite, b) mesomerite.

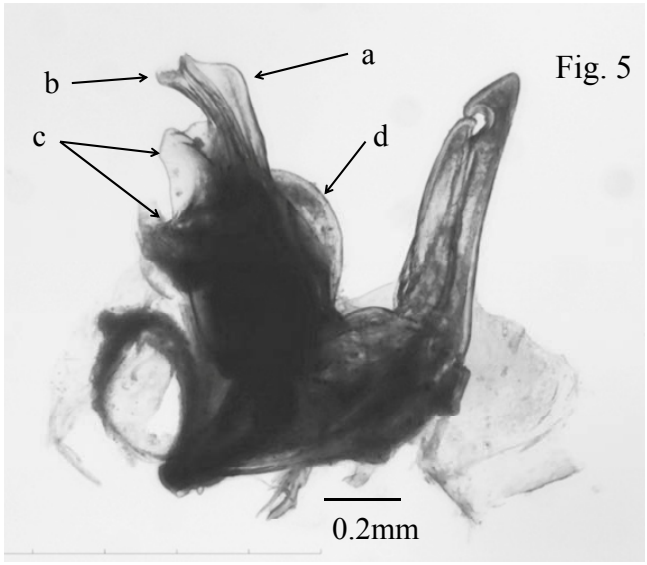

Figure 5: *C. dahli* gonopod external view a) brachit, b) solenomerite, c) phylacum, d) coxit.

Description of *Orthochordeumella pallida* (Rothenbühler, 1899)

On initial examination (Fig. 6) it was assumed that these specimens would be one of the two *Chordeuma* species known to occur in Scotland. Indeed this is how they key out using British identification keys. However the gonopod area appeared wrong for these species and in fact it looked as if much of the gonopodal structure was missing. Following dissection it was obvious that it was only the anterior and posterior paragonopods that were visible in lateral view (Fig. 7) and that all other structures between were concealed within the body cavity.

Various of the paragonopod/gonopod structures are shown in Figs. 8-11 and correspond well with figures provided by Brolemann (1935), Demange (1981) and Schubart (1934). Of particular note is the bifid tip to the coxal process on the anterior paragonopod, illustrated in Fig. 8 a for the Glasgow specimens. Note the inner bulge on the peltogonopod telopodite (Fig. 8 b). The rostral pillars of the gonopod are fairly rectangular, flat topped with the exterior angle produced upwards and with a similar protrusion on the anterior face (Fig. 11 a, b). Of the examples/sub-species illustrated by Brolemann, his Fig. 726 of the gonopod from a specimen from the Meuse, Forest of Argonne (N.E. France), is perhaps the most similar to the Glasgow specimens.

In this study all specimens of this species were adult (approx. 7♂ 5♀) but not all were complete due to the variable preservation of the pitfall material. Therefore all measurements in Table 2 are approximate.

Table 2: Measurements of adult *Orthochordeumella pallida*

	Length mm	**Diameter mm**
Average size ♂ (n=5)	14.6	1.1
Average size ♀ (n= 5)	15.8	1.4

The length of these specimens is greater than that given by Brolemann (♂♀ 13.5mm) but consistent with the 13-18mm given by Schubart (dia. 1.2-1.8 mm). As its name suggests, the body is pale as in *Chordeuma*. In both sexes the number of ocelli was around 26-28 (cf. Brolemann's 27).

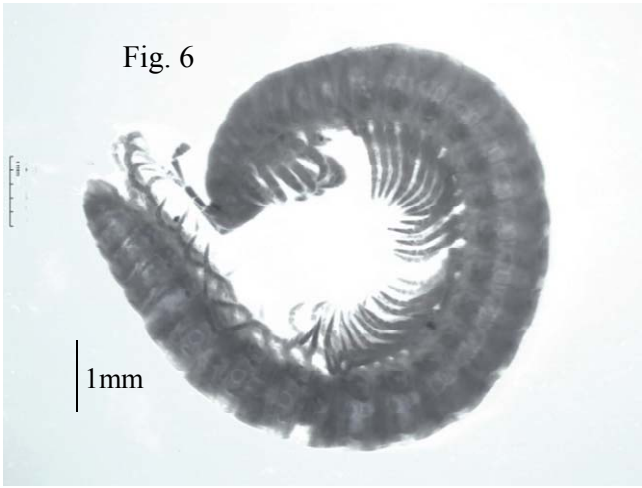

Figure 6: *O. pallida* ♂.

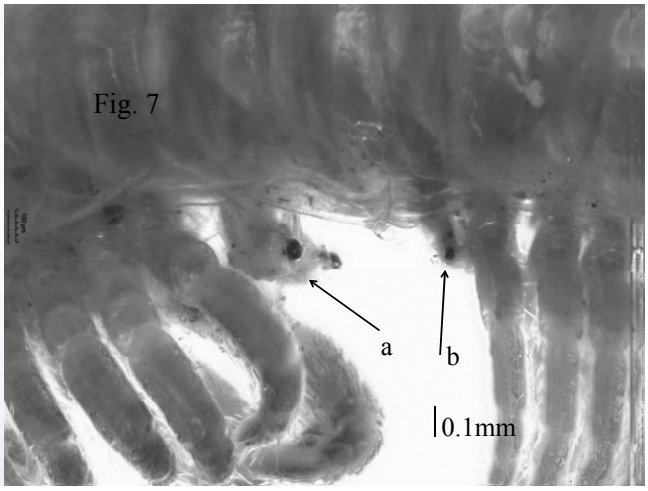

Figure 7: *O. pallida.*
a) anterior and b) posterior paragonopods.

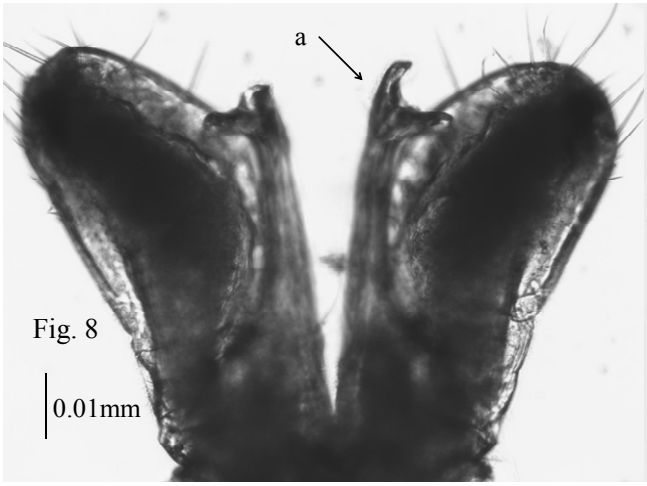

Figure 8: *O. pallida* anterior paragonopods.
a) bifurcate coxal process.

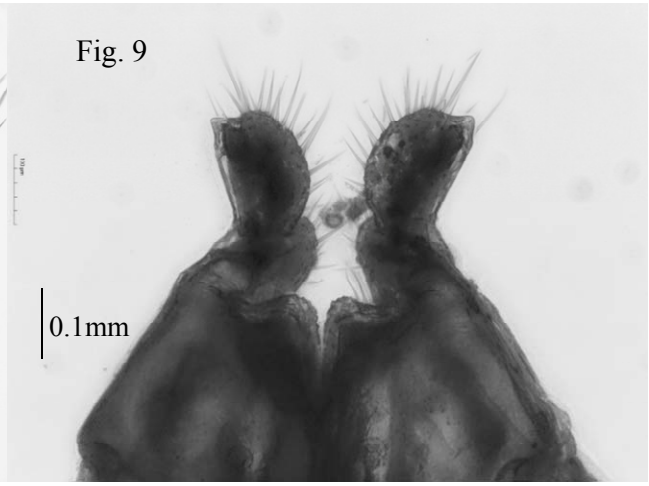

Figure 9: *O. pallida* posterior paragonopods.

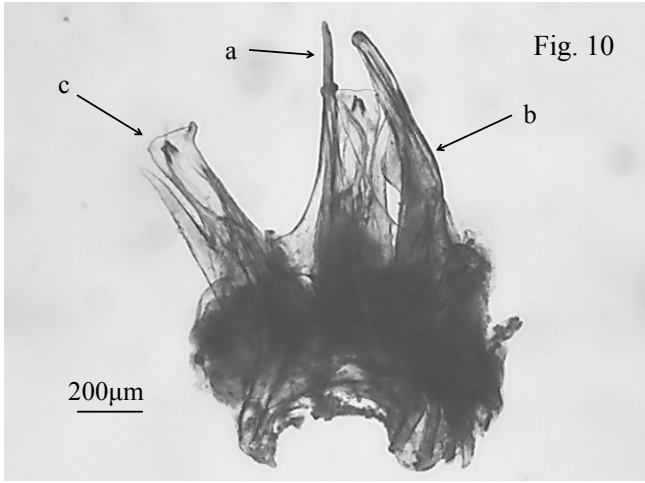

Figure 10: *O. pallida* peltogonopod.
a) colpoxal extension; b). telopodite;
c) gonopod structures: see Fig. 11.

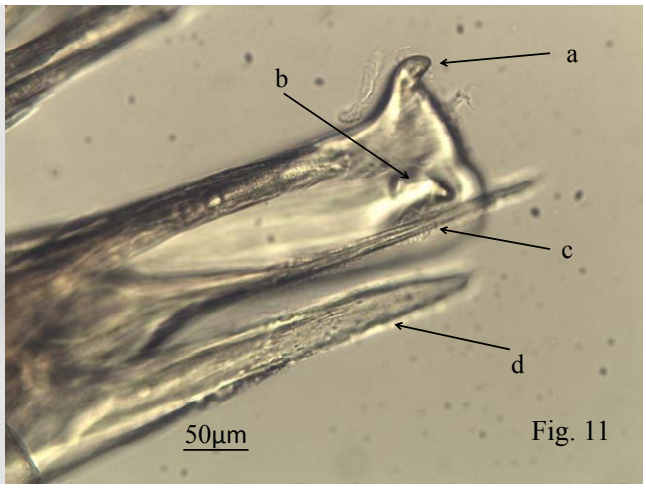

Figure 11: *O. pallida* gonopod showing:
a) & b) protrusions on the rostral pillar;
c) & d) external appendages.

Discussion

It seems very unlikely that the three species of millipede identified as additions to the Scottish (*P. testaceus*) and British millipede fauna (*O. pallida* & *C. dahli*) pre-date the creation of the Hidden Gardens. The probable source of introduction is likely to have been either through importation of soil or plants (most likely potted).

The transformation of the former tram works and depot to a garden presumably involved significant ground remediation and importation of soil. Unfortunately it is not recorded where the soil came from. However it is known that the plants used to establish the garden were obtained from two large commercial nurseries, one in Yorkshire and the other near Glasgow. The present management of the garden includes some importation of local municipal green-waste compost and some purchase of plants (pers. comm. Paula Murdoch).

This first list of millipedes from the Hidden Gardens numbers ten species (Table 1). Six of these are common and widely distributed in Britain. The remaining four are worthy of some comment.

Melogona voigtii has been known from a small number of sites in Scotland for about 25 years (Corbet, 1996) and was first recorded in Glasgow in 2013 (Davidson, 2013). It has recently been found in England for the first time, from West Lancashire (Gregory & Garnham, 2020). Lee (2015) considers its conservation status uncertain due to the limited data and possible past confusion with *M. gallica*. The Scottish records are largely from synanthropic sites or semi-natural woodland with evidence of human disturbance. Jeekel (2001), in his comparison of the Dutch and British millipede faunas, considers *M. voigtii* to be; "a primarily Central European species, which is gradually spreading through horticultural trade; this may also explain the recent discovery in Scotland". Of course with time, human and natural dispersal (e.g. by animal vectors) will bring the species to more natural habitats. Gregory and Garnham (2020) consider that the apparent lack of human influence at the Dalton Crags site, in West Lancashire, supports the view that this is an overlooked native species. However it is surprising how far into remote locations humans will take their garden and building waste to avoid tax.

Propolydesmus testaceus is already known from a number of sites in Britain (Lee, 2006), having been first discovered in Essex in 1903, with modern records in Kent, Oxfordshire, Suffolk and Monmouthshire. It has been found in a variety of habitats in Britain: including chalk downland, woodland and reclaimed industrial land.

Lee (2015) in his review of the conservation status of millipedes in Britain considered *P. testaceus* to be Near Threatened. Although at risk from development pressures on some of its sites, Lee considers it probably under-recorded. In a British context it is considered Nationally Rare. It is not known whether the Glasgow population has been imported from one of the English or Welsh sites or is, perhaps more likely, a new introduction from Europe.

In Europe, Kime & Enghoff (2011) consider it to be of Atlanto-Mediterranean distribution, extending east into parts of Central Europe. They describe it as calcicolous, thermophile and petrophile, most abundant in calcareous grassland but also in damp woodland and occasionally in gardens and reclaimed industrial land. The Swedish records are synanthropic and considered to be introductions and this is likely to be the case for the Glasgow record. Kime (2001) reports collecting "huge numbers of *P. testaceus* in Belgium and Luxembourg, mostly in pitfall traps in grassland and sometimes in rocky woodland". This was the third most common millipede in the Glasgow pitfall trap survey (Fig.1).

Cylindroiulus dahli is recorded for the first time in Britain and its synanthropic location is consistent with it being a recent introduction. It was first described from São Miguel (Demange 1970) and originally believed to be endemic to the Azores. Kime & Enghoff (2017) describe it as Lusitanian and give its distribution as including Mainland Spain (La Coruña, Orense, Pontevedra Provinces) and the

Azores (São Miguel) and suggest it will be found in Portugal. Habitats include: Woodland (*Quercus, Fraxinus, Pinus*), rocky shoreline with grassland, gardens and city parks. It is often found under stones or timber. Read (2007) gives its habitats in Spain as including oak woodland, coastal areas and synanthropic sites including gardens. It is now considered as an introduction to the Azores (Helen Read, pers. comm.).

Orthochordeumella pallida is also new to Britain and, as with *C. dahli*, is considered a recent introduction. At the time of writing, the third volume of the Atlas of European Millipedes is awaiting publication (Kime & Enghoff, submitted for publication). However, Henrik Enghoff has provided the following information, from the atlas, about this species:

Its distribution includes: Austria, Belgium, Switzerland, Germany, France, Luxembourg, Sweden. Its habitat is largely montane and also subalpine, up to 2740 m a.s.l. in Switzerland but found in lowland parts of north-east France and Belgium in particular. It is generally a woodland species. It has been found recently at synanthropic sites in Northern Germany and Sweden (2018). So it would appear that the Glasgow *O. pallida* is part of a wider European range expansion.

Given its long history of international trade it is perhaps not surprising that Glasgow is developing a cosmopolitan assemblage of non-native species, across various taxa, which have become established (e.g. Davidson & Merrett, 2014). However it seems quite remarkable that, having examined only a small amount of pitfall trap material from the Hidden Gardens site, three additions to the Scottish fauna, including two new to Britain have been found. All three are likely to be introductions via the horticulture trade. The Hidden Gardens and the wider Glasgow/Clyde area is worthy of greater investigation by natural historians.

Acknowledgements

We wish to thank the Hidden Gardens (Andrea Gillespie, Volunteer Manager) for permission to survey the invertebrate fauna, Garden volunteers for help with the survey and Paula Murdoch (Head Gardener) for information about the development of the gardens.

We are also grateful to Helen Read who recognised the mystery *Cylindroiulus* as *C. dahli*, to Paul Lee for verifying *Propolydesmus testaceus* and to Steve Gregory for information relating to *Orthochordeumella pallida*. Finally to Henrik Enghoff for verifying *O. pallida* and *C. dahli* for which he also supplied information on distribution and habitat.

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Porcellionides sexfasciatus (Budde-Lund, 1885) new for the UK from Eden Project, Cornwall (Isopoda: Oniscidea: Porcellionidae)

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Abstract

The woodlouse *Porcellionides sexfasciatus* (Budde-lund) is reported new for the UK from the Eden Project, Cornwall. A brief description with figures is provided to enable identification and information is given about habitats and microsites inhabited. This western European species is probably a recent colonist to the Eden Project, aided by human activity, and additional British sites may await discovery.

Key words: Isopoda, Oniscidea, *Porcellionides sexfasciatus*, new for UK, identification.

Introduction

The Eden Project, Cornwall (SX0455, VC1) includes an extensive glasshouse complex (the Rainforest and Mediterranean Biomes) covering 2.2 ha which is stocked with thousands of plant species from around the globe. The woodlice (Isopoda: Oniscidea) inhabiting these biomes were widely sampled by various researchers between 2003 and 2010 and records for 14 species of woodlice (Isopoda: Oniscidea), five species new for Britain, are collated by Gregory (2014). This included *Chaetophiloscia sicula* Verhoeff (Philosciidae), *Lucasius pallidus* (Budde-Lund) (Porcellionidae) and an unidentified (non-British) species of *Armadillidium* Brandt (Armadillidiidae) collected in the Mediterranean Biome.

In February 2018 during a visit to the Eden Project Mediterranean Biome KL observed two unfamiliar woodlice which were photographed (Fig. 1A-B). Subsequently, the images were seen by Franck Noël who suspected that they may be *Porcellionides sexfasciatus* (Budde-lund, 1885) (pers. comm. to SJG).

Currently, two species of *Porcellionides* Miers are known from Britain and Ireland (Gregory, 2009). The Plum Woodlouse, *P. pruinosus* (Brandt), with its characteristic pruinose 'bloom' covering the pereionites, inhabits synanthropic sites such as compost and manure heaps and is most frequent in southern and eastern England. In contrast *P. cingendus* (Kinahan), a typically well patterned species, has a marked south-western distribution, being widespread across southern Ireland, but mainly restricted to southern and western coastal areas in Britain.

Confirmation of *Porcellionides sexfasciatus* in the UK

A formal visit to collect specimens from the Eden Project biomes was arranged by JH-M on 21.iii.2020 (accompanied by SJG and KL). Two specimens collected from the Mediterranean Biome (Fig. 2A-B) were found upon microscopic examination to be female *P. sexfasciatus*. This determination was confirmed by Franck Noël (pers. comm. to SJG) from images taken by SJG of a specimen collected by JH-M (specimen shown in Fig. 2A, 2C-F). Subsequently, on 31.x.2020, a male specimen was collected inside the Mediterranean Biome by Mark Telfer (pers. comm. to SJG). A brief description with figures is provided below to allow separation of the three species of *Porcellionides* now known to occur in Britain and Ireland.

These are the first recorded occurrences of *Porcellionides sexfasciatus* (Budde-Lund, 1885) in the UK.

Figure 1: Two live specimens of *Porcellionides sexfasciatus* observed at Eden Project in 2018. A) Male (with re-generated right antenna) B) Female (recently moulted) (images © Keith Lugg).

Identification

A number of sub-species have been described, mainly from the Iberian Peninsula (Vandel, 1962). The sub-species present in France, and reported here, is *Porcellionides sexfasciatus sexfasciatus* (Budde-lund, 1885). Widely used synonyms include *Metoponorthus sexfasciatus* Budde-Lund, 1885, *Porcellio molleri* Verhoeff, 1901 and *Porcellio variabilis* Lucas, 1849. It should be noted that another widely used name *Porcellionides sexfasciatus* (C.L. Koch, 1847) is a synonym of *Orthometopon phaleronense* (Verhoeff, 1901), a species native to Greece (Schmalfuss, 2003) and not the species reported herein.

Porcellionides sexfasciatus is a well pigmented woodlouse, in life with a characteristic pruinose bloom, with a strongly discontinuous (stepped) pereion-pleon body outline and the antennal flagellum composed of two articles. It is capable of rapid movement. The body bears a distinct pattern of dorsal longitudinal stripes and, characteristically, the basis of each pereiopod bears a darkly pigmented band. The shape of the male first exopodite is diagnostic.

Using Hopkin (1991) live animals are likely to key out as *P. pruinosus* due to the pruinose 'bloom'. However, in preserved material this distinctive 'bloom' is lost, and specimens are likely to key to *P. cingendus* (in both Hopkin, 1991 and Oliver & Meechan, 1993) due to the distinctly raised traverse ridge present on the 2nd to 7th pereionites. Details of how to differentiate the three species are outlined below (but also see also Noël & Séchet, 2007; Noël, Séchet & Lefebvre, 2014). Potential confusion between the identification of *P. sexfasciatus* and *Orthometopon planum* (Budde-Lund, 1885) (Agnaridae), a species that is spreading northwards across France, but not yet recorded from the UK, is highlighted by Noël, Séchet & Lefebvre (2014).

Description

The brief description below is based primarily on the two female specimens (Fig. 2A-B) freshly preserved in 75% ethanol that were collected from the Eden Project in March 2020. The specimens photographed in 2018 (Fig. 1A-B) and the male collected in October 2020 were not available.

Porcellionides sexfasciatus exhibits sexual dimorphism, with the male being much more heavily pigmented than the female (see Fig. 1A vs 1B). Thus, the pigmentation patterns described below will be much less obvious in the male (Vandel, 1962). This, and other details of the male (see *Male sexual characters* below), are taken from published sources. The first female specimen (shown in Fig. 2A, 2C-F; J.H-M leg., SJG det.) is 8.0 mm in length (front of cephalon to tip of telson) by 3.25 mm wide. The second (Fig. 2B; SJG leg./det.) is 6.75 mm by 2.75 mm. Noël & Séchet (2007) give length up to 11-12 mm for French specimens.

The characteristic pruinose bloom seen in live specimens, akin to that of *P. pruinosus*, is lost upon preservation in alcohol leaving a background of purplish-brown pigment visible across the cephalon, pereion and pleon (Fig. 2A-D). The cephalon is mottled with pale spots. Six dark bands (hence '*sexfasciatus'*) run longitudinally along the length of the pereion and are most obvious posteriorly: a pair of either side of the mid line and a pair on each lateral margin running parallel to the epimera (which separated by a noticeably pale band). The dark bands continue onto the pleon, but it is the intervening three white bands that are most apparent here. The basis of the pereiopods each bears a darkly pigmented band (Fig. 2E), which is characteristic of this species (Vandel, 1962), and the underside of the pleon, noticeably the exopods, is also darkly pigmented.

The cephalon with lateral lobes hardly visible from above and the median lobe is lacking (Fig. 2C). Eyes are composed of numerous (c. 18) ommatidia (Fig 2C) and antennal flagellum is composed of two sub-equal articles (Fig. 2F). Posterior margins of the anterior pereionites are rounded, lacking backward projections (Fig. 2C), but backward projections become progressively more pronounced posteriorly (Fig. 2D). The dorsal surface with fine granulations. Pereionites 2 to 7 each with a distinct raised

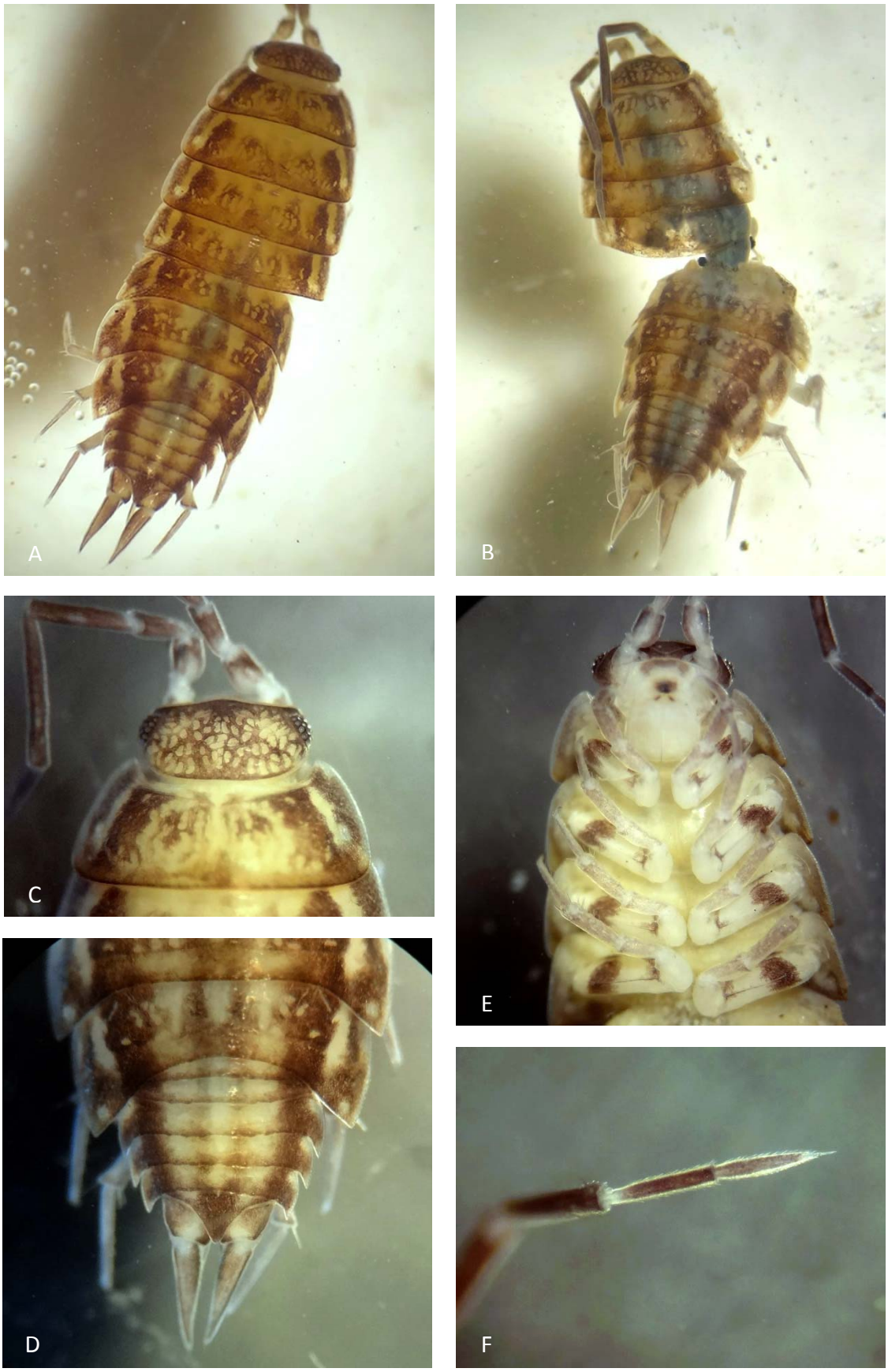

Figure 2: *Porcellionides sexfasciatus* female, specimens collected from Eden Project in 2020. A) & B) Two different preserved specimens; C) Cephalon and pereionite 1; D) Pereionite 7, pleon, telson and uropods; E) Ventral view, showing characteristic darkly pigmented bands on basis of pereiopods; F) Antennal flagellum (images C-F are of specimen shown in 2A).

transverse impression (ridge) that lies within the posterior third. In *P. cingendus* this ridge lies towards the anterior margin of the pereionites and in *P. pruinosus* they are not raised into a ridge (Oliver & Meechan, 1993; Noël & Séchet, 2007; Noël, Séchet & Lefebvre, 2014). The lateral noduli are very distinct, lying in a conspicuously unpigmented patch towards the posterio-lateral corner of each pereionite (Fig. 2A, C- D). These are also apparent in *P. cingendus*, but inconspicuous in *P. pruinosus* (Noël & Séchet, 2007; Noël, Séchet & Lefebvre, 2014).

The pleon is much narrower than the pereion, producing a strongly stepped body outline (Fig. 2D). Each pleonite bears an acute backward projection at the lateral-posterior corner. Two pairs of pseudotracheae are present. The telson is triangular, lateral margins concave and tip just reaching basipod of the uropods. Exopod of the uropods is long and slender (more so in the male; Vandel, 1962).

Male sexual characters

This account is taken from published literature (Vandel, 1962; Oliver & Meechan, 1993; Noël & Séchet, 2007). Exopod 1 of male *P. sexfasciatus sexfasciatus* (Fig. 3A) is of characteristic shape (Vandel, 1962, p.611, fig. 301D; redrawn here) being elongated into a gradually tapering point and lacking a cleft on the outer margin of the pseudotracheae. In contrast, exopod 1 of *P. cingendus* (Fig. 3C) is much broader relative to its length, being rather cordate in shape, with a conspicuous cleft on the outer margin of the pseudotracheae (arrowed). Exopod 1 of *P. pruinosus* (Fig. 3B) is of a very different shape, being much broader than long. In *P. sexfasciatus sexfasciatus*, the carpus of male pereiopod 1 is devoid of spines (Vandel, 1962), whereas both *P. cingendus and P. pruinosus* have a brush of spines on the ventral face of the carpus (Vandel, 1962; Oliver & Meehan, 1993). The male pereiopod 7 lacks secondary sexual modifications in all three species (i.e. is identical to that of the female).

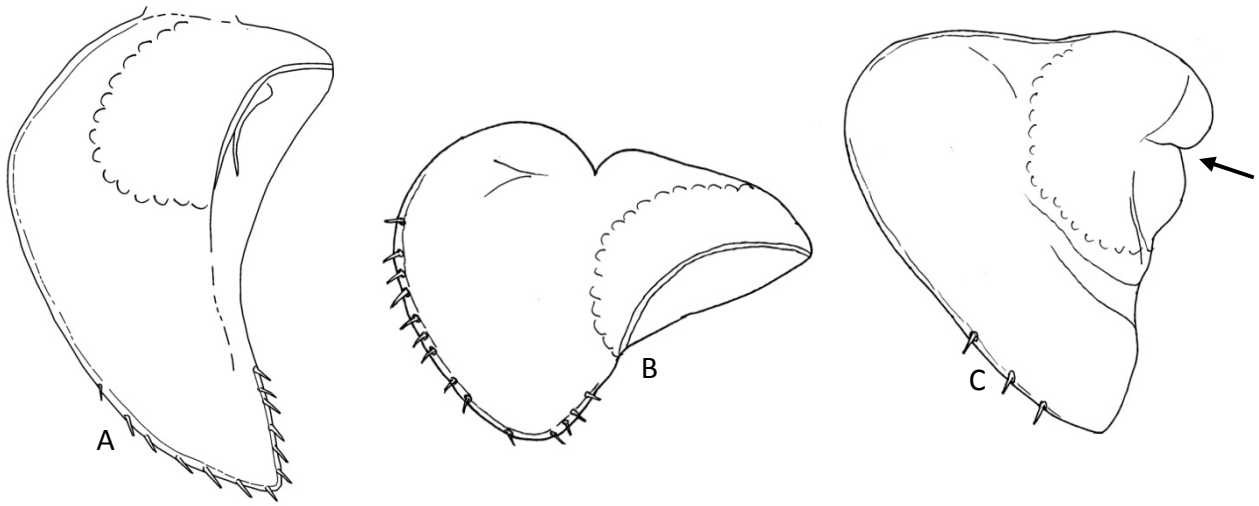

Figure 3: Comparison of exopod 1 of male specimens (anterior to top, posterior to bottom).
A) *Porcellionides sexfasciatus sexfasciatus* (redrawn from Vandel, 1962); B) *P. pruinosus*;
C) *P. cingendus*, cleft in pseudotracheae arrowed (B & C redrawn from Oliver & Meechan, 1993).

Distribution and habitats

Porcellionides sexfasciatus is widely distributed across the western Mediterranean region, including Spain, France, Italy, Malta, Morocco, Algeria, Tunisia and numerous Atlantic islands (see map in Vandel, 1962; p.608, fig. 299) and has been introduced to many other parts of the world (Schmalfuss, 2003).

Figure 4: Locations where *Porcellionides sexfasciatus* were collected in March 2020.
A) Mediterranean 'garden', under uppermost stone behind table;
B) Western Australia 'garden', under stone at top of wall.

In France it is widespread along the coastline of both the Mediterranean and the Atlantic where it reaches as far north as Finistère (Île de Sein), north-west Brittany (Séchet & Noël, 2015; Muséum National d'Histoire Naturelle, 2003-2020). Although this is predominantly a littoral species, it is not confined to the coast and is able to colonise synanthropic habitats inland (Séchet, 2004; Séchet & Noël, 2015), with a preference for relatively dry stony or sandy soils (Noël & Séchet, 2017). Synanthropic sites where it is assumed to be introduced include gardens and a cellar in Paris (Vandel, 1962), where it has not been recorded recently, and it has also been found inside heated glasshouses, e.g. in the Park Phoenix (Lemaire & Gerriet, 2014).

In Britain *P.sexfasciatus* has been recorded only from within the Mediterranean Biome of the Eden Project in Cornwall. The two specimens photographed in Fig. 1 were observed in the 'Mediterranean garden' by KL in February 2018. An additional female was collected there in March 2020 by JH-M. On the same date a second female was collected from the 'Western Australia garden' by SJG, but a third specimen seen nearby rapidly escaped capture. These specimens were found under loose stones in dry situations (Fig. 4A-B), with no other species of woodlouse present. Other woodlice recorded nearby (but in moister microsites) were numerous *Armadillidium nasatum* Budde-Lund, a few *Porcellio scaber* Latreille and a single *Lucasius pallidus* (Budde-Lund) (a species previously recorded here in 2010; Gregory 2014).

It is quite possible that *P. sexfasciatus* may be found at other heated warm temperate 'Mediterranean' glasshouses in Britain and Ireland. Given its occurrence on the Atlantic coast of Brittany it may be just a matter of time before it is discovered outdoors, either in coastal habitats or synanthropic sites, such as gardens. Likely places to look would be the Channel Islands, or even the south coast of England, and its off-shore islands.

Acknowledgements

We thank Marc Mappley of the Eden Project for allowing un-restricted access to survey the biomes, without which this survey would not have been possible.

We are very grateful to Franck Noël for alerting us to the identity of this previously overlooked species, for subsequently confirming the two specimens of *Porcellionides sexfasciatus* collected in March 2020 and for providing useful comments on the draft manuscript.

Mark Telfer kindly allowed his record of this species to be included in this paper.

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Preliminary observations of the ectoparasitic fungus *Rickia laboulbenioides* De Kesel (Laboulbeniales) in Britain

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Abstract

The ectoparasitic fungus *Rickia laboulbenioides* De Kesel (order Laboulbeniales) is known to infect various species of *Cylindroiulus* millipedes in Western Europe. Its occurrence in Britain has been long known, but there are few documented observations. In this paper British records are collated and five host species of *Cylindroiulus* are reported. A preliminary distribution map shows *R. laboulbenioides* to occur throughout England, Wales and into southern Scotland. Its occurrence is determined by the presence of suitable host millipedes rather than by habitat type. Of reference collection samples examined 12% were found to contain at least one infected specimen (with a prevalence of 15.5% in samples showing infection). Observations have been made throughout the year, with a late spring peak possibly reflecting millipede and/or field recorder activity.

Keywords: Laboulbeniales*, Rickia laboulbenioides*, *Cylindroiulus,* Britain, distribution.

Introduction

The order Laboulbeniales (Fungi, Ascomycota) are obligate ectoparasitic fungi that live externally upon the cuticle of their associated arthropod host. Typically they are limited to one, or a few closely related, species. They produce translucent thalli that grow directly from sticky ascospores that are dispersed by physical contact, often during copulation (De Kesel, 1997; Haelewaters *et al*., 2012; Santamaria *et al.*, 2014). As a rule host species must have large and stable populations with overlapping generations (to allow transmission between adults) and inhabit moist environments (Santamaria *et al*., 2014). The fungus seems to have little or no effect on the reproduction or survival of their host (Haelewaters *et al.*, 2012). Although mostly known from a wide range of insect orders (e.g. Wier, 1996; De Kesel, 1997), recent work has revealed many species associated with millipedes (e.g. Santamaria *et al*., 2014; Santamaria *et al.*, 2016). On millipedes, the thalli are often found towards the anterior of the body; on fore legs, body rings, gonopods, antennae, mandibles, etc (De Kesel, Haelewaters & Gerstmans, 2013; Santamaria *et al*., 2016).

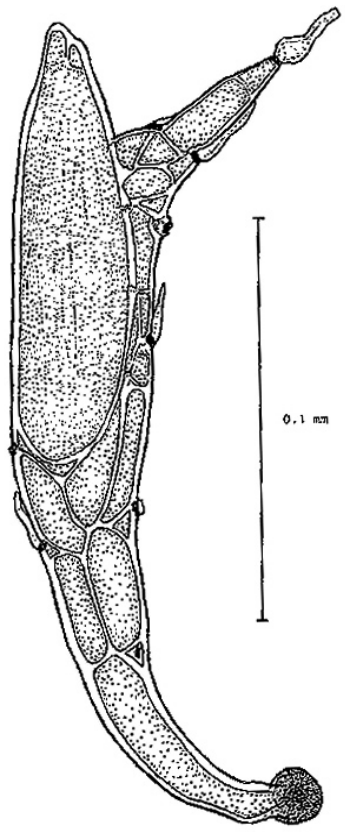

Figure 1: *Rickia laboulbenioides* reproduced from Jeekel (2001).

The occurrence of Laboulbeniales fungi on *Cylindroiulus* millipedes has been known for many years in the British Isles. Blower (1985; pg. 36) noted that "species of the '*luscus'* group of *Cylindroiulus* millipedes are fairly frequently attacked by ectoparasitic fungi of the Laboulbeniales". Irwin (1989) reports an un-identified Laboulbeniales growing on specimens of *C. britannicus* (Verhoeff) and put out a plea for more material in an attempt to discover which species occur in Britain. As far as the author is aware this never happened. A preliminary host-parasite list of British Laboulbeniales (mainly insect orders) was

published by Weir (1996), which erroneously listed *Rickia dendroiuli* Rossi as the species infecting *Cylindroiulus punctatus* (Leach) (based on information in Rossi & Balazuc, 1977). It is now known that *R. dendroiuli* is associated with *Cylindroiulus (Dendroiulus) latzeli* (Berlese), a millipede endemic to Italy (Santamaria *et al*., 2016; Kime & Enghoff, 2017).

In the Netherlands, Jeekel (2001) reported the occurrence of a widely recorded, but un-described *Rickia* species occurring on *C. latestriatus* (Curtis) (which he referred to as *R. cylindroiuli* spec. ined.). Jeekel included a detailed line-drawing (reproduced in Fig. 1), which quite clearly shows the species now known as *R. laboulbenioides* and comments "I am pretty sure it will turn up in the UK before long". It was over a decade later before this fungus was formally described and named as *Rickia laboulbenioides* De Kesel (*in* De Kesel *et al*., 2013) from infected *C. latestriatus* collected in the Netherlands and Belgium. Examination of museum collections (Santamaria *et al*., 2016) has shown *R. laboulbenioides* to be widely distributed across western Europe with records from Denmark (on *C. latestriatus* and *C. punctatus*) to the Iberian Peninsula (on *C. perforatus* Verhoeff and *C. dahli* Demange). However, there were no confirmed records of *R. laboulbenioides* for Britain or Ireland until Santamaria *et al*. (2016) identified the species from images taken by Malcolm Storey (2009) of an infected *C. punctatus* recorded at Bucklebury Common, Berkshire, in 2001 (see Appendix I for record details).

Inspired by Enghoff & Reboleira's (2015) plea to '*Look out for ectoparasitic fungi on millipedes'* and Santamaria *et al*.'s (2016) '*Hidden biodiversity revealed by collections-based research*' this paper attempts to collate modern observations of *Rickia laboulbenioides* in Britain in order to ascertain its host millipede associations, distribution, habitat preferences, phenology and prevalence.

Sources of observations

Observations of *Rickia laboulbenioides* in Britain have been collated from a number of sources:

- **Published literature**: Observations have been extracted from recently published sources.
- **Author's personal collection**: 53 tubes of *Cylindroiulus* species mainly from widely scattered localities across Oxfordshire (VC23 and VC22), including 9 tubes of *C. britannicus*, 4 of *C. latestriatus,* 9 of *C. parisiorum* (Brölemann & Verhoeff) and 15 of *C. punctatus*, were examined.
- **BMIG's basic and research collections** (Harper, 2007): 65 tubes of *Cylindroiulus* species mainly collected from widely scattered localities in south Wales, including 14 tubes of *C. britannicus*, 15 of *C. latestriatus* and 19 of *C. punctatus*, were examined.
- **Author's personal observations**: Recently, millipede specimens have been collected in the field from various locations in the UK and examined for signs of infection.
- **On-line resources**: Records have been gleaned from images posted online, such as BMIG's *Isopods and Myriapods of Britain and Ireland* group (www.facebook.com/groups/407075766387553) and *Insects and other Invertebrates of Britain and Europe* group (www.facebook.com/groups/invertid) and Biological Record Centre's *iRecord* website (www.brc.ac.uk/irecord).
- **Historical records**: Records (listed as *Rickia dendroiuli* Rossi) have been extracted from *Fungal Records Database of Britain and Ireland* (via the NBN Atlas; NBN, 2017).

Specimens of potential millipede hosts (when available for examination) were preserved in 70% ethanol and were examined using a low-power binocular (dissecting) microscope for the presence of thalli of Laboulbeniales fungi. When found, identification was confirmed by transferring thalli to a temporary slide and viewing with transmitted light. A few observations are based solely on photographic images, where although thalli could be clearly seen, key microscopic characters needed to provide positive identification of the fungus may not be visible.

Observations of *Rickia laboulbenioides*

Thirty nine occurrences of *Rickia laboulbenioides* utilising five British host millipede species, *Cylindroiulus britannicus* (Verhoeff), *C. latestriatus* (Curtis), *C. punctatus* (Leach), *C. pyrenaicus* (Brölemann) and *C. sagittarius* (Brölemann), have been collated. Three observations have been previously published; Gregory *et al*. (2018) (a new species host of *C. pyrenaicus*), Gregory & Owen (2019) (a new species host of *C. sagittarius*) and Storey (2019) (a new species host of *C. britannicus*). Eight records have been derived through examination of voucher specimens (author's and BMIG's collections). A number of recent field records have been made by the author and additional field observations have been derived from images posted online. Five records have been extracted from the *Fungal Records Database of Britain and Ireland* (via NBN, 2017). These occurrences are listed in Appendix I and are outlined below.

On occasions thalli can be numerous on the anterior legs, making them look conspicuously 'frilly' even at a casual glance (e.g. Fig. 2B & 2C). However, sometimes only a few thalli may be present, which can be difficult to observe, even in preserved material, and are easily overlooked.

Cylindroiulus britannicus (Verhoeff)

There are eight confirmed British observations (seven sites) of this host being utilised (Appendix I). The first confirmed occurrence of *C. britannicus* as a host species for *R. laboulbenioides* was reported and figured by Storey (2019) based on a male specimen collected from deciduous woodland in the New Forest, southern England in December 2017. However, it is very likely that the un-identified Laboulbeniales infecting *C. britannicus* reported by Irwin (1989) is also *R. laboulbenioides*. Examination of preserved voucher material has revealed two additional sites. One is from the BMIG reference collection (tube CC) from beneath flood debris beside the river Usk in south Wales in 2004 (6.3% prevalence, Table 1) and the other from the author's personal collection from scrubby grassland in western Scotland in 2006 (14.3% prevalence, Table 1). Recently there have been five additional field observations; a domestic garden, an ornamental garden, a deciduous woodland and a sedge bed (*Carex* sp.) scattered across southern England and from inside a glasshouse in an ornamental garden in south-west Scotland.

Cylindroiulus latestriatus (Curtis)

The eleven confirmed observations from six sites listed herein (Appendix I) represent the first recorded British occurrences of *C. latestriatus* as a host species for *R. laboulbenioides*. This not unexpected since this fungus was originally described from this millipede host in the Netherlands and Belgium by De Kesel *et al.* (2013) and was reported to occur widely on this host in the Netherlands by Jeekel (2001).

The earliest confirmed British records are from the author's personal collection collected from Oxfordshire in 1992 and 1993 (but not identified until 2017). Of four tubes (total 17 specimens), three tubes were found to contain infected specimens. Examination by the author (in 2019) of pitfall trap samples collected by J.M. Campbell between 2000 and 2002 from an Oxfordshire golf course (on sandy soils) revealed small numbers of infected specimens mainly between May and July (Appendix I). In Britain *C. latestriatus* is mainly coastal (Lee, 2006) and this is a rare millipede in Oxfordshire (Gregory & Campbell, 1996) with a handful of known records from relict acid grassland/heathland or churchyards on sandy soils. Thus, it is of note that the prevalence of *R. laboulbenioides* on this species appears to be relatively high within the county.

Examination of the BMIG basic collection revealed an additional site (10.8% prevalence, Table 1) from sand dunes at Crymlyn Burrows, south Wales in 2006. Recently, two additional field observations have been made, from upper salt marsh in Lancashire (specimen shown in Fig. 2A) and from coastal grassland in the Lothians (south-east Scotland).

Figure 2: *Cylindroiulus* species bearing thalli of *Rickia laboulbenioides* on anterior legs (arrowed).
A) *C. latestriatus* male (specimen examined by author), Morecambe Bay, West Lancashire;
B) *C. punctatus* male, Yew Tree Tarn, Westmorland; C) Same specimen, close up of badly infected anterior legs (some of the numerous thalli arrowed), ventral view (images © Nicola Garnham).

***Cylindroiulus punctatus* (Leach)**

This is the most widely recorded host millipede with thirteen confirmed British observations from twelve sites (Appendix I). The earliest observation is of an infected female collected in a pitfall trap (J.M. Campbell, leg.) set beside a stream in Besselsleigh Wood, Oxfordshire in 2000 (the sample examined by the author in 2019). The hygrophilous woodlouse *Ligidium hypnorum* (Cuvier) and the centipede *Lithobius muticus* (C.L. Koch) were also recorded in the sample. Both are typically associated with ancient woodland in Oxfordshire (Gregory & Campbell, 1995; 1996). The 14 tubes of this species

held in the author's personal collection (of different localities) showed no evidence of infection. The specimen recorded from Bucklebury Common in 2001 (photographed in Storey, 2019) was collected from under dumped rotting wood in oak *Quercus* sp. and birch *Betula* sp. woodland (M. Storey, pers. comm.).

Examination of the BMIG research collection adds two localities (tubes KH and LB) from south Devon collected in 2005 (with 46.7% and 6.7% prevalence respectively, Table 1). Recently, eight additional records have been added. Five were collected from woodland: from Westmorland, northern England (the specimen shown in Fig. 2B-C); from Kirkcudbrightshire, south-west Scotland; and Oxfordshire, Berkshire and Hampshire in southern England. The other three observations are from domestic or ornamental gardens on Guernsey, Channel Islands, Cornwall, south-west England and the Isle of Arran, western Scotland.

The *Fungal Records Database of Britain and Ireland* (accessed via NBN, 2017) gives additional records of *R. laboulbenioides* (under the name *R. dendroiuli,* as the records pre-date the description of *R. laboulbenioides*) infecting '*C. punctatus*'. However, there is some doubt about the reliability of the identification of the millipede hosts (M. Storey, pers. comm.) and consequently these have been listed as *Cylindroiulus sp.* in Appendix I.

***Cylindroiulus pyrenaicus* (Brölemann)**

Two observations (from a single site) are known, a new host millipede species for *R. laboulbenioides* (Gregory *et al.*, 2018). Several specimens of this millipede collected in May 2017 by Christian Owen from deciduous woodland in the Kenfig Valley, south Wales were found to be infected. This millipede is native to the Pyrenees and Montagne Noire (Kime & Enghoff, 2017) and is believed to be an accidental introduction into Britain.

***Cylindroiulus sagittarius* (Brölemann)**

There is one observation in Britain reported by Gregory & Owen (2019), a new host millipede species for *R. laboulbenioides*. A male specimen collected by Christian Owen in December 2017 from deciduous woodland in the Sirhowy Valley, south Wales was found to be infected. This millipede is native to the Western Pyrenees and Cantabrian Mountains (Kime & Enghoff, 2017) and is believed to be an accidental introduction into Britain.

Discussion

Host species

In Britain *R. laboulbenioides* is able to utilise a range *Cylindroiulus* species with five millipede hosts confirmed: *C. britannicus, C. latestriatus, C. punctatus, C. pyrenaicus* and *C. sagittarius.* This includes several closely related species falling within Blower's (1985) *luscus* Meinert, 1868 group. The first three species have very widespread distributions in the UK (Lee, 2006). The other two are believed to be accidental introductions in the UK that are restricted, albeit locally numerous, within single river catchments in south Wales (Gregory *et al.*, 2018; Gregory & Owen, 2019). It is possible that additional host species, such as *C. truncorum* (Silvestri) and *C. parisiorum* (Brölemann & Verhoeff) may be utilised. However, specimens of the latter species held in the author's collection (9 tubes; 42 specimens) have been examined (twice) for *R. laboulbenioides* without success.

Distribution

The known distribution of *R. laboulbenioides* in the British Isles (Fig. 3, based on records in Appendix I) extends from the Channel Islands (located about 30 miles (48 km) west of Normandy, France), through England and Wales, and continues at least as far north as southern Scotland (Isle of Arran and

The Lothians). However, it is apparent that this distribution reflects the activities of a few key recorders and *R. laboulbenioides* is almost certainly overlooked and under-recorded in Britain. The absence of records from eastern England may be due to the drier climate experienced there, but equally may be due to the lack of active observers. Given the overall abundance of *C. punctatus* throughout the UK, and the widespread occurrence of *C. britannicus* and *C. latestriatus* (Lee, 2006), then it is possible that *R. laboulbenioides* will prove to be considerably more widespread than indicated by this preliminary distribution map. However, at a few sites in Oxfordshire, the author has examined over a 100 specimens of *C. britannicus* and *C. punctatus* over the course of several years and *R. laboulbenioides* has not been found, suggesting its distribution may be patchy.

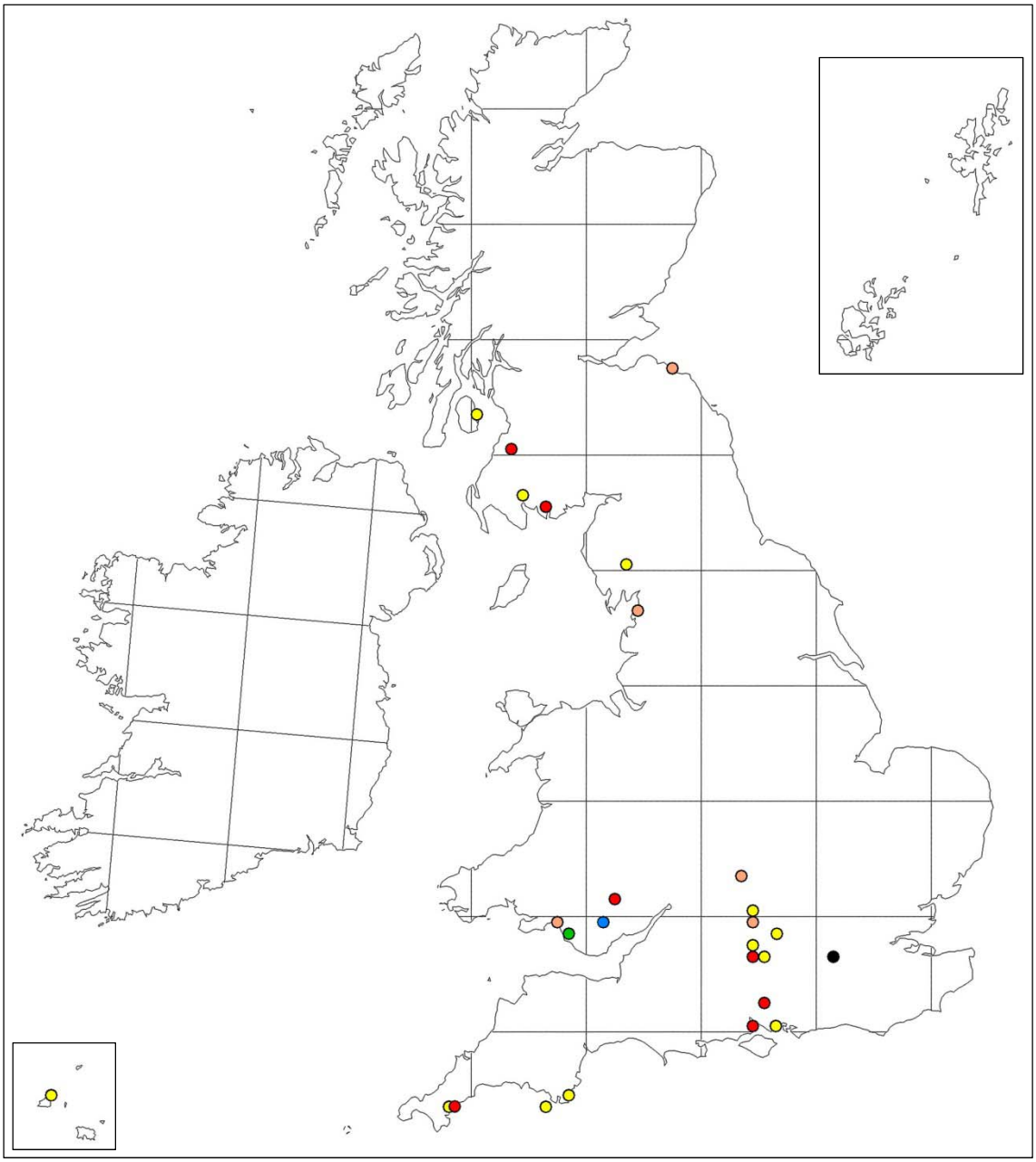

Figure 3: Preliminary distribution map for *Rickia laboulbenioides* in Britain.
Plotted at 10km (hectad) resolution using records listed in Appendix I. Records date from 1992 to September 2020. Host species: ● *Cylindroiulus britannicus*, ● *C. latestriatus*, ● *C. punctatus*, ● *C. pyrenaicus*, ● *C. sagittarius*, ● unknown *Cylindroiulus* sp.

Habitat

Rickia laboulbenioides shows no obvious habitat preferences with records from both semi-natural and synanthropic habitats. Although the majority of infected millipedes have been collected from deciduous woodland (Appendix I) this probably reflects the abundance and habitat preferences of two of its widespread host millipedes, *C. punctatus* and *C. britannicus*, which both favour rotting dead wood (Lee, 2006). Other habitats in which *R. laboulbenioides* has been recorded include acidic grassland, salt marsh and coastal sand-dunes (which are habitats favoured by *C. latestriatus*), a scrubby south facing sea cliff and gardens. It is concluded that the presence of host millipede species is more important than the habitat in which they occur. However, there are likely to be environmental factors at play, such as moisture, which affect the successful development of this fungus on its host millipedes.

Phenology

Plotting the number of British records of *R. laboulbenioides* against month of observation (28 records, Appendix I) suggests that thalli are present on host millipedes throughout the year, but there is a peak of observations in late spring (April to June) (Fig. 4). However, for the few species of Laboulbeniales that have been studied (mainly on Coleoptera) the life cycle of an individual thallus in completed within a few weeks (e.g. De Kesel, 1997). Since transmission of ascospores (at least for epigeal species) is primarily through physical contact between adults of host species, particularly during copulation (De Kesel, 1997; Haelewaters *et al*. 2012; Santamaria *et al*., 2014), then by implication host millipedes bearing mature thalli need to be present all year round. Thus, this spring peak in observations of *R. laboulbenioides* probably reflects the surface activity of millipedes and/or millipede recorders, which both become more elusive during the hotter and drier months of late summer.

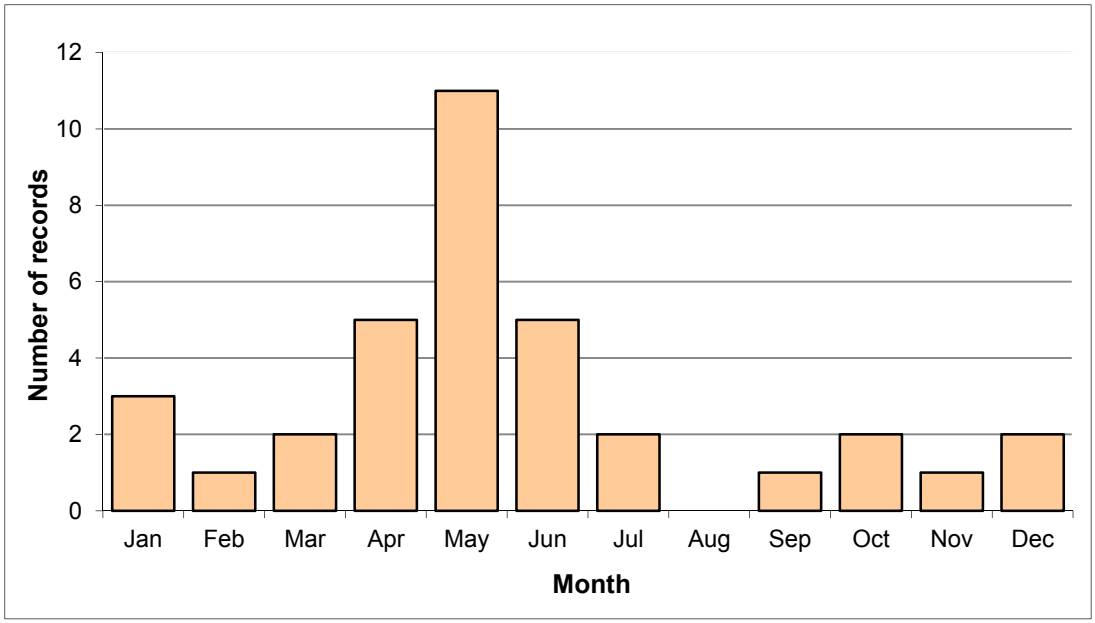

Figure 4: Number of records of *Rickia laboulbenioides* per month (data from Appendix I).

Prevalence

Combined together, the author's and BMIG's collections of *C. britannicus*, *C. latestriatus* and *C. punctatus* include 76 tubes (mostly containing less than ten specimens). Of these, nine tubes (12%) were found to contain at least one specimen bearing thalli of *R. laboulbenioides.* Only five tubes with infected material contained 10 or more specimens (Table 1). For these tubes the prevalence of host

infection within the sample varied considerably. Four samples varied between 6.3% and 14.3%, whereas the remaining sample (Bolberry Down, BMIG Collection, tube KH) showed 46.7% prevalence (seven infected specimens from 15 in sample). For the pooled data (all five tubes combined) this equates to 15.5% prevalence. This is higher than the 5% prevalence reported by De Kesel *et al*. (2013) for *C. latestriatus* (where there were six infected specimens of 120 examined). However, the samples examined here (Table 1) contain relatively few specimens and may not be representative of the larger population as a whole.

Table 1: Prevalence of infection in samples examined that contain more than 10 specimens

Source	Host species	Total no. specimens	Specimens infected	% infected
Author's Collection	*C. britannicus*	14 ♂♀	1♂ 1♀	14.3
BMIG Collection, Tube CC	*C. britannicus*	16 ♂♀	1 ♂	6.3
BMIG Collection, Basic	*C. latestriatus*	37 ♂♀	2♂ 2♀	10.8
BMIG Collection, Tube KH	*C. punctatus*	15 ♂♀	4♂ 3♀	46.7
BMIG Collection, Tube LB	*C. punctatus*	15 ♂♀	1♂	6.7
	Pooled data:	**97**	**15**	**15.5%**

Acknowledgments

I thank Henrik Enghoff for confirming the identification of *Rickia laboulbenioides* in the first instance and for subsequently providing much relevant literature.

I'm grateful Kieran Anderson, Gustav Clark, Nicola Garnham, Garret Maguire and Andy Marquis for providing images and/or specimens of Laboulbeniales fungi infecting their millipede specimens. In addition, Nicola Garnham kindly allowed the use of her images in this paper. Malcolm Storey kindly alerted me to his own records, and those of others, held on the *Fungal Records Database of Britain and Ireland*. John Campbell (Oxfordshire Biological Records Centre) kindly made his pitfall trap material available for examination.

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Appendix I: Observations of *Rickia laboulbenioides* in Britain of which the author is aware up to October 2020

Observations based on published records, examination of reference collections, author's personal observations, records submitted to the author and records held by *Fungal Records Database of Britain and Ireland* (FRDBI; NBN, 2017). * Indicates specimen(s) examined by the author.

IMBI - image originally posted on *Isopods and Myriapods of Britain and Ireland* group (www.facebook.com/groups/407075766387553); IOIBE - image originally posted on *Insects and other Invertebrates of Britain and Europe* group (www.facebook.com/groups/invertid); iRecord - image originally posted on *iRecord* (www.brc.ac.uk/irecord); OBRC/JMC – Oxfordshire Biological Records Centre/John Campbell leg.

Species/Locality	Number specimens	Grid Reference	VC	Date	Habitat	Source
Cylindroiulus britannicus						
River Usk, Abergavenny	1♂	SO242157	35	13.iii.2004	Under flood debris	BMIG Collection, tube CC*
Auchalton Meadows SWT	1♂ 1♀	NS335036	75	08.iv.2006	Scrubby grassland	Author's Collection *
New Forest	1♂	SU410023	11	06.x.2017	Deciduous woodland	Storey (2019)
Upham Village	1♂	SU538208	11	01.i.2019	Domestic garden	Personal Observation*
Cally Gardens, Vinery	1♀	NX604549	73	27.iv.2019	Inside greenhouse	Personal Observation*
Rack Marsh	1♀ 1♂	SU451692 SU452693	22	31.v.2019 30.x.2019	Deciduous woodland *Carex* Sedge bed	iRecord, image Personal Observation*
Lamorran House Gardens	1♂	SW843331	2	09.ix.2020	Ornamental garden	Personal Observation*
Cylindroiulus latestriatus						
Frilford Heath SSSI	1♂ 1♂	SU443985 SU438983	22	05.v.1992 08.ii.1993	Acidic grassland	Author's Collection*
Hook Norton Cutting	1♂ 1♀	SP358315	23	17.vi.1993	Scrubby grassland	Author's Collection*
Tadmarton Golf Course	1♂ 1♀ 1♂ 1♂ 1♂	SP 39 35	23	May 2000 May 2001 June 2001 July 2001 Jan-Feb 2002	Golf course on sandy heathland	OBRC/JMC pitfall traps*
Crymlyn Burrows	2♂ 2♀	SS715933	41	09.v.2004	Sand dunes	BMIG Collection, Basic*
Morecambe Bay	1♂	SD479687	60	28.xii.2018	Upper salt marsh	IOIBE, images*
Skateraw Harbour	1♀	NT738759	82	13.v.2019	Coastal grassland	Personal Observation*

Cylindroiulus punctatus						
Besselsleigh Common Wood	1♀ 1♂1♀	SP449014	22	Jan 2000 June 2001	Deciduous woodland	OBRC/JMC pitfall traps*
Bucklebury Common	1♂	SU547687	22	09.vi.2001	Deciduous woodland	Storey (2009), FRDBI
Bolberry Down	4♂ 3♀	SX689383	3	13.v.2005	Scrubby sea cliff	BMIG Collection, tube KH*
Wood, N. of Slapton	1♂	SX829456	3	14.v.2005	Deciduous woodland	BMIG Collection, tube LB*
Yew Tree Tarn	1♂	NY321003	69	26.i.2019	Mixed woodland	IOIBE, images *
Kirroughtree Forest	1♂	NX455645	73	28.iv.2019	Deciduous woodland	Personal Observation*
Sole Common	1C	SU412706	22	11.v.2019	Deciduous woodland	iRecord, images
St Sampsons, Guernsey	1♀	WV320808	113	20.v.2019	Domestic garden	IMBI, images
Margnaheglish, Arran	1♀	NS043323	100	31.vii.2019	Domestic garden	Specimen sent to author *
Kingwood Common	1♂	SU69-82-	23	16.iii.2020	Deciduous woodland	Personal Observation*
Hilsea Lines, Portsmouth	1♂	SU658044	11	28.vii.2020	Mixed Woodland	iRecord, images *
Lamorran House Gardens	1♂	SW843331	2	09.ix.2020	Ornamental garden	Personal Observation*
Cylindroiulus pyrenaicus						
Craig yr Aber	1♂ 1♀ 1♂ 1♂	SS855850	41	01.v.2017 30.xi.2017 30.xi.2017	Deciduous woodland	Gregory *et al*. (2018) Personal Observation* Telfer, M.G., pers. comm.
Cylindroiulus sagittarius						
Sirhowy Valley	1♂	ST177943	35	03.xii.2017	Deciduous woodland	Gregory & Owen (2019)
Unidentified *Cylindroiulus* sp.						
Esher Common	unknown	TQ12-62-	17	1994 1995	Not recorded	FRDBI (A. Weir, det.)
Slapton Ley	unknown	SX8-4-	3	1995	Not recorded	FRDBI (A. Weir, det.)
New Forest	unknown	SU410012	11	03.iv.2005	Deciduous woodland	FRDBI (M. Storey, det.)
New Forest	unknown	SU412014	11	12.iv.2005	Deciduous woodland	FRDBI (M. Storey. det.)

Metatrichoniscoides celticus Oliver & Trew, 1981 new for England (Isopoda: Oniscidea: Trichoniscidae)

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Abstract

The elusive soil-dwelling woodlouse species *Metatrichoniscoides celticus* (Oliver & Trew, 1981) has been recorded for the first time in England. This discovery also marks the first recorded occurrence of *M. celticus* from a heavily synanthropic habitat, suggesting the species is much more widely distributed and can occupy a broader range of habitat types than previously thought. Revised overlapping habitat preferences with the morphologically similar *M. leydigii* complicates previous distribution records and throws some previously assumed records of female *M. celticus* into doubt.

Key words: Isopoda, Oniscidea, *Metatrichoniscoides celticus*, England, distribution, habitat.

Introduction

The trichoniscid *Metatrichoniscoides celticus* was described new to science by Oliver & Trew (1981) from a handful of coastal erosion banks underlain by limestone (within three contiguous hectads) in the Vale of Glamorgan, south Wales, between Ogmore-by-sea and St Donats. It was initially thought to be a supra-littoral species, being found under deeply embedded boulders on the upper shore where exposed humus-rich soil erodes from grassy or un-vegetated banks (Oliver & Trew, 1981; Harding & Sutton, 1985). However, Chater (1986) reports its occurrence at Crwbin some 7 km inland at 170 m a.s.l. beneath large partly embedded limestone boulders in stony soil in a disused limestone quarry, suggesting a much broader habitat preference. Targeted surveys undertaken between 2003 and 2007 relocated this species at its known coastal sites (John Harper, pers. comm. to SJG, data included within Gregory, 2009). More recently, targeted surveys at Ogmore-by-Sea have re-found the species with relative ease (albeit few individuals) in 2016 (C. Owen & M.G. Telfer, pers. comm. to SJG), 2017 (SJG, pers. obsv.) and 2018 (C. Owen, pers. comm. to SJG). However, *M. celticus* has remained a notoriously elusive woodlouse with no additional localities having been discovered since 1986.

Then in February 2019 the collection of a male specimen of *M. celticus* from Anglesey, north Wales (Mariandyrys NNR) is reported by Hughes (2019), which extends the known global range 170 km further north. These specimens were found under embedded limestone blocks in grassland some 0.8 km inland and at 100 m a.s.l. In addition, a female *Metatrichoniscoides* specimen, which may be conspecific, was collected from limestone grassland at Great Orme, Llandudno on the Welsh mainland 16 km to the east at 190 m a.s.l.

Here we report the discovery of *Metatrichoniscoides celticus* from a synanthropic site in south-west England some 60 km further east on the opposite side of the Bristol Channel.

Metatrichoniscoides celticus new to England

On 10.x.2020 FA collected specimens of an unpigmented blind trichoniscid, less than 2 mm in length, from within the topsoil on an allotment in Horfield, Bristol (ST600763, VC34, 45 m a.s.l.). Macrophotographs were taken in-situ, followed by collection and preservation in 80% ethanol. Specimens were readily keyed to *Metatrichoniscoides* sp. by FA using Hopkin (1991), and a

macrophotograph was posted online to BMIG's Isopods and Myriapods of Britain and Ireland group (www.facebook.com/groups/ 407075766387553) by FA (Fig. 1). The image drew a lot of attention and subsequently FA forwarded the preserved specimens to SJG for species determination.

Figure 1: Metatrichoniscoides celticus immature live specimen from Horfield Allotments.
Live macrophotograph in-situ (Image © Frank Ashwood).

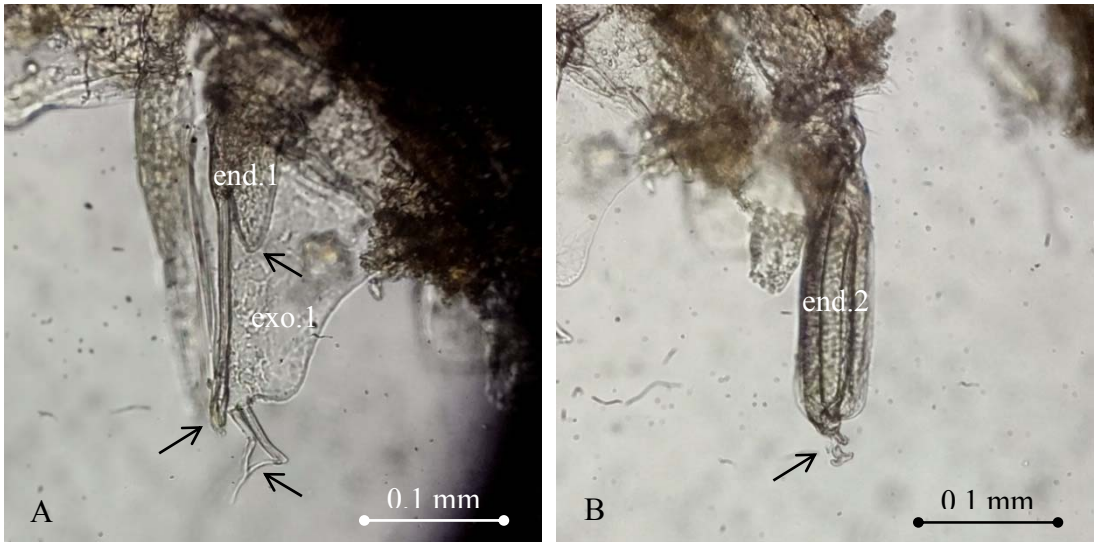

Figure 2: *Metatrichoniscoides celticus* male from Horfield Allotments.
A) Pleopod 1, endopodite 1 (end.1) and exopodite 1 (exo.1); B) Endopodite 2 (end.2).

Given the synanthropic habitat (worked allotments – see Fig. 3A) these specimens were assumed to be *Metatrichoniscoides leydigii* (Weber), however upon dissection of a male specimen it proved to be *M. celticus*. The shape and form of pleopods 1 and 2 matched those for *M. celticus* figured in Oliver & Meechan (1993, p. 33, fig. 8B). Pleopod 1 (Fig. 2A) had the base of the endopodite bearing a well-defined triangular posterior projection (arrowed) and the distal tip was swollen and bearing a series of short bristles (arrowed). The exopodite was terminated with two distal processes ('tails') of uneven lengths (arrowed). The endopodite of pleopod 2 (Fig. 2B) is terminated in hooked projections (arrowed).

To date, eight individuals (two males, four females and two juveniles) have been collected from a single 1 m^2 patch of soil. The specimens were all recovered following shallow digging (to approx. 10 cm depth), removing and breaking apart large clayey soil clods, and inspecting exposed macropores, in which the woodlice reside (Fig. 3B).

Figure 3: Habitat of *Metatrichoniscoides celticus* at Horfield Allotments.
A) Bare allotment soil from which specimens were collected; B) Closeup on soil macropores. (Images © Frank Ashwood).

Specimen details

The specimens collected on 10.x.2020 by FA and examined by SJG consisted of an adult male approx. 1.5 mm body length, two adult females of 1.75 mm body length, and one juvenile of only 1 mm (shown in Fig. 1). The specimens have been retained in the personal collection of FA. Record details have been submitted to the BMIG Non-marine Isopod Recording Scheme via iRecord (www.brc.ac.uk/irecord). Species found on the same allotment plot are *Trichoniscoides sarsi* (Patience) (another important discovery; Ashwood & Gregory, 2021), *Platyarthrus hoffmannseggii* Brandt*, Armadillidium nasatum* Budde-Lund, *Oniscus asellus* L., *Porcellio scaber* Latreille and *Philoscia muscorum* (Scopoli).

Discussion

Current evidence supports the idea that *M. celticus* is an elusive soil-dwelling species and is undoubtedly under-recorded. In common with other elusive soil-dwelling trichoniscids, *M. celticus* is usually found by searching the underside of large stones firmly embedded into damp soil (Gregory, 2009). Although elusive, this species may be locally numerous once a favoured niche is discovered (Chater, 1986): within the allotment patch in which this discovery was made, FA has readily found more specimens during subsequent attempts to do so.

As predicted by Gregory (2009), it is now apparent that *M. celticus* is much more widely distributed than previously thought. Previously known from a small area of south Wales, Hughes (2019) extended its range 170 km further north into Anglesey, north Wales. Now, *M. celticus* has been located in Bristol, south-west England. On current evidence, *M. celticus* shows a preference for humus-rich soil overlying calcareous geology on or near the coast. This seems to fit somewhat with this latest discovery, which was on organic-rich heavy clay soil with underlying limestone (British Geological Survey, 1999). *Metatrichoniscoides celticus* could therefore be expected to occur in other areas underlain by limestone in south-west England both on or near the coast. It is quite possibly more widely present in western Britain, perhaps even north-west France or Ireland too – with the latter two relatively under recorded compared to UK. Despite recent surveys, it has not been recorded from The Netherlands nor Belgium (Berg *et al*., 2008; De Smedt *et al*., 2020).

This finding also marks the first recorded occurrence of *M. celticus* from a heavily synanthropic habitat, suggesting it can occupy a broader range of habitat types than previously thought. Occurrence may be more dependent on soil type and structure rather than associated vegetation. Potential future sites in which this species may be found might include other synanthropic sites, such as gardens and disused limestone quarries, in addition to allotments. Interestingly Harding & Sutton (1985) state that surveys of apparently suitable sites were undertaken in south-west England, but *M. celticus* was not found.

The distribution of *M. celticus* in the UK is complicated by the occurrence of *M. leydigii* which is now also known from the west coast of Britain (Hughes, 2020). *Metatrichoniscoides celticus* and *M. leydigii* are morphologically very similar, and reliable separation between the two species can only be achieved through dissection of male specimens, assessing the shape and form of pleopods 1 and 2 (Hopkin, 1991; Oliver & Meechan, 1993). Within the British Isles *M. leydigii* is known from four localities (Fig. 4). Two sites are clearly synanthropic; a garden centre in Oxford and a walled garden at Wentworth Castle Gardens (Hopkin, 1990; Richards, 2016). However, the other two sites, the Medway estuary in Kent and the Ribble estuary in Lancashire, are coastal and appear to be semi-natural habitat; although industry and docks, respectively, lie close to both sites (Gregory, 2012; Hughes, 2020).

Single female specimens of a *Metatrichoniscoides* (at the time thought to be *M. celticus*) have been collected from semi-natural coastal habitats at St Bees Head, Cumbria (Hopkin, 1987) and Giant's Causeway, Co. Antrim, Ireland (Irwin, 1992). The former was hand-sorted from among accumulations of damp Triassic red sandstone rubble at the base of the sea cliffs (Hopkin, 1987), and the latter under a

stone embedded in grass turf growing on sand derived from basalt (Irwin, 1992), and neither sites have underlying calcareous geology. In light of the discovery of coastal populations of *M. leydigii*, from Kent, south-east England and recently from Lancashire, north-west England (Gregory, 2012; Hughes, 2020) (Fig. 4) the possibility should be considered that the St Bees Head and Giant's Causeway records could in fact prove to be *M. leydigii*. Likewise, it should be borne in mind that inland observations of female *Metatrichoniscoides* sp., especially those in synanthropic habitats, could prove to be *M. celticus*.

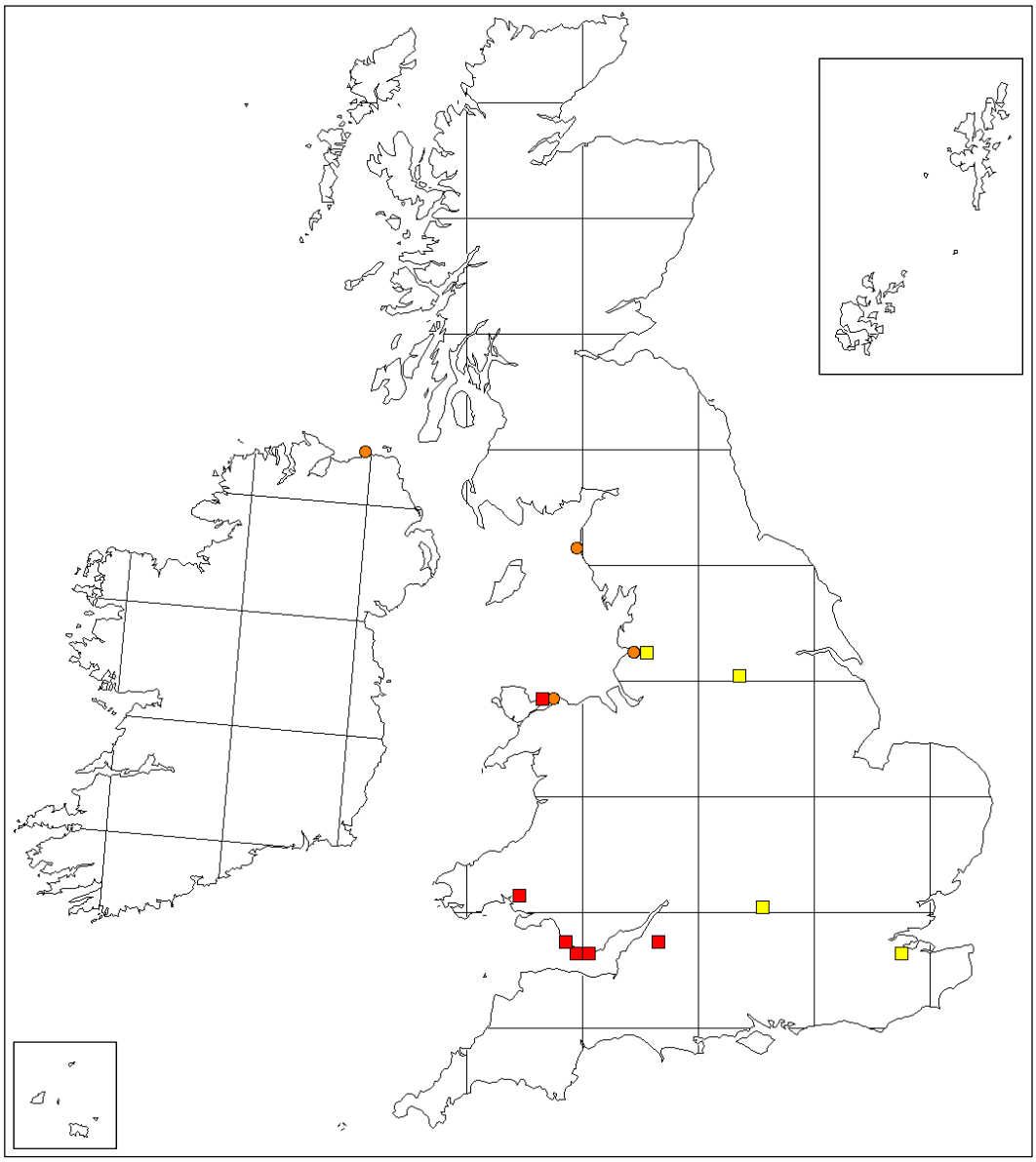

Figure 4: Distribution of *Metatrichoniscoides* species in Britain and Ireland.
■ *Metatrichoniscoides celticus* male; □ *Metatrichoniscoides leydigii* male;
● female *Metatrichoniscoides* species.

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Morphological and genetic confirmation of the millipede *Chordeuma sylvestre* C. L. Koch, 1847 new to Ireland

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Abstract

We report the millipede *Chordeuma sylvestre* C. L. Koch, 1847 for the first time from Ireland. We used morphology of male gonopods and DNA barcoding of the COI gene from two individuals to confirm the identification of one male and one female collected from the campus of University College Dublin. DNA barcoding revealed two mitochondrial haplotypes, implying that colonization was from multiple females or eggs from multiple females. To evaluate how likely it is that *C. sylvestre* arrived relatively recently in Ireland, we used species richness estimates and species accumulation curves to evaluate the completeness of the species list compiled during two previous periods of intensive millipede recording going back to 1971. Millipede recording in Ireland was far from complete during the period 1971 – 1984, with multiple species present but undetected. Recording was more complete during the period 1986 – 2005. The area within 20 km of the new *C. sylvestre* records was poorly recorded during the period 1986 – 2005, so we cannot rule out the possibility that *C. sylvestre* has been in Dublin for at least a few decades. However, the disjunct location of the current records compared to the species's known native range in northern France, the urban location of the current site, and the lack of records from the relatively intensive millipede recording in Ireland between 1986 and 2005 suggest that *C. sylvestre* is a recent anthropogenic introduction in Ireland.

Introduction

The millipede *Chordeuma sylvestre* C. L. Koch, 1847 is native to central Europe, and is known from a few locations in Great Britain (Gregory, 2016). It has not been previously recorded from Ireland. Kime (2004) did not consider *C. sylvestre* a habitat specialist and noted that it has been found in coniferous and deciduous woodlands, peat bogs, and moors, among other habitats. It therefore seems unlikely that *C. sylvestre* has been absent from Ireland because of environmental factors. Morphological identification of *C. sylvestre* requires examining adult males – females of *C. sylvestre* cannot be distinguished from females of the congener *C. proximum* Ribaut, which occurs in Ireland and Great Britain (Blower, 1985).

Here, we present records of *C. sylvestre* from Dublin, Ireland, including DNA barcoding identification of a female specimen for which morphological identification was not possible. To gain insight into whether *C. sylvestre* is a relatively recent introduction to Ireland or whether it has been present but undetected for many years, we examined Irish millipede records from 1971 to 2005. We evaluated the completeness of millipede species lists compiled during previous recording by using species accumulation curves and comparing estimated and observed species richness.

Methods

Specimen collection, preservation, and morphological examination

On 18 January 2020, the first author (WG) collected multiple millipedes from the campus of University College Dublin. Searching was done by turning and sifting leaf litter and soil with a small trowel and by hand, and collecting all millipedes encountered. Collected specimens were placed together into a vial with 70% isopropyl alcohol and stored at room temperature. On 6 March 2020 WG returned to the same location with the explicit purpose of looking for another *Chordeuma* specimen, and collected a female, which was placed by itself into a plastic vial and frozen (without being put in alcohol). The female specimen was kept frozen for three days until DNA extraction. All collected specimens were examined with a microscope using magnifications of 25 to 200 times. Male gonopods were dissected, slide mounted in Euparol, and photographed. Species identification was done by WG using Blower (1985) and the species pages on the British Myriapod and Isopod group website (BMIG, 2020, www.bmig.org.uk/home). Records with photographs were submitted to iRecord (www.brc.ac.uk/irecord/).

DNA barcoding

On 9 March 2020, tissue samples of about 4 or 5 segments, including legs, exoskeleton, and internal organs, were taken from both the male specimen that had been stored in 70% isopropyl for two months and from the female specimen that had been frozen for three days. The tissue samples were separately placed in 400 µl of 10% Chelex solution in a 1.5 mL tube (Eppendorf) and crushed using a pestle (Eppendorf), followed by the addition of 12 µl of proteinase K (20 mg/mL) to each tube. The tubes were briefly vortexed and then incubated at 56^{o} C for 2 hours. After incubation the samples were heated to 99^{o} C for 15 minutes, followed by centrifugation for 1 minute at 20,817 G, and 50 µl of DNA supernatant was removed from the sample and transferred to a new tube.

In order to amplify the *cytochrome oxidase I* (COI) gene, the primers LEPF1 [5-ATT CAA CCA ATC ATA AAG ATA T-3] and LEPR1 [5- TAA ACT TCT GGA TGT CCA AAA A-3] (Hebert *et al.*, 2004) were used. A 25 µl PCR master mix was prepared in a UV-sterilized hood and consisted of 3.125 µl Buffer (Kapa Biosystems), 1.25 µl dNTP (Invitrogen), 1.25 µl of each primer (10 µM) (Integrated DNA Technologies), 0.125 µl Taq polymerase (Kapa Biosystems), 17 µl water, and 1 µl of DNA extract. PCR conditions were as follows: initiation at 94^{o} C for 1 min, followed by 5 cycles of 94 ^{o} C for 40 s, 45^{o} C for 40 s and then 72^{o} C for 1 min, then 35 cycles of 94^{o} C for 40 s, 51^{o} C for 40 s and 72^{o} C for 1 min. The final elongation step was 72^{o} C for 5 min, after which samples were held at 4^{o} C. All PCR amplifications were carried out in a separate room from where DNA was extracted. Successful amplification was based on the presence of a band of the correct molecular weight in a 1% agarose gel after electrophoresis. Both samples amplified successfully and were sent for commercial Sanger sequencing (Macrogen).

Clean, unambiguous sequence was received for both samples, and the forward and reverse strands were aligned using Geneious version 10.2.3 (Kearse *et al*., 2012). Strand alignment and trimming resulted in a 674 bp consensus sequence for the male specimen and 662 bp for the female. The two sequences were then aligned using ClustalX version 2.1 (Larkin *et al*., 2007). Both sequences were then separately analyzed using BLAST (https://blast.ncbi.nlm.nih.gov/Blast.cgi) to find matching sequences in GenBank. Species identification of the two samples was based on sequence similarity to existing sequences on the BOLD website (https://www.boldsystems.org/), and further verified with distance trees generated via the BOLD website using the Kimura 2 parameter model.

Completeness of millipede recording in Ireland

We assessed the completeness of millipede recording on the island of Ireland (Ireland and Northern Ireland) in order to gain insight into how long *C. sylvestre* has been in Ireland. We downloaded records of millipedes between 1970 and 2016 from the Irish National Biodiversity Data Centre (NBDC, http://www.biodiversityireland.ie/ [downloaded 6 October 2017]). Millipede records held by the NBDC primarily came from the BMIG recording scheme (Biological Records Centre, 2017; Lee, 2006), but also included records submitted directly to the NBDC. To evaluate the completeness of millipede recording in Ireland, we estimated species richness using the improved Chao2 estimator (Chui, Wang, Walther & Chao, 2014) and the incidence-based coverage estimator (ICE) (Lee & Chao, 1994), and we graphed species accumulation curves showing the cumulative number of species detected as records were added chronologically and in random order. We estimated species richness and made species accumulation curves for two different time periods (1970 to 1985 and 1986 to 2005), and for both the entire island of Ireland and for the area within 20 km of the new location for *C. sylvestre*. The duration of the two periods during which we estimated species richness was different (14 years for the first period and 20 years for the second period) because the two periods were selected based on distinct periods of intensive recording effort (discussed below). Analyses were conducted in the R statistical programming software, version 3.6 (Chao, Ma, Hsieh, & Chiu, 2016; R Core Team, 2020; Wickham, 2017).

Results

New records of *Chordeuma sylvestre*

One male millipede was identified as *Chordeuma sylvestre* using Blower (1985). The pointed apex of the coxal pillar of the male was not visible *in situ* as described in Blower (1985), but was clearly visible after dissection (Fig. 1). The "bristly" flagellum and the pointed apex of the coxal pillar visible on the

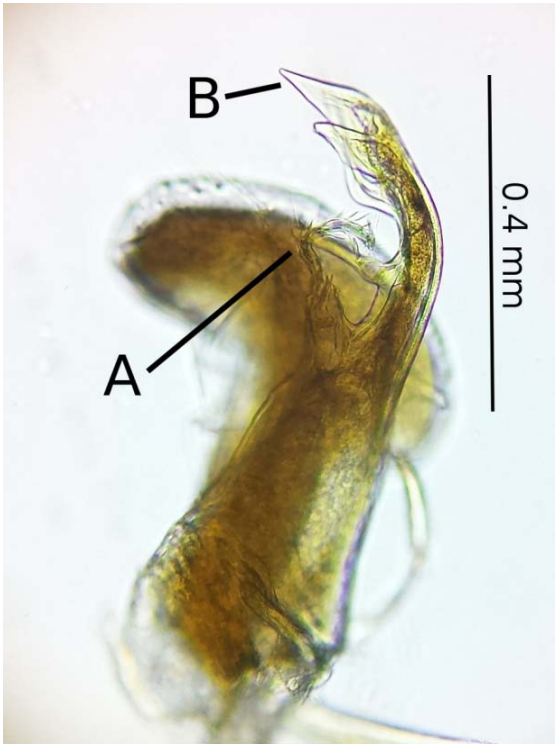

Figure 1: Gonopod of a male *Chordeuma sylvestre* collected in Dublin, Ireland on 18 January 2020, photographed through a microscope.
Note the "bristly" flagellum (A) and the pointed apex of the coxal pillar (B). !

dissected male gonopod (Fig. 1) appeared to match the drawings in Blower (1985) and ruled out *Chordeuma proximum*. The preliminary identification of *C. sylvestre* was confirmed by Steve Gregory and Paul Lee via iRecord, but Steve pointed out that there were other similar chordeumatid species in the Pyrenees that had not been recorded in the UK or Ireland and were therefore not in Blower (1985) and not on the BMIG website. We therefore used DNA sequencing of the COI gene to confirm the species identification. Details of records for both the male and female specimens are in Table 2.

Table 1: Observed and estimated species richness, and the total number of records of millipedes in Ireland during two periods of relatively intensive millipede recording. Species richness was estimated using two methods, the improved Chao2 and the incidence based coverage estimator (ICE). Estimates are given as the estimate with the 95% confidence interval in parentheses.

Time period	Number of records	Number of species recorded	Improved Chao2 estimated species richness	ICE estimated species richness
1971 – 1984	1416	33	36.01 (33.82, 43.99)	40.02 (34.72, 61.56)
1986 – 2005	3356	40	40.25 (40.02, 43.13)	40.24 (40.02, 43.75)

Table 2: New records of *Chordeuma sylvestre* C. L. Koch 1847 from the campus of University College Dublin, Co. Dublin, Ireland. Latitude and longitude use WGS84. Grid references use the Irish National grid.

Date	Latitude	Longitude	Grid reference	Sex	iRecord Record ID	GenBank accession number
18 January 2020	53.3107	-6.2220	O 185 304	Male	12916137	MT511609
06 March 2020	53.3108	-6.2219	O 185 304	Female	n/a	MT511610

DNA barcoding

The two COI sequences (from the male and female specimens) revealed four variable sites in the 662 bp overlap between the two sequences (99.4% match), implying both samples were of the same species, with two different haplotypes present. The BLAST result for the male showed a 99.09% match to a *C. sylvestre* sample collected in Bavaria, Germany (accession number HM888140.1), and the female sequence also showed a 99.09% match to the same sample. Sequences were also checked against the Barcode of Life Database (http://www.boldsystems.org/) (Ratnasingham & Hebert, 2007), which revealed the male sequence to match 99.08% to the same Bavarian sample as in GenBank, in addition to being 99.08% similar to an early release *C. sylvestre* sequence collected in Piedmont, Italy (Fig. 2). The female sample matched 99.39% to the Piedmont sample, as well as 99.08% similarity to the Bavarian sample (Fig. 3). Both consensus sequences were uploaded to GenBank (accession numbers: MT511609, MT511610).

Completeness of millipede recording in Ireland

Over 4,800 millipede records have been collected from Ireland since 1970. There is at least one millipede record from 598 hectads (10 km x 10 km grid squares) in Ireland, which is over half of all hectads. However, of the hectads with at least one record, the median number of records per hectad was five, indicating that even hectads with at least some recording remain poorly sampled. Lee (2006) provided a map of the number of records per hectad. The majority of the millipede recording was done in two periods of activity (Fig. 4), from 1971 to 1984 (with a peak in 1978) and from 1986 to 2005 (with a peak in 1994). ! !

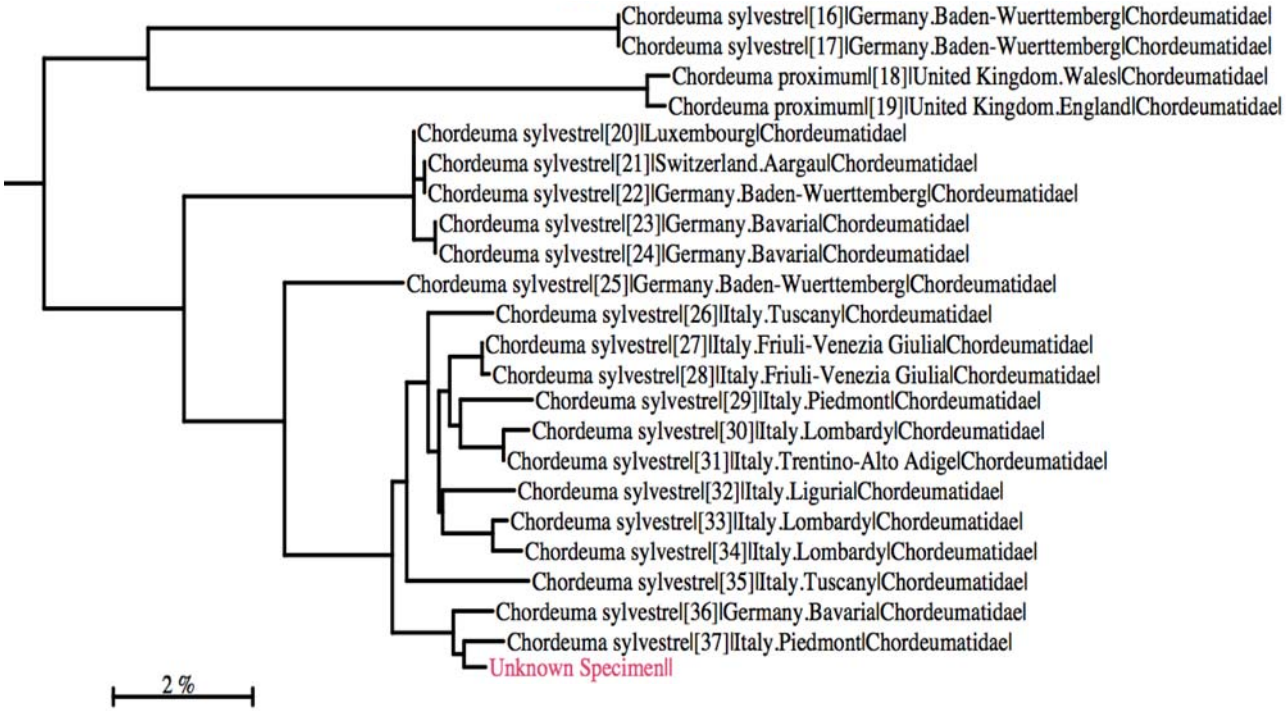

Figure 2: Distance tree generated via the BOLD website using the Kimura 2 parameter model for the male sample. The sequence generated for the male is highlighted in pink. Original figure generated by BOLD systems (Ratnasingham & Hebert, 2007) and modified to show only *C. sylvestre* sequences.

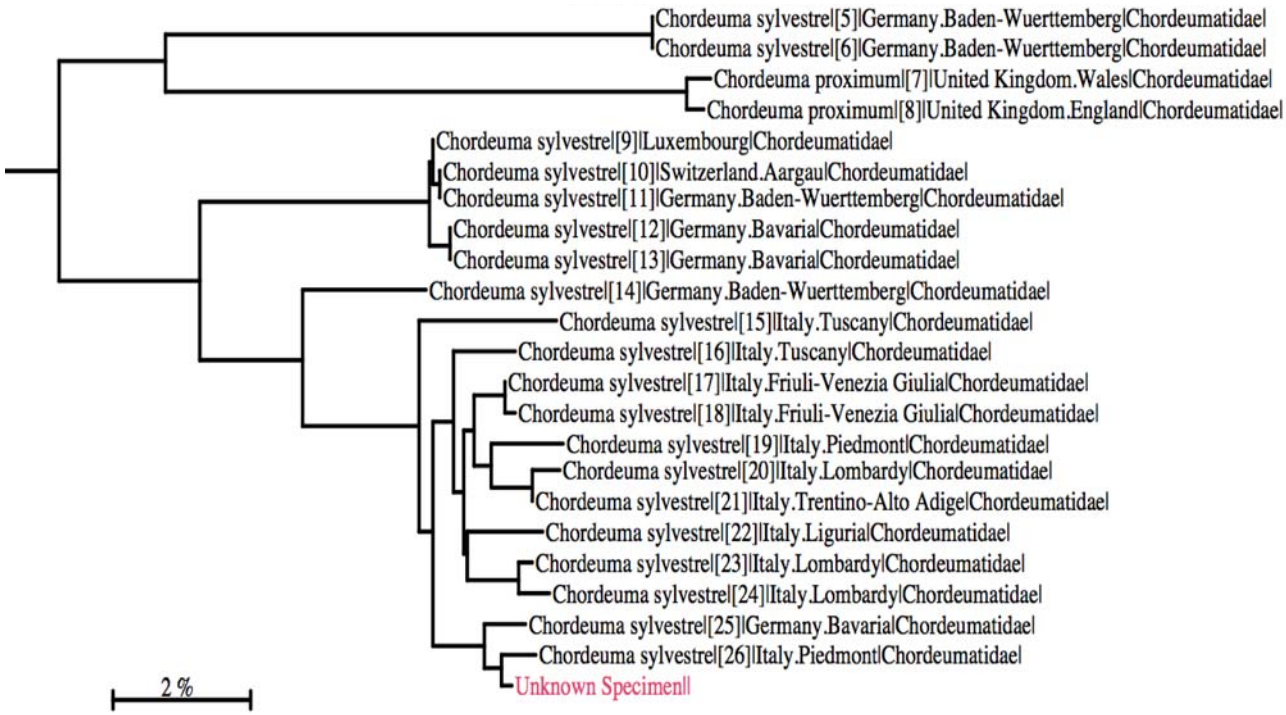

Figure 3: Distance tree generated via the BOLD website using the Kimura 2 parameter model for the female sample. The sequence generated for the female is highlighted in pink. Original figure generated by BOLD systems (Ratnasingham & Hebert, 2007) and modified to show only *C. sylvestre* sequences.

! !

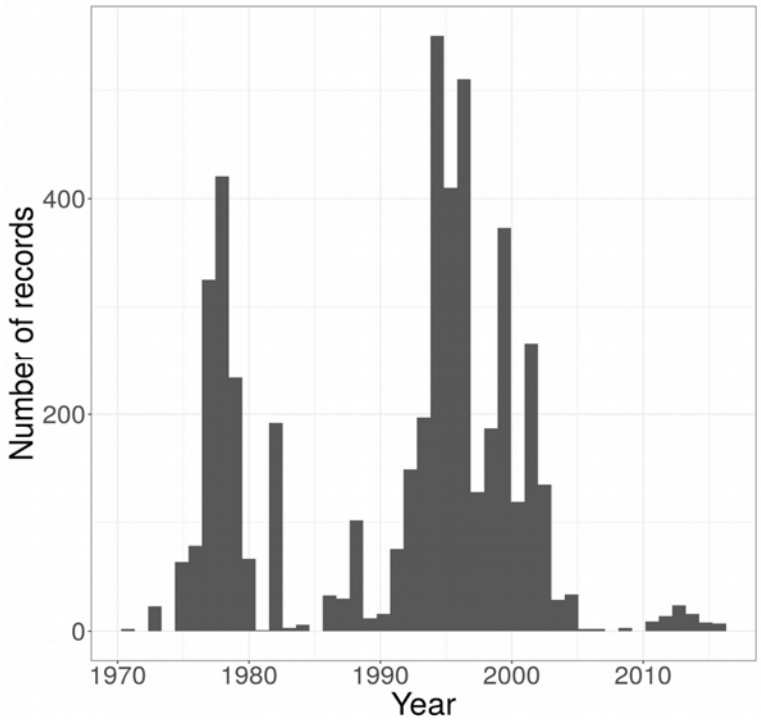

Figure 4: The number of millipede records from Ireland for the years 1970 through 2016. The majority of millipede recording in Ireland occurred during two distinct time periods, from 1971 to 1984 and from 1986 to 2006.

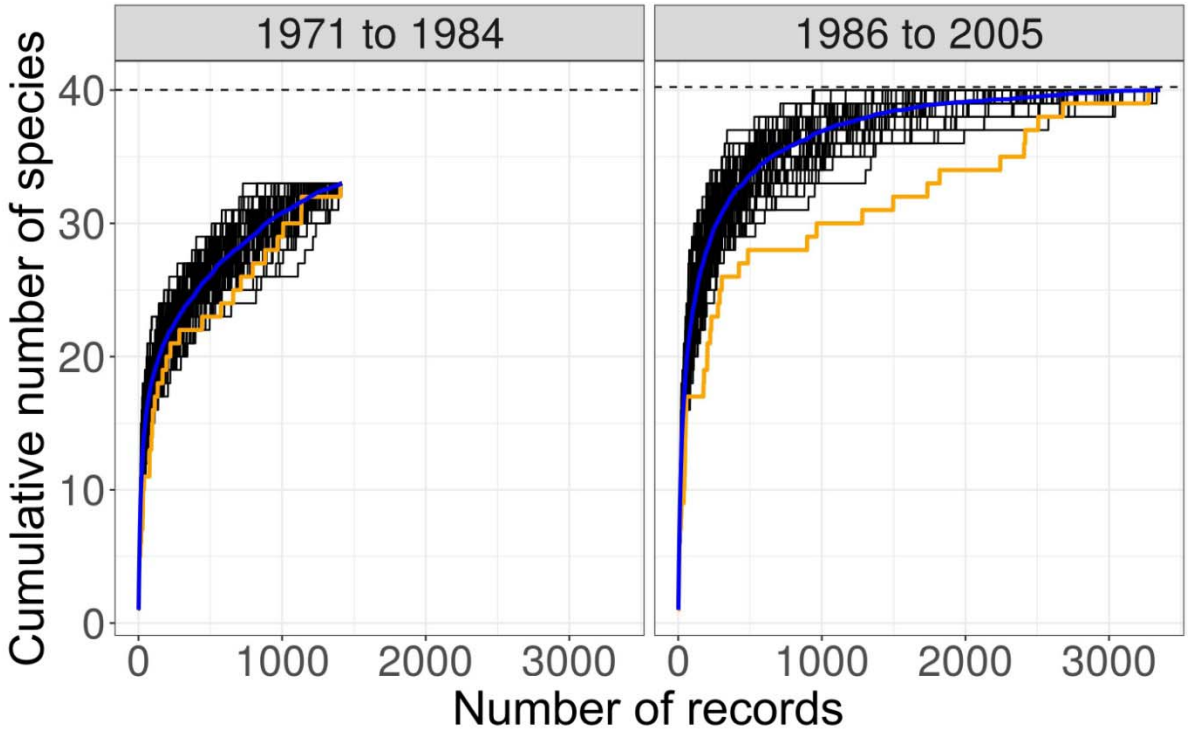

Figure 5: The number of millipede species detected in Ireland as a function of the number of records collected during two periods of intensive millipede recording. The orange line shows the number of species detected as records were added in chronological order. The black lines show number of species detected as records were added randomly for 100 permutations of record order. The blue line shows the mean number of species detected from the 100 randomly permuted orderings of records. The dashed horizontal line shows the ICE-estimated species richness for each time period.

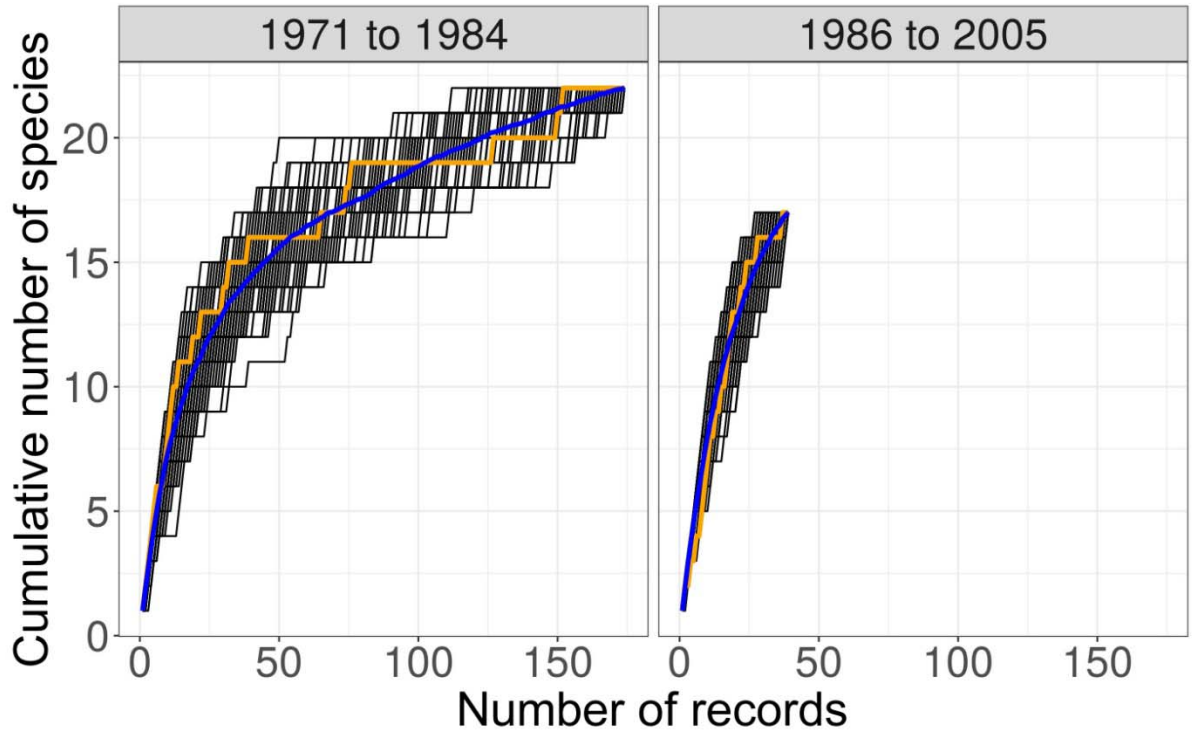

Figure 6: The number of millipede species detected within 20 km of the new *C. sylvestre* location in Dublin, as a function of the number of records collected during two periods of intensive millipede recording. The orange line shows the number of species detected as records were added in chronological order. The black lines show number of species detected as records were added randomly for 100 permutations of record order. The blue line shows the mean number of species detected from the 100 randomly permuted orderings of records. The species accumulation curves did not approach an asymptote in either time period, suggesting that there were many species present but unrecorded in the Dublin area during both time periods.

During the period 1971 to 1984, there were 1,416 records of 33 millipede species on the island of Ireland (Table 1). Using records from 1971 to 1984, the improved Chao2 species richness estimate was 36.0 (95% CI: 33.8, 43.9) and the ICE species richness estimate was 40.0 (95% CI: 34.7, 61.6) (Table 1). During the period 1986 to 2005, there were 3,356 records of 40 species on the island of Ireland. Using records from 1986 to 2005, the improved Chao2 species richness estimate was 40.3 (95% CI: 40.0, 43.1) and the ICE species richness estimate was 40.2 (95% CI: 40.0, 43.7) (Table 1). Species accumulation curves showed that the cumulative number of species detected as records were added approached an asymptote in the later period 1986 to 2005 but was still rising steeply during the earlier 1971 to 1984 period (Fig. 5).

The species accumulation curves and species richness estimates suggested that the list of species was far from complete from 1971 to 1984, with multiple species present but unrecorded in Ireland. The difference between the observed number of species (33) and the expected species richness (36 species using the improved Chao estimator or 40 using ICE) suggests that there were at least three to seven millipede species present but unrecorded in Ireland during the first period of intensive millipede recording from 1971 to 1984. During the second period of intense recording, from 1986 to 2006, over twice as many records were collected, and, unsurprisingly, the recorded species list seems to have been more complete. The estimated number of species present in Ireland from 1986 to 2006 is the same as the observed number (Table 1). The species richness estimates are minimum estimates, so it is possible that there were more than 40 species present during that time period. Nevertheless, the much closer match

between the observed and estimated species richness suggests that the species list from 1986 to 2005 was relatively complete.

Within 20 km of the location of the new Dublin *C. sylvestre* records, steeply rising species accumulation curves from both the 1971 to 1984 and 1986 to 2005 time periods indicated that there were many species present but unrecorded in the area during both time periods (Fig. 6).

Other species recorded from the same site

Other species recently recorded by WG from UCD campus in the same area where the *C. sylvestre* specimens were collected include: *Glomeris marginata* (Villers), *Brachydesmus superus* Latzel, *Polydesmus angustus* Latzel, *Polydesmus coriaceus* Porat, *Ophiodesmus albonanus* (Latzel), *Blaniulus guttulatus* (Fabricius), *Boreoiulus tenuis* (Bigler), *Ophyiulus germanicus* (Verhoeff), *Ophyiulus pilosus* (Newport), *Cylindroiulus punctatus* (Leach), and *Cylindroiulus britannicus* (Verhoeff). This is almost certainly not a complete list and continued recording will likely reveal more species from UCD.

Discussion

Millipede records from 1986 to 2005 appear to have provided a nearly complete list of millipede species in Ireland during that time. The species richness estimators we used provide only minimum estimates of the number of species present – the true number of species could be higher than the estimates. Because recording effort in the Dublin area (within 20 km of the new *C. sylvestre* records) has never been sufficient to compile a nearly-complete species list for that local area (Fig. 6), we cannot rule out the possibility that *C. sylvestre* has been present in Dublin for decades or longer. However, the location of the new records in an urban area, on the campus of a university that gets many international travelers and has relatively extensive landscaping, makes it seems more likely that *C. sylvestre* colonized Ireland within the past few decades. Another millipede species recently added to the Irish list, *Ophyiulus germanicus* (Verhoeff), was found in 2019 in Northern Ireland (Anderson, 2019) and on UCD campus (Gaul, 2020), and was subsequently discovered to have been in samples collected in Northern Ireland as far back as 2015 but mis-identified as *Tachypodoiulus niger* (Leach) (Anderson, 2019). It seems unlikely that *C. sylvestre* has been hiding undiscovered in collected samples in the same way that *O. germanicus* was. The most similar species to *Chordeuma sylvestre* known from Ireland, *Chordeuma proximum* Ribaut, has a relatively limited range in Ireland (Lee, 2006). There is therefore little opportunity for *C. sylvestre* to be mis-identified as a similar-looking, widespread species. On the other hand, morphological identification of *C. sylvestre* (and the similar *C. proximum*) requires an adult male specimen. Blower (1985) reported that only juveniles of *C. sylvestre* were found in August at sites in Great Britain, suggesting that adults may be difficult to find in Ireland during late summer and autumn, though GBIF (2020) has records of *C. sylvestre* from all months of the year in continental Europe. This unavailability of adults at certain times of year could have contributed to *C. sylvestre* remaining undetected in Ireland.

The known locations for *C. sylvestre* in Scotland are from gardens, where Gregory (2016) suggested it was introduced. Lee (2006) and Kime (2001) noted that populations of *C. sylvestre* in Cornwall might be part of the natural range of the species, which is found in northern France. The Dublin and Scottish locations appear even more disjunct from the native range than do the Cornish locations, supporting the idea that the species has been introduced to Dublin. There are no millipede species in Ireland that seem to be strongly limited to Dublin because of environmental conditions, and there is no reason to think that *C. sylvestre* in Ireland would be limited to Dublin by environmental constraints.

With the discovery of *C. sylvestre* in Dublin, at least four additional millipede species have been discovered living in the wild in Ireland since the last period of intense recording ended in 2005, the other three species being *Polydesmus asthenestatus* Pocock (Anderson, 2015), *Cylindroiulus*

apenninorum (Brölemann) (Anderson, 2018), and *O. germanicus* (Anderson, 2019). All of these species are somewhat synanthropic in Ireland and it seems likely they have been introduced to Ireland through the movement of plants or soil. At least one other species (the "Ikea millipede" *Xenobolus carnifex*) was found in a potted plant in Dublin but not subsequently recorded living in the wild (Barber, 2015).

Only one species, *Adenomeris gibbosa* Mauriès, was recorded in Ireland between 1971 and 1984 but not recorded from 1986 to 2005. It is possible that the species was lost from Ireland sometime after 1984. However, the records from before 1985 were from the Dublin area, and the species accumulation curves we constructed for the Dublin area (Fig. 6) found that millipede recording in the Dublin area was less complete between 1986 and 2005 than during the earlier 1971 to 1984 period. The 1 km grid squares from which *A. gibbosa* was recorded between 1971 and 1984 were not sampled between 1986 and 2005, and there was only a single record collected between 1986 and 2005 from the same 10 km grid squares in which *A. gibbosa* had previously been recorded. We therefore see no compelling evidence that any millipede species were lost from Ireland between the 1971-1984 and 1986-2005 periods, though our ability to detect a loss is limited given that the species list from the earlier period almost certainly did not include many species that were in fact present.

The number of species now recorded living in the wild in Ireland is 44, which is slightly higher than the upper 95% confidence interval of the species richness estimates for the number of species present between 1986 and 2005 (Table 1). However, this is not evidence for an increase in the number of millipede species in Ireland, because, while we can detect apparent additions of species, as reported here, the very incomplete recording since 2005 means that it is impossible for us to detect any loss of species since 2005. A third period of millipede recording, equaling or exceeding the recording effort from the 1986 to 2005 period, would give a better picture of whether the total number of millipede species in Ireland is changing, and would provide information about whether the addition of new species discovered since 2005 has been balanced by the loss of other species.

Identification of millipede species based on genetic evidence overcomes the limitation of adult males not being available during some seasons, as identification is possible for specimens of any age and sex (Savolainen *et al*. 2005; Spelda, Reip, Oliveira-Biener & Melzer, 2011). The cost of identifying species using COI barcoding is relatively low (approximately €9 per specimen if equipment is already available), and the skills and facilities for doing so are within reach even of undergraduate students at many universities.

The presence of two unique mitochondrial haplotypes implies at least two maternal lineages present in Dublin, which rules out colonization from a single pregnant female or a clutch of eggs from one female. We cannot rule out the possibility that *C. sylvestre* was introduced to Ireland from one of the British locations, because there were no sequences available in BOLD from the populations in Great Britain. The COI sequences of the Dublin *C. sylvestre* specimens clustered with a specimen from the Piedmont region in Italy and a specimen from Bavaria in Germany. However, there were few COI sequences available from the northern part of *C. sylvestre's* range (e.g. no sequences from Belgium or the Netherlands), and no sequences available from France. As more COI sequences from the northern and western parts of the range become available, it may be possible to attribute the source of the Dublin population to the region near the Alps if the Bavarian and Piedmont sequences remain the closest matches.

DNA barcoding of arthropods is becoming an increasingly useful tool for invasive species identification (Armstrong & Ball, 2005; Madden *et al.,* 2019), for narrowing the list of possible source populations (Harris *et al.*, 2017) and - in addition to sequencing of other nuclear loci - for the reconstruction of dispersal and colonization patterns (Guillemaud *et al.*, 2010). One potential drawback is that using genetics to discover a source population requires that the source population has itself been sequenced. This is problematic for poorly recorded taxa such as millipedes that are dispersed anthropogenically,

because there will likely always be undiscovered and unsequenced populations. However as projects such as the Barcode of Life Database continue to increase the size of the COI database, this issue will become less limiting.

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Brachyiulus lusitanus Verhoeff, 1898 new for the UK from the Eden Project (Diplopoda: Julida: Julidae)

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Abstract

The millipede *Brachyiulus lusitanus* Verhoeff, 1898 was first reported new for the UK from the Eden Project, Cornwall in 2009 based on a single male specimen. Subsequently, additional material has been collected. A brief description with figures is provided to enable identification and details of habitats and microsites inhabited is given. This widespread European species is probably a recent colonist to Eden Project, aided by human activity, and additional British sites may await discovery.

Key words: Julida, Julidae, *Brachyiulus lusitanus*, new for UK, identification.

Introduction

Eight species of *Brachyiulus* are known in Europe (Kime & Enghoff, 2017), but until 2009 just a single species, *Brachyiulus pusillus* (Leach, 1815), was recorded in Britain and Ireland and known to be widespread and relatively common (Lee, 2006). Being of characteristic appearance it was often identified in the field by experienced recorders, without microscopic examination. However, in 2009 a second species of identical appearance, *Brachyiulus lusitanus* Verhoeff, 1898, was recorded by Helen Read from the outdoor educational/ornamental gardens of the Eden Project, Cornwall (17.iv.2009, SX0455, VC1) during BMIG's annual field meeting to the county (Barber, Gregory & Lee, 2010).

This initial record was based on a single male specimen, confirmed by Henrik Enghoff. Subsequently, both *B. lusitanus* and *B. pusillus* have been recorded from the Eden Project on several occasions by the author and others. In 2010 much additional material of *B. lusitanus* (and *B. pusillus*) was collected from the outdoor biome and more recently in 2018 and 2020 from the Mediterranean Biome (Table 1).

A brief description with figures of *B. lusitanus* based on specimens collected from Eden Project is provided below to allow separation of the two *Brachyiulus* species now known to occur in Britain.

Table 1: Observations of *Brachyiulus* species at Eden Project

Species	No. males	Date	Biome	Recorder
Brachyiulus lusitanus	1	17.iv.2009	Outdoor Biome (gardens)	Read, H.J.
	9	18.iv.2010	Outdoor Biome (gardens)	Gregory, S.J.
	1	ii.2018	Mediterranean Biome	Lugg, K.
	1	21.iii.2020	Mediterranean Biome	Gregory, S.J.
	1	21.iii.2020	Mediterranean Biome	Harding-Morris, J.
	2	31.x.2020	Mediterranean Biome	Telfer, M.G.
Brachyiulus pusillus	1	17.iv.2010	Foundation Office flowerbed	Gregory, S.J.
	1	18.iv.2010	Outdoor Biome (gardens)	Gregory, S.J.
	2	18.iv.2010	Mediterranean Biome	Gregory, S.J.

Figure 1: *Brachyiulus lusitanus* male, live specimen from Mediterranean Biome.
Specimen collected by James Harding-Morris, March 2020 (image © James Harding-Morris)

Identification

Brachyiulus lusitanus (Fig. 1) is identical in general appearance to *B. pusillus* with two dorso-lateral yellow/cream stripes running along the entire length of the body and the preanal ring bearing a very short caudal projection (which is easily overlooked). Thus, using Blower (1985) it will readily key to *B. pusillus*. Only mature males of the two species can be identified and are readily separated by the shape of their respective gonopods.

The gonopod of *B. lusitanus* has a very distinctive shape (Fig. 3). The phylacum of the solenomerite is well developed, lamellar, and bears numerous wrinkled ridges. Thus, in lateral view the gonopod widens distally to give a broad rounded appearance. This contrasts with *B. pusillus*, which a lacks a well-developed phylacum, where the gonopod tapers gently from its base towards a gradually narrowed distal tip (Blower, 1985, pg. 185, fig. 58C).

The gonopods of *Brachyiulus* species are not fully retracted into the body and remain protruding slightly (Fig. 2A-C). Because of the differences in the relative proportions of the gonopods described above it is therefore possible to identify the two species without dissection. The broad striate phylacum of *B. lusitanus* is clearly visible in lateral view (Fig. 2B), in contrast to the relatively slender and tapered gonopod of *B. pusillus* (Fig. 2C).

Location, habitat and associated species

In the UK, *Brachyiulus lusitanus* has only been recorded from the Eden Project in Cornwall, where it has been recorded in the Outdoor Biome (outside gardens) and within the Mediterranean Biome (Table 1). First recorded by Helen Read in 2009 from the outdoor vegetable garden (Barbour (sic), 2009; Barber *et al*., 2010), it was readily re-found there in 2010 and proved to be more widely distributed with additional specimens collected from beside nearby ditches and under stones and dead wood around the

main entrance. Associated millipedes were *Brachydesmus superus* Latzel, *Cylindroiulus britannicus* (Verhoeff), *Cylindroiulus latestriatus* (Curtis), *Ophyiulus pilosus* (Newport) and *Polydesmus inconstans* Latzel. It is of note that of ten males collected, only one proved to be *B. pusillus*, while the other nine were *B. lusitanus* (in addition to a number of unidentified females). A male *B. pusillus* was also collected from an ornamental flower bed outside the Eden Project Foundation Offices.

Figure 2: *Brachyiulus* males, preserved specimens from Eden Project.
A) *B. lusitanus*, anterior body rings showing protruding gonopods (arrowed). Specimen collected from Mediterranean Biome, SJG leg., March 2020; B) Same specimen, close up of un-dissected gonopds showing phylacum. C) *B. pusillus*, close up of un-dissected gonopods (note lack of phylacum). Specimen from Outdoor Biome (gardens), SJG leg., April 2010.

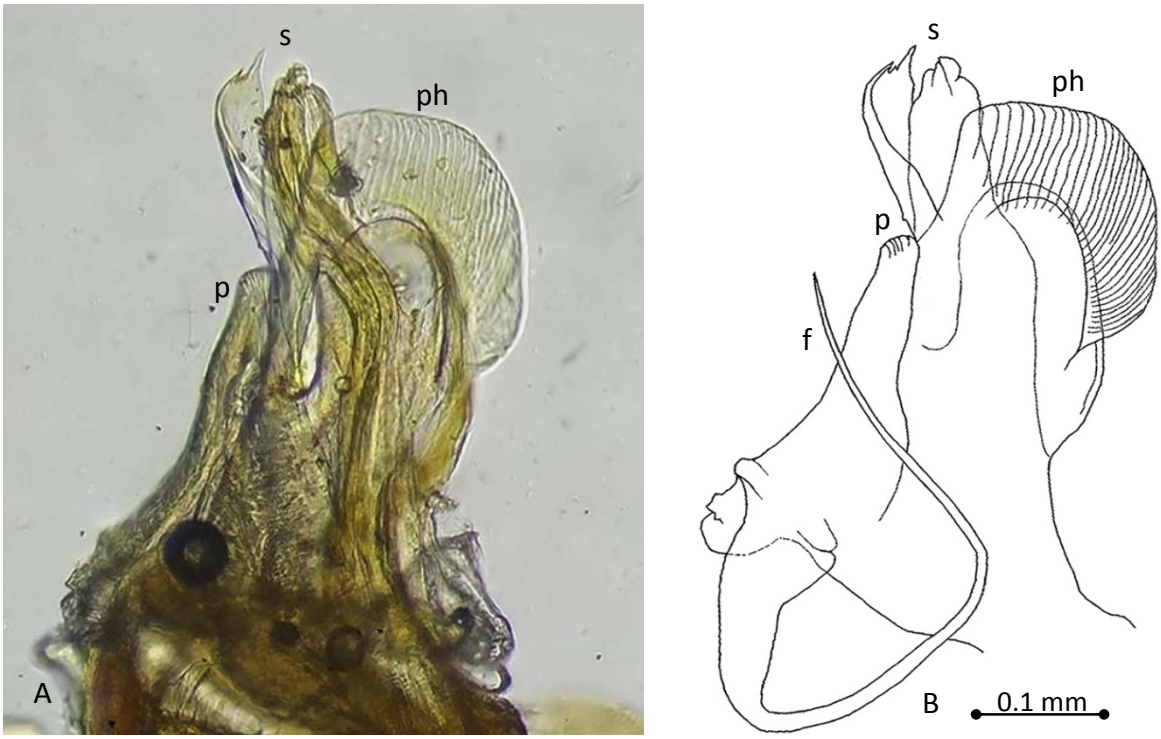

Figure 3: *Brachyiulus lusitanus* male gonopod, internal view.
Specimen from Outdoor Biome (gardens), SJG leg., April 2010. A) Specimen cleared in euparal. B) Sketch of same specimen. p - promerite, s - solenomerite, ph - phylacum, f - flagellum.

In 2010 *B. lusitanus* was not collected from the Mediterranean Biome despite extensive searching, although two males of *B. pusillus* were recorded. However, in 2018 and 2020 male specimens of *B. lusitanus* were recorded from inside the Mediterranean Biome (Table 1). One male, collected in March 2020 (by the author) was found under a piece of dead wood associated with *Cylindroiulus britannicus* (Verhoeff) and *C. truncorum* (Silvestri). In 2018 and 2020 *B. pusillus* was not found in the Mediterranean Biome. It is possible that *B. lusitanus* has expanded its range within Eden Project since 2010 and colonised the Mediterranean biome. It is unfortunate that the Outdoor biome (gardens) was not surveyed in 2018 nor 2020 to confirm its continued existence there.

In light of the discovery of *B. lusitanus* at Eden Project the author has examined his personal voucher collection of *B. pusillus*, which comprises nine tubes from Oxfordshire, and BMIG's basic and research collections (Harper, 2007) of ten tubes from south Wales. All samples that contain mature male specimens have proved to be *B. pusillus*. In addition, Helen Read (pers. comm.) confirms male *B. pusillus* from specimens collected in Anglesey (north Wales), Lancashire (north-west England), Dumfries & Galloway (south-west Scotland), Buckinghamshire and Kent (south-east England).

Distribution and habitats elsewhere

Brachyiulus lusitanus is native to, and widely distributed across, central and southern Europe, from Italy, north to Germany and Czech Republic, and east to Greece, Bulgaria and Romania, with an isolated record from southern Spain (Kime & Enghoff, 2017). It also occurs in North Africa and has been introduced to Australia and North America.

It has been recorded from a wide variety of habitats, including woodland (under bark and moss), meadows, arable fields, vineyards and parks.

Discussion

Brachyiulus lusitanus is clearly well established at the Eden Project, but so far has not been recorded from other sites in the UK. It is most likely a non-native accidental import introduced via the horticultural trade. Thus, it is considered by Lee (2015) to be 'Not Applicable (NA)' for assessment of conservation status under the IUCN Guidelines in his update of the national threat status of British millipedes.

Further work is needed to ascertain whether *B. lusitanus* is more widely distributed across the UK, both by examination of existing voucher specimens and by collection of additional material. It is possible that *B. lusitanus* may be found at other heated 'Mediterranean' glasshouses in Britain and Ireland, or even outdoors in synanthropic sites, such as in ornamental gardens. Thus, when *Brachyiulus* are encountered in future, male specimens should be retained for microscopic examination.

Acknowledgements

I thank Tim Petitt and Marc Mappley of the Eden Project for allowing un-restricted access in the biomes, without which these surveys would not have been possible. I am very grateful to James Harding-Morris for organising the survey in March 2020 and for allowing the use of his image of a live male *Brachyiulus lusitanus* collected during that survey. Keith Lugg and Mark Telfer kindly allowed their records of this species to be included in this paper.

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Observations of millipedes in Kitley cave, Devon, including the first confirmed British record of *Polydesmus asthenestatus* Pocock, 1894

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On 21st November 2020, a visit to several caves in the Yealm Valley, close to Plymouth, was undertaken to carry out some net sampling for stygobitic Crustacea. Amongst these sites was Kitley Cave (SX575512, VC 3) once developed as a show cave in the 1970s and 80s, but which has been closed since 2000 (Fig. 1). During this visit large numbers of pale millipedes were noted throughout the cave on most moist stalagmite and rock surfaces, with concentrations on occasional piles of bat guano. The specimens superficially resembled slightly darkened versions of the common cavernicolous species *Brachydesmus superus*. Specimens (including an adult male) were sent to Helen Read, who identified them as *Polydesmus asthenestatus*, from the description and figures in Anderson (2015), the first confirmed records of this species from Britain. The identification was confirmed by Roy Anderson from photographs.

Figure 1: Kitley Cave, main chamber (image Lee Knight)

Polydesmus asthenestatus is native to north west Italy and Corsica (Kime and Enghoff, 2011), but is now well-established in Ireland, mostly around Belfast and a site south of Dublin. Within its native range, and at many Irish sites, it appears to favour wet woodland, primarily riparian alder, although it does show a small degree of synanthropic behaviour (Anderson, 2015). The entrance to Kitley Cave is within 50m of the River Yealm, to which it is hydrologically connected, although the surrounding habitat is primarily mixed deciduous, rather than alder carr. There is a possible previous record of *P. asthenestatus* from Lamorran House Gardens, near Falmouth, Cornwall by Steve Gregory in September 2020, although only sub-adult males have been obtained from this site so far (Gregory, 2021).

Figure 2: *Polydesmus asthenestatus* in Kitley Cave.
A) Specimens on bat guano, November 2020; B) Close up of an individual (images Lee Knight)

Anderson (2015) mentions that *P. asthenestatus* is resistant to low temperatures and very much a winter species, with sub-adults and adults active from September through May, with its activity in surface leaf litter during two cold winters in Ireland supporting this. However, it might be the case that caves, particularly in the warmer southern parts of Britain, could potentially represent good habitats for the initial colonisation of southern European species, as they provide a relatively stable environment, with significant buffering from temperature fluctuations on the surface, especially in winter. Several other Mediterranean species have colonised Devon caves and mines (analogous to man-made caves) in recent decades, including the Bloxworth snout moth (*Hypena obsitalis*), now a common overwintering member

of the parietal community in many coastal caves around Torbay, and the thysanuran *Trigoniophthalmus alternatus*, common in many Devon caves, both coastal and inland (Proctor 2006). Coastal caves have also been suggested by Mosely and Proctor (2016) to potentially offer colonisation routes and inland expansion for several invertebrate species, including the Lusitanian woodlouse *Trichoniscoides saeroeensis*, first recorded in Britain from a mine adit near Morecambe Bay (Sheppard 1968, 1971, Moseley 1970) and which is now known to occur in several caves and mines around the British coastline. Another introduced north Italian millipede *Polydesmus barberii* has an established breeding colony in Corbridge Cave, near Brixham (Proctor 2012). Substantial numbers are usually observed in the vicinity of a single large boulder in the entrance chamber, covered in tree roots and appear to be limited to this area. There are also surface records of this species in Devon from the Plymouth and Dartmouth areas (Bolton and Jones 1996, Bolton 1996, Lee 2006).

Moseley (2016), describing the fauna of coastal caves and mines on the Isle of Man and around Morecambe Bay lists a group of soil-dwelling invertebrates, termed seasonal transients, that migrate down into the deeper layers of the soil in preparation for winter and in doing so might find their way into cave and mine passages. Within this group he included geophilid centipedes, root weevils and julid millipedes, thus, it is not inconceivable that many soil-dwelling myriapods could end up in subterranean habitats as part of this migratory movement. During a second visit to Kitley on 20th February 2021, specimens of *Polydesmus asthenestatus* were notably scarce throughout the cave compared to the previous visit, being limited to a stalagmite boss, fed by a trickle of water from fissures in a roof hollow, and a couple of small guano piles. Whereas previously specimens in the 100s were present throughout the cave just, 10-20 were observed on this occasion. This second visit also noted at least 15 specimens of *Tachypodoiulus niger* and a single male *Chordeuma proximum* on the roof of the same alcove, although they were confined to dry sections of the roof, whereas the *P. asthenestatus* appeared to prefer the damp guano piles or were present on the thin film of water trickling over the stalagmite. Mosely (2016) also recorded *T. niger* in caves and mines around Morecambe Bay, noting seasonal fluctuations in its occurrence consistent with autumn and spring migration from and to the surface. This species is also known from other caves and mines across Britain and Ireland, although mostly from the threshold zone and it is not believed to be particularly cavernicolous, although in Germany it penetrates much further into caves, including well into the dark zone and is considered a eutroglophile. The specimens in Kitley were certainly within the dark zone and it is possible that this species might be more widely distributed in British subterranean habitats than currently known. According to the database of subterranean biological records held by the British Cave Research Association (the *Hazelton Database*) *C. proximum* has only been recorded at one other subterranean locality, Godstone Mine in Surrey and is not regarded as associated with underground habitats.

In addition to its millipede fauna, Kitley is of significant biospeleological interest as the aquatic sampling (the original purpose of the November visit) also recorded the stygobitic amphipods *Niphargus aquilex* and the British endemic *Niphargus glenniei*, as well as the subterranean diving beetle *Hydroporus ferrugineus*. This latter species is believed to have a subterranean larval stage and is more commonly associated with springs, although it does occur in several caves, mostly in the Yorkshire Dales and Peak District, with the Kitley record being the only cavernicolous record in southern Britain.

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Observations of *Trichoniscoides sarsi* Patience, 1908 (Isopoda: Oniscidea: Trichoniscidae) on the west coast of Britain

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Abstract

Here we report two observations of *Trichoniscoides sarsi* Patience in western Britain from a synanthropic allotment in Bristol city and from semi-natural coastal habitat near Clevedon. We highlight possible confusion between coastal observations of *T. sarsi* and its congener *T. saeroeensis* Lohmander, which has been widely recorded around the entire British coastline (Gregory, 2009). These findings emphasise that all red-eyed *Trichoniscoides* found on the coast of Britain cannot be assumed to be *T. saeroeensis*, and reliable determination of all *Trichoniscoides* species can only be based on examination of male specimens, regardless of where specimens are found.

Key words: Isopoda, Oniscidea, *Trichoniscoides sarsi*, Britain, Distribution, Habitat.

Introduction

The elusive woodlouse *Trichoniscoides sarsi* Patience appears to have an odd distribution in Britain and Ireland. The map published in Gregory (2009) shows a distinct band of localities stretching across eastern England from Kent to Suffolk and then extending westwards across central England through Leicestershire and into Shropshire with an isolated record near Dublin, eastern Ireland (yellow circles in Fig. 4). Subsequently this distribution pattern has been reinforced by the discovery of *T. sarsi* in Bedfordshire, Derbyshire, Lincolnshire and Essex (Richards, 2016; Gregory, 2018; 2019b). However, the discovery of *T. sarsi* on the Scottish east coast of Kincardineshire (Davidson, 2011), some 400 km north of previously known Leicestershire records, and more recently in a garden in west Lancashire (Gregory, 2019a) suggest a much wider distribution (orange circles in Fig. 4).

Here we report two observations of *T. sarsi* in western Britain from a synanthropic allotment in Bristol city and from semi-natural coastal habitat near Clevedon. We highlight possible confusion between coastal observations of *T. sarsi* and its congener *T. saeroeensis* Lohmander, which has been widely recorded around the entire British coastline (Gregory, 2009).

Discovery

On 07.xi.2020 FA collected two specimens of red eyed trichoniscid from beneath a limestone rock on the upper beach at Clevedon (ST38827007, VC6). Macrophotographs were taken in-situ (Fig 1A), and the specimens preserved and keyed to *Trichoniscoides sp*. following Hopkin (1991) (Fig 1B), then sent to SJG for examination. Both specimens were female, so species was unclear. However, SJG felt these may both be *T. sarsi*, as the eyes were quite dark red and 'smudgy' (as clearly seen in Fig. 1A); they are usually pinkish and more distinct in *T. saeroeensis*. SJG said he would like to see a male to be sure, and so FA returned to the area (ST39317044) (Fig. 3) and collected five more specimens on 22.xi.2020, which were forwarded to SJG for determination. SJG confirmed two males (and three females) of *T. sarsi*, noting, in addition to the shape of the male pleopods, the hooked spur on the merus of pereiopod 7 (Fig. 2), which is absent in *T. saeroeensis* and *T. helveticus* (Carl).

Figure 1: *Trichoniscoides sarsi* female specimen from Clevedon.
A) Live macrophotograph in-situ (image © Frank Ashwood). B) Freshly preserved specimen in 80% ethanol (image © Steve Gregory).

Figure 2: ***Trichoniscoides sarsi* male pereiopod 7.** Specimen collected from Clevedon. Note prominent hooked spur at base of merus (arrowed) (image © Steve Gregory).

Additionally, FA collected a specimen of a small, red-eyed, trichoniscid woodlouse from within clayey topsoil on an allotment in Horfield, Bristol (ST600763, VC34) on 06.xi.2020. The specimen was forwarded to SJG for determination and confirmed as male *T. sarsi*. Other species found on the same allotment plot were *Metatrichoniscoides celticus* Oliver & Trew (the first English record; Ashwood & Gregory, 2021), *Platyarthrus hoffmannseggii* Brandt, *Armadillidium nasatum* Budde-Lund, *Oniscus asellus* L., *Porcellio scaber* Latreille and *Philoscia muscorum* (Scopoli). All specimens of *T. sarsi* have been retained in the personal collection of FA, and record details have been submitted to the BMIG Non-marine Isopod Recording Scheme via iRecord (*www.brc.ac.uk/irecord*).

Discussion

Currently three species of *Trichoniscoides* have been recorded from Britain and Ireland (Gregory, 2009); *T. helveticus*, *T. saeroeensis* and *T. sarsi*. *Trichoniscoides helveticus*, a species typical of semi-natural habitats on calcareous soils, is recorded from a handful of sites in central southern England. *Trichoniscoides sarsi* and *T. saeroeensis* are discussed in more detail below.

Trichoniscoides species can only be reliably separated by dissection of a male specimen (Oliver & Meechan, 1993), especially in the case of preserved specimens that have lost their body pigmentation. However, there do appear to be subtle differences in body and especially eye pigmentation of live specimens of *T. saeroeensis* when compared to *T. sarsi* and *T. helveticus*. In live material of *T. saeroeensis* the ommatidium is usually pinkish and the pigment 'eye' boundary usually more clearly defined (SJG, pers. obsv.; also see images at *www.bmig.org.uk/species/Trichoniscoides-saeroeensis*). In live material of *T. sarsi* (and also *T. helveticus*) the ommatidium is typically infused with dark red pigment with a diffuse spreading margin and the body tends to be more heavily 'flushed' with orange

Figure 3: Habitat of *Trichoniscoides sarsi* on Clevedon coastline
A) Upper coastline location from which specimens were collected; B) Limestone rock microhabitat. (Images © Frank Ashwood).

pigment (e.g. see images at *www.bmig.org.uk/species/trichoniscoides-sarsi*). The latter description is more akin to the original female specimens photographed by FA from the Clevedon coast (Fig. 1 A-B), and therefore, in SJG's opinion, more likely to be *T. sarsi* or *T. helveticus* (two species typically found inland, Gregory, 2009), rather than the 'coastal' *T. saeroeensis*. The additional material, including

males, that were collected by FA confirmed this suspicion. However, the pigmentation differences are subtle, and unlikely to be 100% reliable; thus determination should always be confirmed by examination of a male specimen (as figured in Oliver & Meehan, 1993). In addition, *T. sarsi* males have a hooked projection at the base of the merus of pereiopod 7, which can be seen without dissection (Fig. 2; also figured in Gregory, 2012) and is absent in males of *T. saeroeensis* and *T. helveticus*. *Trichoniscoides saeroeensis* males may be readily identified by the conspicuously slender and elongated endopod 2 (Oliver & Meechan, 1993, pg 35, fig. 9B), which can be seen without dissection (these are short and stout in *T. sarsi* and *T. helveticus*; *ibid*, fig. 9C-D).

Trichoniscoides sarsi occurs widely across England with an isolated coastal record in eastern Scotland, (Fig. 4). Almost all records are from inland synanthropic sites, such as old gardens or churchyards in the environs of towns and villages (e.g. Daws, 1994; 1995; Richards, 2016; Gregory, 2018; 2019a: 2019b). However, a few records have been from coastal habitats in eastern Britain. This includes the Kincardineshire record (Davidson, 2011), where specimens were collected from beneath stones embedded in clayey soil at the base of the sea cliff (and also from a cliff-top cemetery above). In Kent, south-east England, *T. sarsi* has been collected from beside the tidal estuary of the River Medway in Kent, beneath stones embedded in clayey soil covered with strandline debris (Gregory, 2012). This latter site, where it was found with the Nationally Rare *Metatrichoniscoides leydigii* (Weber), is akin to habitats in the Netherlands where both species occur as native species (Berg *et al.*, 2008). Until now *T. sarsi* was previously un-recorded from south-west England.

Trichoniscoides saeroeensis is predominantly coastal, typically occurring along the upper shore, but also found inside caves and mines and on the summits of mountains in coastal limestone areas (Gregory, 2009). Unfortunately, it appears that many records of *T. saeroeensis* have been simply based on field observations of 'red-eyed' coastal woodlice (Non-marine Isopod Recording Scheme dataset included within Gregory, 2009). On a few occasions, microscopic examination of male specimens has shown that *T. sarsi* also occurs on the eastern coast of Britain (Gregory, 2009; 2012; Davidson, 2011) (Fig. 4). Thus, Gregory (2012) suggested the possibility that *T. sarsi* may have been overlooked on the eastern coasts of Britain where the 'coastal' *T. saeroeensis* is widely recorded (Gregory, 2009). Indeed, *T. sarsi* is common along the Netherlands and Belgian coastline on the opposite side of the North Sea, where *T. saeroeensis* has never been recorded (Berg *et al*., 2008; De Smedt *et al*., 2020).

It is possible that *T. sarsi* and *T. saeroeensis* occupy different niches, however there are too few records available to draw reliable habitat preference information. Thus, additional field observations, including microhabitat details, are needed to answer this. However, we can now confirm that *T. sarsi* occurs on the coastline of south-west England. Given this observation we re-iterate the possibility that *T. sarsi* may have been overlooked (and mis-identified as *T. saeroeensis*) at some sites around the entire British coastline (not just the eastern coast). However, this may not be true everywhere. For example, in The Lothians (south-east Scotland) where males have been routinely examined, *T. sarsi* has not been found (Warren Maguire, pers. comm. to SJG). What is clear is that it cannot be assumed that all pallid orange-flushed red-eyed woodlice found on the coast of Britain are *T. saeroeensis*. As such, reliable determinations of all *Trichoniscoides* species can only be based on examination of male specimens, regardless of where they are found.

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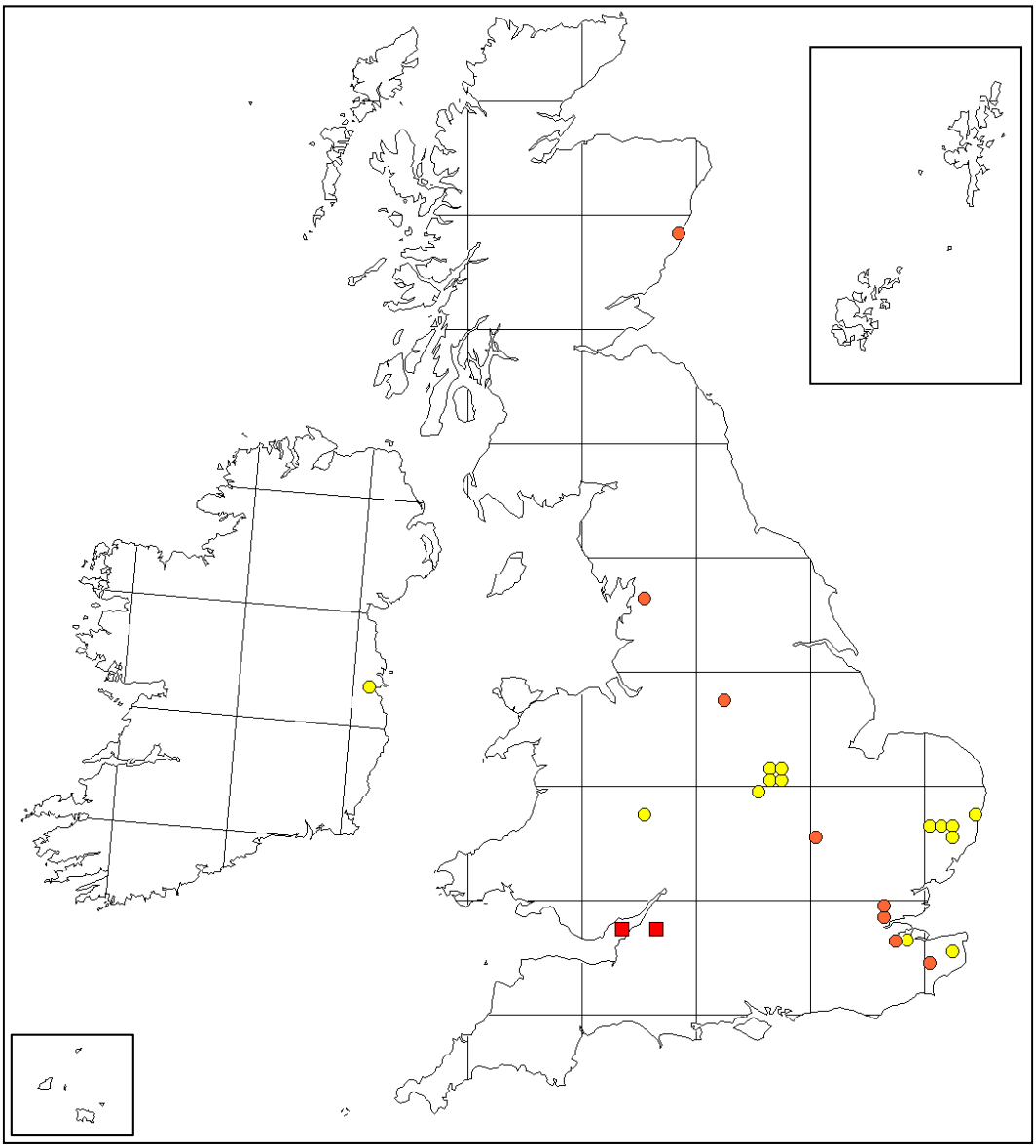

Figure 4: **Distribution map for *Trichoniscoides sarsi* Patience in Britain and Ireland.**
Based on records of male specimens submitted to the BMIG Non-marine Isopod Recording Scheme.
Records up to 2007 (as published in Gregory, 2009); Records from 2008 to 2020;
Records reported herein.

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Confirmation of the presence of *Philoscia muscorum* (Scopoli, 1763) (Isopoda: Oniscidea: Philosciidae) in the Iberian Peninsula

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Abstract

The presence of *Philoscia muscorum* (Scopoli, 1763) in the Iberian Peninsula has been questioned by some authors in the past. New data from northern localities in Spain confirmed the species in the Iberian Peninsula. Additionally, new ecological data and sympatry with *Philoscia affinis* Verhoeff, 1908 are reported. Finally, figures on the morphology of *P. muscorum* and *P. affinis* are provided.

Key words: *Philoscia muscorum*, *Philoscia affinis*, Asturias, Lugo, sympatry, habitat diversity

Resumen

La presencia de *Philoscia muscorum* (Scopoli, 1763) en la península ibérica ha sido cuestionada por algunos autores en el pasado. Nuevos datos procedentes de localidades situadas al norte de España permitieron confirmar la especie en la península ibérica. Además, se reportan nuevos datos ecológicos y simpatría con *Philoscia affinis* Verhoeff, 1908. Finalmente, se proporcionan figuras sobre la morfología de *P. muscorum* y *P. affinis*.

Palabras clave: *Philoscia muscorum*, *Philoscia affinis*, Asturias, Lugo, simpatría, diversidad de hábitats

Introduction

Philoscia Latreille, 1804 is a woodlouse genus belonging to the family Philosciidae that originally included almost 200 species (Schmalfuss, 2003; Boyko *et al.,* 2008). Certain species were described attending to minor criteria, many of them later synonymised or transferred to other genera (Leistikow, 2001; Schmalfuss, 2003). Currently, the presence of the genus *Philoscia* is limited to the western Palearctic region and includes nine valid species, all of them present in Europe (Boyko *et al.,* 2008). Most species are endemic in southern regions of Europe, mainly the Italian peninsula, while others often have a wider range of distribution (Schmalfuss, 2003). Only two *Philoscia* species occur in areas of the westernmost part of Europe, *Philoscia muscorum* (Scopoli, 1763) and *Philoscia affinis* Verhoeff, 1908. *Philoscia affinis* usually shows arboricolous habits (Vandel, 1962) and mainly lives in damp forests near watercourses or on waterlogged soils (Vandel, 1962; Boeraeve *et al*., 2017; Segers *et al.,* 2017; Hughes, 2019; Gregory, 2020). It has been reported from European continental sites in Austria, Belgium, Croatia, France, Germany, Great Britain, Hungary, Ireland, Italy, Slovenia and Spain (Schmalfuss, 2003; Vilisics & Lapanje, 2005; Lefebvre, 2012; Farkas & Vilisics, 2013; Boeraeve *et al*., 2017; Segers *et al.,* 2018; Hughes, 2019; Gregory, 2020). It is also present in north Africa (Algeria) and the Mediterranean islands, for example Corsica, Mallorca, Malta and Sardinia (Garcia & Cruz, 1996; Schmalfuss, 2003). In the Iberian Peninsula, it has only been recorded from the northern half of Spain, namely in Álava, Asturias, Barcelona, Burgos, Cantabria, Girona, Gipuzkoa, La Rioja, Lugo, Navarra, Tarragona and Vizcaya (Schmölzer, 1955, 1971; Fidalgo & Herrera, 1980; Cifuentes, 1984, 2019; Vivar *et al.,* 1984; Cruz, 1991; Vázquez-Felechosa *et al.,* 2004).

On the contrary, *P. muscorum* is an ubiquitous species that inhabits mountainous environments, deciduous forests on humic soils, damp grasslands, salt marshes and estuarine meadows (Vandel, 1962), especially in damp microhabitats as dead wood, leaf litter or moss, since the species shows negative phototaxis and cannot resist desiccation (Cloudsley-Thompson, 1956; Vandel, 1962). It has been reported from Belgium, Czechoslovakia, Denmark, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal and Spain (Schmalfuss, 2003), and was introduced into North America (Jass & Klausmeyer, 2000). In the Iberian Peninsula, *P. muscorum* has scarcely been reported, with records from Lisbon (Preudhomme De Borre, 1886; Jackson, 1926) and Gipuzkoa (Dollfus, 1892). It is difficult to assess the real distribution of both species in Europe because some authors did not use accurate diagnostic characters and misidentified species. In most cases, *P. muscorum* can be readily distinguished from *P. affinis* by the colour pattern (Vandel, 1962; Gruner, 1966; Boeraeve *et al*., 2017; Gregory, 2020), although this character has proven to be quite variable, thus complicating a correct identification when specimens show intermediate patterns. Secondary sexual characters of males are the most reliable to distinguish *P. muscorum* from *P. affinis* (Vandel, 1962; Gruner, 1966; Boeraeve *et al*., 2017; Gregory, 2020). Identification based on these characters made it possible to report for the first time *P. affinis* in some localities of Belgium (Boeraeve *et al.,* 2017) and Great Britain (Segers *et al*., 2018) where only *P. muscorum* had been found.

Records of *P. muscorum* in Spain were questioned by Schmalfuss (2003) because only female specimens could be studied. The main goals of this work are to confirm the presence of *P. muscorum* in the Iberian Peninsula and provide new population data from Álava, Asturias, Lugo and Navarra (northern Spain) where only *P. affinis* had previously been reported. Additionally, morphological and ecological remarks are provided and the distribution of *P. muscorum* in the Iberian Peninsula is discussed.

Material & methods

Surveys were carried out in the north-western Iberian Peninsula (Asturias and Lugo, Spain) (Fig. 1) in 2020. Many localities and habitats were visited to collect specimens, mainly under stones, dead wood, moss, leaf litter and humus (Fig. 2A-F). Additionally, unpublished records from Álava, Gipuzkoa and Navarra provided by S. J. Gregory (British Myriapod and Isopod Group) are included. Specimens were hand collected and then fixed and preserved in 96% ethanol. Specimens are kept in the first author's collection. Specimens of *P. muscorum* were photographed *in situ* with a Panasonic Lumix DMC-FZ200 camera equipped with a Raynox DCR-250 macro lens. Specimens of *P. affinis* were photographed by M. Álvarez Fidalgo with a Nikon D5300 camera equipped with Tamron 90 mm macro lens. Works on the morphology of the genus *Philoscia* were consulted to identify species (Sars, 1898; Vandel, 1962; Gruner, 1966; Sutton, 1972; Harding & Sutton, 1985; Hopkin, 1991; Boeraeve *et al.,* 2017; Hughes, 2019; Gregory, 2020). The seventh pereopods of males were dissected and mounted on glass slides using DMHF. A Nikon Coolpix 995 camera coupled to a Levenhuk 7S NG monocular microscope was used to photograph them. Photographs were edited with GIMP 2.8. Maps were generated with ArcGis Desktop 10.8.1.

Results

Philoscia muscorum (Scopoli, 1763)

Material examined: **Spain – Álava**: Sierra de Peña Gorbeia, Zuia (Álava): 1♂/3♀, 24-IV-2009, 650 m. (30T 0513859 4759129), S. J. Gregory *leg*. **Asturias:** La Finlandesa, Toleo (Oviedo): 1♂/1♀, 20-VIII-2020, 310 m. (30T 270230 4807557). Yana'l Monte, Turón (Mieres): 1♂/1♀, 28-VIII-2020, 297m (30T 276265 4787617). El Rebollar, Siero (Pola de Siero): 10♀, 03-IX-2020, 239m. (30T 284986 4808039). Entrance of the cave Santiago de Rodiles, Selorio (Villaviciosa): 5♂/6♀, 19-IX-2020, 9 m. (30T 307639

4822585). Forest of Monte Naranco (El Llugarín), Cuyences (Oviedo): 1♂, 20-IX-2020, 303 m. (30T 270443 4809117). Misiego beach, Selorio (Villaviciosa): 2♀, 24-IX-2020, 2m. (30T 307679 4821644). Private garden of Somines (Gurullés): 3♀, 27-IX-2020, 204 m. (29T 742012 4805883). Mofusu forest, Piedracea (Lena): 1♂/2♀, 01-X-2020, 435 m. (30T 267647 4781614). Private garden of Piantón (Vegadeo): 3♂/1♀, 03-X-2020, 28 m. (29T 659488 4813935). Near Islote de la Tortuga, Somió (Gijón): 1♂/3♀, 12-X-2020, 9 m. (30T 288653 4826002). **Lugo:** Reme de Arriba (Ribadeo): 1♀, 12-X-2020, 55 m. (29T 655944 4817704). **Navarra**: Sierra de Aralar, Betelu (Pamplona): 1♂/1♀, 21-IV-2009, 270 m. (30T 0584283 4763710); 2♂, 21-IV-2009, 290 m. (30T 0584772 4763038); 1♂/3♀, 21-IV-2009, 400 m. (30T 0584734 4762172), S. J. Gregory *leg*.

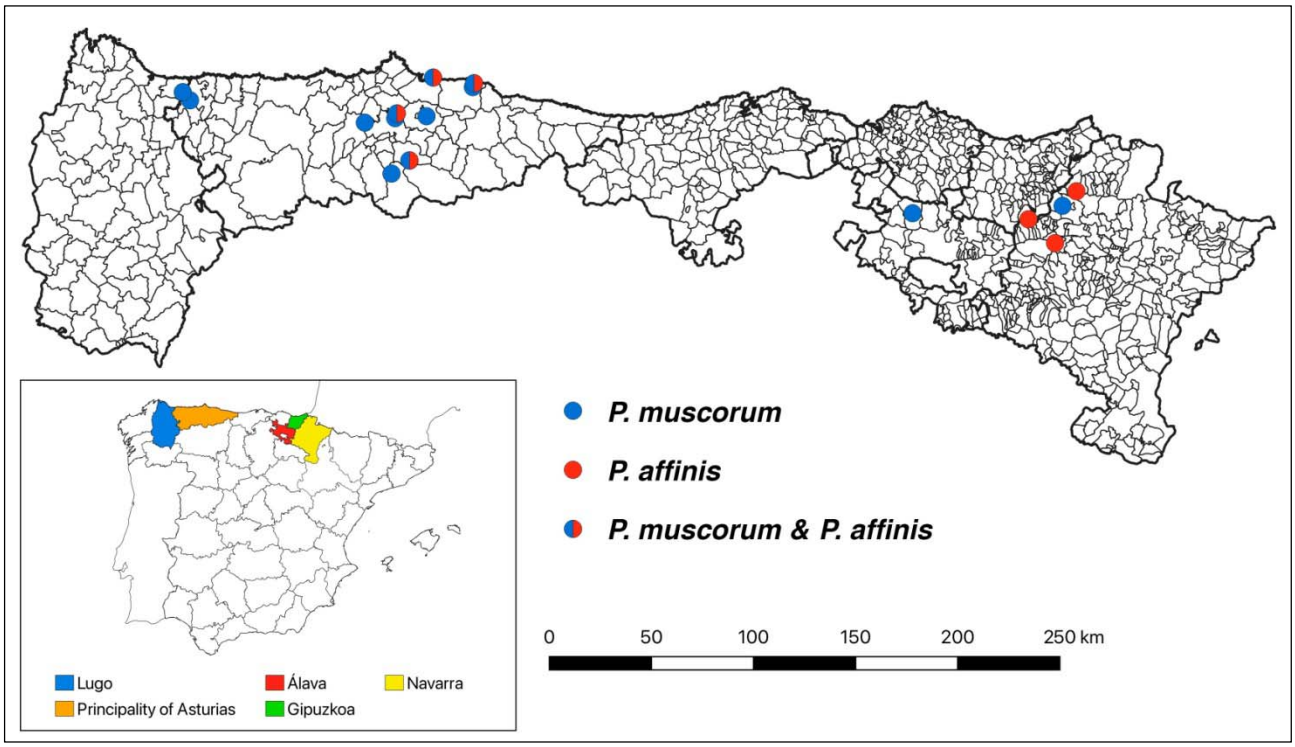

Figure 1. Geographical situation and *Philoscia* populations detected in the northern Iberian Peninsula.

Morphological remarks: Head darker than body, non-mottled and uniformly pigmented with black or other colours, occasionally with a yellow spot on the posterior region. Body with orange/brown and white stripe along the edge of the epimera (Fig. 3A). Only one specimen showed slight variability in the colour pattern. In lateral view, the protuberance of the merus of the seventh pereopods of males appears as a low rounded bump (Fig. 4A-B). Males were detected in 11 of the 15 populations (Fig. 1). The typical *habitus* of *P. muscorum* (Fig. 3A) was found in 54 of the 55 specimens. Only the male from the forest of Monte Naranco (El Llugarín) showed a different *habitus*, similar to *P. affinis,* but male sexual characters corresponded to *P. muscorum*.

Ecological remarks: Specimens were collected under stones and in leaf litter in oak forests (*Quercus robur* L.) (Fig. 2C), beech forests (*Fagus sylvatica* L.), southern blue gum forests (*Eucalyptus globulus* Labill.), laurel forests (*Laurus nobilis* L.) and mixed forests of chestnut (*Castanea sativa* Mill) and hazel (*Corylus avellana* L.) (Fig. 2D). Several specimens were found in dead wood, leaf litter, under the moss on wet walls in rural and urban areas (Fig. 2A-B), under grass on a rocky cliff near a freshwater source (Fig. 2F) and in dune ecosystems (Fig. 2E). Additionally, *P. muscorum* was also found in synanthropic areas as pastures or beside buildings and rubbish. Specimens were found inactive and hidden under moss and bark during the day and active at night walking on moss or grass in damp pastures.

Figure 2. Several habitats of *Philoscia* species. A) Rocky wall with moss in Yana'l Monte (Turón, Mieres). B) Outside wall of the cave Santiago de Rodiles (Selorio, Villaviciosa). C) Oak forest in Monte Naranco - El Llugarín, (Cuyences, Oviedo). D) Mixed forest of oak, hazel and chestnut in Mofusu forest (Piedracea, Lena). E) Salt marsh near Misiego beach (Selorio, Villaviciosa). F) Rocky cliff near a freshwater source, near Islote de la Tortuga (Somió, Gijón).

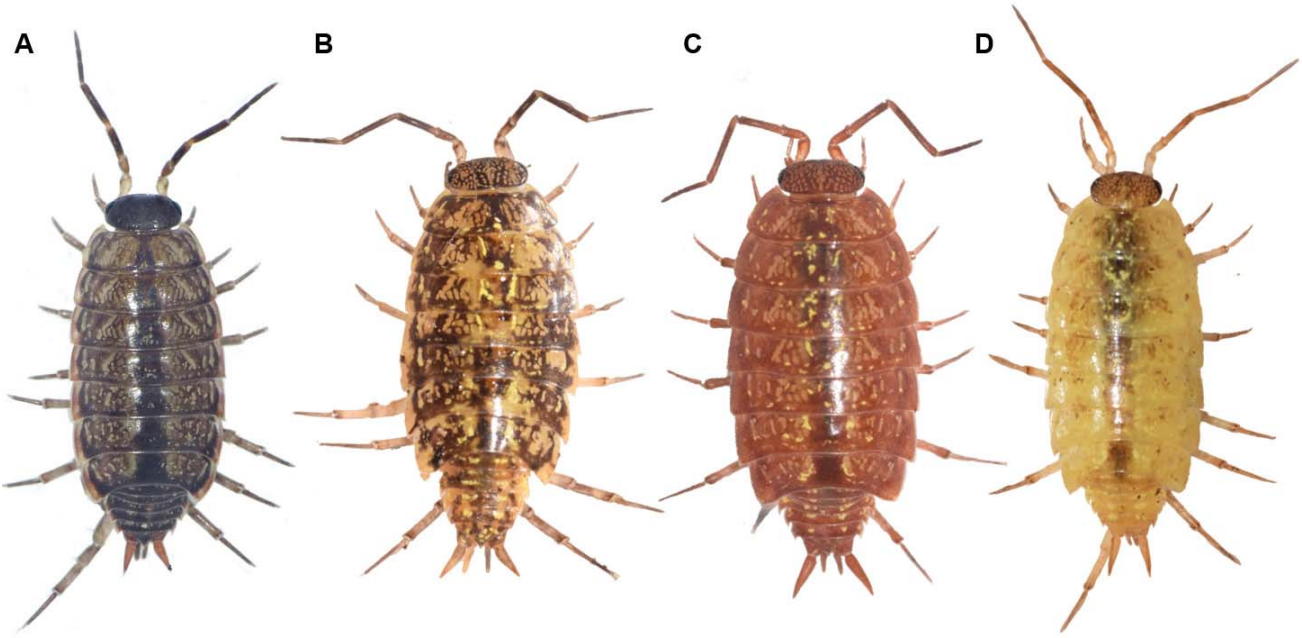

Figure 3: Colour patterns of *Philoscia* specimens collected in Asturias and Lugo**.** A). Typical layout of *P. muscorum* (Author: D. Cabanillas). B-D). Typical layouts of *P. affinis* showing colour variability (Author: M. Álvarez Fidalgo).

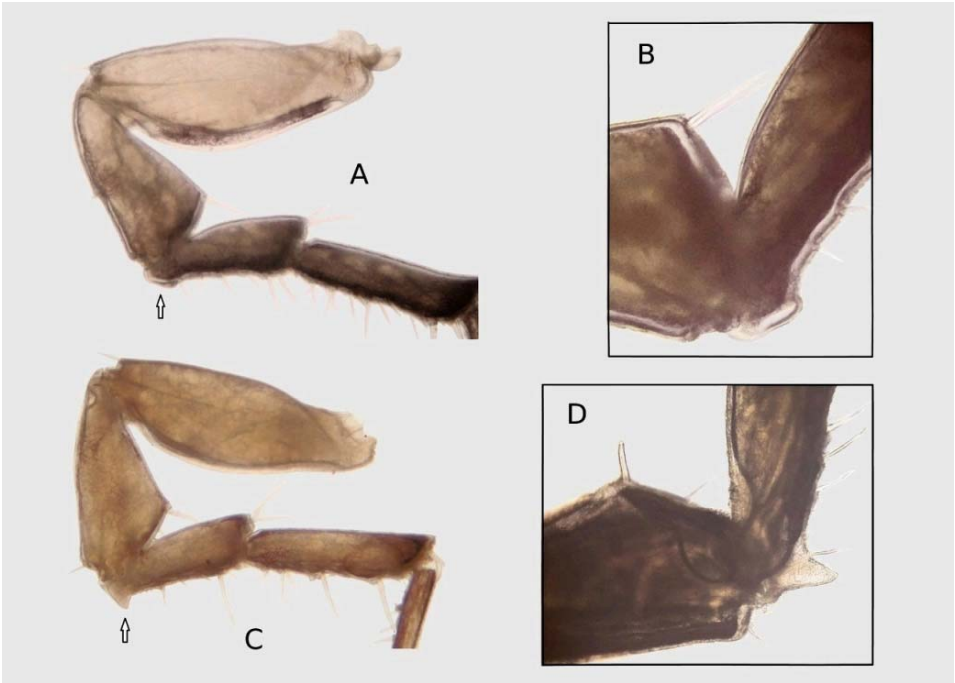

Figure 4: Morphology of the seventh pereopod of *Philoscia* males collected in Asturias, lateral view (arrows indicate the protuberance of the merus). A) Seventh pereopod of *P. muscorum*. B) Small and rounded protuberance in *P. muscorum*. C) Seventh pereopod of *P. affinis*. D) Protruding and triangular protuberance in *P. affinis*.

Philoscia affinis Verhoeff, 1908

Material examined: **Spain – Asturias:** Entrance of the cave Santiago de Rodiles, Selorio (Villaviciosa): 1♂, 19-IX-2020, 9 m. (30T 307639 4822585). Forest of Monte Naranco (El Llugarín), Cuyences (Oviedo): 1♂/7♀, 20-IX-2020, 303 m. (30T 270443 4809117). Forest near Arroyo de Fayas on Yana'l Monte, Turón (Mieres): 1♂/2♀, 03-X-2020, 319 m. (30T 276315 4787462). Near Islote de la Tortuga, Somió (Gijón): 3♂/6♀, 12-X-2020, 9 m. (30T 288653 4826002). **Gipuzkoa**: Sierra de Aralar, Kaxeta (Goierri): 1♂, 21-IV-2009, 310 m. (30T 0568807 4756507), S. J. Gregory *leg*. **Navarra:** Pico del Aritz, Leitza (Pamplona): 1♂/2♀, 20-IV-2009, 580 m. (30T 0591313 4770031); 1♂, 20-IV-2009, 750 m. (30T 0591994 4770251). Between Sierra de Urbasa and Sierra de Andía, Ergoiena (Pamplona): 2♂/1♀, 22-IV-2009, 950 m. (30T 0580758 4746086), S. J. Gregory *leg*.

Morphological remarks: Generally, head brown with pale yellowish mottling often appearing the same colour as body. No orange/brown and white longitudinal stripes along the edge of the epimera as in *P. muscorum* (Fig. 3B-D). Many specimens showed variability in the colour pattern (Fig. 3B-D). In lateral view, males show a prominent, triangular projection on the merus of the seventh pereopods (Fig. 4C-D). A total of 8 populations were detected, all of them with males and females (Fig. 1). The typical *habitus* of *P. affinis* was found in 28 of the 29 specimens.

Ecological remarks. Specimens were collected in leaf litter and under tree bark in mature oak forests (*Quercus robur* L.) (Fig. 1D) on humic soils, southern blue gum forests (*Eucalyptus globulus* Labill.) and mixed forests of hazel (*Corylus avellana* L.) and chestnut (*Castanea sativa* Mill.) (Fig. 2D). *P. affinis* was also found on wet walls (Fig. 2B) and under grass on a rocky cliff near a freshwater source (Fig. 2F). In addition, *P. affinis* was found in beech pollards, at edge of streams and meadows, mostly beneath stones, logs or moss. At night all specimens were inactive. During the day specimens were hidden under bark and moss, but others were active moving on the bark.

Discussion

The presence of *P. muscorum* in the Iberian Peninsula has always been matter of discussion. Vandel (1962) did not question the validity of the Portuguese records of *P. muscorum* but considered the species introduced. He also noted that *P. muscorum* specimens from Catalonia (Arcangeli, 1924, 1925) were actually *P. affinis*. Schmalfuss (2003) mentioned that Iberian records of *P. muscorum* (Preudhomme De Borre, 1886; Dollfus, 1892; Jackson, 1926; Schmölzer, 1955, 1971) needed to be reviewed because only female specimens were studied. Cifuentes (2019) reviewed the collection of Schmölzer and reported that specimens identified as *P. muscorum* actually corresponded to *P. affinis,* thus concluding *P. muscorum* does not occur in Galicia. It is difficult to assess the real distribution of *P. muscorum* in the Iberian Peninsula because no morphological or sexual data were provided in reports from Lisbon (Preudhomme De Borre, 1886; Jackson, 1926) and Gipuzkoa (Dollfus, 1892). Consequently, some authors questioned the presence of *P. muscorum* in the Iberian Peninsula until males could be studied. The present study finally confirms the presence of *P. muscorum* in the Iberian Peninsula after examining male specimens. Although former reports suggested that *P. affinis* was the most common species living in the north of the Iberian Peninsula, the possibility exists that *P. muscorum* could also be common in this area since 15 populations were found in several habitats. Lack of exhaustive studies on woodlouse fauna in the north of the Iberian Peninsula could have concealed the presence of *P. muscorum* in this area. Only 8 populations of *P. affinis* were found in northern Spain, suggesting *P. muscorum* could be more widespread than *P. affinis* in northern Iberian regions. More studies will be necessary to know the relative abundance of *Philoscia* species in northern woodlouse communities. *P. muscorum* is apparently an ubiquitous species and more tolerant to diverse ecological conditions than *P. affinis* (Vandel, 1962). Specimens of *P. muscorum* were always found in moist microhabitats, coinciding with previous ecological remarks provided by Cloudsley-Thompson

(1956) and Vandel (1962). Specimens of *P. affinis* were often found in damp forests, coinciding with findings of other authors (Vandel, 1962; Boeraeve *et al.*, 2017; Segers *et al*., 2018; Hughes, 2019; Gregory, 2020). Coastal records of *P. affinis* are uncommon but sometimes specimens are found in dead wood on beaches, and in pasturelands and forests near the coast (Hughes, 2019; Gregory, 2020). These coastal environments were absent in Islote de la Tortuga, but several specimens were found under grass on a rocky cliff near a freshwater source. In three Asturian sites both species were found in sympatry, coinciding with the observations of Gregory (2020) in Great Britain. When sympatry occurs, it is important to examine secondary sexual characters of males, especially when specimens show intermediate colour patterns. However, *habitus* of both species have been described by many authors. The examined *habitus* of *P. muscorum* fitted the original and later descriptions (Sars, 1898; Gruner, 1966; Sutton, 1972; Hopkin, 1991; Boeraeve *et al*., 2017; Segers *et al*., 2017; Hughes, 2019; Gregory, 2020), particularly the non-mottled head and the layout of the epimera. The studied specimens of *P. affinis* showed more variability than *P. muscorum* in colour patterns, also coinciding with previous descriptions (Vandel, 1962; Segers *et al.,* 2017; Boeraeve *et al.,* 2017; Hughes, 2019; Gregory, 2020). Overall, colour patterns appear to be a good way to rapidly distinguish both species when showing typical forms.

In summary, *P. muscorum* is finally confirmed in the Iberian Peninsula and reported for the first time in Spain, thus expanding its known distribution in southern and western Europe and improving ecological and morphological knowledge of *Philoscia* species in the Iberian Peninsula.

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We would like to thank Steve Gregory and the BMIG Non-marine Isopod Recording Scheme for providing unpublished records of *Philoscia* species in Álava, Gipuzkoa and Navarra. We would also like to thank Marián Álvarez Fidalgo for taking photographs of *P. affinis* specimens and Jorge Rodríguez Pérez for editing and processing some pictures. We would like to express our gratitude to Omar Sánchez, Álvaro Alonso, Nacho Noval, Ricardo López, Cris Rubio, Sonia Méndez, Claudia Fernández and Víctor González García for helping us sample some localities, to Mikel Artazkoz for clarifying the correct name of several localities and to André Burgers for reviewing the English text.

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First recent record of the centipede *Strigamia maritima* (Leach, 1817) from Germany (Myriapoda, Chilopoda, Geophilomorpha).

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Abstract

The geophilomorph centipede *Strigamia maritima* is widespread in littoral habitats along the Atlantic coast in Europe. In Germany it has only been recorded from a single locality in Germany, namely the island of Helgoland. However, the records are more than 50 years old, and its current status on a national level is considered unknown. Here we present a recent record of the species from Germany and the first record from the island of Sylt with a brief discussion of its habitat and possible dispersal mechanisms.

Introduction

The geophilomorph centipede *Strigamia maritima* (Leach, 1817) is well established as a model organism for studying arthropod segmentation (*e.g.* Chipman & Akam 2008) and was the first myriapod to have its genome sequenced (Chipman *et al*. 2014). *S. maritima* is widespread along the Atlantic coastline in Europe with records ranging from France to Norway (Schubart 1929; Kettle & Arthur 2000). The species most commonly occurs in the littoral zone around the high-tide mark, although it has also been found around the mid-tide level in at least a single case (Lewis 1961). It occurs in various habitats, including shingle banks and rock crevices, and is only completely absent from muddy and sandy shores (Lewis 1961).

Despite being so widely distributed, it is surprising that *S. maritima* in Germany has thus far only been recorded from the island of Helgoland. Although the occurrence of the species is mentioned by multiple authors (e.g. Schubart 1929, Caspers 1941, Jeekel 1964), only a few are original records based on actual specimens (Latzel 1894, Hennings 1903, Rüppel 1967). The most recent record by Rüppel was unfortunately overlooked, with *S. maritima* not being listed as present in the recent German faunal lists, but listed as being one of the few centipede species being 'lost' (Decker *et al*. 2016). Despite the lack of official records, the species was recently observed between 1963 and 2000 in the upper-littoral close to the Lange Anna Sandstone stack on Helgoland (O. Larink, personal communication, 20.09.19).

Here, we present the first record of *S. maritima* from the island of Sylt, the first specimen-based record from Germany since 1967.

Methods

Samples were hand collected on the 15th of August 2019 by LP, conserved in 98% ethanol, and deposited as vouchers at the Zoological Research Museum A. Koenig (Bonn, Germany) as well as the Senckenberg Museum für Naturkunde (Görlitz, Germany). Specimens were identified following the key in Barber (2008) under an Olympus SZ51 stereomicroscope.

Results

Numerous *S. maritima* of varying sizes were found under rocks and building rubble in the upper littoral on a pier in the Rantum Harbour on Sylt (54°51'20.6"N 8°18'27.8"E). Two individuals were determined and subsequently deposited as vouchers in the ZFMK collection (ZFMK MYR8795).

Figure 1: The habitat on Sylt on which the *Strigamia maritima* population was discovered

Discussion

Our finding represents the first record of the species from Germany for more than 50 years (Rüppel 1967) and the very first record of the species from Sylt. The absence of *S. maritima* from most parts of the German coastline and islands is likely due to the prevalence of sandy shores, as it is found to be tied closely to more structured habitats (Lewis 1961). Its presence on Sylt is therefore likely attributed to the construction of artificial habitats (Figure 1) and it therefore probably colonized the island more recently, as the rest of the island is devoid of suitable habitats. The origin of *S. maritima* on Sylt, however, remains unknown. Given its wide distribution across the Atlantic coast, including the British Isles (Lewis 1961), a natural dispersal, possibly by passively rafting, is certainly possible. However, a dispersal due to human activity can currently not be excluded.

Similar to Sylt, the shores of other German islands have also been artificially changed with the construction of dams or bridges. It is therefore possible that further investigations might show that the species is more widely distributed in Germany than what is currently known.

Acknowledgements

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A speckled *Trichoniscus pusillus* Brandt, 1833 (Isopoda: Trichoniscidae) from the Green Lane by Asham Meadow, Birlingham, Worcestershire

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Introduction

The author has studied the biota of the superficial deposits of the lower valley of the Warwickshire River Avon for several decades (Whitehead, 1988; 1992; 2006). Knowledge of its isopod fauna is reasonable and its composition and structure is generally predictable. *Trichoniscus pusillus* Brandt, 1833 is especially abundant at the back of the modern flood plain where it may be assembled by periodic flood events; thousands of examples have been seen over the years. Wherever individuals have been closely examined they have been identified as *T. pusillus* and this name is ascribed with fair confidence to all individuals of this valley population thus eliminating the need for mass dissection in order to rule out the key confusion species *Trichoniscus provisorius* Racovitza, 1908, which had for long been ranked as a subspecies of *T. pusillus* (Gregory, 2006) and which I know only from single individuals on chalk and limestone. *Trichoniscus provisorius* has never been found by me amongst *T. pusillus* either in the River Avon valley or elsewhere.

Dystrophic pigmentation in *T. pusillus*

On 16 April 2020 during a visit to the Green Lane flanking the back of the floodplain of the River Avon at Birlingham, Worcestershire (VC37, SO94, 7m a.s.l.) I turned flood-rafted timber and observed about 20 *T. pusillus* under it, of which one example was unusually pigmented (Fig. 1A-C). It appeared speckled due to pigment dispersion and was also slower-moving than any of the other normal examples of *T. pusillus* with it. The specimen was retained and placed in 70% alcohol for further study; the author had absolutely no idea what its appearance implied; of the specialists consulted at the time Steve Gregory stated that he too had no idea about the implications of the find. He persisted and on 6 May 2020 forwarded to me on the recommendation of Thomas D. Hughes a paper by Amato, Amato & de Quadros (2003) describing dystrophic pigmentation in the terrestrial isopod *Atlantoscia floridana* (van Name, 1940) (Oniscidea: Philosciidae) resulting from colonisation by an acanthocephalan or Thorn-headed Worm *Centrorhynchus* sp. Lühe 1911 (Centrorhynchidae), a member of a group known to cause pigment dystrophy in isopods. These authors include coloured images which confirm the high degree of similarity between the appearance of the infected Brazilian isopod and the Birlingham *T. pusillus.*

Amato, Amato & de Quadros (2003) confirm the rarity of this anomaly which represented 0.0375% of all instances in isopods examined by them. *Centrorhynchus* spp. have a distinctive bionomic. According to Nickol (1985) the larval stages colonise terrestrial invertebrates, in particular isopods, whereas the adult stages occur primarily in carnivorous birds. It was initially felt likely that the *T. pusillus* described here was infected with an acanthocephalan. However, on 20 March 2021 the specimen was subjected to an intensive ventral skeletal and gut dissection at x160; no evidence whatsoever existed for any life stages of an acanthocephalan worm.

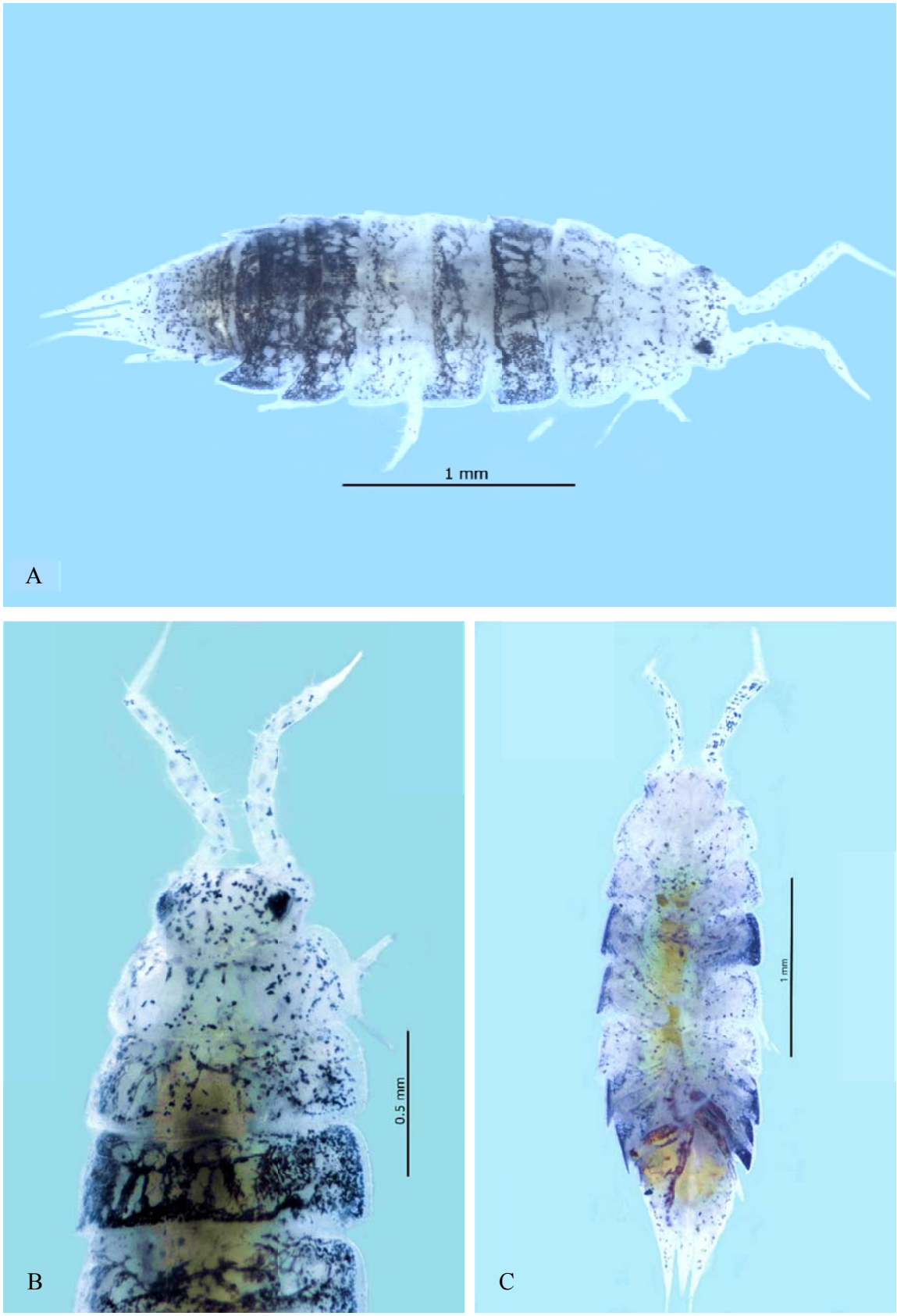

Figure 1. *Trichoniscus pusillus* Brandt, 1833, Birlingham, Worcestershire, 16 April 2020
A) Showing dystrophic pigmentation of dorsal skeleton; B). Enlarged view of dystrophic pigmentation of dorsal skeleton; C) showing dystrophic pigmentation of ventral and appendicular skeleton.

Conclusion

An example of *T. pusillus* collected from Birlingham, Worcestershire on 16 April 2020 exhibited dystrophic pigmentation. Previously unrecorded in terrestrial isopods in Britain this was thought, on the basis of available literature, to result from the presence of a parasitic acanthocephalan or Thorn-headed Worm. Subsequent dissection of the specimen revealed no evidence of such an organism and in this instance the aberration may result from another presently unknown cause. Hopefully further examples may be found and the causative agency explained.

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Report on the BMIG spring field meeting to Linlithgow 2015

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Introduction

The 2015 BMIG spring field meeting was based at the Low Port Centre in Linlithgow, West Lothian, from 10 to 13 April. Linlithgow is situated 20 miles west of Edinburgh allowing easy access to a range of habitats across the Lothians and Fife, and the meeting included a group visit to the Royal Botanic Garden in Edinburgh (RBGE).

Methods and sites

The majority of localities visited during the meeting are Scottish Wildife Trust Reserves (Addiewell Bing, Brock Wood, Carlingnose Point, Dumbarnie Links, Hermand Birchwood, Pease Dean and Petershill). Aberlady Bay is a Local Nature Reserve managed by East Lothian Council. Midlothian Council manages Roslin Glen Country Park, West Lothian Council manages Beecraigs Country Park, the Buccleugh Estate manages Dalkeith Country Park and the City of Edinburgh Council manages the Water of Leith. Arthur's Seat and Duddingston Loch both fall within Holyrood Park, managed by Historic Scotland, although the Loch and some land around it are also a Scottish Wildlife Trust Reserve. Historic Scotland also manage Linlithgow Peel which contains the Palace, St Martin's Church and the Loch. The Low Port Centre, which is adjacent to the Peel, has its own nature garden where BMIG members were able to record and the garden was also used for a discussion of field collecting techniques.

The group visited 17 different localities, the majority of which were in Midlothian or West Lothian, but included two sites in Fifeshire, two in East Lothian and one in Berwickshire (Table 1). The division of some localities into smaller units has produced a longer list of 32 recording sites. For the purposes of this report the research and nursery glasshouses at the Royal Botanic Garden have been lumped together, as have the outdoor areas of RGBE, while the public glasshouses have been reported on separately (Tables 2-4). However, when calculating the number of localities where a species has been recorded RGBE records have been simplified further as being either indoor (*i.e.* glasshouses) or outdoor (*i.e.* gardens).

In attendance at the meeting were Tony Barber (TB), Victoria Burton (VB), Kevin Clements (KC), Gordon Corbet (GC), Mike Davidson (MBD), Una Garland (UG), Steve Gregory (SJG), Paul Harding (PH), Bernard Johnson (BJ), Paul Lee (PL), Angela Lidgett (AML), Keith Lugg (KL), Helen Read (HR), Duncan Sivell (DS) and Imogen Wilde (IW).

Results

Three millipede species were recorded from Scotland for the first time. *Poratia digitata* (Fig. 1), *Prosopodesmus panporus* and *Haplopodoiulus spathifer* were all found in glasshouses at the Royal Botanic Garden. In addition, three species that were first found in Britain at RBGE, the centipede *Lithobius lapidicola*, the millipede *Cylindroiulus salicivorus* (Fig. 2) and the woodlouse *Styloniscus mauritiensis* (Fig. 4), were all confirmed to still be present. The millipedes *Cylindroiulus londinensis* and *Chordeuma proximum* and the landhopper *Arcitalitrus dorrieni* all appear to show a significant leap northwards in their eastern distributions. These millipedes were recorded both outdoors and indoors at the RBGE, while the landhopper was found at a single location along the Water of Leith within

Edinburgh. The woodlouse *Oritoniscus flavus* (Fig. 3) was recorded several times at Dalkeith Country Park, confirming the continued presence of this species in Midlothian.

Table 1. A list of sites visited during the field meeting.

Site	Location	OS grid ref	VC	date	recorders
1	Aberlady Bay	NT 471 804	82	11/04/2015	VB, UG, SJG, KL
2	Addiewell Bing	NT 003 631	83/84	11/04/2015	PL, DS, HR, IW
3	Arthur's Seat	NT 275 729	83	13/04/2015	DS
4	Beecraigs Country Park	NS 997 741	84	11/04/2015	PL, DS, HR, IW
5	Brock Wood	NT 662 748	82	12/04/2015	KC, SJG, KL
6	Carlingnose Point	NT 135 809	85	12/04/2015	GC, DS
7	Dalkeith Country Park	NT 334 676	83	11/04/2015	TB, VB, KC, GC, UG, SJG, AML, BJ, KL
8	Duddingston Loch	NT 279 725	83	13/04/2015	DS
9	Dumbarnie Links	NO 441 022	85	12/04/2015	GC, DS
10	Hermand Birchwood	NT 031 618	83	11/04/2015	PL, DS, HR, IW
11	Linlithgow				
11a	Low Port Centre	NT 003 772	84	11-12/04/2015	TB, VB, KC, SJG, AML, HR
11b	Palace and Church	NT 002 773	84	09-13/04/2015	KC, GC
11c	around Linlithgow Loch	NT 002 773	84	09-13/04/2015	MBD, KC
12	Pease Dean	NT 790 704	81	12/04/2015	KC, SJG, KL
13	Petershill	NS 984 696	84	11/04/2015	PL, DS, HR, IW
14	Redhall Walled Garden	NT 219 704	83	13/04/2015	MBD
15a	Roslin Glen Country Park	NT 271 626	83	11/04/2015	TB, KC, GC, AML, BJ
15b	Rosslyn Chapel and Cemetery	NT 274 630	83	11/04/2015	TB, KC, GC, AML, BJ
16	Royal Botanic Garden Edinburgh (RBGE)				
16a	Arid Lands House	NT 247 755	83	10/04/2015	KC, KL
16b	Ferns and Fossils House	NT 247 755	83	10/04/2015	TB, KC
16c	Montane Tropics House	NT 247 755	83	10/04/2015	KC, GC, UG, SJG,
16d	Orchid & Cycad House	NT 247 755	83	10/04/2015	KC, KG, MBD, SJG, HR, DS
16e	Plants & People House	NT 247 755	83	10/04/2015	TB
16f	Wet Tropics House	NT 247 755	83	10/04/2015	SJG, KL
16g	Temperate Houses	NT 247 755	83	10/04/2015	TB, KC, MBD, SJG, KL, HR
16h	Tropical Palm House	NT 247 755	83	10/04/2015	TB, KC, GC, PL, AML, KL, SJG, HR, DS
16i	non-public glasshouses	NT 247 755	83	10/04/2015	TB, VB, KC, GC, MBD, AML, KL, UG, SJG, DS
16j	RBGE outdoor gardens	NT 24 75	83	10/04/2015	TB, VB, KC, MBD, PL, AML, HR, DS
17	Water of Leith				
17a	near Currie	NT 188 679	83	13/04/2015	MBD
17b	by The Colonies	NT 247 750	83	10/04/2015	DS
17c	The Dene	NT 244 742	83	10/04/2015	DS

A total of 60 BMIG species were recorded during the course of the meeting, comprising 33 millipedes, 14 centipedes, 12 woodlice and one landhopper. Five of the millipedes, *Brachychaeteuma bagnalli*, *Craspedosoma rawlinsii, Choneiulus palmatus, Allajulus nitidus* and *Cylindroiulus londinensis* are Nationally Scarce (Lee, 2015). One of the centipedes, *Lithobius lapidicola*, is listed as Near Threatened (Lee, 2015), but this is based on its distribution in the wild and records from glasshouses at RGBE should not influence the conservation status of this centipede.

Millipedes

The millipedes were well represented at this field meeting with 33 species being recorded. The most significant finds were amongst the species found in glasshouses at the Royal Botanic Garden, of which *Prosopodesmus panporus*, *Poratia digitata* and *Haplopodoiulus spathifer* are all new for Scotland.

Helen Read and Angela Lidgett both recorded *P. panorpus* from the Tropical Palm House. This species was first collected in 1975 by Adrian Rundle in four of the tropical houses at Kew Gardens and was subsequently described as a species new to science (Blower & Rundle, 1980). The provenance of this millipede is unclear as other *Prosopodesmus* species range across the tropics from South East Asia to Africa and South America. At Kew this species appears to favour the tropical palm house over other glasshouses, which is consistent with the records made in Edinburgh. This species does not appear to have been recorded anywhere else apart from Kew Gardens (Lee, 2006), which means RBGE is only the second known site for this millipede.

Poratia digitata (Fig. 1) was recorded by Helen Read, Steve Gregory and Keith Lugg, and was found in the Tropical Palm House, the Orchid & Cycad House and in House 18 (a non-public glasshouse). *Poratia digitata* has been previously recorded from four localities in England, including repeated observations from Kew Gardens (Lee, 2006). Gregory & Lugg (2020) have already reported these Edinburgh records being the first for Scotland, and in 2017 they also found *P. digitata* in the Tropical Dome of National Botanic Garden of Wales, which is another national first.

Haplopodoiulus spathifer was found by Keith Lugg and Mike Davidson in temperate glasshouses at RBGE. This is another millipede that was first recorded in Britain from Kew Gardens (Corbet & Jones, 1996). For several years this species seemed to be restricted to Kew and two related sites in the south east of England (Lee, 2006), but more recently it has appeared at other sites including the Isle of Wight and Cornwall (Barber, 2015). In the south of England this species lives outdoors and can be abundant where it occurs. It will be interesting to see whether *H. spathifer* will venture out of the glasshouses in Edinburgh to colonise the gardens.

Cylindroiulus salicivorus (Fig. 2) was reported as new to Britain based on specimens collected by Charles Rawcliffe from glasshouses 5 and 6 in 1987 and 1988 (Read, Corbet & Jones, 2002). In 1988 Gordon Corbet confirmed this millipede was still present at RGBE and also found it at the St Andrews Botanic Garden in Fife. Apparently still only known in Britain from these two Scottish sites (Lee, 2006; Gregory & Lugg, 2020), this millipede was recorded from six different glasshouse areas in RGBE during this field meeting (Table 2) by Steve Gregory, Helen Read, Keith Lugg and Kevin Clements.

Oxidus gracilis was similarly widespread across the glasshouses (Table 2) but more common than *C. salicivorus* and was reported by nearly all the BMIG members who visited RBGE. *Oxidus gracilis* is a distinctive millipede that is frequently found in nurseries and glasshouses across Britain, and often in good numbers (Lee, 2006; Gregory & Lugg, 2020). One outdoor record of *O. gracilis* was made by Kevin Clements, but as this millipede was dead the record has not been added to Table 2 on the presumption this species does not survive outdoors.

Cylindroiulus londinensis was recorded multiple times at RBGE both inside the glasshouses and outdoors in the wider gardens. This native millipede is often associated with woodland and is more common in western Britain (Lee, 2006). These Edinburgh records are a significant leap northwards in

this species' eastern range, as although *C. londinensis* has been recorded as far north as Skye on the west coast, these appear to be the first Scottish records of this species on the east coast. It is notable that this species was only recorded at RBGE and not found elsewhere; it will be interesting to see if this species expands its local range in years to come.

Figure 1: *Poratia digitata.* Live specimen from RBG Edinburgh (image © Keith Lugg).

Figure 2: *Cylindroiulus salicivorus.* Live specimen from RBG Edinburgh (image © Keith Lugg).

Table 2: Millipedes recorded during Linlithgow field meeting (*RBGE glasshouses combined when counting number of sites per species)

	1	2	3	4	5	6	7	8	9	10	11a	11b	11c	12	13	14	15a	15b	16a	16b	16c	16d	16e	16f	16g	16h	16i	16j	17a	17b	17c	*No. Sites
Glomeris marginata					X									X			X	X														**4**
Brachychaeteuma bagnalli																													X			**1**
Craspedosoma rawlinsii				X			X																									**2**
Nanogona polydesmoides		X												X	X																	**3**
Chordeuma proximum																										X		X				**2**
Melogona scutellaris		X			X		X							X	X														X			**6**
Oxidus gracilis																					X	X		X	X	X	X					**1**
Brachydesmus superus		X			X		X	X					X	X	X											X		X	X	X		**11**
Polydesmus angustus	X	X	X		X	X	X		X	X	X		X	X	X	X	X											X	X	X	X	**18**
Polydesmus coriaceus														X																		**1**
Polydesmus deniculatus																	X															**1**
Prosopodesmus panporus																										X						**1**
Poratia digitata																						X				X	X					**1**
Ophiodesmus albonanus											X		X																			**2**
Choneiulus palmatus						X															X	X		X		X	X					**2**
Proteroiulus fuscus		X		X	X		X			X	X			X		X											X	X	X			**11**
Blaniulus guttulatus					X					X	X	X	X	X		X			X		X	X			X	X		X	X	X		**11**
Archiboreoiulus pallidus							X						X																			**2**
Boreoiulus tenuis					X		X		X		X		X					X														**6**
Nemasoma varicorne										X			X																			**2**
Julus scandinavius				X	X	X				X			X		X		X				X											**8**
Haplopodoiulus spathifer																									X							**1**
Ophyiulus pilosus	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X											X	X	X		**18**
Allajulus nitidus										X	X		X					X								X	X				X	**6**
Cylindroiulus britannicus	X	X	X		X	X	X			X			X	X	X	X						X			X	X	X	X	X	X	X	**16**
Cylindroiulus caeruleocinctus	X									X	X																					**3**
Cylindroiulus latestriatus	X							X	X																		X					**4**
Cylindroiulus londinensis																					X			X	X		X	X				**2**
Cylindroiulus punctatus	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X			X							X	X	X	X	**22**
Cylindroiulus salicivorus																					X	X		X	X	X	X					**1**
Brachyiulus pusillus	X				X			X	X								X															**5**
Ommatoiulus sabulosus	X							X				X		X			X															**5**
Tachypodoiulus niger	X	X	X	X	X		X	X		X	X		X	X	X		X	X										X	X	X	X	**18**
Species per site:	**9**	**9**	**5**	**6**	**13**	**5**	**11**	**7**	**6**	**11**	**9**	**3**	**13**	**13**	**9**	**6**	**9**	**5**	**1**	**0**	**7**	**6**	**0**	**4**	**6**	**10**	**9**	**10**	**10**	**7**	**5**	

Table 3: Centipedes recorded during Linlithgow field meeting (*RBGE glasshouses combined when counting number of sites per species)

	1	2	3	4	5	6	7	8	9	10	11a	11b	11c	12	13	14	15a	15b	16a	16b	16c	16d	16e	16f	16g	16h	16i	16j	17a	17b	17c	*No. Sites
Haplophilus subterraneus							X										X				X	X			X			X		X	X	6
Schendyla nemorensis			X			X	X										X											X				5
Geophilus alpinus					X		X							X			X											X				5
Geophilus flavus					X		X				X	X					X															5
Geophilus truncorum	X	X			X		X		X	X				X																		7
Stenotaenia linearis																									X							1
Cryptops hortensis																			X	X		X	X	X			X	X				2
Cryptops parisi			X																													1
Lithobius crassipes		X	X		X		X			X							X															6
Lithobius forficatus		X	X			X	X			X	X	X		X			X	X									X	X			X	13
Lithobius lapidicola																											X					1
Lithobius melanops					X		X			X			X																			4
Lithobius microps	X				X	X	X				X																					5
Lithobius variegatus							X																					X				2
Species per site:	**2**	**3**	**4**	**0**	**6**	**3**	**10**	**0**	**1**	**4**	**3**	**2**	**1**	**3**	**0**	**0**	**6**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**0**	**3**	**6**	**0**	**1**	**2**	

Table 4. Woodlice and landhoppers recorded during Linlithgow field meeting (*RBGE glasshouses combined when counting sites per species)

	1	2	3	4	5	6	7	8	9	10	11a	11b	11c	12	13	14	15a	15b	16a	16b	16c	16d	16e	16f	16g	16h	16i	16j	17a	17b	17c	*No. Sites
Androniscus dentiger					X		X					X			X			X									X			X		7
Haplophthalmus mengii	X						X																									2
Oritoniscus flavus							X																									1
Trichoniscus pusillus agg.	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X										X			X	18
Trichoniscus pygmaeus	X				X						X										X											4
Styloniscus mauritiensis																					X			X			X					1
Philoscia muscorum agg.	X		X		X	X	X	X	X		X		X		X	X	X											X			X	14
Platyarthrus hoffmannseggii	X																															1
Oniscus asellus	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X							X	X		X		X	X	20
Porcellio scaber	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X		X	X					X	X	X	X	X	21
Porcellionides pruinosus																						X				X						1
Armadillidium vulgare						X		X																								2
Arcitalitrus dorrieni																														X		1
Species per site:	**7**	**3**	**4**	**3**	**6**	**5**	**7**	**5**	**2**	**3**	**5**	**4**	**4**	**3**	**4**	**1**	**4**	**4**	**1**	**0**	**3**	**2**	**0**	**1**	**1**	**2**	**3**	**4**	**1**	**3**	**4**	

Chordeuma proximum was also recorded in the glasshouses and the outdoor gardens at RBGE. Helen Read found this species in the Tropical Palm House and in woodland near the Rock Garden. There are scattered records of this species in western Scotland but it is thought these may have been introductions (Lee, 2006). *Chordeuma proximum* is normally found in south west England and Wales so these records are quite far outside its expected range.

The most frequently recorded millipede of the meeting was *Cylindroiulus punctatus*, which was found at 22 sites. *Ophyiulus pilosus*, *Tachypodoiulus niger* and *Polydesmus angustus* were each recorded from 18 sites, *Cylindroiulus britannicus* was found at 16 sites while *Brachydesmus superus*, *Blaniulus guttulatus* and *Proteroiulus fuscus* were all reported from 11 sites (Table 2).

Other relatively common species recorded from between 5 and 10 sites were *Julus scandianvius*, *Allajulus nitidus*, *Boreoiulus tenuis*, *Melogona scutellaris*, *Brachyiulus pusillus* and *Ommatoiulus sabulosus*, all of which are expected for the area (Lee, 2006). Less frequently recorded but still expected for region were *Cylindroiulus latestriatus*, *Cylindroiulus caeruleocinctus*, *Nanogona polydesmoides*, *Archiboreoiulus pallidus*, *Choneiulus palmatus*, *Craspedosoma rawlinsii*, *Nemasoma varicorne* and *Ophiodesmus albonanus* (Lee, 2006).

Glomeris marginata is at the northern limit of its British range in the Lothians (Lee, 2006). The pill millipede was recorded from three woodland sites and from the cemetery of Rosslyn Chapel.

Polydesmus coriaceus was found at Pease Dean, under dead wood in mixed woodland, by Keith Lugg. This appears to be the third site for this species in Scotland. Previous Scottish records for *P. coriaceus* have come from Hopetoun House, west of Edinburgh, in 1979 and 1983, and from Culzean Country Park during the 2006 BMIG meeting to Ayrshire (Collis, 2007). Although *P. coriaceus* is common in southern England and in Wales, reports of this millipede north of the Humber are scarce (Lee, 2006).

Polydesmus denticulatus is known from the region but this millipede was only recorded once. A single specimen was found at Roslin Glen by Angela Lidgett. *Polydesmus denticulatus* is thought to favour wet woodland and shy away from synanthropic sites (Lee, 2006). Another species with a single record was *Brachychaeteuma bagnalli*, a synanthropic species that is not common in Britain but is known from the Lothians (Lee, 2006). Mike Davidson found *B. bagnalli* at a brownfield site by the Water of Leith near Currie.

Centipedes

Fourteen species of centipede were recorded during the meeting of which *Lithobius forficatus* was the most common, being reported from 13 sites. Other frequently encountered centipedes (recorded from four to seven sites) were *Geophilus alpinus*, *Geophilus flavus*, *Geophilus truncorum*, *Lithobius crassipes*, *Lithobius microps*, *Lithobius melanops*, *Haplophilus subterraneus* and *Schendyla nemorensis* (Table 3).

Lithobius variegatus was found at just two sites, in the grounds of the Royal Botanic Garden and at Dalkeith Country Park. The Scottish distribution of *L. variegatus* is biased towards the west, and although it is known from the Lothians the paucity of records here may not be surprising. *Lithobius forficatus* has a tendency to replace *L. variegatus* in rural sites where the latter species does not occur.

Cryptops hortensis, a common species in southern Britain, was only recorded from RGBE where it was found in a number of glasshouses and also in the wider gardens (Table 3). There are scattered records of *C. hortensis* elsewhere in Scotland and this species seems to be more synanthropic the further north it is found.

A single record of *Cryptops parisi* was made by Duncan Sivell on Arthur's Seat. The British distribution of this centipede is centered on south west England and Wales. Outlying records of *C. parisi* are typically synanthropic and Richards (2018) recently recorded this species from a garden in Sheffield.

The two specimens collected from Arthur's Seat were found under stones embedded in the ground in a small copse of Scots pine. Although this record was made within the City of Edinburgh the location is approximately half a mile from the nearest building.

Lithobius lapidicola was recorded from the Royal Botanic Garden as a species new to Britain in 1986 (Rawcliffe, 1987a). Steve Gregory and Angela Lidgett both recorded this species from the non-public glasshouses at RBGE. This centipede has an odd distribution in Britain as it occurs at a handful of outdoor coastal sites in Kent and Suffolk, but is otherwise a glasshouse species. *Lithobius lapidicola* has been reported from glasshouses in Dorset (Barber, 2009) as well as the Birmingham Botanical Gardens and Whipsnade Butterfly House (Gregory & Lugg, 2020).

Stenotaenia linearis was found in the Temperate House at RBGE by Steve Gregory and Keith Lugg (Gregory & Lugg, 2020). The RBGE is the only known Scottish locality for *S. linearis*, a species more often associated with outdoor synanthropic habitats in southern Britain, particularly around London.

Woodlice

Twelve species of woodlice were recorded during the meeting (Table 4). The commonest species were *Porcellio scaber* (21 sites), *Oniscus asellus* (20 sites), *Trichoniscus pusillus* agg. (18 sites) and *Philoscia muscorum* agg. (14 sites).

Philoscia muscorum is being treated as a species aggregate for the purposes of this report, as we cannot rule out the possibility that some records might have been *Philoscia affinis*, a similar woodlouse that was already present in Britain in 2015 although this was not realised until 2017 (Gregory, 2020). Recent recording efforts in the Lothians have confirmed *P. muscorum* to be widespread across the region, but have not yet found *P. affinis*, which appears to prefer the west of Scotland (Gregory, 2020). It therefore seems likely that the majority, if not all, records of *P. muscorum* agg. reported here will refer to *P. muscorum sensu stricto*. However, as many of these records would have been field observations that cannot be verified they are being treated with caution.

The remaining woodlouse belonging to the "famous five" group of common and widespread species, *Armadillidium vulgare*, is near the northern limits of its range in the Lothians. Although *A. vulgare* is widespread across much of England and Wales, records north of Yorkshire tend to be restricted to coastal areas (Gregory, 2009). This woodlouse was recorded twice during the meeting; from the Fife coast at Carlingnose Point, and from Duddingston Loch in Edinburgh.

Platyarthrus hoffmannseggii is another woodlouse at the northern edge of its British range. This woodlouse appears to be genuinely rare in much of northern England, but it has been recorded at a few sites around the Firth of Forth (Gregory, 2009). A single record of *P. hoffmannseggii* was reported from Aberlady Bay by Una Garland. It is thought this woodlouse was found in the nest of a *Lasius* species, although ant specimens were not collected for verification.

Oritoniscus flavus (Fig. 3) was recorded several times at Dalkeith Country Park on the River North Esk. In Britain this woodlouse is only known from one other site in South Wales, and that population was likely introduced from Ireland where this species is more common (Gregory, 2009). The North Esk population was discovered in 2010 (Sivell & Gregory, 2015) and more recent surveys (Maguire, 2020) give a more detailed account of this species' local distribution. Roslin Glen Country Park is approximately six miles upstream from Dalkeith Country Park and was surveyed during the field meeting, but no *O. flavus* were reported there.

An important isopod record from the field meeting was the rediscovery of *Styloniscus mauritiensis* at the Royal Botanic Garden. This exotic woodlouse was initially found by Charles Rawcliffe in a non-public glasshouse in 1986 and was reported as a new species for Britain (Rawcliffe, 1987b; Collis & Harding, 2007). *Styloniscus mauritiensis* had not been recorded again at RGBE or elsewhere in Britain

since its initial discovery, so Steve Gregory and Keith Lugg made a concerted effort to find this species in 2015. A small number of specimens were recorded in the non-public glasshouses by Keith Lugg and Una Garland, and a larger population of *S. mauritiensis* was discovered in the Montane Tropics House by Steve Gregory and Keith Lugg (Fig. 4). More details of these discoveries have been published by Gregory & Lugg (2018; 2020) who also report *S. mauritiensis* in glasshouses in England and Wales.

Figure 3: *Oritoniscus flavus.* Live specimen from Dalkeith Country Park (image © Keith Lugg).

Figure 4: *Styloniscus mauritiensis.* Live specimen from RBG Edinburgh (image © Keith Lugg).

Among the other woodlice that were recorded, *Androniscus dentiger* was relatively common appearing at seven sites and *Trichoniscus pygmaeus* was found at four sites. *Haplophthalmus mengii* was recorded from Aberlady Bay and Dalkeith Country Park and *Porcellinoides pruinosus* was reported from glasshouses at RBGE.

Amphipods

The landhopper *Arcitalitrus dorrieni* was recorded by Duncan Sivell at a single location along the Water of Leith near Stockbridge. This site is relatively close to the Royal Botanic Garden but the absence of records from RBGE suggests there may be no connection between the two. *Arcitalitrus dorrieni* can be abundant where it occurs and its habit of jumping energetically when disturbed can make it an easy species to find, but not always easy to catch.

The Water of Leith is effectively a wildlife corridor running from the Pentland Hills through the heart of Edinburgh to the meet the sea at Leith. *Arcitalitrus dorrieni* may well be present elsewhere along the waterway, although it was not found at the two other sites surveyed during the field meeting. Conversely the east coast of Scotland may not be the ideal place for this species to thrive. The landhopper has been recorded at several sites in the west of Scotland and this species has a clear western bias in its distribution across Britain (Gregory, 2016).

Discussion

The site with the largest tally of species records was the Royal Botanic Garden Edinburgh, which is not surprising given its combination of glasshouses and wider gardens. The discovery of three new species for Scotland and the rediscovery of other species found new to Britain by Charles Rawcliffe in the 1980s were highlights of this meeting. Of the 35 species recorded at RGBE 27 were found in glasshouses and 20 were recorded outdoors. Everyone who attended the field meeting visited RGBE and the species lists no doubt reflect the increased recording effort that took place.

Dalkeith Country Park produced the largest tally of 28 “wild” species. This site also benefitted from a higher number of visitors, no doubt in search of the woodlouse *Oritoniscus flavus*. Other sites reporting good numbers of species were the woodland reserves of Brock Wood, Pease Dean, Roslin Glen and Hermand Birchwood. The coastal nature reserve at Aberlady Bay produced a decent list and a respectable number of species were also recorded from around Linlithgow where the field meeting was based.

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Report on the BMIG field meeting at Morecambe 2017

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Introduction and background

The 2017 BMIG field weekend, held from 30th March to 2nd April, was based at The Berkeley Guesthouse, Marine Parade, Blackpool. During the weekend sites in Lancashire (West VC60 and South East VC59) and Cumbria (Westmorland with Furness VC69) were visited.

The first ever joint field meeting of the British Isopod Study Group and the British Myriapod Group was held at St Martin's College, Lancaster in April 1983. Twenty-eight members attended what seems to have been a busy weekend in the field with visits to eight coastal and limestone sites around Morecambe Bay, and sessions in lecture room and bar.

Twenty-two species of millipede are listed in the meeting report in BMG Newsletter 2 (Richardson, 1983). The finding of both *Brachychaeteuma bagnalli* and *B. bradeae* along with a variant that could not be ascribed to either species from Meathop Wood (VC 69) was described and the specimens figured and discussed by Gordon Blower in BMG Bulletin 3 (Blower, 1986).

Richardson (1983) also reports 16 species of centipede collected. Barber and Steeden (2012) report a further six species including both segregates of *Geophilus carpophagus* and an indoor record of *Scutigera coleoptrata* and provide more detail of the distribution of all 22 species. Records of a further four species were found in the database of the Centipede Recording Scheme bringing the total known from the area prior to the BMIG visit to 26.

There is no record of the woodlice recorded during the 1983 meeting. Currently 20 species of woodlice are recorded from the area (VC59, 60 & 69), but this includes two species, *Philoscia affinis* and *Metatrichoniscoides leydigii*, which have been recorded since BMIG's 2017 field meeting (Gregory, 2020; Hughes, 2020).

Methods and sites

The 2017 meeting was not organised as a systematic search for any target species but the collection of *Brachychaeteuma* specimens was hoped for with a view to finding more specimens of the Meathop Wood variant in order to shed more light on its true status.

A summary of the sites visited and the sub-locations within these sites is shown in Table 1. Further details of the species records for each site are summarised in Tables 2 to 4.

Results

Only five of the species recorded during the weekend are listed in the Natural England species status review (Lee, 2015) as being anything other than common and with a threat status greater than Least Concern. These are the centipede *Lithobius lapidicola,* the millipedes *Choneiulus palmatus*, *Cylindroiulus parisiorum* and a *Brachychaeteuma* species, and the pill-woodlouse *Armadillidium album*. The species lists contain a strong synanthropic element reflective of many of the sites visited.

Table 1: List of sites visited. Recorders: KA - Keith Alexander; TB - Tony Barber; KC - Kevin Clements; SG - Steve Garland; SJG - Steve Gregory; PL - Paul Lee; AL - Angela Lidgett; HR - Helen Read; PR - Paul Richards; AW - Ashley Watson; DW - Derek Whiteley

Site no.	Locality	Grid Ref	VC	Date	Recorder
1a	Myerscough College (inside glasshouses)	SD4940	60	31/03/2017	TB, SG, SJG, AL, HR, PR
1b	Myerscough College (outside glasshouses)	SD4940	60	31/03/2017	TB, AL, HR, PR
1c	Myerscough College (western gardens)	SD4939	60	31/03/2017	AL
2	Salthill Quarry, Clitheroe	SD756425	59	30/03/2017	PR, AW
3	Eggerslack Wood	SD4079	69	01/04/2017	TB
4	Brown Robin, Grange	SD4179	69	01/04/2017	HR, PR, AW
5	Humphrey Head, Grange	SD3973	69	01/04/2017 02/04/2017	TB, SJG, HR, PR, AW SG, DW
6	St Paul's Church, Lindale	SD4180	69	01/04/2017	TB, HR, PR, AW
7	Royal Oak, Lindale	SD418806	69	01/04/2017	TB, HR, PR
8	St Mary's Church, Allithwaite	SD386768	69	01/04/2017	TB, HR, PR
9	Middleton NR, Heysham	SD4159	60	31/03/2017 01/04/2017	TB, PL, HR; KC
10	Overhouses Great Wood	SD6465	60	01/04/2017	KA
11	Thrush Gill Wood	SD5770	60	31/03/2017	KA
12	Littledale	SD5662	60	01/04/2017	KA
13	Cow Fall Wood	SD5762	60	01/04/2017	KA
14	Dallam Tower Deer Park	SD4980	69	31/03/2017	KA
15	Spinks Gill	SD590791	60	31/03/2017	KA
16	Marl Hole Wood	SD5869	60	31/03/2017	KA
17	Yealand Manor Estate	SD5074	60	31/03/2017	KA
18	Sunderland Point	SD4255	60	31/03/2017	DW
19	Arnside Knott	SD451774	69	31/03/2017	KC
20	Jack Scout	SD460734	60	31/03/2017	KC
21	Crag Foot	SD466735	60	31/03/2017	KC
22	Eaves Wood	SD471759	60	31/03/2017	KC
23	Warton Crag	SD496724	60	31/03/2017	KC
24	Red Nab, Heysham	SD403591	60	01/04/2017	KC
25	Heysham Power Station	SD407592	60	01/04/2017	KC
26	Overton	SD432578	60	01/04/2017	KC
27	Grubbins Wood	SD4478	69	01/04/2017	DW, SJG
28	Gaitbarrow reserve entrance	SD4776	60	01/04/2017	DW
29	Dalton Crags	SD5576	60/69	01/04/2017	DW
30	Park Wood NR	SD563778	69	01/04/2017	SG
31	Sandscale Haws NT	SD1875	69	02/04/2017	DW
32a	Walney Island	SD199637	69	02/04/2017	DW
32b	Walney Island	SD200637	69	02/04/2017	DW
33	Sandscale	SD200755	69	02/04/2017	SG
34	Formby	SD274081	59	02/04/2017	KC

Two of the five locations with the highest species richness, Myerscough College, inside glasshouses (4 centipedes, 7 millipedes, 3 woodlice) and Myerscough College, outside glasshouses (1 centipede, 9 millipedes, 3 woodlice plus landhopper) were associated with gardens. A third, Middleton Local Nature Reserve (3 centipedes, 7 millipedes, 5 woodlice), was a brownfield site. However, the two richest sites, Brown Robin and Humphrey Head were semi-natural sites on limestone but, the fauna recorded from these sites on this occasion did not prove as interesting as expected.

Centipedes

As can be seen from Table 4, a round dozen species were found, a relatively low number compared with the diversity recorded previously. The only species of note was *Lithobius lapidicola* Meinert, 1872 collected from inside glasshouses at Myerscough College. In Britain this centipede was first reported from greenhouses at the Royal Botanic Garden, Edinburgh (1986, coll. Charles Rawcliffe, det. E. H. Eason). The only subsequent outdoor records are from above the beach, at Sandwich Bay on the Kent coast and from East Suffolk and South Essex, close to the coast. However, there are also records from heated glasshouses at Abbotsbury (Dorset), Bangor (North Wales), Birmingham Botanic Garden and the Butterfly House at Whipsnade Zoo. Its presence in these two distinct habitats remains an enigma. The animal is small (8mm) and without very obvious identification features. Of a comparable size to *Lithobius microps*, it lacks the swollen last legs of that species. Lee (2015) lists it as IUCN Status (GB) Near Threatened and GB Rarity Status Nationally Rare.

Millipedes

During the 2017 meeting 29 species were recorded, five from South East Lancashire (VC59), 19 from West Lancashire (VC60) and 17 from Cumbria (VC69) (Table 6). The only notable species were the Nationally Scarce *Choneiulus palmatus* and *Cylindroiulus parisiorum* and an unidentified species of *Brachychaeteuma.* The latter was collected from Brown Robin in VC69. These were female specimens and cast no further light on the *bradeae/bagnalli* variation. A female *Chordeuma* was noted also but this was not identified to species. *Boreoiulus tenuis* was one of the species reported but the site name was not available.

Although the first English specimens of the Nationally Rare *Melogona voigtii* have since been reported from Dalton Crags (Gregory & Garnham, 2020), the species was not collected here or elsewhere in 2017. The only *Melogona* species reported was the common *M. scutellaris* from the nearby site of Park Wood.

The glasshouses at Myerscough College produced a good range of hothouse and other synanthropic specialists including *Choneiulus palmatus* and *Cylindroiulus parisiorum*. Non-native *Oxidus gracilis*, *Poratia digitata* (Fig. 1), *Cylindroiulus truncorum* and *C. vulnerarius* were frequent with *C. truncorum* spilling out into outdoor areas around glasshouses.

Woodlice

During the 2017 field meeting 12 species of woodlice and the landhopper *Arcitalitrus dorrieni* were recorded (Table 5). The only species of note was the Nationally Scarce *Armadillidium album* which was found at Sandscale Haws in VC69. The gardens and glasshouses at Myerscough College proved to be the most diverse site visited with eight species of woodlice and *Arcitalitrus dorrieni* recoded. The woodlice included *Trichoniscus provisorius* and an unidentified styloniscid (Fig. 2), alas female and immature specimens (that cannot be identified), from inside the heated glasshouses and *Porcellionides pruinosus* from the outdoor gardens.

Philoscia 'muscorum' was recorded from nine sites (making it the fourth most widely recorded woodlouse after *Oniscus asellus*, *Porcellio scaber* and *Trichoniscus pusillus* agg.). However, in the following autumn (2017) *Philoscia affinis* was reported from Britain for the first time (Segers *et al*.,

2018) and subsequently it has proved to be widespread in woodlands and coastal habitats in western Britain, including six woodland sites in West Lancashire (VC60) (Gregory, 2020). Thus, it is highly probable that some of the *Philoscia* recorded during the BMIG weekend may actually be *P. affinis* and they are listed herein as *P. muscorum sensu lato*. It is perhaps unfortunate that previously *P. muscorum* had been considered to be an 'easy' species that could be readily identified in the field with no need for the collection of specimens and microscopic examination.

Figure 1: *Poratia digitata* live specimen from glasshouses at Myerscough College
(Image © Paul Richards, www.flickr.com/invertimages)

Figure 2: Immature Styloniscid (recently moulted) from glasshouses at Myerscough College
(Image © Paul Richards, www.flickr.com/invertimages)

Table 4: Summary of species of centipede recorded during the BMIG meeting at Morecambe.

Location:	1a	1b	1c	2	3	4	5	6	7	8	9	18	19	20	21	22	23	24	27	29
Haplophilus subterraneus			X		X	X	X		X				X			X	X			X
Schendyla nemorensis								X												
Strigamia maritima							X							X	X			X		
Geophilus flavus				X																
Geophilus alpinus				X	X	X				X										
Geophilus truncorum			X		X						X									
Cryptops hortensis	X										X									
Lithobius forficatus	X					X					X	X	X			X			X	
Lithobius lapidicola	X																			
Lithobius melanops	X	X					X													
Lithobius microps				X	X						X								X	X
Lithobius variegatus					X											X			X	

Table 5: Summary of species of woodlouse and landhopper recorded during the BMIG meeting at Morecambe.

Location:	1a	1b	1c	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	27	29	30	31	32a	32b	33
Androniscus dentiger						X	X	X																			
Haplophthalmus mengii									X																		
Trichoniscus pusillus agg.	X			X	X	X	X				X	X			X			X	X								
Trichoniscus provisorius	X																										
Trichoniscus pygmaeus						X	X		X																		
Styloniscidae spp.	X																										
Philoscia muscorum s.lat.		X		X		X	X				X					X			X			X			X		
Oniscus asellus	X	X	X	X		X	X			X	X		X			X	X				X	X	X				
Porcellio scaber	X	X	X	X	X	X	X			X	X	X	X	X		X		X			X						X
Porcellionides pruinosus		X																									
Armadillidium album																								X			
Armadillidium vulgare		X		X			X				X									X					X	X	
Landhopper																											
Arcitalitrus dorrieni		X																									

Table 6: Summary of species of millipede recorded during the BMIG meeting at Morecambe.

Location:	1a	1b	1c	2	3	4	5	6	7	8	9	10	11	12	13	18	19	21	22	23	25	26	27	28	29	30
Glomeris marginata					X		X					X							X	X				X	X	X
Chordeuma sp.								X																		
Melogona scutellaris																										X
Brachychaeteuma spp.						X																				
Nanogona polydesmoides						X	X	X																		
Oxidus gracilis	X																									
Brachydesmus superus		X	X		X	X	X				X														X	
Polydesmus angustus		X	X			X	X	X			X		X		X			X	X	X	X				X	
Polydesmus coriaceus			X	X							X															
Poratia digitata	X																									
Macrosternodesmus palicola										X																
Ophiodesmus albonanus								X		X																
Nemasoma varicorne													X	X												
Choneiulus palmatus	X																									
Proteroiulus fuscus	X			X							X								X	X						
Blaniulus guttulatus		X				X	X	X																		
**Boreoiulus tenuis*																										
Julus scandinavius							X	X																		
Ophyiulus pilosus		X		X	X		X		X	X	X				X											
Cylindroiulus britannicus	X	X	X								X															
Cylindroiulus caeruleocinctus								X		X																
Cylindroiulus latestriatus							X									X										
Cylindroiulus parisiorum	X																									
Cylindroiulus punctatus		X	X	X		X	X		X		X	X	X	X			X	X		X		X	X			
Cylindroiulus truncorum	X	X																								
Cylindroiulus vulnerarius	X																									
Brachyiulus pusillus		X																								
Ommatoiulus sabulosus										X																
Tachypodoiulus niger		X	X	X	X	X	X	X	X	X	X						X	X	X	X		X				

*site details not recorded

Acknowledgements

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Obituary

Ron Daniel, 1938–2015

I still remember meeting Ron for the first time, a large genial man with a generous laugh, firm hand shake and a passion for the natural world. He had just returned to the then Plymouth Polytechnic from his master's degree at Bangor with a keen interest in litter faunas and a special interest in myriapods. So our first conversation was about Tüllgren funnels (he was a man that like to cut to the chase). I remember trying to catch up with the conversation as I had not encountered these before but by the end of the day plans to build a set were drawn and my introduction to the industrial Mecano that was Dexion had also begun.

The Tüllgren funnels became synonymous with Ron, as every student field trip to a woodland habitat was followed by a weeks' worth of processing litter samples in the funnels.

He had a broad approach to the natural world, as he was an excellent botanist and, as he lived on the coast, he reveled in the life on the seashore. But he was equally happy on the moors or heaths of the South West. However, it was in a woodland that he was truly at home. His knowledge of the fauna and flora of all of these habitats was impressive. Like many Cornishmen he appeared to be impervious to the elements and field trips went ahead regardless of the weather. But even Cornishmen have their limits as I recall one day on Dartmoor when the temperature was zero on arrival at the site but just an hour later Ron called a halt to the exercise when the temperature dropped below -12°C.

He lived at Downderry a small village at the head of the Hessenford valley which ran inland to Bodmin moor. A valley that ran from moorland to rocky shore over a comparatively short distance offered a great diversity of habitats. So rather that driving students across Cornwall and Devon to examine different habitats he focused much of the field days on the valley in order to build a picture of its natural history and conservation potential. It was a plan that worked well and when in the 1980s the department initiated a series of residential field trips Ron seized the moment and ran a week-long ecology course in the Downderry holiday park, using the village hall as a lab and lecture hall. He gathered a huge data set in an effort conserve and protect his local valley. So he was delighted when in the 1990s the lower half of the valley became a Cornish Wildlife Trust (CWT) nature reserve.

He did suffer one major embarrassment in the shape of the hunt for the bristly millipede *Polyxenus*. On almost every trip he would stop at a likely piece of habitat and send the minibus full of students searching for it for but always to no avail. He had everyone in the department scouring the south west for it, but no luck. Then once its true habitat was discovered, south facing lichen covered walls, Ron realised there was a large population on his garden wall.

As he approached retirement he became involved in local politics, becoming chair of the Parish Council and steering it towards a more ecological approach to managing the parish.

He was a man of great enthusiasm, drive and a dedicated teacher but he did not stand for any nonsense and was deadly accurate with a piece of chalk should students become distracted during his lectures. His contribution to the understanding of Cornish natural history was enormous and his loss has left a space that will take some time to fill.

Peter Smithers

Ron was instrumental in the revival of the British Myriapod Group through the organisation, with Peter, of the first annual field meeting after a pause of some years, with that in Easter 1982 held in Plymouth. The photograph shows some very young British Myriapodologists at that meeting.

Left to right: Tony Barber, Ron Daniel, Peter Smithers, Doug Richardson, Helen Read, Desmond Kime and Kathleen Kime. We think the picture was taken by Gordon Blower.

Obituary

Erwin Meyer, 1948–2020

Erwin Meyer
(Photo: Michael Steinwandter)

I first met Erwin Meyer at the International Congress of Myriapodology in Amsterdam in 1984, also attended by J. Gordon Blower, my supervisor at the time, who introduced us. Gordon was influential to Erwin who spent some weeks in Manchester as a PhD student in the 1970s. Also visiting Colin Fairhurst in nearby Salford (both of whom he had met at the congress in Hamburg in 1975) Erwin was clearly interested in the life histories of millipedes and learnt from Gordon about determining stadia in the Julida and Chordeumatida. He wrote an appreciation of the contribution of Gordon Blower to the study of millipede life cycles in the BMIG commemoration volume 19 in 2003 which resulted from a meeting in Manchester to celebrate the life and work of Gordon and Ted Eason. Erwin was joint author of a substantial paper about the millipedes of a beech woodland in South East England, the work on which was presumably a result of his stay in Manchester.

Erwin started working as a university assistant at the University of Innsbruck (Austria) in 1976, where he stayed, eventually heading up the Soil Ecology working group within the Department of Ecology, until his retirement in 2013. He completed his doctorate in 1978 and published many papers on millipede ecology, as well as diversity, distribution and physiology, especially of species from the montane and alpine zones. The Manchester influence regarding the interest in life cycles can clearly be seen in several of these. One of his favourite millipedes is reputed to have been *Ommatoiulus sabulosus*, a species widely distributed in the Central Alps which, as well as being a spectacular species, has an interesting life cycle in being periodomorphic.

In 1990 Erwin hosted the International Congress of Myriapodology in Innsbruck, a memorable and successful congress with a full day outing into the Alps where a chairlift took us high up the mountains. The resulting proceedings were edited by Erwin, along with Konrad Thaler and Wolfgang Schedl and published in 1992.

In 2003 I caught up with Erwin again in Innsbruck, but for rather different reasons. I was in Austria on a trip to look at pollarded trees in Europe. Austria was not actually one of my planned destinations, but I had to pass through, and so I contacted Erwin to see if he was able to put me in touch with anyone in Austria who might be able to help. Of course he very cheerfully did, and as a result I spent a couple of really interesting days, facilitated by him, learning about traditional methods of managing trees in the Austrian Alps.

Erwin is reported by his students to have been an inspiring teacher, encouraging them to study ecology and especially soil zoology. His outgoing and friendly personality must have been a contributing factor to his successful teaching style. He sadly died very unexpectedly in his sleep on June 7, 2020 at age 71.

Helen Read

With additional information from the Obituary in the CIM newsletter No. 5 November 2020
by Julia Seeber & Michael Steinwandter

Selected publications of Erwin Meyer on Myriapoda:

1973: **Meyer E.**: Über die Diplopoden Nordtirols und Vorarlbergs (Kritische Artenliste, mit biologischen Daten aus der Literatur). *Diploma thesis*, University of Innsbruck: 102 pp.

1974: Thaler K., **Meyer E.**: Fragmenta Faunistica Tirolensia, II (Diplopoda, Chilognatha: Julidae, Craspedosomatidae). *Berichte des naturwissenschaftlichen-medizinischen Verein Innsbruck*, **61**: 93–99.

1975: **Meyer E.**: Über einige Diplopoden aus dem Rätikon (Vorarlberg, Österreich). *Berichte des naturwissenschaftlichen-medizinischen Verein Innsbruck*, **62**: 63–69.

1979: **Meyer E.**: Life-cycles and ecology of high alpine Nematophora. In: Camatini M. [Ed.]: *Myriapod biology*, Academic Press, London, 456pp., 294–306.

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Obituary

Walter Hüther, 1931–2019

Soil Zoologist with an interest in Pauropoda

Amongst the distinguished myriapodologists present at the International Myriapod Congress at Manchester in April 1972 was Walther Hüther who presented a paper on the ecology of pauropods (Hüther, 1974). Born in Saarland and at school in Zweibrücken, he took his doctorate from Johannes Gutenberg University Mainz, looking at the fauna of vineyard soils with special consideration of Collembola and Acari. He then carried out research at the Technical University of Braunschweig from 1960 before working at the University of Saarbrucken, continuing his interest in soil organisms. In 1970 he moved to Ruhr-University Bochum where he remained until his retirement in 1996, dying at Bochum in 2019. An obituary and appreciation of his work with a list of publications was published in 2020 and is available on open access (Decker *et al*., 2020).

During his lifetime, Dr Hüther described one genus and eight species of pauropods as well as one genus and thirteen species of collembolans and one proturan. As well as his more academic work, he also brought his expertise to support local citizen science surveys. To honour his taxonomic work eleven soil arthropods have been named after him. His Manchester paper, along with that of Ulf Scheller on pauropods of arable soils in Great Britain and presented at the same congress (Scheller, 1974), is probably one of the good starting points for anyone interested in working on these small myriapods.

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A.D. Barber

Book Review

Projet d'atlas des chilopodes (Chilopoda) des Pays de la Loire: Bilan des 5ème et 6ème années

Antoine Racine & Étienne Iorio, coordinateurs, Novembre 2020. GRETIA 27: 22pp

This is the latest update on the atlas project for the Pays de la Loire, a region comprised of the départéments of Loire-Atlantique (44), Maine-et-Loire (49), Mayenne (53), Sarthe (72) and Vendée (85). Brittany is to its north and west, Normandy to the north and the Atlantic Ocean (Bay of Biscay) to the west. As such, it is just that much further south than Normandy and Brittany and is obviously likely to show differences in its fauna compared with these latter regions which, in turn will show differences from southern England. Its interest to British (and Irish) recorders will be not only in the ways that the centipede species found there differ from our fauna but those which we have in common as well as differences between the various parts of Pays de la Loire such as the relative scarcity of *Geophilus truncorum* overall and its northern tendency whereas the similar sized *Schendyla nemorensis* is very widespread.

By comparison with Britain or Ireland (or The Netherlands, for instance), France (even without Corsica) is a large country geographically and between the Channel coast and that of the Mediterranean and between the Bay of Biscay, the Pyrenees and the Alps there is a correspondingly wide diversity of topography, habitats and land use as well as of centipede species. This makes mapping on a scale comparable to that carried out for these other countries a much larger task. Jean-Jacques Geoffroy and Étienne Iorio had started this by drawing up species lists and maps by départements and this can be seen, for instance, in the latter's *Catalogue biogéographique et taxonomique* (Iorio, 2014). There have also been studies of individual areas such as the Masif Armoricain or some of the national parks but here we have an ongoing project in a (relatively) limited area of France with mapping on a hectad (10km grid square) basis with a large number of contributors. This initiative, commenced in 2014 when 35 species were recorded (it was 32 in 2009, with 10 or less from each départément except Maine-et-Loire where there were 28). In the current list, which includes distribution maps, all of the five départéments have at least 29 species, 36 in Loire-Atlantique and a regional total of 43. The current number of reliably recorded (outdoor) species for Britain is just under 50.

The species common to both Britain and Pays-de-la-Loire are *Stigmatogaster subterranea*, *Hydroschendyla submarina* (2), *Schendyla nemorensis*, *Henia vesuviana*, *Strigamia acuminata*, *S. crassipes*, *S. maritima* (2), *Geophilus alpinus* (2), *G. carpophagus*, *G. easoni*, *G. electricus* (4), *G. flavus*, *G. osquidatum*, *G. pusillifrater* (1), *G. seurati* (2), *G. truncorum* (3) *Pachymerium ferrugineum* (4), S*tenotaenia linearis* (2), *Cryptops anomalans*, *C. hortenis*, *C. parisi* (2), *Lithobius calcaratus*, *L. crassipes, L. curtipes* (2), *L. forficatus*, *L. macilentus*, *L. melanops*, *L. microps*, *L. muticus*, *L. piceus*, *L. pilicornis* (4), *L. variegatus* (1), *Lamyctes emarginatus* and *Scutigera coleoptrata*. Numbers in brackets indicate the number of départéments in the region the species has been recorded from if less than all five. The most commonly recorded species were *L. forficatus*, *C. hortensis*, *S. nemorensis*, *L. calcaratus*, *H. vesuviana, G. easoni* and *L. melanops*.

Species recorded from the region but not, so far, from Southern Britain or Ireland were *Dignathodon microcephalus* (2), *Schendyla monodi* (1), *Arctogeophilus inopinatus* (5), *Geophilus algarum* (1), *G. gavoyi* (5), *Lithobius agilis* (3), *L. aeruginosus* (2) and *Lamyctes africanus* (2). Of these, *L. agilis*,

12mm, has somewhat doubtful records from Ireland and Cornwall and is included in the Synopsis (Barber, 2009) whilst *L. aeruginosus*, up to 9.5 mm and, like both *Lithobius crassipes* and *Lithobius curtipes* with only 20 antennal articles, is referred to there as "possible"; both have 2+2 coxosternal teeth. *L. africanus* has been reported once from a glasshouse in Scotland but it is quite probable that it may have been reported as *L. emarginatus* as it is only in recent years that it has been distinguished in northern Europe. An article about it was included in the Autumn 2016 BMIG Newsletter (Anon, 2016).

Dignathodon microcephalus is a relatively large species, brown red in colour and up to 50mm with up to 89 leg-pairs. It is a member of the same family (Dignathdontidae) as *Henia.* As its name suggests, it has a distinctively small head which is broader than long. The coxal pores on the last legs (which are much swollen) open into pits and these legs lack claws. *Schendyla monodi* is a rare species of the littoral Atlantic, recorded twice and with 37-41 leg pairs. It has the usual schendylid characters of 2+2 coxal pores and no claw on the last legs. *Arctogeophilus inopinatus* (*Gnathomerium inopinatum*) (Fig. 1) is a small geophilid, comparable in size to *Schendyla nemorensis* and *Geophilus truncorum*, 18mm long and 39-41 leg-pairs of which the last pair are much elongated and have numerous small pores on their coxae. Each poison claw has a distinct basal tooth and there are similar teeth on all the other articles. *Geophilus algarum* is another littoral species, first described from Chausey (French Channel Islands) and is one of that group of littoral *Geophilus* species including *Geophilus seurati* which would seem to require further study. It is described as 35mm, 51(?)- 59 leg pairs and with 4+4 coxal pores on the last legs. *Geophilus gavoyi* is a species recorded from a number of departéments in southern and western France; it is up to 30mm in length, has 39-55 leg-pairs and 4-7 coxal pores on the last pair. Accounts of all these geophilomorphs can be found in Brölemann (1930) and further information in Iorio (2014) and Iorio & Labroche (2015).

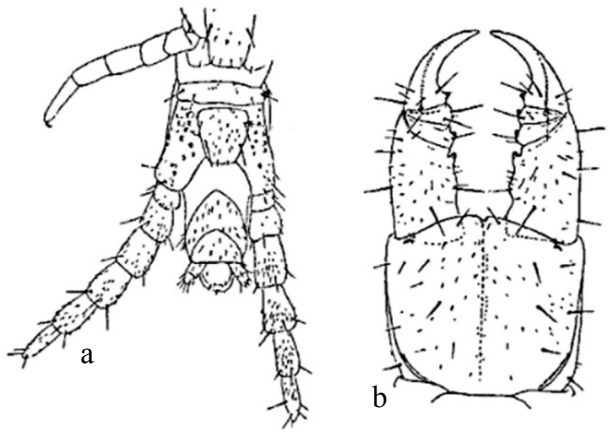

Figure 1: ***Arctogeophilus inopinatus*** after Brolemann, 1930. a) Posterior end, male, ventral; b) Forcipules, ventral.

These non-British species are always possibly going to be found in England at some time in the future as a result of chance introduction, extending range or climatic changes or might even be here already but rare and, as yet, undiscovered and the possibility of them being found in the Channel Islands should not be ruled out. *Lithobius aeruginosus* and *L. agilis* are both listed for the Massif Armoricain by Iorio (2006) along with *Schendyla monodi*, *Geophilus algarum*, *Geophilus gavoyi* and *Arctogeophilus inopinatus* and the latter was reported from both Normandy and Brittany in early issues of the BMG Bulletin (Kime *et al*., 1987; Lewis & Kime, 1988).

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