

## 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 *Psichrosoma*, 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 '*Psichrosoma*', 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) *Psychrosoma 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

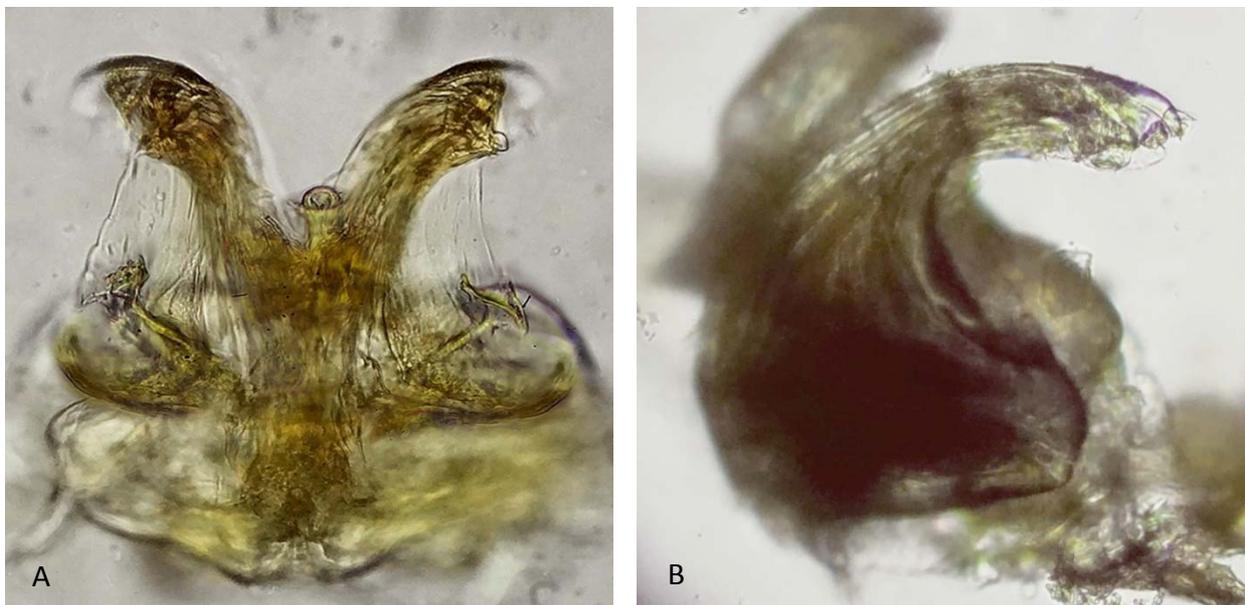
On 8<sup>th</sup> October 2015 CO undertook a casual survey of the invertebrates occurring at a site at Newbridge (ST201966, VC35); a disused railway embankment, strewn with much dumped ash and slag, above a small stream. Here a number of small pallid Chordeumatidan millipedes were encountered under 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 15<sup>th</sup> 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](http://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 *Ophiulus 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](http://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 revegetate 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 *Ophiulus 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 17<sup>th</sup> 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 4<sup>th</sup> 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).

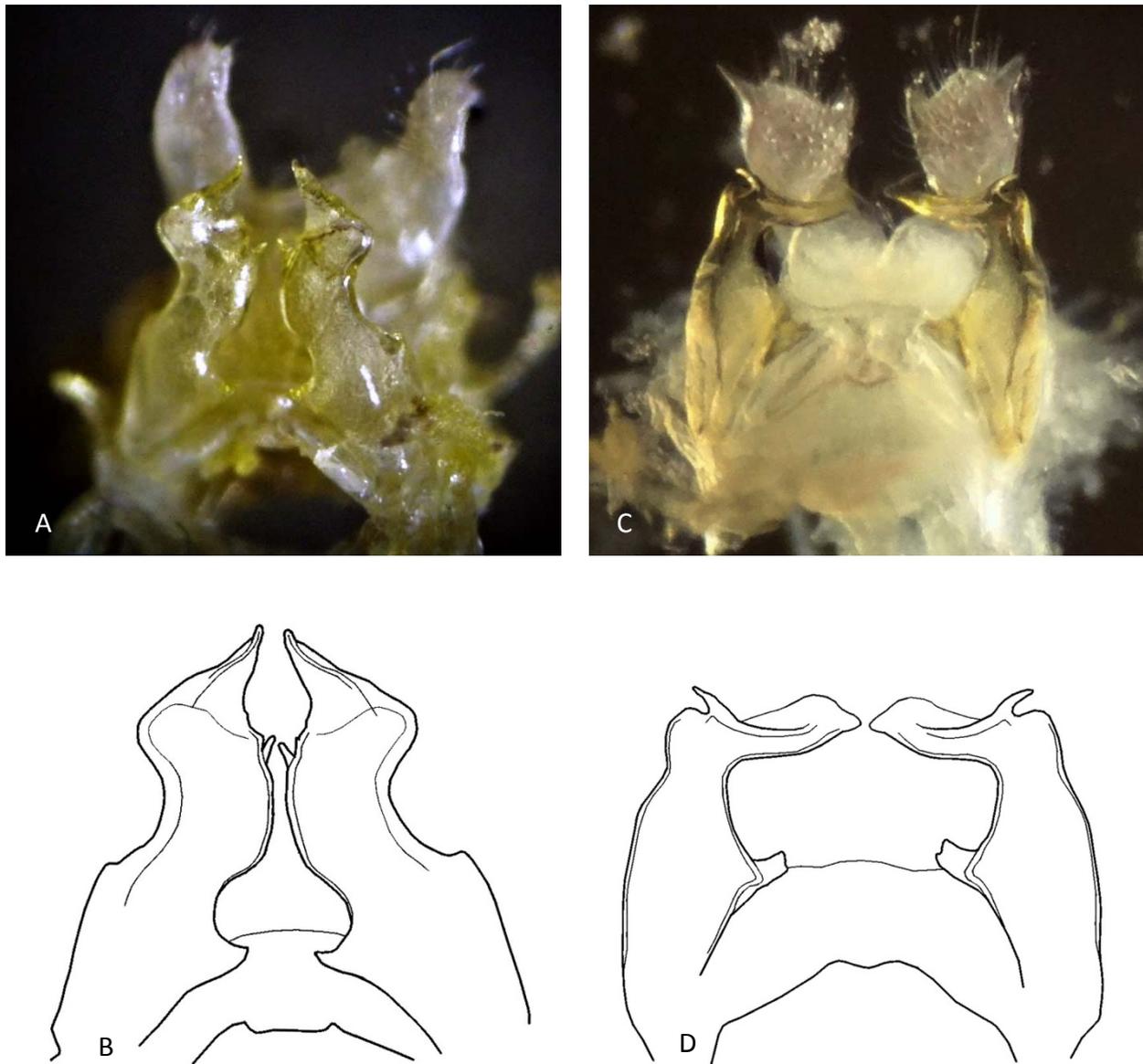
#### **Identification**

*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](http://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	CO
			04.xi.2017	CO
			30.xi.2017	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	41	18.ix.2020	LO (female only)
	SS892927		06.xi.2020	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 30<sup>th</sup> 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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